Concrete-Cement Age

Devoted to the manufacture and uses of Portland cement

CEMENT AGE · CONCRETE ENGINEERING · CONCRETE

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Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

American Association for Highway Improvement, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

Iowa Association of Cement Users, Ira A. Williams, Secretary, Ames, Ia.

Nebraska Cement Users' Association, Secretary-Treasurer, Frank Whipperman, Omaha, Neb.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Building, Minneapolis, Minn

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Canadian Cement and Concrete Association, William Snaith, Secretary, 57 East Adelaide St., Toronto, Ont.

In This Issue

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The *Editors* invite your correspondence on all matters relating to the industry which the magazine represents. Discussions, notes and inquiries will be gladly received.

Advertising rates upon application. Complete information regarding size, character and distribution of circul tion cheerfully furnished upon reques .

In requesting change in address give old address also.

Concrete-Cement Age

Vol. I | JULY, 1912 | No. 1

Editorials

IN PUBLISHING this, the first issue of Concrete-Cement Age, the publishers feel that an introduction is scarcely necessary. Concrete-Cement Age is a combination of *Concrete*, *Cement Age* and *Concrete Engineering*, papers with which all of our readers have been familiar for a number of years.

The reasons that led to the combination were quite clearly set forth in the June issue of the periodicals first named. Unity of effort, stronger financial support, the opportunity to make a broader, more representative periodical, covering every phase of the great cement and concrete industry, were the compelling motives.

In effecting a consolidation of the three papers, there has been but a single purpose, namely, to give to subscribers and advertisers a service that shall be both capable and comprehensive, a journal that shall represent in the most efficient manner the many and varied interests identified with the manufacture and use of Portland cement. There has been and will be no elimination of the valuable features of the several publications. On the contrary, they will, under the consolidation, be amplified and strengthened. No one paper has "bought out" the other papers, nor has any important change been made in the personnel of the staffs, who will continue to represent the paper in four of the most important concrete centers in the country: Detroit, the publication city; New York, Philadelphia and Chicago. Thus the present paper is a combination in the best and fullest sense. It represents the combined experience, energy and fidelity of men who have worked separately to advance the interests of the Portland cement concrete industry, and who are now working together in a stronger effort toward the same end.

Robert W. Lesley, of Philadelphia, will give to the enterprise the benefit of his ripe and practical experience in the capacity of consulting editor. An experienced newspaper man, and one of the first to engage in the manufacture of Portland cement in this country, the services of Mr. Lesley, not only as a prominent manufacturer, but as an active member of the various scientific associations that have put the industry on its present high plane, will be of immediate and practical benefit to you. Allen Brett, who has been actively engaged in editorial management on *Concrete Engineering* and *Cement Age*, assumes the title of managing editor of the joined papers. His experience in the field and his wide acquaintance with the leaders of the cement and concrete industry are at the service of the readers of Concrete-Cement Age. Associated with Mr. Brett in the active editorial work will be Harvey Whipple and E. A. Trego. The name of Mr. Whipple is familiar to many of our friends through his connection with *Concrete* for nearly two years. Mr. Whipple is a trained newspaper man, and for a number of years before he undertook magazine work was the building editor of the Detroit *Free Press*. Mr. Trego has been associated with *Cement Age* since its foundation in 1904, in an editorial capacity. He is closely in touch with architectural progress and contracting, and his continuance at the New York offices will insure an adequate review of matters of interest in that territory. Mr. Whipple will continue his work at the Detroit offices.

Walter C. Boynton becomes general manager of CONCRETE-CEMENT AGE. He has been associated with *Concrete* since 1906, when he became one of the purchasers of the paper with the late E. R. Kranich. Mr. Boynton is an old newspaper man, serving on the staff of the Detroit *Free Press* in a number of capacities from 1896 to the time of his connection with the industrial press. He has been identified with the editorial and business management of several successful publications. R. Marshall, formerly associate editor and later business manager of *Concrete*, retains the latter title with the larger paper. Mr. Marshall is also a graduate of the daily press, but has been identified with magazine work since 1906.

F. F. Lincoln will be in charge of the New York offices, under the title of eastern manager. Like others of the staff, Mr. Lincoln has had experience in daily newspaper work. He was a reporter for the New York *Sun*, but his connection with the Portland cement papers dates back to 1906, a time when the cement industry was just beginning to attract its present wide attention. His connection with *Cement Age* has been in the business department and he will continue to devote his attention to this work. R. M. Babbitt is stationed at the Chicago office, with the title of western manager. For a number of years, Mr. Babbitt has been connected with publications devoted to the general building field, but his recent work has been especially directed to the field of concrete, where he has made a number of friends.

With its organization perfected and with trained men in every department, the CONCRETE-CEMENT AGE Publishing Company feels that it is peculiarly fitted to serve the industry and the men interested in it. Men of practical experience and trained editorial ability are in charge of definite departments. They will have the assistance of a number of contributing editors, who include many of the best known experts in the various fields. The editorial staff of CONCRETE-CEMENT AGE is absolutely unique in the field of periodicals devoted to cement and concrete. A feature of the editorial work will be the solution of the reader's problems—questions that come up in everyday work. The paper will be a forum for the discussion of methods and costs and a medium of exchange for the questions and answers of men in the field and in the office.

The field to be covered is large and widespread and our organization has been laid out along broad lines to handle a big undertaking. Discussion is welcomed. We want to hear from every subscriber with a difficulty or an idea for solving his own difficulties or those of the other man. The cement industry is a live, growing enterprise. It needs a live, growing paper to serve it, and the need has been realized in CONCRETE-CEMENT AGE.

* * *

The American Road Congress

FORMAL announcement is made elsewhere in this issue that the first American Road Congress will be held in Atlantic City, N. J., September 30 to October 5, 1912. While the selection of the coast city is frankly a disappointment to many other localities which felt that they had good claims to the honor of entertaining the Congress, there is no disposition on the part of any of them to draw back because they were not selected. The Congress is a good thing, and it should be liberally supported by men interested in cement and concrete. Roadways of concrete are enjoying a constantly increasing reputation, based on the splendid showing they have made in many sections of the country.

The intimate relation between good roads and automobile traffic lends interest to the announcement that the first two days of the meeting will be assigned to road users, under the auspices of the American Automobile Association. Two days will be taken up with problems of legislation, finance and economics, under the auspices of the American Association for Highway Improvement, and two will be devoted to the discussion of problems of construction and maintenance.

Opportunities for definitely determining the best type of roadway from the standpoints of excellence, construction cost and maintenance charges will be abundant at the Congress, and CONCRETE-CEMENT AGE is with the enterprise, wherever the sessions are held. At some future date, we shall hope to see the Congress in Detroit, where opportunities for observing concrete roadways under construction and after continued use are unsurpassed. In the meantime, our congratulations to Atlantic City and our assurances of hearty support.

* * *

Cheaper Marketing: Cheaper Foods

WHEN the taxpayers in the broad spaces of the country—the farmers who provide our food—first confronted the matter of country road improvement near the cities to meet the needs of increasing motor car traffic, they didn't proceed with the improvement with unnecessary alacrity. The motor car was a city luxury. Yet the farmer possesses a surprising business acumen. The link between motor cars and the necessity for better highways is of economic importance. To get the fullest benefit of motor car development there must be provided the broadest field for their profitable operation. In the profitable operation of motor cars the farmer finds an opportunity better to market his products. He gains by every development which makes access to the city easier for him, and the consumer—*you* and *us*—profit also by the farmer's readier access to the food depots.

* * *

From Sidewalks to Pavements

SOME six or seven years ago this journal predicted that the time would come when cement in the building of railways and public highways would be regarded as essential as its use in ordinary sidewalks. We could not see wherein cement for sidewalks could represent the highest type of construction from the standpoint of durability and convenience, and at the same time fail to be serviceable for railways and roads. Our readers are familiar with the fact that immense quantities of cement are used in street railway construction and that its application is constantly broadening in steam road construction, especially where bridges, tunnels and kindred structures are required. That its use for highways is keeping pace with progress in other lines is clearly shown by the proceedings of the recent meeting of the Association of American Portland Cement Manufacturers in Chicago. Indeed, cement in road construction was the keynote of the meeting so far as public interest was concerned. The association devoted a great deal of time to papers and discussions of the concrete road problem, having invited eminent authorities to participate in the proceedings. The presence of Messrs. Page, McCullough and Hines, representing respectively government, municipal and county interests, was in itself indicative of the widespread interest in the subject prevailing at the present time. In brief, the status of the concrete road is already such that the cement manufacturer may look forward with confidence to largely increased use of his product for this purpose, while it hardly need be said that the public will profit thereby.

* * *

For Fewer Fires

THE National Fire Protection Association and the National Association of Cement Users are to be congratulated upon the action of the former organization at its recent meeting in Chicago, when a committee was instructed to confer with the Cement Association so that there might be uniformity of action with reference to certain types of reinforced concrete construction. Working jointly along this line the two organizations will accomplish much that will be of service to themselves as well as to the public. The recent meeting of the Fire Associaion was encouraging in every sense and the good work it has already done deserves public approbation and support. In the appointment of President Richard L. Humphrey, of the Cement Association, as a member of its Executive Committee, the Fire Association gave recognition to his valuable services in advancing the important work of reducing fire losses. With influential organizations of this character working in harmony we may look for the ultimate development of the highest standards in fire-resisting construction and a corresponding increase in the efficiency of preventive measures.

* * *

A Panama Exposition Cement Show

ELSEWHERE in this issue, we urge that steps be taken toward holding a cement show at San Francisco in 1915. It seems to us the exposition in itself will be a cement show. The buildings will be probably of concrete or at least of concrete architecture, the walks, pavements, bridges, etc., will be of concrete; and for a great engineering structure, a concrete viaduct is proposed to connect the Presidio and part of the exposition's park. Present plans call for a viaduct nearly 7000′ long, and containing at the main span two 500′ arches. Probably the best work that a "Cement Show" organization could do at this exposition would be to point out some of the concrete wonders on every side. At any rate, a cement show at San Francisco in 1915 would be a fine excuse to see the big exposition. Let's all boost.

Reinforced Concrete In Sea Water

THAT the International Congress of Navigation after thoughtful discussion—reported elsewhere in this issue—reached the conclusion which it did as to reinforced concrete in hydraulic works is of large interest. These conclusions, expressed succinctly in two paragraphs, are here quoted again:

Reinforced concrete combines the structural qualities of steel and timber with the durability of good masonry. It is subject to no form of deterioration which cannot be avoided by reasonable precautions. It is free from many of the limitations surrounding the use of masonry in mass; because of the greater latitude it affords in the design and execution of structures, it often yields the best and most economical solution, and in some cases the only practicable solution of the most difficult problems.

When properly designed and executed it is, therefore, among the most valuable, if not the most valuable material now available for use in connection with hydraulic works of all kinds.

We do not know how early in human history lime was discovered. It was very long ago, perhaps 6,000 years. No doubt some householder built fireplaces of limestone and saw them calcine before his eyes. The stone crumbled and turned into a white powder, afterwards becoming hard when water was applied. The addition of sand naturally followed to save expense, and the addition of sand was found to make a firmer and harder stone, and the mixture of lime and sand set much faster than the lime alone, when mixed with water into a mortar. Lime mortar was soon introduced into the interior of houses to form a base on which to decorate the walls. On the outside a small admixture of clay was found to enable it to better resist the action of the elements. Some man later found that when gypsum was calcined the result was what we know as "plaster of Paris," which was used to shorten the time of setting and make a harder plaster.

The addition of about fifty per cent of ground brick-dust or clay to lime-paste made a hydraulic cement, one that would set under water. This discovery, made very early in the history of construction work, enabled men to erect important maritime works and cover houses with stucco which has lasted for centuries. The Romans mixed ashes from volcanoes in the vicinity of the village of Puzzuoli with lime and produced the famous "Roman cement," the secret of which was lost for nearly ten centuries, and the search for which led to the discovery of Portland cement. The use made of Roman cement in making stucco was well known, but as the centuries went on without Roman cement, the masons forgot that anything better than lime had ever been used for mortar, either for interior or eyterior work, and houses plastered on the outside were erected for poor people in all countries. The plaster was not durable, and only in Italy, where many trade secrets were preserved among masons, did the stucco house perists. A century or so ago the use of plastered exteriors came in again for houses of a good class, and plasterers and masons from Italy were employed. With the discovery of Portland cement the stucco house immediately became popular.—*An extract from an address before the North-Western Cement Products Association.*

One Course Concrete Sidewalks

Work Done in Salt Lake City, Utah, Using a Uniform Mixture Throughout the Construction

BY H. M. JONES*

During 1911 all the concrete sidewalks laid under the supervision of the Engineering Department and the Board of Public Works of Salt Lake City were constructed on the new one-piece plan in which a uniform mixture is used throughout, the top coat being omitted entirely and the finishing accomplished with a wooden float in such a way as to leave a slightly roughened wearing surface. The first walks were purely experimental but proved so satisfactory from every standpoint that the method was permanently adopted.

While no priority claims are urged for this method it was, in fact, worked out independently of any other similar scheme, and the numerous inquiries received would indicate that it belongs among the pioneers, at least, in the movement toward one-piece construction.

The old system of tamping into place a rather "dry" and "lean" mixture for the base and then spreading over it a "fat" mortar, did very well under proper conditions, but it possessed certain inherent weaknesses that made it undesirable under ordinary working usage. These are in detail as follows:

First, the base was usually put in so "dry" that the proper degree of compactness could not be obtained by hand-tamping.

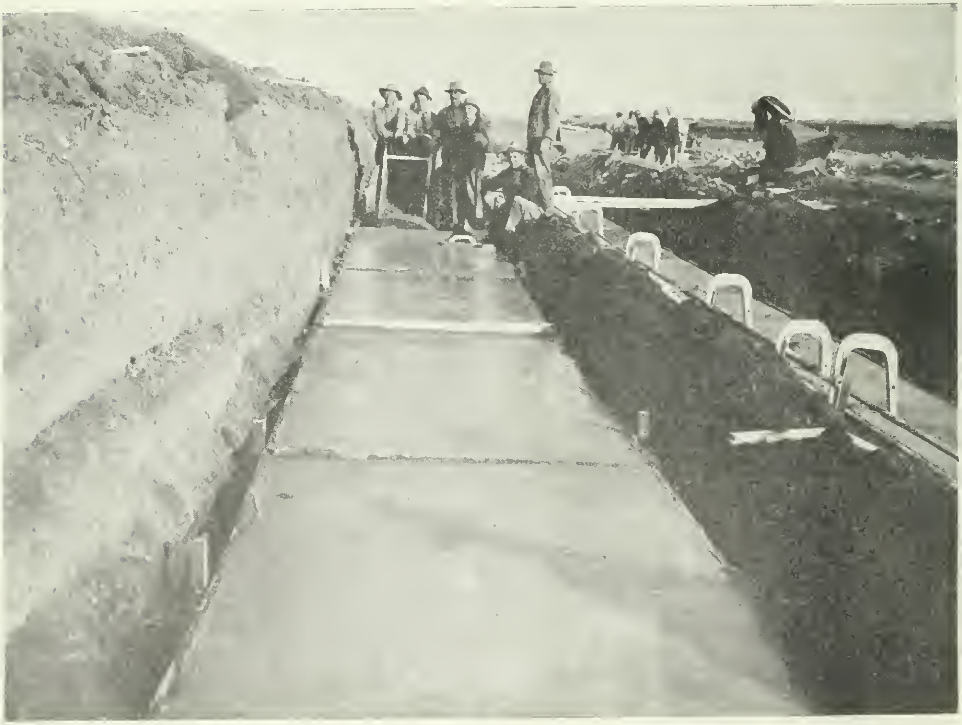
Second, the needed moisture was absorbed from the top coat, leaving the latter porous.

Third, the base was often laid so far in advance of the finish coat that it had to stand over night, subject to dust, leaves, etc., which would tend to prevent a perfect bond between the two layers.

Fourth, any lack of bond would be accentuated by the slight difference in the coefficients of expansion of the layers, thus subjecting the walks to the harmful effects of alternate freezing and thawing, and occasional severe compressive strains.

Fifth, the custom of finishing the top coat with a metal trowel made the walks too smooth for

*Chemist, Engineering Department, Salt Lake City, Utah.



Sidewalk and Curb Construction in Salt Lake City, Utah safe traffic during inclement weather, and when trowelled too much the moisture was drawn to the surface, causing unsightly hair line cracks and excessive evaporation.

Sixth, two mixing operations had to be carried out before any given section could be completed. The problem before the engineers and inspectors was to eliminate as many of these factors as possible without sacrificing the durability and usefulness of the walks or increasing the cost.

Theoretically the one-piece method solved this problem, but practically there were a number of important points to be considered before the result was entirely satisfactory.

Materials—The Portland cement was carefully tested in advance and required to meet the standard tests of The American Society for Testing Materials. The sand and gravel were tested for voids and then proportioned to bring the necessary cement content down to sixteen to eighteen per cent.

A very convenient method for determining the per cent of voids was found to be the following: Get an ordinary 50-lb. scale and a medium sized water-pail. Fill the pail level full with the aggregate and weigh. Let y represent the net weight of the aggregate. Now add water slowly, letting it run down the side of the pail, until it just appears on the surface, and weigh again. Let x equal the net weight of the aggregate and water. Then clean out the pail, refill it with water and weigh again, letting z represent the net net weight of the water. The percent of voids $= \frac{x-y}{z} 100$. Where repeated tests of voids are to be made by several different operators using the same apparatus a table can readily be prepared showing the percents of voids from the gross weights of pail and aggregate, and pail, aggregate and water, respectively. Reference to this table, after quickly making the two weighings, will give the voids at a glance.

All sorts of sand and gravel were submitted for use, river-sand, bank-sand, pit-sand, some clean and others containing as high as ten percent of deleterious material. The gravel varied from fine pea-gravel passing a two mesh sieve, to coarse broken stone passing a two inch ring. Some natural mixtures of sand and gravel, or "run of pit," were also used, but the very best work was done where the aggregate was kept separated in piles of the different sizes and mechanically proportioned as needed. Void and elutriation tests were the only safe means of determining the relative values of these materials and were resorted to repeatedly. The mixture was estimated on a one to six basis and the proportions of the aggregate were adjusted from time to time as the materials necessitated.

Mixing—Machine mixing was used in all cases. The charging wheelbarrows were all measured in advance and checked at intervals with a cement sack as the unit of measurement. The water content or consistency of the mixtures was best regulated by having water for every batch carefully gauged. Where the gauger could see into the mixer he was soon able to make slight variations as needed by observing the batch as it was turned in the machine. Care at this point always saved time and trouble for the finishers and form pullers. The best results were obtained with a consistency about midway between "quaking" and "flowing" as these terms are usually applied to concrete. The ordinary precautions for getting a thorough mixture are sufficient.

Placing—High-wheeled hand carts, as shown in the illustrations, were found to be the most satisfactory means of conveying the concrete from the mixer to the forms, except where local conditions demanded extra long hauls. Sectional tracks of planking properly spaced to accommodate the wheels of the carts, were

ONE COURSE SIDEWALK, COMPLETED IN FOREGROUND

placed between the forms so that the heavy loads could be handled by one man. These track sections were removed, as the work progressed, and placed between the forms for the next strip to be laid, so that no time was lost by the change from one place to another. The concrete was dumped on the wetted sub-base as shown in the photographs and pushed about into place with shovels. It was then struck off flush with the forms and separated into panels with the spreaders, at once. Solid metallic spreaders about ¼″ thick were found to make the most uniform and permanent joints.

Finishing—Just as soon as the spreaders were in place the surface was smoothed off with a wooden float just enough to submerge the coarse aggregate, but without trying to bring the fines and water to the surface. The metal trowel was not used. The work was then left until the concrete had set enough to permit pulling out the spreaders without any liability of the joints closing over, or "sealing." The edges and panel marks were finished as usual with edging tools. A three or four-inch smoothed strip on the edges, and a two or three inch strip on each side of the panel marks were found to present a more pleasing appearance than narrower ones.

Protection—In hot weather, especially, the walks were covered as soon as possible with a layer of damp sand about ½″ thick. This covering was kept wet from four to six days. In weather of a temperature approaching freezing the walks were covered with burlap made into long mattresss filled with straw, wood shavings, etc. When there was reason to believe that the concrete would freeze before it could harden, experience proved the wisdom of those who contended against laying concrete in such weather.

Expansion Joints—In the case of the 4″ walks, joints ¼″ wide were made clear through the concrete at intervals of 12′. Every 60′ a wider joint of 1¼″ to 1½″ in width was made and filled with a grouting of hot asphaltum and sand. No trouble with cracking was experienced where these joints were properly made, and filled.

Specifications—The ordinary sidewalk specifications as prepared by the organization of city officials, were used with the exception of those paragraphs immediately concerning the mixtures. These portions were replaced with a clause fixing the maximum dimension of the gravel or stone at one inch, and the proportion of cement to aggregate at one to six, by volume, leaving the sizing of the aggregate to the discretion of the engineer.

Contractors' Systems—Two contractors used virtually the same systems of handling materials and men, as shown in the illustrations. Both mixers and charging floors were mounted and were moved about to prevent long hauls of concrete. To be successful this method requires careful calculation of quantities of materials, so that the latter will not have to be moved back and forth to keep the mixer supplied. Both contractors gauged the water by pailfuls as needed.

Another contractor used a batch loader or skip which was loaded from the ground level. He also used an adjustable gauge on the tank that supplied water to the mixer. This plant was also moved about to facilitate short wheeling.

Still another one was forced to make his plant semi-stationary due to the fact that water was not everywhere available. He adopted the use of tight-boxed, metal-lined, horse-drawn dump carts. These approached the machine in a shallow trench and took one-half of a cubic yard of concrete at a load. Long hauls were thus made possible without delaying either end of the work. The only objection to these carts was that they rutted the sub-base quite badly, and the horses' feet loosened the forms, often knocking them out of place.

Another contractor practiced commendable economy in hiring a handy-man whose duties were to attend to those many little items that ordinarily take the time of the skilled laborers, such as supplying the engineer with coal, stretching hose lines, placing drinking water at convenient spots for the use of the workmen, checking daily consumption of cement, directing teamsters, and shaking out cement sacks and bundling them up for return to the factory. This handy-man saved more than his wages every day in cement recovered from sacks.

Cost of Materials—Average prices on materials for 1911 were about as follows: Portland cement, $1.90-$2.10 per bbl.; sand, loose, $0.90-$1.15 per cu. yd.; gravel, loose, $1.00-$1.15 per cu. yd.; crushed stone, loose, $1.25-$1.35 per cu yd.

Cost of Labor—For a nine-hour day these prices are reasonably fair: Foreman, $5.00; mixers, $3.25; engineers, $3.00; laborers, $2.25.

Accepted Bids—

Contractor.	Dimensions.	Total sq. ft.	Bid per sq. ft.
A	5 ft. x 4 ins.	237,000	$0.0925
A	5 ft. x 6 ins.	7,000	$0.14
B	5 ft. x 4 ins.	143,000	$0.10
B	5 ft. x 6 ins.	3,000	$0.12
C	5 ft. x 4 ins.	83,000	$0.106
C	5 ft. x 6 ins.	600	$0.15

These figures would indicate that the new method has effected a saving of not to exceed one-half of a cent per square foot over the cost alone of sidewalks laid under the two-piece system.

Steam-Curing---An Announcement

Concrete-Cement Age is in need of a large amount of information on the subject of steam curing plants in concrete products factories. On page 105 in the May issue of *Concrete*, an offer of a $25.00 prize was made for the best description of a steam curing plant, regardless of the size or output of the factory. Several excellent descriptions have been recived. Other readers have been too busy to prepare descriptions of their plants and have asked for more time. We think that while the material we now have on hand is good, we should have a larger expression of opinion and a fuller discussion of practice in steam curing, and the time in which these descriptions will be received has been extended to August 1. Every man who writes a description of his steam curing plant for Concrete-Cement Age has an opportunity, not merely to get $25.00 for it, or have his subscription extended for one or two years, but to contribute knowledge to the common fund from which he will derive as much benefit as the next man. We feel that many readers of Concrete-Cement Age will contribute information as to their steam curing methods and equipment on this basis, who might feel that they did not have time to enter a contest, merely for a $25.00 prize. Write the description of your steam curing plant in all detail. Include pencil sketches if they will serve better to explain the layout of the curing department, and send the material to the Editors of Concrete-Cement Age, Detroit, Mich., on or before August 1. Readers of *Concrete* who already have contributed descriptions of their steam curing plants may send additional information, if they choose. This is done to be fair to those who sent in their descriptions within the time originally set for the contest.

A Large Concrete Products Plant in Winnipeg

Glazed Sewer Pipe, Hollow Wall Tile and Block and Dimension Stone Manufactured

Four distinct lines of concrete products are manufactured on a large scale by the Perfection Concrete Co., Winnipeg, Manitoba—glazed concrete sewer pipe from 4″ to 24″ in diameter; hollow concrete partition and wall-tile, concrete block and dimension stone.

Glazed Concrete Sewer Pipe Machine in Winnipeg Plant

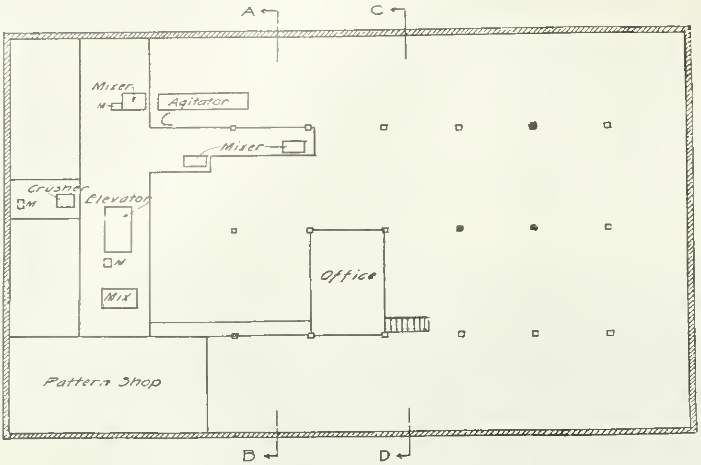
The factory building is 90′ x 150′ with walls 26′ high in the machine end and 16′ high over the rest of the plant with a 5′ lantern or turret above for light and ventilation. The boiler house at one side is 20′ x 32′. Accompanying drawings show the layout of the establishment. The curing rooms take up 88′ of the length of the building. There are eight of these rooms, two for tile, three for block and three for the sewer pipe. The walls of the factory are of concrete block and hollow tile, manufactured by the company. The division walls of the kilns are of 8″ concrete block. Curtains are used at one end of these kilns and double doors at the other, outside end of each kiln—this for the reason that the temperature frequently goes 40 degrees below zero in winter. The roof of the kiln is of reinforced concrete, designed for a heavy load inasmuch as it forms the floor for the room in which the ornamental stone is made.

The office is up in the lantern with glass on all sides, so that all parts of the open building may be seen from it. Concrete floors are used throughout the entire plant. The more important items of equipment in the factory are: 1 Thomas glazed cement sewer pipe machine; 1 Perfection block press; 8 Pauly hollow tile machines; 4 mixers: (one Northwestern Steel & Iron Works make, one Cargill make; two home-made by the Perfection Company); 1 Mitchell crusher; 1 H. W. Petrie band saw; 1 H. W. Petrie planer; 1 Darling Bros. freight elevator; 130 Chase Foundry & Manufacturing Co. three-deck cars cars for block and tile; 1 Vulcan Iron Co. 3-ton overhead traveling crane, for moving heavy ornamental stone; 2 Fairbanks 10-h.p. electric motors; 5 5-h.p. electric motors (one Packard Electric Co., four General Electric Co.); 3 3-h.p. electric motors (two Packard Electric Co., one General Electric Co.); 4 Briggs carts.

All material is brought to the west end of the factory by rail where it is unloaded in wheelbarrows to the various bins. From the bins, the sand, gravel, crushed stone and cement are measured in their proper proportions in a two-wheel Briggs cart. This load with its attendant is raised by the freight elevator to the platform in the second story where it goes through its particular mixer and is dumped, going by gravity to the particular machine which is to use it. Then in the case of the tile and block the product goes onto the cars and into the kilns and after curing, out to the piling yard.

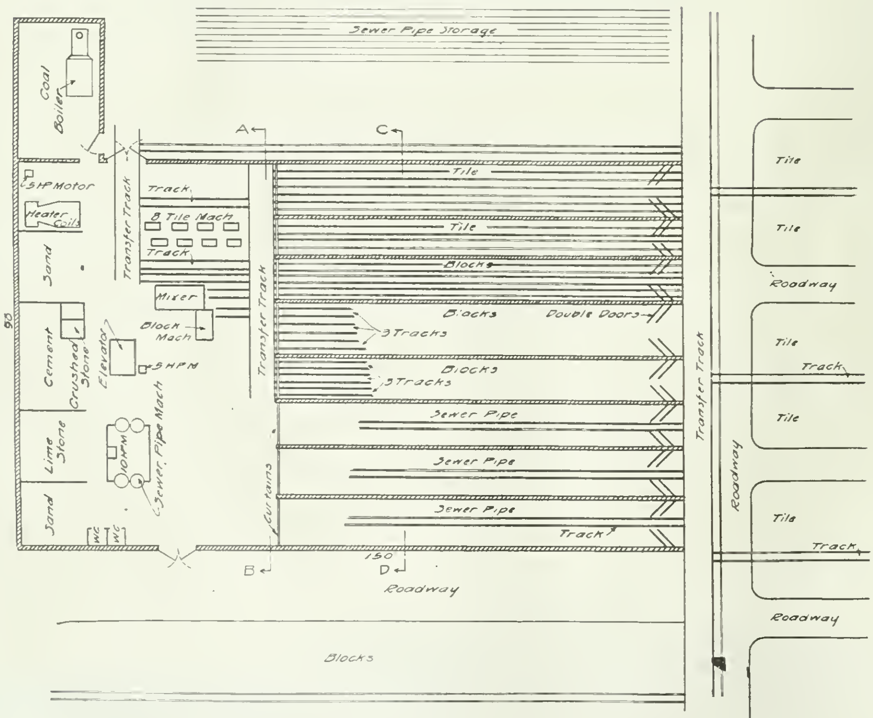
The sewer pipe is stood on end between the ma-

Plant of the Perfection Concrete Co., Ltd., Plant, Winnipeg

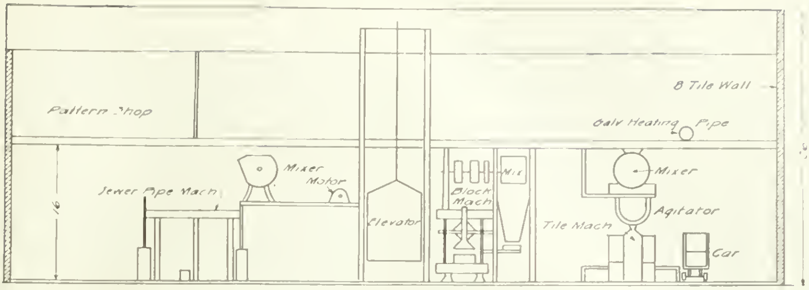


SECOND FLOOR PLAN

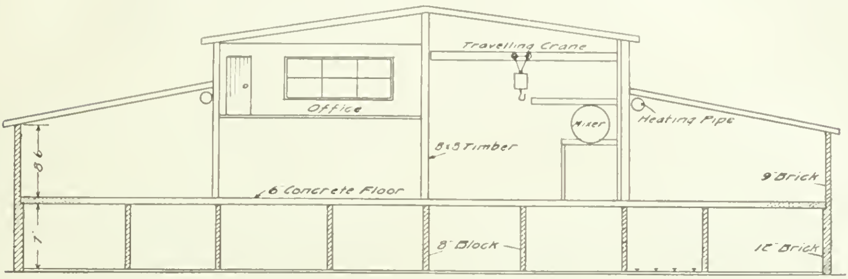
Layout of
Winnipeg
Concrete
Products
Factory



GROUND FLOOR PLAN



SECTIONAL ELEVATION A B



SECTIONAL ELEVATION C-D

chine and the curing room. The space is large enough to accommodate one day's run. The next day this tile, having attained considerable strength, is removed to the kilns and stacked. They remain in the kiln at least a week. All through the various lines of manufacture, the raw material enters the factory at one end and goes out finished at the other end. Nothing goes over the same ground twice.

In the kilns there is a main steam pipe 1″ in diameter near the floor. From this are five ½″ pipes each 8′ long with 1/16″ perforations about 1′ apart. Steam from the boiler is reduced to 5 pounds pressure for the kilns. Overhead is a water supply pipe with common revolving garden sprinklers every 10′, so that the entire kiln may be sprinkled at once.

A 60 h.p. boiler furnishes steam for the tile machines, the kilns and for heating (coil and fan system) and also for thawing out frozen sand in winter.

The plant has operated steadily all winter with a crew of more than 30 men and in the busy building season the force is still larger.

The plant was planned by the company's superintendent, A. E. Cline, and built by day labor under his direction.

Lockwood, Greene & Co., Boston, have completed the plans and specifications for the four-story reinforced concrete kiln, sorting and drying building of the Studebaker Corporation, South Bend, Ind. This building will be 244′ wide with sides 639′ and 431′, the west end curving to follow the adjacent railroad tracks.

Notice To Subscribers

All subscriptions paid in advance, either to "Concrete" or to "Cement Age," will be filled by CONCRETE-CEMENT AGE. Subscribers who were paid in advance for both publications at the time of consolidation, will have the expiration date for CONCRETE-CEMENT AGE advanced on their cards to correspond with the amount paid to each publication. The work of consolidating the subscription lists is in progress, but of course it will require some time in which to adjust properly each subscription account on the basis of the new magazine. Every possible care will be taken to avoid errors but some errors are sure to creep in, and we ask your co-operation. Please be patient—but be sure to bring these errors to our attention. Send subscription remittances and report subscription matters to CONCRETE-CEMENT AGE, Detroit, Michigan. The subscription rate for CONCRETE-CEMENT AGE is $1.50 a year in the United States and Mexico; $2.00 in Canada, and $2.50 in other foreign countries.

CONCRETE-CEMENT AGE.

The Metamorphism of Portland Cement*

An Analysis of the Changes in Portland Cement and Conditions Affecting Changes

BY ALBERT B. PACINI†

From a petrological viewpoint, Portland cement may be considered an artificial rock, consisting of definite minerals, and subject, as are all rocks, to metamorphism. The effects of metamorphism upon cement, and especially those changes in its constitution and properties which are brought about by the action of water, are of the highest practical importance, as the durability of concrete structures is thereby influenced.

The most stable rock minerals, when ground to the fineness of Portland cement and treated with water, undergo physical and chemical changes of startling rapidity when compared to those undergone in their normal unsubdivided state; this process is quite analogous in many ways to that which goes on when Portland cement is similarly treated. A systematic inquiry into the results of such action will help to explain causes of failure for which, perhaps, the cement itself was unjustly blamed.

The action of water upon Portland cement is a resultant of

1. The temperature of water
   - A. at first added (‡)
   - *B.* that may subsequently come into contact with the system.
2. The quantity of water
   - *A.* at first added (‡)
     - *a.* Size of cement particles
     - *b.* Mechanical agitation when water is added
     - *c.* Total water added
   - *B.* that may subsequently come into contact with the system.
3. The quality of water
   - *A.* at first added
     - *a.* having material in solution
   - *B.* that may subsequently come into contact with the system.
     - *a.* having material in solution
     - *b.* having material in suspension.

In connection with the action of water upon cement it may be well at this point to draw the distinction between hydration and hydrolysis: the former is the process whereby water molecules enter into chemical combination with the components of cement, the latter the decomposition ensuing when large numbers of hydrogen and hydroxyl ions are free to enter into combination with the ions of these components.

1. *Temperature of the Water at First Added.*—Within the possible range of temperature under working conditions, it has been established that as the temperature of the mixing water used is higher, the set becomes more rapid. Considering the setting due to the deposition of a network of crystals from the reaction-products in the mixing water, the beginning of this deposition would be sooner attained if the water reached its condition of supersaturation more quickly, and this condition would be brought about by a higher original temperature, provided, of course, that the dissolved substances increased in solubility with the temperature.

With a higher temperature, the volume of water would be greater and the viscosity less, and consequently its range of activity would be increased; that is, it would be enabled to reach a larger number of cement particles, and thereby more quickly arrive at its saturation point, the deposition of the crystalline network being, in consequence, hastened. To these factors may be added the increase in speed of chemical reaction by increase of temperature.

If the temperature of the mixing water be above 100° F., the setting, instead of being hastened, begins to be delayed. If the deposition of this network were a simple case of precipitation from a hot solution, it would be logical to surmise that the solubility of the compounds concerned was so high at this temperature that they were not deposited from solution. It is more probable that this delaying effect is due to hydrolysis.

Hydrolysis increases with the temperature. In the case of the weak salts that exist in the system we have under consideration, the ultimate products of hydrolysis are the gelatinous materials—silica in the hydrated form, aluminic hydroxide, and ferric hydroxide. The absorptive and coagulative properties of these materials unquestionably do not compare with the powers of the colloid which Michaelis postulates. If therefore, the hydration of cement does not proceed in a properly regulated manner, it is conceivable that it may become a hydrolysis, with deleterious effects.

The setting time at these critical temperatures, which are found to vary with different cements, is a resultant of two opposed processes—the formation of the crystalline network, and the destructive hydrolytic action of water upon the constituents of cement. Where the second process overbalances the first is the point at which the speed of setting ceases to increase and begins to diminish.

2. *Temperature of the Water That May Subsequently Come Into Contact With the System.*—The action of hot and boiling water upon set cement is strongly marked in the case where free lime is present, producing after a few hours, swelling, distortion and

†Chemist, Board of Water Supply, City of New York.

*Abstract of a communication presented before the section of Geology and Mineralogy, New York Academy of Sciences, January 8th and April 1st, 1912.

‡Owing to the peculiar auto-protective action of cement against the action of water, the quantity of water coming into contact with cement is a function of the size of the particles and of mechanical stripping of protective films, as well as of the ratio of cement to water.

cracking, and even total disintegration. A normal cement so treated, however, preserves its original form and volume.

The viscosity of water at high temperatures is greatly diminished, and it is thereby enabled to penetrate more readily the capillary and subcapillary voids, thus reaching more quickly a larger internal area. If, as in the case of an unsound cement, free lime is thereby reached, it is slaked much sooner than it would be under normal conditions of immersion, and moreover with great violence, owing to the higher temperature of the water, producing internal disruption, and perhaps thus opening up further avenues to the penetration of water, with a repetition of the slaking process.

In experiments made at this laboratory upon the storage of neat cement and mortar briquettes in waters of low temperature under different conditions it was found that low temperatures are adverse to the hardening process in cement, and that this effect is more pronounced in mortars than in neat cement.

The adsorption of calcium hydroxide by the complex hydrogel must therefore proceed at a lower rate at lower temperatures, or, the primary hydration of which this hydrogel is the product may proceed more slowly at these temperatures, and so less hydrogel be produced, either of which processes will detract from the hydraulic activities of the mass. The latter is probably the more satisfactory explanation, as test specimens which were chilled at first and allowed to return to normal temperatures showed a tendency to return to normal strength at longer periods, while the tendency in specimens kept continuously in cold water was to fall further off from the normal, indicating only a limited amount of hydrogel available for coagulation.

3. *Quantity of Water at First Added—Size of Cement Particles.*—The finest particles in cement, provided that they are chemically identical with the remainder, are the most active cementitiously, because of the ease of reaction and of the greater probability of this action being uniform throughout the mass of each particle. This is recognized under the microscope by the ultimate disappearance of these particles as individuals upon the addition of water. Owing to the relative insolubility of the constituents of cement, both before and after metamorphism, each particle becomes covered to a certain depth with the reaction products, which in this case take the shape of gelatinous films in such a manner as to offer hindrance to the further action of water. The particles whose diameter is smaller than or equal to the thickness of this zone are evidently the most chemically efficient, but on the other hand are the most susceptible to hydrolysis.

The formation of such protective film upon the surface of a coarse particle will so regulate the access of water to its interior that the contents will be slowly and normally hydrated. If the entire mass of the particle be at once accessible to an excess of water, the weakly acid and basic compounds at first formed will soon be hydrolysed and shorn of their binding power, and instead of the normal complex colloid described by Michaelis, capable of adsorbing electrolytes and so coagulating into a dense rigid mass, a series of simpler colloids, as hydrous silica and aluminic hydroxide will form, which have not these powers to so high a degree.

That the finer portions of cement are the elements of greatest strength has been repeatedly demonstrated by previous experimenters. A series of permeability tests of mortars made at this laboratory shows conclusively that the finest particles of cement are also the active elements in producing impermeability: that the more water-tight mortars are made by using more finely ground cement, when all other factors are constant.

4. *Quantity of Water at First Added—Mechanical Agitation When Water Is Added.*—The ultimate strength of cement will benefit by prolonged working up to a certain maximum time. *A priori,* it is legitimate to surmise that the setting is hastened, within limits.

After the maximum time referred to, which in experiments made at this laboratory has been found to correspond roughly with the time of initial set, continued working will cause a falling off in the strength. The formation of the coagulated colloid is rendered imperfect and discontinuous, and the structure of the set mass reflects the weakness of its component units. It may be supposed, moreover, that more cement has been brought into contact with water, and therefore within the range of hydrolysis by this treatment, even the larger particles being stripped of their protecting films by the attrition.

5. *Total Quantity of Water at First Added.*—Under certain conditions, the entire range of particles of a cement might be destructively hydrolysed, resulting in what is termed "drowned" cement. The effect of an increase in the quantity of the mixing water is known to result in a diminution of strength clearly due to the formation of a larger amount of the products of hydrolysis, as indicated by the larger volume of paste observed. As before pointed out, these products have not the hardening qualities of the hydrogel formed by normal hydration, and moreover, the structure this formed is liable to abnormalities. Being discontinuous, it will not offer the same total resistance, in the shape of connected films, to the passage of water. Moreover, in the presence of an excess of water, the working ratio of electrolytes to colloids will be less because of the greater dilution of the former in proportion to the volume of colloid.

Laitance, formed when concrete is mixed very wet, or when it is deposited under water, represents cement which has undergone hydrolytic decomposition. From the foregoing considerations, it is evident that the finest particles, those most cementitiously active, are transformed to *laitance* by careless manipulation. That this effect is independent of actual removal of these particles from the body of the structure has been demonstrated by experiments conducted at this laboratory; in other words, *laitance* remaining *in situ* detracts from the strength of the structure, as well as *laitance* washed away. From these studies it was found, however, that the effect of hydrolysis on the strength of cement is reversible, at least to a certain extent, although it is practically certain that cement treated with an excess of water will probably never regain its normal strength.

The conclusion is justifiable that *laitance* must possess adsorptive power, even if in inferior degree. This was demonstrated by analyses of *laitance,* as artificially prepared by treating cement with a large excess of water, and of the same *laitance* allowed to stand in contact with lime water, and then washed. The lime content showed a marked increase, but did not approach the lime-silica ratio of fresh cement.

6. *Quantity of Water That May Subsequently Come Into Contact With the System.*—The solvent effect of water coming into contact with cement structures is best studied by the percolation test. Although this test is designed to ascertain the resistance which these materials offer to the flow of water, it is evident that this resistance is not a consant quantity.

The temperature and pressure of the percolating water being constant, the flow is diminished by cementing and clogging, and increased by erosion and solution: the quantity of water flowing through the mortar or concrete, therefore, is a function of the balancing of these processes.

Cementing may result from deposition of material originally in solution in the percolating water, or dissolved from one portion of the structure and deposited in another.

Clogging, similarly, results from material originally in suspension in the percolating water, and deposited in the pores of the concrete, or from material eroded from one part of the mass, either mechanically or as a result of solution of the attaching portions, and deposited in another part.

Erosion *per se* is a negligible factor; that is, the flow of pure water carrying no suspended matter will have a very small mechanical effect upon a hard, insoluble material. When the water is armed with suspended matter its corrasive effects become proportionally magnified.

Solution is the most important factor in the process of percolation. Following the order laid down by Van Hise for the natural rocks, the basic materials removed are (1) the alkalies, and (2) the alkaline earths, calcium first, magnesium second. Since the alkalies exist in cement in the proportion of little over 1 per cent, and are not essential to the hydraulic properties or the strength, their solution is a matter of little consequence, except in that it may result in solutions which react upon the lime compounds and render their solution more easy of accomplishment. The removal of magnesium compounds proceeds at a lesser rate, although there is a greater percentage of them present, and their removal, in the main, may be dismissed as insignificant.

Since more than half the weight of fresh cement consists of lime, and since the strength of cement depends for the greater part upon the presence of calcium hydroxide, its removal is the factor of the greatest importance.

Although the removal of an adsorbed electrolyte from its colloidal captor is much slower than the reverse process, yet the infiltration of water through a cement structure will accomplish it in time, and finally, in its completion of the metamorphic process will hydrolyse the remaining compounds, and finish the transformation from the complex to the simple, leaving a mass of material of little or no mechanical resistance as an end product.

The effects of solution are enhanced, as will be shown, by the presence of dissolved electrolytes in the permeating water, and since in all natural conditions there is an appreciable burden of saline material, this effect is accelerated. On the other hand, the general effect of percolation upon the strength is a decreasing one, because of the reversion of the soluble material to a less soluble form, and the consequent protection afforded by the insoluble portions of the system decreasing the exposed area of soluble material.

It may be laid down as a general principle, from experiments made in this laboratory, that the cementing effect in moderately dense and dense concretes outweighs the solvent effect; that is, the percolation tends to diminish by "healing."

Where the effect of water is confined to the exterior of the cement structure, it is needless to say, all these effects are only experienced in a greatly moderated degree.

Experiments made at this laboratory indicate that concrete offers less resistance to the flow of water when the direction of flow is parallel to the bed than when at right angles to it, as is the case in the stratified rocks. In its applications, the result would be to enhance lateral percolation, and in the case of disintegration would exercise a localizing influence.

7. *The Quality of Water at First Added—Having Material in Solution.*—It has been shown by Rohland that the salts which respectively accelerate and retard the setting of cement are the same as those which accelerate and retard the hydration of quicklime. Their influence on the setting of cement is an intricate chemical problem which is as yet only in a partially clarified state.

The effect of such dissolved salts upon the ultimate strength may be stated in general as deleterious. This point is of marked importance in construction, as the problem of mixing water is often solved by using the water nearest at hand, without further inquiry into its qualities. It is the custom indeed to specify that such water shall be free from oil, acid, strong alkalies or vegetable matter, yet the presence of large quantities of dissolved neutral salts in water used for construction is easily overlooked. It is of the utmost importance that the water be subjected to such additional tests as will reveal its mineral content.

The results of tests made at this laboratory, in which dilute solutions of a large number of electrolytes were used for gauging neat and mortar specimens, show that although there is a temporary augmenting of the strength over that obtained in specimens mixed with pure water, at the later periods this difference became a loss. The early increase is probably due to additional cementing or void-filling material precipitated in the pores by reaction between the added electrolytes and the solutions resulting from the action of water upon cement. This deposited material, in its later history, evidently reverts to a soluble form and is washed out, leaving abnormal voids, else in its growth may disrupt the cells it occupies, in either case reducing the strength.

There is a strong analogy between the action of mixing water containing dissolved electrolytes and the action of excess water, that leads to the tentative conclusion that these electrolytes may act as accelerators of hydrolysis, in addition to their metathetical action. Under certain conditions, the addition of clay to cement was found to retard the hydrolysis in each case. The effects of these two treatments were also found to be additive when superimposed upon each other.

8. *The Quality of Water That May Subsequently Come Into Contact With the System—Having Material in Solution.*—The action of waters containing dissolved salts upon concrete structures has been a fruitful field for investigation recently and much work is still being done upon the subject. A large part of the mischief done by the saline waters so far found harmful has been admittedly the result of mechanical action, the crystallization or efflorescence of these salts disrupting the concrete when the contact of the water was intermittent. Much of the harm, however, is traced to direct chemical action, and recent literature on the reactions involved has been quite copious. Discussion here is therefore superfluous; the activities of the Board of Water Supply, as far as they have been carried, have been towards the discovery of remedial measures.

For the sake of convenience the natural waters of neutral reaction may be classed together, as they differ mainly in the proportions of the dissolved salts, the same salts being common to nearly all of them. It may be stated broadly, in this case as well, that in addition to the specific metathetical reactions between these salts and the separate components of cement, it is quite likely that they also act as accelerators of hydrolysis, even after the cement has attained the greater part of its ultimate strength. Their tendency then is to break down the essential constituent of hardened cement, the complex hydrogel of Michaelis, and to transform it into simpler products of little or no strength. As part of their attack may be reckoned the volume changes resulting from reactions of direct substitution causing expansions which disrupt the cement and open up its interior to further attack.

Using the salts which occur in these waters, and in larger concentrations than obtain in practise, it was found that high silica cement resisted the attack much better than low silica cement, and that finely ground cement was more resistant than coarsely ground, possibly because of its greater impermeability when set. The strength at early periods in experiments of this type shows an increase which is probably due to precipitation in the pores of void filling material, as before observed, which may later revert to a soluble form, or the strengthening effect of which is neutralized by its growth and consequent disruption of the cement structures.

Much remains to be done to discover preventive measures, as the conditions of construction are necessarily such that these solutions, dilute or concentrated, are always coming in contact with concrete structures, and exact quantitative determination of their dangerous possibilities is vital.

9. *The Quality of Water That May Subsequently Come Into Contact With the System—Having Material in Suspension.*—Where water has immediate access only to the outer surface of a mass of set cement the effect of its moving suspended matter is a corrasion of the dense surface skin and ultimate removal thereof, gradually rendering the interior more accessible.

The speed of the process depends upon the velocity of the water and the size of the suspended material. External effects, however, are generally of no great moment. Where the pressure of the water is such that there is a marked motion thereof in the pores of the concrete, the suspended material is furnished by the structure itself—small particles of cement, or grains of sand from the mortar, are whirled around by the current, and shortly enlarge the cavity in which they are rotating until it merges with some adjacent cavity. Under favorable conditions this process may continue until the interior of the structure is markedly honeycombed.

A factor which neutralizes this flow is the choking of the pores by sediment, coming from the water itself, or furnished by the action of the water upon the concrete. If the flow is oscillatory, as in concrete exposed to the range of the tides, this protective effect will not be so marked. Diatoms and other microscopic organisms with siliceous or calcareous tests undoubtedly play an extensive part in the preliminary stages of this internal mechanical action, by choking the capillary spaces. At the same time the organic débris thus introduced may by its decomposition give rise to compounds, as carbon dioxide and hydrogen sulphide, which have an accelerating action upon the process of solution, and the silting effect may thus be neutralized or even overbalanced.

United States Consul Homer Brett, at Maskat, Oman, Arabia, writes that most of the houses in his district are built with flat roofs and that many of these are made of a sort of concrete, sometimes using a rather inferior native material for binding the aggregate and sometimes using Portland cement. They are covered with a plaster which is only approximately waterproof and which is easily broken, so that the people suffer a great deal in rainy reasons, inasmuch as the roof covering not only lets water through, but soaks full of water and retains dampness for a long time. Mr. Brett believes that there is a market in his district for waterproofing materials which may be used in such roofs.

Absolute solidity and entire freedom from vibration is necessary in a laboratory balance table. *Mines and Minerals* reports that at the Butte School of Mines balance tables have been built using concrete for its solidity. A concrete pillar is built up of the size necessary for a balance table and the wooden frame of the table is built around this pillar, the pillar projecting about ½″ above the surrounding table level. Instead of bolting this wooden frame to the concrete, as is commonly done, it is left entirely free, so that any vibration which may be communicated to the wooden floor upon which it rests in no way affects the concrete pillar, which is built up from the earth below.

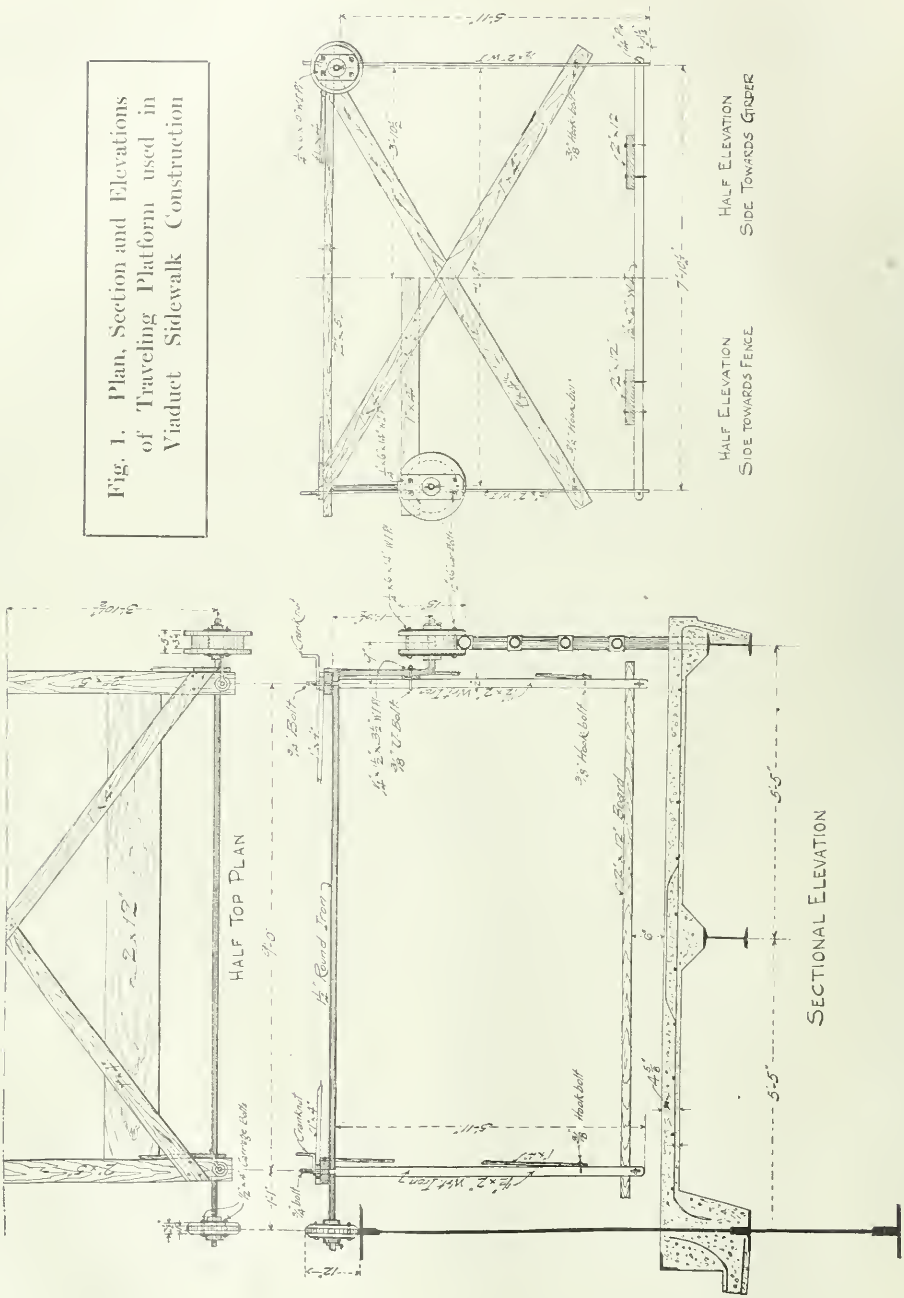


Fig. 1. Plan, Section and Elevations of Traveling Platform used in Viaduct Sidewalk Construction

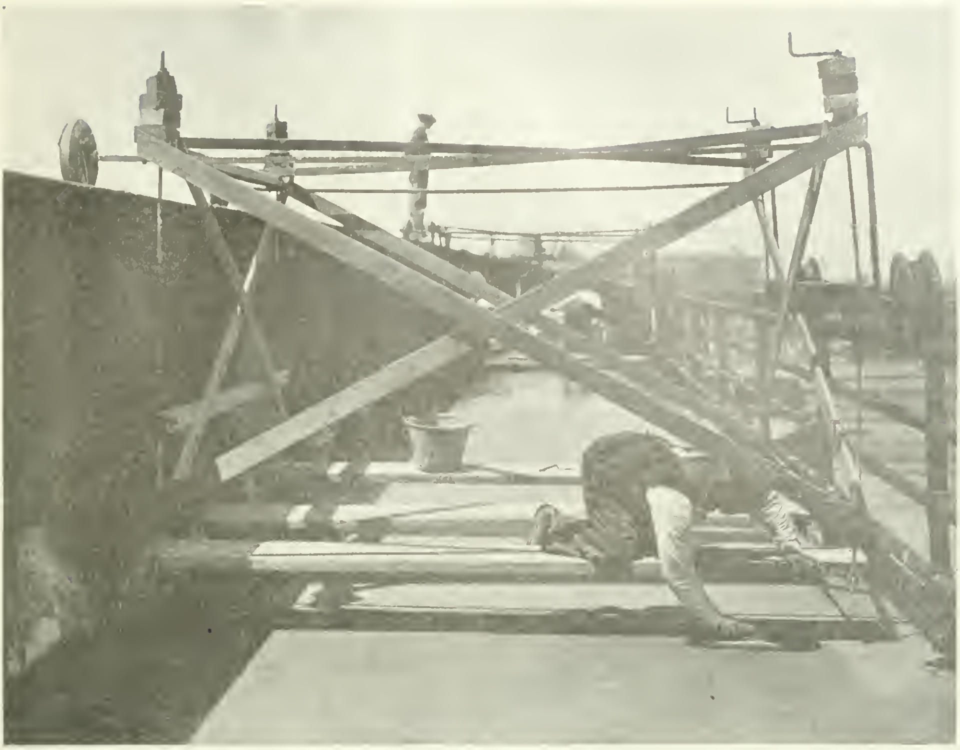


FIG. 2—TRAVELING PLATFORM IN USE IN VIADUCT SIDEWALK CONSTRUCTION

A Movable Platform In Viaduct Sidewalk Construction

BY C. M. KURTZ*

In the construction of the reinforced concrete sidewalks of the Mission Bay Viaduct, San Francisco, Cal., by the Southern Pacific Company, two movable or traveling platforms or "carriages" of novel design were employed to place the laborers in convenient positions for applying the straight-edge to the freshly placed concrete, "floating" the surface of the sidewalk, and for marking the same into squares.†

The viaduct sidewalks are of cross-section as shown in Fig. 1, 4⅝" thick by 10′ 10" wide and as will be readily observed, quite inaccessible for working purposes except from above. The concrete was made up of 1 part of cement to 2 parts of sand to 4 parts of gravel and no "topping" coat was placed. The 4⅝" slab of concrete is therefore homogeneous and the maximum strength for that thickness thereby acquired.

The first of the carriages constructed is shown in the reproduction of the photograph, Fig. 2, the laborer working thereon at the time the photograph was taken being in the act of "floating" the surface. The second carriage is seen in the background of this illustration and was being used in straight-edging of freshly dumped concrete. The second proved to be the better design of the two, being slightly heavier and of more rigid construction. It is shown in the drawing, Fig. 1.

Briefly described, this carriage consists of a framework made up of four ½" x 2" wrought iron verticals suspended from two transverse 1¼" round iron rods, at the ends of which are two pairs of wooden wheels, the pair on the left to run on top of the viaduct girders and the pair on the right (provided with flanges) to run on the top pipe of the viaduct fence. As the top of the fence is about two feet lower than the upper flanges of the girder, the rods are bent downwards and reversely at the right and held vertically in that position by a connecting member, a 1" x 4" board with two ⅜" U-bolts. These U-bolts also tie the vertical portions of the 1¼" rods to the ½" x2" verticals adjacent. The vertical members are joined longitudinally by two 2" x 5" x 8′ 10" boards at the upper ends, and by two ½" x 2" wrought iron members at the lower ends. These latter or lower chords of the carriage support the two (or three) 2" x 12" planks for carrying the laborers. Welded to the upper ends of the four verticals and passing through the 2" x 5" upper chords are ¾" bolts provided with cranknuts, the latter for conveniently adjusting the elevation of the platform planks to a suit-

*Construction Department, Southern Pacific Co., San Francisco, Cal.

†A general mention of this device was made in *Concrete*, January, 1912, p. 49, with the reproduction of a photograph.

able height (about 6″) above the surface of the sidewalk. Rigidity of the frames is secured by X-braces on the sides and top, consisting of 1″ x 4″ boards.

The carriages being of light construction were easily moved over the work as was necessary by hand, and they gave excellent satisfaction for the purpose for which they were designed.

Renewed Discussion of Concrete Sands

The important discussion of concrete sands introduced some years ago has been revived by an article in *Engineering News*, written by John R. Freeman, consulting engineer, Providence, R. I. Mr. Freeman states that it is a fact beyond all doubt or question that here and there are banks of sand and gravel which upon ordinary inspection appear ideally perfect for making mortar and concrete, but which are nevertheless dangerous in the extreme and all because of some ultra-microscopic content probably similar to tannic acid (in a colloidal film around the sand grain), which works in some mysterious way to prevent the union between the cement and the sand grains.

The author cites an occasion where he found at the site of a proposed dam what promised to be a most economical resource in the shape of excellent sand and gravel, but upon being tested some of the samples of 1:3 mix—six days in water—hardly maintained their integrity while being placed in the clamps and before any load was applied. The cement was of a brand that had given excellent results with other aggregates. The tests were made by Sanford E. Thompson. The subject was called to the attention of several experts, who advanced various theories in explanation of the defect, among them E. E. Free, an investigator in the borderland between chemistry and physics, for some years past connected with the Department of Agriculture at Washington, D. C., and now engaged upon physical and chemical investigations for the Bureau of Soils, with particular reference to the means by which the plant is able to take into solution the mineral ingredients, silica, etc., required to strengthen its constitution. Mr. Free had run across analogous phenomena in studying the relative fertility of different soils. He said that in popular terms the situation could perhaps best be explained by considering that an extremely thin film of a complex form of tannic acid surrounded each grain of the troublesome sand, and prevented its chemical attachment to the cement; that these complex organic acids had a strong tendency to thus spread themselves thinly and strongly adherent over the outside of the siliceous material and that the reason why one particular brand of cement was able to break through this filmy barrier so as to get a firm grip upon the sand grain, was because of its containing a small quantity of some form of alkali that united with this acid film, or somehow changed its colloidal state.

Discussing the matter editorially, the *News* reviews briefly the history of investigation along this line and treats the subject in part as follows:

A tendency to stiffen the sand test was shown in the following clause from the Report of the Joint Committee on Concrete and Reinforced Concrete:

Mortars composed of one part of Portland cement and three parts fine aggregate by weight, when made into briquettes should show a tensile strength of at least 70% of the strength of 1:3 mortar of the same consistency made with the same cement and standard Ottawa sand.

This clause, if inserted in concrete specifications, would exclude many defective sands even though it does not help in the question of what makes them defective. Unfortunately, it is rarely called into play. There are a number of reasons for this, principal among which is the reluctance of engineers to force the contractor to make what he considers an unusual and unnecessary test. There are also the difficulties of sampling and storage to overcome, but in the main the trouble lies in the inertia of established custom. Attempts are being made by several societies to bring this matter of definite sand specifications to a head and we may expect a marked advance in the near future.

We are quite aware that these defective sands are the exception rather than the rule and that there will be a number of engineers and contractors who will think the whole investigation a highly interesting laboratory amusement of no value whatsoever to practical construction. The fact remains that there are sands whose availability for concrete aggregate cannot be predicted under any of the ordinary methods now in vogue, and that every so often one of these sands gets into a structure to its detriment. The reasonable thing to do then is to provide some practicable test for such sands, and to devise such a test intelligently requires a knowledge of the reasons for the defects in the sand.

Messrs. E. Ellmer & Co., Stettin, Germany, builders in cement and reinforced concrete, have constructed a petrol-motor boat which is entirely built in reinforced concrete, the keel, heelpost, frames, shell and bulkheads being all made of this material. The boat is intended for pleasure trips on the River Oder, and a moderate speed only is intended; the boat, 7 meters in length and 1.75 meters in width, is not to run at more than 6 miles per hour.

The value of concrete in tree dentistry is very generally recognized and a development of this idea is found in a report of an interesting experiment in Missouri. A. G. Higgins, Trusswall Manufacturing Co., Kansas City, Mo., writes that a square wooden porch post had practically rotted away at the bottom. A carpenter, in making repairs, cut out the decayed wood, filled the hole with concrete, smoothed it off carefully and painted right over it when the post was painted.

Leonard C. Wason, president of the Aberthaw Construction Co., Boston, states that in one case the saving of concrete by reducing the size of columns on successive floors was $2.30 per column. On the other hand, the increase in form cost was $5.70 per column, entailing a loss of $3.40 per column. This is a very good example of why it is cheaper to use the same size columns on successive floors than to reduce the dimensions. To avoid frequent changes in column sizes, the column reinforcement may be varied in successive stories.

Proposed Building Codes for New York City and Pittsburgh

BY EDWARD GODFREY.*

I have before me what appears to be the complete building code proposed for New York,† and the portion of Pittsburgh's proposed building code‡ that relates to reinforced concrete. There is a notable feature in these two codes as regards shear in steel rods in concrete. Neither of them gives any unit for such shear. It is a common thing in regulations relating to concrete structures to allow 10,000 or 12,000 lbs. per sq. in. of shear on steel rods embedded in concrete. As I have repeatedly pointed out, the fallacy of this is apparent.

Stirrups and shear members and the alleged "stress" they take is another favorite theme for building codes and for writers on this subject. These are elaborated in the Pittsburgh code, but are quite conspicuous by their absence in the New York code. On the other hand, the New York code, on page 81, refers to shear allowed on concrete "when all diagonal tension is resisted by steel." This looks at least like an entering wedge for safe and sane design. For if the diagonal tension is resisted by steel, any sane individual would look for full anchorage both above and below the section where "all diagonal tension is resisted by steel," and would not imagine that floating stirrups or shear bars can perform this important office. I have always maintained that stirrups, and shear bars, and reinforcing bars bent up and not having full anchorage beyond the support, cannot properly resist the diagonal tension in a beam.

One form of reinforced concrete design open to criticism, the rodded column, is allowed in both codes; in the New York code, on page 83, it is rightly, though possibly inadvertently, called a "plain column." This is the king of wreck breeders. Every great reinforced concrete wreck has had plain concrete columns with slender upright rods embedded in them; but it seems that it will take a disaster on the order of the Titanic or the Iroquois fire to waken up engineers and the public. The latest wreck, which occurred in the Pittsburgh district, has had a very salutary effect on the design of the columns of some large buildings being erected in Pittsburgh, and the change was in the addition of hoops or spirals.

The deplorable feature about most of the faults in the building regulations is not that the construction allowed is comparatively weak but that it is apt to be positively dangerous. A battened post, cast iron columns in a 12-story building, concrete shafts with slender rods in them (without closely spaced hoops), girders with end shears of 100 to 150 lbs. per sq. in. and having no diagonal steel that is *anchored beyond the edge of support*—these are not merely comparatively weak, they are dangerous. They all have wrecks to their discredit. One could view with equanimity a regulation that allows 9,000 lbs. per sq. in. on cast iron columns instead of 8,000. But when 800 lbs. per sq. in. is allowed on a so-called reinforced concrete column, and a well-seasoned column of this identical design failed under 200 lbs. per sq. in., the error is seen to be not one of degree but is a fundamental error; the style of design itself is erroneous. The column failure to which I refer occurred not three months ago and not far from here.

In the matter of live loads to be used in design there is little to criticise in either code. It would seem, however, that a flat roof ought to be designed for the same live load as a regular floor, because such roofs very often have rooms or pent houses built upon them later. The New York code calls for 40 lbs. of live load on such roofs, and the Pittsburgh code but 25 lbs.

On page 37 of the proposed New York code it requires that methods of construction must be installed the same as tested. This would preclude the use of a 1″ layer of reinforced cement mortar overlaid by a 6″ layer of soft tile for wide span slabs, based on tests of slabs that included in addition to the above a 2 or 3″ layer of cement mortar above the slab. This was done in a large building in Pittsburgh.

The New York code, on page 40, requires that hollow building block stand an ultimate compressive test of 750 lbs. on the gross section and absorb no more than 10 per cent of water. A set of specifications on concrete construction recently balloted on by the National Association of Cement Users gives these values as 1,000 lbs. and 5 per cent, which is very much better. This set of specifications, by the way, is an excellent one. The only fault I could find with them is that they recommend *heating* the materials in cold weather.

On page 73 of the New York code a very wise provision is given. Segmental arches are required to have steel tie rods of the proper size, spacing and location to resist the thrust. It is common to see segmental arches with little or no provision to resist the thrust. I recently examined a plan in which wide-span arches had no tie rods whatever.

On page 83 of the same code there is a joker in paragraph 15. Columns are allowed to be strained 20 per cent above the regular limits if the aggregates are carefully selected and the mixture is somewhat richer. It is easy for the designer in the office to say that in a certain spot a special rich mixture must be dumped and that carefully selected aggregates are to be used in these particular batches. It would keep several inspectors busy to see that this was carried out. This paragraph is not a practical one. It would be used as a loop hole to skimp the design and still not violate the code.

In the Pittsburgh code there is a formula for the distribution of load two ways in a slab supported on four sides. This formula is an importation; it is not based on any rational analysis; it is not substantiated

*Pittsburgh, Pa.

†*Proposed Building Code for the City of New York* prepared by the Joint Committee on City Departments of the following organiations: New York and Brooklyn Chapters American Institute of Architects; Building Trades Employers' Association; New York and National Boards of Fire Underwriters; American Institute of Consulting Engineers; New York Society of Architects; and the building superintendents of the five boroughs of Greater New York.

‡Report of Committee on Reinforced Concrete as submitted to and ordered issued by the Commission for the Revision of the Building Laws, Pittsburg, Pa.

by any tests ever made; it is discredited by the very committee which gave it forth and by this code itself in the same paragraph with the formula. This paragraph says: "If the length exceeds one and one-half times its breadth, the entire load shall be assumed to be carried by the transverse reinforcement." This is as it should be. But the formula in the code would show that only 83 per cent of the load is carried by the transverse reinforcement at this limit. This is the inconsistency and error of the formula.

The New York code wisely omits mention of reinforcement for compression in beams. The Pittsburgh code gives countenance to this fallacy. True reinforcement for compression in beams would require either stiff steel members or rods held in by steel wires or rods at close intervals to prevent bulging up. The latter is not practical because of the expense. There is the same objection to a beam "reinforced" for compression in the ordinary way as to a rodded column.

The provisions of the Pittsburgh code as regards columns are most unsatisfactory and confusing. Apparently wires tied around column rods in square columns are called "rectilinear hoops." Who ever heard of square hoops? The code is apparently cunningly worded so as to admit square column with a slender rod in each corner wired with "square hoops" at wide intervals on exactly the same basis as real hooped columns. There is no comparison between the strength of these.

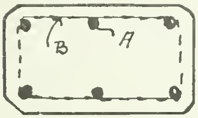


Fig. 1

The sketch herewith shows the section of a column that would seem to pass the proposed Pittsburgh code as a hooped column, good for 750 lbs. per sq. in. on the concrete and 7,500 lbs. per sq. in. on the steel rods. *Query*—How does wire *B* hold rod *A* against buckling? This is the section of a seasoned concrete column that failed under 200 lbs. per sq. in. recently.

The Pittsburgh code, on page 19, allows rods to be bunched in the bottom of a beam until they are within ¾″ of touching in a horizontal direction and ½″ of touching in successive layers. How could steel ever be gripped by the trifling amount of concrete in these *laminae?*

In the matter of shear reinforcement, the Pittsburgh code is woefully lacking. It would allow the worst that has been found in the worst wrecks recorded.

This code would allow sketches (*a*) and (*b*) with 120 lbs. per sq. in. in shear in the weak section. This is just a little less than the probable ultimate strength. This is a feature very common in wrecked buildings and bridges; that is, so-called shear reinforcement such as shown at (*a*) and (*b*) and unit shears of 120 lbs. per sq. in. and more. Steel placed as in sketch (*c*) would really reinforce a beam where it needs reinforcement for shear.

A hook is sanctioned as a splice for rods in the Pittsburgh code. This ought not to need any comment.

In several instances the language of the Pittsburgh code is devoid of definite meaning.

When building code commissions realize that the whole sum and substance of reinforced concrete knowledge is not bound up in the minds of the commercial designers, and that independent engineers are not laboring to annihilate reinforced concrete, they will

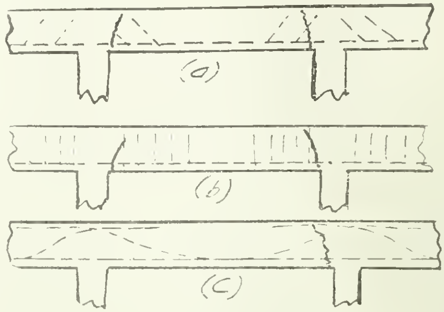


Fig. 2

probably take *some* advice from sources outside of those who are vitally interested in "acreage" and "cubic feet" in reinforced concrete construction. The result will be safer building laws.

State Supervision of Bridges.

In an article in *Engineering News* describing the rapid construction of a small concrete bridge in Illinois, P. E. Green, consulting engineer, takes occasion to refer to the supervision of highway bridges, and makes the following suggestions:

All country highway bridges should be built under the supervision of a state engineer, having full authority and ample powers by law. One reason for this is that the consulting engineer has little authority when employed by the township. In fact, the contractor often ignores him and deals directly with the highway commissioners. Under the present system an engineer is rarely employed for anything except to make the plans, and very meager plans are desired.

Almost always, under the present system, both cnotractor and engineer are forced to be politicians, and much of the work is actually the result of promotion by the contractor.

Most highway commissioners have little conception of an engineer or his duties, and if they employ one it is as likely as not to be the contractor who is bidding on the work.

The contractor, as a rule, is much superior, mentally, to the men under whom he works.

Under the present system, in Illinois at least, competition is practically strangled.

Only a strong central authority can hope to cope with such a situation.

The supervision of the state should only apply to the country districts, and not to incorporated cities and towns.

Motor Transportation for the Contractor

Facts and Figures as to Operation from Tests by Two Large Contracting Companies

BY ROLLIN W. HUTCHINSON, M. E.

The necessity for efficiency and economy in all lines of business is nowhere more pressing than among contractors and builders. Modern competition demands the closest attention to details of methods and cost of operation.

Among the problems confronting the contractor, the disposal of waste and the haulage of building material is one of the most important. The increase in the cost of maintaining a horse equipment and the necessity for speed limit the use of horses to a comparatively narrow field, as compared with mechanical methods of moving material.

The rapid progress of the motor truck industry and the present reliability of service provided by motor-driven vehicles, places at the disposal of the contractor a means of increasing his efficiency and reducing his operating costs. That engineers and builders have given this subject their serious consideration is proven by the increasing number of motor trucks in use by contractors throughout the country. The introduction of the motor truck into the contracting field is comparable in importance to the introduction of the steam shovel and the air drill.

In the following typical cases the ability of the motor truck to save money and do the work has been well proved.

The problem of removing muck and tunnel rock from the Catskill aqueduct shaft, in New York City, is a serious one. The Pittsburgh Contracting Co. is building that part of the tunnel lying between 176th and 106th street. They are using motor trucks to remove material from the lower shaft to the dumping ground at 129th street and the Hudson River.

After making several tests with motor trucks in this line of work, the company installed two 6½-ton Saurer trucks. The distance from the farthest shaft to the dumping ground is about two miles. With horse-drawn carts it would be necessary to have a large number of teams of small capacity to do this work. Every effort is made to keep the truck in constant motion. To effect this the loading of the truck is done at the shaft mouth from chutes as shown in the illustration. The truck, carrying a 4-yd. skip bucket, is driven under these chutes and the material loaded directly from bins into the skip. The trucks are equipped with special platform bodies designed to hold these buckets rigid.

It is proposed to attach to each truck a trailer carrying a similar skip so that the total load for each trip will be approximately 13 tons. It is expected that by having the buckets suspended under the chutes leading from the bins that they may be loaded while the truck is making a trip and a great

Motor Truck Handling Cement up Steep Grades for Catskill Aqueduct

Hauling Steel in Pittsburgh

Loading Cement on Truck for Catskill Aqueduct deal of time saved in this way. The skips are removed at the dumping ground by a derrick boom equipped with a dumping line. This line is hung from the end of the boom and is attached to a hook riveted at the rear and at the bottom of the bucket. The load is carried out over the dump by means of a hoisting line attached to the bucket, at a point slightly in front of the center of gravity. When the point at which it is desired to dump the load is reached, this hoisting line is slackened and the load is taken on the dumping line, which tilts the bucket forward and discharges the load.

Each truck makes an average of 12 trips per day, carrying 42 cubic yards when operating without a trailer.

It is estimated that 300 working days in the year is the maximum that a truck may be expected to operate. This allows time for overhauling and holidays.

6½-Ton Truck Without Trailer

TABLE I

The material is excavated from aqueduct tunnel and the time of loading and unloading is three minutes. The material is dumped into bins and then to buckets by chutes at the shaft mouth. At the dumping ground the bucket is hoisted off the truck and dumped.

Conditions—	
300 days per year	
50 miles per day	
15,000 miles per year	
3½ yards per trip in single bucket	
42 yards per day of 8 hours.	
Investment—	
6½-ton Chassis	$6,000.00
Special platform body	300.00
	$6,300.00
Fixed Charges—	
Interest on $6,300 at 6%	$ 378.00
Insurance: Liability to persons	75.00
Depreciation (not figured)	......
Driver at $21.00 per week	1,092.00
Garage at $17.50 per month	210.00
	$1,755.00
Operating Charges—	
Maintenance at 4c a mile	$ 600.00
Gasoline at 2.4c (5 miles to a gallon)	360.00
Tires at 5.5c (8,000 mile guarantee)	825.00
Oil and grease at 1c per mile	150.00
Total cost per annum	$3,690.00
Total cost per day	12.30
Total cost per yard	0.292
Total cost per mile	0.256

Figuring the cost of hauling this material according to the table, where the motor truck is operated without trailer, the cost per cubic yard is approximately 29c, against 80c where horse equipment is used. The interest in this case is figured on the full investment and no depreciation is charged against the truck. Interest is normally figured on half the investment as an average charge during the entire life of the truck; the depreciation is figured on a mileage basis covering the estimated life of the truck. If the figures shown in the table were altered to conform to this standard, the sum of $432 should be added to the total yearly cost. This would bring the daily cost to $13.74, making the cost per cubic yard 33 cents. From the standpoint of earning power, these figures show that the truck without the trailer hauling 42 yards per day actually earns 47 cents per cubic yard or a net profit of $19.47 per day over the horse equipment.

Among contractors the customary amount chargeable to depreciation on all kinds of equipment is said to be 60 per cent on a three-year contract, making an annual charge of 20 per cent. If this method were used in figuring costs for operation of a motor truck in the same capacity as in the table, the amount chargeable to depreciation would be $1,260 per year—$4.20 per day—and the total cost per cubic yard increased to 39 cents. This would still leave a large margin of profit to the credit of the motor truck, against horse-drawn equipment.

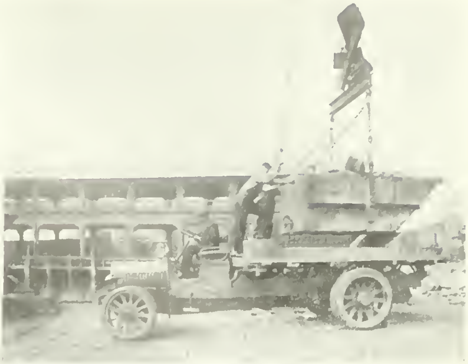
Estimating the cost of handling this material by motor truck with trailer when the interest is figured on half the investment and the depreciation is based on the mileage life of the truck, we find the cost per cubic yard to be 33 cents. By using a trailer in connection with the truck a much greater reduction of cost can be made. The additional investment entailed and the maintenance of the trailer would be more than offset by the increased capacity and the cost per cubic yard would be reduced to approximately 17 cents. Aside from this earning power of the truck, the ability of these trucks to move large quantities of material rapidly enables the other work carried on by this company to proceed much more rapidly than it could do if a horse equipment were used.

Another contractor using one 6½ ton Saurer truck, hauls cement and building material over seven miles of very hilly country. Some of the grades encountered by this truck are from half a mile to one and a half miles long and vary from 8 to 15 degrees. Nine trips per day over these roads made an average days work for this truck. It is loaded with 110 bags of cement on each trip, making an average load of 10,450 lbs. In this work the truck replaces 12 teams of horses, costing $5.00 per day for each team. One of these teams, making approximately two trips per day over this road, would carry 8,000 lbs., or 80 bags of cement. Twelve teams would, therefore, carry 96,000 lbs., or 960 bags for approximately $60.00, or 0.063 cents per bag. The motor truck carries 990 bags per day for approximately $17.00, or 0.017 cents per bag.

The Empire Engineering Co., working on a contract requiring the constant haulage of large quantities of cement and lumber, installed two five-ton Mack trucks. These trucks made two trips per day over 18 miles of good road, replacing a horse equipment of ten teams. These trucks, loaded only one way, hauled approximately 20 tons of building material a day, at a maximum total cost of $40.00 or $2.00 a ton. If this work had been done by the ten teams the total cost would have been approximately $50.00 per day or $2.50 per ton.

The Keystone State Contracting Co., Yonkers, N. Y., uses a 6½-ton Saurer truck, with hand dump-

Loading Rock from Bins to Motor Truck



Preparing to Unload Truck with Lines from Derrick Boom

ing body, hauling cement, coal and miscellaneous supplies. This truck makes local deliveries over good roads but in a very hilly section where the grades are constant and heavy: it replaces ten teams and the service rendered by this truck enables the company to carry on its building operations much more efficiently and economically than when a horse equipment was used.

The opportunities for utilizing the motor truck in contracting work are many and varied. Aside from the increased speed and capacity obtained by using motor trucks, the auxiliary devices with which the motor truck may be equipped are of great value in general contracting work. These devices have been in use a long time with horse-drawn carts and their application to contracting work is well known, but their development as applied to motor-driven equipment is not generally realized.

Too much stress cannot be laid on the importance of time in connection with motor truck work. The horse during the course of the day's work requires many rest periods, especially after a long haul over a severe grade, and the efficient use of horse equipment demands that fully as much of the working day be given over to stops as is devoted to keeping the team in motion. For this reason, the capacity of the horse is limited to his endurance, and this, in turn, is dependent upon conditions which are not under the control of the contractor. A period of very hot weather or a sudden fall in temperature, covering the streets with ice or snow, may render the horse almost useless; while if the weather conditions are favorable a number of heavy grades may necessitate either a reduction in the amount of work done by a single team or an increase in the number of horses required to pull a single load.

It is therefore clear that the time taken in unloading such teams or the time spent by the teams in waiting to be loaded is not in reality wasted time, but a necessity in the efficient handling of such work.

The motor truck has none of the limitations of the horse. While it is kept well oiled, well adjusted and supplied with fuel, it is always ready to work. It is not affected by hot weather nor do heavy grades require that it take a rest at the top of the hill. If it is to make money, however, it must be kept in motion. For this reason a motor truck should not be given the same treatment accorded to horses, even though it may be worked on the same job. Motor trucks should not be allowed to stand for hours in line with horse teams and then blamed for not doing more work than the horses.

It is quite as important to arrange for the constant movement of a motor truck equipment after it has been bought as it is to use great care in the selection of that particular make or type of truck most adaptable to the work that it is to do. By far the greater part of time unavoidably lost is lost in loading and unloading by methods that were used in connection with horse trucks, often no attempt being made to make use of the devices already available for saving time. Any device that can be installed to shorten the time necessary for stops will pay for itself and earn money right along.

Two loading and unloading devices that have been used for years by contractors are readily available for use in a modern form with motor trucks.

The dumping body and the winch have been used by contractors as an important part of their equipment for years, but they did not reach their highest development until after the introduction of the motor truck into this field.

The use of the power-driven winch on motor trucks is becoming more common every day. This device is operated by the engine and is connected with the driving shaft and controlled by the truck driver. It is used in many cases with a crane or derrick for loading or unloading trucks. This crane or derrick may often be attached to the truck itself and so arranged that any part of the load may be removed without disturbing the surrounding units. A truck equipped with a power winch may be driven along the side of a building under construction and may hoist its load to the upper stories, saving much time in doing away with the labor and expense of rehandling the material.

It is possible in many cases to use removable bodies or racks as a means of saving delays due to loading or unloading. These bodies may be loaded and unloaded by means of the winch and may be placed in any position that may seem convenient. If the motor truck is operated in connection with horse trucks, the winch may be found to be extremely valuable in assisting the horse trucks over rough places or where foundations are being dug, in pulling them up the steep incline leading out of such excavations.

The power dump truck on which the body of the truck is raised by a shaft geared to the main engine drive is one of the greatest labor and time saving de-

TRANSPORTATION OF BUILDERS' SUPPLIES

vices used in connection with motor truck work. It is operated by the driver without leaving his seat and may be stopped and held at any desired angle. This body, however, is available for hauling ordinary builders' supplies and is particularly desirable where some of the material used is of such character that it slides readily and is not injured by rough handling. In dumping stone, sand, asphalt and other road materials, the body may be elevated by the driver without leaving his seat and when the desired elevation is attained the machine may be driven slowly ahead, spreading the load over a considerable surface. The full load may be dumped in this manner from a 7 ton truck in 35 seconds from the time of its arrival at the dumping ground, without the necessity of the driver leaving his seat.

If as a contractor you are not using motor trucks, ask yourself the following questions and answer them honestly: 1. How many horses have you? 2. How much money have you invested? 3. How much does it cost per day to operate your teams? (a) Including interest on total investment for horses, trucks, harness and other equipment? (b) Stable charges? (c) Drivers, etc? 4. What is the life of a horse? 5. Do you figure depreciation on this basis? 6. How many cubic yards or tons can you haul per day? 7. Are you willing to be convinced that motor trucks can do this amount of work at a lower cost? 8. Can you improve your loading and unloading facilities to reduce time lost in this way? 9. What is your average length of haul? 10. How many trips can you make with horse trucks? 11. Do you know that a single automobile truck is doing the work of four horse teams in your business? 12. Is there any reason why the automobile truck cannot do as much for you? 13. Isn't it worth your while to investigate this situation?

Concrete Letter Boxes and Telegraph Poles in New Zealand

We have received through Wm. A. Prickitt, American consul general at Aukland, New Zealand, a letter from D. Robertson, secretary of the General Post Office at Wellington, New Zealand. This letter states that the Post Office Department has entered into contracts for over 1,000 concrete poles and sample pillar letter boxes. The poles and boxes so far as satisfactory, Mr. Robertson says, and there is every reason to suppose that they will be a success, although the contracts have not yet been completed, and a final opinion would be premature.

CONCRETE-CEMENT AGE has also received a letter from R. M. Baird, the telegraph engineer for the Post and Telegraph Department of New Zealand. From this letter we quote the following description of the poles:

With regard to the construction of the reinforced poles, these are in general 26' long, reinforced with 5/8" mild steel rods, which are held in position by spreaders and bound round with No. 8 galvanized iron wire. The poles are square, measuring 8"x8" at the butt and 6"x6" at the top. The top of the pole is slightly rounded off to a neat finish and the four edges are slightly chamfered.

The poles are slotted during their manufacture to receive four arms and the necessary bolt.—the distance between the slots being 13" center to center, and the depth of each slot 5/8" The pole is hollow, a 2" pine rod being placed in the center during manufacture, and this is turned to prevent it setting in the pole, and is withdrawn when the concrete sets.

When the poles are three months old, they are required not to deflect more than 10" when a load of 650 lbs. is applied in any direction near the top of the pole at a distance of 18' 6" from the ground line, the pole being sunk 5' in the ground. If poles are tested without being sunk in the ground, the fulcrum shall be at 5' from the butt of the pole. The poles are tested by applying 50 lbs. weight at a time, which is taken off after a load of 650 lbs. has been applied, and the permanent set measured. It is stipulated there shall be no permanent set after 650 lbs. has been applied.

The poles have been tested and taken up the following weight without permanent set, viz.—966 lbs., equivalent to 17,870 ft. lbs. These are 2" x 8" to 6" x 6" and 26' long as stated.

Another class of poles used for angles, has an oblong section and measures 27', 11"x8" butt and 8"x4" at the top. A 20-ft. fulcrum pole was loaded to 1,190 lbs., right angle pull at the top, which gave a deflection of 7¼", but when weight released pole had no permanent set. This is equal to 23,000 ft. lbs. Some of the poles have failed at 900 lbs., but this has been attributable to them being tried too early, the concrete being in a green state.

The various tests have been proved very satisfactory. None of the poles has been erected yet, but this will be put in hand shortly along the main line of railway between Auckland and Wellington.

With reference to the project for a Portland cement factory in Peru, Consul General Eduardo Higginson, of Peru, located at New York, writes to the Bureau of Manufactures that he has received the following cablegram from his government:

"Under date of April 26, 1912, the government rejected the reconsideration solicited by Mr. Rospigliosi, leaving in full force the exclusive privilege granted to Mr. Garcia Lastres for 10 years, to manufacture Portland cement."

Information as to Concrete Road Work

Your correspondence as to concrete road work is invited. CONCRETE-CEMENT AGE wants to be just as useful as possible in giving information along this line. Aside from the general problems which are handled in these pages, we shall be glad to help in every possible way in solving individual problems. We shall do our best to supply the information you want—either as to roads which have been built or as to methods which should be followed.—THE EDITORS.

Two Important Changes in Wayne County, Michigan, Paving

The Board of County Road Commissioners of Wayne county, Mich., announces a change in its specifications governing the construction of 40 miles of concrete roads which are to be put down this year. On all roads 12′ wide or wider there will be a longitudinal joint. This joint will be made just exactly as are the joints used transversely in the pavement. This joint is made, as most of our readers know, with steel plates*, from which lugs are punched extending back into the pavement from the joint. The space between the steel plates at each joint is filled with two thicknesses of asphalt felt running clear through to the bottom of the pavement. The road commissioners have had no trouble with longitudinal cracks until this year and the trouble now is by no means serious, but, as Commissioner Edward N. Hines says, "We are not satisfied as long as there are any cracks at all." The new provision is being made in an effort to obviate these cracks. The cracks this year are confined to a few 25′ sections of pavement on River road and out Michigan avenue on stretches of highway through sticky clay soil, which has poor drainage. Cracks of this kind have not developed where the sub-soil has been of gravel; but to obviate, if possible, any further trouble with these longitudinal cracks, longitudinal joints will be provided on all roads of concrete 12′ wide, no matter what soil foundation. The effect will be, on a 12′ road, to produce a pavement consisting of blocks of concrete laid in pairs, each block 6′ wide and 25′ long.

Another change in the specifications also intended to obviate cracking is to make the sub-grade flat instead of with a crown. The practice, up to this year, has been to give the sub-grade practically the same crown as the finished concrete. The effect of this is to produce a concave under surface on the concrete which rests on a convex earth foundation. This does not allow the pavement slabs easy movement when affected by expansion and contraction, and it is believed by Mr. Hines and engineers of the Wayne County Board that by making the sub-grade flat, the concrete slab will be free to move upon the sub-grade.

These new provisions in the specifications are particularly interesting when considered together with the opinion of Logan Waller Page, Director, United States Office of Public Roads, which is given in a letter in the Correspondence department of this issue. Wayne county is about to use more joints in concrete roads, and Mr. Page is convinced that concrete may be laid successfully without any joints at all. The development of the two ideas will be watched with interest.

*R. D. Baker, Detroit, Mich.

Will Hold Road Congress September 30 to October 5 at Atlantic City

Atlantic City, N. J., and September 30 to October 5, have been decided upon as place and time of the first American Roads Congress. The announcement comes from Logan Waller Page, director United States Office of Public Roads and Active President of the Congress. An almost nation-wide interest in good roads indicates a big Congress and good results from the Congress in the deliberations and discussions, in which nearly two score road organizations will participate, among them the American Association for Highway Improvement and the American Automobile Association. The meeting will be held on the million dollar concrete pier, the use of which has been tendered by Atlantic City. President Taft is honorary president of the Congress and Lee McClung, Treasurer of the United States, is treasurer of the Congress.

The National Association of Road Machinery and Material Manufacturers has voted to hold its exposition of materials and equipment in conjunction with the Congress. Among the members of the association are many of the largest manufacturing companies in the world. Every industry relating to the building and care of roads and bridges will be represented, and it will be possible for the road builders and road users to acquaint themselves fully with all the labor saving devices, methods and formulas that American ingenuity and inventive genius have brought out in the last century.

A remarkably ingenious exhibit will be made by the United States Office of Public Roads, consisting of a complete set of miniature models illustrating every known type of roads and miniature working models of rollers, crushers and various equipment operated by tiny electric motors. The government's priceless collection of models showing the development of transportation from the primitive human burden bearer to the modern automobile and locomotive may also form a feature of the exposition. "Old Trails," exhibits recalling scenes along the famous old roads and trails such as "The Old Cumberland Road" and the "Santa Fe Trail" will add picturesqueness to the display.

One of the principal organizations composing the Congress will be the American Association for Highway Improvement composed of about 1,500 men who are leaders in their respective lines of activity throughout the United States. Interstate Commerce Commissioner James S. Harlan is chairman of the board of directors; W. W. Finley, president of the Southern Railway Company, is chairman of the executive committee; Thomas Nelson Page, the noted author, is chairman of the membership committee, and W. C. Brown, president of the New York Central Lines, is vice-president of the association.

The American Automobile Association will represent at the Congress the large and ever increasing number of road users who, while adding to the difficult problem of road construction and maintenance because of motor traffic, are giving new importance and use to the roads and are contributing heavily to road improvement. Tours from all important cities will be conducted by the association in time so that all will arrive in Atlantic City on Road Users' Day. From Quebec and intermediate points will come a great contingent of good roads enthusiasts who are striving for a great through international highway stretching from Quebec to Miami, Florida, traversing the entire American seaboard. These will be met at Atlantic City by the southern boosters who will come from Miami and intermediate points. The arrangements for these tours will be under the direction of the American Automobile Association and the American Association for Highway Improvement.

The United States is paying $1,000,000 a day for our roads, more than $300,000 of which, according to government estimates, is wasted. Some of this country's roads are among the finest in the world; many of them are the worst in the world. It is to find ways and means of stopping this tremendous drain of road revenues, and of introducing the best possible methods of management of construction and maintenance that the leading engineers, chemists, financiers, legislators, educators and executives will assemble at Atlantic City. The first two days of the Congress will be assigned to the road users under the auspices of the American Automobile Association, the second two days to the great problems of legislation, finance and economics under the auspices of the American Association for Highway Improvement, while the last two days will be given up to the engineers, who will discuss problems of construction and maintenance, and to the various associations which will meet and map out their plans of action, correlate their efforts and make definite arrangements to pull together in the greatest campaign for road improvement and wise conservative management ever undertaken.

Third International Road Congress

The third International Road Congress will be held in London, June 23 to June 28, next year. The first of these international congresses was at Paris in 1908 and the second in Brussels in 1910. The plan now is to hold them triennially henceforth. There will be two sections: First, on construction and maintenance, with two subdivisions, (*a*) on work outside of towns and (*b*) on work in towns, and the second section will consider traffic and administration, with two divisions, (*c*) traffic and vehicles and (*d*) administration, finance and statistics. Leading authorities of the world will contribute to the success of the Congress, which is to be held in England on government invitation under the patronage of King George V. Sir George S. Gibb is the London chairman of the organization committee.

W. Rees Jeffreys, secretary of the English Road Board and Secretary-General of the Third International Road Congress, is visiting the United States and will see road work in various parts of the country.

Great impetus was given to the movement of the American Association for Highway Improvement to induce the United States to become a member of the International Commission of Road Congresses, at a dinner tendered to M. Chargueraud, councilor of state, inspector general of bridges and highways, and director of road and navigation of the French Republic, in Washington recently. While the dinner to M. Chargueraud was an expression of the sense of courtesies extended by French officials at the conference of the international commission of road congresses held in Paris in 1908 and in Brussels in 1910, it also brought together those who are urging the United States government to become a member of the commission. At the present time, the United States is the only world power that is not a member of the commisison.

For a long time the American Association for Highway Improvement has been urging the United States government to become a member of the commission, arguing that this nation would thus obtain the experience of the entire world in the matter of road building. M. Chargueraud, the supreme road official of France, honored the American Association for Highway Improvement by stipulating that all arrangements for his entertainment in the United States must accord with his acceptance of the program arranged for him by the American Association. The distinguished Frenchman refused to make any formal engagements until he had consulted the officials of the Association. As soon as he arrived in New York, he proceeded directly to Washington, where, in the afternoon, he was the guest of Logan Waller Page, president of the American Association, and made a brief address to the Senate and House committees dealing with the subject of roads, and in the evening was the guest of honor at the dinner given by the American Association for Highway Improvement.

In his address at the banquet, M. Chargueraud warmly invited the United States to become a member of the international commission on roads, complimenting this nation on the rapid strides being made in the road movement, and yet pointing out that much might be learned from contact with other nations.

One point about laying concrete floors and gutters in stables is often overlooked. It is the hardest kind of work to scrub water up hill into the drain. Plan the floor or gutter so that when the stable is scrubbed out every part will drain uniformly to one point. One inch in 10″ will give sufficient slope and without this there is bound to be water standing on the floors, which is unsanitary and unhealthful. Stake or mark out the proper height along the walls with a straight edge or level, then put enough stakes within the floor area or mark the posts so that when the concrete is finally tamped it can be brought almost to the proper height. Then with the finish coat smooth out the inequalities. This will give a smooth, well drained floor that will dry off rapidly after flushing.—*Bulletin of the Universal Portland Cement Co.*

If readers of CONCRETE-CEMENT AGE write the EDITORS about concrete roads being built in their localities the courtesy will be greatly appreciated. If you cannot give details please tell us who to ask for them.

Cement Manufacturers Give Impetus to Good Roads Movement

The last meeting of the Association of American Portland Cement Manufacturers in Chicago was, from the standpoint of public interest, one of the most important ones held by that body. This was due to the fact that there was discussed in detail a subject of interest to every community in the United States, namely, the subject of concrete roads. The attitude of the association was entirely liberal, the only restriction being that concrete in some form should be used if the best results are to be obtained. Aside from this, those who participated in the proceedings were invited by President Edward M. Hagar to express their honest convictions without fear or favor. The audience listened to such distinguished experts as Logan Waller Page, Director of the Office of Public Roads, Washington, D. C.; Edward N. Hines, member of the Wayne county (Michigan) Road Commission, who has acquired a national reputation through work done under his supervision, and of J. C. McCullough, City Engineer of Fond du Lac, Wisc., equally well known to paving experts. To the cement manufacturers of America the entire proposition is one of extreme importance, as the extended application of concrete to roads of the better class would mean a tremendous increase in the consumption of cement. That the public would benefit thereby goes without saying.

The first speaker was Mr. Page. His paper appeared in full in June *Cement Age*.

What Experience Has Shown

Mr. Hines is an enthusiast on the subject of concrete roads. The reason is made clear in the following extracts from his address:

After thoroughly investigating the subject, studying the experience of nearby smaller towns in the matter of concrete cross-walks, inspecting concrete bridge floors and noting the general satisfaction concrete was giving in other forms of construction, the grades of material used, the light form of construction as applied to cross-walks and bridge floors, we decided that a concrete road would come more nearly realizing the ideal than other forms. The points considered as being in its favor were: comparatively low first cost; low maintenance cost; freedom from dirt (there being no detritus from a concrete road in itself); its comparative noiselessness; ease of traction for vehicles of all descriptions, and the small crown necessary to get rid of surface water. We crown our roads but one-quarter of an inch to the foot, which tends to distribute the traffic over a greater area of road, instead of following a defined wagon track such as usually exists on macadam and like roads, and which later means the development of ruts.

While we were reasonably sure of our ground, we also felt that in case we scored a partial failure we could use the concrete for foundation purposes. Three stretches of road, aggregating two miles on varying subsoils, and with differing specifications were decided upon. Woodward avenue was selected for the first test, on account of the enormous and varying traffic it is called upon to carry. It is a continuation of the principal main paved retail street of Detroit, leading to the state fair grounds, Palmer Park, a popular playground, two large cemeteries and to Oakland county, a rich farming section, whose hills and gravel roads combine to make a very popular and much traveled automobile drive

Concrete Pavements in Fond Du Lac

Mr. McCullough described the pavements in his city. He said in part:

In our own experience we have endeavored to build a cheap pavement, eliminating all items of cost that did not promise a positive improvement. For that reason we do not go to the expense of blocking off the wearing surface to give the appearance of block pavement.

We do not protect the edges with angle iron or other form of protection, as the traffic on most of our streets is so light that we have not considered the expense warranted. I would, however, recommend the protection of edges of cross street expansion joints on streets carrying any considerable traffic.

We do not consider with our method of finishing wearing surface that much crown is necessary, and in fact believe that the less the crown, the easier the slab will contract, and consequently help to overcome the tendency to crack longitudinally down the center of the street.

I am satisfied that Fond du Lac, with her eight and one-half miles of cement pavement, averaging less than $1.25 per sq. yd., will get a good value for every dollar expended.

If in the course of ten years it becomes necessary, I see nothing to interfere with our putting a bituminous wearing surface on these streets.

As compared with asphalt or any of the pavements costing over two dollars a yard, we can apply the argument put forth by former officials of Milwaukee, with reference to their type of bituminous macadam pavement; that is, that the difference in cost between the $1.25 pavement and the one costing $2.25 or over, invested at 5%, will provide a fund large enough to maintain these pavements indefinitely.

Our pavements are all built on a five year guarantee, so we have no maintenance charges until the first five years have elapsed.

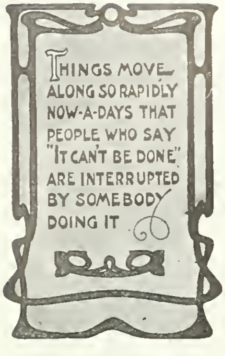
Concrete pavement is not claimed to possess all good features and no faults. As we build it we have endeavored to build a cheap pavement; and claim for it low first cost, ease of traction, that it will stand the wear from automobile traffic, that it is easily cleaned and is sanitary, not more slippery than creosote block, will not cost much to maintain, and finally, as we have stone quarries, sand and granite practically at hand, it is the cheapest hard surface pavement we can build in our locality.

Paving Brick With Concrete Base

Paving brick with concrete base construction was described in an interesting address by W. P. Blair, Secretary of the National Paving Brick Manufacturers' Association. Mr. Blair paid full tribute to the value of cement in securing a sound base for the product he represents, and went into the details of construction methods. "The one important feature in the use of cement," he said, "is the binding together of the whole into a single mass or monolith, enabling the load to be transmitted in distribution to the whole. Hence no single portion receives the entire force of any shock or impact as is the case if the foundation is made up of so many single and independent units as must be the case in the use of gravel and broken stone alone. It is a most economical feature of road construction because it does not come in actual contact with any destructive force in the use of the pavement, and once properly built, it endures for all time."

Concrete Homes for Everybody

Benjamin A. Howes Replies To His Critics as to Concrete Houses*



The editor of *Cement Age* courteously suggested my making some rejoinder to criticisms in the May number of that publication. The matter under discussion was several phrases occurring in a general article on building construction in a recent number of the *Saturday Evening Post*, in which phrases I deprecated the spreading of erroneous impressions as to the real costs of reinforced (or monolithic) concrete for small individual home builders, and gave some figures.

Let me say at once that nothing was further from my thought than to include *Cement Age* among these reckless optimists, as I considered that the magazine had always refrained from unwarranted claims for concrete; in the same way that it has repudiated, with me, the erroneous use of the term "concrete house" as applied to various stucco and plaster combinations.

I am also in full sympathy with the enthusiastic hopes for the future of the small fireproof house expressed in the editorials and letters, and in spite of their somewhat polemic tone I do not find that they have brought out facts to controvert my own scrupulously weighed and limited statements. I said that the great economies of reinforced concrete not appearing under an expenditure of twenty thousand dollars, the *individual* modest house of *reinforced concrete*, i. e., for the *single* home builder who is at the same time a *small* builder, is not economical, but dear in comparison with other constructions. But this case is one my critics have not even approached. In their articles the few examples of actual construction are houses (1) largely of wood, including stairways (opening article); (2) of concrete tile walls with inside structure of wood (Mr. Paully); (3) of concrete block, or "concrete to form the major portion" (Mr. Newman); (4) bungalows without cellars or plastering (or furring) in a "village" or group of fifty or more houses (Mr. Morrill); (5) of concrete tile, at a cost of "approximately $20,000."

That is, either not fireproof, or not reinforced concrete (or neither), or not individual houses for the single home builder, or not "under $20,000." I am not concerned to disprove that fireproof houses of whatever size or material may not be built in large groups of a few fixed models very economically. What I do say is, that John Jones, with his $6,000 to $10,000 (over or under) to spend in building on his particular lot out in Long Island or West Chester or Greater Boston, isn't going to be able to attract alongside such a flock or fifty other concrete houses just so that *he* can get a small concrete house economically! If he could, it would not be a question of my "single small builder" at all, but of a large development operation. Nor can John Jones, under any circumstances known to me, get in reinforced concrete his particular house, planned and adapted to his needs and tastes, (which was the case explicitly stated in my article), for any sum reasonably near what it would cost in frame—"the individual modest house." Of course the whole context of my article implies a good grade of architecture, construction, finish and equipment, and I state explicitly that all my figures cover complete equipment. I am not comparing a frame (or other) house of standard construction fully equipped with any concrete box of factory construction and finish, partly equipped, but with a reinforced concrete house of the same grade of construction and equipment as the frame one of the hypothesis. *Grades of appearance, construction and equipment being equal, and good,* as implied in my article, my statement, I believe, cannot be disproved, that the individual reinforced concrete house for the single builder is not economical under an expenditure of twenty thousand dollars, for reasons set forth in my article and further elaborated by Allen Hazen and others in the May *Cement Age*.

As the editor has referred so kindly to my previous work and experience in concrete, I may add that for ten years I have eagerly followed up every clue which I have come upon as to possibilities in fireproof construction for the "individual modest owner" who demands good architecture and finish—and I have not found a single instance of such a house, built entirely or practically entirely of reinforced concrete, for the individual requirements of the owner, which did not involve a large premium for the benefits of concrete.

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*In the *Saturday Evening Post* for March 2nd last, Benjamin A. Howes, writing on the subject of residence construction, and under the title of "How to Beat the Building Game," plainly gave the impression that, in his opinion, concrete was not economical for individual residence construction costing less than $25,000. Throughout the article, Mr. Howes seemed to have a point of view apart or above the great development in moderate-priced concrete houses, and overlooking it entirely. In our opinion, the article by Mr. Howes was not comprehensively accurate, and gave to the average reader a misleading idea of concrete, to say the least.

Consequently, in the May (1912) issue of *Cement Age*, which was the Seventh Annual House Building Number, a series of articles refuted Mr. Howes' position, we believe, by descriptions, with costs of houses actually built. The issue presented an interesting and up-to-date symposium on concrete house construction. The above letter from Mr. Howes is in reply to that series of articles. A limited number of the May issue of *Cement Age* can be furnished upon order to this office at a special rate. We feel that old *Concrete* readers would like to have a copy of the Housebuilding number, for homes are of universal interest.—THE EDITORS.

I have myself had some experience with such houses under $15,000; in one case the owner insisted on reinforced concrete after my warning that it would cost much above frame; he had his own reasons for being willing to pay the premium.

All this, of course, does not fit the case of development companies, where a large initial expense is possible, or corporations, with large "workmen's villages" to construct, where a few rough models may be indefinitely duplicated. Conditions are undoubtedly tending toward the development of a technique for the small house which can be brought to perfection only in such large groups built by development companies in the lines so brilliantly laid down by Mr. Morrill and others. Such companies are certainly justified in putting large sums not only into plant for building operations, but into research and experimental construction. Many have already done so, and some notable cases are now in process of solution. Certainly no one welcomes more sincerely than I the advance of the art of concrete in this direction.

But even here, it is to be noted, my critics speak mostly in terms of the future. I, on the other hand, was speaking only of what is practicable today, for the average man, unlearned in concrete, looking forward to building, with the ordinarily experienced architect and contractor, a single modest house for his individual needs. I consider it morally unjustifiable not to point out to this man the large premium that, in the present state of the art, he must pay for the benefits of concrete. He cannot afford to experiment with the hard-won sum he has laid aside for his home. As to the wisdom of sinking a large proportion of it in fireproof construction, opinions may certainly differ and doubtless his special circumstances will decide.

So far from being inimical to concrete, I am so enthusiastic for concrete that I am unwilling to see it "watered." Reinforced concrete construction today rests on a firm foundation of economic achievement, with satisfied users. Satisfied, because the owner, corporation or individual, has been advised by the best engineering talent and has investigated the experience of others. It would be a pity to becloud honest reinforced construction in the public estimation as was done to cement block construction and plaster on metal lath some time ago, through the wide dissemination of information advising construction unduly cheapened in order to secure the benefits of these materials, excellent in themselves when properly employed. Three years ago it seemed as well understood by well informed persons not identified with the business, that concrete was unavoidably damp and promoted mildew, as that salt is water-attractive and rubber water-repellent. Knowing this idea to be erroneous, from my own experience, I was surprised and mystified until I found that it was all based on the experience of John Jones, or "a friend of a friend or his," in omitting from his cement block construction the precautions against dampness which are always taken in the case of brick or stone. It has taken three years to free reinforced concrete from this slur.

Let us then, in the field of reinforced concrete, proceed carefully by exploiting its superiority as a building material, rather than by forcing its use by undue claims of cheapness, with their inevitable afterclap.

Benjamin A. Howes.

New York.

Editorial Note:—We regret the necessity of pointing out certain fallacies in Mr. Howe's reply. As detailed in *Cement Age* for May, an all-concrete house, two stories, basement and roof garden, was built for less than $2,600. Admitted that this may have been built adjacent to other similar work, yet this situation did not, we believe, very materially affect the cost. It would be quite as logical to assume that it may have been built in an isolated suburb, where labor was high, and hauls were long, and even if "fifty or more" of these had been built in two or three years' time, the cost might have been unusually high. At least a good all-concrete house was built, and cost less than $2,600.

When Mr. Howes infers that a house could not be a reinforced concrete fireproof structure for the *individual* builder, and cost less than $20,000, he overlooks hundreds of examples to the contrary, among them the work done at Mt. Lebanon by A. Morgan Smith.* Here is a reinforced concrete house, fireproof, and built by the individual builder for the individual owner. In this case we have a residence costing $9,000, and 15 to 20 per cent less than any other fireproof construction.

To all our readers we want to point out two statements by Mr. Howes in the above letter:

"Grades of appearance, construction and equipment being equal and good * * * my statement, I believe, cannot be disproved that the individual reinforced concrete house for the single builder is not economical under an expenditure of $20,000. * * *"

Also the following:

"I consider it morally unjustifiable not to point out * * * the large premium that in the present state of the art, he (the builder) must pay for the benefits of concrete."

It seems to us that the experience of capable engineers and constructors, as published in the May issue, proves that concrete *is* very economical under the $20,000 limit, and under the same conditions as any other construction. The $20,000 structure described in the May issue† of *Cement Age* which Mr. Howe seems to enjoy referring to, was a large mansion and would have probably cost much more in any other material. Mr. Howes fails to quote further concerning the cost of this structure, which was built entirely of pre-cast units, concrete wall tile, concrete floor joists and slabs.

"With a centrally located plant to produce concrete units, the economy of such (unit) construction would not depend on the size of the structure, and the small house, as well as the large mansion could be built (economically)."

As to the moral side of this question, we would like to ask Mr. Howes whether it is better to encourage fire-proof, hygenic, permanent, *economical* construction, or to discourage it? In one of our western

**Concrete*, page 25, November, 1911; *Cement Age*, page 227, May, 1912.

†Page 240.

states, a man is building small concrete fireproof houses. He has been doing this for several years and his example being followed. He shuns publicity for reasons which he states, and we are requested not to publish his name. It seems to us that his letter, his work, his experience, answers Mr. Howes' most directly.

A Letter From a Concrete Home-builder

"I have read the advanced proof* of the article dealing with Mr. Howes' screed on "How to Beat the Building Game" with a great deal of interest. I do not know anything about building either $20,000 or $25,000 houses. My experience runs from one little poured cement barber shop costing about $300, to a $6,000 4-room, 2-story schoolhouse and mostly $1,000 to $2,000 cement block cottages. My experience with poured or monolithic work is limited and hardly worth basing opinions upon. That any one outside of the locality should be interested in the fact that I build and sell little dwellings was a great surprise to me.

"A gentleman in Washington, D. C., buys mortgages of me on these little houses occasionally. *The Daily Consular and Trade Reports*, published in Washington by the Department of Commerce and Labor, wrote me for a statement. This I made—much flattered. The result was most disconcerting; many papers copied the matter, and I was inundated with inquiries. At first I was pleased and expected a large addition to my market for first mortgages and a consequent extension of my business. But either because of my poor ability as a letter writer or because the inquiries were from the merely curious, from either or both of these reasons, I never received a single item of business out of it; and yet was forced to answer letters by the hundred until I just quit. This experience caused me to require of subsequent publications that they do not use my name or address in any article about my work and I must for these same reasons refuse to permit you to publish anything quoting me by name or address. I have invented nothing; I cannot see that I have accomplished anything worthy of attention.

'I have used only ordinary common sense. Any one can do all that I have done, and many can do much more. * * * As the matter now stands I am building nice little four, five and six room cottages that are fireproof and entirely satisfactory to the buyers, and that excite much attention from observers. I get from $1,000 to $2,000 for them and make a little money. The money lender is pleased, the buyer is pleased—many people copy them, and so far no one has found that they are bad in any way. I build them with concrete block partitions as well as outside walls, concrete floors, concrete roofs or with steel ceilings and money lenders do not even require insurance against fire upon them as security. In the town of ————, ————, I built a good many of these houses and they were copied until the whole town seems as if it were built entire of concrete block. A cyclone recently passed through and did practically no damage to any one of the buildings I had built. The only one damaged that I know of was a dwelling—four-room—that I still own; the chimney was torn down.

"As I sit and write you a most violent wind storm is raging about this house, and yet except for the smash of sheets of water on the window panes I do not notice it. My wife has always been extremely afraid of our wind storms, running to a cyclone cellar on the slightest evidence of an approaching storm. About six years of living in concrete houses has completely allayed that fear and she now sleeps peacefully in the next room, although tomorrow's associated press will certainly tell of cyclones in this immediate vicinity. Rats, mice, bed-bugs, we have lost all thought of them, never having them on the premises. I have never known of a concrete house being struck by lightning and don't believe it can be. One gallon of wood stain for interior casings, 1 gallon for outside of doors and windows and frames, covers our entire paint bill on this 5-room house. Eighty-five pounds of alabastine decorates the ceilings and interior tastefully and antiseptically. I have never known any one to "take cold" or have "grippe" while living in a concrete dwelling with concrete floors.

By a carefully watched comparative test, we heated cubic foot for cubic foot, at a saving of over 14% for fuel cost in our concrete house, as against a first class wooden building belonging to a neighbor. We kept our thermometer at 70°, while his varied, at the best he could do, from a point low enough to freeze flowers in his house to 92°. During this period of one month every member of his family was down with a cold one or more times. We had more flowers than he had and never moved them night or day, and never covered them up, and never lost a flower. He covered and moved his flowers every night, and lost every one and on two other occasions after his flowers were frozen and thrown out he had water freeze in his house. He would certainly have lost his flowers a third time in one month. Both houses were heated with stoves and were about the same size, faced the same way and were in same block adjoining. We had no account of our thermometer going below 60°, to which we reduced it on retiring, or above 74, to which it went once with 24 guests in the house at a card party. About one month after we made our comparative test on the cost of heating the houses, our neighbor's wife, in unpacking their spring clothing, found the owner's spring overcoat and some two or three spring suits of clothing of the owner and oldest son completely destroyed by mice. They thought this destruction had been worked at about the time of the comparative test. The loss amounted to more than their entire coal bill for the whole winter.

"In the summer of the next year some people who had bought one of these concrete cottages installed a gasoline cooking stove. The woman of the house was getting breakfast, her first meal on the new stove; three children were asleep, and the man was trying to catch a horse in a large pasture lot adjoining. The woman was in the garden cutting lettuce and went to her husband's assistance in the chase of the horse. When they were both about a quarter of a mile from the house they heard an explosion and saw the flames break out of their kitchen door and window. They came as fast as they could to the house, but did not get there in time to save anything in the kitchen. The kitchen cabinet, kitchen table, kitchen press, two chairs, the outside door and two windows were ruined; the fire was practically over; *and the children were still asleep*. The total cost of repairing the house was less than $30.00. The children would certainly have been burned up had it been a wooden house. *Fire insurance would not have saved the children or replaced them. There is no 'just as good' substitute for the fire-proof dwelling.*

"In many other ways cement lends itself to the betterment, economy and permanence of the small dwelling. Most of the tenants of these little houses I build find it wise and necessary to keep poultry. Mice will open the road and rats and skunks will get into any wooden-floored hen house. A concrete floor of only 2" in thickness cuts them out permanently.

"I am completing six four, five and six room dwellings, the nearest one 408 ft. from the interurban railway. A 4-ft. walk 4" thick, topped with cement and sand, a proper walk, would have cost me $225 to the first house and $580 to reach all of the houses, and would have been commercially impossible at the selling price of the house. A 2-in. walk 2' wide, not topped at all, just chat and cement, laid on top of the grounds, rough troweled, 920 ft. long, cost $76, or about $12.30 per house. This will last eight or ten years and adds

*"Concrete Homes for Everybody," page 218, *Cement Age*, May, 1912.

materially to the useability of the cottages. Walks about the houses on the same scale of thickness are cheap and effective. None of these walks would be accepted by a $25,000 house builder on any part of his property, but not a millionaire alive would step off one of these walks into the mud. A day's work a year, with a total cost for material and labor of not over $5.00 will keep this 920' of walk in good condition for many years. They would, however, be impractical in a colder climate than this.

"A 6-in. sewer made of cement and chat in the ground connects the six houses with a three-chamber aseptic sewer tank and costs less than 15 cts. per ft. for excavation, labor and material. This gives the owner of one of these little cottages all the advantages that there are in the house sewage system.

"The paint and repair bills of the wooden house make the well-to-do man swear, make the poor man cry, and force every member of his family to endure economies that are often damaging to health. *The well-to-do man can afford a wooden house. The poor man can not.*"

And there we rest our case, until the August issue, at least.

National Fire Protection Association Meets

The sixteenth annual meeting of the National Fire Protection Association held in Chicago disclosed the fact that this important organization is making gratifying progress. While the attendance chiefly represented insurance interests, there was a noticeable increase of men not directly connected wtih the insurance business, but none the less deeply interested in ways and means to protect life and property from fire, showing that public sentiment is alive to the importance of conserving creatures as well as natural resources.

The telegram from President Taft and the very excellent address from Governor Deneen of the state of Illinois and that of Mayor Harrison of Chicago, gave evidence of co-operation of the federal, state and the municipal authorities which is essential in any effective campaign of this character.

The revisions of the by-laws which led to the modifications looking to an increase in the membership of the Association, thereby increasing its revenue, were along the line of the progressive policy of the Association.

Reference to the Executive Committee of the motion to appoint a committee to consider the advisability of including the federal, state and municipal bureaus seems to be a logical step in the direction of real success through the active co-operation of such bureaus.

One matter of special interest in connection with the meeting was the referring back of matters relating to reinforced concrete reported by the Committee on Gravity Tanks, with instructions to confer with the National Association of Cement Users so as to harmonize its recommendations with those of the Cement Association. This is a recognition of the National Association of Cement Users which must be gratifying to those who are interested in its development and is another evidence of the high standing and importance of the National Association of Cement Users. A further compliment to the Cement Association was the appointment of its President, Richard L. Humphrey, as a member of the Executive Committee.

In his annual address President W. H. Merrill made the statement that the fire waste is growing more rapidly than the defense, citing the loss of 1911 and that of the first four months of 1912.

Chairman Stewart, of the Executive Committee, read the report of the committee, which emphasized the value of the publicity work of the Association, which has had a pronounced influence in arousing public interest in the Association and the subject of fire prevention generally. In addition to the direct circulation of bulletins, pamphlets and reports, as well as the *Quarterly*, 133 daily papers receive matter prepared by the Educational Committee.

International Navigation Congress Holds Important Session

As is the case in every important conference concerned directly or indirectly in engineering work, concrete was a factor discussed before the International Navigation Congress, which held its twelfth session in Philadelphia during the week beginning May 12. It was a gathering of eminent foreign engineers with equally distinguished members of the profession representing this country.

The most important discussion pertaining to concrete had to do with its utility in hydraulic construction.

Major John Stephen Sewell, formerly Corps of Engineers, U. S. A., presented a summary of the several papers submitted, Major Sewell acting in the capacity of "General Reporter," it being the function of the "General Reporters" to summarize the papers presented by representatives of different countries. The communications presented by Major Sewell were under the title of "Reinforced Concrete in Hydraulic Work." The authors were: M. Jacquinot, Chief Engineer of Ponts et Chaussées, Chaumont (Haute-Marne), France; R. W. Vawdrey, A. M. I. C. E., Portscatho, Parkhill Road, Sidcup, England; The Hungarian State Water Survey; M. Mederico, Chief Engineer of the Genio Civile, Ravenna, Italy; Richard L. Humphrey, President National Association of Cement Users, United States of America.

The following abstract from Major Sewell's resumé of the papers will show the status of reinforced concrete as presented to the Congress:

It is quite apparent that the use of concrete, both plain and reinforced, for all classes of hydraulic works, is making rapid headway, especially in the United States, France and Italy; and that opposition to its use is disappearing elsewhere.

Strictly speaking, the application of reinforced concrete to hydraulic structures is the only subject under discussion. All of the objections to the use of plain concrete in such cases are included within the greater number that have been urged against reinforced concrete. What follows, therefore, will apply especially to the latter material, and to the conditions surrounding its use in connection with works of inland navigation.

The objections that have been raised against the use of reinforced concrete for the purpose under discussion relate to the durability of the concrete itself, to its resistance to abrasion, chemical action, and freezing in contact with water, and to the durability of the reinforcement under various conditions.

Durability of Concrete—A few years ago, difficulty was sometimes experienced in securing a Portland cement that was sound and secure against disintegration due to chemical changes within itself, after setting. This difficulty is now easily avoided, and if aggregates are selected of durable and inert materials, there can no longer be any doubt that concrete is in itself a thoroughly durable material, quite secure against disintegration due to action originating within the mass itself.

Resistance to Abrasion—Concrete, as a rule, exhibits more chipping and chafing under impact and abrasion than masonry of the harder stones. But this damage is usually only superficial, and rarely threatens the integrity or continued usefulness of the structure. In many cases, it is more resistant than any other form of masonry available within practicable cost limits; the best of masonry is liable to be disfigured under impact and chafing, and there is very little of it in existence subject to these conditions that does not show the wear and tear. In any case, the trouble can be avoided at moderate expense, by means of strips of steel or timbers applied in the proper manner. This objection to concrete is therefore not a valid one, for it can be removed by simple and practicable methods.

Resistance to Chemical Action—Under this head may be included atmospheric agencies, the action of sea water, of sewage, and of acidulated water. So far as atmospheric agencies are concerned, there is too much concrete which has successfully withstood them, to leave any room for discussion. It is merely a question of good materials and workmanship, including proper mixtures to secure a dense and impervious mass.

A great many concrete structures exposed to sea water have suffered from extensive and rapid disintegration. It was at first supposed that this was due to the action of the sea water on some constituent of the cement, probably the free lime. Some experiments and investigations have seemed to indicate that the addition of trass or puzzolana to the cement would prevent this action, by satisfying the free lime. But it also appears probable that, as Mr. Humphrey states, a dense, strong and impervious mixture allowed to harden before exposure in place, is in itself sufficiently resistant, whether the preliminary disintegration has been due to freezing when saturated with water, or whether it is due entirely to chemical action. The requisite density and strength can best be obtained with a well balanced and rather wet mixture.

Navigation canals may carry domestic sewage, factory waste, and acidulated water from mines, since all of these ingredients are to be found in the waters of streams from which canals are fed. So far as navigation works are concerned, the deleterious ingredients will generally be so diluted, that their action will be very slow, and probably the same precautions that suffice in the case of sea water will serve the purpose here also. Should cases arise where the deleterious ingredients exist in greater proportion, it is probable that any kind of masonry would suffer more or less, by action upon the cement in the joints, if in no other way.

M. Jacquinot describes a reinforced concrete conduit for carrying sewage; many large sewers of reinforced concrete have been constructed in the United States. The inverts are sometimes protected by other masonry—often of vitrified bricks or blocks—and sometimes by pitch or other coating. Many reinforced concrete chimneys have also been built without a lining and they seem to resist the chemical action of the flue gases, and, in some cases, of the gases from smelters, very well. Melted paraffin could be applied to the finished surface and driven in by heat; while it is not known that this method has been tried, it is known to be inexpensive, and should greatly increase the resistance to acids.

Freezing in Contact With Water—Resistance to damage from this cause seems to be merely a question of density and strength. The same thing is true of stone and bricks. That concrete can be made sufficiently impervious and strong is demonstrated by many examples. Here again, a well balanced wet mixture, protected from washing out of the cement during the hardening process, is all that is required.

The damage from waters charged with alkaline salts seems to be of a mechanical nature, similar to that produced by freezing. While the problem here presented is not completely understood or solved, it seems probable that it is again merely a question of sufficient strength and density. While the problem is in process of solution, however, protective coatings are still within reach at moderate cost, and there is no valid objection to the use of concrete with proper precautions.

Durability of Reinforcement—It is no longer open to serious doubt, that steel or iron thoroughly embedded in Portland cement concrete will last indefinitely, as long as the covering remains intact. If it is exposed directly to the air, whether near the sea or not, it will inevitably corrode and ultimately destroy the structure. Careful design and good workmanship are all that are required properly to embed it in the first place. The only danger that threatens it thereafter is the danger of cracks, which will destroy the integrity of the concrete and open up a way for atmospheric moisture or water to gain direct access to the reinforcement. Such cracks might be due to shrinkage in setting, to expansion and contraction under changes of temperature, or to deformation, under stress. If the concrete is mixed wet and kept wet while setting, there is small danger of shrinkage cracks.

Cracks due to expansion and contraction after setting are brought about probably by a slight slipping of the mass on its bed during expansion, and by the excess of frictional resistance over the tensile strength of the concrete during the subsequent contraction. This trouble can be overcome by proper reinforcement, but it would be well to divide a long wall or other structure into sections, so that each could act as a unit.

Cracks due to deformation under stress will occur only when the reinforcement is stressed so that the strain exceeds the limit of extensibility of the concrete. This can be avoided by proper design and workmanship. This danger makes it inadvisable to utilize the high working stresses, otherwise permissible in high-carbon steel, since the modulus of elasticity is no greater than with low carbon or medium steel. If working stresses are kept well within the limits allowable for mild steel, there is no danger of cracks in the concrete.

Mr. Humphrey refers to the corrosion of reinforcement exposed near the sea. It is also a fact that if the concrete is mixed with sea water, or with sand from the sea beaches, or if it has salt mixed with it, and it is subsequently exposed to dampness, the reinforcement will corrode. This was shown by examples on a rather extended scale in some fortification work on an island in Long Island Sound, some years ago. The writer, then in the service of the United States, inspected this damaged work, and afterward had two experimental slabs of reinforced concrete made with a view of finally testing the matter. They were of identical composition except that one was mixed with sea water and one with fresh water. They were exposed to the weather on a roof in Washington, D. C., for some months. At the end of that time, the reinforcement in the sea-water slab was badly corroded, while that in the other one was entirely untouched. It is of importance, therefore, that the ingredients used in mixing concrete for hydraulic work should contain no corrosive material in themselves, if the concrete is to be reinforced.

Conclusions—The conclusion seems justified that all of the objections that have been urged against the use of reinforced concrete as a material suitable for use in connection with hydraulic works are either imaginary, or can be overcome by practicable methods, and must have arisen at a time when the subject was not so well understood as at present.

A study of the successful applications of reinforced concrete submitted to the Congress by the various reporters appears to justify the adoption of the following conclusions:

Reinforced concrete combines the structural qualities of steel and timber with the durability of good masonry. It is subject to no form of deterioration which cannot be avoided by reasonable precautions. It is free from many of the limitations surrounding the use of masonry in mass; because of the greater latitude it affords in the design and execution of structures, it often yields the best and most economical solution, and in some cases the only practical solution, of the most difficult problems.

When properly designed and executed it is, therefore, among the most valuable, if not the most valuable material now available for use in connection with hydraulic works of all kinds.

Subject Aroused Great Interest

That great interest in the subject had been aroused by the papers was shown in the extended debate that followed. Through the efforts of Richard L. Humphrey, author of one of the papers, and M. Voissin, Engineer of Bridges and Highways, France, a resolution was adopted advancing the subject from a communication to a question, and further providing that the officers of the permanent association be asked to place it as a question for consideration before the next Congress. Under the method of procedure, conclusions on subjects presented as communications to each Congress cannot come before general session for adoption, but if deemed sufficiently important they may be introduced as a question, whereupon the succeeding Congress may take action on the conclusions. At the session in Second Section on "Ocean Navigation" the action of sea water on concrete was discussed, when Col. Bogart referred to the action taken by the First Section, which resulted in further debate, showing clearly that the Second Section also recognized the importance of the subject. On motion of Mr. Humphrey, the resolution referred to above was also adopted by Second Section with the additional request that the subject be considered at joint session of both Sections next Congress. Inasmuch as it is not customary to have joint sessions, the entire proceedings may be regarded as unusual recognition of the importance of concrete in connection with maritime and inland navigation.

Working Drawings for a Bungalow of Poured Concrete

BY JENS C. PETERSEN

The California bungalow with its wide spreading eaves, long low roof lines, exposed rafters and half timber construction is a style very much appreciated by the Eastern home builders and the type, originally intended for warm climates, has found favor in the colder climates and in localities where substantial construction is necessary. Many are built of concrete, and the plans shown on the following pages serve as a suggestion for a concrete bungalow.

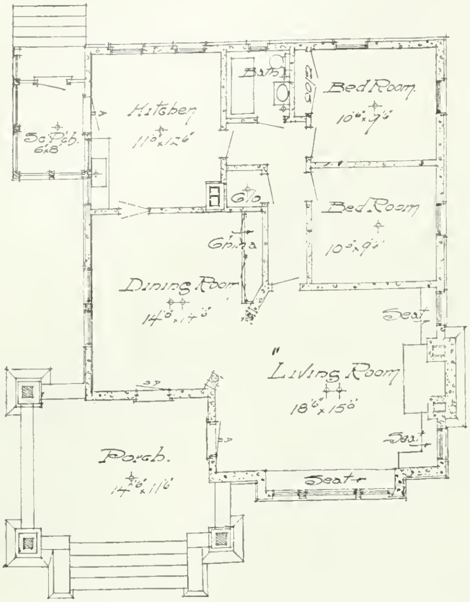
The foundations are put in as for any ordinary building, and the walls above the foundations, as well as the interior partitions, are built of solid poured concrete inside of plank forms, if any of the superior patented wall form systems are unavailable. The house may be built of concrete block if preferred, and these would probably be just as economical, as the inside walls would be plastered directly on the block, and the inside of the outside walls would be plastered on lath over furring strips.

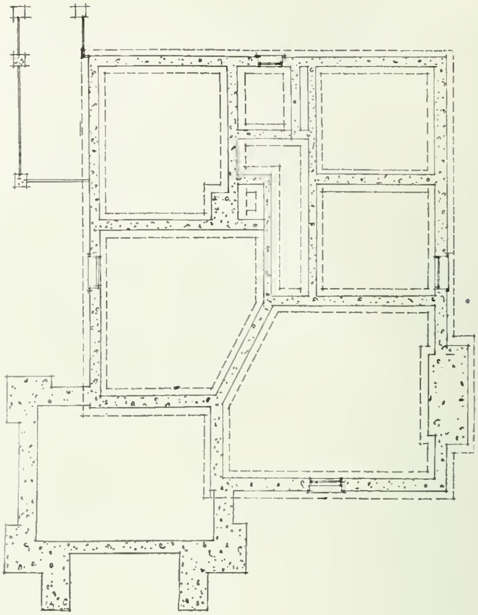
The entire exterior is to be given a coat of rough cast or pebble dash directly on the concrete wall. This pebble dash finish could also be used as well over the concrete block construction.

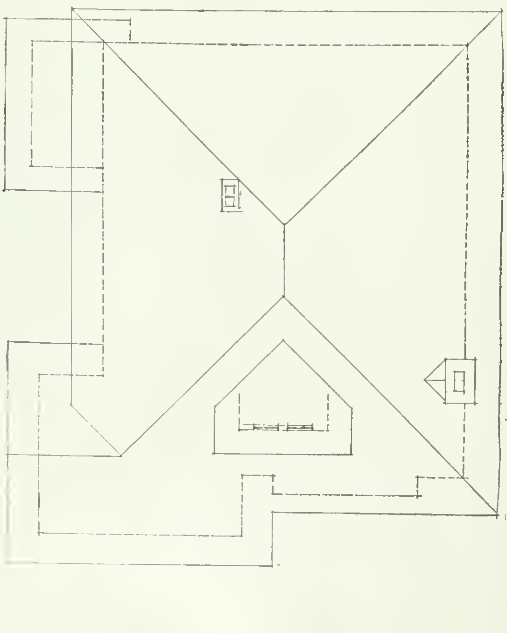
The exterior design, with the battered walls, piers and chimney, is substantial in character, and has originality. Concrete work, in monolithic construction, looks best with unbroken surfaces, rather than when cut up into many patterns. It was never intended that concrete construction should be false or pretend to be what it is not, and the closer home builders and designers adhere to a design which fits the material, the better will be the result and the more substantial will be the building. When you build with concrete, you build but once, and your home, if built of concrete, does not begin to deteriorate when the contractor drives the last nail, or when the painter has put on his finishing touches with the brush. There is no annual repair bill for the owner of a concrete home. The roof of this bungalow is to be covered with a soft gray cement shingle, like the soft gray tone of the pebble dash. What little exterior wood work there is in this design may be stained some harmonizing color or painted cream white.

This bungalow, in plan, is livable, convenient and well arranged. The fire place in the living room shows off well from the dining room, and with the convenient bathroom off the hall, good convenient kitchen, screened porch for refrigerator at the rear, two good bedrooms and a large front porch, it should make an unusually pleasant home.

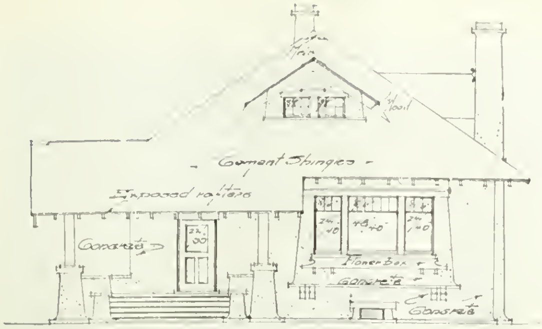
Construction in the average locality should not cost more than $3,000. A full basement would add to this amount.



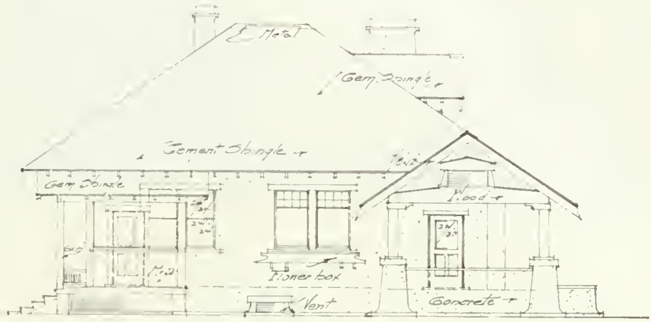


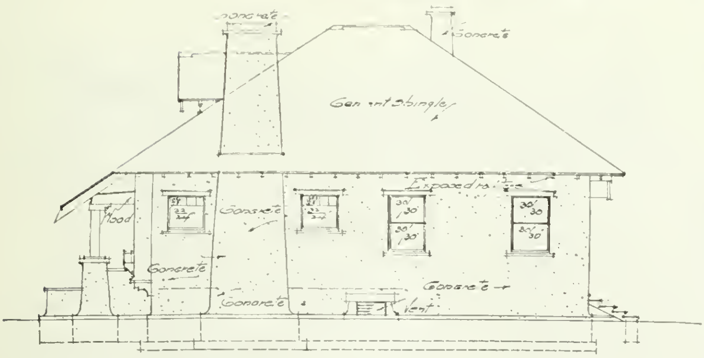


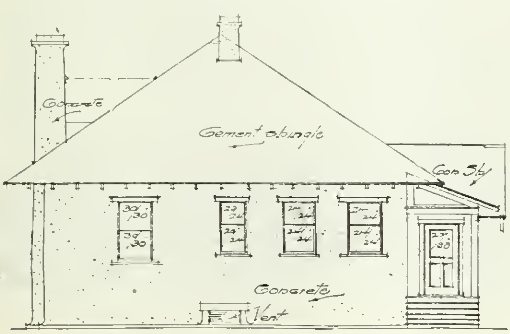
First Floor, Basement and Roof Plans of Poured Concrete Bungalow—Scale 1-12" to 1'



Elevation and Section Details for Poured Concrete Bungalow—Elevation, Scale 1-12" to 1'; Section, 1-4 size







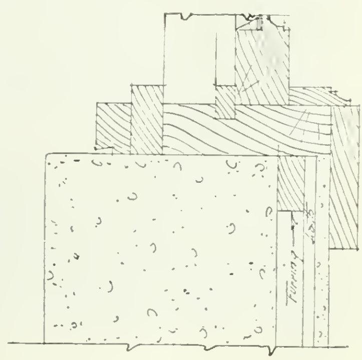


Fig. 2. Rotary Kilns in the Plant of the Inland Portland Cement Co., Metaline Falls, Washington

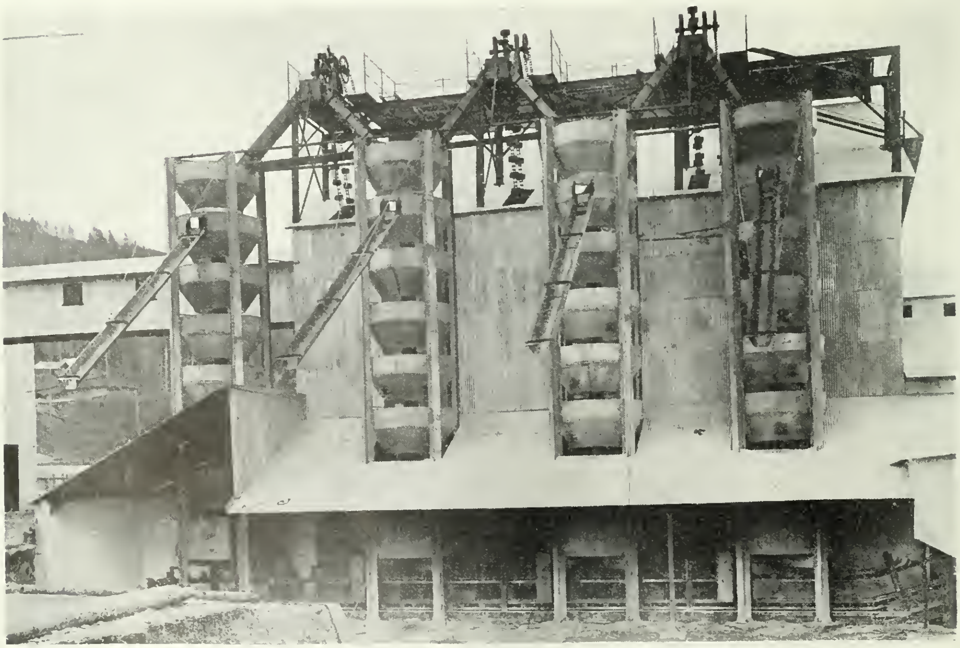


Fig. 3. Vertical Clinker Coolers and Belt Conveyors

Power Supply and Machinery Equipment of a New Portland Cement Plant

The manufacture of Portland cement in the Pacific Northwest has shown sure and steady progress. The first two cement plants to be erected were located in the Puget Sound district—on the Pacific coast; the third east of the Rocky mountains in Montana. It was but natural that the fourth should be located in the stretch of territory between the Cascade mountains and the Rocky mountains, commonly known as the Inland Empire.

This plant is owned by the Inland Portland Cement Co. of Spokane and Metaline Falls, Wash., and forms one of the group of the Lehigh Portland Cement Co.

Work on the plant was commenced on the first of June, 1910, and the mill was completed on the first of April, 1911. Because of a delay in completing the water power development, the plant was not in operation until the first of August.

In constructing the plant the first important consideration was the question of adequate power. Although the development of water power represented a number of difficult engineering problems, this was decided upon as the most feasible and economical. The power development is of the high head class—approximately a 500 ft. head.

Sullivan Lake in the Kaniksu national forest covers an area four miles long by a mile wide. By the construction of the dam and the diversion of the waters of Sullivan creek, the lake was raised approximately 25′, providing an enormous water reserve. After being carried 13,000′ in a timber flume 8′ wide by 6′ deep, the water, passing through the head gates, is conveyed to the power house through a tunnel. This, in a distance of 1400′, has a vertical head of 480′, with a resultant pressure of 200 lbs. per sq. in., as delivered to high-head impulse water wheels.

Two electric generators 1,785 k. v. a., direct connected to water wheels, combined with the required exciters and switch boards, comprise the power installation. The current is developed at 2,300 volts and transformed at the mill to a 550-volt base for operating purposes.

As an indication of the efficiency of the method of water power development adopted, it might be interesting to note that from the start of the power plant to the present time, there has been a loss of only 8 minutes, and the results in power costs have been all that could be anticipated.

Good deposits of limestone and shale are found in the Metaline Falls district. The limestone quarries, 2,700′ from the plant proper, are of open quarry formation, the usual methods of quarrying being used. The material is delivered to the crushers by cars.

One No. 9 style "K" Gates breaker, and two No. 5 style "K" Gates breakers, comprise the crushing equipment.

Automatic trams, used to convey the stone to the storage bins and from there to the mill, operate on the gravity system. An excess of 16 H. P. over the amount necessary to return the empty buckets is generated. The shale quarry is located directly back of the power station, the shale being conveyed to the raw storage department by a short tram of the power-operated type.

A system of tunnels and conveyors eliminates labor in handling, in drawing the raw material from the raw storage department. Passing entirely separate through the rotary dryers, which consist of two 7′ diameter by 60′ of the "Vulcan" type, the limestone and shale are stored in bins above automatic weighing machines. After being weighed separately, the raw materials are dumped on a conveying belt in the proper proportions.

The preliminary raw grinding is accomplished by type "B" Jeffrey hammer mills, and completed by 40″ Griffin mills, weighing 26,000 lbs. each, which reduce the raw materials to a powder of a fineness of 95% to 98% on a 100-mesh sieve. The machines are driven by 75 H. P. vertical motors, and have a capacity of 4 tons per hour.

The Finishing.—The powdered raw materials are carried by screw conveyors to the stock bins of the rotary kilns, and fed automatically into rotary kilns, 9′ 6″ x 140′.

To obtain the burning heat (2,700 to 3,000 degrees Fahrenheit) necessary to calcine and thoroughly flux the raw material, a finely powdered coal is used, which is ground in 40″ Griffin mills. After being stored in the coal stock bins in front of the rotary kilns, the

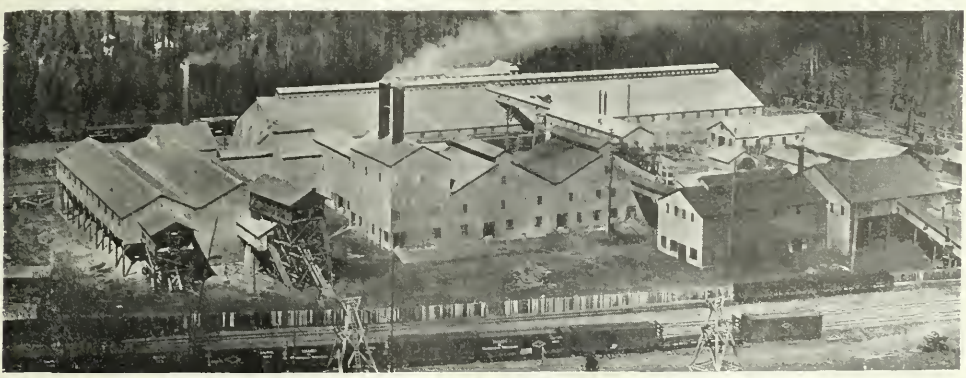


FIG. 1. PLANT OF THE INLAND PORTLAND CEMENT CO., METALINE FALLS, WASHINGTON

coal is conveyed to a blast pipe and blown into the kiln by air pressure.

Fifty h. p. variable speed motors operate the rotary kilns. When cooled, the clinker is weighed by automatic scales and the required amount of gypsum added. The preliminary reduction of the clinker is made on Sturtevant rotary crushers. The finished grinding is done on 40" Griffin mills and a fineness of 96% to 97% on the 100-mesh sieves, and 85% on the 200-mesh sieves is the standard maintained. The mills are operated by 75 h. p. vertical motors. Through the use of one class of grinding machines, the stock of repair and renewal parts is not excessive. The raw materials are sampled hourly.

Accessory Features.—In connection with the power development the city of Metaline Falls is furnished with light and power, and the surrounding mines have an available supply of electrical power to the extent of 10,000 h. p. Incidental to the cement plant proper are the machine shop, consisting of a concrete building and modern equipment, and the stores department.

Fig. 4. Bagging Machines at Plant of Inland Portland Cement Co., Metaline Falls, Washington

The plant and power development represents an investment of $1,400,000 and a monthly pay roll and purchasing expenditure of $45,000.

The present officials of the Inland Portland Cement Co. are: Harry C. Trexler, president; F. A. Blackwell, vice-president; A. F. Walter, treasurer; Dan R. Brown, secretary; Irvin J. Kohler, general superintendent, and Earnest Ashton, chemical engineer.

The sales, distribution, purchasing and accounting are conducted through the general offices in the Old National Bank Building, Spokane, Wash., with the following personnel: Dan R. Brown, secretary and assistant treasurer; John H. Marks, assistant sales manager; Wm. J. Harry, auditor; F. Tilford Brown, purchasing agent.

Equipment—The high-head impulse water wheels were furnished by the Pelton Water Wheel Co., San Francisco. The equipment in the power station was built by the Westinghouse Electric and Manufacturing Co., Pittsburgh, while the works equipment, the 75 h.p. vertical motors on the preliminary grinders and the 50 h.p motors on the kilns were furnished by the General Electric Co., New York City. In the quarry, the Marion Steam Shovel Co., Marion, Ohio, furnished the steam shovel equipment, and the automatic tramway equipment made by A. Leschen & Sons Co., St. Louis, was used in handling raw materials. The crushers were built by the Allis-Chalmers Co., Milwaukee. The drilling equipment in the quarry was furnished by the Hardsocg Drill Co., Ottumwa, Iowa, and the air compressors by Laidlaw-Dunn-Gordon Co., Cincinnati. The rotary driers and the kilns were built at the plant of the Vulcan Iron Works, Wilkes-Barre, Pa. The Jeffrey Mfg. Co., Columbus, Ohio, furnished the hammer mills for preliminary grinding. Griffin mills, made by the Bradley Pulverizer Co., Boston, are used as coal grinders, and the rotary crushers used for preliminary reduction of clinker were built by the Sturtevant Mill Co., Boston. Among the miscellaneous equipment, the cranes were built by the Whiting Foundry Co., Whiting, Ind., the elevating and conveying machinery by the Link-Belt Co., Chicago; the clutches and similar mechanical equipment by the Geo. V. Cresson Co., Philadelphia. The Gandy Belting Co., Baltimore, furnished the conveying belts; the transmission belts were furnished by the Bradford Belting Co., Cincinnati. The weighing equipment for handling the raw material was built by the Automatic Weighing Machine Co., Newark, N. J., and W. F. Mosser & Son, Allentown, Pa., furnished some of the special conveying equipment. Rotary blowers were built at the plant of the B. F. Sturtevant Co., Boston. The bagging machines shown in Fig. 4 were made by the Bates Valve Bag Co., Chicago. The automatic feeders were furnished by S. R. Vanderbeck, Cleveland.

The plant was erected under the direction of R. R. Baer, chief engineer of the Lehigh Portland Cement Co. Irvin J. Kohler was general superintendent. The structural steel was furnished by the McClintic Marshall Construction Co., Pittsburgh; the galvanized roofing and siding by M. S. Young & Co., Allentown, Pa.; roofing for stock houses by the Phillip Carey Co., Cincinnati.

A plant of such construction and equipment is an impressive example of the place that Portland cement is today filling in the industrial world.

The attention of subscribers—those who have made subscription payments either to CONCRETE or to CEMENT AGE—is called to an announcement on page 37. Please read that announcement and help us to correct any errors which may arise in combining the two subscription lists.

Concrete-Cement Age.

COMMENT

Sooner or later every editor feels the necessity of having some place in the journal where he can talk informally to the readers. We have felt this need for some time, and "Comment" has suggested itself as a rather appropriate title for such a department. This is short and suggestive and fits in very well with Correspondence, Information and Consultation.

In Correspondence, our readers have their say; in Information, questions are asked and answered; in Consultation, problems of field, office and mill, and general problems of development are discussed in detail. Comment, however, is where we have our say. It's the woodpile, where we can use a saw, or an ax, or a wedge, to get at the thing we want. Further comment on any points or suggestions for new topics are always cordially invited.

A Cement Show at the Panama-Pacific International Exposition

The opening of the Panama Canal marks an epoch in world development, and the exposition to be held at San Francisco in 1915 to commemorate this event should be a great achievement. Within six years, San Francisco has risen from ashes, and her civic pride and effort have been aroused and united. The achievement to be celebrated is of world interest, and the outlook indicates a great and successful gathering.

Our immediate interest in this is to take advantage of this gathering to hold a cement show which will bring home most effectively the wonderful development and the universal utility and economy of this material. Concrete is used throughout the canal structure, and building the canal has developed new methods of handling concrete, new forms, etc. The canal construction from the first has been a wonderful concrete exposition, a "Cement Show" on a stupendous scale. It seems especially fitting that at the world exposition to celebrate the canal's completion a cement show should be held, and we hope that steps will be taken toward that end.

* * *

A Carload a Minute, Ten Sacks a Second

At one of the recent meetings of the Association of American Portland Cement Manufacturers, Mr. Mallory, who is recognized as the "statistician" of the Association, in a lull in the proceedings occasioned by the non-arrival of some speaker, rose to say that he had made some memoranda which might be of interest to the members. Taking the total annual production of cement in the United States, and averaging working conditions, etc., Mr. Mallory estimated that 10 sacks of cement were produced every working second, or about a carload a minute. This is rather an unusual unit on which to base production, but is an interesting side light on the situation.

Some Bituminous Coated Concrete Paving Experiments

There is much interest in the type of concrete paving which supplements the concrete with the application of a bituminous surface. The success of the experiment conducted under the direction of City Engineer E. W. Groves at Ann Arbor, Mich., suggesting similar treatment for other cities, gave first prominence to the method of covering the concrete with hot bitumen and sand—the latter being rolled in by traffic. It is pointed out to CONCRETE-CEMENT AGE by excellent authority on highway matters that there is a question as to whether or not the idea originated in Ann Arbor. This authority writes: "The objection to the lack of resilience, noise and dust incident to travel over concrete roadway was in many cases the deciding factor which led to the adoption of other forms of pavement, and a natural sequence to the surface treatment of macadam roads with various bituminous materials was the application of a similar treatment to the then existing concrete road surfaces."

An experiment at Ithaca (N. Y.) was first tried in 1909, when an application of oil asphalt and screenings was made to a portion of a newly constructed concrete surface. In 1910 it was decided to cover the remainder of the concrete sections in a similar manner and a refined coal tar, refined water-gas tar, oil asphalt and heavy residual oil were used. The data* regarding these experiments are given in part as follows:

Experiment No. 12, Sections Nos. 15 and 14. (b) Bituminous-surfaced Concrete. The first 39 feet of section No. 14 were coated with the artificial oil asphalt described in experiment No. 4.

Analysis of artificial oil asphalt† *(used on section 14.)*

Specific gravity 25°/25° C.	0.964
Float test at 100° C. (time)	1′ 27″
Melting point °C. (cube method)	67°
Penetration (No. 2 N, 5 seconds, 100 grams, 25° C)	168°
Per cent of loss at 163° C., 5 hours (20 grams)	0.85
Float test on residue at 100° C. (time)	1′ 29″
Percent of total bitumen insoluble in 86° paraffin naphtha	22.0
Per cent of fixed carbon	8.60
Per cent of bitumen soluble in CS_2, air temperature (total bitumen)	99.74
Organic matter insoluble	.12
Inorganic matter	.15
	100.00

This material was applied hot at the rate of 1 gallon per square yard and was covered with stone chips. The bitumen did not adhere very well to the cold, damp surface. After the concrete was laid the road was kept closed for about fifteen days, and on December 2 (1909) the entire road was in good shape, except in one place, where a retaining wall should be placed.

Experiment No. 12—(a) Cement-Concrete; (b) Bituminous-Surfaced Cement Concrete.‡ (a) When inspected on September 9, 1910, the straight cement-concrete section was in fair condition, but presented a rather rough and uneven surface, due evidently to the method of laying. There was only one small crack about 8′ long in this entire section. It was decided to cover this section with a bituminous mat in the

*Office of Public Roads, Circular No. 92.
†Dense, semi-solid.
‡Office of Public Roads, Circular No. 94.

same manner as in experiment No. 12*b*. This was done before the last inspection on November 2 in the following manner:

The surface was first thoroughly cleaned by sweeping, after which the hot bituminous binding material was applied by pouring from buckets at the rate of ¾ gal. per sq. yd. While the bitumen was still hot, stone screenings ranging from ¼" to ½" in diameter were applied in sufficient quantity to take up all excess bitumen. A number of bituminous binding materials were applied to this section. * * * (At a cost of 11.02 cents per square yard. Complete cost data are given in Table 35, Circular No. 94, office of Public Roads.)

(*b*) This section was in better condition than that treated in experiment No. 12*a*, but the greater part of the bituminous surface had worn away and it was therefore treated again in the same manner, as described under experiment No. 12*a*. The cost and materials data for this work are to be found in Table 35.

When inspected in the latter part of October, 1911, the evidences of these treatments had largely disappeared from the traveled portion of the middle of the road, but a thin mat was left along each side. More durable roads would undoubtedly have resulted if the work had been done in more favorable weather, and if the surface of the old portion of concrete had been thoroughly flushed with water to remove all the dust before the bituminous material was applied. Similar experiments were conducted in Massachusetts several years ago, says our informant. In this case a carpet of refined coal tar and screenings was applied to some old Hassam surfaces, and we have been informed that the results were of a very satisfactory character. Recently three varieties of bituminous products were applied to the oil-cement-concrete surface constructed a year ago at Jamaica, N. Y. This section is exposed to particularly heavy automobile traffic and the work will be kept under careful observation.

On the new concrete it is quite probable that a wearing surface of some bituminous material will serve an excellent purpose aside from the fact that it makes a more desirable surface. It has been clearly demonstrated that concrete shrinks upon drying out and cracks frequently develop from this cause. If a rapid drying out can be checked by means of a protecting bituminous top, such treatment will pay for itself in producing a better and more durable concrete, and moreover, should cracks develop, the bituminous material will be immediately driven into them and chipping and spalling of the concrete will be largely prevented.

Standardized Contract and Specification Forms

Recently we noted that the American Institute of Architects announced the publication of standard forms for contracts and specifications. It is easy to see the many advantages of standardized documents of this kind if they can be made to represent the best practice and by their clearness, equity and final interpretation in courts of law become generally understood and accepted by owners, architects and builders.

While of necessity the contractor must bear the burden of responsibility, the committee in drawing up these specifications has felt that in a great majority of instances the general conditions of contracts as individually drawn by various architects have been in certain respects unfair to the contractor; and even where clearly expressed and apparently binding on the face of the contracts, were not as a matter of equity enforcible in a court of law. Heretofore it seems to have been assumed that all of the stringency of the contract is to be directed toward the contractor and that the architect and owner are necessarily honorable persons. The new documents, however, are distinctly more binding upon the owner than such documents have heretofore generally been and distinctly more liberal to the contractor. Nor do they assume that the architect's decisions will necessarily in all cases be equitable and therefore instead of the very few matters which have formerly been capable of arbitration, it is arranged that a number of classes of decisions made by the architect shall be subject to arbitration. A number of specific instances of this attitude are found throughout the documents, which make specific provisions, for example, for the termination of the contract by the contractor, interest on past due payments, claim for extension of time, damage and extra remuneration.

Certain members of the committee have during the past year or more put into use forms substantially corresponding to the first standard edition of the Institute documents as now published, and they have appeared to stand well the test of actual use. Provision has been made by the committee, however, for revisions by the Institute at intervals; and it is hoped that as amended by use and the criticism of both architects and builders throughout the country, the Standard Documents of the American Institute of Architects will eventually become the basis of all building contracts, as well as a recognized code of procedure representing the judgment of the Institute as to what, in that respect, constitutes the best practice of the profession.

Cement and Sand Lime Bricks

According to the U. S. Geological Survey the sand-lime brick industry has sadly declined. In a sense the sand-lime brick started as a competitor of cement, especially cement in the form of the concrete block, which probably suggested the construction of sand and lime units in brick size. The sand-lime brick industry started in 1901 but did not make much progress until 1903, when there were 16 plants reporting products valued at $155,040. The industry grew rapidly from that year until 1907, when there were 94 plants reporting $1,225,769 worth of products. From this it has declined, until in 1911 there were but 66 operating firms. The decline certainly is not due to the cost of the material, for the average price per thousand for common sand-lime brick in 1911 was $6.09, compared with $6.36 in 1910. Evidently the sand-lime brick has never appealed to architects and builders. Portland cement is in every sense superior, representing greater durability. Concrete products in the way of building stone and block are constantly improving in appearance and quality, and this fact no doubt accounts for the decline of what promised at one time to be quite an important industry.

The Concrete House From a Sanitary Standpoint. The public today hardly realizes the risk which may accompany the occupation of a residence of ordinary construction. We need only search the records of the Committees on the Prevention of Tuberculosis to see that in certain cases houses have become infected, and are literally death traps. These reports are for the most part made upon city buildings occupied by the poorer class under bad sanitary conditions, but the same rule holds good in healthy locations and homes where every sanitary precaution is taken.

One record relates to a fine old Colonial residence in a healthy New England village which was in reality a deathtrap. The building was of the usual frame construction. During its occupancy by a large and well known family, one after another was stricken with tuberculosis, or quick consumption, as it was then termed. In two generations this family was wiped out. It was commonly said that tuberculosis was in the blood, but after the death of the last member of the family, and upon the purchase and thorough renovation of the house by another prominent family, the march of death went on. A few years ago a great fire swept the village, taking with it this handsome Colonial house, together with many other dwellings. The destruction of this residence was without doubt a good thing.

Conditions of this sort could hardly exist in modern reinforced concrete houses. Here are no spaces for the breeding of bacteria or insects. In a house of this sort occupation would be accompanied with little or no danger, as it would be feasible to cleanse thoroughly every part of it.

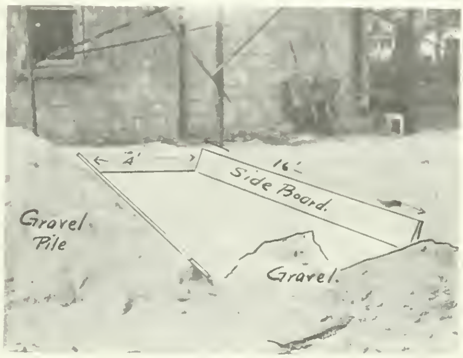
Cement Sacks Make Expensive Tarpaulins A contemporary points out, in a recent issue, the "penny-wise" policy of using cloth sacks to cover concrete work. To quote:

"The area of a cement sack spread out flat is about 3¼ sq. ft., so that the cost of covering concrete with 10 cent cement sacks is at least 3c a sq. ft. The price of tarpaulins ranges from 3½c to 9½c per sq. ft. and a good, waterproof tarpaulin may be purchased for 6c per sq. ft. Therefore, if such a tarpaulin is bought and used twice, it has paid for itself as compared with the use of cement sacks for the same purpose; and there still remains a tarpaulin in first rate physical condition, capable of being used many more times as against the pile of rotten sacks which is all that is left after they have been misused in this way."

Cement sacks are too often slung around on a job as though they had little value. A comparison such as the above is of value, and it is very apparent that tarpaulins would be a good investment.

Concrete as a "Trust Buster" The paper by Harlan David Smith in the *Technical World Magazine* describing the overthrow of a bridge trust in Kansas, a subject also discussed at the recent convention of the N. A. C. U. in Kansas City, makes public information that applies or has applied to other states. It is no unusual thing to find a single bridge firm receiving contracts year after year in a certain locality. Concrete has not only been the chief factor, but practically the only influence, that has broken up some local monopolies. In this connection it is interesting to note that the very simplicity of concrete construction in the case of small bridges has had a most potent influence in promoting public interest in its use. Taxpayers are able to understand and appreciate it. In some counties controlled only a few years ago by the makers of iron and steel bridges, the commissioners now employ local designers and contractors to do every feature of the work. With the possible exception of the cement and steel, all material as well as labor is found at the site, thus not only effecting a saving as to cost but keeping the money in the community. Argument in favor of concrete as opposed to iron and steel bridges becomes unanswerable when attention is called to the gross extravagance represented by maintenance costs in the case of metal structures, especially in the matter of highway bridges of moderate dimensions.

A Good Mixing Box, Easily Built. On some work recently, we saw a mixing box which had some unusual features. The box was open at each end and was simply four 2″ x 12″ x 16′ rough planks laid across some cleats, and brought close together. The side pieces were 2″ x 12″ also, inclined, with the sand banked under them, and probably toe-nailed at the bottom to hold



TYPE OF MIXING BOX

them in place. The open end seems to be a rather unusual feature. The contractor said that it worked out very well indeed.

Such an arrangement is more of a mixing board with two inclined sides than a box; but at any rate, it is an interesting suggestion.

An Effort to Solve "Curing" Problems "Sprinkling" and "natural curing" are uneconomical methods for the concrete products manufacturer. This is apparent to anyone as soon as his business has begun to grow. He must clog his storage yards with at least a month's output and at the same time sacrifice something in the quality of his product. We want you who have developed various methods of steam or vapor curing to help us in standardizing curing plant installations. Will you help? Read an announcement under the caption "Steam Curing," on page 34 of this issue.

Information Department

> Inquiries regarding sand and all other materials are cheerfully answered, like all other questions, but in cases of importance it is best to invest in a laboratory analysis. Write to us for particulars, address, Laboratory Department.

Effect of Acids on Silos

I have heard it said that acid formed by ensilage causes deterioration in the walls of concrete silos. Is concrete a proper material to use in the construction of silos? T., Iowa.

Your fears in this respect are without foundation. There are thousands of concrete silos and the walls are not affected by the acids of the ensilage. Concrete, when very green, might be injured by such acids, but when hardened, it resists all attacks except those of very strong acids not to be found in ensilage.

* * *

Cleaning Steel Forms

Please inform us what we can use to clean steel forms. We have in mind steel sidewalk forms that have collected concrete to such an extent that they are rough and it is impossible to scrape same off. V., Nebraska.

The simplest and best way to free metal forms from hardened concrete is to heat them slightly and then cool them suddenly with cold water. The resulting expansion and contraction will break off the concrete. Care should of course be taken not to heat the forms so hot as to injure them.

* * *

Facing Mixture

I should like to use hydrated lime in a 1:2 facing mixture of cement and sand for concrete block and I want to know how much lime to use to give the facing a stone color. D., Nebraska.

It is impossible to give you a definite answer for two reasons. One is that you do not name the color of the stone which you would like to imitate, and the other is that you do not tell us what Portland cement you are using, and as cement varies greatly in color, much will depend upon this factor. We do suggest, however, that you use no more than 25% (by weight of the cement) of lime in the mixture.

* * *

Sidewalk Crazing

I am a sidewalk contractor and have trouble with hair cracks or crazing of the top coat. I use a 1:2:4 mixture for the foundation 4" thick and a 1:2 mixture for the top 1" thick. It is a medium coarse sand. I have tried covering the walks, but have had no better results. I have also tried a drier composed of a mixture of cement and sand. These cracks seem to be in a thin film on top. P., Pennsylvania.

Hair cracks result from improper curing, also from an excess of troweling in the top dressing. Better results will be obtained if you do not try to get such a smooth surface on the top dressing. The fact that you say that cracks occur on the top dressing, leads us to believe that troweling may have a great deal to do with it, coupled with a lack of moisture when the walk is curing.

* * *

Oil Stains Block

We are having trouble with our white facing stone. We have been casting white lintels face down on pallets which have been oiled. To make the finish smoother and to prevent the oil from staining the fact of the stone, we have put in a supposedly water-proof paper, which also appears to have been oiled, and it makes the result no better, so far as the stain on the block is concerned. What shall we do?. B., Pennsylvania.

If you are careful in using the oil on your pallets, wiping it off after it has been applied, you should have no trouble from stain. Melted paraffine, applied hot, has been used with success. A paraffine oil, costing from 12 to 15 cts. per gallon, should not stain the concrete. If you think better results are to be obtained by using a paper lining, however, we suggest that you get a waxed or paraffine paper, which you should find at your nearest wholesale paper dealer.

* * *

Block Silos a Success

Are silos of concrete block a success? C., Indiana.

There is no doubt about the practicability of the concrete block silo. Thousands of them have been constructed in many parts of the country and we have published a great deal at various times on the subject of concrete block silo construction. Full instructions for the construction of a concrete block silo would be too long to give you in the space available here. We suggest that you write to the Association of American Portland Cement Manufacturers, Land Title Bldg., Philadelphia, Pa., sending 5c for a copy of Bulletin No. 21, which contains very complete instructions on the subject of silo construction. The United States Department of Agriculture also publishes a bulletin on this subject. "Practical Silo Construction,"* by A. A. Houghton, is an instructive book on this subject.

* * *

Colors for Concrete

I should like some information on mixing colors with cement to give colored concrete surfaces. B., Massachusetts.

From 1 to 3% (by weight of cement) of dry mineral color added to the cement before mixing will give a fairly permanent tint. These proportions are suggested for each 100 lbs. of cement: For black concrete, 2 lbs. of excelsior carbon black. For blue, 5 to 6 lbs. of ultramarine. Brown, 6 lbs. of roasted iron oxide. Gray, 8 oz. of lampblack. Red, 6 to 10 lbs. of raw iron oxide. Yellow or buff, 6 to 10 lbs. of

*Book Department, Concrete-Cement Age, price 50 cents.

yellow ochre. Where strength and hard wearing quality are required in a concrete surface which is to be colored, it is recommended that no color be used requiring more than 4% by weight of color to cement. This eliminates some of the combinations suggested above. We shall take up the matter of color in the Consultation department in a later issue.

* * *

Smoothing Porch Posts

I have built a concrete porch, using a mixture for the concrete posts which was too coarse. The result is that the posts haven't the smooth finish which they should have. Can I go over these posts with a fine cement wash and get a smooth surface? S., Wisconsin.

There is no reason why you should not use a thin cement grout, applied with a brush, to the pillars, unless the pillars are very rough. If they are very rough then the grout would, of course, not fill up the depressions, in which case you should make a thin mortar and apply the mortar with a wooden float. Do not trowel the surface any more than is absolutely necessary, because if you do there is a likelihood that your coating of thin mortar will crack. Whichever way you fill the pillars, great care should be taken in curing the grout and mortar. When this has been applied and the mortar has taken its initial set, wrap the pillars in burlap or some such material and keep them wet for several days. This should be done to avoid checking and cracking.

* * *

Simple Test of Cement

What simple test can be made on cement without employing laboratory methods and apparatus? Some cement has been received here, and is now on the market, which is not up to the standard, and it is necessary to give some test to the cement shipment before the cement goes into the work. S., Nebraska.

Briefly, the best way to test cement without laboratory apparatus is to make the cement up with water in such a way as to form a pat about 3" in diameter and about ½" thick in the center, tapering it to nothing at the edges. This pat should be spread out on glass and the cement and water permitted to dry out, keeping the pat from sun and wind. The behavior of the cement can we watched from all sides, in this manner. If the neat cement and water set promptly and do not crack or blister in curing, it is a fairly good indication that the cement is all right. You must understand, of course, that this is merely a rough test and where any considerable quantity of cement is to be used, a laboratory examination is an economy.

* * *

Concrete Retaining Wall

A town of which I am a commissioner wants to put up a retaining wall about 250' long, with water on one side and a street on the other. It is salt tide water and I have found that a solid clay foundation lies under 2' of sand. The wall is intended more for looks than anything else. Fearing that the wall might settle out of line, I have intended to drive small locust wood piles about 4" in diameter as far down into the bed of clay as possible, and then build the wall around these piles, completely hiding them. Will these posts do any harm in the concrete walls? The wall will be from 4' to 5' high and we expect to make it about 16" thick at the bottom and 12" thick at the top, tapered on the water side. At high tide the water will come up 2' or [illegible]. On account of tides to contend with, we expect to build the wall in sections of about 25', joining the sections with tongue and groove joint. B., Maryland.

You will find that you are making a mistake in thinking that this retaining wall, in holding back a wet sand bank 5' high, is more for looks than for strength. The lower part of the wall will be submerged twice each day when the tide rises. The wall should go into the clay at least 1' and should not be less than 2' thick at the bottom instead of 16" as you decided. The wall should be about 15" thick at the top. It will not be advisable to put wooden posts into this wall, no matter how hard the wood. The tongue and groove joint is all right for the ends of the sections.

* * *

Cement Front in Oil Shafts

In this country there are, as you know, thousands of oil wells. The formations are varied, mostly shale and clay, with strata of lime. We now propose sinking wells where the principal formation is soil and clay. In many places no rock of any character is encountered at all, even to 1,000 ft. depth. The difficulty is that after, say 100 feet, the walls above where the tools are working will give way and cave onto the tools. Usually the water used with the action of the tools leaves a smooth mud wall which will stand until the well is finished and the casing is inserted, or until either sand or rock is struck and the casing placed in to that depth. Then the smaller tools, etc., work inside this casing to the lower depth. Now, what we are seeking information on is: First—can we make a thin cement mixture and use instead of water alone? Would the cement be forced into the walls sufficiently so that when the bailer lifts out the product of mud and cement, the cement left on the wall would set sufficiently to stand while the bailer was lifted out, emptied, refilled and returned and proceeded to go another screw length in depth, about six feet? Second—what mixture would you make? What is the probable quickest time possible for it to set? Is any special make of cement necessary? Do you think it would penetrate the walls of the hole (6" at bottom to 13" at the top) to hold a soft or caving foundation? So as to make the best possible time in drilling, the time consumed in drilling a 6 ft. scew and bailing out would require from 20 to 30 minutes. Could the cement be made so as to set in that time? S., Oklahoma.

In the first place your cement mixture could not be used neat; that is, in the form of a simple combination of Portland cement and water. It would have to be poured in a thin grout composed of cement, water and sand, and this mixture would certainly not set hard enough to resist any pressure within the time you give—20 to 30 minutes. The effect of its use would be to deposit merely a very thin crust on the inside of the shaft, and even if it were permitted to harden for several hours it would not develop any material resistance. Soil and clay are both bad for concrete, for the reason that they coat the particles of sand and cement and prevent crystallization, upon which the stability of concrete depends. We shall undertake to present this matter later in the Consultation Department.

* * *

Concrete Pavement Tracks

This company is laying a concrete pavement. The concrete is composed of a mixture of 1 part cement, 2 parts sand and 4 parts washed river gravel. We are putting this mixture down to make a 59' street, 6" thick, in one course.

We are putting expansion joints transversely every 50′ and when the sun is hot we are covering the pavement with sawdust and keeping it thoroughly moist. Otherwise, we keep the pavement well wet down for seven days. Why does this pavement show cracks other than the expansion joints, and what can be done to prevent them? E., Oregon.

There are several recommendations to be made which would tend to avoid cracking, which you say you have experienced in some of your work.

We suggest that you put in your expansion joints every 25′ instead of every 50′. In many places engineers are now making joints every 12½′ throughout the length of the street, and in a pavement 59′ wide we certainly recommend that you have at least one, and probably you should have more than one joint running lengthwise of the street. We think the pavement should be in blocks not larger than 25′ x 25′, and some engineers consider it advisable to have blocks even smaller than this.

The Board of County Road Commissioners of Wayne county, Mich., which has laid more than 30 miles of concrete pavement out in the country, and which will lay about 40 miles of it this year, has laid this pavement with joints every 25′ across the roadway, with no other joints in the pavement. Two pavements laid last year on soil which does not have an ideal drainage are showing a few longitudinal cracks in some of the sections, and for this reason it has been decided to put a joint down the center of the pavement.

One thing that has to be considered in concrete paving where the sub-grade is given a crown like that of the finished pavement, is the fact that this crown naturally fits into a corresponding convex surface on the under side of the concrete slab. This does not admit of the pavement sliding in expansion and contraction—the crown prevents it. The Board of County Road Commissioners of Wayne county will eliminate the crown on the sub-grade this year, so that the surface on which the concrete is laid will be perfectly flat. The concrete itself, however, will be given the same curvature on top as before. It is hoped in this way to obviate all possibility of cracking. We know nothing about the street in which you are laying the concrete pavement, but 7″ of concrete makes a better pavement than 6″.

Cracking is caused also by too dry a mixture, although you say you gave the pavement a very careful curing, keeping it wet for a week.

* * *

Sidewalk Expansion Joint

Please tell me something about expansion joints in sidewalks. We have no steel forms in use here for sidewalk building and we are having a great deal of trouble with cracks in the sidewalks. We use a 1:8 mixture for the base and a 1:2 mixture for the top. If I use ½″ wooden strips and take them out after the base is thoroughly tamped, what shall I use to fill up the cracks? Most of the sidewalks are about 5′ 4″ wide with a 3″ concrete base and a ½″ finish. We notice you advise not using fine sand. Why? I cannot make smooth work with coarse sand. D., California.

The best way to make joints in sidewalk slabs is to put in strips of wood (if you haven't steel forms), which are to be removed before the concrete has become entirely hard, so that there will be no difficulty in taking out these strips. It is important that this cut or division in the walk should go clear through from the top to the bottom of the base course, so that when the walk is completed it will not be in one piece, but will consist of a series of slabs.

It is not necessary to make ½″ joints at the end of a 5′ or 6′ slab, but it is to be recommended that at least a ½″ leeway be left for expansion of the walk in every 50′ of length. The custom of putting these joints every 5′ or 6′ is chiefly to break up the monotony of a continuous stretch of concrete. These joints, wherever you place them, may be filled with loose sand after the walk is entirely completed and the concrete hard.

Perhaps when we say you cannot get a good finsh with fine sand, it is more because we do not understand each other in the matter of what is fine sand. River sand or shore sand is apt to be very fine. It is not necessary that the sand shall all be coarse. The best sand to use in concrete is a sand that is well graded from fine to coarse particles. In the best sidewalks now being laid there is no effort to get an extremely smooth surface as used to be the case in sidewalk building. It has been found that this extremely smooth surface is more of a disadvantage than an advantage, as the walk is more slippery, and many of the best sidewalk builders are now laying walks which are not troweled down smooth with a steel trowel, but are merely struck off with a steel tool, and then gone over lightly with a wooden float. The walk will wear longer and is much better for pedestrians. The reason many smoothly finished walks crack badly is because in an excess of troweling the cement and the fine particles of sand have been brought to the top. Cement and very fine sand do not make the best wearing surface. The walk will give more wear if coarse particles are allowed to remain on the top, rather than being forced down by the steel trowel and their place being filled with a fine creamy mixture of cement and sand. This very fine mixture is apt to crack or craze, unless it is very carefully cured, particularly in a warm climate such as we suppose you have. Wherever the sun is very warm, particular care should be taken in curing the walk. Do not let it dry out for several days, as the moisture is very necessary in hardening the concrete.

Ferro-Concrete, London, says that in the discussion at a recent meeting of the Instition of Municipal Engineers on "Methods of Inviting Public Tenders," attention was directed once again to the popular but undesirable practice of accepting the lowest tender for works to be exectued. It was pointed out by H. C. Adams that the tendency nowadays is to get work done as cheaply as possible, often at such a rate that the contractor cannot carry out the work honestly and make a fair profit. The principle of accepting the lowest tender is particularly undesirable in reinforced concrete work, because it leads to unjustifiably hopeful estimates of loads, bending moments, stresses, and the capacity of reinforcement for the resistance of stresses. That this is not an incorrect view is proved by many cases where the accepted tender has provided for far less steel—sometimes even fifty per cent less—than the next tender.

CONSULTATION

197. Foundations for Heavy Impact Machinery

"An ore-stamping mill is under design in our office, and we are very desirous of securing whatever data we can on the best design for "mortar blocks," or stamp mill foundations for this work. What is the best practice in designing foundations for heavy impact machinery?"

Discussion (Editorial).

Concrete is used almost universally in foundations for all kinds of machinery. The most efficient way of placing the bolts is an important question, and in a recent issue of the *Mining and Scientific Press* a correspondent calls attention to the different ways of placing anchor bolts in battery foundations. We quote in part as follows:

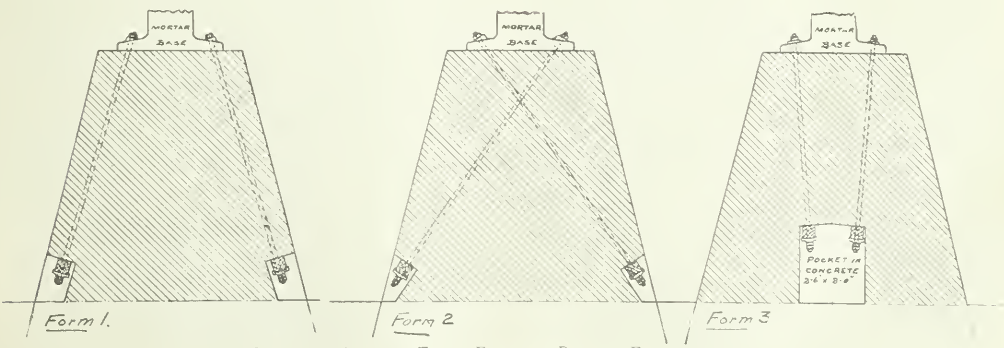
"In regard to the best form of battery foundation, I have been comparing forms recently built or planned, and find there is considerable difference as well as divergence of opinion among engineers as to the advantages of each form. Form No. 1 shown below, is essentially that in use at the Goldfield Consolidated, the Nevada Hills, the Mother Lode (British Columbia), and perhaps other mines. In this form, as in all the others, a pipe is bedded in the concrete and the bolts are placed in this pipe so that broken bolts may be easily replaced. There are nuts at each end. At the upper end an iron washer brings the nut snug against the mortar base. At the lower end a wooden beam placed lengthwise of the battery distributes the stress and by its compressibility permits the bolt to be kept tight. This form works well in practice. It is simple and easily built, there being no hollow space in the concrete block, the strength of the latter is not impaired, and reinforcement of the concrete is not necessary. Where old cable or iron rods are available some reinforcement is, however, occasionally used.

"The disadvantages of this form are that renewal of broken rods is awkward. Owing to the shape of a mortar it is necessary to lift it off the block whenever a new rod is placed. It will be noted, too, that the mortars are tied not to the main body of the block, but to what amounts to a ledge or heavy cornice on each side. So far as I know, nonetheless there have been no failures in practice.

"To obviate the difficulties noted, Form 2 was designed, and it was reported that this form was to be used both at Goldfield and Nevada Hills. I understand that it was given up in each instance. It was, however, adopted for the Santa Gertrudis mill and is being built there. In Form 2 the bolts cross through the foundation. This attaches the mortar securely to the whole block of concrete and it also makes it possible to replace rods without lifting the mortar. The objection urged against this form is the danger of a rocking motion developing. Personally I am unable to see why this should be and I am attracted to this design.

"The third form has been adopted at a number of mills in Mexico. It has the advantage that the mortar is securely anchored to the center of the block, no rocking motion is possible, and bolts may be replaced often, though not, apparently, always, without lifting the mortar. It has the disadvantage that either more concrete or some reinforcement is necessary in order to build an arch which is as strong as the solid block of the other forms. The men who are using this form are entirely satisfied, but apparently experience with it has been too brief to determine what objections, if any, will develop. In view of the increased capacity of stamps set on concrete blocks and the widespread tendency to use concrete in mill construction, consideration of these matters is distinctly worth while."

In building foundations for heavy machinery, engines, etc., the methods actually developed in the field are of interest. The anchor bolts must not only be positioned exactly, and at an approximately correct height, but there must be a certain amount of lateral play to the bolt. These conditions must be assured during the pouring of usually a great mass of concrete. We venture to say that the bolts in engine foundations have caused builders about as much thought as any one thing, and we would be glad to have further detailed discussion, with sketches and photographs, of methods used.



Diagrams Showing Three Forms of Battery Foundations

244. Concrete Vats for Fruit Storage

"How can concrete surfaces be protected against the acidic qualities of fruit juices, so that concrete vats can be used for storage?"

Discussion.—The Use of Paraffine Coatings.*

Laboratory tests conducted by the Chemistry Department of the Agricultural Experiment Station, Fort Collins, Colo., show that 4% acetic acid readily acted upon porous cement work. While several reports to the effect that cider and vinegar had been stored in cement-lined cisterns are available, the fact that acetic acid readily acted upon some of the material in the cement was considered sufficient reason for considering cement an unsatisfactory lining for vinegar cisterns. For this reason it was deemed advisable to try other lining materials than neat cement.

The following experiments or tests were begun: First, a cement tile of very rich mixture was stopped at one end by means of a cement plug and the whole covered with four coats of neat cement in water. Fresh cider was placed in the tile, and it was stored in a warm cellar. For a time everything went well; but at the end of a month the cider began to leak through the tile. Later the vinegar contents of the tile turned black, and a thick, mouldy scum formed over the top. Of course, in case of the tile, more surface of the vessel was exposed per gallon of vinegar than would be exposed in the case of the large cistern. Nevertheless, had the vinegar in the tile contained a far smaller percentage of impurities it would still have been unfit for use.

Second, at the same time that the tile experiment was started, a small cement cistern, lined with two coats of neat cement and a thin coating of paraffine was filled with fresh cider. Monthly tests were made to determine whether or not the contents were leaking out. There was no leaking, and each month the samples showed an increase in acid in the cider, which was rapidly turning to vinegar.

After about a year, the cistern was dug up and its contents removed to other receptacles. The cistern was opened and a careful examination was made in order to determine the condition of the paraffine lining. It was found to be intact. The vinegar, when compared with that stored in barrels, showed a favorable test, both as to acidity and flavor. In fact, the Domestic Science Department of the college pronounced the vinegar superior to other samples which had been stored in barrels by orchardists, who make vinegar on a commercial scale.

The process of lining a cement cistern with paraffine is so simple that any one with ordinary ability can easily obtain the desired results. In case an old cement-lined cistern is to be coated with paraffine, it must first be cleaned thoroughly. Then it should be given at least two coats of neat cement and water. The coats need not be applied more than 24 hours apart.

The cistern is now ready for the paraffine coat. The paraffine is heated by means of a small blow torch or gasoline stove until it is a very little above the melting point. It may then be applied to the inner surface of the cistern with a cloth or paint brush. In case a cloth is to be used, the hand should be protected by a heavy leather glove. The paraffine should be put on in a thin layer and thoroughly rubbed while hot. It should not be rubbed after it starts to solidify. The operator must necessarily work rapidly in order to get the coating well rubbed before the paraffine begins to harden. The coating will not allow bruising, and for this reason it is suggested that the bottom of the cistern be left until last, and the work of coating be done from a suspended platform rather than a ladder placed upon the bottom. Great care should be taken not to drop any objects upon the coated parts.

In case a new cistern is to be made, the walls may be constructed of one part Portland cement to four parts of clean, sharp sand. The walls should be made of a wet or "slush" mixture. The wall should be thick enough to insure it against cracking. When the forms are removed, the inside of the cistern may be coated with neat cement in water, the same as in the case of the old cistern. The paraffine should not be applied until the second coat of neat cement has had time to harden for at least 24 hours. This provides a solid wall, to which the paraffine will readily adhere.

*Abstracted from a report on this subject by H. B. Bonebright, Agricultural Experiment Station, Fort Collins, Colo.

245. Concrete for Sanitary Sewers

"There is a question raised in this city (Mobile, Ala.,) relative to the fitness of concrete sewer pipe for sanitary sewage, it being contended that the gases, acid or alkali solutions destroy concrete. What data are available?"

[Note: The action of sewage on concrete was discussed in this department in *Cement Age* for March, 1911, under Item 194. That discussion was a detailed report by Sidney H. Chambers, an English engineer, on the sewage disposal plant at Hampton, England. The studies on which this report were based covered several years, and many valuable data were presented.

The following general discussion of the situation is of interest.—Editor.]

Discussion by C. M. Powell.*

Regarding the suitability of concrete sewer pipe for sanitary sewers, similar attempts to discredit concrete for this use have been made in numerous instances in the past. Wherever such attacks are met with determined opposition and the true facts are presented, concrete invariably wins on its merits, as has been the case recently in San Diego, Cal.; Tacoma, Wash.; Kansas City, Mo., and in many other cities.

After a thorough investigation of the suitability of concrete pipe for sanitary sewers, the Board of Public Works of Kansas City, Mo., admitted concrete pipe into the city sewer specifications on equal terms with salt glazed vitrified clay sewer pipe. Recently the board let a contract for a sanitary sewer over a mile in length to be laid with concrete sewer pipe. In this connection, we might say that the clay interests are advertising the sewer pipe controversy at Kansas City as a victory for clay pipe, claiming that the committee appointed by the council to investigate the relative

*Chicago, Ill.

merits of the different kinds of sewer pipe reported in favor of vitrified clay pipe. This committee did go out of its way to make some recommendations on this question, but the conclusion of the committe was that the whole matter of sewer pipe was up to the Board of Public Works, and that the council had no jurisdiction in the matter. The final result was, as stated above, that the Board of Public Works is now using concrete sewer pipe for sanitary sewers in Kansas City.

Some of the first Portland cement manufactured in the United States was used for making concrete sewer pipe. Some of these concrete pipe are in use today in a sanitary sewer in South Bend, Ind., and this sewer is still giving satisfaction. The city of Brooklyn, N. Y., has over 450 miles of this class of pipe in its sanitary sewers, some of which have been laid for almost half a century. Milwaukee, Wis., has between 200 and 300 miles of concrete pipe in its sanitary sewers, and this city has laid concrete pipe ever since it commenced to be put in sewers. Milwaukee is today considered to be one of the best sewered cities in the country, and is still using concrete sewer pipe.

Concrete pipe sewers were laid in South Bend, Ind., about 1880; Mishawaka, Ind., in 1883; at Milwaukee, Wis., 1878; at Oshkosh, Wis., in 1883; at Elkhart, Ind., in 1883; at Duluth, Minn., in 1895; at Allegheny, Pa., one sewer was laid in 1872 and thirteen sewers were laid prior to 1878; at Chicago, Ill., about 1865. All of the early concrete pipe were made of natural cement, which is much inferior to Portland cement.

Havana, Cuba, is building what is recognized as one of the best planned sanitary sewer systems in the world. This system was designed and is being built under the supervision of the United States government engineers, and concrete pipe of all sizes are being used in large quantities.

In the last few years concrete pipe for sanitary sewers have been used extensively in the cities along the Pacific coast; this in spite of the fact that the clay interests have attempted, by all possible means, to discredit the use of concrete pipe. We are informed that the clay pipe interests have gone so far as to buy the rights to use one of the concrete pipe machines in the state of Washington, and in some cities have bought the sewer pipe plants and closed them down.

The writer recently examined a portion of a concrete pipe sanitary sewer here in Chicago which is said to have been in use 47 years. These pipe were made with natural cement and were in first class condition. The remainder of this sewer is over a half mile in length, and is laid with the same kind of pipe; and an examination made last year shows that it is in first class condition.

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246. Precedure in Pouring Floors

"I have been told by several concrete contractors that it is considered the best practice nowadays to pour columns and beams at the same time. They say that it is impossible from a practical standpoint to remove all the 'laitance' from the top of the column and, in nine cases out of ten, a joint is shown where the column was stopped off and the beam run over. They claim they have erected a number of buildings in which they have poured slabs, beams and columns at the same time and have yet to discover any crack where beams join columns. By pouring beams, slabs and columns at the same time, they claim they get a better structure on account of not having a joint due to 'laitance.' They say the beam will keep settling into the column while the whole mass is 'fresh,' and that the idea that the beam will pull away from the column due to the column shrinking is largely theoretical.

"What has been your experience from a practical standpoint regarding above, and your opinion regarding their arguments."

* * *

247. One or Two Course Concrete Pavements

"In the June issue of Cement Age I note a cost estimate comparing one and two-course concrete pavements. The evidence there seems in favor of two-course work. What data are available on the general comparative value of these two methods?"

Discussion by J. H. Chubb.*

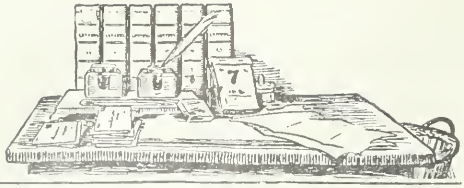
We consider that the choice between the two types of construction should be governed entirely by the cost and character of materials available for the work. In localities where but one grade of material is available, such as sand and gravel for example, we should recommend the use of single course pavement. Hard stone, such as trap rock and granite, we consider most acceptable for use in the construction of concrete pavement. Granite and trap rock screenings or crushed stone are more expensive than sand, gravel and crushed limestone, and a much better pavement can be laid at a reduced cost by using the expensive materials only in the wearing surface. Under these conditions we would recommend the use of the two-course pavement.

A 6″ concrete pavement having a 4½″ 1:3:5 concrete base and a 1½″ 1:2 cement mortar wearing surface will require practically the same amount of material as a single course pavement 6″ thick of a 1:2:3 concrete. With the cost of materials and labor the same in each case, the one-course pavement could be laid at a less cost than the two-course pavement, and we believe would be more satisfactory.

As we have pointed out, the cost and choice between the one anw two-course pavements will depend upon the cost and character of materials. In localities where they have a good grade of granite that is more expensive than other aggregate to reduce the cost of construction, we recommend a two-course pavement. Where various aggregates cost the same, or there is but one aggregate available, we recommend one-course pavement.

*Chicago.

Concrete-Cement Age particularly invites correspondence on concrete road work—either in city, town or country. We shall be glad to supply information as to road work in various parts of the country and we shall be glad to have every reader give information about any road work which may be done or which may be proposed in his locality.—The Editors.



CORRESPONDENCE

Jointless Concrete Road

I believe that it is not necessary to have expansion and contraction joints in these (concrete) pavements at all. To let you know my idea along this line, I might say that I am going to construct 4,500 linear feet of concrete pavement at the beginning of the next fiscal year as an experimental road, and I do not plan to put one expansion or contraction joint into it. I want, if possible, to have the work done continuously—that is, working three shifts of eight hours each, so that there will be no appreciable joint anywhere in the whole surface. Providing natural expansion and contraction cracks do appear in this pavement, I can not see why they may not be repaired and maintained just as easily as expansion and contraction joints purposely laid in the pavement.

LOGAN WALLER PAGE.

Director, U. S. Office of Public Roads,
Washington, D. C.

* * *

Making Block of Quarry Waste

Our business consists in manufacturing stone and other concrete products. First, we have nine acres of quarry land producing yellow, blue and white limestone; the deeper we sink our hole the harder and whiter our stone becomes and the better it is suited for our products.

With the introduction of concrete the use of the old type of native stone for building purposes began to diminish and the manufactured concrete product is taking its place. We began to crush our stone, and finding an over surplus of fine aggregates we started to turn this waste into artificial stone. Since that day, however, an immense market has developed in the line of road work for this same product and we are now constantly figuring how to produce enough.

Our block department operations begin in the crusher bins, where a ¾-in. aggregate is carried by means of chutes and elevators to our block department bins. Here, if the weather is cold, this material is thawed and heated by means of steam pipes. Our cement house is in connection with these bins, as is also our continuous mixer. This mixer has three feeds and in case our aggregate is too coarse, fine stone or sand is added. Water either cold or hot enters through a feed pipe and as a result our product in winter, when taken from the machines, steams like pancakes off the griddle.

Our plant at present is operating an hydraulic block press, an automatic tamper and two hand-power block machines. We use also separate molds for special work. Hydrated lime and waterproofing are used when occasion demands, but in the case of the hydraulic press, this is not necessary, as the aggregates are put together so tightly that the block will shed water like a duck's back, when taken from the molds.*

From the machines the block are placed on waiting cars. These, when filled, are rolled into steam kilns and exhaust steam keeps them moist for forty-eight hours. They are then placed in the yards and the theory is to leave them there for at least sixty days.

A yard man loads them on large spring wagons and makes a record of the job, day and driver. When the contract is complete it is only necessary for the office to add up the columns and figure out the wall feet of the various types of blocks used on any particular job and from this the charge is made.

FRED K. CARRICO.

The Carrico Stone Co., Rockford, Ill.

*Equipment consists of Fisher hydraulic press, Ideal and Miles block machines and a Kramer automatic tamper.

* * *

Concrete Products Plant

The main floor of our block plant contains about 12,000 sq. ft. The building is nearly square. The walls are of concrete block, forming a two-piece wall (Denver type) and the lower floor is all concrete, except the driveway. On the south side is the railroad track where we receive cement, sand, crushed stone and gravel. We have a bucket elevator with buckets large enough to enable us to unload cement in bags, sand and gravel and elevate these materials to our second floor. The elevator discharges on to a flat belt and we are able to convey materials and deposit them anywhere between the head of this elevator and the north wall of our building. We heat the building with steam from our plaster plant which adjoins the block plant on the east.

The second floor is of concrete and the roof is of mill construction; 3″ stuff fastened with splines with 1″ boards running diagonally across and finished with tarred paper and gravel. We have room on this floor to make special work and we have an elevator which enables us to lower sills, lintels, watertables and other work of this nature to load them directly on the trucks. On the second floor is also the power mixer, and we might say in connection with this floor, that it is of reinforced concrete slabs and is sufficiently strong to carry 800 lbs. to the sq. ft. Special forms and all pattern work are gotten out on this floor.

On the first floor we have a transfer track running north and south and our presses are in the northeast corner of the building. We have installed at the present time two hand presses and one power press. Back of the presses are shelves for palettes and the mold box fillers for making a large variety of block. We have about 600′ of track, including the transfer track on the lower floor, and there is left available space for a steam room which has not been constructed but which we expect to build later. Our curing is all done within the walls of this building. We have a small crusher* to reduce coarse gravel, defective blocks or brick bats.

Our object in laying out the plant as we have is to reduce the labor cost to a minimum. We had only a certain amount of room available and we have tried to make it as satisfactory as possible under the circumstances.

Outside of this building to the west is a lot of about 10,000 sq. ft. that we use for piling block after they have been cured and while they are held ready for delivery.

As mentioned, sand comes to us by rail, is shoveled into the elevator and carried up and deposited on the flat belt, then delivered at the desired point on the second floor. The same is true of the cement, crushed stone and gravel.

The proximity of the railroad track enables us to ship by rail from the south side and on the north side is the canal which also affords us water delivery. We, however, are not sending many block out of town as the freight factor is too great to overcome as against a local manufacturer in any of the surrounding towns.

W. K. SQUIER.

The Paragon Plaster Co., Syracuse, N. Y.

*Jeffrey Manufacturing Co., Columbus, O.

Concrete for Country Highways

In this letter I am advocating concrete for highways and not for city streets, as I believe asphalt, wood block, brick, Belgium block, and granite block. will serve a better purpose when laid over a concrete base than would plain concrete for city traffic.

Concrete highways have positively passed through the experimental period. They are an economic fact. The writer recently, in company with a number of highway engineers, including Logan Waller Page, Director of the Office of Public Roads, Agricultural Department, Washington, inspected some sixty miles of concrete highways in Wayne county and in Ann Arbor, Mich. The roads in Wayne county are county highways, and are not surfaced with any other material. The roads in Ann Arbor are city streets and are surfaced with hot bitumen, on which sand has been sprinkled and rolled in by the traffic

Mr. Page had always been skeptical as to the value of concrete when used as a road material After seeing these roads he was so enthusiastic that he made the statement that these concrete highways were undoubtedly from every standpoint far superior to anything he had ever seen in the world. They serve all the purposes of a proper, permanent highway. They are not slippery in rainy weather and not dusty in dry weather. Cracks are exceptional and when they do occur they are not of sufficient width to cause any damage to the road. These roads are undoubtedly economical both as to first cost and ultimate cost. In five years' time they are cheaper than a macadam road.

One road particularly attracted our attention on account of the enormous traffic that had passed over it for the last four years. It is a ten mile stretch over which passes a large number of farm and other iron tired vehicles and a tremendous automobile traffic. In addition thereto the Packard, Ford, Cadillac and other cars manufactured in Detroit, are tried out over this road daily. There is no speed limit. Over a million vehicle of all kinds have passed over this road since it has been built.

There has not been one cent spent on this concrete road since it was laid. The repairs charged against the road were some slight fixing up of the gravel shoulders, the cost amounting to less than $6.00 per mile. The average cost of maintenance of state roads in New York is $826 per mile.

The cost of the road, including grading, drains, drain tile next to the trolley tracks, and gravel shoulders was $1.28 per sq. yd. The road today shows no wear and is in perfect condition.

The lessons learned by the building of these concrete highways in Wayne county, Mich., are of great value to all interested in a permanent highway which will withstand the traffic of iron tired vehicles in combination with automobiles.

To get a good idea of these highways really requires a personal visit. Reading about them or having someone else describe them to you does not give anything like the idea as does a careful inspection.

The lessons learned are as follows:

The road bed must be well rolled. more evenly and better than might be required by some other forms of highways, and thoroughly drained, even if it is necessary to use a blind drain and drain tile in addition to the side ditches.

The concrete must be thoroughly and evenly mixed, of properly proportioned aggregates. The stone should not be over 1″ in size; that is, all should pass through a 1″ ring, giving a size of approximately ¾″ down to ¼″.

The mixture should be rich, probably 1:1½:3. The concrete should be 6″ or 7″ thick, should be crowned ¼″ to the foot. Expansion joints must be placed every 25′; the edges of these joints protected by a strip of steel containing lugs punched out of the side and anchored in the concrete. Between these two pieces of steel which form the expansion joint, there should be a space of not over ½″ filled with pitch or asphaltum. The shoulders should be rounded off so that the iron tired vehicle traffic which gets off on the gravel shoulders can climb up on the concrete road without spalling the concrete.

The surface should be floated smooth and even and broom finished, that is, brushed with a stiff street sweeper just before it gets hard. This will give the road a texture which seems to wear down evenly, if there is any wear at all

The concrete must be properly seasoned; that is, kept wet or damp for at least a week. This may be accomplished by throwing earth, or gravel that is used for the shoulders, over the road, and wet down with a hose every day. The gravel can be placed on the road as soon as it is sufficiently hard, say the next morning.

It has been pretty well established that expansion joints are not necessary. At the same time if they were not placed every 25′ a line of weakness would have to be provided for, as these joints are in reality contraction joints To provide a line of weakness would require laying the road in alternate slabs, which would be as expensive as putting in expansion joints, steel bound.

It has been positively demonstrated that such longitudinal cracks as have occurred have not been due to either contraction or expansion, but positively due to weakness in the foundation. Success in concrete roads, therefore, lies altogether in the workmanship.

A properly rolled foundation, properly proportioned aggregates, proper drainage, the proper placing of the concrete, the proper finishing of the surface and protection or seasoning after finishing, will produce a permanent highway.

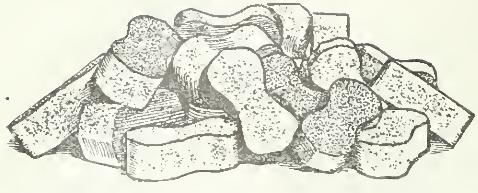
You can easily picture in your mind that if a slab of granite 25′ long by 18″ wide, were placed on an even, firm foundation, with the edges protected, traffic could roll over this slab for a great number of years before any noticeable wear could occur. You are furnishing similar conditions by building a concrete road. It is simply manufacturing a stone slab 25′ long by 18′ wide, of as touch a texture as and of almost equal crushing strength with a piece of granite.

ALBERT MOYER.

Manager Sales Department, Vulcanite Portland Cement Co.

[If the statement in Mr. Moyer's first paragraph is meant to be as sweeping as it seems, there is opened up an opportunity for interesting discussion. At the present stage of development of concrete pavements, generally, Mr. Moyer may properly reserve his approval of their use on the city streets which bear the incessant hammering of heavy metal-tired vehicles. Yet we think there should be something more definite said as to the value of concrete paving for average big city conditions, for even under the severest wear given them in smaller cities, they have stood hard tests and proved to be economical.

Again, there may be some value in a discussion of the size of stone to be used in the concrete. Mr. Moyer says "passing a 1″ ring." We shall be glad to see further discussion of this point. In the Wayne county paving the stone is graded from 1½″ to ¼″ and it is believed that the large stone helps materially in giving a better wearing road. The Wayne County Commissioners did use crushed stone at one time, but find that pebbles, or gravel, give better results—only washed pebbles being used.—EDITORS.]



BRIQUETTES

Monthly Comparative Table

Imports of Portland, Roman and Hydraulic Cements

Country	Month of April, 1911 Barrels	Value	Month of April, 1912 Barrels	Value
United Kingdom	84	$ 140	168	$ 296
Belgium	111	102	....	....
Germany	22,336	34,931	711	1,170
Canada	300	542	7	17
Other Countries	868	1,207	647	1,281
	23,699	$36,922	1,533	$ 2,764
Less Foreign Cement Exported	1,017	1,601	1,519	$ 3,263
	22,682	$35,321	14	....

Decrease in imports during the month of April,, 1912, as compared with April, 1911 . . . . 22,668 barrels

Country	10 Months Ending April, 1911 Barrels	Value	10 Months Ending April, 1912 Barrels	Value
United Kingdom	21,751	$24,707	25,038	$30,586
Belgium	77,005	95,926	5,147	5,935
Germany	67,281	98,586	57,003	90,899
Canada	679	1,505	113	238
Other Countries	15,459	22,398	9,071	14,324
	182,175	$243,122	96,372	$141.982
Less Foreign Cement Exported	16,011	20,616	4,706	9,327
	166,164	$222,506	91,666	$132,655

Decrease in imports during 10 months ending April, 1912, over 10 months ending April, 1911 . . . . 74,498 barrels

Imports of Portland Cement into the U. S. During April, 1912, by Districts

District	Barrels	Value
Boston	332	$ 571
New York	1,028	1,902
Philadelphia	165	274
Minnesota	8	17
	1,533	$2,764

Exports of Cement

Exports of cement, month of April, 1911, 282,582 barrels, value . . . . $ 397,339
Exports of cement, month of April, 1912, 312,608 barrels, value . . . . $ 476,695
Increase in exports, month of April, 1912, over month of April, 1911 . . . . 30,350 barrels
Exports of cement, 10 months ending April, 1911, 2,432,237 barrels, value $3,510,906
Exports of cement, 10 months ending April, 1912, 2,682,011 barrels, value $3,978,749
Increase in exports during 10 months ending April, 1912, over 10 months ending April, 1911 . . . 249,774 barrels

Pacific Coast Organization

The newly organized Association of Western Portland Cement Manufacturers is entering vigorously into a campaign for good roads. This missionary work is largely in charge of Percy W. Rochester, secretary of the organization, who was formerly sales manager for the Washington Portland Cement Company. This new association was organized to further the use of Portland cement; headquarters in San Francisco, Cal. It is proposed to create a greater demand for the material in public and private works by an educational campaign as to the value of concrete as a structural material, and in increasing the demand, to lower the cost of production.

Mortar for Lining Cement Kilns

A patent has been granted in Germany to J. H. Schutt for mortar designed for the above purpose. In a former or chief patent the mortar described as consisting of a mixture of cement clinker, cement, and slaked lime. According to the present patent, the cement clinker is omitted, whereby the proportion of slaked lime may be increased from 20 to 50 per cent., being adjusted so that the sintering of the mortar occurs at the maximum temperature of the rotary kiln in which it is used. The mortar may be applied to the walls of the kiln by stamping, or it may be molded into blocks, which are used in the unburnt state to line the kiln.

Cut Canadian Duty in Half

The Canadian government has reduced the tariff on cement by one-half, owing to the cement shortage in Canada. This reduction applies between June 12 and October 31, 1912. In this period, the duty will be 26c per barrel on importations from the United States.

The consumption of cement has risen very rapidly in Canada. In 1907, 3,100,000 barrels; in 1908, 3,100,000 barrels; in 1909, 4,200,000 barrels; in 1910, 5,100,000, and in 1911, 6,300,000. Nearly all the cement consumed in Canada is locally manufactured, the Canadian production being in 1907, 2,400,000 barrels, or 78% of the consumption; in 1908, 2,600,000 barrels, or 85%; in 1909, 4,000,000 barrels, or 97%; in 1910, 4,750,000 barrels, or 93%, and in 1911, 5,600,000 barrels, or 89.5%. The importations in 1911 were only 662,000 barrels, or 10%. Of this 441,000 came from the United States.

Government Cement Specifications

After work extending over several years, the United States government has adopted standard specifications for the cement used in all government work. Due to the pressure of other work, it was not practicable to publish these specifications in *Concrete* for June, and as they were published in full in *Cement Age* for June, will not be published in full in CONCRETE-CEMENT AGE. In order that *Concrete* readers can have on file these specifications, we shall be glad to send upon request to any *Concrete* readers a complete copy of these specifications.

Ideal Concrete Block Machinery

Its Perfections

Its Advantages

An interchangeable, mechanically perfect block machine of greatest range.

In universal use, its product in universal demand. Nothing to adjust, nothing to get out of order. A strong, simple, rapid, labor-saving device.

All parts, accessories, attachments, face plates, etc., can be purchased as required, with the assurance that they will work perfectly.

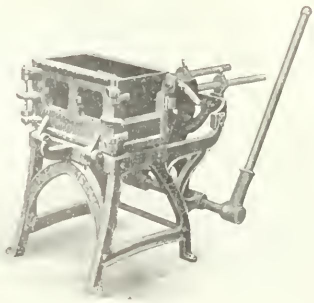
IDEAL Block Machines are used for either hand tamping or under IDEAL Automatic Power Tampers.

IDEAL Customers have built up from an original, single block machine outfit to an up-to-date plant of IDEAL Automatic Power Block Making Machinery, paying for enlargement out of profits.

IDEAL Concrete Blocks command the highest price and therefore IDEAL Manufacturers are universally successful.

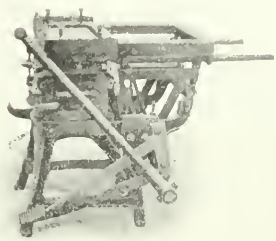
IDEAL Concrete Blocks are preferred by masons, because they are exact in measurement, easily handled and easily laid.

A profitable, successful business awaits the man in any locality who will manufacture good IDEAL Concrete Blocks.



Model "A" Block Machine

The simplest, strongest, most easily operated machine made, and the blocks from it are perfection itself.



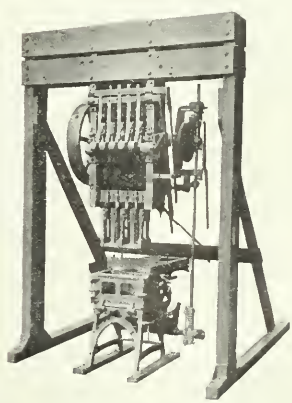
Block Machine Equipped with Scraper and Finisher. An attachment that can be added to any IDEAL machine.

Part of the IDEAL Line

Block Machines, hand and power tamp.
Brick Machines, hand and power tamp.
Dimension Stone Machines.
Curbstone Machines.
Spanish "S" Roofing Tile Machines.
Automatic Tampers, Scrapers and Finishers.
Batch and Proportioning Mixers.
Ornamental Molds.
Tycrete Waterproofing Compound.
Sewer and Drain Tile Molds.

We've a lot of interesting information regarding the IDEAL line which will be sent free of charge. Ask for it.

Our 160-page catalog, which is in reality a concrete encyclopedia, will be sent for one dollar. We make this stipulation to be sure that this extremely valuable book reaches only parties who are really interested. Every one receiving it who later sends an order amounting to ten dollars (net) or over will receive a credit of Two Dollars.



Block Machine, same one, equipped with Automatic Tamper, Scraper and Finisher and Core Actuator. This combination is unequaled.

Ideal Concrete Machinery Co.

London, Ont. South Bend, Indiana.

Export Office, 8-10 Bridge St., New York.

U. S. Government Statistics on Cement Production in 1911

The statistics of cement production in 1911, prepared by Ernest F. Burchard, of the United States Geological Survey, show that the total production of Portland cement in the United States in 1911 was 78,528,637 barrels, valued at $66,248,817. This quantity reduced to tons is equivalent to 13,321,822 long tons, valued at $4.97 per ton. As compared with the production of Portland cement for 1910, which was 76,549,951 barrels, valued at $68,205,800, the output for 1911 represents an increase in quantity of 1,978,686 barrels, or 2.58 per cent, and a decrease in value of $1,956,983, or 2.87 per cent. The average price per barrel in 1911, according to the figures reported to the Survey, was a trifle less than 84.4 cents, as compared with 89.1 cents in 1910. In the average price for the country is included the value of 135,775 barrels of white Portland cement, which sold at an average price of about $2.50 per barrel.

The total quantity of Portland, natural, and puzzolan cements produced in the United States during 1911 was 79,547,958 barrels, valued at $66,705,136. Compared with 1910, when the production was 77,785,141 barrels, valued at $68,752,092, the year 1911 showed an increase of 1,762,817 barrels, or 2.27 per cent in quantity, but a decrease of $2,046,956, or 1.48 per cent in value.

Specifications for Concrete Reinforcement from "Rail Steel" and "Billets"

The Association of American Steel Manufacturers, at its June meeting at Atlantic City, N. J., adopted "Standard Specifications for Rail Steel Concrete Reinforcement Bars" and at the same time also made revision of the manufacturers' specifications for reinforcement bars by inserting the clause which requires that the reinforcement "shall be rolled from standard new billets," giving the old specifications the new title: "Standard Specifications for Concrete Reinforcement Bars Rolled from Billets." The Association hopes that the adoption of two distinct specifications will end discussion as to the meaning of the word "billets," and it is pointed out that the existence of the two specifications should assist engineers whose choice of reinforcing is a matter of strong opinion, enabling them to name one of the two specifications. The specifications follow in full:

Rail Steel Concrete Reinforcement Bars

Manufacture—1. All steel shall be rolled from standard section tee rails.

Physical Properties—2. The physical properties shall conform to the following limits:

Properties Considered.	Rail Steel Grade. Plain Bars.	Deformed and Hot-Twisted Bars.
Ultimate tensile strength, minimum, pounds per sq. in.	80,000	80,000
Yield point, minimum, pounds per sq. in.	50,000	50,000
Elongation, per cent in 8", minimum	1,200,000 / T. S.	1,000,000 / T. S.
Cold bend without fracture:		
Bars under ¾" in diameter or thickness	180°d.=3t.	180°d.=4t.
Bars ¾" in diameter or thickness and over	90°d.=3t.	90°d.=4t.

Portland Cement Production by Commercial Districts

DISTRICT.	Active Plants. 1910	Active Plants. 1911	Production, Bbls. 1910	Production, Bbls. 1911	Change 1911. per ct.	Average Factory Price 1910	Average Factory Price 1911
New Jersey and eastern Pennsylvania (Lehigh District)	24	24	26,315,359	25,972,108	— 1.30	$0.729	$0.715
New York	8	7	3,296,350	3,314,217	+ .54	.882	.805
Ohio and western Pennsylvania	9	9	6,072,987	6,756,313	+11.25	.776	.766
Michigan and northeastern Indiana	14	13	4,524,591	4,519,726	— .11	.921	.827
Kentucky and southern Indiana	3	3	2,824,832	2,818,820	— .21	.799	.793
Illinois and northwestern Indiana	6	6	8,376,450	8,617,341	+ 2.88	.940	.791
Southeastern States (Maryland, Virginia, West Virginia, Tennessee, Georgia and Alabama)	8	11	3,071,009	4,049,063	+31.85	.794	.793
Iowa and Missouri	6	7	5,722,971	6,067,449	+ 6.02	.916	.862
Great Plains States (Kansas, Oklahoma and central Texas)	16	17	7,723,253	7,010,396	— 9.23	.996	.834
Rocky Mountain States (Colorado, Utah, Montana, Arizona and western Texas)	8	7	2,236,561	2,124,930	— 4.99	1.288	1.186
Pacific coast States (California and Washington)	9	11	6,385,588	7,278,274	+13.98	1.385	1.406
Total	111	115	76,549,951	78,528,637	+ 2.58	$0.891	$0.844

Honor R. L. Humphrey

Another honor from a foreign society has come to Richard L. Humphrey, American engineer and President of the National Association of Cement Users. Mr. Humphrey has received notice of his election as a member of the Institute of Civil Engineers of England. Few Americans have been honored by the British institution, which includes such men as Alfred Noble, William B. Parsons, Samuel Rea, Howard G. Kelley, E. L. Corthell, Robert W. Hunt and Onward Bates. The British membership follows Mr. Humphrey's election as an honorary member of the Austrian Concrete Association and the French Society of Civil Engineers, indicating that his work in behalf of concrete in this country and his lectures abroad have been highly appreciated.

Yield Point—3. For the purposes of these specifications, the yield point shall be determined by careful observation of the drop of the beam of the testing machine, or by other equally accurate method.

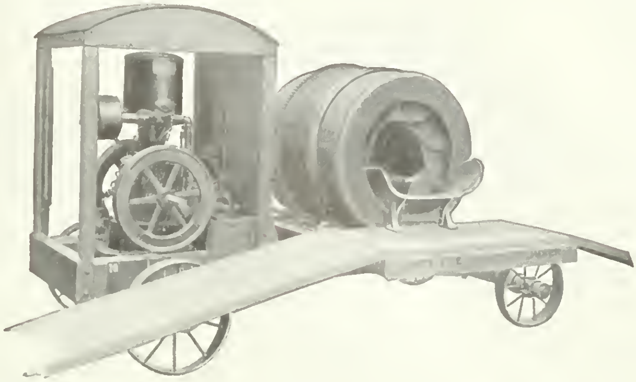
Form of Specimens—4. (a) Tensile and bending test specimens may be cut from the bars as rolled, but tensile and bending test specimens of deformed bars may be planed or turned for a length of at least 9" if deemed necessary by the manufacturer in order to obtain uniform cross-section.

(b) Tensile and bending test specimens of hot-twisted bars shall be cut from the bars after twisting, and shall be tested in full size without further treatment, unless otherwise specified.

Number of Tests—5. A complete physical test shall be made, by an approved testing laboratory, of each size of bar to be applied by the manufacturer on the contract from each ten ton lot or less. Should a test specimen develop flaws, or should the tensile test specimen break outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor. In case a tensile specimen

"The Standard" Batch Mixer

LOW CHARGING



What are the substantial reasons for the enviable position of "The Standard" Low Charging Concrete Mixer?

What is the source of enthusiasm which every contractor and user has for "The Standard" Batch Mixer?

What qualities does it possess which compel the contractor, after having used "The Standard" to consider no other Mixer?

What advantage does the contractor using "The Standard" enjoy day by day which convinces him that he has the best mixer?

What causes contractors using "The Standard" to report that they would not exchange for any other mixer, no difference what the price?

What is the explanation for contractors everywhere ordering "The Standard" Low Charging Concrete Mixer, frequently exchanging or discarding other machines costing two or three times as much?

Low Charging Simplicity Results

"The Standard" patented Low Charging open drum whereby the materials are charged into the mixer from a low platform about two feet from the ground is perhaps the most important and highly appreciated feature.

"The Standard" simplicity is another of the principal features. Only the mixing drum, simply connected to the power for driving.

"The Standard" open drum enabling the batch to be inspected while mixing, results in high grade uniform concrete.

"The Standard" patented semi-automatic discharge is operated from either side of the drum.

"The Standard" simple equipment is built compact and light and can be moved to the best mixing location on the job in a moment's time.

"The Standard," easy of access to all parts, including interior of the mixing drum.

"The Standard" moderate size outfit has surprisingly large mixing capacity per day. Not necessary to purchase big machines.

"The Standard" can usually be placed in cars for shipment without taking apart, except removing platform, which is held by four bolts.

"The Standard" weight is not excessive and transportation charges by freight or drayage are reduced to a minimum.

"The Standard" is economical in first cost as well as economical in operating cost.

"The Standard" all regular sizes in stock at factory, warehouses and agencies ready for immediate shipment.

"The Standard" special designs to meet particular requirements often afford great saving in operation.

"The Standard" built in capacities 2 to 40 cubic feet per batch, 20 to 300 cubic yards per day.

Advantages which the contractor enjoys and disadvantges which he escapes when using "The Standard" Batch Mixer

"The Standard" is low charging. The materials are charged into the mixer from platform about two feet from the ground, avoiding building high platforms with long runways or purchasing complicated charging hoists and hopper arrangements.

"The Standard" simple construction is always ready for use, and avoids frequent breakdowns, so common with all complicated machinery, especially when subject to rough usage around building operations.

"The Standard" discharging arrangement simply operated from either end of the drum, saves extra man required with other machines.

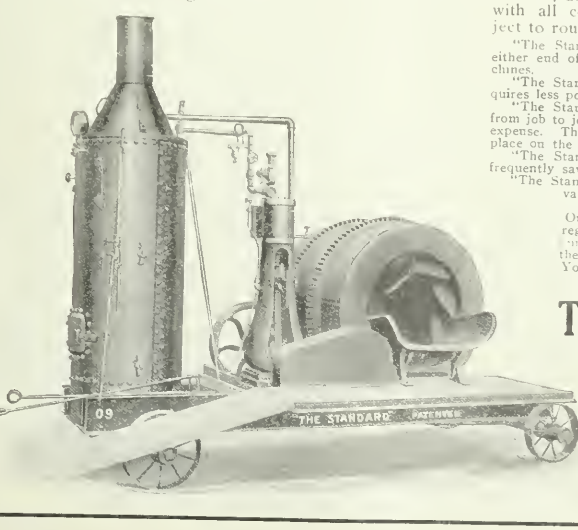
"The Standard" easy running avoiding unnecessary friction, requires less power, less fuel and less attendance.

"The Standard" moderate weight machine can be easily moved from job to job, avoiding excessive freight charges or heavy hauling expense. The moderate weight machine can also be located any place on the job, often avoiding much manual labor.

"The Standard" special designs to meet peculiar requirements frequently save heavy expenses.

"The Standard" users will find they enjoy numerous other advantages and escape many additional disadvantages.

"The Standard" [illegible] No. 6, now ready. Our new "cart charger" and other special as well as regular designs described in this catalogue will save hundreds of contractors thousands of dollars before the year 1912 is over. Will you be one of them? Your name brings a catalogue. Write for it today.



The Standard Scale and Supply Company

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PHILADELPHIA 35 South Fourth St.	CHICAGO 1345-1347 Wabash Ave.

does not meet the specifications, an additional test may be made.

(c) The bending test may be made by pressure or by light blows.

Modifications in Elongation for Thin and Thick Material—6. For bars less than 7/16" and more than ¾" nominal diameter or thickness, the following modifications shall be made in the requirements for elongation:

(d) For each increase of ⅛" in diameter or thickness above ¾" a deduction of 1 shall be made from the specified percentage of elongation.

(e) For each decrease of 1/16" in diameter or thickness below 7/16", a deduction of 1 shall be made from the specified percentage of elongation.

Number of Twists—7. Hot-twisted bars of rail carbon steel shall be twisted with one complete twist in a length equal to not more than 12 times the thickness of the bar.

Finish—8. Material must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

Variation in Weight—9. Bars for reinforcement are subject to rejection if the actual weight of any lot varies more than 5% over and under the theoretical weight of that lot.

Reinforcement Bars Rolled from Billets

Manufacture—1. Steel may be made by either the open-hearth or Bessemer process. Bars shall be rolled from standard new billets.

Chemical and Physical Properties—2. The chemical and physical properties shall conform to the following limits:

tensile test specimen break outside of the middle third of its gauged length, it may be discarded and another test specimen substituted therefor. In case a tensile test specimen does not meet the specifications, an additional test may be made.

(d) The bending test may be made by pressure or by light blows.

Modifications in Elongation for Thin and Thick Material—7. For bars less than 7/16" and more than ¾" nominal diameter or thickness, the following modifications shall be made in the requirements for elongation:

(e) For each increase of ⅛" in diameter or thickness above ¾", a deduction of 1 shall be made from the specified percentage of elongation.

(f) For each decrease of 1/16" in diameter or thickness below 7/16", a deduction of 1 shall be made from the specified percentage of elongation.

(g) The above modifications in elongation shall not apply to cold-twisted bars.

Number of Twists—8. Cold-twisted bars shall be twisted cold with one complete twist in a length equal to not more than 12 times the thickness of the bar.

Finish—9. Material must be free from injurious seams, flaws or cracks, and have a workmanlike finish.

Variation in Weight—10. Bars for reinforcement are subject to rejection if the actual weight of any lot varies more than 5% over or under the theoretical weight of that lot.

Properties Considered.	Structural Steel Grade.		Hard Grade.		Cold-Twisted Bars.
	Plain Bars.	Deformed Bars.	Plain Bars.	Deformed Bars.	
Phosphorus, maximum—					
Bessemer	.10	.10	.10	.10	.10
Open-hearth	.06	.06	.06	.06	.06
Ultimate tensile strength, pounds per sq. in.	55/70,000	55/70,000	80,000 min.	80,000 min.	Recorded only
Yield point, minimum, pounds per sq. in.	33,000	33,000	50,000	50,000	55,000
Elongation, per cent in 8", minimum	1,400,000 / T. S.	1,250,000 / T. S.	1,200,000 / T. S.	1,000,000 / T. S.	5%
Cold bend without fracture—					
Bars under ¾" in diameter or thickness	180°d.=1t.	180°d.=1t.	180°d.=3t.	180°d.=4t.	180°d.=2t.
Bars ¾" in diameter or thickness and over	180°d.=1t.	180°d.=2t.	90°d.=3t.	90°d.=4t.	180°d.=3t.

The hard grade will be used only when specified.

Chemical Determinations—3. In order to determine if the material conforms to the chemical limitations prescribed in paragraph 2 herein, analysis shall be made by the manufacturer from a test ingot taken at the time of the pouring of each melt or blow of steel, and a correct copy of such analysis shall be furnished to the engineer or his inspector.

Yield Point—4. For the purpose of these specifications, the yield point shall be determined by careful observation of the drop of the beam of the testing machine, or by other equally accurate method.

Form of Specimens—5. (a) Tensile and bending test specimens may be cut from the bars as rolled, but tensile and bending test specimens of deformed bars may be planed or turned for a length of at least 9" if deemed necessary by the manufacturer in order to obtain uniform cross-section.

(b) Tensile and bending test specimens of cold-twisted bars shall be cut from the bars after twisting, and shall be tested in full size without further treatment, unless otherwise specified as in (c), in which case the conditions therein stipulated shall govern.

(c) If it is desired that the testing and acceptance for cold-twisted bars be made upon the hot rolled bars before being twisted, the hot rolled bars shall meet the requirements of the structural steel grade for plain bars shown in this specification.

Number of Tests—6. At least one tensile and one bending test shall be made from each melt of open-hearth steel rolled, and from each blow or lot of ten tons of Bessemer steel rolled. In case bars differing ⅜" and more in diameter or thickness are rolled from one melt or blow, a test shall be made from the thickest and thinnest material rolled. Should either of these test specimens develop flaws, or should the

House Design Prizes Awarded

Anything which encourages a broader study of concrete architecture, particularly as applied to home building, is an advantage to the industry as a whole. Some time ago it was announced that the Blaw Steel Centering Co., Pittsburgh, Pa., would give prizes for the best designs for concrete residences to cost no more than $3,000. Professor A. D. F. Hamlin, of Columbia University, acting as judge, made awards as follows:

E. Parmiter, Room 202, 25 West 42nd street, New York City, first prize, $100.00; William C. Lurkey, 144 Winslow avenue, Buffalo, N. Y., second prize, $75.00; Jack Lehti, Apt. 103, The Eckington, Fourth and T streets, N. E., Washington, D. C., third prize, $50.00; Grover Lippert, 418 West Doty street, Madison, Wis., Everett H. Crabb, 904 State Life building, Indianapolis, Ind., and Clyde W. Smith, 3236 Fifth avenue south, Minneapolis, Minn., each receive a fourth prize of $25.00.

The Blaw company will soon issue a booklet containing the prize designs and specifications, together with about 40 other sets of designs and specifications sent in by contestants.

Letters to the New Magazine

Announcement of the consolidation of *Concrete* and *Cement Age* (with which was combined *Concrete Engineering*) brought to CONCRETE-CEMENT AGE many letters. Excerpts from a few of these are published below:

"I note the announcement of the consolidation of *Cement Age*, *Concrete* and *Concrete Engineering*. I am strongly of the opinion that much more effective work can be done by consolidating the numerous cement publications, thus making one strong and influential organ to represent the industry."

JOHN B. LOBER,
President Vulcanite Portland Cement Co.,
Philadelphia, Pa.

"I feel sure that the new journal, if carried out on the same high plane as the two old ones, will be successful. I enjoyed in the past each issue of these two standard journals, and I believe that the consolidation of two such well edited organs of the industry will result in something even better for the cement and concrete industry. The combination of 'what is to be done' with the 'how to do it' certainly appeals to me as the practical idea of technical journalism. I shall look forward with pleasure to each issue of CONCRETE-CEMENT AGE if conducted along these lines."

RICHARD K. MEADE.
General Manager Tidewater Portland Cement Co.,
Baltimore, Md.

"I should say that this was a most desirable move, since there are now so many small journals relating to cement in the field, and those interested in the industry will be better served by a large journal which will represent the industry of all. I congratulate you on your move and wish you every success."

CLIFFORD RICHARDSON,
Consulting Engineer,
New York City.

"We congratulate you upon this union, and will certainly try to call upon you as soon as you are 'at home.' We also trust this union will result in a large family."

THE BLYSTONE MANUFACTURING CO.,
Cambridge Springs, Pa.

[It will.—ED.]

"As old advertisers in these publications, we cannot help but feel that this is a decided step in the right direction. We are firmly convinced that a publication with such management behind it will mean a great deal to the concrete industry in general and we certainly wish all connected with the business the greatest possible success in the new undertaking."

CENTURY CEMENT MACHINE CO.,
Rochester, N. Y.

"I was very much pleased to receive an announcement of the consolidation of *Concrete* and *Cement Age*. You know full well, I think, my high opinion of both these papers and I am satisfied that the combination will result in the production of a journal reflecting the highest credit on the industry."

J. P. BECK,
Manager Publicity Bureau, Universal Portland Cement Co.,
Chicago, Ill.

"We beg to acknowledge receipt of your announcement in reference to CONCRETE-CEMENT AGE. We think the idea is a splendid one and wish you all the success in the world."

BLAW STEEL CENTERING CO.,
Pittsburgh, Pa.

"May the union be a happy one and productive of much good to all your readers, should be the wish of all your subscribers, and that it will prove to be such I have no doubt. I consider this a move in the right direction."

R. L. RICKMAN.
Eau Claire, Wisc.

"We note with interest the change that is taking place in *Concrete* and in appreciation of the management of the old *Concrete* we desire to express our thanks for your many courtesies in the past, and we note with much pleasure that our friends are to continue in the new company. We wish you and the new publication success."

ARCHITECTURAL MOLD CO.,
Detroit, Mich.

"It is an excellent move for both of you and I wish you the success you deserve."

GEORGE WALTERS,
President, Concrete Age Publishing Co.,
Atlanta, Ga.

"I wish to congratulate you upon the consolidation and I know it will prove to be profitable to all concerned and I wish you success."

WILLIAM A. RADFORD,
Chicago, Ill.

"I believe that you have accomplished something of benefit to the industry in getting these papers together, as it is no doubt true that there were too many papers in the field, both for the good of the industry and for the good of the publications themselves. This trio combined into one should make a very strong paper, carry weight and be a benefit to all."

EDWARD M HAGAR.
President, Universal Portland Cement Co.

Books Reviewed

Reinforced Concrete Buildings. By Ernest L. Ransome and Alexis Saurbrey. Pages, 232. Illustrated. Size, $6\frac{3}{4} \times 9\frac{1}{2}$. Price, cloth, \$2.50. McGraw-Hill Book Co., New York City.

This is a treatise on the history, patents, design and erection of the principal parts of a modern building of reinforced concrete, by Ernest L. Ransome and Alexis Saurbrey, both of the Ransome Engineering Co. An unusual and valuable feature of the book is comprised in the historical data relating to reinforced concrete, with special reference to patents granted in the United States, thus making the volume of value to inventors and patent attorneys as well as engineers and contractors. In brief, the book was written to show what reinforced concrete is and how it arrived at the present status as one of the most valuable of modern building materials.

* * *

Concrete From Sand Molds. By A. A. Houghton. Pages, 124. Illustrated. Size, $5\frac{1}{4} \times 7$. Price, cloth, \$2.00. The Norman W. Henley Publishing Co., New York.

The present work by Mr. Houghton, who has prepared several special booklets for concrete workers, will be received with a great deal of interest because it handles a subject which is not generally known in detail to the workers in the concrete industry. The use of sand molds in casting special pieces of concrete is one which has been used successfully by numerous manufacturers, but certain methods in the use of these molds are covered by patent and Mr. Houghton's ideas along the same lines are reasonably sure to be valuable in the industry. He explains various ways of making the sand molds to turn out cast stone, and tells how to handle these molds when they are made.

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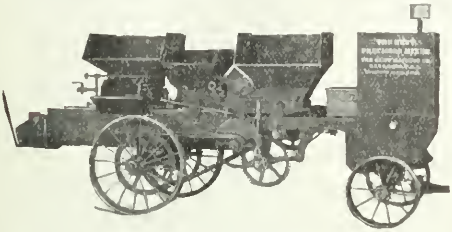

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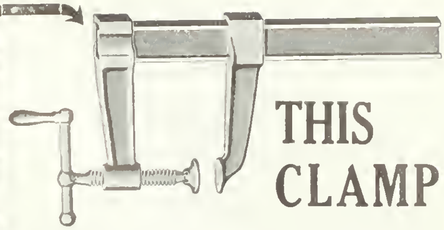
- Wm. Pattison Supply Co., Cleveland, O.
- Sanford Concrete Machinery Co., Toledo, O.
- The W. E. Austin Co., 2 Spring St., Atlanta, Ga., New Orleans, Houston, Dallas, Oklahoma City, Memphis, Roanoke and Norfolk.



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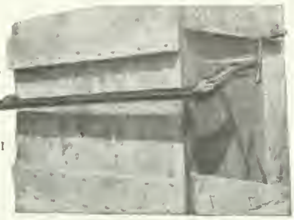

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Mississippi River Improvement

In the May issue of *Concrete* there was reference to the possible and practicable use of concrete in connection with levee building along the Mississippi river. Attention was called to a suggestion of Colonel C. McD. Townsend, United States engineer at Detroit, that it may be found abvisable when the earth levees have been brought up to the height to which they should be built—to make a trench from the crest to a a line below the base of the levees and fill the trench with concrete, making a wall which would add considerable to the strength of the levee and which would be effectual in preventing destruction by burrowing animals—crawfish, muskrats and so on. This idea is roughly illustrated in Fig. 1. Since then, an anonymous writer in the *Scientific American* (May

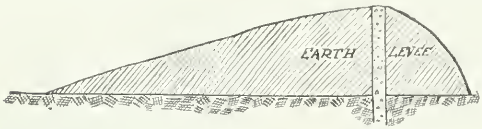


Fig. 1.

22) makes the suggestion which is illustrated in Fig. 2. Colonel Townsend regards this later suggestion as impractical, and points out that the expense incident to such improvement would be prodigious even with the large percentage of earth fill shown in the construction. We quite agree with the writer in the *Scientific American* in one thing: that "no more important im-

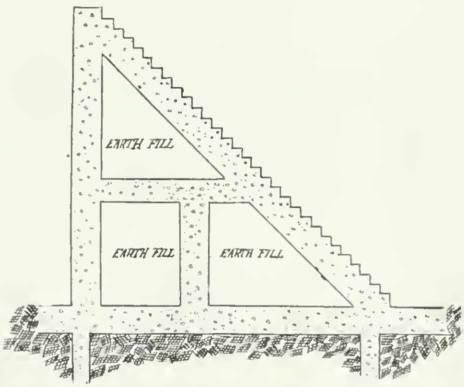


Fig. 2.

provement awaits the government than the successful diking of the Mississippi" and in his statement that "it isn't fair that Louisiana should suffer by water loosed in Pennsylvania or the Dakotas." There have been still other suggestions for remedying the Mississippi flood conditions. One would require the construction of huge regulating reservoirs in the regions from which the floods come, by the aid of which the Mississippi flow might be distributed properly over the entire year. Concrete-Cement Age welcomes further discussion of the matter. There is this much to be considered: Engineers who have devoted years to study of the Mississippi conditions still believe that the earth levee measure provides adequate protection if properly carried out and that a simple curtain wall of concrete to keep out the burrowers, thus reinforcing the earth construction, would make the earth levees entirely satisfactory without enormous outlay.

Colonel Townsend will leave his government post at Detroit in a few weeks to be president of the Mississippi River Commission at St. Louis. Concrete-Cement Age wishes him well in his new responsibility which to him is by no means a new work.

Cement Merger Fails

The effort to effect a merger of thirteen Portland cement plants in the southwest has failed. For three months past the directors of the thirteen companies—nine plants in Kansas, one in Missouri, one in Texas and two in Oklahoma—have been endeavoring to effect a consolidation, to save what is known as "cross freights" on cement and also administrative expenses.

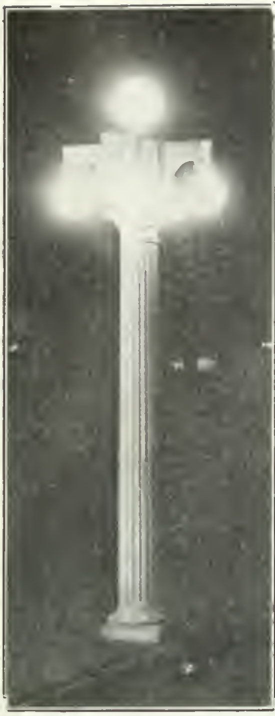
The stockholders of the various companies met and authorized the merger and the plan had gone so far that details of the organization of the parent company had been perfected. The new company was to have been incorporated with a capital of $40,000,000 under the laws of West Virginia, but with the main offices in Kansas City.

The hitch came in the division of stock in the merger company in accordance with the appraisement of the various plants. Some of the companies were dissatisfied with the appraisement and held out on the final negotiations. The chief objector was the Red Ring plant at Kansas City, owned by St. Louis capitalists, which refused to merge on the proposed basis and weeks of negotiations failed to change its decision.

It was thought for a time that perhaps the merger could be effected without this company, but the whole structure crumbled June 22 when two of the larger plants, the Dewey Portland Cement Co., Dewey, Okla., and the Oklahoma Portland Cement Co., with plant at Ada, Okla, withdrew from the proposed consolidation.

This action caused those promoting the Central Portland Cement Co., which was to have been the name of the big concern, to abandon further efforts in that line. The various companies will now have to exist as before the merger was proposed. About one-half of the plants in the Southwest are running, and most of them on half time.

The Northfield Iron Co., Northfield, Minn., has developed a small hand-power mixer, which has met with a cordial reception among builders in various parts of the country. Recently, in a case where a contractor was in a hurry for these machines, three of them were shipped by express. This was rather unusual procedure, as mixers do not usually go by express. Light portable mixing equipment meets a real need in this field.



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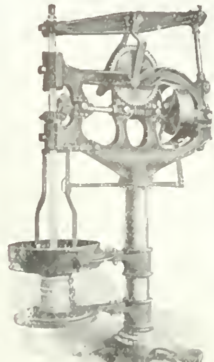

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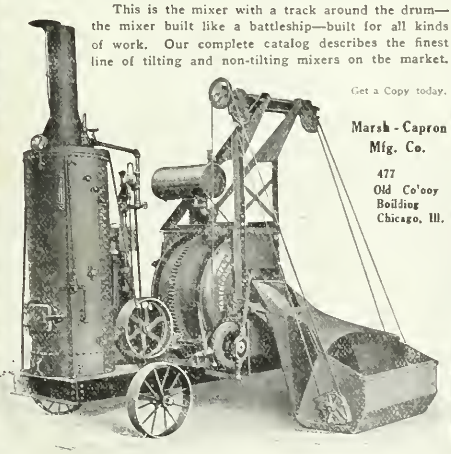

The Record of Andrews Concrete Tamper is a Record of Success

Successful contractors prefer the Andrews Tamper because they are good business men with a keen eye to economy and efficiency. They demand the best work; none other will satisfy them; they insist that the best work be done as economically as possible.

Used in horizontal concrete work, the Andrews Tamper saves about $2 on every 100 square feet laid. It is not an expense. **It's a profit earner!** The price is but $2 (discount in lots of ½ doz. or more). **Sign the coupon and mail it to us today and we'll show you how to save on horizontal concrete work.**

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Please send me full details about the Andrews Tamper.

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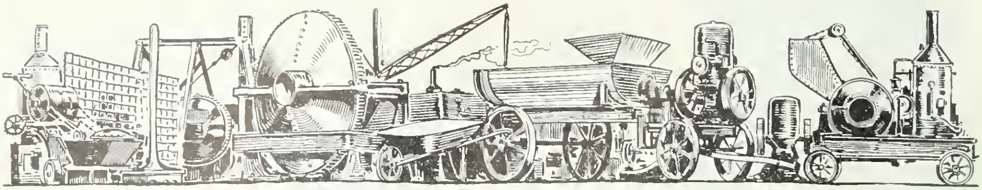


NEW EQUIPMENT, METHODS and MATERIALS

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

A New Waterproofing

"A real waterproofing with a real guarantee" is the encouraging line on a folder put out by the Dri-Crete Co., 148 South Anderson St., Los Angeles, Cal., introducing a new waterproofing preparation. This compound may be used in two ways, either mixed with the sand and cement to make mortar or applied to masonry walls already constructed. In the latter use it is applied with a brush. It comes in wooden containers, ready to apply. The manufacturers say that one gallon of the liquid mixed with cement and sand will make mortar enough to cover two square yards one-quarter inch thick. When applied with a brush, Dri-Crete is said to waterproof 100 square feet of concrete block. On other masonry surfaces the area covered depends upon the porosity of the material, and this feature of course also governs the number of coats necessary. The material has this added advantage, it is said, that it can be mixed with Dricret colors and will penetrate a pressed brick, stucco or concrete wall one-half inch, giving any desired tint. It comes all ready to use and must not be dlute l. The surface on which the material is to be applied should be dry and clean.

Concrete Flower Boxes

The illustration shows a concrete flower box for plants and shrubs, a product of one of the latest molds manufactured by the Architectural Mold Co., 1117 E. Warren Ave., Detroit, Mich. The opening in the box is large—18″ square and 16″ deep, and it affords ample room for plants with large roots, and is adapted for use wherever flower boxes are used in decoration.

FLOWER BOX

Monument Molds

There is a great deal of interest in the development of the use of concrete monuments, because their manufacture may be undertaken either as a business in itself in a small or a large way or as a profitable side line in a factory where a large line of concrete products already is manufactured. In monument manufacture it is practicable—because of the price at which it is possible to sell the products—to devote a great deal of attention to facing, and facing materials and to surface treatment on individual products. In fact it is practicable to put a great deal of care into a single piece of work which cannot be done frequently in ordinary concrete products which are to be used in quantity. It is now coming to be very well known that the possibilities for surface treatment of concrete are almost unlimited and it is a question depending only upon the amount a person cares to pay for the result-

(Continued on page 88)

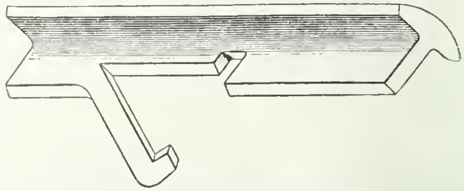
(Continued from page 8·)

ing products, how much work shall be done on each piece with excellent results. With marble and granite facings and with acid washes and abrasive materials for working down the surface, concrete monuments may be made which rival in attractiveness, and which admit of treatment impossible in, the natural stone. J. R. Wattam, 109 West Eleventh street, Fort Worth, Tex., has a line of molds on the market which form the work and do the engraving in one operation. The manufacturers' claims that with the device mentioned it is possible to turn out the highest class monument work and to cut the granite monument prices in half and still make a substantial profit, do not seem at all unreasonable. There is this about the manufactured products—they keep on getting harder and harder as time goes on.

Steel Protection for Concrete Corners

In all concrete structures, corners exposed to severe wear are very apt to be broken. For concrete curbs a steel corner is an economy for its use absolutely insures longer and more satisfactory wear, alignment is better, and the corner is, of course, protected.

The "Ebco" curb bar, manufactured by Edward E. Buhler & Co., 103 Park Ave., New York City, is a solid steel rolled section. Shear hooks are punched



"Ebco" Curb Bar

from the web, which form a secure bond in the concrete.

Such a corner bar is also used quite extensively in the corners of columns in factory or warehouse construction, where the columns are exposed to passing traffic.

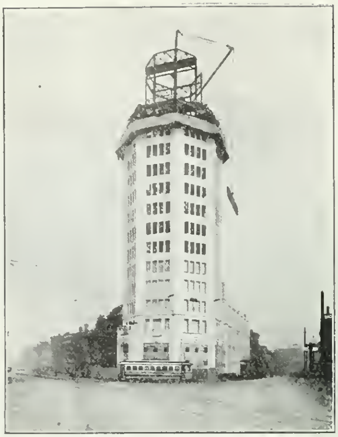
(Continued on page 90)

(Continued from page 88)

Big Waterproofing Job

The General Electric Co. is now erecting at Buffalo a 17-story octagonal tower office building. The surface finish is white marble, and the building will be a beautiful structure. In all the concrete sub-structure "Hercules" waterproofing compound was used. This includes the footings and foundation walls. The columns in the battery room were covered with a cement plaster in which this waterproofing compound was used.

Esenwein & Johnson, architects, Buffalo, designed the building, and John Gill & Sons, Cleveland, are the contractors. The Hercules Waterproofing Cement Co., Buffalo, furnished the waterproofing material.



General Electric Office Building

"Eureka Mixers" is the title of a new catalog issued by the Eureka Machine Co., Lansing, Mich. It gives a lot of valuable information about the use of the continuous mixers manufactured by this company, with some facts as to the power required in driving them.

(Continued on page 92)

On the Scale of Efficiency and Economy TRUS-CON WATERPROOFING PASTE CONCENTRATED

EXCELS ALL OTHER WATERPROOFINGS

By a newly discovered process the strength of TRUS-CON WATERPROOFING PASTE has been wonderfully increased so that only a little more than one-third of the former amount is now required, affording

UNPRECEDENTED WATERPROOFING ECONOMY

Mixed in the water used for the concrete and penetrates with it to all parts of the mass. Simple to use, doing away with all expensive and special mixing. Saves time and money. Positive in results. Does not weaken the concrete work in any way. TRUS-CON WATERPROOFING PASTE CONCENTRATED marks a new era in waterproofing of concrete. Absolutely the best and most economical.

Tell us about your waterproofing problems and we will furnish valuable suggestions, estimates and catalogue.

Hand Book on Waterproofing and Finishing--FREE

Contains the latest scientific and practical information on waterproofings, dampproofings and technical finishes for all structures of concrete, brick, masonry, plaster or steel. TRUS-CON COMPLETE HAND BOOK sent FREE, if you write us about your particular work.

KAHN Building Products TRUSSED CONCRETE STEEL CO

Trussed Concrete Steel Company

450 Trussed Concrete Building, Detroit, Mich.

WATERPROOFINGS—DAMPPROOFINGS—TECHNICAL PAINTS

(Continued from page 90)

Catalogs Received

Usually a manufacturer is glad to send out his catalogs without any expense to the interested person, yet when a catalog takes on the importance and general usefulness of a text book for the concrete products manufacturer and not only devotes 160 pages, 9x12 inches to the intricacies of an important line of concrete machinery, giving explicit instructions as to every procedure which is likely to present a problem to the producers of concrete products, the manufacturer is not unreasonable in putting a nominal price upon the volume. The ne wIdeal Concrete Machinery Co., South Bend, Ind., book is not only of the size and importance mentioned but it is handsomely gotten up, so that the manufacturer of products turned out on the machines cataloged not only has valuable information available but has page after page of plate paper adorned with illustrations of a character to bring out the telling points in the products themselves.

Aside from intimate descriptions of the machines and each working part of the machines made by the Ideal company the book contains specifications and detailed instructions which should give the best results. Many pages are devoted to the illustration of buildings which have been erected with the products of the machines listed. The book may well be worth more than the dollar asked, to any man in the industry which the machinery represents and anyway he has the opportunity to get back his dollar as a part of a rebate of $2 which is made to every buyer of the catalog who afterwards invests $10 or more in any of the articles cataloged.

The development of the use of pressure—a large amount of pressure—in forming concrete products, has given some remarkable results. The pressure supplements the important factor of well graded aggregates with the further possibility of close physical combination, thus increasing density and impermeability. The Enamel Concrete Co., Des Moines, Ia., makes a brick machine, the product of which is making great progress in acceptance by the public in several localities where plants have been installed. A handsomely prepared catalog of the Des Moines manufacturers describes the new brick machine and illustrates the use of its product in some fine-looking buildings. The brick has a smooth, dense, hard surface which makes it admirably suited for use as a facing material at a price which competes strongly with other facing materials. The brick are produced in any color which it is practicable to use in any cement mixture and with white cement at a price considerably below that at which similar white enamel surfaces may be obtained in other materials.

Raber & Lang Manufacturing Co., Kendalville, Ind., in its new catalog 11, gives information about its line of sewer pipe and drain tile molds and about the "Crescent" vertical tamping brick machine. The book also reports tests, presents letters from users and illustrations showing prosperous plants where the equipment is used. The same company has just issued another book (No. 10) which is devoted to the "Crescent" mixer.

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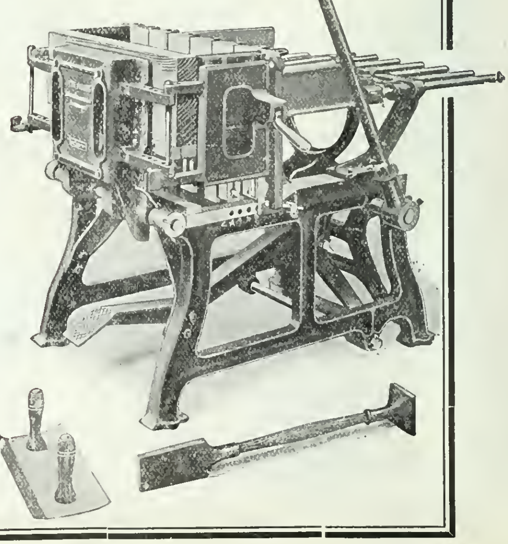

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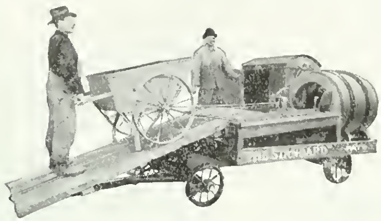
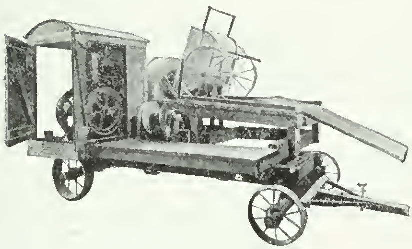
A Low-Charging Mixer With a Cart Charger

For rapid work, and to do away with the use of wheelbarrows for bringing the materials to the mixer, a "cart charging" equipment is in successful use on the "Standard" mixer. Several carts, each having capacity of one batch for the mixer, are taken to the material piles, and the proper proportions for one batch of stone or gravel, sand and cement are placed in them. By using the hoist at the mixer with a rope or cable for attaching to the carts, they are brought onto the mixer platform where the complete batch is dumped into the mixer, as soon as the previous batch is discharged. The cart is then taken back by the man





Using a "Cart Charging" Equipment With a Standard Mixer

who guides it to the mixer, and the rope removed from the empty cart and attached to another loaded cart and the process is repeated. The man operating the engine on gasoline outfits also operates the hoist and the automatic water tank, and it is not necessary to have a man on the mixer platform.

With this outfit, from one to three less workmen will be necessary for bringing materials to the mixer and a greater amount of work will be accomplished with the few men required. It will be seen by this, that the saving in labor cost alone would pay for the complete outfit in a very short time.

After rains and in wet weather when the runways are slippery or during extreme hot weather the "cart charger" will bring the materials to the mixer just as easily and rapidly without over-exertion of the men. The mouth of the carts being as wide as any other portion allows the material to fall very easily and the complete batch is discharged into the mixer from the carts in about five seconds.

When using the "cart charger" the mixer can be raised above the street level if desired so as to give a down grade for handling mixed concrete from the mixer to the forms. The mixed concrete can then be handled in carts down a slight incline easily and quickly.

On street or other work, where the mixer is moved forward as the work progresses, the cable which is used to draw the carts to the mixer can be attached to some stationary object ahead, such as a telegraph post, and the mixer pulled forward on the job by use of its own power. The hoist used for drawing the carts to the mixer platform can be used for hoisting material or equipment when the mixer is not being used for concrete. Both the mixer and the hoist are operated independently and either can be thrown out, while the other is being operated.

The Standard Scale & Supply Co., designers and manufacturers of this equipment, 1345 Wabash Ave., Chicago is glad to furnish further information upon reauest to their main, or any one of their branch offices.

Fireproof Windows

Fire proof windows, if of proper design, are a decided advancemen in building construction, not only from a fireproof standpoint, but from the standpoint of economy and strength. It is an acknowledged fact that the majority of the disastrous conflagrations have been occasioned by the inflammability of the window frames and sashes. It is authentically estimated that 73% of all the damage done by fire to buildings, other than those in which it originates, is due to the window route. It is also estimated that 48% of the entire fire loss in the country is due to the lack of window protection.

Metal windows are weather, dust and vermin proof, and have all the advantages of fire shutters, with none of the disadvantages.

The Canton Mfg. Co., Canton, Ohio, has recently brought into the market a metal window with an adjustable section between the jamb and the back and side of stile, so that if the sash, after being erected, fits too tightly or too loosely, easy adjustment is made to insure smooth and perfect operation of the window.

The top and bottom rails of sash are reinforced with a 3/8" x 3/4" steel bar, the bar running the entire width of the sash. These bars are bolted at the ends where the stiles and the rails meet with 1/4" x 1" bolts. This construction strengthens the sash at the four corners, making it practically indestructible. To these bars, the sash chains are fastened, taking the entire strain of the sash weights off the sash when windows are raised or lowered.

The frames are made of 24 gauge galvanized steel, which permits of the necesasry strength, allowing a liberal safety factor. Frames and sashes are of copper, copper coated, steel or aluminninum coated steel, furnished to meet special specifications.

The Canton Mfg. Co. is sending out an interesting 25-page circular, prepared very much like a standard specification. Sketches and structural and erection details are shown, and beside metal sash, other products of the same company, fire-doors, ventilators, sky-lights, etc., are described.

Concrete-Cement Age

CEMENT AGE · CONCRETE ENGINEERING · CONCRETE

Devoted to the manufacture and uses of Portland cement

New York DETROIT Chicago

CEMENT AGE · CONCRETE ENGINEERING · CONCRETE

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Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa., Convention, Pittsburgh, Dec. 12-18, 1912.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Bldg., Philadelphia, Pa.

American Association for Highway Improvement, J. E. Pennybacker, Jr., Secretary, Colorado Bldg., Washington, D. C.

American Road Congress, Atlantic City, N. J., Sept. 30 to Oct. 5, 1912.

Nebraska Cement Users' Association, Secretary Treasurer, Frank Whipperman, Omaha, Neb.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Building, Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Pittsburgh Cement Show, Exposition Hall, Dec. 12-18, 1912.

Chicago Cement Show, Coliseum, Jan. 16-23, 1913.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

In This Issue

Vol. I DETROIT and NEW YORK, AUG., 1912 No. 2

Subscription, $1.50 a year; single copies, 15 cents. Canadian subscription, $2.00 a year; Foreign subscription $2.50 a year.

The *Editors* invite your correspondence on all matters relating to the industry which the magazine represents. Discussions, notes and inquiries will be gladly received.

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They are quicker and easier to build, and you *save money* besides. Our free booklet (31) explains how by using

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you can put up a concrete silo (practically monolithic and absolutely permanent) without the trouble and expense of forms. Farmers who have built their silos this way say the results are more than satisfactory. Our free booklet (31) gives full information. Send for one today.

TO
CONCRETE CONTRACTORS

In the last few months we have received upwards of a thousand inquiries from farmers throughout the country asking how and where they can most easily procure

KNO-BURN EXPANDED METAL LATH

with which to build their silos. For no reason other than the lack of sufficient number of names of contractors to whom to refer them, we have been compelled in some instances to sell the material direct. We are firm believers in the old saying "Live and let live" and want YOU to make the substantial contractor's profit on the large volume of silo construction that will take place this year. Therefore write for our special proposition to contractors; act quickly so that we can refer to you the names of all live prospects we have in your locality. A contractor in Eastern Kansas, building silos with this material, has found the demand so great that he has to refuse orders. *Some* business! His name on request.

Silos thus constructed last forever. Are easily and economically put up and absolutely without cost to maintain. The Kansas Agricultural Department is very enthusiastic over this form of construction; they have erected 23 to date, and contrary to an impression started and fostered by the competitors of concrete construction, they have shown an absolutely perfect preservation of the silage thus stored.

NORTH WESTERN EXPANDED METAL COMPANY

940-970 Old Colony Building, CHICAGO, ILL.

MONROE BUILDING, CHICAGO
Basements Waterproofed with Ceresit

CERESITIZED CONCRETE IS PERMANENTLY WATERPROOF

and possesses the highest efficiency at the lowest cost of any known method of waterproofing. Ceresit Waterproofing is a cream white paste which is incorporated in the concrete mass or cement mortar. It is put into the water used in mixing the ingredients before the mixing is done. The water carries the Ceresit into every portion of the concrete mass uniformly and thoroughly, and when set renders it absolutely water-tight.

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is guaranteed to be an absolutely unfailing water repellant and thus protects concrete structures from disintegration and damage from frosts.

There is no known method of waterproofing, regardless of cost, which is more efficient on important concrete engineering such as tunnels, foundations, sewers, bridges, reservoirs, dams, tanks, swimming pools, water towers and tanks, floors, cellars, walls or roofs.

Ceresit is also applicable for use in cement mortar and will dampproof and waterproof structures whose exterior surfaces are of concrete, stucco, brick, stone, cement, plaster or tile.

Write for our Free Book "N" and try Ceresit on your next job.

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Concrete-Cement Age

Vol. I AUGUST, 1912 No. 2

Editorials

UNLIKE many movements to bring people together for the discussion of public matters, the Road Congress, to be held at Atlantic City, September 30 to October 5, is not merely to arouse public interest. The Congress, it appears, is instead, the fruit of that public interest which already is aroused. It will have for its object the beginning of the systematization of the national road movement, the influences of which scarcely a community has escaped.

* * *

THE PROPER spacing, filling and protection of expansion joints in concrete pavements are questions which have been uppermost very nearly everywhere that concrete roadways have been either proposed or constructed. Therefore a big *If* hangs on the experimental work being undertaken by Logan Waller Page, Director of the United States Office of Public Roads, in his endeavor to establish as a fact the uselessness of any purposely constructed joint whatever. Whether or not he will be so successful as to make the more conservative concrete paving engineers adopt the jointless road specifications, is of course only a matter of conjecture, but the fact that the Wayne County (Michigan) Road Commissioners are seriously considering a big reduction (probably 50 per cent) in the number of transverse joints, at least shows a new trend of investigation upon the outcome of which much will depend.

* * *

THE FORTHCOMING Congress of the International Association for Testing Materials to be held in New York September 3 to 7 will be an important occasion for the cement and concrete industries of this country. It would be impossible in this day to give comprehensive consideration to engineering and industrial science without discussion of cement and concrete, and we venture to say that foreign representatives and members of the Association will find in this country nothing more interesting than the concrete work in subways and river tunnels in and about New York. These, with the Panama Canal and the New York State Barge Canal, will make concrete construction the chief feature of interest so far as inspection of American public works is concerned. Therefore it is not too soon to suggest that our cement manufacturers, engineers and builders in concrete bear in mind the date of the Congress in order that they may keep in close touch with all the proceedings relating to the use of cement. In looking over the Congress papers at random we find that they are not merely abstruse treatments of profound subjects, but on the contrary include discussion of many of the very practical problems confronting engineers from day to day. It is to be hoped that the cement interests of the United States will not fall behind other industrial and scientific bodies in striving to make the first Congress in America the most important meeting ever held by the Association.

* * *

CONCRETE-CEMENT AGE receives many letters from concrete products manufacturers revealing a puzzled attitude toward certain evidences of a lack of uniformity in concrete block, dimension stone, tile and so on. Investigation of and progress in the matter of curing concrete products have not kept pace with the other features of the industry. Many concrete products plants are operated uneconomically and without proper guidance which comes from careful research and exhaustive tests. From time to time we have been able to present information for our readers on improvements in curing methods, and in this issue we give additional information which should be of considerable value. It will serve to emphasize the importance of the factor of curing. The cement may be good, the sand clean and hard, and the mixture well graded, etc., still the products will be far from what they should be if proper attention is not given to the conditions under which the cement hardens. In the near future we hope to present to our readers still other information along the line of high pressure steam curing, which is now the basis of investigation by the Bureau of Standards. We are sure that those advocates of low pressure steam curing who have insisted that high pressure curing will disrupt the products, will be surprised to learn of tests which show the degree to which crystallization of cement may be accelerated in the use of steam under considerable pressure. Concrete products manufacturers will observe one thing, however, in the report of tests of the Bureau of Standards, abstracted in this issue, and that is, that the products should not be subjected to this steam at high pressure and high temperature immediately after they have left the molds. The concrete should attain its initial set before the steam is applied. We hope that readers will feel that the steam curing question is an open one and that they will feel inclined to write their views, report their tests and relate their experiences in full. It is only in this general discussion of so important a matter that best practice may eventually be standardized.

* * *

Reinforced Concrete vs. Electricity

WHILE injury to reinforced concrete buildings by the escape of electricity from outside sources is very rare, the following paragraph from what is as the "Peoria decree," wherein the Peoria Waterworks Co. was plaintiff, and the Peoria Ry. Co. defendant, is interesting:

"It is thereupon adjudged and decreed as follows: The defendant Peoria Railway Co. and its officers, agents and servants after one year from and after the date of this decree, are enjoined and restrained from injuring the water pipes, service pipes, hydrants and all other structures and property of complainant, Peoria Water Works Co., through or by the escape of electric current from the rails or structures or property of the defendant."

The railway company was given authority to examine the plaintiff's property in its effort to conform to the decree.

During recent extended discussion concerning injury to a factory building from this source, inquiry took the form as to whether or not reinforced concrete is dangerous on that account. This journal held that the question involved the proper control and use of electricity rather than reinforced concrete, and that all structures of any kind are liable to electrolytic action from random currents. We are glad to find this view sustained by a court.

Recognition For The N. A. C. U.

IT FREQUENTLY happens that an individual or association becomes so engrossed in the development of a project or purpose as to become oblivious to self, a very admirable thing to do. If the undertaking is such as tends to benefit the world at large, individuals and associations of this character sometimes awaken to find that they have become famous. Apropos of this, we wonder whether or not the members of the National Association of Cement Users know that their organization is regarded as a very distinguished body by foreign engineers and societies interested in the development of concrete construction. In a recent number of the leading British journal devoted to cement, *Concrete and Constructional Engineering,* we find the following editorial paragraphs:

"Whilst we are making but moderate progress in the development of cement uses—and the application of reinforced concrete in particular—the United States of America are making rapid strides in every possible direction where Portland cement can be practically and economically utilized for building and engineering purposes. The enthusiasm, energy and businesslike acumen with which the majority of the members of the architectural and engineering professions of America are adapting modern methods and modern forms of construction for structural purposes—and thereby using Portland cement in largely increasing quantities—is only to be accounted for by the general appreciation of the advantages of Portland cement by the American public, both by residents in the great industrial centers and in the agricultural districts.

"A recent echo of this progressive movement in the application of cement, concrete, and of reinforced concrete, may be found in all the technical societies of the American continent; and whether we turn to the proceedings of the National Association of Cement Users of the United States—whose primary purpose is obviously to consider problems relating to the application of Portland cement—or to the conferences of the National Fire Protection Association, the Association of Water Works Engineers, or gatherings such as that of the International Congress of Navigation recently held in Philadelphia, everywhere we find a prominent position accorded to the subject we have so much at heart."

"The important work done by the National Association of Cement Users is well known, and has on several occasions been commented on in this journal. At their recent Annual Convention, however, the papers presented seem to have been of even more technical interest than usual. All the well-known authorities on reinforced concrete contributed to them, and we shall have pleasure in publishing most of these at a later date."

Our contemporary laments the fact that in England "these questions are only dealt with in a very half-hearted sort of manner, and it is as much as the Concrete Institute can do to obtain papers and discussions of practical utility and value, whilst enthusiasm is conspicuously absent."

The tribute to the National Association of Cement Users is fully deserved. Every member should feel proud of the fact that the Association has won not only recognition abroad, but that the result of its research and effort has really become international in its scientific and industrial importance. This should bring to every member of the Association a deeper appreciation of the value of his membership and should make clear to others the necessity of joining the Association.

Steam Curing Concrete Products*

A New Detroit Factory Described With Special Reference to Steam Room Layout

BY ROBERT F. HAVLIK, M. E.†

In describing our steam curing plant, I must deviate somewhat from the subject of this article and also describe our factory proper and our methods of handling the finished product and the raw material, as these all go hand in hand. A steam curing plant may be well designed and yet it may be so located in reference to the manufacturing plant that the combination will be very impractical.

Building and Location of Machinery

Our manufacturing building is 40′ wide, 60′ long and two stories high with a flat, sloping roof. Every inch of space in it is utilized for some purpose or other. The walls of our building are built of 2″x6″ studding for the first story and 2″x4″ studding for the second story. Herringbone metal lath of No. 27 gauge was securely fastened to this and the exterior was plastered with two coats of cement plaster and one splatter-dash coat. The first floor is made of concrete with the exception of the car pits and the spaces between the transfer car rails. The second floor is supported on 2″x12″ joists spaced on 16″ centers. The two floor spans nearest the railroad and the one next to the kilns are designed to support a floor load of 200 pounds per sq. ft. The roof is supported on 2″x6″ rafters spaced on 20″ centers and these rest on beams built up of two 2″x8″ pieces which in turn rest on 4″x4″ posts. The roof is covered with two-ply "Ruberoid" roofing. It will be noticed that the windows are very close together for a building of this size. It is important, however, to have plenty of light in a concrete products factory.

The building is set about 30′ away from the side track and this space will be utilized for storage of sand and gravel and a driveway. We are now using a pit run of gravel and screen this through a 1″ screen right into a wheelbarrow. It is then wheeled into the building and dumped into a large hopper standing about 20″ from the floor. From this it is conveyed by a screw conveyor into an elevator boot from which it is elevated by means of a single strand, link belt bucket elevator into the mixer, which is located on the second floor. The mixer has been elevated sufficiently to allow a Chase dump car to pass under the discharge end of the trough. The mixer is a type A Ideal proportioning mixer. The hoppers have been built up about two feet so as to increase their capacities. The elevator is set high enough so that we can instal a rotary screen above the mixer and allow the elevator to discharge direct into this.

As stated above the concrete discharges into a Chase dump car which is operated on a 24″ track running the entire length of the building directly over the block machine. We have two Ideal automatic tampers located as shown in the accompanying drawings. One is for 16″ machines and the other can be used on either an Ideal, model G, brick machine or an Ideal, model E 24″ machine. Back of each tamper stands an Ideal automatic loader. The hoppers of these loaders have been built up to the floor above and the concrete is dumped from the Chase dump car direct into these hoppers. From them the concrete is fed automatically as needed to the block or brick machines. The space next to the model A tamper has been reserved for the hand machines which are always required for special or fractional block. It will be noticed that each tamper has two car pits in front of it. It was our original intention to set the rails of these car pits 6″ below the floor of the factory, but on account of a mistake in the width of the cars we found it impossible to do this.

We use 30″ wide, No. 195, three-deck Chase cars, with a capacity of 54 plain 8″x8″x16″ block. These cars are suitable for both 16″ and 24″ block. We set one complete car, fully supplied with pallets in one car pit and one bare car without any decks in the second car pit. We set the freshly made block on this car and take pallets off the first car as needed. As the last car is filled with block we take the top deck of the first car and set it on the second and continue this process until the car is fully loaded with block and the operator then proceeds to place his freshly made block on the first car. A laborer then runs the loaded car into the steam kiln and brings in another empty car fully supplied with decks and pallets and places it in the empty car pit. In this way the block machine operator is not forced to wait for a car. Only one car pit is supplied for the hand machine, because the block are not turned out as rapidly as on the power machines. The space between the 24″ Ideal tamper and the north end of our building is reserved for art stone work. We have two bankers in place now and have reserved a space for the third. The art stone will be left on these bankers until the evening of each day or until the following morning, at which time it will be loaded on a car and run into one of the steam kilns. A transfer car track is located at one side of the building directly in front of the car pit and runs the full length of the building. We have made provision for five steam curing kilns, but will erect

*This article was written for CONCRETE-CEMENT AGE as a result of the request for descriptions of steam curing plants and methods published in the May issue of *Concrete* and followed up in the July issue of CONCRETE-CEMENT AGE.—EDITORS.

†President and manager, Superior Concrete Products Co., Detroit.

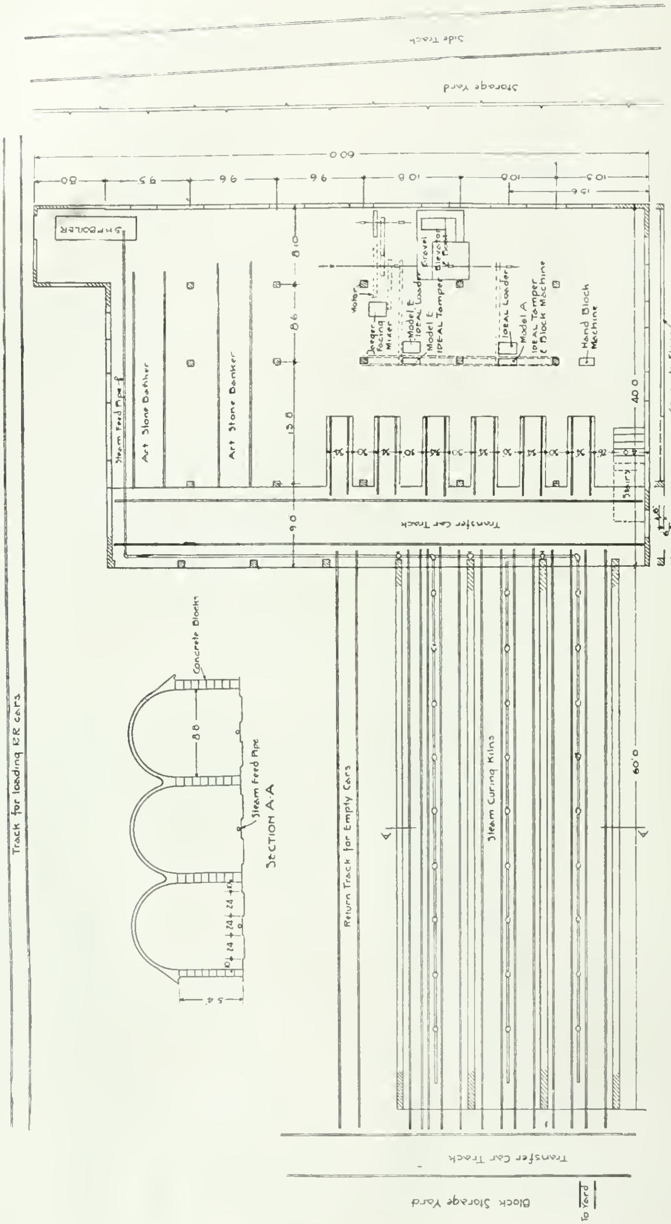


Fig. 1—First Floor Plan Superior Concrete Products Plant

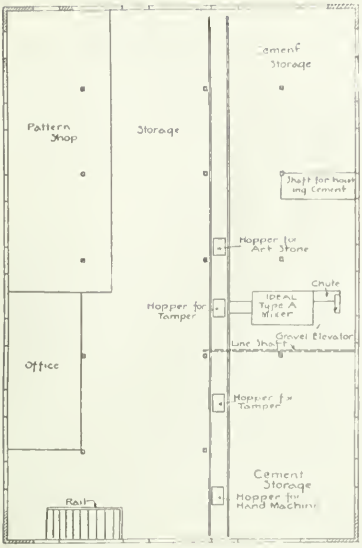


FIG. 2—SECOND FLOOR PLAN

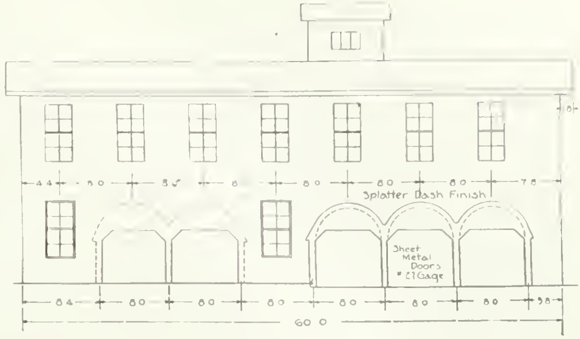


FIG. 3—ELEVATION

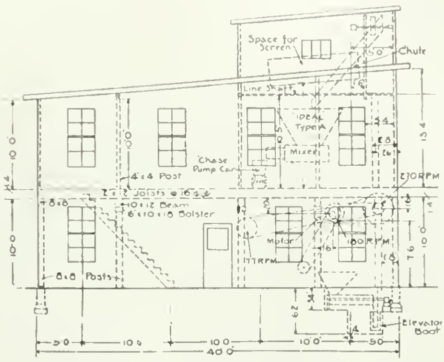


FIG. 4—ELEVATION SHOWING MACHINERY

only three to start with. These kilns are located directly in front of the block machines but are entirely separate from the manufacturing building. It is a great mistake to locate these in the same building for the reason that valuable space is lost, and furthermore when the kilns are opened up each morning the steam in them fills the entire manufacturing room and is likely to spoil any cement that is stored in the manufacturing building. As our

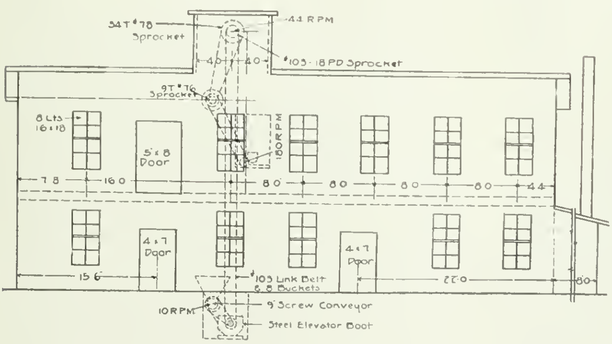


FIG. 5—ELEVATION

factory is now laid out we can increase our facilities merely by building on to the long way of the building and not in any way disturb the present plant. The scheme of the car pits in front of the machines is copied after the O. C. Barber concrete products plant at Barberton, Ohio,* but the rest of the layout is original. Ours is built on the unit plan.

Electric power is being used in the plant, the boiler being used only to take care of the curing rooms. At present the equipment consists of one 10 h. p. alternating current, 220 volt, 60 cycle, 3 phase Westinghouse motor. Other individual motors will be installed as required and a separate electric power equipment will be used in the pattern shop.

Careful thought should always be given the layout of a concrete products plant as it is very important to eliminate all unnecessary labor. This briefly describes our manufacturing plant, and we now come to the steam curing kilns. I use the words steam

*Described in *Concrete*, December, 1911.

curing kilns advisedly. This is not a misnomer as said by a recent contributor to *Concrete*.*

Construction of Steam Curing Kilns

The steam curing kilns are 88″ wide in the clear and 60′ long. The roofs are built of Hy-Rib metal lath curved to a 4-ft. radius, thus making a semi-circular arch roof. This is plastered on the top with 2½″ of concrete and on the underside with about ½″ of cement plaster. All steam curing kilns should have semi-circular arched roofs so as to make the condensation run down the side walls of the kiln instead of dripping onto and staining the concrete products. I have seen kilns with roofs that were arched but one or two feet in height to eight feet in width and the condensation dripped onto the block and stained them. Each kiln accommodates 16 cars and thus has a capacity of 864 plain 8″x8″x16″ block. We aim to cure our products 48 hours and this requires the use of three kilns. Each kiln has two sets of rails to accommodate two rows of cars. We will place another rail near the center of one kiln and use it with one rail of the other two sets so that we can run a car in the center of the kiln as sometimes we may wish to load long pieces of art stone across the car and we could not run this into the kiln without the use of this extra rail. The walls of our kilns are built of 8″x8″x16″ hollow block. The doors are merely a frame work of 2″x4″ lumber covered on the steam side with No. 27 gauge galvanized iron. All the doors are swung on hinges from the top so that when they are opened up they will be out of the way. I believe that this type of door is the most economical that can be built and as satisfactory as a special metal door, and the best feature of it is that it can be made without the services of a skilled sheet metal workman.

We have a 25 h. p. horizontal locomotive type steam boiler and set it up in one corner of our plant. We feed the steam to the curing kilns by means of a 2-in. steam pipe placed on the floor of the kiln half-way between the two walls, and every 6′ we have placed a reducing cross, reducing from two inches to one and one-quarter inches. For the first 20′ or so we plug these openings with reducing bushings reducing from 1¼″ to ¾″, and we plug the remaining openings with bushings reducing to ½″. The idea of using these bushings is that if more or less steam is fed at any one point the flow can be regulated by means of these bushings. The steam pipe is placed slightly above the rails so that the steam from the crosses moves over the rail, strikes the side walls of the kilns, moves upward to the ceiling and the two currents of steam meet in the center of the kiln and go downward again to the pipe. This gives a continuous circulation of steam throughout the kiln. Some manufacturers use a perforated steam pipe, but this is unnecessary as the steam must flow from the pipe to the side walls of the kiln and this usually is at least 4′. If the steam travels this distance it is inconsistent to place the openings in the pipe any closer, in fact they can be almost twice this

*An article by H. H. Burns entitled "Vapor Curing Kilns" in the May, 1912, issue of *Concrete*.

(Continued on page 82)

Better Subgrade and Fewer Joints is Now Wayne County Paving Plan

The fact that road experts have traveled from all parts of the world to see the results of the lesson in road building which has been learned in Wayne County, Mich., on the use of concrete in country highways, lends considerable importance to the changes and proposed changes in specifications which the Wayne County Commissioners either adopt or consider.

In the July issue of CONCRETE-CEMENT-AGE attention was called to the fact that the Board of County Road Commissioners of Wayne County had decided upon two important changes in road building specifications. First, it was decided to put in longitudinal joints in the pavement in addition to the transverse joints, in all roads 12′ wide or wider, using the Baker steel plates and two thicknesses of asphalt felt, just as these materials are used in the transverse joints. The other change announced was the elimination of the curvature in the sub-grade, which is now being made practically flat. It develops that while the second change is and undoubtedly will be adhered to, unless it proves to be a mistake, it also develops that the commissioners are privately debating the matter of the longitudinal joints.

It will be remembered that in the Correspondence department of the July issue of CONCRETE-CEMENT AGE, a letter from Logan Waller Page, Director of the U. S. Office of Public Roads, was published, in which mention was made of the fact that plans had nearly been completed for the construction of an experimental stretch of concrete roadway 4,500′ long in which there are to be no expansion joints.

The most important single factor in concrete road building has been very generally regarded as the expansion joint, and while for some time there has been a tendency to use more and more joints in paving, it appears that Mr. Page is not alone in his belief that concrete roads may be constructed satisfactorily with fewer joints than are ordinarily provided. Mr. Page's plan is to build a concrete road in warm weather and leave it to nature to work out the matter of joints. If, as Mr. Page says, the cracks do come from contraction in winter, he sees no reason why these cracks should not be filled and taken care of just as easily as joints, which are purposely made in the road. The Wayne County Commissioners do not share Mr. Page's views, believing that cracks are absolutely necessary, and that it is more sightly and more economical and better engineering to anticipate contraction and expansion, providing joints at regular intervals and protecting them beforehand, when it can be done with proper plates and filler, than to let the cracks come where they will, irregularly, and then try to prevent chipping at the edges. At the same time, there is a certain feeling influencing the members of the Wayne County Commission, that the introduction of more joints than have been used in the past is a step backward rather than a step forward. There is also a feeling that with proper attention to the sub-grade, cracks will be less likely. It must be taken into consideration that the Wayne County Commissioners do the work themselves. They have

(Continued on page 86)

Reinforced Concrete Lumber Dock at Balboa

Description of Government Methods on a Panama Work with Details and Cost Data

BY W. J. SPALDING

[Forwarded Through the Courtesy of Col. Geo. W. Goethals, Chairman of the Isthmian Canal Commission.]

The increased shipping in the last few years has made it necessary for the Panama Railroad to increase its docking facilities at Balboa. It was decided to construct a reinforced concrete dock 706 ft. long by 55 ft. wide, to take care of shipments of lumber, machinery and cargo that can be exposed to the weather. The dock is located along and forms part of the permanent terminal scheme contemplated for the Pacific entrance to the Canal.

It is noticed from the plan that the dock site lies partly on dry land and the south end crosses a small river. This river is cut off above and below the dock site by coffer dams, and the sump is kept dry by two centrifugal pumps. The work then is done practically in the dry except for the underground seepage water. After construction work is completed, the dredges will excavate a channel along the front of the dock of a contemplated change in direction of future wharf extension. Later these two bents were omitted and the length of wharf cut down to 650 ft.

Substructure

Foundations.—A line of wash borings was made at intervals of 40′ along the center line of the outer row of piers, and a test pit was sunk to determine the character of material overlying the foundations. These borings were carried to rock and a diamond drill was set up and three or four feet of rock core was obtained.

The following material was found along the dock site at fairly uniform elevations:

From + 10.00 to — 5.00 loose earth and clay.

From - 5.00 to - 20.00 water-bearing sand silt and rotten wood.

From - 20.00 to - 43.00 stiff bluish-gray clay.

From - 43.00 to - 62.00 water-bearing sand gravel and boulders, overlying a bed of argillaceous sandstone.

Construction of Piers.—The piers were built by sinking heavy reinforced concrete shells to rock, then filling interiors with concrete.

The footing of the shell is a hollow frustrum of a cone, 10′ in diameter at the base or cutting edge, tapering to 8′ in diameter at the top. From this point the pier is of uniform diameter (8′). The inner diameter of shell is 6′ throughout.

This enlarged footing is used in order to decrease skin friction in sinking and provide for a foundation large enough to bring the unit pressure well within the allowable limit.

In building up this footing, the shoe and inner form are set up in position, the reinforcement is placed and the outer form set up. It is then partially filled with concrete, making it just light enough for a crane to handle conveniently.

Before the footing is set in position, a hole is excavated about 10′ deep and 12′ in diameter at the bottom. The bottom is leveled off and centering stakes set. The footing is then set in position by a crane. The purpose of this excavation is to keep the top of the footing below the working platform and to provide foot-hold for shores used in keeping pier plumb while sinking.

The filling of the shell was then completed and sinking begun. When sunk a sufficient depth, forms and reinforcement were set in place and a 6 ft. additional shell was molded. This operation continued as sinking progressed.

This method proved to be very slow, as the building up of forms and molding interfered with the sinking, and the concrete in shell had to set a sufficient time to become hard enough so shores could be applied in guiding caissons. It was also very inconvenient to place the concrete in shell, placing being done by hand.

It was then decided to mold the shell in 6-ft. sections on a platform nearby, and set them in position with a crane.

By this method it was necessary to cut the vertical reinforcement at the joints, but bond was given by passing six 1-in. rods through the shell. These rods(12′ long) are made continuous by using a 1-in. sleeve nut, 2″ square, which engages 2″ of top of one rod and 2″ of the bottom of next rod above. A large O. G. washer is placed under each sleeve nut to provide more bearing surface, so nut can not cut into the concrete and open up a crack.

Holes for rods are molded in shell by using 1½″ pipes, which are afterwards removed and used repeatedly. Small openings are also molded on inside of shell in every second section so the sleeve nuts may be adjusted. The inner halves of the sections are raised 2″ top and bottom, and so engage with each other as to prevent slipping or sliding. A rich mortar is placed between sections to give a good bond and make a water-tight joint.

The inside forms (6′ high) are made collapsible and can be quickly taken down and set up again.

The outside forms are 3′ high, three sections to each form. The footing is provided with a special form.

By this method the sections are made in advance, set aside and well seasoned before using. The sinking is stopped only long enough to set on a section and tighten up the rods, which requires only about ten minutes. Concrete in shell is 1 :2 :4.

For molding the sections, a platform 100′ long by 10′ wide was made on which to set the forms. Along this platform was an elevated track for a car

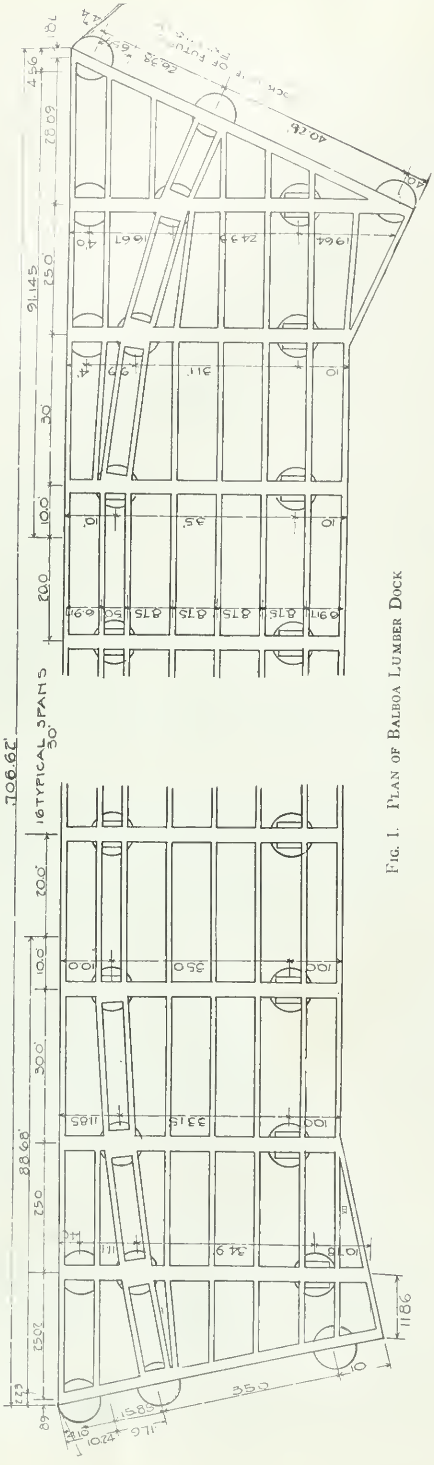


Fig. 1. Plan of Balboa Lumber Dock

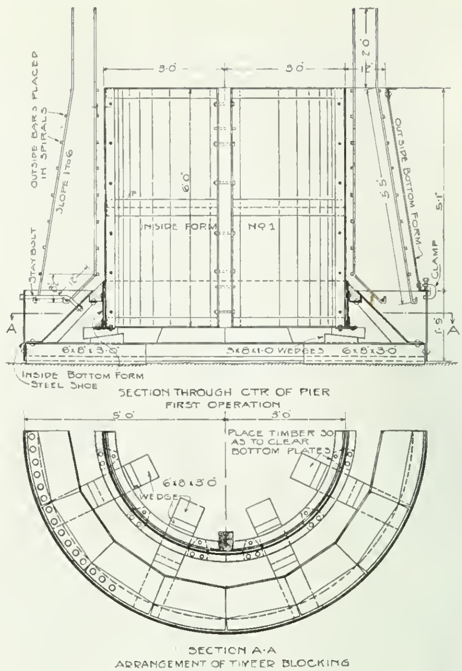


Fig. 2. The First Operation in Building a Pier Caisson

The detailed instructions accompanying this sketch were: Assemble and place steel shoe on timber as shown. Set inside bottom form and raise by wedges to make tight fit with steel shoe. Set inside form No. 1 and bolt to inside bottom form. Lower inside reinforcement (previously assembled) to rest on steel shoe. Slip bar *B* under and wire to stay-bolts of shoe. Raise reinforcement until hooks of vertical bars catch on bar *B*, and fasten with wire. Set outside reinforcement and bar *C* in similar manner to placing of inside reinforcement. Set outside bottom form and fasten to steel shoe with clamps. Lay concrete to top of forms.

which supported a ½ cu. yd. concrete mixer. The mixer was moved back and forth along the track by means of a winch mounted on the car. Near this track is another track for storing rock and sand.

A row of forms are set up ready for molding. The mixer is then moved along the row filling the forms as it comes to them. After setting about 3 or 4 days, the forms are removed and sections are set in storage yard. The sections are lifted by means of two anchor bolts, 1″ by 36″, threaded on both ends. A large threaded washer is screwed on lower end, and washer and all but about 6″ of rod set in concrete. When the section is placed in position the rod is unscrewed leaving only the washer in the concrete.

Sinking Piers.—Three methods were tried in sinking the piers. First, the jet method, in which four 2½″ pipes ran down through the shell and terminated in a 1″ nozzle about 3″ below the cutting edge. These were augmented by a nozzle handled by a man inside the caisson, to break up the center or any hard spots on the sides. Four 2″ pipes ran down the shell midway between the 2½-in. pipes and terminated in a half circle, the end coming to the outside of the shell just above the cutting edge. The water from these pipes

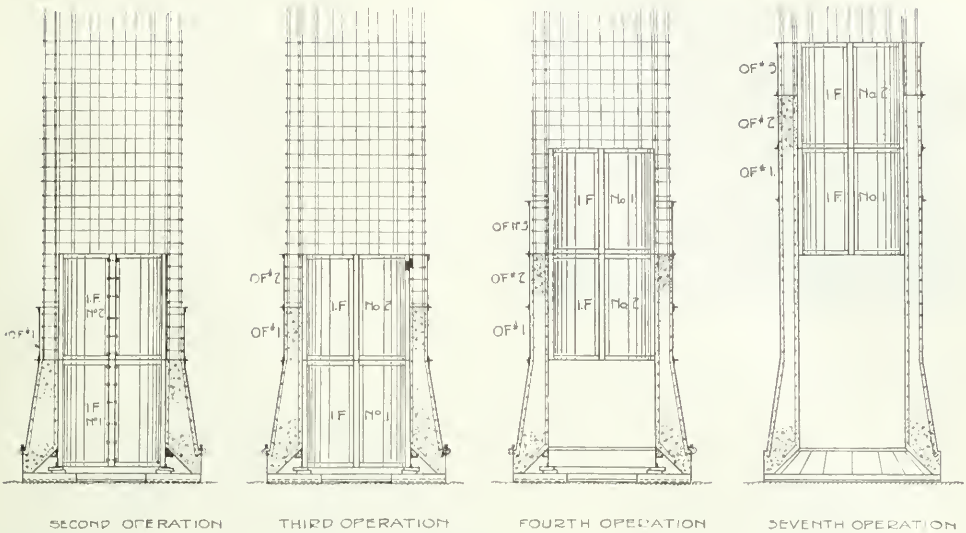


FIG. 3. PROGRESS SKETCHES SHOWING OPERATIONS 2 TO 7 IN BUILDING CAISSONS

The detailed instructions accompanying these sketches were:

Second Operation: Set inside form No. 2. "I. F. No. 2." Place second section of inside reinforcement and connect to first by wiring the overlapping vertical bars. Set second section of outside reinforcement in similar way. Set outside form No. 1, "O. F. No. 1." Lay concrete to top of outside form.

Third Operation: Set outside form No. 2. Place concrete.

Fourth Operation: Disconnect and collapse inside form No. 1, raise and reassemble on top No. 2. Set outside form No. 3. Place concrete. Remove outside and inside bottom forms at any convenient time after this operation.

Fifth Operation: Disconnect outside form No. 1 and reassemble on top No. 3. Place concrete.

Sixth Operation: Disconnect and collapse inside form No. 2. Raise and reassemble on top No. 1. Disconnect outside form No. 2, raise and reassemble on top No. 1. Place concrete.

Seventh Operation: Disconnect outside form No. 3 and reassemble on top No. 2. Lay concrete.

First section of shell ready for sinking. Complete and sink additional sections in like manner.

All reinforcement, except that in lowest portion, to be assembled in lengths of 18', and so placed as to allow a two foot lap of the vertical bars.

exerted a vertical upward pressure, tending to sink the caisson, and lubricated the outer surfaces. A water pressure of 150 lbs. per square inch was applied to nozzles, and water and broken up material was thrown out by a pump. This method proved unsatisfactory, as the jets made very little impression on the hard compact clays, and the material had to be broken up very fine for the pump to handle it.

Orange peel excavation inside the caisson was tried. A 15 cu. ft. bucket was rigged up on a locomotive crane. This proved to be quite satisfactory in soft material, but when hard clay was reached, the bucket dug a hole in the center and the stiff material stood up on the sides under the cutting edge preventing the cutting edge from sinking. It became necessary to cut this down by hand. The bucket also formed a pocket so that when it was lowered the leaves were forced shut by the pressure on the sides without getting any load.

It was then decided to adopt hand excavation. For this purpose several star drills were fitted up with buckets of 7.5 cu. ft. capacity. Each drill was provided with two buckets, one being filled while the other was hoisted and dumped. The sand line on the drill passed through a snatch block, at some distance away, and hauled the bucket to one side, so it could be dumped into a Decauville car, by which the material was conveyed to a dump. Two laborers worked in bottom of caisson filling the buckets, one man operated the drill, one man guided the bucket, hooked and unhooked the sand line and two men dumped the bucket and operated the car.

When the first layer of sand was reached it was necessary to use a pump* to keep the caisson dry enough for the men to work. No pumping was necessary except passing through the clay strata. On reaching the second layer of sand, a larger pump† was used. In many instances this pump could not handle the water, so a No. 1 pump was also put in.

Some of the caissons were sunk along the bed of the river that had been cut off above and below the wharf site by cofferdams, and a little seepage water always stood in this bed, especially on spring tides, when the water seeped through the embankment.

Almost invariably when these caissons reached the second layer of clay at elevation —43.00, the water, standing around the outside, worked its way down along the caisson around the footing and blew up on

*A No. 1 Emerson pump was used with a capacity of 225 gals. per minute.

†A No. 3 Emerson pump, 725 gals. per minute capacity.

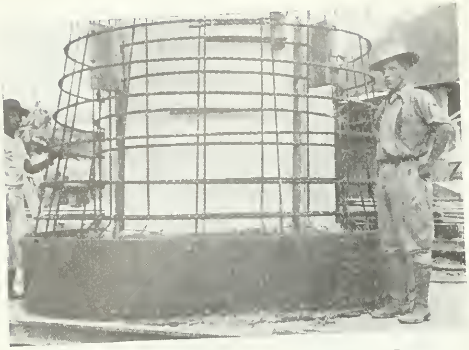


FIG. 4. RUNNING THE FIRST COURSE OF THE CAISSON

This is a photograph of the work proceeding as shown in the sketch, Fig. 2.

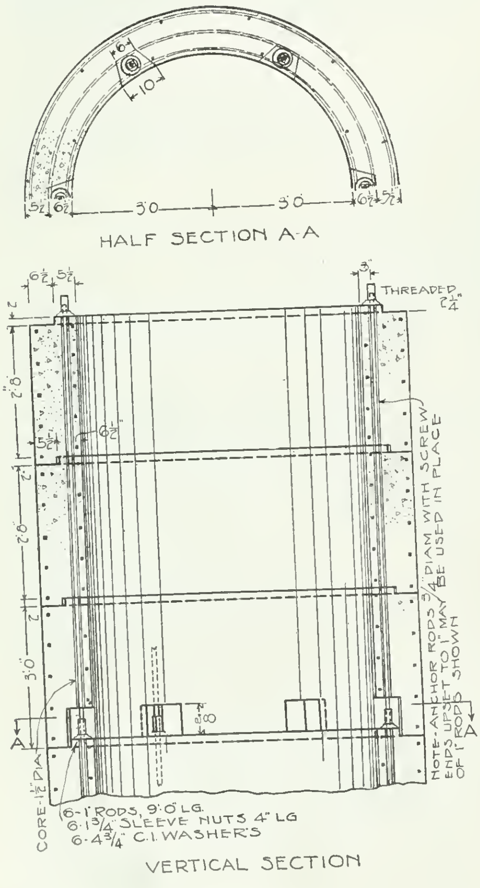


FIG. 5. TYPICAL LONGITUDINAL AND CROSS SECTION OF THE CAISSON

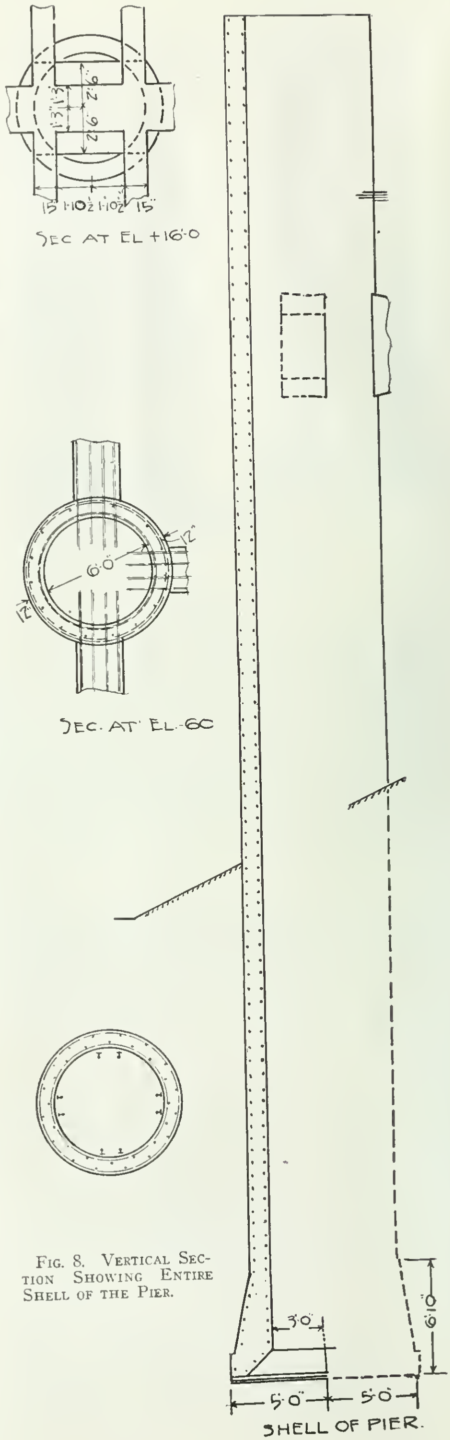


FIG. 8. VERTICAL SECTION SHOWING ENTIRE SHELL OF THE PIER.

the inside, completely filling it with water and bringing in from 10 to 20′ of soft earth.

The orange peel bucket was then used in removing the silt and continuing the excavation, while a quantity of hay was packed down along the outside of the caisson. The water was again pumped out after no further progress could be made with the orange peel bucket, and until the outside pressure was sufficient to force the water around the cutting edge again bringing in a quantity of silt. Hay was again put down around the outside of the caisson, and this operation continued until the hay had been drawn down near the bottom, catching up sand, silt and gravel, and cutting off the surface water.

Each time the water blew in the caisson it would sink a little, except, when near rock, it would become lodged on trap boulders. A great deal of trouble was experienced in removing these boulders, and at this point a great deal of water had to be pumped.

Excavation was then continued by orange peel or by hand until rock was encountered, and the footing driven into this about 1′. The center was then hollowed out with a small charge of dynamite, to give a good bond between concrete and rock and to prevent any possibility of sliding.

Eight old French rails were then fastened vertically along the inner wall of the caisson, two in each quadrant, spaced about 1′ apart and 2″ from the wall.

Other rails were fastened on these by fish plates as the filling progressed and were thus carried to the top of the pier and extended into the girder.

The concrete used in filling was a 1-3-5 mixture.

It was not always possible to cut off all the water from the bottom of caisson, so about 3′ of concrete was placed in bags, which effectively cut off the flow. In all but a few cases the weight of the caisson was found sufficient to sink it. When the caisson would not sink of its own weight, other weights were applied and the material around the outside loosened up by spudding down along the caisson.

In two instances after applying 50 tons weight and spudding around caisson, no movement was effected, but fortunately caissons were very near rock and little difficulty found in building up under footing.

Superstructure

The piers are stiffened by tie girders connecting them transversely, and longitudinally along the front line at elevation —5.00.

The cross-section of girder is 2′ deep by 1′ 10″ wide. It is reinforced by eight 1″ twisted steel rods; three rods are placed near the top, three near the bottom and one on either side midway between. These girders are molded on the platform and set in position with a crane. They extend just flush with the inside of the shell, while the reinforcing rods are 2 feet longer and are flared out so as to give better bond with concrete when the shell is filled. Concrete was 1:2:4.

Fig. 6. Molding Yard for Shell Sections of Pier

Fig. 7. Handling Sections of Pier Shell with Locomotive Crane

The openings in the shell are made in the section while being molded.

Floor System.—The floor system consists of girders at right angles to the axis of the wharf, cross-sectional dimensions 4′ 8″ deep by 2′ 6″ wide between piers. Details are shown in accompanying drawings.

These girders support a system of 8 floor beams running longitudinally along the wharf. The cross-section of the outer beams along the front and back is 3′ deep by 14″ wide; the intermediate beams are 3′ 9″ deep by 15″ wide.

On top of beams and girders is placed the reinforced concrete floor slab, 6″ thick.

The system is designed to support a uniformly distributed live load of 400 lbs. per sq. ft., and a concentrated live load over track beams equivalent to the weight of a 122,310-lb. locomotive.

The track comes directly over the outer line of piers and the top of rails comes flush with the top of floor. Track beams are of same cross-section as other intermediate beams, but heavier reinforcing is used. Concrete in floor system is mixed 1:2:4.

Forms.—The beam and girder forms were made of 2-in. lumber and slab forms of 1-in. lumber. They

Detailed Cost of Operations, Balboa Lumber Dock—Commencement to Completion, February 29, 1912

	Excavation for Piers.	Work done Quantity.	Labor.	Material.	Charges from other Divisions.	TOTAL.	Unit Cost.
A/c # 8840	Excavating by hand...	7197 cu. yds.	13034.53	4708.54	799.96	18543.03	$2.5765
8841	Excavating by orange-peel	15469	4080.16	1217.36	291.63	5589.15	.3613
8842	Disposal of waste......	22666	10475.61	1541.14	170.98	12187.73	.5377
8843	Pumping (To cover special pumping, keeping water out holes)....	22666	5453.33	2333.54	221.82	8008.69	.3533
8844	Maintenance of equipment	22666	5861.79	3329.18	573.91	9764.88	.4308
8845	Preliminary and General work	22666	3434.27	4774.93	161.46	8370.66	.3693
8848	Plant arbitrary	22666		4229.67		4229.67	.1866
8849	Division expense	22666	2868.30	71.96	546.55	3486.81	.1538
		22666	45207.99	22206.32	2766.31	70180.62	3.0963
	Concrete Masonry—Sub Structure.						
8850	Wood forms in place..	6341 cu. yds.	1330.35	784.17	55.45	2169.97	.3422
8851	Steels forms in place..	6341 concrete	3879.46	1237.85	85.61	5202.92	.8205
8852	Cement	6341	863.49	9118.44	1009.33	10991.26	1.7334
8853	Rock	6341	841.40	5899.24	28.87	6769.51	1.0676
8854	Sand	6341	907.76	1932.03	27.11	2866.90	.4522
8855	Mixing	6341	6849.36	1053.34	237.85	8140.55	1.2838
8856	Placing	6341	5771.02	2365.75	152.46	8289.23	1.3072
8857	Reinforcement	6341	7996.36	23668.27	455.99	32120.62	5.0655
8858	Division expense	6341	2401.23	55.33	413.18	2869.74	.4526
8859	Large rocks in mass..	6341	429.35	7.99	3.97	441.31	.0696
8860	Maintenance of equipment	6341	2484.37	1320.18	169.33	3973.88	.6267
8861	Preliminary and General work	6341	2176.23	2108.71	67.74	4352.68	.6864
8862	Plant Arbitrary	6341		2348.01		2348.01	.3703
		6341	35930.38	51899.31	2706.89	90536.58	14.2780
	Iron Work in Dock.						
8864	Placing and Adjusting.		787.49	1198.98	94.39	2080.86	
8866	Division Expense		39.91	1.14	11.23	52.28	
			827.40	1200.12	105.62	2133.14	
	Concrete Masonry—Superstructure.						
8870	Wood forms in place...	2353 cu. yds.	9955.94	7195.50	448.05	17599.49	7.4796
8871	Steel forms in place...	2353 concrete			117.61	117.61	.0500
8872	Cement	2353	41.77	4880.61	398.75	5321.13	2.2614
8873	Rock	2353	9.85	1678.72		1688.57	7176
8874	Sand	2353		1122.02		1122.02	.4768
8875	Mixing	2353	2201.16	1044.78	168.54	3414.48	1.4511
8876	Placing	2353	1265.44	530.18	24.58	1820.20	.7736
8877	Reinforcement	2353	5198.99	1271.07	293.62	6763.68	2.8745
8878	Division Expense	2353	880.81	23.84	243.45	1148.10	.4879
8879	Maintenance of equipment	2353	672.58	356.88	41.92	1071.38	.4553
8880	Preliminary and General work	2353	919.22	506.56	11.10	1436.88	.6107
8881	Plant arbitrary	2353		1056.80		1056.80	.4492
		2353	21145.76	19666.96	1747.62	42560.34	18.0877
	TOTAL COST		$103,111.53	$94972.71	$7326.44	$205,410.68	

Note: The cost of plant was $54,501.88. Of this amount 2% deterioration per month has been charged in the above cost of Lumber Wharf distributed over the various operations, amounting to $7,218.14. The balance of plant cost or $47,283.14 will be transferred to BALBOA TERMINAL FACILITIES to be disposed of similarly when other work opens up in that line.

Credits due after completion of wharf, material left on hand and to be deducted from cost $205,410.68

25 cu. yds. No. 2 ROCK @ 95c cu. yd	$ 23.75	
316 bags CEMENT @ $1.86 bbl. (4 bags to bbl.)	146.94	
632 BAGS, containing above cement, @ 8½c each	53.72	
13200 BAGS (empties on hand), at 8½c each	1122.00	
158,500 lbs. REINFORCEMENT rods and stirrups @ .01463 lb	2318.61	
Used PIPE, various sizes	958.22	
Valves, unions, couplings, nipples, reducers, etc	186.08	
Used LUMBER from tresles, supports and forms ....(half value)	1116.31	
		5295.63

ENTIRE PRACTICAL COST $199,485.05

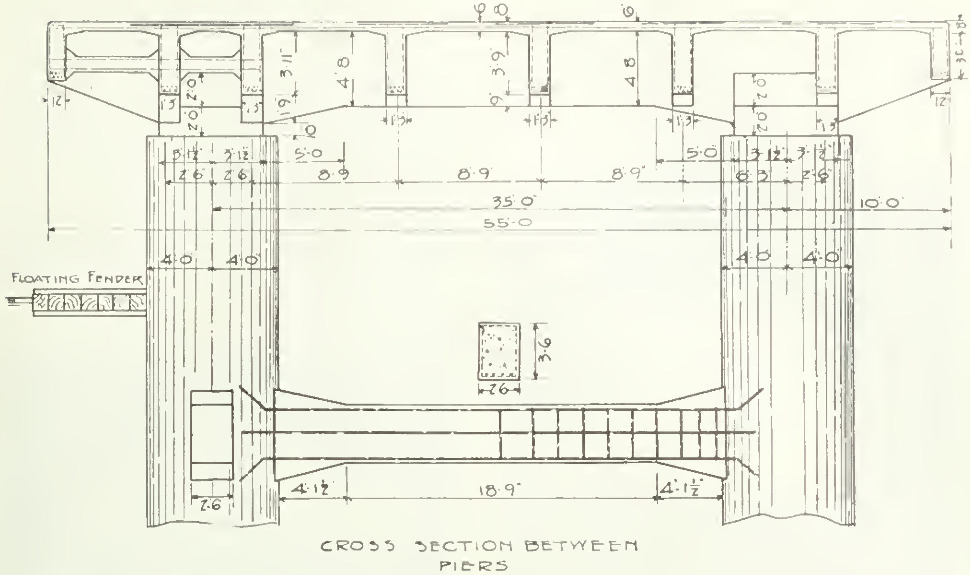


Fig. 9. Cross Section Showing Arrangement of the Dock Floor Structure, and the Cross Girders below Water-level

Fig. 10. The Completed Structure from Below

were made collapsible so they could be readily taken down and used over again.

In assembling, the bottom forms and one set of side forms of beams and girder were set up, the reinforcement placed in position and the other sides then set up. The reinforcement was supported on small concrete blocks with grooves along the sides to provide a good bond with the concrete. The slab forms were next set in position and steel for reinforcement for floor was laid. A panel length of 30′ was laid at one time, the joints in the panel coming midway between girders.

A concrete mixer (½ yard) was placed near the edge of the wharf and discharged into Decauville cars, which conveyed the concrete to the desired position in the panel.

The main girder was first filled to about 6″ below the top reinforcement. Next the beams were filled, starting at the edge of the panel and working back to the girder, tamping the concrete up under the reinforcement to prevent any voids. Next the slab was laid commencing near the center of the panel and working towards the sides.

To work over the panel 14″ by 4″ levelers were placed on blocks 2 by 4 by 6″ high. The bottom of the levelers was at grade and the concrete was smoothed down to this line. The levelers also supported the Decauville track. Each panel was laid monolithic and required about 8 hours to lay. Next day after panel was laid the top surface was cleaned off and a finishing coat of mortar placed and floated to a sand finish.

Plant.—The plant consists of 1 French locomotive and six dump cars for disposal of waste; 2 locomo-

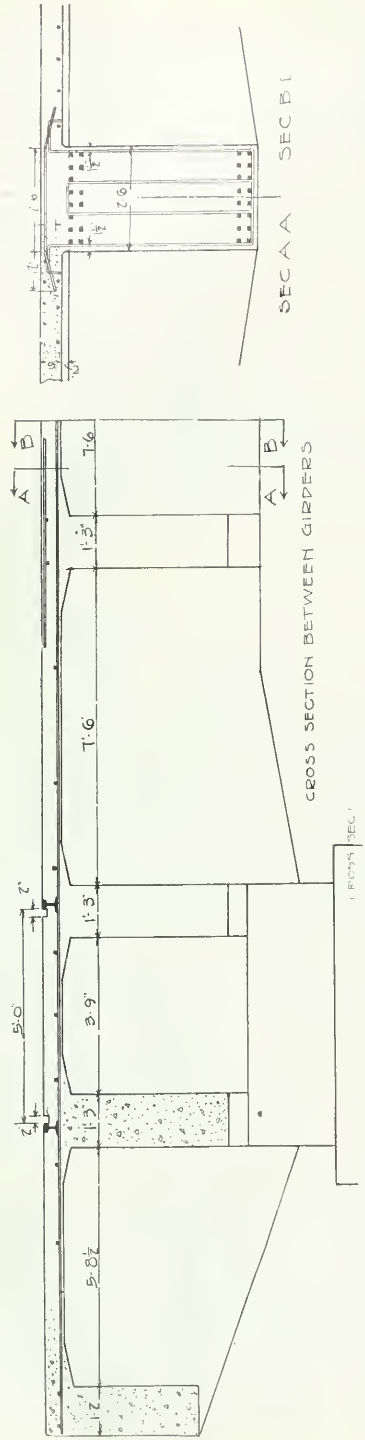


Fig. 11. Detail Cross-section of Dock and of Main Girder

tive cranes, one having a capacity of 20 tons at 12 ft. radius and 1 of 15 tons at 10 ft. radius; 1 pile driver; 6 No. 1 and 2 No. 3 Emerson pumps; 2 centrifugal pumps, one 16-in. and one 8-in. discharge, used to drain the pit inside the coffer dams; 1 Scotch marine boiler (300 H. P.) for suplying steam for the above pumps; 3 concrete mixers (½ cu. yd. capacity); 1 mixer (⅓ cu. yd. capacity) and 13 star drills. The mixers and star drills were operated by air.

Progress of Work.—The first work in sinking caissons was begun March 22, 1911, but was carried on with a very small force until the first part of June, as proper equipment could not be secured before that

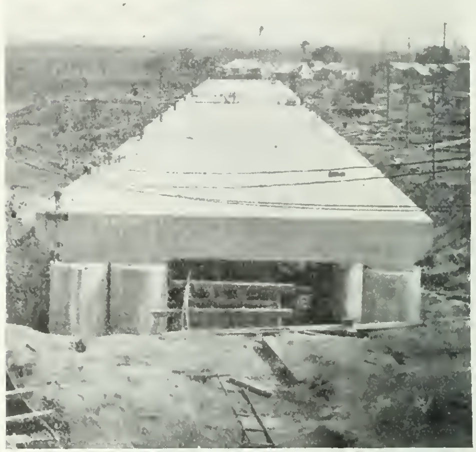


Fig. 12. The Completed Structure from Above

time and it was necessary to do some experimental work to determine the best method of sinking. In favorable material 3′ to 5′ of penetration per day (9 hrs.) was made. After the second layer of sand was reached sinking was very slow, from 1 or 2 inches up to 2 feet.

On Dec. 10, 1911, all the caissons were on rock with the exception of one that came under the railroad track and was finished on December 23rd.

The tie girders were set in position at odd times as the sets of piers were completed and filled.

The first concrete work on the floor system was begun December 2, 1911, and 7½ panels or 220 lin. ft. laid in that month. Within the month of January, 1912, 11½ panels were laid, 340 lin. ft. The three remaining panels were completed by February 6, 1912.

Swiss architects and building contractors held a meeting recently in Zürich to discuss means of introducing concrete construction to a larger extent in Switzerland, especially in the matter of buildings. A committee was appointed to investigate this question and suggest means of meeting the problem.

An Experiment In Shipping Cement In Bulk Is Successful

A car-load of cement in bulk left the Buffington mill of the Universal Portland Cement Co., last month consigned to the Pennsylvania Coal & Supply Co., Milwaukee, Wis. This was done to determine the possibility of shipping cement in this way and the experiment was highly successful in every way. The car arrived at destination with absolutely no signs of loss or leakage. The cement was lying smooth and undisturbed, in apparently the same condition as when it left the mill.

The car was lined with a waterproof paper of comparatively light weight for 4′ above the floor and the doors were boarded similarly to common practice in grain shipments. The cement was loaded into the car from wheelbarrows. The lining of the car may not be necessary when the car is reasonably new, although it is too early at this time to tell what precautions must be taken against loss. The lining with paper has proved conclusively to be sufficient protection, but how much less is advisable must be found out by subsequent shipments.

Fig. 1 shows the interior of the car after the door had been opened and the bars removed from across the door. It was found practicable to unload the cement with shovels and wheel-barrows and, in fact, much less dust was raised than if the cement had been handled in sacks. The cloud of dust which is given out when a sack of cement is dropped onto a truck was absent. The cement was shoveled into wheelbarrows and wheeled into one corner of the block and sewer pipe factory of the Pennsylvania Coal & Supply Co. Some of it was wheeled directly to the mixing platform.

Fig. 2 shows the platform with the cement and sand piled in the foreground. At the back is cement sacked in the usual way. The mixer shown at the right has two feed hoppers; one for cement and one for sand. It was found much easier to shovel this cement into the mixer than to lift up 95-lb sacks, open them, empty and shake them into the hopper.

This experiment on the part of the Universal Portland Cement Co. was made to find out whether or not the cement companies are wasting a great deal of time, energy and money in handling cement sacks. Of course dealers and cement users who have to handle their cement by team will have to continue getting it in sacks, at least for some time. But factories making cement products and contractors doing big jobs adjacent to railroad tracks and using central mixing plants can probably be better served with cement in bulk rather than in sacks.

Is there any reason why cement should be put into sacks and then emptied out again when it could make the trip from the mill to the job just as well in bulk? Is there any reason why a large amount of capital should be tied up in cloth sacks, or spent for paper sacks, or why the other items of expense connected with the package end of the cement business should be incurred if cement can be handled in bulk.

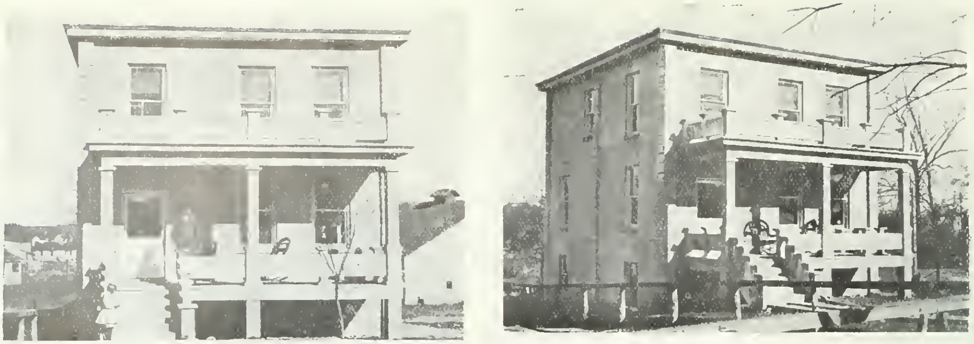
Portland cement is now one of the cheapest manufactured commodities on the open market. Its value F. O. B. mill, is now not more than $3.00 to $4.00 per ton. This is ¼ the value of pig-iron and about the same as some grades of coal. What is

Fig. 1 (Above) and Fig. 2 (Below). Shipping Cement in Bulk

the use of putting 70 to 80c worth of cement into 40c worth of package if that package can be dispensed with? Grain and other commodities having a much higher value per ton are shipped in box cars in bulk and there is no reason why cement should not be handled in the same way. The small investment in unloading equipment and storage facilities is all that is required and this investment can be made to pay for itself several times in a single season on a job using any quantity of cement.

The Niles Sand, Gravel & Rock Corporation, Niles, Cal., is about to install new equipment for electric drive consisting of four motors of 15, 75 and two of 50 H. P., respectively, orders for which have been placed with the General Electric Company.

The concrete work in the spillway of Gatun Dam is about 89% completed, 199,101 cu. yds., out of a total of 225,000, having been placed at the close of work on June 1.



TWO VIEWS OF BRENTWOOD, MD., HOUSE

Poured Concrete House With Concrete Roof for $2,300

William T. Redman, Brentwood, Md., showed considerable ingenuity in planning and carrying out the construction of this monolithic house himself, even devising a special wooden form with which the hollow walls were built. By raising the wall forms 12″ at a time, a course of concrete of that thickness was poured entirely around the house, the marks left by the forms of the previous day's run were effaced with a brush while the concrete was still green. Outside walls for basement, first and second stories were 10″ thick. The air space, 4″ wide, was formed by a collapsible core.

The roof is deserving of special attention, as it is a flat reinforced concrete slab with only enough pitch to drain off the water. Concrete is better adapted to the flat pitched roof and has more architectural possibilities than have been developed in the steep pitched shingle roof of wooden construction.

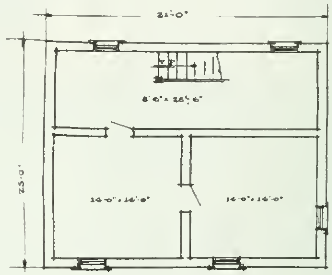
The porch is of concrete throughout and the steps leading to it has a balustrade consisting of concrete pedestals of effective design.

The house is 25′ x 31′ in plan and has nine rooms, three of which are in the basement. Four of these rooms are of unusually generous size and all are well lighted and ventilated. This house, which cost but $2,300 with gas, electricity, heating and plumbing installed complete, is a direct contradiction to Benjamin A. Howes' contentions printed in an article in the *Saturday Evening Post* recently, wherein he maintained that houses such as the one just described are a "hurt and disappointment to their owners."

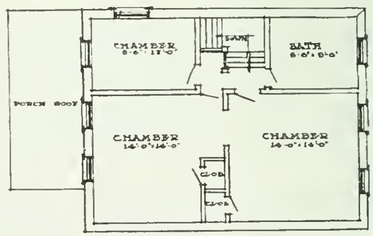
Wooden floors in this building could have been replaced by fireproof concrete floors, and still the cost of the house would not have been excessive.

That concrete is economically adapted to the building of houses well below the $10,000 mark is evidenced by thousands of examples all over the country. The position of pre-eminence that concrete has attained above all other building materials is due to a careful observance of the fundamental principles which govern its use. Where dissatisfaction or failure is recorded it may safely be said that one or more of such principles were violated.

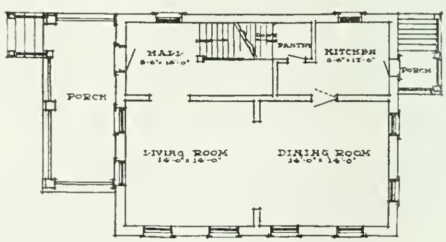
With due regard to architectural treatment and with the exercise of the fundamental principles for obtaining good concrete and handling it properly, the result will prove a great source of satisfaction to both architect and owner.



BASEMENT · PLAN



SECOND FLOOR PLAN



FIRST · FLOOR · PLAN ·

Accidents in Building with Reinforced Concrete

BY DR. F. VON EMPERGER.*

(Translated by C. Salter)

[Editorial reference is made in this issue to the importance of the forthcoming Congress in New York, September 3 to 7, of the International Association for Testing Materials, the first meeting of this disinguished body in America. The proceedings will include subjects of great interest to cement manufacturers and engineers. The summary of a paper presented herewith is an example. It touches upon a matter of vital moment, namely, the importance of having not only responsible and official experts to investigate and report as to accidents in reinforced concrete construction, but international discussion and action upon them rather than the inefficient hit or miss practice that prevails in many countries and cities. Dr. F. von Emperger, the author is too well known to require introduction to an American audience, and the suggestions he makes in the following abstract of his paper will receive the attention they deserve.—EDITORS.]

Experiments in which accidents in the course of building are brought about by design are known to be capable of affording valuable information on the properties of materials; and thus an accident during building also forms a material test, carried to the point of rupture and furnishing particulars of a defective property of the material. It is naturally to the general interest that these tests should be confined to the laboratory and we believe therefore that these experiments and the increased knowledge gained thereby on the building materials and their coaction form the means whereby accidents in practice may be prevented. In order, however, to ascertain what are the points on which our knowledge is capable of improvement, and where experimental investigation should begin in order to attack the problem effectually, we must endeavor to trace the main origin of these building accidents and find in what their causes consist. The same dual task had to be faced in drawing up the report on building accidents, presented to the Brussels Congress in 1904. The inadequacy of private means for an exhaustive representation was expatiated upon in that report, and the desire was expressed that a clearer insight into the circumstances of the case might be afforded by the aid of unimpugnable official statistics.

This endeavor, the primary aim of which is the prevention of accidents, has, in the meantime, been able to record an important success, inasmuch as two countries have given effect to the aforesaid wish of the Congress by introducing a system of official reports, thereby creating an unimpeachable basis for further work of the kind. This was effected in a particularly thorough manner in Germany by an ordinance issued by the Ministry of Public Works on Sept. 18, 1911, which, at the outset, was applicable only to Prussia.

This ordinance not only prescribed the procedure to be adopted in all kinds of building accidents (and therefore including also such accidents as, not being attended with any injury to life or limb, were not previously subjected to any jurisdiction), but also ensured competent judgment, by providing a list of experts, whereas the pre-existing reports on building accidents were not only very imperfect, but had also been drawn up, as a rule, by persons more or less unquailfied for the work.

A similar, though less detailed ordinance was issued by the Austrian Ministry of Public Works at a somewhat earlier date. These two important ordinances fulfilled a principal wish expressed in the report of the Brussels Congress in 1906, in this connection, and at the same time created an influential example. At all events they have restricted the system of private reports to the other countries exclusively.

One of the chief causes of such accidents in concrete work has always resided in imperfect knowledge of the material at the time of removing the false work, since, in view of the divergent influences to which the material is exposed in building operations, the quality of the material can only be imperfectly judged in the laboratory; or also because, in the absence of any connection between the laboratory and the building site, the material has actually escaped any checking. It has happened, for instance, that the false work has been taken down from concrete which has been spoiled by frost or checked in its development, although the regulations laid down for ordinary average conditions have been strictly complied with; and that this premature dismantling of the false work has led to extensive accidents. Moreover, it has also happened that some contractors have had accidents when working along approved lines, through using materials to which they were not accustomed, without having ascertained whether the same were equal to those with which they were acquainted.

Even the most careful precaution cannot, perhaps, always prevent accident; for builders do not always possess the warning consciousness of danger at the time when the latter is most imminent. For such contingencies, the present writer has found a trustworthy and proved auxiliary* in the form a check — or test beams, which enable one to ascertain, in a simple and reliable manner and on the spot, whether the concrete of a structure is quite ready for the falsework to be taken down, or whether that operation should be delayed. The use of this auxiliary is strongly recommended when building operations are being carried on under unusual conditions, especially in autumn and winter; also in excessively hot weather and when unknown material is being used; and a warning must be uttered against the assumption, so frequently expressed, that an experienced concrete layer can judge concrete by touch. For instance, I have, on several occasions on which specimens of sand and gravel have been rejected, or declared, from their appearance, as bad, by experienced men in the trade, obtained fundamentally different results by means of the test beam. How much less is it possible to determine the influence of cold on the concrete from

*Vienna.

*For description of the "Control Beam" and its operation, see *Cement Age* for Nov. and Dec., 1911, and Jan., Feb., March, May and June, 1912.

its external appearance only. For the purpose of affording a thorough check on concrete, I have applied and tested this method during several building operations in Vienna in 1910.

Taking all these circumstances into consideration, the further continuance of the system of making private reports does not seem advisable; and it is recommended that the German and Austrian official representatives should be consulted, in order that a report from official sources may be available for the next Congress. The wish might also be expressed that the other States would follow the example, and by means of these facts, afford a comprehensive review of the measures to be adopted for the prevention of building accidents. The matter would become more complicated and important by the inclusion of the Latin countries, such as France, in which there is no stringent building-police supervision, at least of the kind customary in the Germanic countries. It would furnish an opportunity for comparing which of the methods gives the best results, or in which respect they have an improving influence on the contractor, if the statistics were compiled in an approximately uniform manner. The question at issue is whether a high condition of independence and the consequent feeling of responsibility are able to replace the present extensive but always insufficient supervision, or not. The matter of uniformity of the reports demands an international pronouncement, which, however, is only possible on the occasion of our Congresses; and it would be desirable if this could be brought about by the time of the next Congress.

As one of the most important measures in connection with the widening of our knowledge on the matter in question, the fostering and extension of experiments in building-mechanics in general and in their simplest, and therefore so important form, namely the test beam, are warmly recommended to all interested in the matter. It would also, in the first place, be desirable that reports on the use of the test beam in practice should be presented to the next Congress.

Cement Shows to be Held in Chicago and Pittsburgh—Convention in Pittsburgh

Cement shows will be held in the coming winter in Pittsburgh and in Chicago and in connection with the Pittsburgh show, December 12 to 18, the National Association of Cement Users will hold its ninth annual convention. The Pittsburgh show will be held in Exposition Hall, Duquesne Way, and the Chicago show will be in the Coliseum as before, and from January 16 to 23.

The announcement of the Cement Products Exhibition Co. is to the effect that the selection of Pittsburgh for a show and the abandonment of New York was based upon the desire of the management to hold a show in a new territory. President Edward M. Hagar of the Cement Products Exhibition Co., in issuing a statement regarding the shows said, "Pittsburgh was chosen for one of the shows for a variety of reasons. In the first place, Pittsburgh is centrally located and readily accessible from all points in a large and important concrete using territory. The facilities for holding a large exhibition and convention in Pittsburgh are excellent and assurance of the hearty co-operation of the people of Pittsburgh has been tendered. Second, the policy of conducting shows in new territory offering possibilities for concrete construction appeals to me. I believe it advantageous to hold shows at points which will attract the largest number of people who can be influenced in favor of concrete construction."

Exposition Hall, Pittsburgh, has even more floor space than the big Coliseum in Chicago. The conditions for installing and removing exhibits are ideal. The building is conveniently located with reference to the principal hotels and central business district of Pittsburgh. The dates for the two shows this time have been fixed earlier in the winter. This action was taken after a careful study of the advantages offered by the various months and after consulting the opinion of a great many exhibitors. Many of those with whom conferences

Concrete Bridge Over Charles River, Boston

Charles River Bridge, Boston

This view of the Charles River bridge, Boston, an ornamental concrete structure, 1700′ long, is an interesting illustration of the utility of concrete in this field, whether judged from the standpoint of structural worth or its beauty. Work on the bridge was begun July 31, 1907 and inspection of the completed structure by state and city officials as the guests of the Boston Elevated Railway Co., took place May 27, 1912. The bridge foundations contain 24,633 cu. yds. of concrete and the superstructure 9,000 cu. yds., the latter built of Giant Portland cement.

were had expressed a strong preference for December and January dates for the cement shows, the argument being that those are the months in which the manufacturer of, and the salesmen for cement products, appliances and machinery have the greatest leisure for attending exhibitions. It is also the time of the year when architects, contractors, builders and dealers have the most time to spend a day or two visiting the show and taking in the sessions of the convention of the National Association of Cement Users. Building operations are almost at a standstill and there is little of interest in the building material line to occupy the attention of the trade. Experience has shown that when the exhibitions are held too late in the spring, construction plans have advanced too far and builders are too actively engaged in preparing plans and estimates to allow them to take in the shows. Again many exhibitors state that it is necessary to have some time intervening between the close of the cement shows and the opening of the building season in which to follow up prospects for sales developed at the shows. In one instance an exhibitor at the Chicago show last year produced evidence that at the exhibition he was placed in touch with over four hundred good prospects, practically all of whom could undoubtedly have been induced to purchase his flooring material. The time after the show was so short, however, that he found it possible to send salesmen to interview and sell only a small proportion of his prospects. Other manufacturers report similar experiences. By advancing the dates for the shows the management hopes to solve this problem.

The space rates for the shows next season have been put upon a very reasonable basis. That the cost of space has not been too high in the past is evidenced by the annual report of the Exhibition company, which shows that there was only a surplus of $900 remaining at the close of business last winter. While the total income and expenses exceeded $75,000, the balance of only $900 indicates very conservative management. The policy originally adopted by the Exhibition company, of spending all revenue for the benefit of the shows has been rigidly adhered to and has been adopted as the policy for all future shows.

All indications point to the continued success of the cement shows. A number of innovations in the cement show arrangement, equipment and decorations are promised. The personnel of the management remains the same. J. P. Beck is general manager; F. E. Guy, traffic manager, will again assist exhibitors in their transportation problems and M. E. Gordon has again been selected as installation manager.

The coming shows will be advertised more widely and vigorously than ever. They will be of their usual scope, embracing all articles and appliances concerned with the use of concrete. This includes, cement, sand, gravel, special aggregates, concrete mixers, cement brick, and block machines, machines and molds for sewer pipes and drain tile, special form systems, molds for fence posts, burial vaults, porch columns, vases and culverts, forms for cement sidewalks, curbs and gutters, wheelbarrows, carts and wagons for cement work, hoists, elevators, buckets, belts, chains and gears, portable saw mills, gasoline engines, contractors tools, rock crushers, sand and gravel washers, pumps, reinforcing rods, wire, metal lath, fireproof metal doors, windows and fittings, cement, trade and technical periodicals and books, decorative floor tile and floor finishing machines, ornamental cement work, concrete garbage and ash receptacles, waterproofing materials, cement paint, coloring compounds, wire ties, bags, bag filling devices, pile drivers and pile systems, testing apparatus and special reinforcing systems.

President Richard L. Humphrey of the National Association of Cement Users is busily engaged in preparing the program of papers and addresses for the convention. Efforts are being made to secure papers from not only the most famous authorities of this country, but from the experts of foreign countries as well. The entire field of concrete construction will be touched upon by the subjects as outlined by President Humphrey. The proceedings of the association each year constitute the most valuable contribution to the knowledge of concrete that may be found anywhere. The various standing committees have received letters from President Humphrey containing instructions to push their researches as rapidly as possible so as to be able to report their findings and conclusions when called upon at the convention in December. An active pre-convention campaign for more members is being conducted by Secretary Edward E. Krauss. The annual dues are only five dollars and the secretary seems to have no difficulty in convincing those who do not belong, that membership in the association is worth several times the annual dues.

Free Lime in Portland Cement

H. E. Kiefer, in the *Journal of Industrial Engineering and Chemistry*, reports results of tests which show that the presence of free lime (anhydrous) cannot be the sole cause of the failure of certain samples of cement to pass the boiling test. Le Chatelier has stated that the addition of 1 per cent of freshly calcined lime to a sound cement will render it unsound, but in the author's experiments, finely ground lime was added in relatively large quantities (in one case up to 25 per cent.) to samples of cement without rendering them unsound. In all the cases tried, the quality of the cement was improved by finer grinding or by removing the coarser particles by sifting. In other experiments in which unsound cements were exposed to moist air at 150° F. (65.5° C.), the absorption of from 0.1 to 0.27 per cent of moisture sufficed to render the cements sound.

Elbert Hubbard voices this timely epigram: "Instead of hitching your wagon to a star, suppose you just get in touch with the good roads movement."

Some Notes on Essential Details in Depositing Concrete

BY RUDOLPH N. MAXWELL

Depositing concrete after mixing is a very important step in concrete work, and to secure the best results, the following points shoull be thoroughly observed.

Preliminary

(1) The excavation for all foundations, footings, and bearing walls should be carried down to a hard firm sub-stratum and to original ground if possible, and brought to a horizontal plane, or if necessary, horizontally stepped off to prevent sliding of the superstructure and to reduce settlement to the minimum. The excavation should be free from loose earth, insecure or spongy matter, sewage, contaminated water and refuse.

(*a*). Where formwork is used, it should be practically watertight, cleaned out, well sprinkled with water and secure against bulging, and should be thoroughly braced to prevent being misplaced by the shaking and jarring incident to concreting.

(*b*) If the concrete is deposited directly upon other concrete, the surfaces of contact should be clean, free from oily matter, and should be rough and well grouted to secure a good bond for the new work. All blocks of wood, shavings, saw-dust, rust, scales, locomotive cinders, and stray matter should be removed without fail, and extra care should be given to the first and last batches of concrete deposited in each day's work.

(2) Reinforcing steel should be properly located and securely wired or fastened to prevent being misplaced. Reinforcement should be employed in the specified amounts and should not be crowded. The steel should be free from rust-scales, mud coatings, grease, oil and all matter likely to interfere with adhesion. A slight coating of rust on the steel is not objectionable providing the steel is not scaly.

(3) Formwork and other materials that absorb water and all concrete surfaces of contact should be thoroughly wetted prior to concreting to prevent the absorption of the necessary water from the concrete being placed.

(4) Concrete work should be thoroughly inspected, preferably by a representative of the owner or architect, previous to concreting as well as immediately after the removal of the forms. This inspection should include footings, foundations, forms, steel work and the various concrete joints.

(5) All concrete ledges likely to be broken off by falling or other objects should be protected from injury.

Depositing Concrete

(1) Concrete should never be thin enough in consistency, either in plain or reinforced concrete work, to allow quantities of water to collect or stand in the barrows or other receptacles on the concrete contained therein; but concrete in reinforced work should be somewhat thinner than in plain work, to allow the thinner portions of the concrete to flow around the steel reinforcement.

(2) Concrete should always be deposited in bulk and never be allowed to scatter by falling great distances or by coming in contact with reinforcing steel or other intervening objects.

(3) Concrete should never be placed in running water without protection from the washings thereof or allowed to come in contact while being deposited, with contaminated water, oils or strong alkalies.

(4) Concrete should be deposited in relatively small quantities at a time, but these deposits should not be regarded as layers as usually spoken of in specifications. One lot having been deposited, thoroughly tamped and brought to a level, should, if possible, be followed up immediately with other concrete with no appreciable break.

(5) All concrete whether of a wet or dry consistency should be thoroughly tamped, but a dry mixture requires somewhat more tamping than a wet mixture.

(6) Those engaged in the tamping should not be changed about while concreting. Changing men about at this important stage not only shifts responsibility but increases the chance for honeycomb and inferior work.

(7) Tapping the formwork gently on the outside, with a mallet or other device during concreting, lessens the danger of the formation of honeycomb, stone-pockets, air-bubbles and pin holes. This tapping must be done gently, however, to prevent the breaking out of the formwork which at such times is under great pressure.

(8) Concrete should never be jarred, shaken or disturbed for at least 12 hours after being placed in position, and if possible, more time should be allowed. Concrete after being placed should be protected from the hot sun and drying winds and should be kept thoroughly wet for several days or more to prevent rapid or unequal drying out.

(9) Formwork should be allowed to remain around the members as long as possible, as this lessens the danger of accident, sagging horizontal members and of the breaking off of prominent corners and edges or of otherwise marring the work while it is green.

(10) In important building construction, concrete should never be allowed to be patched up until it has been inspected and passed upon by a representative, other than that of the contractor doing the work. Poor concrete is often otherwise covered up, greatly to the detriment of the work. The positive enforcement of this rule will be accompanied by better results generally. Patched work is usually detectable, being of a slightly different color than the body of the work and often is accompanied with shrinkage cracks around the patch.

Joints in Concrete Work: Care should be exercised in the formation of joints in concrete work, especially in conspicuous places. A poor or unsightly joint not only mars the appearance but may effect the strength of the member or structure as a whole. The first and last batches of concrete therefore, deposited in each day's work should be especially well tamped and all surfaces brought to a level and roughened up afterwards where more concrete is to be placed upon it, but never left rough due to insufficient tamping.

A wooden strip nailed horizontally to the interior of the formwork, forming when later removed, a groove or false joint, an inch or so deep in the exposed face of the concrete, may be used to advantage to mark the end of one day's concreting and the beginning of the next, and the concrete stopped off at this level. This groove not only adds to the appearance of the structure on exterior surfaces, hiding what otherwise might be an unsightly joint, but is an effective means of breaking the monotony in the face of long stretches of concrete.

The outside faces of exterior columns just below the floor line, when columns are concreted up to the soffit or under side of the beams and girders, may be treated effectually in this way, as also walls that cannot be carried to the top in one day's concreting. These strips should be thoroughly secured to the formwork from the inside to prevent being misplaced in the depositing and tamping of the concrete, and should be saturated with water to prevent swelling, with resultant injury to the concrete.

Temperature of Concrete During Setting

In view of the fact that inquiry is frequently made as to the temperature of concrete when setting, it is interesting to note that in a paper read before the Iowa Engineering Society, W. D. Maxwell gives the following account of tests made during the Des Moines River concrete bridge work to determine the temperature of concrete during setting. A large number of readings were taken in pipes set in the piers and abutments. Readings were made from 5 to 10 ft. below the top of the concrete and 3½ to 6 ft. back from the face. The concrete was a 1:3:6 mixture, Hawkeye cement. A summary of the observations shows that the temperature increases 15° to 20° F. within the mass during setting, and that the maximum temperature is attained in 7 to 10 days, after which the temperature falls at a rate depending on the outside air. In pier No. 1, temperature increased from 45° to 64° in seven days, outside temperature ranging from 27° to 44°. In pier No. 2, temperature increased from 43° to 58° in seven days, outside temperature ranging from 6° to 33°. In west abutment, temperature increased from 66° to 86° in ten days, outside temperature ranging from 65° to 95°. In east abutment, temperature increased from 70° to 90° in ten days, outside temperature ranging from 65° to 95°.

The British Concrete Institute

The third annual general meeting of the British Concrete Institute was held May 9, with Sir Henry Tanner presiding. The annual report was presented, showing that important progress had been made during the past year.

The Standing Committee on Tests has under consideration the following subjects:

(1) The effect upon steel of the presence of sulphur in aggregates.

(2) The grading of aggregates.

(3) The expansion and deterioration of concrete due to changes in atmospheric temperature.

(4) The effect of the use of sodium silicate on the surface of concrete as affecting reinforcing metal.

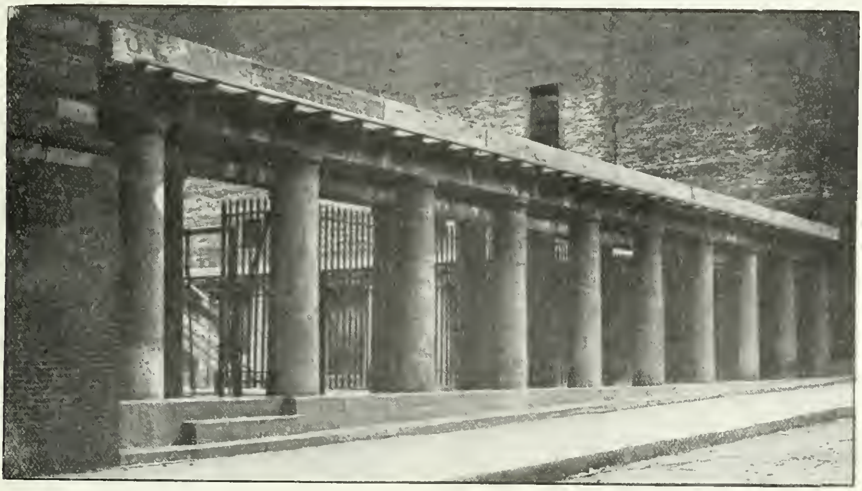
(5) The erratic results obtained by the Vicat needle in ascertaining the initial set of cement.

The Reinforced Concrete Standing Committee has under consideration:

(1) Methods of treating the surface of concrete.

(2) Cracks due to the expansion and contraction of reinforced concrete.

The Institute is taking steps to enlarge its scope, a resolution to that effect having been passed with special reference to structural engineering.



Pergola With Concrete Posts, Base and Timbers, Built on the Playground of the Columbus School, Boston

House in Oak Park, Illinois

Working Drawings for Concrete Block and Stucco House

BY JENS C. PETERSEN

The complete drawings illustrated this month are for a nine-room house, 34′ wide and 30′ deep in the main portion, with a kitchen and pantry 11′ 6″ x 21′ 6″ as an extension to the first story. It was built in Oak Park, Ill., and is shown in the illustration from a photograph on this page.

This house is roomy, convenient and economical, having large rooms, separated with trimmed openings and sliding doors. A 10′ porch extends entirely across the front. The rear porch is large enough to be used as a dining porch if desired.

One particularly good feature of this house is the great number of windows permitting plenty of circulation of air. The large rooms also leave ample wall space. The arrangement of the rooms and the exterior of this house have been very highly complimented.

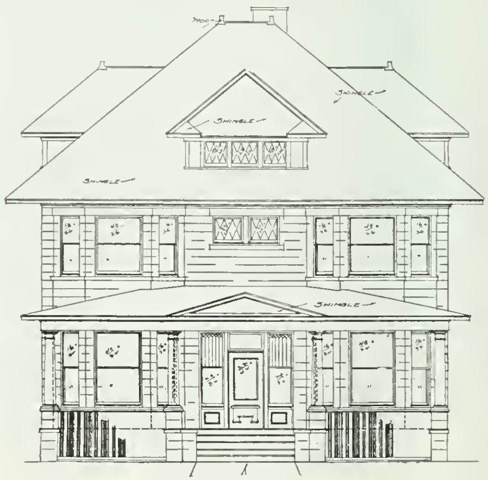
The main rooms on the lower floor are trimmed in oak, which is stained a deep brown. The rooms on the second floor are birch, stained mahogany.

The construction of the basement is of solid concrete, to the grade, with the water-table three block tiers above grade.

It will be noticed from the working drawings that the outside walls are built of block; over the block has been laid a heavy coating of pebble dash stucco slapped on with a paddle. Wherever the exterior trim is exposed it is painted white. Roof lines and cornice lines have been made wide and projecting, with no frieze, except at the porch.

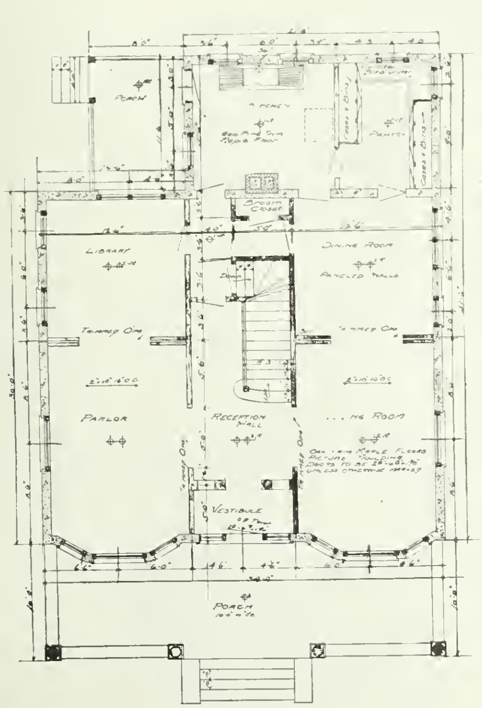
The approximate cost of this house is $5,000, not including plumbing and heating. These figures will hold good in the average locality, and may be proportioned about as follows:

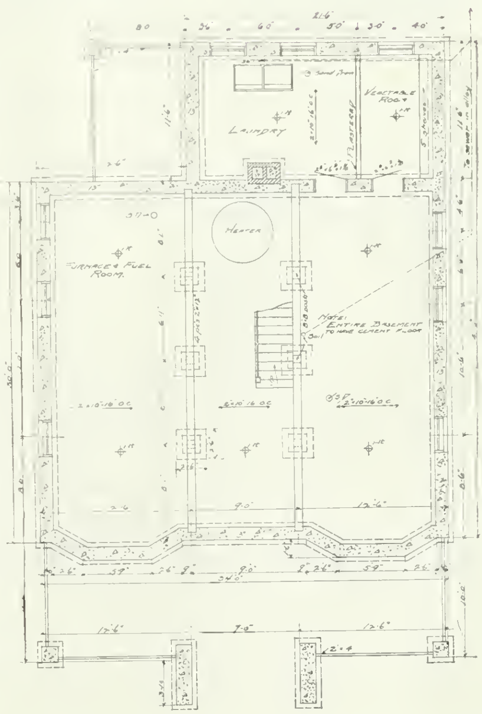
Excavation		$ 100
Concrete		1,600
Rough carpentry		1,200
Finish, frames, etc.		900
Plastering		600
Painting		300
Hardware		150
Fixtures		150
		$5,000
Heating	$500	
Plumbing	400	
		$ 900
		$5,900

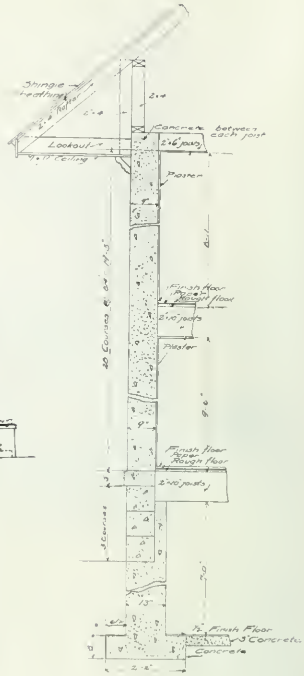


Front Elevation—Scale 1/12″ to 1′

SIDE ELEVATION AND FIRST FLOOR AND BASEMENT PLANS—SCALE 1/12" TO 1'; OAK PARK, ILLINOIS, HOUSE

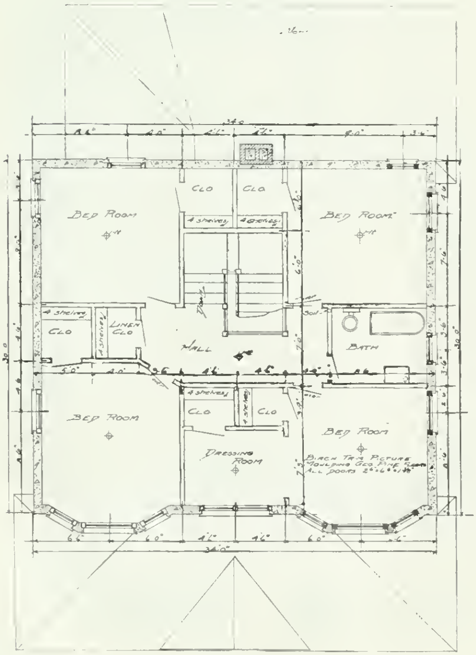






Side Elevation, Second Floor Plan and Rear Elevation—Scale 1/12" to 1'; Oak Park, Illinois, House

Above is a Wall Section of the Oak Park House —Scale ¼" to 1'



Effect of High Pressure Steam in Curing Concrete*

It is well known that the hardening of Portland cement is accelerated by exposure to heat after hydration, but the value of this acceleration and the possibilities of its application to commercial purposes have not been extensively investigated. In the manufacture of concrete products it is highly desirable to produce a material of uniform and known quality. Even under laboratory conditions a variation of 50% in strength may be obtained between maximum and minimum values for similar concrete, mixed and molded under apparently the same conditions.

The purpose of the investigations reported in this paper was to determine what acceleration in hardening could be obtained by using steam under pressure, with corresponding higher temperatures.

Outline of Tests

There were two series of investigations: 1. To determine the effect of different steam pressures on the hardening of Portland cement mortars. 2. To determine the effect of duration of steam exposure on the hardening of Portland cement mortars.

Inasmuch as mortar mixtures are extensively used in the manufacture of cement products, and since it was thought they would give relatively similar results to those which would be obtained with concrete mixtures, one mortar mixture exclusively was tested. This mortar was composed of 1 part by volume of Portland cement to 4 parts by volume of well-graded sand. Two percentages of water were used in mixing, corresponding to those employed in molding cement products. One has been termed a damp consistency, the mixture containing only sufficient water to permit of molding a ball in the hands and holding between the thumb and finger. Water could not be drawn to the surface by troweling. The other designated a "quaking" consistency, contained all the water it would hold and permit of making a ball in the hands and holding between the thumb and finger. Water could easily be drawn to the surface by the pressure of a trowel.

Unfortunately the second series of tests was not made until eight months after the first series. The same cement was used in both series but it was stored in galvanized-iron cans during this period and became slightly lumpy. The large lumps were screened out by passing the cement through a quarter-inch mesh sieve, and an endeavor was made to crush the small lumps; but it would appear from the results that the tests were affected somewhat by this difference in the quality of the cement, due to its age and condition, and the results of the second series are not directly comparable with those of the first series.

*This is an obstract of Technologic Paper No. 5 of the U. S. Bureau of Standards, entitled: "The Effect of High-Pressure Steam on the Crushing Strength of Portland Cement Mortar and Concrete," by Rudolph J. Wig, Associate Engineer-Physicist of the Bureau of Standards. The matter appearing under the caption "Summary" was published in *Cement Age*, March, 1912. Attention also is called to a paper by R. F. Havlik published in *Concrete* April, 1911. Mr. Havlik assisted Mr. Wig in making the government tests. More complete details of tests are now published because of greatly increased interest in "curing" methods by concrete products manufacturers. Numerous detailed tables are presented in the paper as published by the Bureau of Standards and a study of the full report as published by the government bureau is recommended.—THE EDITORS.

FIG. 1.—VIEW OF STEAM CURING EQUIPMENT

FIG. 2.—STEAM CURING TANK

However, each series is complete in itself and gives the desired information.

A detailed outline of tests is given in the table following:

OUTLINE OF TESTS

One part Portland cement to four parts Meramec River sand.

SERIES.	Steam pressure (gage) Pounds	Time in steam Hours	Test pieces tested at the following periods in days: 2	7	14	28	Total[1]
1. Quaking consistency	Atmos.	48	3	3	3	3	12
	2	24	3	3	3	[2]3	12
	10	24	3	3	3	3	12
	20	24	3	3	3	[3]3	12
	40	24	3	3	3	[4]3	12
	80	24	6	6	[5]6	[6]6	24
2. Quaking consistency	80	3	3	3	3	3	12
	80	12	3	3	3	3	12
	80	17	3	3	3	3	12
	80	24	3	[3]3	3	3	12
	80	48	.....	3	3	3	9
2. Damp consistency	80	3	3	3	3	3	12
	80	6	3	3	3	3	12
	80	12	3	3	3	3	12
	80	24	3	3	3	3	12
	80	48	.....	3	3	3	9

[1] The total number of test pieces tested in the series here shown aggregate 198. [2] Tested when 113 days old. [3] One tested at 110 days, two at 297 days. [4] Two tested at 84 days, one at 110 days. [5] Three tested at 89 days. [6] Three tested at 77 days, one tested at 210, other two not tested.

Tests of Constituent Materials

Only one sand, Meramec river sand, from Moselle, Mo., was used in these investigations. It is composed of flint grains having comparatively smooth surfaces. The yellowish-brown color of the flint imparts a tint of the same color to the sand as a whole. The physical properties and mechanical analysis of the sand are as follows:

Specific gravity	2.60
Percentage of voids (computed)	37.90
Weight (pounds per cubic foot)	100.6
Mechanical analysis:	

Sieve—	Per cent passing.
200	0.20
100	1.30
80	3.60
50	13.90
40	37.00
30	64.00
20	81.50
10	97.00
4	100.00

The cement used is known as typical Portland cement, being prepared by thoroughly mixing together a number of Portland cements.

Details of Tests

Although the proportions of the mortar mixture are stated by volume measure, they were converted into their weight equivalents for greater accuracy in measuring the individual batches, an allowance being made for the moisture contained in the sand. The weight per cubic foot of the cement was assumed as 100 pounds and the weight per cubic foot of the dry sand was 100.6. The materials were mixed in a cubical batch mixer. They were mixed dry for five minutes when the water was weighed, added, and materials mixed another five minutes. The test piece was cylindrical in shape, 8″ in diameter by 16″ in length, made in a cast-iron mold.

The mold was filled one-fourth full and hand tamped systematically with a 13-lb. peen-shaped tamper, care being taken to cover the entire surface. This operation was repeated until the mold was filled, when it was leveled off with a plasterer's trowel.

The molds were placed in the moist room immediately after filling, and the following day they were removed from the test pieces. After steam treatment all test pieces were stored in the moist room (with a few exceptions) until they were tested. The test pieces which were not steam treated were not removed from

Fig. 3.—Diagram of Steam Curing Tank and Piping

the moist room until the day they were due to be tested. All test pieces in the moist room were sprinkled three times each 24 hours.

Steam Treatment

The steam-curing equipment is shown in Figs. 1 and 2. The details of the construction and arrangement of the tank, piping, etc., are shown in Fig. 3. The equipment consisted of a curing tank 36″ in diameter by 10′ in length, with one head removable; three steel flat cars 24″ wide by 30″ long, track, steam-pressure regulating valve, steam trap, steam gage, and necessary piping. The steam was obtained from the power plant of the laboratory.

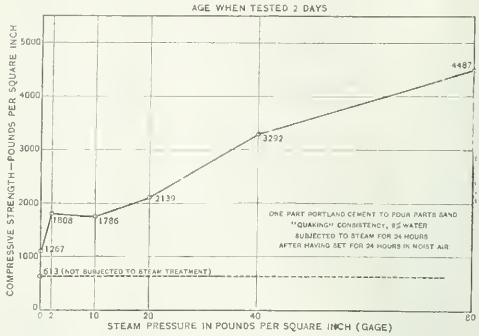


Fig. 4.—The Effect of Various Steam Pressures on the Compressive Strength of Portland Cement Mortar

The method of subjecting the test pieces to steam was as follows: Twenty-four hours after the test pieces were molded, the molds were removed and the test pieces were placed on the flat cars. The cars were rolled into the tank, the section of the track at the entrance of the tank was removed, and the head of the tank which was suspended on a rail was rolled into place and bolted. Valve *A* and the back pressure valve *B* were opened to permit the air to exhaust with the entrance of the steam. Valve *C* was opened, permitting the steam to flow through the pressure-regulating valve *R* into the tank. It required from 15 to 45 minutes to exhaust the air from the tank and bring the steam up to the desired pressure. For low pressures a mercury column was attached to the tank for greater accuracy in reading. The high pressures were read directly from the steam gage. When the desired pressure was reached the regulating valve *R* was set. After the desired period of steaming valve *C* was closed and valve *A*, back- pressure valve *B*, and the steam trap were opened, permitting the steam to exhaust from the tank. When the pressure was removed, the head of the tank was unbolted and removed. The cars were drawn from the tank, the test pieces removed, and either tested immediately for compressive strength or stored in the moist room until they were due to be tested.

Compression Tests

The ends of the cylindrical test pieces were smoothed off with plaster of Paris at right angles to the axis a short time before testing. The capacity of the largest testing machine available at the time some of the earlier tests were made was 200,000 pounds, which was not sufficient to cause the failure of all the test pieces. A machine of 600,000 pounds capacity was available later, however, upon which all test pieces could be crushed to failure.

Resuts of Tests

Examining Figs. 4 and 5, in which the pressure and temperatures, respectively, have been plotted with the ultimate compressive strength, it is observed that the acceleration in strength is very marked with the increase in the steam pressure and temperature. The gain in strength of the mortar exposed for 24 hours to steam at 80 pounds per sq. in. over the untreated

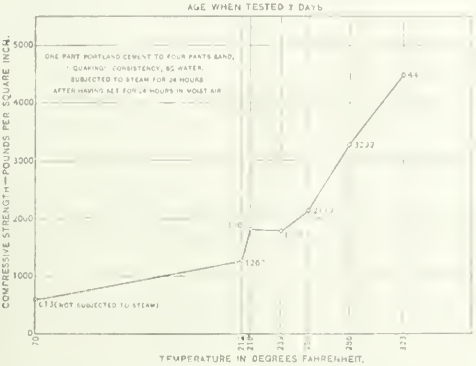


FIG. 5.—THE EFFECT OF STEAM OF VARIOUS TEMPERATURES ON THE COMPRESSIVE STRENGTH OF PORTLAND CEMENT MORTAR

mortar is 632%. Lower steam pressures give a corresponding increase in strength over the untreated mortar, and from the slope of the curves it would appear that the increase in strength would be correspondingly higher for higher steam pressures and tempeartures.

In Fig. 6 the age of the mortar when tested is plotted with the ultimate compressive strength for various steam pressures. It will be observed that there is no retrogression in strength with age in any case. The

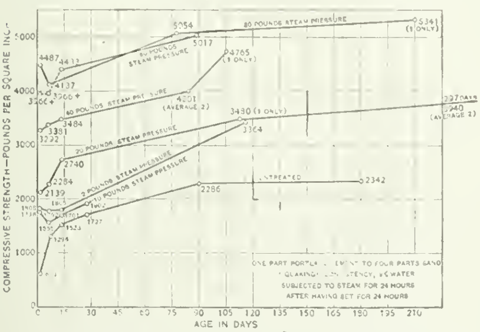


FIG. 6.—THE EFFECT OF VARIOUS STEAM PRESSURES ON THE COMPRESSIVE STRENGTH OF PORTLAND CEMENT MORTAR

untreated mortar does not equal in strength the steam-cured mortar at any period, and at the age of 180 days it has less than 50% of the strength of the mortar steam cured under 80 lbs. pressure for 24 hours.

Fig. 7 shows how the length of time of exposure to steam affects the compressive strength, the steam pressure being maintained constant. All mortar exposed to steam under 80 lbs. pressure for from 12 to 48 hours resulted in an increase in compressive strength over the untreated mortar. The increase in strength is from approximately 400% at the age of two days to 100% at the age of 28 days. None of the steam-cured mortar showed retrogression in strength between 2 and 28 days. The steam treatment of only three hours duration apparently had an injurious effect upon the hardening of the mortar, as that mortar developed only 60% of the strength of the untreated mortar at the age of 28 days. Comparing the 24-hour curve of Fig. 7 with the 24-hour curve of Fig. 6, it will be observed that the former lies below the latter for all periods, though, if the mortar were of the same quality in both cases, they should have developed equal strength. As previously explained, eight months elapsed between the making of the test pieces of these two series, and the cement had become slightly lumpy during this interval.

The mortar of series shown in Fig. 8 was mixed very dry, only 5½% of water being used, as compared with 9% in mortar of quaking consistency. The untreated mortar of this series is approximately equal in strength to the untreated mortar of quaking consistency shown in Fig. 7, but the steam-cured mortar of the damp consistency has developed only about 50% of the strength of the steam-cured mortar of the quaking consistency shown in Fig. 7. There is no apparent reason why the test pieces subjected to 12 hours steam treatment should exceed the strength of those exposed to steam for 24 hours and 48 hours. The strength of very dry mixtures is more dependent upon the personal equation of molding than is the strength of wetter mixtures, and it may be that this lot of test pieces received more tamping, as the weight per cubic foot of these test pieces was slightly greater than those of 24 and 48 hour tests.

Considering all of the above tests, it is apparent that steam under pressure will greatly accelerate the hardening. In order to determine the effect of steam on a lean mixture, one set of cylinders was molded of one part Portland cement and eight parts of sand, using 12½% of water. They were permitted to attain an initial set in moist air for 24 hours, when they were exposed to steam under 80 pounds pressure for 24 hours. They were tested immediately after removing from the steam, being two days old, with the following ultimate strength in compression (lbs. per sq. in.):

2038; 2307; 2040: Average, 2128.

From these tests it would appear that the strength of a steam-cured mortar is directly proportional to the cement content, but of course, too much dependence should not be placed on a few results. One set of limestone concrete cylinders made in the proportion of one part of Portland cement, three parts sand, and six parts limestone was made and tested. They were placed in moist air for the first 24 hours, attaining an initial set, after which they were exposed to steam at 80 lbs. pressure for 24 hours. They were tested directly after taking from the steam, being two days old, with the following ultimate strength in compression (lbs. per sq. in.):

2429; 2615; 2320: Average, 2455.

Several sets of cylinders, both mortars and concretes, were exposed to steam immediately after molding without permitting the material to attain an initial set. In every case the test pieces were cracked longitudinally by the steam, but the concrete or mortar was hard and the test pieces developed about half of the strength of those which were permitted to attain an initial set before exposure to steam. It was found that if the concrete was mixed to a creamy consistency, although it was permitted to set in the air for four days previous to exposing to steam, the test pieces would be cracked longitudinally by the action of the steam.

Several sets of cylinders were made in which hydrated lime was substituted for part of the cement,

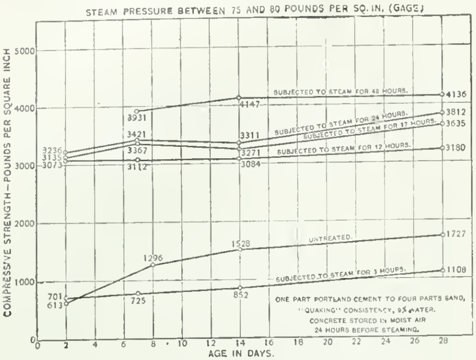


Fig. 7.—The Effect of Duration of Exposure to Steam on the Compressive Strength of Portland Cement Mortar

but the strength was reduced almost proportionally with the reduction in the cement content, the lime acting apparently as so much inert material.

Summary

The conclusions drawn on tests of this character must be understood as only directly applicable to materials similar to those tested and they must be lim-

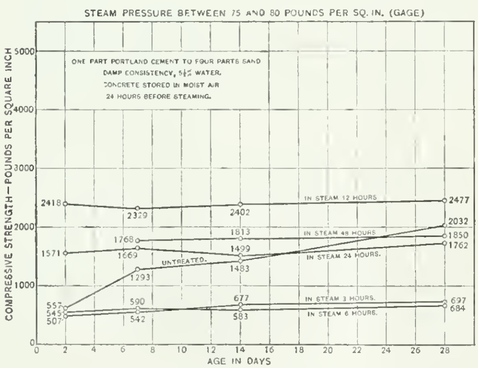


Fig. 8.—The Effect of Duration of Exposure to Steam on the Compressive Strength of Portland Cement Mortar

ited by the limitations of the investigation. However, the test piece was of good size and considering the large number made and tested, the reliability and accuracy of the results may be accepted.

1. Steam up to 80 pounds per square inch gage pressure has an accelerating action on the hardening of Portland cement mortar and concrete.

2. The compresisve strength increases as the steam pressure is increased.

3. The compressive strength increases with the increase in the time of exposure to steam.

4. A compressive strength considerably (in some cases over 100 per cent) in excess of that obtained normally after aging for six months may be obtained in two days by using steam under pressure for curing the mortar.

5. Steam under pressure, if of sufficient duration, permanently accelerates the hardening of the mortar, giving subsequent constant increase in compressive strength with age.

6. The steam-cured mortar or concrete is of much more uniform appearance and much lighter in color than normally aged mortar or concrete made from the same materials.

7. The mortar or concrete should attain an initial set before it is exposed to the steam treatment.

8. For steam curing a "quaking" or medium consistency is preferable to a very dry or a very wet consistency.

9. The initial modulus of elasticity and the yield point of the mortar increase directly with the duration of steam treatment.

10. The initial modulus of elasticity and the yield point of the mortar increase directly with the steam pressure.

11. The initial modulus of elasticity does not increase in direct proportion to the increase in the ultimate compressive strength of the steam-cured mortar.

12. Results indicate that the compressive strength obtained by steam curing is directly proportional to the cement content of the mortar.

Cost of Centering

The cost of the form lumber, no matter what method of figuring is used, depends upon the number of times the forms are used. For example, in a one-story structure the whole cost of the lumber (less its salvage), as well as the entire cost of making, must be charged to the surface or volume of the concrete in this one floor.

The following example illustrates the error in not taking into account the number of times the forms are used. Suppose the column form lumber at $30 per 1,000 ft. B. M. averages in first cost $0.60 per sq. ft. of surface, including sheathing, supports and bracing. If used for a one-story structure, the lumber cost is therefore $0.16 per sq. ft. in addition to a labor cost of, say, $0.045 for making and $0.155 for erecting and moving, or a total of $0.36. If the lumber, on the other hand, is used three times without alteration, the cost per sq. ft. of surface is ⅓ of $0.16=$0.053 for the lumber plus ⅓ of $0.045=$0.015 for making, plus $0.15 for erecting and removing, or a total of $0.22 for the total cost per square foot of surface, as against $0.36 for the one-story building.

Notwithstanding this direct effect upon the cost, the number of times moving is frequently not considered at all in estimating even by those who are otherwise accurate in their methods.

Providing for Steam Curing in a Plant Built for Natural Curing

BY PROSPER L. GOTTSCHALK*

In the past five or more years, I have read several dozen articles on steam curing, by men of more or less practical experience in the manufacture of concrete products.

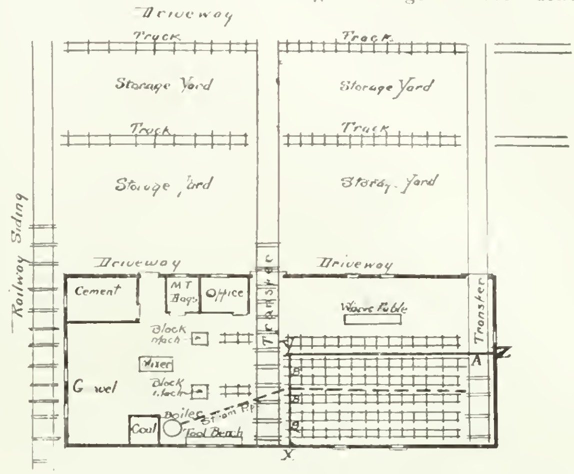
The great majority of these writers were of the opinion that it is absolutely necessary that steaming tunnels be used.

It is obvious that the principal manufacturers of concrete products of today are the conservative business men who were able to survive the reaction that followed the big concrete boom of several years ago. Most of these men have fairly good sized plants, substantially built of concrete block, which would not permit the installation of curing tunnels without incurring great expense.†

The writer being in the same predicament had to install a large curing room. Having found no advocate of this system, I have taken this opportunity to describe a practical steam curing room.

We had repeatedly been swamped with orders in the spring of the year as it required four to five weeks to cure concrete so we decided to cure our product by steam.

Our plant was 40′ x 100′ in plan and laid out as shown in the sketch.



Partitions of matched boards were put in at places indicated by lines *X-Y-Z*. A curtained opening being left at point marked *A* for the transfer car used to remove loaded cars from the curing room. The entire front of this room marked *B*, has an opening 5′6″ high and is closed by three canvas curtains having a lap of 15″. These curtains are fastened at the top and sides and bottom by hooks, through brass eyelets spaced 15″ apart. This method of fastening the curtains makes a steam tight room that readily permits placing cars in it with the least possible loss of steam. Wooden doors could not be used, due to swelling and warping.

The steam is applied through a 1½″ pipe direct from a boiler which was purchased second-hand at a small cost.

The piping is shown on the sketch and is overhead outside, but drops to about 6″ above the ground immediately inside the curing room. From this point it pitches down to the ground where the water is carried off by drain tile.

The pipe along the ground has a ⅜″ hole every foot throughout its length which gives a uniform distribution of steam.

The curing room has a capacity of 30 cars and the block are allowed to remain in the room until the cars are needed, carying from 24 to 36 hours. A temperature ranging from 90° to 100° is maintained during the day, but drops to about 75° in the early morning, when the fire is low. Everything in the room is constantly saturated with moisture and slight damage has been done by water dripping from the joists above onto fresh block. This slight loss is very inconsiderable and can be remedied by putting in a pitched ceiling so the water that gathers there can run off to the sides.‡

No extra help is needed as one of the laborers tends the fire at regular intervals and the only additional cost of steam curing is the coal. We are using coal screenings with success, curing 600 block per day at a cost of 20 cents.

After removing the block from the curing room they receive a thorough sprinkling. In our plant we are using electric power and at first the steam curing seemed an increase in cost. The decided decrease in breakage of block alone, more than offset the small sum paid for coal, not to speak of the additional efficiency of our plant. The natural conclusion is that steam curing decreases the cost of manufacture and increases the efficiency.

The city of Calgary is going to build three reinforced concrete bridges with an aggregate of about twenty-five spans across the Bow and Elbow rivers within the city limits. Bids are being received on the work.

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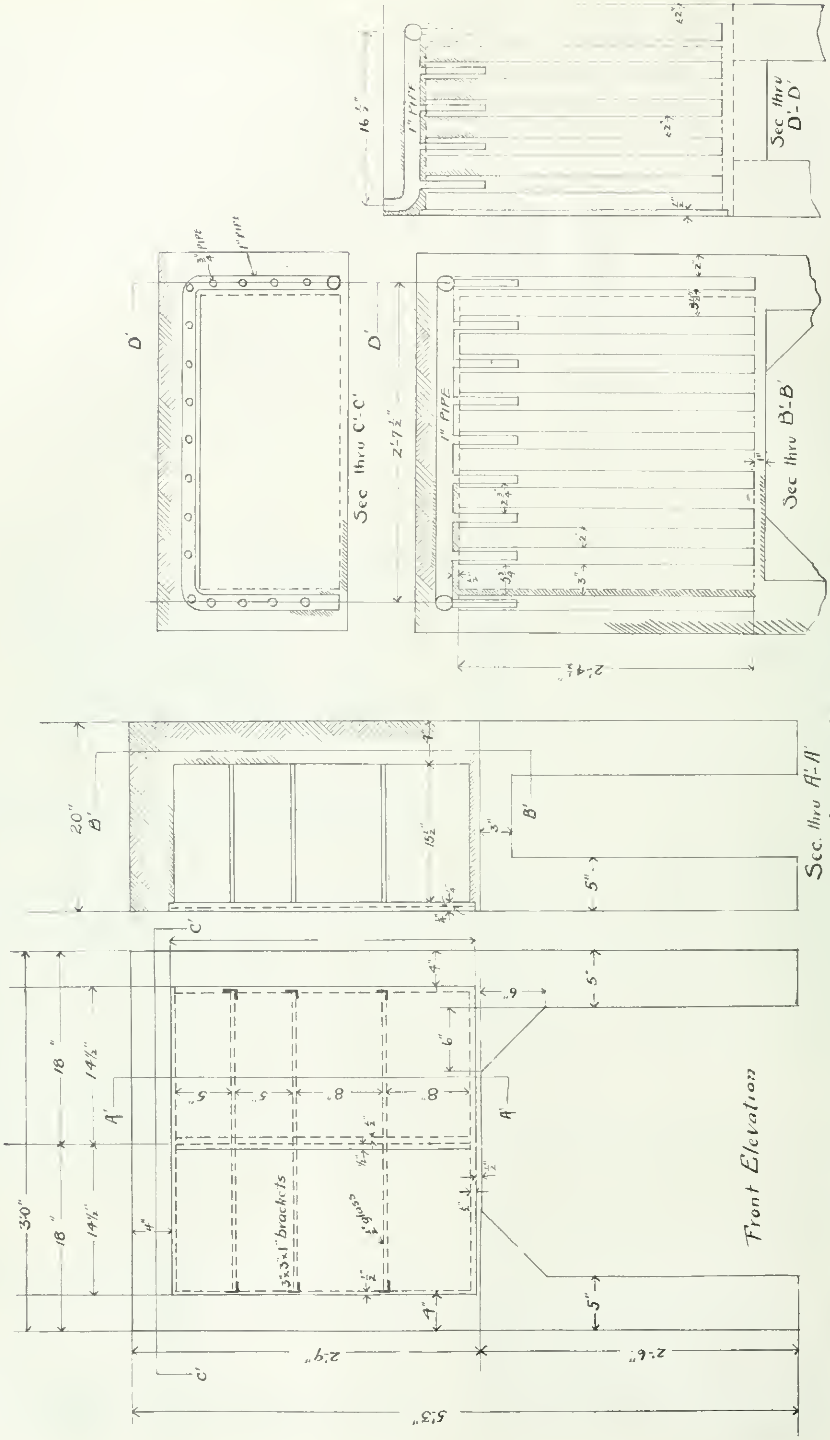
*Secretary-Treasurer of the Granite Concrete Stone Co., Milwaukee Wis.

†Mr. Gottschalk's contribution to the general fund of information on steam curing is one of the results of CONCRETE-CEMENT AGE's requests for articles on this subject. This particular suggestion in the way of steam curing equipment is not to be considered in the light of an ideal arrangement, but it certainly should prove valuable to those manufacturers who began their work with the idea that sprinkling and natural curing met all their requiements, and whose plants, like that of the Ganite Concrete Stone Co., were originally laid out without special thought for quick curing. We suggest that most concrete products manufacturers will find it an advantage to make their partitions of concrete rather than of matched boards, and with an arch concrete ceiling constructed on metal fabric.—EDITORS.

‡If the plant is so constructed that it is not feasible nor economical to construct an arch ceiling of concrete as appears to have been the case in the plant described above, another way to avoid dripping is to put pieces of corrugated metal suspended from the ceiling and sloping from one side to the other, or the center to the sides, so that the water will run down and drop off clear of the cars of block.—EDITORS.



DETAILS OF MOIST CLOSET

A Moist Closet for Cement Testing Laboratories

BY CLARENCE N. WILEY.*

In the physical testing of hydraulic cements, test pieces are made for the purpose of determining setting time, tensile strength and compression strength. For the first determination test pieces called "pats" are used, made of the neat cement and water, while for the tests determining strength of tension and compression, briquettes, cubes or cylinders, composed of various proportions of cement, sand, stone or gravel, and water are used.

To insure true comparative results it is necessary that these test pieces be kept under uniform conditions from the time mixing and molding is completed until the time when the test is made.

Cement requires a certain definite percentage of water to effect its chemical transformation into "artificial rock," and this is best determined by some form of the Vicat needle. When the proper percentage of water is added to a cement and the mixture worked into a paste, the paste is said to be of normal consistency. In order to secure uniform results, it is necessary that this percentage of water remain in contact with the cement particles until they have absorbed all they require for the chemical reaction. This reaction is not completed until some hours after the gauging. If these test pieces were allowed to remain in the air of the testing room, some of the water would be absorbed by the surrounding atmosphere and this absorption or evaporation might extend to such a degree that there would remain insufficient water for the proper hardening of the cement.

To guard against this, it is customary to store these test pieces, for a period of from 20 to 24 hours after mixing and molding, in a "moist closet." This receptacle may be constructed in a number of different ways, depending on the magnitude or importance of the work. If only a few small test pieces are made, these may be set in a shallow pan which is then covered with a wet towel or cloth. If a large number of test pieces are made at regular intervals a more elaborate receptacle is required and nearly every testing laboratory has a type evolved through experience or circumstances. These "moist closets" are made of some non-absorptive material, such as soap-stone, slate or concrete and are provided with shelves of glass or metal. The moisture is supplied usually from a pan of water resting on the floor of the closet and in this may be a large sponge for increasing the rate of evaporation or strips of felt or other cloth of good capillarity may extend from the water up the sides and across the top of the interior.

The author has used and constructed a number of different forms, but in all of them it was found difficult to maintain a uniform degree of humidity throughout the entire closet. Last year while examining a section of plaster tile through which were a series of longitudinal holes about one inch in diameter, an idea presented itself which was worked out as shown in the sketch.

Concrete was selected as the construction material and the idea was to construct the interior walls so that they would remain constantly damp while the exterior walls were dry and waterproof. The legs and base of the closet were first cast of 1 part cement, 2 parts sand and 4 parts gravel, to a point 2′ 6″ above the floor. The top surface of this concrete was roughened before final settings so that a good bond would be made with the upper section. The forms of this top section were then build and 15 wooden rollers were turned to 1″ in diameter and cut into lengths of a little over 2′. These rollers were then set in the forms as shown in the sketch and securely fastened by nailing a light strip to each one and then to the forms so that the rollers would remain in position. The surfaces of the rollers were thoroughly soaped. A light partition was then placed ½″ back of the rollers and fastened to the forms.

A mixture of cement and very fine sand in the proportion of 1 to 4½ was then made with water only sufficient to make the consistency of the mortar like that of moist earth. This mortar was then carefully tamped into the form and around the rollers. Small portions were introduced at a time and thoroughly tamped so that the mixture was made as dense as possible. When the mortar had reached the top of the rollers, it was covered with a damp cloth and work was discontinued for two days. At intervals the rollers were turned so that the moderately dry and weak concrete would not be cracked when removing them.

At the end of the second day the concrete was hard and the rollers were removed. There was then set in place the section of 1″ galvanized pipe with its ¾″ branches, one of which projected into each cavity. The temporary partition was removed and a fairly wet cement paste was carefully worked around the top of each cavity, so that the cavities should be entirely closed at the point where the ¾″ pipe entered.

A rich mortar was then made of cement and sand and 3% of waterproofing compound. The forms were entirely filled with this and the top of the work smoothly trowelled. At the end of a week the forms were removed and the concrete was found to be perfectly smooth and hard. The inside of the closet had the appearance of a poorly seasoned concrete building block and the surface was dull and dry in appearance.

Small pieces of lead had been fastened to the inside form at the proper levels for shelves and to these were screwed galvanized iron brackets. Pieces of lead had also been incorporated for fastening the door hinges. Glass shelves were then placed on the brackets.

It was the intention to make the doors of concrete. This was done by cutting pieces of expanded metal lathing to the proper size and plastering on both sides. After these were hung, they were adjudged too unwieldy and heavy and sheet

*General Manager, Atlantic & Gulf Portland Cement Co., Ragland, Ala.

iron doors, coated with an asphaltum paint were substituted. The bottom of the interior was sloped towards a central outlet for drainage.

The water was then gradually turned into the pipe line and in a short time the walls became damp and small drops of moisture appeared on the surface. The cavities were filled up and the water turned off. In a few hours the walls and ceiling were saturated with moisture and there was a slight trickling down the walls which kept the floor moist. After the closet had been in operation for a few days, experiment showed that the humidity was constant throughout.

This closet has been in daily use for over a year and its success warrants this article.

It is now proposed to rebuild Sheridan drive, an important lakeside boulevard between Chicago and Fort Sheridan, of concrete. A macadam pavement was put down a few years ago and it is going to pieces so rapidly that interested citizens and officials have been looking around for some durable material to replace it. A party numbering about thirty-five Highland Park (Chicago), citizens and officials, including engineers and contractors, visited Detroit the latter part of July and were shown over the Wayne county concrete roads by Commissioner Edward N. Hines. The visitors are said to be so enthusiastic over the possibilities of concrete as revealed to them in Wayne county, that they want to use it on Sheridan drive to make a permanent good road which will stand the wear and tear of automobile traffic, which destroyed the macadam.

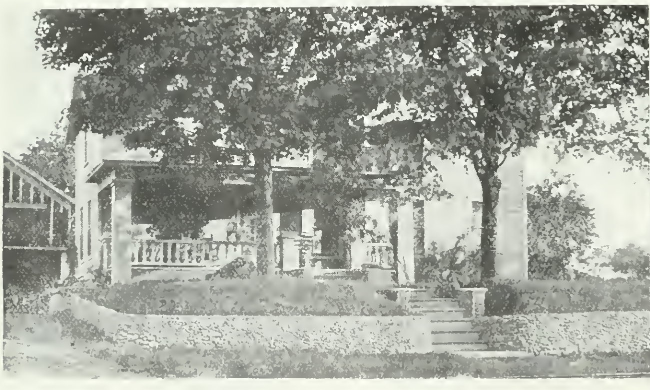
Comparative Costs of Cutting and Replacing Pavements

In a paper presented at the recent meeting of the Association of American Portland Cement Manufacturers, J. S. McCullough, City Engineer of Fond du Lac, Wis., gave the following description of the methods employed in that city by the Wisconsin Telephone Co. in cutting through the concrete pavement in order to construct conduits. The company cut a trench 18″ to 20″ wide through 4,300 lin. ft. of concrete pavement and replaced it. The concrete was broken out in slabs by drilling holes 10″ to 12″ apart on the line of the trench and breaking out the slab with wedges and feathers. A small steam drill such as is used in stone quarries would drill about 400′ a day and two men could break out the slabs. After completing the installation of the conduit the cut-out piece was replaced with all new material by a concrete paving contractor and it is stated that up to the present time there are no places showing any defect. The cost of the work was as follows:

	Per sq. yd.
Breaking out concrete	$0.246
Replacing pavement, original contractor's price, as provided in contract with city	1.500
Replacing asphalt joint, old asphalt used	.082
Total	$1.828

Mr. McCullough also gave the following as showing the cost of removal and replacement on about 2,000 lin. ft. of brick street on this same work:

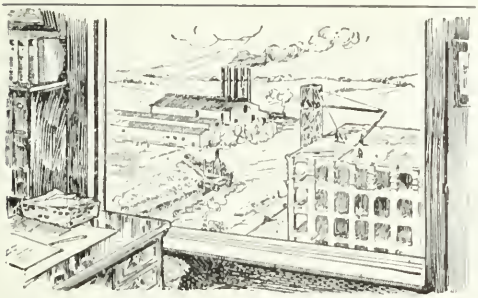
	Per sq. yd.
Removing brick and concrete foundation	$0.286
Cost of brick to replace those broken in removing	.924
Relaying concrete foundations and sand cushion	.830
Laying brick	.230
Total	$2.27



Two Views of Concrete Porch

Making Square Porch Columns

The two illustrations show some interesting concrete porch columns which recently have been made to contribute largely to the appearance of a home in Brocton, N. Y., by C. S. Fay. Mr. Fay says he made the molds for the columns by using two boards, each 16″ wide, and two other boards each 18″ wide, screwed together to make a 16″ square interior. A hole was dug 2′ deep and filled with concrete as a base for each column, and forms were then set on end over this base. To prevent the boards bulging with the weight of the concrete, Mr. Fay made yokes, placed them 16″ or 18″ apart throughout the height of each column and tightened them with wedges. The concrete was then poured in at the top. The girder above is 16″ square, and the concrete roof is 3″ thick, except at the eaves from the girder outward, where it is 4″ thick. Medussa waterproofing was used in the roof only. The porch is 10′ by 24′.



COMMENT

Bulk Shipment of Cement

Reference is made elsewhere in this issue to experiments conducted to determine the possibility of shipping cement in bulk, placed "in mass" in box cars. Some actual shipments have been made recently and carefully watched to determine the actual value of the proposal. In this connection it is interesting to note that probably the first shipment of cement in bulk in this country was made in 1874 at a time when practically all cement was shipped in barrels and by water. In order to enable the Cumberland Cement Co., which was a "rail" mill, to compete in the Philadelphia markets with the Rosendale cement companies, which were water mills, cement was brought down from the Cumberland, Md. region in cars, in bulk, to Philadelphia. A small frame packing house was built at the west end of the Callowhill St. bridge then under construction, for the purpose of packing this bulk cement into barrels. The full barrels were delivered at various points upon the work during the construction of the bridge. There were many concrete walls and river piers.

The agreement between the cement dealers and the contractors provided that the empty barrels were to become the property of the party supplying the cement. In this way the barrels were used many times, being re-coopered in the shed and then filled with cement. The Cumberland Cement Co. was thus enabled to meet in its rail shipments the price of the Rosendale cements, which, as stated, came to Philadelphia by water. The shipment of cement in bulk to Philadelphia continued for many years, packing houses being erected at Williams St. wharf for the Hart Creek sewer job; in Fairmount Park for the Centennial work and at various other points where important work was going on. The same method of packing bulk cement into barrels and re-using the barrels was practiced. A few years later the first shipments of cement in bags were made from the same mill.

In competition with Rosendale cements in barrels of 300 lbs., which reached Washington by water, the firm of Lesley & Tringle Co., Philadlephia, put in a bid to furnish Natural cement to be shipped in waterproof bags. These bags were to be collected by the contractor and no charge was to be made to the government for the bags. This bid was approved by the legal authorities of the Treasury Department and all the cement for the construction of the building for the Bureau of Engraving and Printing was supplied under this contract. This was probably the first shipment of cement in bags in this or any other country. The bags originally, at least so far as the first carload was concerned, were waterproofed, but after the first carload, it was found that the cement powder coated the bags and thus waterproofed them. Long after the introduction of bags under this method, and in fact within the last three years, a return to shipments in bulk occurred in the case of a contract of the H. E. Talbott Co. in the construction of government dams near Pittsburgh. About 50,000 barrels of cement were shipped from the works of the American Cement Co., at Egypt, Pa., to the work in question, all of it being shipped in bulk. It was elevated from the cars to stock houses especially planned by the contractors and was delivered in bulk by gravity to the contractors' mixers.

This practice of shipments in bulk was followed by the American Cement Co. in deliveries to its warehouses in Jersey City, where millions of barrels were shipped and packed in barrels and bags at tidewater.

The shipment of cement as described in the article elsewhere in this issue is in light of this information, not the first time cement has been shipped in bulk, but is merely a return to practice that existed thirty or forty years ago, and was introduced in order to get a foothold in the cement industry for "rail" mills against "water" mills.

* * *

The Extreme Demands Made Upon Concrete

Cement is a wonderful material, but now and then there is encountered a specification or demand no substance could meet. While specifications of this character are in the nature of a tribute to the known durability of cement and concrete, they frequently manifest thoughtlessness that approaches the absurd. For example, a reader sends us a letter from an engineer containing specifications for Portland cement, which, among other things, must be "especially guaranteed to withstand the effects of long exposure to dry air without 'chalking' or disintegrating due to oxidation, and to withstand the scouring effect of water and the mechanical wear and attrition of ice, etc." We can only guess as to what may be embraced under "etc.," but the demand that the cement itself shall not only withstand wear but must in turn protect the sand and stone it binds together, is rather extreme. As stated, the most durable material, even bronze, would show more or less attrition, probably not to the extent of destruction, but to the degree that this exacting and unqualified specification could not be met. For example, we have in mind a concrete pier at Bar Harbor, where the large ice fields break up in the spring carrying with them rocks and stones from the beach which, with the constant motion of the tide, grind against the structure, damaging it to some extent. It is really remarkable that the concrete stands the strain so well, as the stress is akin to the action of the glacier upon the moraine at its edge or base. It is needless to say that cement manufacturers of experience and judgment would not guarantee their product to this extent. However, as stated above, the requirement really means unqualified endorsement of concrete, for the fact that it accompanied a request for quotations shows that the author believed it possible to obtain a cement that would be absolutely indestructible.

* * *

Rotary Machines for Concrete Pole Manufacture

The possibility of producing concrete poles, piles or similar structures by a turning process, has long demanded the careful consideration of concrete engineers. The basis of practically all the experiments has been a rotating mandrel to which concrete is applied in some way. In Switzerland, the "Siegwart" process "wraps" concrete around the mandrel, using this practically as one rotor for a simple belt, and feeding a dry concrete between the belt and the mandrel. The mandrel or core, is moved axially on a carrage, and the "wrappng" process started at one end, is carried in a very low-pitched spiral, continuously to the other end. Another method* developed in Kansas City, Mo., uses a slowly rotating mandrel or core, and applies the concrete shell by hand. This work so far has been in the main, producing porch columns, and the product has met architectural approval, and commercial success.

A somewhat different though related development is a centrifugal process.† This uses a cylindrical mold the shape of the finished product. The concrete, rather wet is placed inside, and the shell rapidly rotated on its axis in a machine similar to a lathe. The concrete forms a hollow shell, tightly packed by the centrifugal force resulting from rapid rotation.

The latest addition to development along this line is a belt and compression roll machine which forms a product around a core by a back and forward movement over and between rolls of a belt as wide as the product is long. The process is described elsewhere in this issue. The work so far has been experimental, and whether or not the proposition can be made commercially successful, remains to be seen. The inventor is to be complimented on the thorough manner in which he has conducted and reported his investigations. The development will be watched with interest.

* * *

Cement Export and Import Figures Reversed

The value of Portland cement was recognized in this country long before its manufacture became one of our established industries. At that early period we were regarded as large importers, notwithstanding the fact that the figures seem exceedingly small compared with the vast quantity of cement now manufactured in the United States. They are not so insignificant, however, when we consider that we are now sending more cement beyond our borders than was ever imported. The high water mark of importations was reached in 1895, when 2,997,395 bbls. were brought from foreign countries. Turning to present figures we find that for the eleven months ending in May, 1912, we exported 3,053,539 bbls,. thus completely reversing the figures of our highest import year. There has been considerable fluctuation in import figures. For example, imports dropped to 994,624 bbls. in 1901, but in 1903 had advanced to 2,439,948.

The first reversal occurred in 1905, when imports were a little under a million barrels and exports 60,000 in excess of a million barrels. This was not strictly maintained, however, the pendulum continuing to swing to and fro for some years.

* * *

Fire-Resisting Construction

In an excellent and unbiased address before the New York Insurance Society on the subject of fireproof construction, Edward W. Cairns, general agent of the North British & Mercantile Insurance Co., made the following statement:

"The reinforced concrete man will give you many reasons why a hollow tile building is not fireproof and cannot be. and show you a good many more buildings where tile has failed than where concrete has stood up under fire.

The hollow tile man will be quite as insistent on the merits of his methods and materials, and show examples of concrete buildings which have fallen down in course of construction to distract your attention from the weaknesses of tile as shown in the pictures of the Baltimore and San Francisco conflagrations."

The arguments for and against the two materials by their respective advocates are significant. In brief, the hollow tile man would find it difficult, if not impossible, to successfully attack concrete if compelled to cite examples of its failure under practical test by fire. The reason is that concrete buildings do not succumb to fire. Therefore the tile man is compelled to ignore the real subject under discussion and rely upon something else—a weak argument, at that, for concrete failures are not frequent and are invariably due to bad design or poor workmanship when they do occur. Mr. Cairns' purpose, however, was to show that modern fire-resisting construction of the highest type can only be satisfactory where every precaution is taken to prevent the spread of fire by establishing protected openings, isolation of combustible contents and the elimination of wooden trim. With these safeguards, and a building of reinforced concrete throughout, we have the ideal fire-resisting construction.

A section of concrete roadway 200′ long of a type which has proven so successful in Wayne county, Mich., will be laid at the State Fair grounds at Hamline, Minn., by the Universal Portland Cement Co., through the permission of the Minnesota State Agricultural Society. The Agricultural Society is to be congratulated upon having seen the advantage of such an exhibit for the prosperous farmers of that section of the country. An object lesson in good roads is more emphatically convincing than any amount of preaching on theory.

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*Described in detail in *Cement Age*, October, 1911, and in *Concrete*, March, 1912.

†Described in *Cement Age*, March, 1911.

INFORMATION DEPARTMENT

Inquiries regarding sand and all other materials are cheerfully answered, like all other questions, but in cases of importance it is best to invest in a laboratory analysis. Write to us for particulars, address, Laboratory Department.

Removing Stain

What shall I do to remove alkali stain from concrete? R., Oregon.

Wash the concrete surface with a 5% solution of muratic acid and then clean with water.

* * *

Disintegration Due to Acid

I made some concrete block faced with spar and mica and cleaned them with a solution of 5 parts water and 1 part muriatic acid. After the block were set in the wall a solution of 3 parts water to 1 part sulphuric acid was spilled over some of the block and has resulted in bad discoloration, turning the work to a lighter color. What can I do to restore these block? R., Michigan.

We know of no remedy for the damage done by the surphuric acid except to replace the concrete which is not only discolored, but is undoubtedly in a disintegrating condition.

* * *

Lighting Standards

I have been requested by the college authorities to provide a lighting system for the campus. I have seen illustrations of concrete posts for this purpose and I should like information as to their construction. S., New Mexico.

We refer you to an article, page 43, June, 1911, issue of *Concrete*, by P. Zinner, describing the construction of posts for Lincoln Park, Chicago, and also to an article, page 37, April, 1912, issue of *Concrete* describing the construction of posts for the campus of the University of Washington at Seattle. Further, we suggest that you see the advertising pages of CONCRETE-CEMENT AGE for addresses of manufacturers who supply not only molds for special posts, but the lighting posts complete.

* * *

Sulphide of Sodium and Concrete

I want to put in a concrete floor and wall under a vat in which we use large quantities of sulphide of sodium. The floor would be saturated with the solution much of the time. This has been detrimental to lime in the wall. Will it injure concrete? What can we do to avoid disintegration? A., Massachusetts.

Sulphide of sodium itself probably would not injure concrete to any great extent. No chemical action is likely to be set up which will do any harm to the concrete, unless in the processes which go on in the vat which you speak of, some sulphur compounds are formed of an acid nature, either sulphuric or sulphurous, either of which would cause disintegration in the concrete. We do not know, of course, what chemical action takes place in this vat, so we cannot advise you any more definitely.

* * *

Quaking Consistency

What is meant by "quaking consistency" of a concrete mix? Under what special conditions is it to be recommended? D., New York.

It is hard to define consistency, yet what is generally meant by concrete of a quaking consistency, as the writer has used the term and has heard it used, is a concrete which will flow, yet with a viscosity such that the concrete's friction with the supporting surface gives the edges a bulging effect and the concrete will remain in a low mound when dumped on a board. When tamped with the foot the entire mass moves, but the surface tension is such that it will not flow. It is a good consistency to use. Our American practice has run to extremes in the use of wet concrete while in Europe a drier mix is used.

* * *

Effect of Sea Water

We are building a reinforced concrete and wooden pile wharf and some of the concrete has to be placed under water. Will the salt water injure the concrete? R., Texas

As to the effect of sea water on concrete, the best opinion of the day is to the effect that a good dense concrete will set before exposure to sea water has effected it in any way.

The effects sea water might have upon concrete, could be either physical or chemical. The physical action would be due to sea water entering the surface pores of the concrete and by either crystallizations of salts or ice in cold weather, disrupt the surface of the concrete.

Chemically, some of the active salts in solution in sea water might attack high line cement concrete and disintegrate it to some extent.

We refer you to a report of the Twelfth International Congress of Navigation.

* * *

Reinforcing Failure

Some statements have been made to us about reinforcing in concrete and we saw one case where expanded metal lath with concrete on a frame building had gone to pieces in three years. Can you advise us as to the durability of such reinforcement? C., Michigan.

We shall appreciate it very much if you will give us details of the failure mentioned, or give us names of those to whom we may refer. There is, of course, no reason why concrete properly spread on expanded metal lath should disintegrate. Properly made concrete acts as a protection to the metal and the writer has seen numerous cases of reinforced concrete several years old which, when it was taken down, showed the reinforcing fabric to be as bright and clean as when it was put in place. Owing to the fact that the co-efficient of expansion of steel and concrete are practically the same, there should be no difficulty from internal strain. These facts are so well known and so well attested that we are more than interested in your report of reinforced concrete that failed after three years.

* * *

Concrete Did not Harden

We have a reinforced concrete floor on top of a wooden floor with two layers of tar paper under it. The top coat is 1½" thick of a mixture of 1 part cement to 2 parts sand. Some of the surface three weeks old is still soft and it is easy to scrape off the top to a depth of ¼". My foreman thinks it was finished too wet. What do you believe is the trouble? C., Minnesota.

We should like to have you supply more information as to the concrete floor which has proved a failure. From the information you give us, any one of several things may have caused the trouble. A snap judgment would be that the cement is dead or it certainly should have set up in three weeks. Too much water might have something to do with a temporary retarding of the setting, but in the length of time which you mention, the excess of water should have disappeared, and even this should have a tendency to make the concrete stronger, as it aids in the crystalization of cement. Then again, the soft concrete may be due to the fact that the sand which you used was very dirty. If it contained a great deal of loam or other soft material, or fine dust, this would prevent the binding qualities of the cement getting in their work. Again temperature may be at the bottom of the matter.

* * *

Green Color

I should like information as to a mineral color which will impart a green shade to concrete, the color to be mixed with the concrete and not applied after the concrete has set. Do you know of any green color which can be used in this way and which will give a permanent color? J., Illinois.

Decided greens are something of a problem in cement work, used as you propose. Green color can be obtained in concrete, but a permanent green cannot be had at any where near so low a price as other colors. A mixture of Prussian blue and Chrome yellow will give you a green, but whether or not it will give you a strong enough green when used in quantities that may be safely used without threatening the strength of the concrete, is a question. Most of the green colors are not stable when mixed with cement. A Chromium oxide undoubtedly may be used with good results, but we think it cannot be used to any great extent for the purely commercial reason that it is not a common color. However, we suggest that you correspond with advertisers in CONCRETE-CEMENT AGE, who sell colors.

The editors will be glad to hear from readers who have knowledge of permanent greens to be mixed with cement.

* * *

Concrete Crosswalk Construction

Our town engineer is getting out plans for concrete street crosswalks. He says the top coat will have to be a 1:1½ mix. I do not think this is necessary. I have been successful with a 1:2½ top coat. What information can you give me as to crosswalk construction? R., Iowa.

We recommend, generally speaking, for street crossings that the surface should consist of a layer 1½" thick, composed of 1 part Portland cement and 1½ parts of good, clean sharp screened sand. Much depends, however, upon the sand used. In the July issue of CONCRETE-CEMENT AGE there is an interesting article about one course sidewalk construction. We believe that the tendency in sidewalk construction is toward one course work. The value of the cement, as you probably know, is not in its wearing quality, when subjected to traffic, but in its binding quality to hold the wearing particles of sand and stone together. If good, hard, well graded sand is used, an effort should be made to get as much of the surface area of the walk or pavement composed of these hard wearing particles, as possible.

The old idea of excessive troweling to make a glossy surface is being discarded because it is realized that the glossy surface is good neither for the comfort of travelers over it, nor for wearing quality. The utmost importance should be given the matter of aggregate, and the precise mixture will depend much upon how these are graded.

* * *

Prejudice Against Concrete

Can you help me to account for local prejudice against concrete construction? I submitted bids on a concrete building and my figures were satisfactory, and the company intending to build had to borrow money for a part of the investment, and found that they could not get a loan on a concrete building in this locality. Money was offered the company if brick were used instead of concrete. It seems strange to me that nearly all buildings here have concrete foundations and that there is a prejudice against the use of concrete above the foundations. This may, of course, be only a local affair worked up by the brick people. H., Arkansas.

There appears to be no answer to your question as to the prejudice against concrete construction in your community. We are at a loss to give any advice in this case. We surmise that the men who are supplying the money for the building which it was proposed to erect of concrete may be in some way interested in other building materials. It is likely, however, that the prejudice is due entirely to ignorance as to the value of concrete, and still the prejudice may be due to some unfortunate experience which they may have had in concrete which was dishonest in construction or unsightly in appearance. Every new industry has just such prejudices to overcome, and they may be overcome only by sticking closely to the path of honest work, and by an effort (in the case of concrete) to use the material in some of the many forms in which it presents an attractive appearance. This certainly is only a local feeling. Concrete buildings elsewhere are recognized as the best sort of investment because they represent *permanent* value.

* * *

Concrete Floor Under Garbage Tank

We put a concrete floor under a garbage tank, for teams to drive on which haul away the garbage. There is a chute in the tank bottom and under this chute the concrete is disintegrating in a circle about 3' feet across. The tank is cleaned three times a day with lye and hot water, and this wash is discharged on to the concrete floor in which there is a drain. How is the floor to be repaired so that it will be permanent? What is responsible for the disintegration? M., Kansas.

The best way to repair the floor will be to chip off very carefully all the injured concrete to a depth of at least ½", and preferably ¾" to 1", washing the newly exposed concrete surface very carefully, taking out all the fine dust which results from the chipping, and then while the surface is still wet, blow on a thin cement grout. Over this put on a suitable top coat of concrete and press it firmly into the old concrete. Do not trowel with a steel trowel any more than is absolutely necessary to get a good mechanical bond, because excessive trowelling is likely to cause cracks later on.

It appears that the action of the animal fats in the garbage is undoubtedly responsible for the observed disintegration of the concrete floor. Animal fats are sensitive to saponification in the presence of alkali, tending to form a salt with whatever metal, combined with the hydroxyl, with which they come in contact. As a concrete surface is distinctly basic, due to the presence of calcium hydroxide, there would be opportunity for the formation of the calcium salt of the fatty acids in the animal fat, manifesting an expansive action that would disrupt the concrete. This is quite analogous to conditions which have been observed particularly in packing houses where animal greases have come in contact with the concrete surfaces, causing progressive disintegration, particularly intensified if the greases are carried in emulsion in hot water. We refer you to advertisers in CONCRETE-CEMENT AGE for suitable filler and coating to protect the concrete in future.

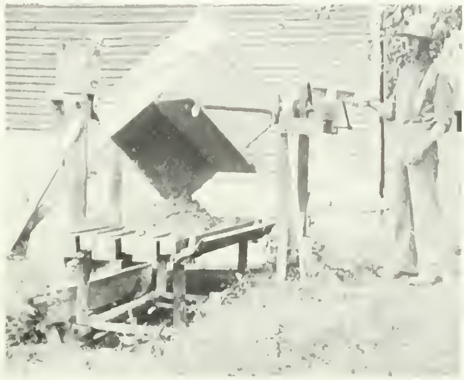
Springfield, Ill., has just ordered 300 reinforced concrete lighting standards, 220 of which are to be used in Washington and Lincoln Parks, the remaining 80 to be used on the Boulevard system. Springfield is not trying an experiment. It is profiting by the experience of neighboring cities. In the past, iron standards have been used. These 300 standards are being manufactured by the Pettyjohn Co.*

U. S. Surgeon-General Rupert Blue says that concrete foundations and basement walls stop access of plague germs.

*Terre Haute, Ind.

A Home-Made Mixer Satisfactorily Used in Making Posts

The illustration shows a home-made device for facility in making concrete fence posts on a small scale. The photograph will itself suggest to the handy man the possibility of making such a device for himself if he chooses, without an elaborate description. The best way to do things and the most economical way to do things, is not always the immediate and feasible way to do them for the individual who is operating on a small scale. This picture shows what one man "fixed up" for himself to save a strain on his back, in the ordinary operation of mixing and placing concrete. A

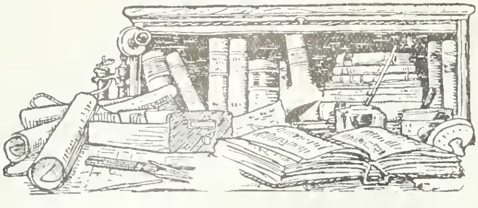


HOME-MADE CUBE MIXER

frame holding the post mold is set into a shallow excavation on which there is an inclined wooden track on which the post mold frame runs for the removal of the posts. The home-made cube mixer is nothing but a sheetiron box and it is operated by a crank, as is shown quite plainly. To provide for the wetting of the concrete in the mixer, the operator has arranged a pail which holds the correct amount of water for each batch, with a gas pipe conection which terminates in a number of small holes in the pipe. After the gravel and cement have been turned over several times dry, the pail is filled with the correct amount of water which is applied to the concrete mixture in small streams like a spray from a perforated pipe. Inasmuch as the frame holding the molds provides for just six posts at a time, the batch required is the same at each operation, which makes for facility in handling a batch mixer of this kind. Molds used are manufactured by the D. & A. Post Mold Co.,* and it is through the courtesy of this company that CONCRETE-CEMENT AGE is able to present the photograph and description.

The proposed standard specifications tentatively adopted by the National Association of Cement Users, which were published in the April, 1912, issue of *Concrete* covering the manufacture of drain tile, plain concrete floors, reinforced concrete floors, stone, block, brick, etc., have been adopted by letter ballot and become standard.

*Three Rivers, Mich.



CONSULTATION

248. Sinking a Large Well in Quick Sand

"Do you know of any easy, and inexpensive means of making a well 7' in diameter and about 20' deep, concrete curbing or casing? The soil consists of quicksand. The water level is found at a depth of approximately 14'. How would you suggest sinking such a well and how would you proceed in building such a casing? About how thick should the walls be?"

Discussion by Coleman Merriwether;* The Use of a Pre-cast Concrete Shell.

In sinking a well of this character it would be feasible to make reinforced concrete caissons 7' in diameter, 8" thick and 4' long. These should be reinforced with a heavy wire mesh or ¼" bars placed every 4". There would be required five of these sections to sink a well 20' in depth, each section to have a bevel, slip, or other type of joint.

The method we would suggest in sinking these caissons would be to place the first section in the desired position, excavate the interior and underneath the wall until the top of the caisson section has become almost flush with the ground. Then place the next section in position and proceed with the excavation until the top of this section has come just above the ground, and continue this operation until all five sections are down.

We note that the water level is found at approximately 14'. In other words, this well would have to be sunk 6' below water level. This could be done in two ways. After the water level has been struck a pump could be used, and the water kept down sufficiently to allow men to work; or, if the water came in too freely it would be necessary to excavate with buckets or long handled shovels, so that they could work above the water level.

If a bevel joint is used there would be no need of cementing the two sections together.

Discussion by T. R. Weminger.† The Use of Sheet Piling and a Monolithic Shell.

In the first place, we do not know of any easy and inexpensive means of making such a well. We know, however, that one method is that of using a very light steel sheet-piling driven by means of a water jet within an excavation thus made. The wall of the well can be cast monolithically. The first step would be, of course, to excavate the well to a depth of 4-ft. and even more if the ground will stand up. The next step is to set up the sheet-piling so as to complete the casing. If this is properly braced on the inside so that it can be displaced readily, and assuming that a suitable platform has been constructed on the outside so that the piling can be readily handled, we would apply the water jet at the same time that the sheets are driven with a heavy maul at the top. Inasmuch as the sheet piling would be used presumably only once, there would be no need of any special precaution for the tops although, of course, a driving caps which is especially adapted for hand driving can be used.

A pump developing a pressure of 85 to 100 lbs. per sq. in. at the nozzle of a 1-in. pipe reduced to ¾" would be about the pressure required. Procedure would follow the general uses in such construction.

*Pres. Lockjoint Pipe Co., N. Y.

†Pres. The Wemlinger Steel Piling Co., New York.

249. Does Oiling Forms Affect the Bond for Plasters or Stucco?

"We are oiling our steel form to present the concrete sticking. Will this affect the surface so that plaster or concrete will not stick?"

Discussion by Milton Dana Morrill.*

We handle this problem as follows:

Each time the forms are swung up and moved, they are oiled with a transparent jelly, made by melting 1½ lbs. of paraffine in 10 qts. of kerosine oil. This is applied with a white wash brush or with waste. It gives a transparent oil, which does not stain the concrete, and which makes the forms leave the concrete with little or no concrete adhering to them. And even though the kerosine may evaporate to a certain extent a film or coating of the paraffine remains on the steel surface. The surface thus formed is exceptionally smooth, and upon floor centering where our forms are left in place for from 10 days to two weeks there is almost a gloss or polish left on the surface.

We anticipate that some difficulty might be met in making a surface adhere to this smooth concrete. We have, however, found that a thin spatter coat of white cement and sand with 10% of hydrate of lime added, adheres perfectly with no separation or cleavage on ceilings or side-walls. In some cases this spatter coat is stippled by the use of an ordinary scrubbing brush, which gives an interesting rough texture, tinted any desired color in the wash. On some 20 houses in the southern states, we have plastered the walls on the inside directly on the concrte with no difficulty from separation. While on some buildings where wood floors have been employed, we have had some difficulty in plaster falling from the ceiling which was put on over the laths. It is possible that the hydrate of lime which we use in the percentage of 10% of cement employed throughout our walls, helps in making a bond between the smooth concrete surface, and the plaster applied.

*Read & Morrill, Inc., Brooklyn, N. Y.

250. Concrete Construction on Pacific Coast

"In re-building San Francisco, how broadly is concrete being used, expressed in terms of the total building being done? What is the situation in California generally?"

DISCUSSION BY H. J. BRUNNIER.*

It would be considerable work to give the exact percentages of the different kinds of building construction in this neighborhood, but roughly I should say that 60% of the buildings of all kinds in San Francisco are reinforced concrete or steel frame, fireproofed with concrete and floor construction of reinforced concrete. Lately the tendency has been more towards straight reinforced concrete construction, and I believe it is safe to say that 80% of the fire proof buildings now under construction are of this type. In our Class *"C"* buildings, that is, brick or concrete exterior, with wood framing on the inside, at least 40% of these are of the concrete type while practically all of them have concrete up to the first floor.

In San Diego where I have done considerable work at least 95% of the fire-proof buildings are reinforced concrete.

In Los Angeles it is about the same proportion as in San Francisco, likewise Fresno.

In San Jose of the fire-proof structures which have been erected in the last five years, and of those proposed, there are only two containing a steel frame making a proportion of about 95% reinforced concrete structures.

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251. Concrete From Washed Aggregate

"Is concrete made from washed gravel any stronger than a concrete made from the same material unwashed?"

DISCUSSION BY W. G. MCCLELLAND.†

Our expierence has been that unless the unwashed material is very clean and free from dust, loam, clay or other organic matter, washed material gives best results. Accompanying this is a quotation giving the experience of E. S. Larned, civil engineer of Boston, taken from a paper read before the Cement Users' Association, from which you will notice he brings out very clearly the conditions that prevail in the average unwashed natural sand. Following is this quotation:

Few unwashed natural sands are free from dust, of a loamy or clayey nature, and containing a high percentage of organic material, and in specifications usually calling for sand to be clean and sharp and free from fine material the importance of excluding this deletrious agent is recognized. It is, however, not always possible to enforce this absolutely, and from mechanical analysis of a large number of samples, and casual inspection of sand in use at various points, much sand plication of cement, concrete, and of reinforced concrete, is used that contains 5% dust, and a good deal that carries as much as 10%, and even more in some instances.

We also enclose herewith a memoranda which gives the results of a course of tests made by the Engineering Department of the City of Toronto, showing the value of washed sand as against pit sand covering a period of from 24 hours to 90 days. In this the gain runs all the way from 2% at 24 hours to 57% at 90 days in favor of washed sand.

Following are these data. The mix was 1 to 3, cement and sand:

	Pit Sand	Water Washed Sand	Gain in Water Washed
24 hours test Briquette broke at....	51 lbs.	52 lbs.	2%
7 day test Briquette broke at.....	157 lbs.	213 lbs.	35%
28 day test Briquette broke at....	212 lbs.	300 lbs.	41%
90 day test Briquette broke at.....	242 lbs.	382 lbs.	57%

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252. Cost of Steel Window Sash

"What is the average cost of steel window sash? Some architects seem to be under the impression that it is very costly."

DISCUSSION.

[This question was referred to various manufacturers, from whom we have received the following replies.—Consultation Editor.]

This information is very difficult to give accurately, as the price of steel sash always increases with the amount of ventilation required. We should say on the average, however, that the sash will cost approximately 24c per sq. ft.; glazing with 1/8-in. glass 11c; and erecting 4c,—making a total of 39c installed complete in the building. If 1/4 in wire glass is used, this price will be increased about 5c per sq. ft. In case fixed light sash were used throughout, the price would run 5c to 6c lower per sq. ft.

The cost of steel sash varies greatly with quantities ordered, size of sash, size of lights, amount of ventilation and type of ventilator used. We find that in all cases outside of plain factory construction, the architect wants his ideas carried out in regard to size, shape, ventilation, etc., and we are usually catering to a demand for special sash. Generally speaking, the cost of steel sash for factory purposes with about 25 to 30% ventilation is approximately forty cents (40c) a sq. ft., without freight or erection. The cost of steel sash without ventilation is about 25c a sq. ft. Double thick glass and glazing cost from 10 to 15 cents a foot.

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253. Data on Irrigation Ditch Construction

Do you know where I can secure any articles on the concreting of irrigation ditches?"

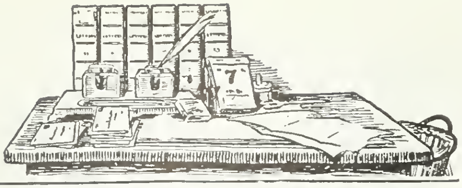
DISSCUSSION BY F. H. NEWELL.*

Relative to any available text, or bulletins on field methods in lining irrigation ditches with concrete, no publication treating of this subject in a thorough manner is known to this office, but a number of articles on the subject have appeared from time to time during the past year or two, in the leading engineering journals.

The Reclamation Service has done much work of this character and, of course, has considerable unpublished data on the subject, but only one extended article has thus far been published; viz., a paper by Supervising Engineer E. G. Hopson in the Proceedings of the American Society of Civil Engineers, August, 1910, on sectional concrete lining of the Tieton Canal, and a resume of this article which appeared in the *Engineering Record* of September 10, 1910. This lining, however, was done under peculiarly difficult conditions, in a novel manner, and is in no sense representative of ordinary practice.

*Consulting Structural Engineer, Monadnock Bldg., San Francisco.
†Sec.-Treas. Sand and Supplies, Ltd., Toronto, Canada.

*Director, U. S. Reclamation Service, Washington, D. C.



CORRESPONDENCE

Early Flat Slab Construction and Patents

I note in your June issue, a communication from Mr. George Hill, Consulting Engineer, New York City, relative to early flat slab construction and the patent situation.

From this letter it would appear that Mr. Hill has probably failed to read and understand the character of the Turner patents, particularly patent No. 1,003,384. For his information and those of the readers who may perhaps have similar ideas it may not be amiss to call attention to the fact that this application was filed January, 1905: that it has been under the continuous consideration of the United States Patent Office for nearly seven years: that it has been involved in two interference proceedings, during which the state of the art has been thoroughly threshed out and not only the references which Mr. Hill has cited, but many other patents and inventions in this line.

The idea of Mr. Hill may be that any man who conceived the idea of flat slab construction supported by columns was in fact the inventor of the commercially practical building of this type. The general idea of such construction lacking only the necessary practical details, is quite old in the art. The successful or commercial development of it so that this type can be put up economically in competition with older types is all that is claimed by the writer.

Referring to Mr. Hill's paper to the American Society and to the publications in the *Railway Age Gazette,* there seems to be nothing more than the suggestion in the *Gazette* that expanded metal was used for bond. It is true a flat ceiling slab on the under side with beams was used and more specifically as described in the *Engineering News* some very short flat slab spans had been used with expanded metal in the bottom of the slab. In this respect, perhaps Mr. Hill has anticipated Norcross, but the criticism of the editor of the *Engineering News* of that date puts the writer in mind of the statement of Justice Robb, Court of Appeals, District of Columbia, Schmidt vs. Clark, 138 O. G., 768:

> "A 'would-be' inventor frequently has a general idea of the result which he wishes to accomplish and possibly a general idea of the means to accomplish that result, but being unable to give his ideas practical form, allows them to slumber. Upon learning that another has successfully worked out such ideas the mists of uncertainty are immediately dissipated; vagueness takes definite form and the 'would-be' inventor becomes in his own mind the actual inventor and acts accordingly."

Thus we have had seriously quoted as anticipations of the "Mushroom" system in answers to infringement suits, I-beams and brick arches, with tie rods, beam and flat slab constructions and many other things equally pertinent.

It may be that the general allusion of Mr. Hill to the use of steel in the tension zone of a slab and the employment of the concrete to resist compression constitutes honestly in his mind invention of every form in which these useful relations are employed. If so, it would seem that neither Mr. Hill nor the writer could figure in the class of originators since it appears from the ruins of Rome that metal and concrete have been used in substantially these relations in special cases of flat arches antedating the birth of Christ.

Our patent laws are not such that they allow the inventor to claim a principle. Claims are not allowed on the general principles of mechanics, but on the combination and arrangement of materials in such manner as to apply these principles to the greatest economical advantage. An amazing instance of this confusion may be found in the Norcross patent in which the inventor through oversight of an inexperienced examiner, has claimed a general principle of design, placing the greatest amount of metal where the moment and shear is the greatest. This, as a claim, means nothing. Each and every designer tries to place the greatest amount of material where it is most needed to resist stress and this idea will be found in various patents back from early in 1850 to date, and then today we have one somewhat prominent concern boldly advertising that a meaningless claim of this character covers as a basic patent flat slab and column construction. Analyzing the claim, even supposing that a principle could be secured, we would find that it might mean the greatest amount of steel in the middle of the span and the greatest amount of steel in the bottom of the slab near the support where the shear is the greatest, which in fact was actually what was shown. The examiner correctly decided that this was an entirely different type or combination of material from the Turner invention, not even coming within the same classification.

Perhaps the writer's letter would not be complete without citing Justice Grier in a decision in Goodyear vs. Day, 10 Fed. case, 683, where he says:

> "And yet when genius and patient preserverance have at length succeeded, in spite of sneers and scoffs, in perfecting some valuable invention or discovery, how seldom is it followed by reward. Envy robs him of the honor, while speculators, swindlers and pirates rob him of the profits. Every unsuccessful experimentor who did, or did not, come very near making the discovery now claims it. Everyone who can invent an improvement, or vary its form, claims a right to pirate the original discovery. We need not summon Morse, or Blanchard, or Woodworth, to prove that this is the usual history of every great discovery or invention."

Justice Grier seems to have seized up the situation in reference to varying the form of the invention about as accurately as though he himself were an inventor and had had experience in pushing or promoting something which did not at once meet with and command the confidence of those not familiar with it.

It may be of interest to Mr. Hill and also to the other members of the profession to have attention called to the fact that the first step taken by a competent attorney in the investigation of the scope and validity of a patent is to examine the record or file wrapper of that application in the Patent Office, and had Mr. Hill taken this precaution before sending in his letter to *Concrete-Cement Age* he would have found that the references cited were before the examiner and were urged without avail in an argument by opposing parties in an interference proceeding. The training of Mr. Hill apparently has been somewhat scanty on legal lines, and it would behoove those who have any interest at stake on the question of patents to secure the advice of competent attorneys who would take pains to look up the record of an application resulting in a patent, particularly one which has been issued after such a long and vigorous contest in the United States Patent Office and which has been passed on repeatedly by experts, not only in the mechanics of the art of construction, but also well versed through continued practice with the law relating to the subject of patents.

I trust that the references to the state of the art and the general principles governing the design of flat slab construction and the investigation of patents may prove of interest to your readers.

C. A. P. Turner.

Minneapolis, Minn.

* * *

Using Spirals in Long-Span Girders

In a thesis written by W. H. Fisher for a B. Sc. degree at the University of Illinois, May, 1911, the use in girders of spirals in compression was worked out in an interesting way; and it has seemed to me that this use deserved more consideration by American Engineers. It is meeting extended use abroad.

The title of this thesis is, "Constructive Features and Planning of a Western District Motor Sales House." The problem is handled under the assumption that

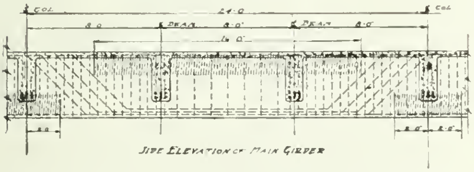


Fig. 1—Elevation of Girder, Showing the Use of Spirals in Horizontal Compression

reinforced concrete be used as the structural material, and a comparison is made between the "beam and girder," "flat slab," and "wide beam" types of floors.

Automobiles are assumed to develop a live load of 120 lbs. per sq. ft., and a 4-in continuous slab is used with beams 8′ 0″ on centers. These beams are 13″ x 36″ to top of slab and designed as I-beams, on a 38′ span from wall to center line of girder. The columns are spaced 24′ on centers, and it is assumed that the depth of main girders can not exceed 48″ to top of slab.

These main girders are large and carry a heavy load even though figured as countinuous girders, so I suggested the girder as detailed on the enclosed drawing and which is designed to be safe for a moment or 722,000 ft. lbs.

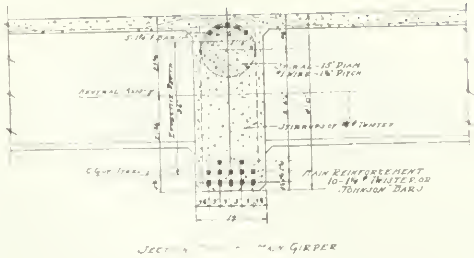


Fig. 2—Section of Girder at Center Showing Position of Spiral

John B. Hutchings, Jr.

Louisville, Ky.

* * *

Resurfacing Floor

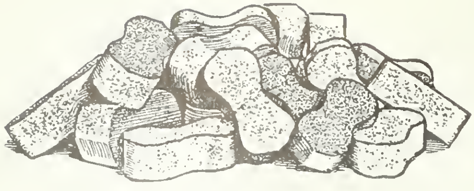
Referring to instructions on resurfacing floor, Vol. 12, Feb., 1912, No. 2, page 79 (*Concrete*). Had a thick wash of neat cement been broomed on to the base, and followed while soft with the mortar mentioned, perfect adhesion would have resulted. Any surface can be treated from 1/16″ upwards, and mortar of sand or fine gravel may be applied by hand, or with a cement gun. This method insures watertight walls, and if the finishing sand or coarser material is applied like roughcast, without any mixture of cement, hair cracking will not show, and the natural color of the sand and gravel will permit variation. The writer put a wash of neat cement on concrete paths some two years ago, and dusted the wet cement with ground carbonate of lime, like sand—result first class. In another case a thin wash of mortar was applied on top of the cement wash, and adhesion is intact after eighteen months' hard wear.

John Wilson.

Aukland, N. Z.

* * *

After trying both cinders and wooden plank, the Moline Automobile Co., Moline, Ill., decided in October, 1910, that a concrete test track would give better service than a track of any other material. Accordingly a quarter mile track was built of concrete, 18′ wide and 8″ thick, with a slope varying from 6″ to 3′, depending upon the radius of the curve. Concrete was applied on top of the cinder track, which make a good foundation. Expansion joints were from 12′ to 24′ apart. Concrete was laid in one course and reinforced with wire mesh. It is estimated that the track is circled 1200 times each day in the year, which is equivalent in the twenty months in which it has been used, to the passage of 720,000 automobiles. The company reports that the track shows no appreciable wear. There is no skidding in any weather conditions, and the circuit of this quarter mile track can be made safely at a speed of 45 miles an hour.



BRIQUETTES

Monthly Comparative Table

IMPORTS AND EXPORTS OF PORTLAND, ROMAN AND HYDRAULIC CEMENTS

Imports of Cement

	Month of May			
	1911		1912	
Country	Barrels	Value	Barrels	Value
United Kingdom	84	$ 140	84	$ 146
Belgium	496	589	....	....
Germany	11,804	19,515	1,695	2,231
Canada	680	1,360	10	23
Other Countries	2,422	3,644	570	753
	15,486	$25,248	2,359	$ 3,153
Less Foreign Cement Exported	3,375	5,700	422	667
	12,111	$19,548	1,937	$ 2,486

Decrease in imports during the month of May, 1912, as compared with May, 1911 . . . . 10,174 barrels

	11 Months Ending			
	May, 1911		May, 1912	
Country	Barrels	Value	Barrels	Value
United Kingdom	21,834	$24,847	25,123	$30,732
Belgium	77,501	96,515	5,147	5,935
Germany	79,086	118,101	58,698	93,130
Canada	1,359	2,865	123	261
Other Countries	17,881	26,042	9,640	15,077
	197,661	$268,370	98,731	$145,135
Less Foreign Cement Exported	19,386	23,316	5,128	9,994
	178,275	$242,054	93,603	$135,141

Decrease in imports during 11 months ending May, 1912, over 11 months ending May, 1911 . . . 84,672 barrels

Imports of Portland Cement into the U. S. During May, 1912, by Districts

District	Barrels	Value
Boston	84	$ 146
New York	1,835	2,244
Philadelphia	46	67
Porto Rico	173	340
New Orleans	210	333
Alaska	10	23
	2,358	$3,153

Exports of Cement

Exports of cement, month of May, 1911, 298,072 barrels, value	$ 454,488
Exports of cement, month of May, 1912, 371,528 barrels, value	$ 581,114
Increase in exports, month of May, 1912 over month of May, 1911, 73,456 barrels, value	$ 126,626
Exports of cement, 11 months ending May, 1911, 2,730,309 barrels, value	$ 3,965,394
Exports of cement, 11 months ending May, 1912, 3,053,539 barrels, value	$ 4,559,863
Increase in exports, 11 months ending May, 1912, over 11 months ending May, 1911, 323,230 barrels, value	$ 594,469

The Canadian press prints a dispatch from Edmonton, stating: "Citizens of this city claim they are suffering a loss of $5,000 per day due to cement shortage."

Cement Into Canada

In the July issue, mention was made that the Canadian government had reduced the tariff on cement by one-half, making the duty 26 cents per barrel until Oct. 31 next. The *Contract Record,* of Toronto, comments on this as follows:

The recent action of the Dominion Government in suspending the collection of half the customs duty on cement has caused some concern among the independent cement manufacturers of Canada. Some of them go as far as to state that the order will practically mean closing down. In halving the duty the government states that they did so in order to meet the urgent demands of western consumers who complained about the inability of eastern cement manufacturers to ship promptly and advantageously. The Canada Cement Co. in order to meet competition, will sell their product in Ontario at the rate of $1.40 per barrel and they say that they will put a fleet of four steamers on the lakes to transport cement to the western provinces and thus meet the demands of the western consumers and incidentally cut down the freight rate considerably. The independent cement manufacturers, on the other hand, say that they will have to maintain the standard price of $1.50 per barrel or else go out of business. It was decided at a meeting of nine of the independent cement mill representatives, held at the office of James Pearson, of the Maple Leaf Co. in the Confederation Life Building, Toronto, a few days ago, that a deputation consisting of every cement mill man in the province would go to Ottawa as soon as an appointment could be secured with the Premier or the Minister of Finance, to ask the government why the order halving the duty on cement should not be limited to the territories west of the Great Lakes.

According to recent reports from Canadian centers, the reduction of the duty has apparently not had the expected effect either in increasing the importations of cement from the United States or in decreasing the cost to consumers. The Customs Department reports that so far there has been in eastern Canada at any rate very little increase in imports of cement. There has been a slight increase reported from Toronto, but any increase is probably due rather to the normal increase in demand rather than to any cheapening of price through the cut in duty. Reports from the west have not yet been received in any detail, but the same conditions appear to exist.

The reason given is the United States cement manufacturers have increased their prices to the Canadian builders, so that practically the decrease in duty is offset, and cement is now said to be procurable just as cheaply from the Canadian manufacturers as from across the line.

The new underground public comfort stations recently completed in Charlottenburg, near Berlin, were built entirely of reinforced concrete. The reason given for the awarding of contracts to the reinforced concrete firm was the lower cost of maintenance and repairs, as also the hygienic value of concrete, in spite of the greater cost of construction.

FIG. 1—EXTERIOR VIEW OF BAKERY OF REINFORCED CONCRETE IN PHILADELPHIA WHERE 150,000 LOAVES OF BREAD ARE MADE DAILY

A Reinforced Concrete Bakery Building Erected In Philadelphia

In the erection of the new bakery for the Acme Tea Co., located at Twenty-fifth, York and Hagert streets, Philadelphia, reinforced concrete was used throughout for column, floor and roof construction, and reinforced concrete girders of unusual span and construction have been used in the rooms used for baking and mixing.

The new building has a frontage of 225′ on Twenty-fifth street and 161′ on both York and Hagert streets. It is two stories and basement in height, the basement extending under about one-half of the building, and the second story portion over about one-third of the building. The basement at the York street end is used for flour storage, and the Hagert street end for power plant. The second story is used for the mixing of doughs for both bread and cake, the preparation of materials, and for lunch rooms and employes' quarters. In the first story the wagon space extends along the entire Twenty-fifth street front, back of which is a loading platform of the same length, which communicates with the bake room, which extends the entire distance from York to Hagert street.

It was the arrangement of the bake room and ovens which determined the layout of the building. The ovens are in two rows extending north and south and facing each other, with a clear space between them 50′ wide and 225′ long. In planning the locations of the ovens, one of the objects sought was to make the working conditions in front of the ovens as comfortable as possible by permitting the escape of the excess heat from the ovens directly to the outer air. This has been accomplished by placing the ovens in one-story sections of the building which adjoin the two-story building on each side, the sections of the building over the ovens being provided with ventilating skylights at frequent intervals. At the fronts of the ovens their walls are continued to the ceiling and faced with enamel brick, which shuts off the space over the tops and backs of the ovens from the bake room in front. This is of great sanitary value, as it prevents any heat, dust, or gases in connection with the firing and cleaning of the ovens from entering the bake room where the dough and baked bread are being handled.

The east row of ovens consists of ten double Petersen tile ovens with provision for two additional ovens of the same size. With these ovens the bread is placed in and taken from the baking chamber by means of long-handled wooden implements called "peels." The ovens on the opposite or west side consist of ten double Werner & Pfleiderer draw-plate ovens, with provision for four additional ovens of the same size. The bread is placed in and removed from the baking chamber in these ovens by means of steel cars, which are pushed in and drawn out on tracks in front of the ovens, requiring a space in front of the ovens equal to the depth of the ovens. In order to obtain the wide space between

FIG. 2—REINFORCED CONCRETE CONSTRUCTION PERMITS OF ABUNDANT LIGHT AND SPACE IN MIXING ROOM

the ovens required for the manipulation of the long-handled 'peels" on one side and the steel cars on the other, reinforced girders 18′ apart and having a span of 52′ center to center of supporting columns, were used. These girders are of *T* section, having a total depth of 6′, the top flange of the *T* being 52″ wide, 16″ thick. The stem of the *T* is 18″ thick, except near the bottom, which is sloped out to 22″, forming a small flange similar to the flange on a plate girder or *I*-beam.*

This construction, which reduces the total weight of the concrete in the girders, and is therefore economical of materials, was adopted in order to meet the requirements of the Building Department of the City of Philadelphia, which requires that the steel reinforcement in the concrete beams be placed in not more than two layers. This requirement, together with the requirement as to the amount of concrete necessary around the reinforcement, for fireproofing purposes, practically fixed the width of the girder at the bottom, and the increased width at that point of the girders described above was necessary in order to provide for the proper number of reinforcing rods in the two layers, as called for by the calculation of the loads to be carried.

The steel reinforcement consists of ten 1⅜-in. square twisted bars, six of which are bent up near the

*Compare description of design and construction of an 80-ft. clear space girder, *Cement Age*, April, 1911, Pg. 192.

(Continued on page 72)

FIG. 3—VIEW SHOWING OVEN ARRANGEMENT
On the Floor Above is the Heavy Mixing Machinery, but the Vibration is Negligible Owing to the Firm Reinforced Concrete Girders

FIG. 5—SHIPPING ROOM ADJOINING BAKE ROOM
Horses do not Enter the Building Proper and there is no Lifting as the Floor is on Bake Room Level

FIG. 4—LOADING ROOM TO ACCOMMODATE 33 DELIVERY WAGONS

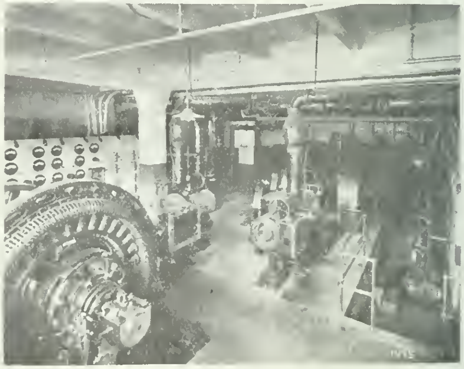


FIG. 6—DYNAMO AND ENGINE ROOM OF THE BAKERY

(Continued from page 70)

ends, and four of which are straight from end to end of the girder. Stirrups of 3/8-in. round rods are provided at suitable intervals, being spaced close together near supports and at wider intervals nearer the center.

To carry the floor between girders, beams 7″ wide and 12″ deep reinforced with four 7/8-in. square twisted bars are provided spaced 5′ 6½″ center to center. The slab between these beams is 4″ thick, reinforced with 5/16-in. square twisted bars, 6″ center to center, with ¼-in. square twisted bars 24″ center to center, at right angles thereto.

In the roof construction of mixing, or dough, room, second story, *T* girders of similar construction, with the exception that the beams are not flanged, are provided, the span being the same as in the bake room below. The depth of these roof girders is 5′ ½″, with the *T*-head 52″ wide and 16″ thick, the stem of the *T* being 18″ wide.

Owing to the fact that the flues from the ovens occur immediately under the concrete beams at the point of connection with the concrete columns, it was decided to allow the concrete beam in each case to pass through the flue.

A 1:2:4 mixture of Alpha cement was used in this building. The J. H. Day Co. mixer was used.

Since the completion of the building an additional flour storage cellar has been constructed under about one-half of the wagon space on Twenty-fifth street. This is 106′ long and 32′ wide, and of flat slab construction, the slab being 8½″ thick. There are two rows of columns 11′ center to center, making the bays 11′ by 14′. Whitehall cement was used in the addition.

The entire building and equipment was designed and the construction supervised by Ballinger & Perrot, architects and engineers, Philadelphia.

Points Worth Noting: In conclusion the following points are worth emphasis:

This is a carefully planned structure with practical features that could not be obtained with the same facility by the use of any other material.

It is a building that cannot burn, or it is as nearly fireproof as it is possible to make a modern structure.

The insurance rate is $0.06⅔ per $100 on building and contents.

Through the use of reinforced concrete there has been provided abundant light and room, while the massive concrete girders that carry the heavy mixing machinery reduce the vibration to a negligible factor.

Details of a Recent Fire Test of Partition Construction

To determine the comparative value of different standard partitions and wall construction, the Associated Metal Lath Manufacturers held in Cleveland, June 27, a fire test which developed data of the greatest value.

The Testing Station: This, as shown in Fig. 1, is a seven-sided concrete structure, presenting practically six "fire-plates" on six external faces; the seventh side is left open for entrance. The walls, the "back-walls" of the "fire-places," are of heavy concrete, and even when firing with oil furnaces is in full blast, it is possible to work in this interior open section. Against the six external faces are swung heavy frames of steel channels in which the test panels are built. These "doors" are 8′ x 10′, and during the test are swung tightly against the firing chamber.

Heat is furnished by oil-burners, situated in the interior section, behind each firing chamber; and the air compressor is driven by a gasoline engine. Fig. 1 shows part of the surrounding frame structure cut away. A panel partly swung open is shown at the right. The open interior of the 6-sided structure and the oil-burners are shown in the central part of the view, and at the right is shown the interior of the firing chamber, a "fire-place," with a door swung entirely open. Note the track on which the outer edge of the door swings.

Procedure: Extracts from the specifications for testing fireproof partitions adopted August 16, 1909, by the American Society for Testing Materials, which were followed here, explain the firing procedure:

The construction to be tested shall be subjected for two hours to the continuous heat of a fire, rising in temperature to 1700° F. by the end of the first half hour, and maintained at an average temperature of 1700° F. for the balance of the test; the fuel used being either wood, gas or oil, so introduced as to cause an even distribution of the heat throughout the test structure.

The temperature obtained shall be measured by means of standard pyrometers under the direction of an experienced person. The type of pyrometer is immaterial so long as its accuracy is secured by proper standardization. The temperature should be measured near the center of the test structure about 6″ below the roof or ceiling, and also at the center of each partition under test about 7′ above the grate level. In case the partition under test is more than 15′ long, additional pyrometers shall be used, symmetrically disposed and not more than 12′ apart. Temperature readings at each point shall be taken every three minutes, and the average used as the controlling temperature.

At the end of the heat test, a stream of water shall be directed against the construction under test, discharged through a 1⅛″ nozzle, under 30 lbs. nozzle pressure, for 2½ min., the nozzle being held within 20′ of the panel and the hose stream being played backward and forward over the entire surface of the partition under test.

The test shall not be regarded as successful unless the following conditions are met: No fire or smoke shall pass through the partition during the fire test; the partition must safely sustain the pressure of the hose stream; the partition must not warp or bulge, or diintegrate under the action of the fire or water to such an extent as to be unsafe.

Construction: The panels were erected and plastered between May 2 and May 8, according to stand-

(Continued on page 76)

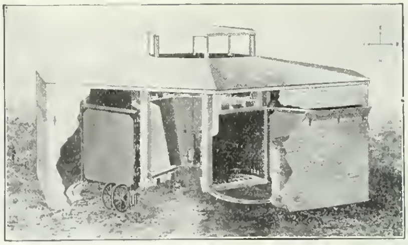


Fig. 1—General View of Testing Laboratory

Fig. 2—Panel No. 1 After Firing

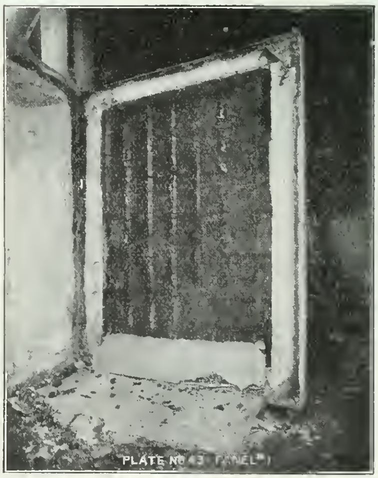


Fig. 3—The Fired Side of Panel No. 1 Partly Torn Down to Show Metal Lath

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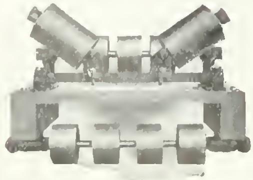

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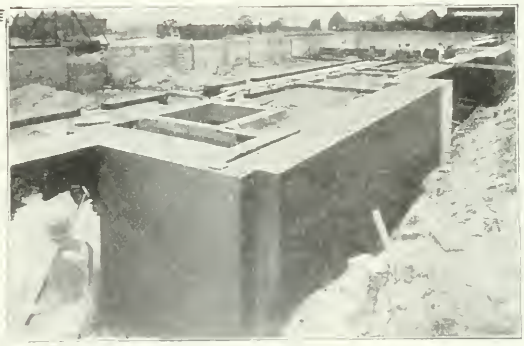

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MAKERS OF THE FAMOUS *Carey Flexible Cement Roofing*

(Continued from page 74)

ard approved practice, and under the direction of Virgil D. Allen, building inspector of Cleveland, and the committee appointed by him at the request of the Associated Metal Lath Manufacturers. This committee consisted of Prof. John H. Nelson, Case School of Applied Science; L. H. Miller of the Bethlehem Steel Co., and W. S. Lougee, a Cleveland architect.

Fig. 4—Panel No. 2, Wood Lath on Wood Studding, After the Test

A. W. Zesiger, concrete engineer of the city building department, acted with the committee. The construction was as follows:

Panel No. 1 was metal lath on wood studding; 24-gauge painted expanded metal lath stapled to 2 x 4-in. pine studs at 12-in. centers and plastered with a cement and lime plaster 3/4-in. grounds, about 5½" over all.

Panel No. 2 was pine lath on wood studding at 16-in. centers, plastered with a patent gypsum plaster on 3/4" grounds, according to the specifications of the leading manufacturers.

Panel No. 3 was constructed by wiring painted 24-gauge expanded metal lath to 3/4-in. steel channels spaced at 12-in. centers, plastered on both sides with lime and cement mixture, making a solid wall 2" thick.

Panel No. 4 was a stucco wall such as would be built with metal lath and cement plaster for the outside wall of a stucco house. The metal lath was fastened directly to the studding, then plastered and back-plastered between the studs, giving a thickness of 1½". This side, which corresponds to the outside of a house, was placed next to the fire, as it was desired to learn how far this kind of a house might prevent the spread of a conflagration through a residential district. On the outer side of the 2 x 4-in. pine studding, which would correspond to the inner side of the walls of a house, 24-gauge metal lath was fastened and plastered the same as Panel No. 1—metal lath on wood studding.

Panel No. 5 was made by wiring metal lath on both sides of a studding 2½" over all, built by fastening two 3/4-in. steel channels together. The cement plaster was applied to both sides alike, the same as specified in Panel No. 1, with 3/4-in. grounds, thus making a 4-in. hollow metal lath partition.

Panel No. 6 was 3/8-in. Sackett plaster board nailed to 2 x 4-in. pine studding as specified by the leading manufacturers of plaster board. The plaster known as "Imperial" was put on 3/8-in. grounds in three coats.

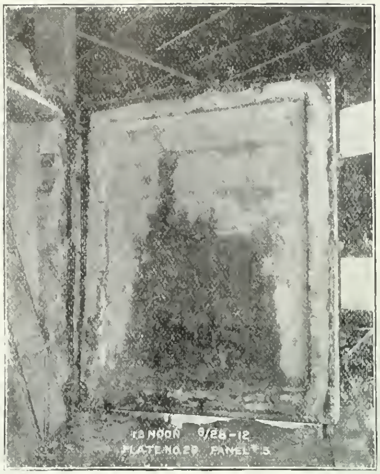

Fig. 5—Panel No. 3, the 2-in. Solid Partition After Test

Fig. 6—Panel No. 4 After the Fire Test

The Test: Temperature readings on the interior or fired surface were taken by electric pyrometers. On the outer surface thermometers were placed at three points on each panel. They were held in place vertically by a plaster of Paris socket. Readings during the firing were taken every ten minutes.

The contours of the panels were taken by direct reading of deflection. Wires were stretched horizontally at three levels, fastened to the surrounding frames, and about 3" from the plaster surface. The readings were taken in nine points, three at each level.

The log of the test was as follows:

Panel No. 1, metal lath on wood studding, was fired for two hours. It took 30 min. to bring the temperature up to 1700° F. and for the remaining hour and a half it ranged between 1700° and a maximum of 1912° F. At the end of the two hours' fire the door was thrown back and water

(Continued on page 78)

(Continued from page 76)

from the city hydrant directed against the hot panel through a 1⅛-in. nozzle within one minute after the door was opened.

The appearance of the specimen after this abuse is shown in Fig. 2.

After it had cooled the metal lath and plaster were torn down to see what the action had been on the wood studs and outside of wall. Fig. 3 shows that what was left of the studding was charcoal, but that the outside of the wall was still intact and in a condition to resist more fire.

Panel No. 2, wood lath on wood studding, was fired in the same way for two hours, reaching a maximum temperature

Fig. 7—Panel No. 4 Partly Torn Down

of 1865°, but before the first hour was up, it was observed that all but the outside shell of palster was destroyed and that was gradually cracking and opening up, allowing the cold air to enter the chamber, with the result that it held together long enough to give it the two hours' fire. After the water had been thrown on it, there was nothing left, as is pictured by Fig. 4. The committee seemed to be of the opinion that had the water been thrown on the hot wall at the end of the first hour, there would have been total destruction then.

Panel No. 3. This was metal lath on steel studding, 2-in. wall. This partition got the required heat of 1700° to a maximum of 1929°, and at the end of the two hours' fire, water was thrown against it as on the other partitions, but with the exception of the washing off of an unappreciable quantity of the plaster that had recalcined under the intense heat, the partition had the appearance of being able to go through another such test successfully.

Fig. 5, which is the view of this panel taken after "fire and water," shows the wonderful performance of this light 2-in. partition. Within the first 15 minutes of fire, a formation of steam from moisture between coats, scales off a section of the second coat on the extension wall.

Panel No. 4 was a stucco wall built by fastening metal lath to wood studding. The mixture of the cement plaster used in this wall was particularly designed to prevent hair cracks and other imperfections to which stucco walls under alternating weather conditions, when not properly built, are subject, but it seemed to stand the abuse about as well if not better than Panel No. 1. This furnace was fired the full two hours, the highest temperature reached being 1943°.

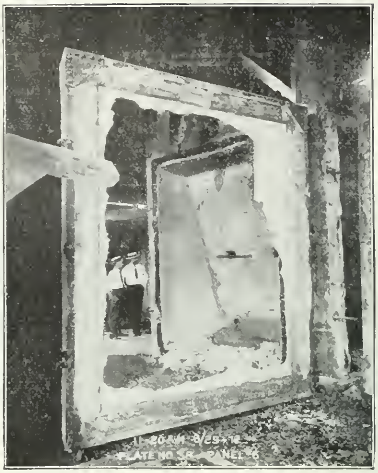

Fig. 8—Panel No. 6 Completely Wrecked

Fig. 6 shows the condition of the wall after "fire and water" and Fig. 7 shows that after tearing the fire side of the wall off after cooling the wood studding was in much better condition than in Panel No. 1, and that the outer side of the wall was intact.

Panel No. 5. Four-in. hollow metal lath—supposed to be the most efficient fire retardant of the light partitions—lived fully up to all expectations. It had full two hours' fire, reaching 1976° at the highest.

The metal lath was slightly exposed on the inside of the wall, but unquestionably a similar test might well be repeated several times before the partition would be destroyed, as the outside of the wall has received no damage as yet and the fire-side is good for quite a further time of service to protect the outside from heat.

Panel No. 6 was plaster board on wood studding. This partition had a total fire of 74 min. at a maximum of 1562°, and then water was allowed to flow on it at low pressure to quench the fire in the partition and after that the full stream was turned on for half a minute, with the result shown in Fig. 8. Fig. 8 shows the debris at the base of the furnace and in this picture is quite clearly shown the method of measuring the heat in all of the furnaces. The couples connected by wires to a pyrometer are run down into the protection tube which projects into the furnace.

It is interesting to note that the panels using steel studs showed the greatest deflection under heat attack. There was not enough left of the wooden studs to buckle, and they failed as they stood, with little change of position.

As the time for swinging the door open drew near, block and tackle were adjusted, and a large sheet iron the size of the door was placed ready. The firemen with the hose line were ready. The stream was always directed at approximately right angles to the surface. At a signal, the door was swung open, the sheet-iron shield placed in front of the white-hot "fire-place," and the hose turned on. Every endeavor was made to reproduce the most extreme possibility of actual fire destruction.

The test was witnessed by engineers, architects, insurance men and others interested in fire protection

(Continued on page 82)

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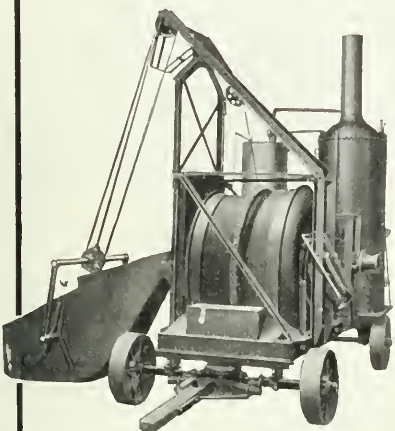

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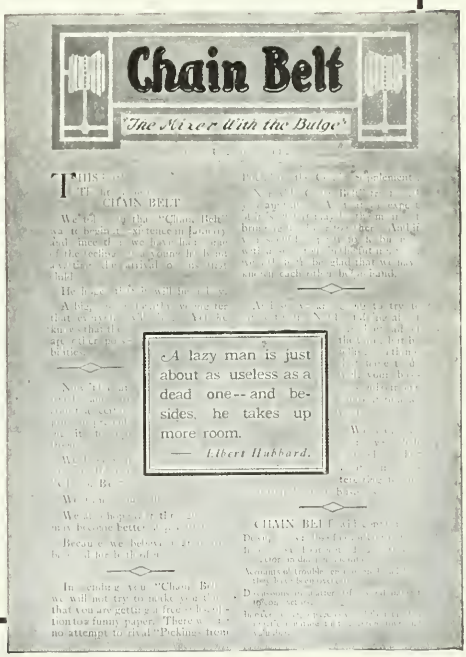
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(Continued from page 78)

and building materials, from many parts of the country. Among those present were: Chief Wallace of the Cleveland fire department; V. D. Allen, the inspector of buildings; C. F. Ringer, building inspector from Milwaukee; C. H. Patton, manager of the Cleveland Inspection Bureau and representing the Underwriters' Laboratories of Chicago; J. McMahon, building inspector, from Toledo; S. A. Dies, building inspector, Pittsburgh; Frank S. Barnum, architect for the Cleveland board of education; Ira H. Woolson, consulting engineer of the National Board of Fire Underwriters; W. B. Uniack and L. Redding, assistants of the Ohio state inspector of workshops and factories; J. Norman Jensen, Chicago building department; J. W. Stromberg, Clinton Wire Cloth Co.; L. J. Neale of J. B. King & Co.; H. B. McMaster, commissioner Associated Metal Lath Manufacturers; Fred W. Elliott, Ohio State architect; Dr. C. W. Kanolt of the United States Bureau of Standards; E. A. Roberts, secretary Cleveland Builders' Exchange; W. J. McSorley, general president Wood, Wire and Metal Lathers' International Union; H. G. Goodwin, building inspector, Akron; A. R. Kellogg of the National Plaster Board Co.

Steam Curing Concrete Products

(Continued from page 32)

distance as the steam will move in all directions from the openings. There is no objection to the perforated pipe except that in case the perforations are made too small the pipe must be de-drilled and the average concrete products plant has no facility for drilling and in consequence the pipe must be taken to some machine shop to be drilled. With our method the manufacturer can regulate this himself by means of reducing bushings. The openings nearest the main feed pipe should be smaller than those toward the discharge end as otherwise all the steam will escape through the first openings and there will be no steam in the other end of the kiln. This feature should be watched carefully when the kilns are used the first time and the openings reduced to the proper size.

Principles of Steam Curing

I do not for a moment claim to know the last word about this process of steam curing of concrete products, but my experiments, backed by actual tests of commercial size products, give me very strong evidence in favor of my conclusions. The trouble with most discussions of this subject is that hasty conclusions are drawn by the authors based on mere guesses and theories, not substantiated by actual tests. Some manufacturer puts in a steam curing plant, cures his block for 24 hours or more, and then picks the edges with his fingers and immediately remarks, "By George, these are twice as strong as block cured by sprinkling for 28 days." Soon after, he is visited by a manufacturer from another city and proceeds to show him his kilns and block and repeats the assertion. The second manufacturer, for fear of being behind the times or displaying ignorance, immediately agrees with him,

(Continued on page 84)

No. 61 Ransome Street Mixer with 20-ft. distributing chute.

Note how operating levers are brought to one point and can be operated from platform.

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Ransome Street Mixers

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The "Ransome 1912 Mixer Catalog" will make you "mixer wise". Send for it.

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(Continued from page 82)

and before long this opinion is regarded as actual fact by almost everyone interested in the subject. As a matter of fact, it is a mere guess, not substantiated by actual tests. Steam curing by this method accelerates the hardening of concrete products by about ten days, but not by the period of 28 days.

I had the pleasure, together with R. J. Wig, now of the U. S. Bureau of Standards, to make the first extensive scientific series of tests on steam curing concrete products, both under atmospheric and high pressures, and all statements that I make in this discussion are based on the results of these tests.

What Mr. Jones or Mr. Smith says about the strength of steam cured block applies also to what is often said about what happens when steam is fed direct from the boiler or engine or through a body of water. Most of these discussions are individual theories not backed by any actual tests, and it is time the concrete product manufacturers gave serious attention to the subject.

Saturated steam is steam at a temperature due to its pressure and is developed in the presence of a body of water and not heated after it is withdrawn from that body. Super-heated steam is steam at a temperature higher than that due to its pressure and to attain this has been heated after being withdrawn from the generating body of water. Water in the presence of superheated steam will flash into steam. Cold water in the presence of saturated steam will reduce the temperature thereof until it is all of the same temperature and cause condensation. All steam drawn from the ordinary steam boiler is saturated and may either be dry or wet. Dry saturated steam contains no particles of water; all the water is in the form of a gas. Wet saturated steam carries with it small particles of water, not in the form of gas. It is obvious that neither dry nor wet saturated steam can extract moisture from a colder body than itself as it is already saturated with all the moisture it can hold. As soon as saturated steam leaves the boiler it loses heat by radiation through the steam pipes and begins to condense. This is actually what happens when steam is fed from a boiler to a steam curing kiln. Before it enters the kiln the temperature is somewhat lower than when it left the boiler and the temperature in the kiln itslf is so much lower than that of the boiler that the steam then condenses very rapidly. It cannot therefore extract moisture from any concrete block in the kilns but rather gives up moisture to these products. The only way moisture could be extracted from the block would be to heat the kiln by external means, in other words, convert it into a steam boiler. There is nothing else that could happen when the kiln doors are closed and the kilns are filled with steam, for the steam is already saturated and if moisture could be extracted from the block under such conditions it would have to take the form of steam and cannot be converted into steam by any other means except heating externally. This is one of the first principles of steam engineering and knocks in the head any theory that steam fed direct from the ordinary boiler (without superheating) into a steam curing kiln, will extract moisture from the block.

To say that steam under these conditions does extract moisture from the block is equivalent to saying that if water is placed in a closed and air tight vessel and steam allowed to come in contact with it the water will evaporate. The exact opposite is what actually occurs, as amply illustrated in the case of a closed steam header. Such a header will always contain water of condensation. The closed end of a steam pipe acts in the same manner. If the water could be evaporated it would be creating energy out of nothing.

In the article in *Concrete* previously referred to it is said: "The virtue of a concrete curing kiln is not in its heat, but in the moisture supplied the product at the time crystalization begins, etc. * * * Steam is hot and unfit for the curing of concrete products. * * * In constructing a kiln the main object should be to produce dampness." These statements are made through a misunderstanding of steam and also through a misunderstanding of what actually occurs in the hardening of cement. Heat is just as essential to the curing of concrete as moisture. The mere fact that cement heats up in setting proves this contention and is further demonstrated by the fact that products cured in high pressure steam up to 80 pounds per square inch are much stronger than those cured by any other process.* Moisture is essential but is supplied by saturated steam and as explained before, all steam taken direct from a boiler is saturated, and the very best way of producing dampness is to fill the room with saturated steam.

The temperature of the kilns is very important. Inasmuch as the steam is always saturated when used as above, the temperature of the steam room may be as high as is due to the temperature of the steam. This will never exceed 212°, as that is the temperature of steam at atmospheric pressure. The heat is just as essential in curing concrete products as is moisture. However, heat alone is not sufficient. It must be combined with moisture. That is why an atmosphere of steam is an ideal one, so long as the steam is saturated. Regardless of the pressure, the temperature of the room may be as high as that of the steam itself, and as already said, this temperature will never exceed the temperature of steam at atmospheric pressure unless a steam-tight compartment is used, such as a cylindrical steel high pressure kiln. In such a kiln the temperature of the wiln will correspond with the temperature of saturated steam at whatever pressure is used. The best results are to be obtained in the use of high pressure steam, as shown in the great strength obtained in concrete products in tests which have been made using high pressure steam.

Feeding the steam through a body of water does no harm but is unnecessary and wastes too much heat. To put a closed steam pipe into a body of water and thus evaporate the water by feeding live steam through the pipe, is ridiculous as it is repeating the process that actually takes place in the steam boiler. It amounts to making a boiler of the steam kiln. No openings whatever should be made through the roof

(Continued on page 86)

*The attention of the reader is called to an article elsewhere in this issue which abstracts a recent report on this subject made by the U. S. Bureau of Standards.—EDITORS.

(Continued from page 84)

unless it is to exhaust the steam when opening up the kilns in order to take out the block. Steam rises and if there are any openings in the kilns the steam will escape through these openings and will not circulate throughout the kilns, and in the case of the method suggested in the May issue of *Concrete* by Mr. Burns, the steam or vapor will rise from the pipe or water tank straight up to the roof of the building and escape through the openings. With our method the steam would rise up the side walls of the kiln, flow straight up and also escape through these openings, whereas without the openings most of the steam will strike the side walls, rise to the roof, meet in the center and flow downward again to the steam pipe. Some of it will flow straight upward from the pipe a little distance to one side of the pipe. There are quite a number of plants using this or similar methods, with satisfactory results.

High pressure, steam curing gives far better results than the atmospheric pressure, but the initial expense is considerable, so on that account we adopted the method described, but our kilns are so built that we could install the other system at any time. Atmospheric steam curing for two days makes the product about as strong as it would be in ten days when cured by sprinkling, but the big advantage is that the block attain this strength before they have to be removed from the pallets and thus there is no danger of breaking the edges or corners of the block.

I can substantiate all the statements and conclusions given herein by a series of tests which Mr. Wig and I made five years ago, and another that we made soon after for the government laboratory at St. Louis, Mo. It will be interesting to readers to know that the government has made tests on curing concrete products in an atmosphere of steam up to 1000 pounds per sq. in. pressure and the results have been very satisfactory. This test may some day be adopted for testing the soundness of cement. As *Concrete* published a synopsis of my first tests in April, 1911, I will not include them in this article.

Better Subgrade and Fewer Joints

(Continued from page 32)

been personally responsible for the success of the Wayne County work, and have built up a reputation for a quality of work which they hesitate to sacrifice for a small additional expenditure, believing that the general public will remember quality when price has been forgotten. At the same time the Wayne County Commissioners are also anxious to make the $2,000,000 bond issue, the proceeds of which they are spending at this time, build just as many roads as possible, and if any unnecessary element of expense can be eliminated with the result that 5 or 10 per cent more roads can be built, they want to eliminate that expense.

The roads built in Wayne County last year cost a little more per sq. yd. than those built the year before, and this was due in a large measure to the necessity for additional sub-grade work on some of the highways, and also to the fact that long hauls for materials were necessary on some of the roads which were being built at considerable distance from the city and from lines of railway transportation. The roads built last year, which this spring developed the few cracks which led to a determination to eliminate them by the use of longitudinal joints, are on particularly bad soil, over a soft foundation where it was not easy to build up and make a firm sub-grade. This condition exists on part of the river road and on part of the Michigan avenue road.

There is a feeling, however, that the longitudinal joints may not be necessary, and only two miles of road with the longitudinal joints will be constructed. Some of those closely identified with the work are convinced that the few cracks mentioned are due entirely to the foundation and drainage conditions. In this connection it should be mentioned that the drainage problem is an important one which goes hand in hand with road building. The Wayne County Board is learning this of late in trying to solve the drainage problem along the highways which it builds, so that these highways may be properly protected in all seasons; but where the surrounding drainage systems of the county are so high, as they are in many places, it is impossible to put down road drainage which the County Commissioners do put down, to the proper depth, without inviting a back-flow in time of wet weather. It is evident that the matter of drainage will have to go forward along with the road building if road building problems are to be permanently solved.

Still other innovations are in the wind in Wayne County work, and it is not at all unlikely, CONCRETE-CEMENT AGE has reason to believe, that the transverse joints in the roads will be at least 50′ apart instead of 25′ as at present. The Wayne County roads have been built of concrete 7″ thick, all of the early roads having been built on a sub-grade which had a crown like that of the finished pavement, of ¼″ to the foot. Now that this sub-grade crown has been eliminated, the commissioners find that they are using more concrete and that instead of a road 7″ thick at every point, they are putting in the concrete fully 8″ thick in the center. It is not unlikely that the thickness of the road will be decreased to 6½″ or even to 6″ in the near future. The very first concrete road put down in the county was but 6½″ thick and it has been entirely satisfactory. It has been the policy to err on the side of safety rather than to have any failures to bring discredit on the good work of the Board, but it is argued that should the thickness of the pavement be decreased and a 10 per cent saving made in cost, the road builders could well afford to have a 5 per cent loss by error, whereas the repair cost at present is negligible. It is also felt that an extra expense in compacting and leveling the sub-grade will help to make it possible to reduce the number of pavement joints. Great attention is now being given to sub-grade.

The Coltrin Mixer in General Contracting

No. 12 Coltrin with Automatic Measuring Hopper Feed.

A Coltrin Mixing Concrete for Reinforced Tank Floor. S. S. Thos. Maythem. Krohn Bros., Buffalo, N. Y., Contractors.

The Coltrin Continuous-Batch Mixers

SHIPPED ANYWHERE ON FIVE DAYS' TRIAL—WRITE FOR CATALOG.

THE KNICKERBOCKER CO., JACKSON, MICH.

Much Attention to Concrete at American Road Congress

It is announced that special attention is to be given to the use of concrete in road construction at the sessions of the American Road Congress to be held in Atlantic City, September 30 to October 5. While concrete is virtually a newcomer in the field of roadmaking its adaptability to modern traffic conditions has gained for it recognition among highway engineers.

Logan Waller Page, Director of the United States Office of Public Roads and active President of the American Road Congress, has just announced that the exhibit of the government at Atlantic City will contain a model of a modern concrete road. There will also be models showing all other types of roads.

The highway departments of every state in the union will be represented at the Congress and some of the leading contractors of the country will be among the speakers. There will be a comparative analysis of the contract and force account systems in road construction, and papers will also be read on the relation of the contractor to the public official.

In the general discussion of these subjects many of the existing difficulties encountered by contractors in dealing with public officials will probably be straightened out. It is believed that a better understanding and more effective co-operation will be brought about as a result of the exchange of views at the sessions of the Congress.

Under the contract system the work should be let to the lowest responsible bidder. Unfortunately this is not always the case. Under the force account system the highway officials of the state, county or city undertake the work themselves and engage laborers. The contractors who will appear on the program have the opportunity to show that better results are obtained by letting out the contract to a contractor, and may point out the weakness in the existing contract regulations.

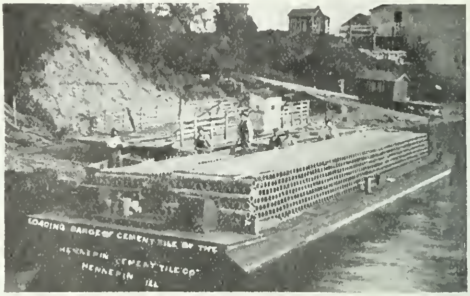
The American Road Congress marks the crystallization of the entire road movement, which has led to the investment of more than $150,000,000 annually by the people of the United States.

More than half a hundred state, county and local associations are now affiliated with the American Association for Highway Improvement and all of these will participate in the big road Congress. More than one thousand state, local and county automobile associations and clubs are affiliated with the American Automobile Association and all of these likewise will be represented at the Congress.

More than 80,000 sq. ft. of space have been set aside on the Million Dollar Pier for the exhibits of the manufacturers of road machinery and road materials. The Association of Portland Cement Manufacturers has engaged a large space for its exhibits, while individual members of the association have contracted for large areas for their own special exhibits. Many of the states have also engaged booths, where they will have on file maps and publications of various kinds showing the location and character of their own roads.

Active Tile Plant

The illustration shown herewith gives evidence of the prosperity of concrete products business, in central Illinois. A barge loaded at Hennepin, on the Illinois river, by the Hennepin Cement Tile Co., Inc., has on board 1400-12″ tile, 3400-10″ tile, 5000-8″ tile, 4250-7″ tile, 5000-6″ tile, and 4450-5″ tile, a total of 23,500 tile, having an estimated weight of 375,000



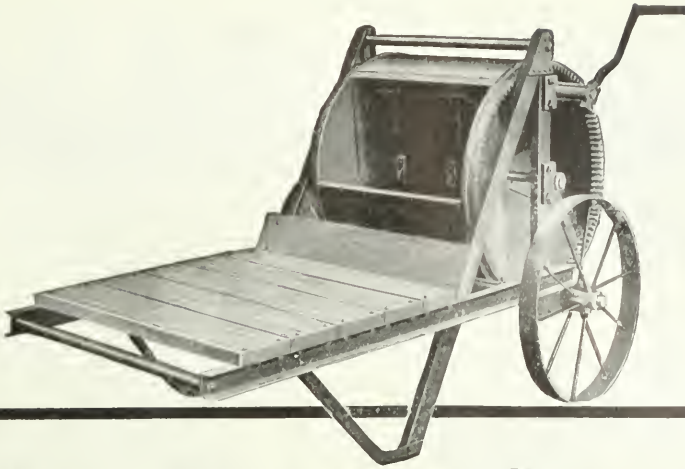
LOADING TILE ON BARGE

pounds. This barge was loaded from wagons, but now the company has a slide down which the tile go from the high bank to the barge, going down endways at the rate of 42 tile per minute. The Hennepin plant was built only last fall and got under operation just as cold weather came. Since the last week in April, the plant has made and sold more than 200,000 tile. These tile are made on equipment furnished by the Cement Tile Machinery Co.,* and are steam cured for 48 hours.

Before the Republican and Democratic National Conventions made their Presidential nominations, President Taft and Governor Wilson of New Jersey, were invited to address the American Road Congress, to be held at Atlantic City, September 30 to October 5. Both men, realizing the importance of the good roads movement, promised to address the Congress, and the situation has not changed since both of them have become candidates for election to the Presidency. It is not likely that they will appear together on one platform in their autumn campaign except at the American Road Congress. The Congress is a national movement in which every one seems to be united, and the fact that the American Association for Highway Improvement, the American Automobile Association, and the National Association of Road Machinery and Material Manufacturers, will combine their interests in the one big meeting, gives ample assurances of its success.

Editorial Note—Editorial mention is made, page 60, of a new compression roll machine for the manufacture of concrete poles. After the "form" containing this reference had gone to press it became impossible to publish the article this month, although the description was then "in type" and "cuts" made for illustrations. It will appear in a later issue.

*Waterloo, Ia.



Why Take a Chance
on Crude Methods of Mixing Concrete?

Lay down your shovel and look around you. No matter how small the yardage, first class concrete is worth while; and first class concrete is impossible at prevailing prices, unless mechanically mixed. The old shovel and hoe methods are obsolete— they don't pay. But surplus capacity and weight, cost of operating, erection and haulage make a power mixer unprofitable on the small job. There's *no escape* either way. The progressive contractor MUST use the

SMITH HAND MIXER

It is a batch mixer with a capacity of 2½ cu. ft.— a thoroughly tested machine, guaranteed to mix in *three turns* of the drum — a MIXER capable of reliable service under long, hard service — a REAL mixer backed by the best and oldest firm of mixer builders in the U. S. This machine will improve your work and increase your income at the same time.

Write for our special Smith Hand Mixer proposal and booklet No. 10

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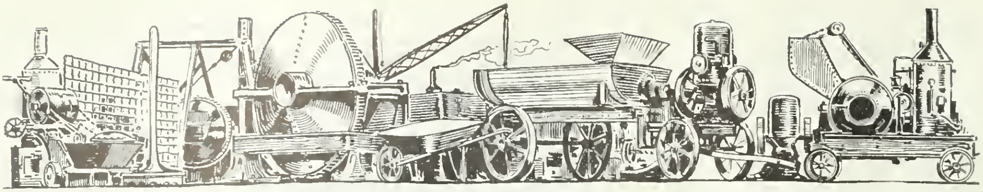
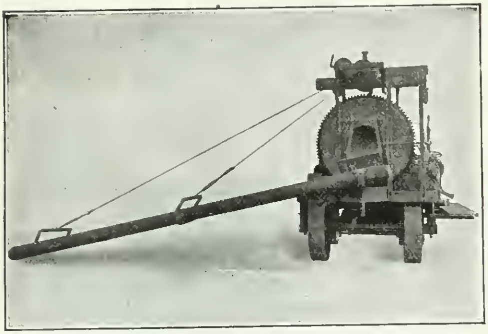


NEW EQUIPMENT, METHODS and MATERIALS

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in tbis paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

A New Design of Street Mixer

The Ransome Concrete Machinery Co., Dunellen, N. J., has just put on the market two new types of street mixers, the No. 60 and No. 61. There are many points about these which are different from anything which has been offered to date by mixer manufacturers, and



NEW MODEL OF RANSOME STREET PAVING MIXER, SHOWING DISTRIBUTING CHUTE

the design has been made by the Ransome company after a long study of the street-paving contractor's problems. The No. 60 machine is a steam driven outfit regularly furnished with 10-ft. distributing chute capable of handling 14 cu. ft. of loose material, and will mix 40 to 60 batches per hour, depending upon the speed which the material can be fed into the pivot hopper. The engine is 8 h. p. and the boiler 9 h. p. The machine is arranged to drive in both directions along the work.

The various levers controlling the operations of hoisting, discharging and traction are all brought to one point and the entire operation can be controlled by the engineer. The chute will swing through an arc of approximately 180° while the discharge point is 3′ 7″ above street level. The outfit is mounted on 20 and 28-in. wheels with 10-in. tires The net weight of the machine complete with power is approximately 11,000 lbs.

The No. 61 Ransome street mixer will handle up to 20 cu. ft. of loose material and will mix from 40 to 60 batches per hour. It is regularly equipped with a 2-cylinder opposed gasoline engine and a 20-ft. distributing chute. It is arranged with a clutch by which the drum can be thrown out and remain idle while the machine is traveling along the rod, and it is also equipped with a traction device adapte l for moving in either direction. A notable feature of this outfit is the fact that the over-all height has been kept within 11 ft. 2 ins. This has been done by eliminating the charging hopper and emptying direct from skip into mixer.

The driving wheels are 44″ in diameter and the front wheels 40″, the tires being 10″ and 8″ respectively. By using these large wheels an 18-in. clearance above the ground has been made possible, thus avoiding any jacking up of the machine to clear manholes which are liable to project 12″ or more above the subgrade of an unfinished street. When desired, flanges may be bolted to the tires, thus making the outfit suitable for operation under the machine's own power on trolley tracks, etc. If the outfit is to be drawn behind a trolley car at high speed, standard flanged wheels may be readily substituted for the ones regularly furnished as the wheels are easily taken off inasmuch as the driving axle is mounted in split boxes and the front axle can be swung around and the wheels slipped off.

All of the operating levers have been brought adjacent to the operating platform at one side of the machine. The steering wheel is in front. The line shaft

(*Continued on page 92*)

THE KOEHRING

3 In 1 Principle of Mixing Means Three Times as Much Mixing

Three times as much mixing in a given time or an equal amount of mixing in one-third of the time.

It is all due to the fact that there are three independent and opposed continuous mixing actions in the Koehring drum, any one of which produces as much mixing as the entire mixing action of most other mixers.

There is a cutting through at the bottom and lifting and pouring of material from the side and end-to-end mixing, breaking the material over against the heavy cast drum heads and a cataract flow off the inner end of the discharge chute, producing a thoroughness of mixing, a rapidity of mixing and a uniformity of mixing no other machine equals.

There are almost equally important advantages in the mechanical construction of the Koehring Mixer.

The heavy cast special metal Koehring drum will outlast the drum of any other mixer

The trunion rollers are keyed onto the axles and rotate as a unit precisely in the same manner as a railroad truck, making impossible "wabbly" drums and rollers.

The charging bucket raises to nearly vertical position, enabling all material to pass into drum without pounding the bucket.

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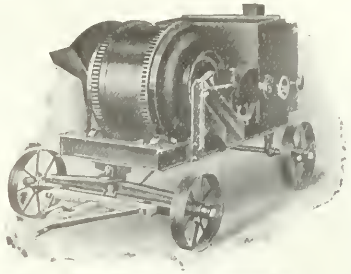
KOEHRING MACHINE CO., Milwaukee, Wis.



Equipped with [illegible] wing Ho[illegible]soline Engine

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Birmingham, Ala.—J. F. Donahoo Co., 8th Floor Woodward Bldg
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Botte, Mont.—Montana Lime & Flux Co., 501 W. Galena.
Charleston, S. C.—Carolina Portland Cement Co.
Chicago, Ill.—Koehring Machine Co., 857 Peoples Gas Bldg.
Columbus, Ohio—Williams Contractors Supply Co., 8th Floor Brunson Bldg
Dallas, Texas—Wm. T. Fulton Co., 2035 Commerce St.
Denver, Colo.—H. S. Hitchman Co., 411 Nassau Bldg.
Detroit, Mich.—Good Roads Supply Co., 1408 Ford Bldg.
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Salt Lake City, Utah.—Harris Bros., 310 Atlas Blk
San Francisco, Cal.—Hicks, Nell & Marks, 604 Mission St.
San Antonio, Texas—Alamo Iron Works.
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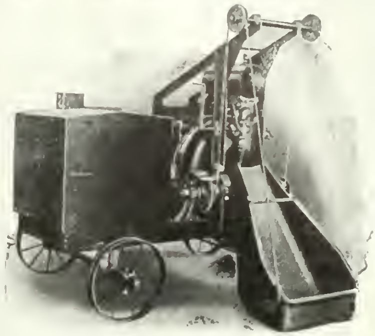
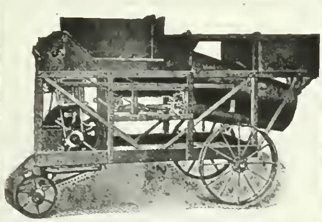
Toronto, Ont.—Canada Foundry Co., Ltd.



Charging Side View. Equipped with Side Loader, Water Tank and Gasoline Engine



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Make perfect concrete.
Have ample capacity.
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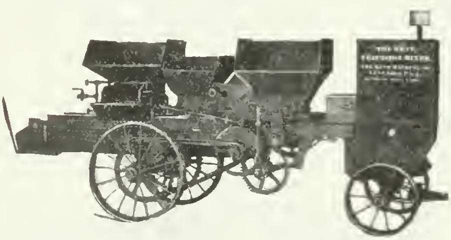
The "Kent" Precision Mixer

It is a well built concrete mixing machine, built on scientific principles. It measures and proportions materials accurately and delivers mixed concrete at lowest cost. Get our mixer catalog. **Ask about the "Kent" Mortar Mixer.**



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(Continued from page 90)

is driven by chain and the power is transmitted through clutches to the windlass for operating the hoist, the drum and the traction wheels. Of course, when desired an electric motor can be substituted for the gasoline engine, and when operated in railway service the motor could be run from overhead trolley wires. The general dimensions are as follows:

Weight	15,000 lbs.
H. P.	16
Height over all, skip raised	14′
Height over all, exclusive of skip	11′ 2″
Extreme width	8′ 6½″
Length, exclusive of skip and chute	17′ 1″
Length, with skip lowered	20′ 10″

Marquette, Mich., Building Waterproofed

Guild Hall, Marquette, Mich.
Charlton & Kuenzli, Architects.

Charlton & Kuenzli, architects of Marquette, Michigan, have had an unusual opportunity the efficacy of good waterproofing for stucco exteriors on the Guild Hall Building in that city, shown in the accompanying illustration.

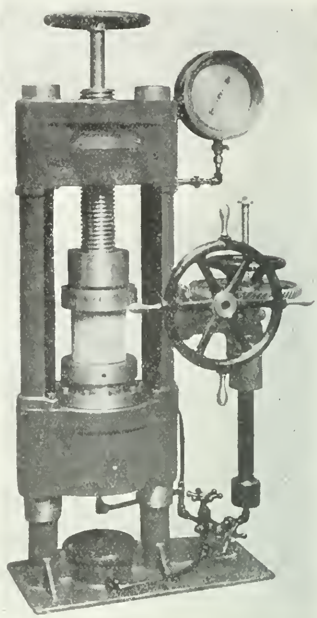
A portion of the building was waterproofed in 1908, but owing to exhaustion of funds, three years elapsed before the work could be completed, so that the waterproofed portion could be compared with the part that was not waterproofed. The results are described by the architects in a letter to the manufacturers of the waterproofing, as follows:

"In regard to the waterproof cement stain which you furnished for this building would say that on account of lack of funds only a portion of the building was treated with your stain. This portion has shown no deterioration whatever in the course of the last three years, but that portion that was not treated was badly affected by the weather, so much so that it has been necessary to do considerable repairing on the stucco work. The entire building is now protected with your stain so we trust we shall have no more trouble in the future."

The waterproofing material used was made by Samuel Cabot (Inc.), manufacturing chemist, Boston. A special color, made to suit the requirements of this particular job, was used.

A New Testing Machine

Constructing engineers are realizing more and more the necessity of knowing accurately the quality of the concrete they are using. To do this, many methods have been developed, and of these probably the one in most general use is a direct compression test on the concrete.



Tinius Olsen & Co., Philadelphia, advise us that they have recently developed (at the request of Cloyd Chapman of Westinghouse, Church, Kerr & Co., New York city, also on the committee for standardization of test specimens for cement and concrete of the American Society for Testing Materials, and a similar committee of the National Association of Cement Users) a 200,000 lbs. capacity compression testing machine.

The endeavor has been to make the 6 in. cube and 8 in. diameter by 16 in. deep cylinder the standard size specimen for this test. The machine was accordingly designed with a view to maximum accuracy, ease of operation and with a compactness for transportation at a minimum cost.

The machine is arranged with a screw plunger pump so that an even application of load may readily be applied by hand up to 200,000 lb. and the one stroke of the pump sufficient to break almost any specimen. A valve is provided whereby pressure may be maintained on specimen and pump filled and a second stroke applied to the specimen, if required. The adjustment is by upper screw, and a fast or slow means of applying pressure by pump provided. The spherical bearing is placed in the upper head, which

(Continued on page 94)

Tender

Calgary, June 24th, 1912.

THE CITY OF CALGARY.

TENDER FOR CONCRETE BRIDGES.

Sealed Tenders, marked "Tenders for Concrete Bridges" will be received by the undersigned, until the 31st day of August, 1912, for the construction of three reinforced concrete bridges aggregating some 25 spans across the Bow and Elbow Rivers within the city limits of Calgary.

Plans and all information can be obtained from the office of the City Engineer in Calgary. A charge of $5.00 will be made to parties securing plans and which will be returnable to party depositing same when the plans are returned to the engineer.

J. M. MILLER, City Clerk.

(Continued from page 92)

is probably the preferable construction, as the adjustment is then the best.

The manufacturers will be glad to answer enquiries for further information concerning this equipment.

Flat Slabs in the Chicago Building Code

The Chicago Building Ordinance, passed in 1910, did not have any provision in it for girderless floor construction of reinforced concrete and the Commissioner of Buildings recently appointed a commission of experts consisting of A. N. Talbot, of the University of Illinois, W. K. Hatt, of Purdue University, and L. E. Ritter, Consulting Engineer of Chicago, to pass upon flat slab floor construction. This commission formulated for the guidance of the Chicago Building Department design standards for flat slab floor.

These "Design Standards" are rules for determining the thickness of slab and the amount of reinforcement to be required for given loadings, based on the usual allowable unit stresses for reinforced concrete designs.

There have been a number of tests on exterior panels of flat slab construction, made and reported by various builders, and quite recently, such a test was made for the owner of one of the buildings designed and built on the "Akme" system. In this particular case, (the Wagner building), the exterior span was 24 ft., center to center of columns, and the span in the other direction was 21 ft. A test load of 500 lbs. per sq. ft. covered the entire area of two panels, one an exterior, the other an interior panel. The construction was the paneled ceiling type of the "Akme" system. The results of this test conducted at the Wagner building, together with other tests on "Akme" system buildings, are shown in the following table:

Flat Slab Construction in Portland, Ore.

The following regulations have been adopted by the building department of Portland, Ore., as a general basis for the design of flat slab floors:

It has been necessary for the Department of Buildings to use a general method of calculation for the purpose of checking any system of reinforced-concrete flat-slab construction, bceause there is a large and increasing number of systems and the advocates of each make special claims for their own system and have individual methods of calculation, many of which are not susceptible to a rational analysis to determine if the stresses allowed in the building code were adhered to in the design.

As the general procedure and methods used in checking by the Building Department may be of interest, they are herein stated with the hope that designers may be relieved from the annoyance of changing the plans of such systems after they have been submitted to the Building Department.

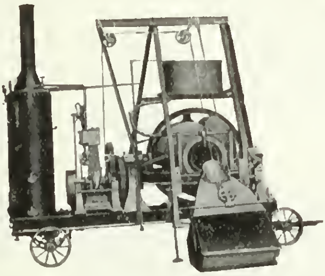
Any reinforced concrete flat-slab construction can be separated into two main parts; first, the cantilever portion (extending out from the column), and second, the suspended portion. The first step in the analysis is to determine the extent of each. The Building Department leaves the designers free to assume the size and shape of the cantilever portion with the limitation that the di-

(Continued on page 96)

RESULTS OF FLOOR TESTS, "AKME" SYSTEM

Building	Column Spacing	Diag. Span	Slab Thickness Max.	Slab Thickness Min.	Slab Thickness Ave.	Live load Lbs.	Test Load Lbs. per Sq. Ft.	Test Load Area Sq. Ft.	Test Load Total Load, lbs.	Max Def. In.
Studebaker	24'-0"x23'-9"	33'-9"	12"	6"	8.6"	100	300	570	171,000	0.34"
Peck & Hills	14'-8"x14'-0"	20'-3"	7½"	4"	5.7"	150	280	196	54,800	0.06"
Oak Park, W. H.	16'-10"x15'-3"	22'-8"	9"	4½"	6.5"	150	300	256	76,800	0.08"
Peck & Hills	16'-2"x15'-10"	22'-7"	7½"	4"	5.5"	100	275	256	70,400	0.12"
Sharples	18'-0"x17'-5"	25'-0"	8"	8"	8.0"	225	550	620	344,000	0.22"
Wagner	24'-0"x21'-0"	31'-10"	14"	6½"	10¼"	200	500	1,000	500,000	0.38"

Note:—The last two tests each covered two entire adjacent panels. In the "Wagner" test one panel was an "exterior" or end panel.



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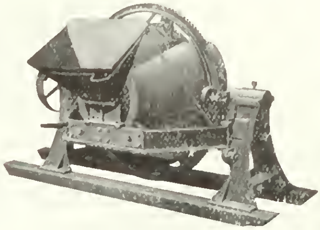

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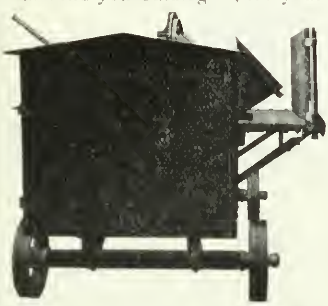

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(Continued from page 94)

ameter of such portion should not exceed one-half the distance center to center of columns plus one-half of the diameter of the column cap. The flare of column cap should not be less than 60° from the horizontal. The designer is also free to assume the proportion of the load carried by any reinforcing band, where two or more bands are under such load. The suspended slab is figured as freely supported.

The suspended load is considered to be uniformly distributed along the edge of the cantilever portion and the bending moment of the cantilever is figured in the usual way. The maximum bending moment of the cantilever is considered to be resisted by a width of slab greater than the width of the support, according to the conclusions of Prof. A. N. Talbot ,after a series of experiments, and his recommendations are followed, which are as follows:

The effective width of the support plus twice the depth from compression face of slab to center of tension steel, plus half the remaining distance to the point of inflection or the edge of the cantilever. The resistance of this effective width is figured in the usual way.

Steel should be placed in accordance with assumptions made by designer so that all stresses are adequately resisted.

In all cases the stresses allowed in the ordinance are adhered to.

Punching shear is figured around the perimeter of the column cap, but in figuring diagonal tension, the resistance to maximum load is figured around a perimeter one-half the effective depth of slab out from the edge of the column cap.

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WALTER C. BOYNTON, General Manager
R. MARSHALL, Business Manager
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Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa., Convention, Pittsburgh, Dec. 12-18, 1912.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Bldg., Philadelphia, Pa.

American Association for Highway Improvement, J. E. Pennybacker, Jr., Secretary, Colorado Bldg., Washington, D. C.

American Road Congress, Atlantic City, N. J., Sept. 30 to Oct. 5, 1912.

Nebraska Cement Users' Association, Secretary-Treasurer, Frank Whipperman, Omaha, Neb. Convention and Show, Auditorium, Omaha, Feb. 6-12, 1913.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Building, Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Pittsburgh Cement Show, Exposition Hall, Dec. 12-18, 1912.

Chicago Cement Show, Coliseum, Jan. 16-23, 1913.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

In This Issue

Vol. 1 DETROIT and NEW YORK, SEPT., 1912 No. 3

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Concrete-Cement Age

Vol. I SEPTEMBER, 1912 No. 3

Editorials

MOST OF the early development of the concrete highway was in the Middle West. Now California on one coast and New York on the other are spending millions in this construction.

* * *

THE DIFFERENCE between a seemingly inconsiderable detail in one concrete pavement and a corresponding detail in another concrete pavement may represent the difference between a good pavement and a poor pavement.

* * *

WE ARE only beginning to learn the value of power vehicles. Their possibilities will not be fully realized until roads are built on which they may travel. The concrete highway offers a surface which they cannot tear to pieces and one on which they can develop their full value. The motor car came disguised as a pleasure vehicle. In its possibilities along the line of mechanical haulage the development of the invention now bears a close relationship to the possibilities of lowering the cost of living.

* * *

FROM 1906 to 1911, inclusive, the New York State Commission of Highways expended $48,995,000. The state pays the entire expense of state roads and 50 per cent of the cost of county roads, while the county pays 35 per cent and the township 15 per cent. For the maintenance of 3,151 miles of highway (state and county) in 1912, the Commission asked for $926 per mile, a total of $2,919,959. In view of these figures a statement in the report of the commission is interesting: "* * * It seems wise whenever possible to construct a foundation of concrete and to cover this with a thin wearing course composed of bituminous material and screenings or sand which is economical in first cost and easily and cheaply renewed. The foundation of a road, so constructed, is good for all time and the wearing course serves the purpose of carrying all classes of traffic without rubbing, raveling or raising a dust."

* * *

IN PRESENTING the information as to concrete country highways and city pavements in Tables 1, 2 and 3, an effort has been made clearly and fairly to set forth the details and opinions supplied by engineers and officials in charge of work done in the 85 localities listed. It is regretted that many reports came too late to be included in the tabulation. All these which are not covered in separate descriptions in this issue will be handled in later issues, together with much additional information which, due to its varied nature—could not be used in tabular form in connection with the reports which are included in the tables. This issue of CONCRETE-CEMENT AGE—which, in its predecessors now combined in one magazine, has been the principal exponent of concrete pavements—carries a summary of careful investigation which will be continued in greater detail and more particularly along the line of field methods and equipment, in subsequent issues.

Concrete Pavement References In This Issue

Reports Tabulated from 85 Places Where Concrete Is Used on Streets and Roads

Cities, towns, counties and states, from which information has come to Concrete-Cement Age as to concrete pavements and highways are indexed at the bottom of this page.

Information from 85 places, listing more than 100 different pieces of work, is published in tabular form, pages 33 to 51, so that differences will be more obvious and comparisons made the more readily. All these places are indicated in the index by an asterisk (*) after the name.

In Table Number 1, the various columns describe the work as to number of square yards, width of roadway, contour of subgrade, crown of pavement, thickness of courses, cost of pavement per square yard and cost of subgrade whenever the information has been supplied separately, contract or public work and in the last column, treatment of surface.

Table Number 2 describes the mixtures used as to kind, quantity and quality of materials and the prices of the various materials.

Table Number 3 describes the joint spacing, filling and protection, tells what special precautions were taken, if any, in curing the pavement, tells kind and cost of curb in many instances, kind of traffic using or to use pavement and states the opinion of our informant as to the satisfaction given by the work. Note is made of changes in specifications with foot notes and explanations in most cases. Special features are mentioned when our informant has called attention to them. The name of the engineer in charge of the work is given in almost every instance and also the name of our informant—in most cases identical. The foot notes are not to be considered editorial foot notes except as they call attention to other references to the pavement described. The entire tabulation should be read as coming direct from the informant, every effort having been made to incorporate our informant's statements of fact and opinion in the spirit in which they are given. Dates and places are repeated in all three tables so that one piece of work may readily be followed through the three tables.

Unfortunately many reports came to us after it became necessary to close up the forms containing the tables. For this reason some pavements are mentioned in this issue which are not mentioned in the tables. Many other interesting pieces of work are not mentioned in any way in this issue owing to lack of space.

Places listed in the tables which receive further mention elsewhere in the issue are indexed by page numbers. Places which are not in tabulation and are otherwise mentioned are listed in the index by page numbers only and have no asterisk after the name.

Index To Pavement Information

FIG. 1—BUILDING CONCRETE ROAD, ERIE COUNTY, NEW YORK

The Template, on Wheels, is in the Foreground. It is Pulled along the 4"x8" Forms by Two Men—Only one shown in the Picture

Concrete Highways In New York State

Particular Reference to a Jointless Concrete Road on Grand Island, Erie County

One of the most significant developments in the acceptance of concrete paving for country highways is found in the action of the State Commission of Highways of New York, deciding to build this year about 200 miles of concrete roadway. Details as to how most of these roads are being built will be found elsewhere in this issue in Tables 1, 2 and 3. One of the most interesting pieces of concrete road building being done under the direction of the state commission in New York is the stretch of 4.67 miles now being put down on Grand Island, near Buffalo, in Erie county. This work is a departure from the ordinary, in the fact that no expansion joints are being provided. In this the work differs from the course being followed in the construction of the 200 miles of concrete highway on which the State Commission of Highways furnished information for the tables mentioned.

The work near Buffalo is on the East River road and is known in New York state as Job. No. 991. It involves the placing of approximately 44,000 sq. yds. of concrete for a roadway 16′ wide. Gravel shoulders will increase the driving width by about 3′ on each side. The road is being put down on a red clay sub-grade and the work is being crowned, both sub-grade and finished surface ¼″ to 1′. There are no expansion joints whatever. The concrete is laid 6″ thick in one course and is being made of a 1:6 mixture of Universal cement and Niagara river gravel, which is clean and of good quality, and up to 2″ in size. About 45% of this aggregate is sand. The cement costs $1.30 per bbl. on the job. It has to be ferried from Tonnawanda to Grand Island. The gravel costs about $1.60 per yard on the job. It is pumped from the river onto scows and taken to Grand Island where it is removed with clam-shells to stock piles. From there the longest haul is about 1½ miles, the location of the stock piles being changed as the work progresses. Most of the road is near the river bank, but it is not possible to get close to shore with the scows at every point. The surface of the road is to be covered with tar and screenings. With these conditions and these prices the road is to cost about 90 cents per sq. yd. exclusive of sub-grade preparation. The total cost of the work will be about $1.36 per sq. yd.

The specifications under which the work is supposed to be executed are known as Specifications No. 5 of the New York State Commission of Highways. These, however, provide for rolling the concrete after it is placed, with a 10-ton roller and they provide for the use of concrete with only so much water in it that the mortar will not be forced to the surface under the roller.

These specifications are not being adhered to in this detail. Quite the contrary, the concrete is being used very wet, so wet that it just stands up enough to per-

FIG. 2 IN THIS PICTURE THE MIXER IS BEING MOVED BACK UNDER ITS OWN POWER

mit of making the crown ¼″ to 1′ and with no stiffness to spare.

The work is being done by Louis Gipp, Buffalo contractor, and is under the supervision of Charles Rice, resident engineer in Buffalo for the state commission. Both of these men are emphatic in their statements that it is highly impractical to use a roller on the work between the mixer and the finished pavement and to get it off the road without touching any concrete previously rolled.

The interesting features of the specifications in question are as follows:

Bottom Course: The bottom course of this road shall be as shown on the plans when rolled in place and shall be formed of gravel concrete 6″ thick.

Top Course: The top course of this road shall be approximately ¼″ in thickness when rolled in place and shall be formed of bitumuous material T. (tar) and H. O. (heavy asphaltic oil) and sand or screenings.

Concrete-Bitumumous Top Course: After the subgrade has been thoroughly rolled so that the surface conforms to a line parallel with and at the proper depth below the grade lines shown on the plans, gravel concrete shall be spread to the depth and cross-section shown on the plans. The concrete shall be mixed with only a sufficient amount of water so that when the mass is rolled with a ten-ton roller the mortar will not be forced through the stone to the surface but enough so that there will be a slight appearance of moisture on it. The rolling shall be continued until the aggregate is thoroughly compacted, care being taken to remove the roller before the concrete begins to take its initial set. At the end of each day's work the roller must be taken off the concrete, care being taken to avoid running the roller over any concrete which has been previously rolled.

After the removal of the roller the concrete shall not be disturbed for a period of 12 days except that after it has taken its initial sit it shall be kept sprinkled for 48 hours and as often thereafter as may be ordered by the division engineer.

In order to obtain a uniform surface timbers shall be placed at the edges at such an elevation that when the surface is struck with template it will give the proper crown and will be true and even with no depression or irregularity. After the surface of the concrete has become thoroughly dried, all dust, if any, shall be swept off and ¼ gal. per sq. yd. of bitumuous material T. (tar) heated to a temperature of approximately 250° F. shall be sprayed on the concrete and immediately covered with a layer of screening ¼″ in thickness, which shall be spread uniformly over the surface before the bitumuous material has become cool. It shall be rolled with a self-propelled road roller weighing not less than 5 tons. As soon thereafter as possible ¼ gal. per sq. yd. of bitumuous material, H. O. (heavy asphaltic oil), heated to a temperature of approximately 350° F. shall be sprayed on the rolled surface and immediately covered with a layer of screenings ¼″ in depth and rolled to the satisfaction of the engineer. When screenings are not available, clean sharp sand may be substituted with the permission of the division engineer.

The machine used for spraying these bitumuous materials shall be of such construction that the amount to be applied can be regulated and spread on the road in a thin uniform sheet.

Contractor Gipp has done a great deal of pavement work and is to put down some of the Dolarway type in the vicinity of Buffalo in the near future.

On the Grand Island work in Erie county he employs a mixer gang of 20 to 21 men, and puts down more than 500 lin. ft. of road for each full day.

A Koehring mixer is used with boom and dump-bottom bucket as shown in Figs. 1 and 2, and the bucket dumping in Fig. 3. In this gang are 1 foreman, 1 engineer, 1 fireman, 9 wheelers, 2 men handling cement, 1 at bucket end of boom and 4 follow-up men. These follow-up men haven't a hard job. As already mentioned the concrete is used very wet; it is dumped

(Continued on page 74)

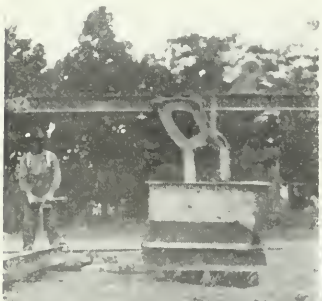

FIG. 1 FIG. 2 FIG. 3

Dumping the Slushy Concrete; The Template Which Gives the Crown; the Follow-up Man "Patting" with Long Handled Shovel.

Concrete Paving---Table No. 1

When Laid	Place	Number Sq. Yds.	Width of Roadway	Length of Roadway	Sub-Grade, Flat or Crown	Street Crown When Finished	Thickness: 1st Course	Thickness: 2nd Course	Cost of Pavement: Per Square Yard	Cost of Pavement: Subgrade Preparation	Contract or Public Work	Surface Finish
1911	Aberdeen, Wash.	2,000	20′	900′	Convex	4″	4″	2″	$1.49	Included	P	"Picked-up" with brush after floating.
1910	Aberdeen, Wash. (Alleys)		20′		Concave	2″ to 5″ dip	6″	2″	1.69	Included	P	Scored 6″x24″
1911	Alpena, Mich.	6,507	40′	1,464′	Crown	4′ in 40′	6″	2″	1.15[1]	Included	P	Floated and roughened
1906	Anderson, Ind.* (Alley)	480	20′	216′	Dip	4″ Dip	5″	1″	1.26		C	Smooth
1911	Ann Arbor, Mich. [2]*	64,800	24′–34′		Crown	6″	4½″	1½″	Less Than 1.00	Included	P	
1908–1912	Appleton, Wis.		24′–36′	2.75 mi.	Crown	4″ in 36′ St.	5″	1¾″	1.10 to 1.39	Included	P[3]	Various[3]
1909	Bad Axe, Mich.	2,500	24′–50′			4″ to 6″	5″	2″			C	Slightly roughened
1893 & 1894	Bellefontaine, Ohio*	3,600	24′ & 50′		Crown	6″	4″	2″			C	Grooved and scored.
1911	Bettendorf, Ia.	30,000	40′		Crown	9″ in 20′	6″	None	.85		C	Broomed.
1911	Billings, Mont [4]* (Alleys)	2,000	20′	900′	Concave	5″ Dip	7½″	None	2.25[4]	Included	C	Wood floated and brushed.
1910	Boise, Idaho*	20,184	40′ & 60′	2,880′		Straight Slope 6″ to 9″	8″	None	1.15		C	Wood floated.
1910	Boise, Idaho* (Alley)	6,878	16′	3,600′		3″ Dip	6″	None	1.10		C	Wood floated.
1911	Boise, Idaho	54,865	40′ to 61½′	9,895′		6″ to 9″	6″	None	1.12		C	Wood floated.
1912	Boise, Idaho	3,482	50′	607′		6″ to 9″	6″	None	1.04		C	Wood floated.
1908	Bozeman, Mont.[5]*	27,000	62′ to 65′	3,600′	Crown	10″	5½″	1½″	1.95	Footnote[5]	C	Scored ¾″ deep, 4″x8″
1911	Burlington, Wis.*	12,232	30′ to 46′	3,330′	Crown	3⅛″ in 30ft. Rdy	5″	1½″	.96	.10	C	Broomed.
1912	California, San Francisco to Burlingame *		24′	5.4 Mi.			5″	1″ asphalt	1.03	Footnote[6]	C	Tamped only
1912	Carlinville, Ill.	3,800	28′	1,300′	Crown	6″	5″	2″	1.285		C	Wood floated
1912	Centerville, Ia.	3,000			Crown	4″ for 24ft. St.					C	

*See more detailed mention elsewhere in this issue.

1—Includes curb measuring area of curb in with pavement.

2—See *Concrete*, May, 1911, p. 59, and March, 1912, p. 36. Also see mention elsewhere in this issue under caption "Ann Arbor, Michigan."

3—Done on contract previous to 1912, but is now city work. Surface on some pavements broomed; some left smooth; some marked with garden rake and some was marked in blocks 2½″ square when a squeege coat of asphalt was applied hot, covered with dry, fine stone chips and well rolled.

4—This pavement is reinforced. See mention elsewhere in this issue under caption "Billings, Montana."

5—See *Concrete*, April, 1909, p. 46. Pavement cost $[illegible] per square yard which did not include excavation at [illegible] per yard or gravel fill at $1.25 per yard. The total cost was $2.28 per sq. yd.

6—Excavation cost 37c per [illegible]. See mention under caption "California" elsewhere in this issue.

Concrete Paving---Table No. 1---Continued

When Laid	Place	Number Sq. Yds.	Width of Roadway	Length of Roadway	Sub-Grade, Flat or Crown	Street Crown When Finished	Thickness 1st Course	Thickness 2nd Course	Cost of Pavement Per Square Yard	Cost of Pavement Subgrade Preparation	Contract or Public Work	Surface Finish
1912	Centralia, Wash.	9,387	16′	5,280	2″	2″	4½″	1½″	1.04	$ .06	C	Wood floated
1912	Chippewa Falls, Wis., (Alley) *	675	16′	396′	....	3″ Dip	6″	1½″	1.28	Included	C	Broomed
1912	Clinton, Ia.	12,000	30′ to 60′	....	....	5″ for 30-ft. St.	4″	2″	1.34		C	Broomed
1912	Connersville, Ind.*	65,000	20′ to 32′	2 Mi.	2″ Crown	6″	5″ at side 9″ at center	1½″	1.02	...	C	Floated and broomed
1912	Davenport, Ia., *7	5,253	30′	1,459′	Crown	8″	5″	1½″	1.17	......	C	Floated and broomed
1905 to 1910	Denver, Colo., (Alley)	12,000	16′	....	5″ Dip to Center	5″ Dip	4″	2″	1.27	Included	C	Floated smooth
1910	Des Moines, Ia., *	767	21′	329′	Crown	5″	6½″	1½″	1.57	Included	C	Grooved transversely every 4″
1910	Des Moines, Ia*	3,070	23′	1,190	Concave	3″ Dip	6½″	1½″	1.69	Included	C	Same
1911	Des Moines, Ia. (Alleys)*	6,000	....	....	....	....	6″	None	1.25 to 1.30		C	
1912	Des Moines, Ia, *	20,250	20′ to 40′	....	Crown	5″ to 9″	6″ and 8″	None	1.22 to 1.46	Included	C	Floated
1910	Detroit, Mich. *	16,472	22′	1.39 Mi.	....	....	5″	2″	1.39	...	C	..
1912	Detroit, Mich. * (7 Alleys)	....	....	....	3″ Dip	3″ Dip	5″	2″	....	....	C	Struck off
1912	Detroit, Mich. *	4,152	26′	1,437′	Crown	5″	5″	2″	2.32	Included	C	Troweled
1912	Detroit, Mich. * (Alley)	288	15′	....	Dip	3″ Dip	5″	2″	2.76	Included	C	Trowled
1912	El Dorado Springs, Mo.	13,000	26′	3821′	Crown	6″ to 7″	6″	None	.87	.	C	Tamped
1910	Eldora, Iowa	3,000	24′ to 50′	....	Crown	2% of ½ Width	5″	2″	1.36	...	C	Troweled and broomed
1911	Eldora, Iowa	32,000	24′ to 50′	....	Crown	2% of ½ Width	5″	2″	1.36	....	C	Troweled and broomed
1912	Eldora, Iowa	28,000	24′ to 50′	....	Crown	2% of ½ Width	5″	2″	1.23	...	C	Same
1911	Escanaba, Mich.	7 Blocks	30′ to 50′	....	Crown	8″	4″	2″	.87[8]	.	C	
1908 to 1910	Fond du Lac, Wis. 9*	106,527	27′ to 56′	About 6 Mi.	Crown	4″ for 27-ft. St.	5″	1½″	1.10 to 1.37	Included	C	Floated and broomed
1910–1911	Fond du Lac, Wis. 9*	34,740	27′ to 40′	About 3 Mi.	Crown	3½″ in 27′	5″	1½″	1.20 to 1.27	Included	C	Floated and broomed
1910	Fort Dodge, Ia.	30,000	16′	1½ Mi.	Crown	4″	5″	2″	1.60	Included[10]	C	Troweled
1912	Fort Smith, Ark.	33,000	20′ to 40′	....	Crown	6″ for 25-ft. St.	6″	None	.75	....	C	Floated and broomed

1906	Gary, Ind. *		66'	1 Mi.	Crown	10" to 12"	5½"	1½"	1.65 to 1.90	Included	C	Grooved in bricks 4" by 7½"
1907–1908	Gary, Ind. *		46'	½ Mi.	Crown	10" to 12"	5½"	1½"	1.65 to 1.90	Included	C	Grooved in bricks 4" by 7½"
1910	Grand Forks, N. D.	20,756	30'		Crown	3" to 7"	5¼"	1¼"	2.35	Included	C	Grooved in blocks 4½" by 9"
1911	Grand Forks, N. D.	35,451	30'		Crown	3" to 7"	5¼"	1¼"	2.40	Included	C	Same
1911	Grand Island, Neb.	3,755	16'		Dip	3-in. Dip	5"	2"			C	
1911	Grand Rapids, Mich.	530	22'	212'	Crown	5"	5½"	1"	1.10	Included	C	Troweled and broomed
1911	Greenville, Ill. *	2,900	16'	3,000'	Flat	None	8"	None	.90	Included	C	Hand tamped
1911	Harlan, Ia.	20,000	24' & 30'	½ Mi.	Crown	Varies	4"	2"	1.18	$.10	C	Floated[11]
1912	Hennepin Co., Minn. *	8,213	14'	1 Mi.	1 in. Crown	1"	7"	None			C	Floated and broomed
1912	Highland Park, Ill., * Lake Co.	13,000	20' & 30'	6,000'	Flat	2" & 3"	7" and 8"	Bituminous	1.01		C	Broomed
1912	Hudson, Mich.	24,000	24'	8,000	Crown	3"	6"	None			C	Broomed
1909	Huntington, Ind., (Alley)	450	16'	266'	Dip to Center	Dip to Center	5"	1"	.95		C	Wood floated
1911	Huntington, Ind., (Alley)	1,350	16'	800'	Dip to Center	Dip to Center	6"	None	.95		C	Wood floated
1911 & 1912	Huntsville, Ala.		30' & 40'	3,700'	Crown	6" & 8"	6"	1¾"			C	Blocked
1910	Independence, Mo. *	2,172		717'	6"	6"	5"	None	1.19	.10	C	Smoothed
1910 to 1912	Kansas City, Mo. *	65,433		4.16 Mi.	Crown	6" for 26-ft. St.	6"	None	1.20[12]	Included	C	Tamped and broomed
1910 to 1912	Kansas City, Mo. * (Alleys)	46,169		5.66 Mi.			6"	None	1.20[12]	Included	C	Tamped and broomed
1904	Le Mars, Ia. *	½ Block					5"	1½"	1.25	Included		See note[13]
1911	Liberty, Mo.	16,500	28'	4,800'	3"	3"	5"	1"	1.18	Included	C	Broomed[14]
1911	Lincoln, Neb., (Alley)	752	16'	423'	3" Dip	3" Dip	4"	2"	1.43	Included	C	Troweled
1912	Lodi, Cal.		56'	10 Blocks	Crown	10"	5½"	None	1.66		C	Roughened
1908	Lowell, Mass.	6,423	50'	1,576'	Crown	3"	6"	None	1.40	.24[15]	C	Smoothed
1907	Lynn, Mass.	10,855	50'		Flat	Nearly Flat	4"	2"	1.35		C	See foot note[16]
1910	Mason City, Ia.,[17] (Ada St.)	4,500	30'			6"	5"	2"	1.25		C	Corrugated

*See more detailed mention elsewhere in this issue.

7—These data apply to but one job—Farnam St. See further mention under caption "Davenport, Iowa," elsewhere in this issue.

8—The contractor says he lost $1,000 on job.

9—See *Concrete*, September, 1909, p. 48, and February, 1912, p. 33. The 34,740-yd. job is reinforced. See further mention under caption "Fond du Lac, Wisconsin," elsewhere in this issue.

10—Curb also included.

11—On streets with more than 4% grade surface was grooved.

12—See mention under caption "Kansas City, Missouri," elsewhere in this issue.

13—Special reference to surface is made elsewhere in this issue under the caption, "Le Mars, Iowa."

14—Since the first work which was broomed, E. H. Collins, engineer, says he finds that a surface which is wood floated is better.

15—[illegible] grade

16—When top [illegible] cement [illegible] pavement

17—See *Concrete*, April, 1911, [illegible]

Concrete Paving---Table No. 1---Continued

When Laid	Place	Number Sq. Yds.	Width of Roadway	Length of Roadway	Sub-Grade, Flat or Crown	Street Crown When Finished	Thickness 1st Course	Thickness 2nd Course	Cost of Pavement Per Square Yard	Cost of Pavement Subgrade Preparation	Contract or Public Work	Surface Finish
1910	Mason City, Ia., * (Adams Ave.)	14,000	30′			6″	5″	2″	1.25		C	Corrugated
1911	Mason City, Ia. *	11,000	30′			6″	5″	2″	1.38		C	Wood floated
1912	Mattoon, Ill.	5,200	16′	3,000	Crown	2″	6″	None	.90		C	Floated
1909 to 1911	Memphis, Tenn.	30,629	30′ to 40′	11,600′	Crown	6″	6″	None	1.10 to 1.15		C	See foot note [18]
1912	Menasha, Wis		14′	3,200′	Flat	Flat						
1911	Menominee, Mich.	2,000	26′	640′	Crown	8″	6″	2″	1.225			Roughened
1910	Milford, Del. *	750	26½′ Average		Slight Crown		6″	None	1.05		C	Smoothed with back of rake.
1911	Milford, Del. *	2,185	26½′ Average		Slight Crown	7″	6″	None	1.05		C	Same
1912	Milford, Del. *	2,400	26½′ Average		Slight Crown	6″	6″	None	1.05		C	Same
1912	Milwaukee Co., Wis. *		15′ to 18′	16 Mi.	Crown	¼″ to 1′	7″	None	.90		C	Wood float
1912	Mitchell, S. D., *	26,000	42′ to 56′		Crown	7″ on 56′ 5″ on 42′	5½″	1½″	1.47 to 1.55	Included	C	Floated and broomed
1911	Montesano, Wash., [19]*	5,345	20′	2,020	4″	4″	4″	2″	1.32	Included	C	Troweled[19]
1911	Montesano, Wash., * (Alley)	2,063	10′ & 20′	1,627′	Concave	2″ Dip	4″	2″	1.27	Included	C	Grooved[19]
1912	Muscatine, Ia., (Alleys)	3,333	20′	900′	Dip to Center	4″ Dip	7″	None	.95	Included	C	Broomed
1911	New Hampton, Ia.	11,480	52′	6 Blocks		6″	5″	2″	1.29		C	Roughened
1908	New Haven, Conn.	12,399	34′	3,062	⅜″ to 1′	⅜″ to 1′	5½″	1¾″	2.20		C	Marked in blocks[20]
1908 to 1912	New Orleans, La. *	154,726			6″ for 30-ft St.	6″ for 30-ft. St.			2.37 to 2.95		C	Marked in blocks[20]
1912	New York State * (in various localities)	1,876,000	14′ & 16′	200 Mi.	Crown	¼″ to 1′	5″ & 6″	None	.90		C	See foot note [21]
1911	Niagara Falls, N. Y.	18,453	16′ & 30′	8,484′	Crown	6″	7″		2.00		C	Hassam pavement
1909	Norristown, Pa.	2,800	26′	720′	Crown	Slight Crown	6″	None	1.10	Included[22]	P	Rough[22]
1910	Osage, Iowa	28,000	52′ to 72′		Crown	2% of ½ Width	5″	2″	1.36		C	Troweled and broomed

1910	Plymouth, Wis., [23]*	10,780	40′	7 Blocks	Crown	8″	6″	1½″	1.235	.	C	Rough[23]
1912	Portland, Maine, *[24]	16,627					5″	None	1.19	See foot note [24]	C	
1907 to 1911	Portland, Maine, *	18,660		6,605					1.73[25]		C	
1911	Portland, Maine, *	14,849		4,025					See foot note [26]		C	
To 1912	Portland, Ore. *			2 Mi.			6″	None	See foot note [27]		C	
1912	Punxsutawney, Pa., (Alley)	185	10′ & 11′	150′	Flat	½″ Dip	4½″	1½″			C	Broomed
1896 to 1912	Richmond, Ind., [28]*	18,238					5″ & 6″	1½″	See foot note [28]		C	Floated
1912	Rockville, Ind. *	5,000	26′	1,700′	4″	4″	5″	None	1.10[29]	Included	C	Rough floated
1911	Sheboygan, Wis. *	14,000	30′ & 40′	3,540′	Slight Crown	6″ for 30-ft. St.	6¾″	1¾″	1.20[30]	Included	C	Broomed
1911	Sioux City, Ia., [31]		24′ to 52′	About 4 Mi.	Crown	0.4′ for 28-ft. St.	5″	None	1.18[31]		C	Woodfloated
1907	South Omaha, Neb.	1,303	32′	320′	Crown	6″	6″	None	1.19		C	Wood floated
1911	South Omaha, Neb.	10,981	24′ & 32′	3,784′	Crown	6″	6″	None	1.25 to 1.55		C	Wood floated
1911	South Omaha, Neb., (Alley)	2,227	20′	1,140′		4″ Dip	6″	None	1.25 to 1.34		C	Wood floated
1911	Spokane, Wash. *	23,778	26′ to 51′		Crown	6″	6″	None	2.70 to 3.41	Included	C	Rolled and brushed[32]
1911	Spokane, Wash. *	26,775	40′ & 51′		Crown	6″	5″	1¾″	2.71 to 7.24	Included	C	
1911	St. Johns, Mich. *	1,213	36′	296′	Crown	6″	5″	2″	1.333	Included	C	Floated[33]
1912	Superior, Wis. *	14,315	24′	5,200′	Crown	6″	6″	1½″	1.25	Included	C	Floated and brushed
1910–1911	Tacoma, Wash.	20,288	16′, 24′, 30′		Crown	3″ for 16-ft. St.	4″ & 5″	2″	1.20		C	See note[34]
1911	Vancouver, Wash.	15,500	24′		4″	4″	5″	None	1.15		C	See note [35]
1912	Watertown, N. Y	9,000	30′	3,000′	Crown	4″	6″	None	1.30		C	Broomed
1909	Waukegan, Ill.	642	36′	175′	Crown	7″	6″	2″	1.50	.20	C	Grooved in blocks 4½″ x 8″

***See more detailed mention elsewhere in this issue.**

18—Pavement surface left just as it was after plank, on which men tamping had stood, was moved along.

19—See *Concrete*, June, 1912, p. 43. After troweling, surface is tapped with sidewalk roughening brush. The alley grooves were made by ⅜" ribbons tacked on a plank.

20—A "Blome" pavement.

21—The surface of this one-course work receives no special treatment but is covered with ½" of bitumen and screenings. See elsewhere in this issue under caption, "New York State."

22—This pavement was laid on old macadam for base. This surface was patted with shovels.

23—This is a reinforced pavement. See *Concrete*, February, 1912, p. 33. Also see further mention elsewhere in this issue under caption, "Plymouth, Wisconsin." The surface was made rough by the use of granite chips.

24—See mention elsewhere in this issue under caption, "Portland, Maine."

25—"Hassam" pavement.

26—Of this total of 14,849 sq. yds., 11,237 sq. yds. are on a state highway and cost $1.29 per yard; 1,125 sq. yds. have a Hassam base at $1.41 and 1,361 yards a Hassam base at $1.75 and all three roads have a bituminous surface.

27—See further mention elsewhere in this issue under caption, "Portland, Oregon."

28—See *Concrete*, April, 1910, p. 54. The cost of pavements is given elsewhere in this issue under the caption, "Richmond, Indiana." Richmond's first concrete paving was done 18 years ago.

29—This work is being done by private contract by public-spirited citizens and the cost feature is noteworthy because the pavement is reinforced. See mention elsewhere in this issue under caption, "Rockville, Indiana."

30—A reinforced pavement. Cost includes removel of cedar block. See mention elsewhere in this issue under caption "Sheboygan, Wisconsin."

31—See *Concrete*, April, 1911, p. 35.

32—This is a "Hassam" pavement. Brushes were used after pavement had been rolled by 10-ton roller

33—Then covered with "Tarvia."

34—See mention elsewhere in this issue under caption "Tacoma, Washington."

35—Grout flushed over this one-course pavement, then gone over with hand tampers to make it smooth

Concrete Paving---Table No. 1---Continued

When Laid	Place	Number Sq. Yds.	Width of Roadway	Length of Roadway	Sub-Grade, Flat or Crown	Street Crown When Finished	Thickness 1st Course	Thickness 2nd Course	Cost of Pavement Per Square Yard	Cost of Pavement Subgrade Preparation	Contract or Public Work	Surface Finish
1909 to 1911	Wayne Co., Mich. *	....	....	33 Mi.	....	....	....	....	....	....		....
1912	Wayne Co., Mich. *	....	....	40 Mi	....	1/4″ to 1′	....	....	....	....	P	Floated
1912	White Plains, West Co., N. Y.	2,141	18′	1,035	Crown	6″	6″	None	2.20	Included	C	Broomed
1907	Wilmington, Del.	5,462	....	....	Crown	6″ for 30-ft St.	5″	1″	....	....	P	Broomed
1908	Wilmington, Del.	20,967	....	....	Crown	6″ in 30′	5″	1″	....	....	P	Broomed
1909	Wilmington, Del.	16,536	....	....	Crown	6″ for 30-ft. St.	5″	1″	....	....	P	Broomed
....	Worcester, Mass. 36	....	....	....	....	....	....	....	....	....	C	....

*See more detailed mention elsewhere in this issue.

36—Hassam pavement.

Concrete Paving---Table No. 2

When Laid	PLACE	CONCRETE PROPORTIONS: Cement to Sand to Gravel, Base	Cement to Sand to Gravel, Top	Cement to Sand to Stone, Base	Cement to Sand to Stone, Top	Cement to Gravel, Base	Cement to Gravel, Top	MATERIALS: Kind of sand, gravel and stone, as to quality, size, cleanliness, etc.	Cement	PRICE: Cement per barrel	Sand per yd. or ton	Stone per yd. or ton	Gravel per yd. or ton
1911	Aberdeen, Wash.					1:7	1:2	The aggregate for base 1 part sand to 2 parts pea gravel. Top gravel washed	Wash.	$2.00	$1.45 yd.		$1.45 yd.
1910	Aberdeen, Wash. (Alley)					1:7	1:2	Same as above	Wash.	$1.90	$1.20 yd.		$1.20 yd.
1911	Alpena, Mich.			1:3:3				Shore sand, clean and sharp, up to 3½″	Huron	$1.25	$0.65 yd.	$1.40 yd.	
1906	Anderson, Ind.					1:5		Good clean gravel—medium size		$1.20			$0.80 yd.
1911	Ann Arbor, Mich.							Clean gravel, using 1 sack of cement to each sq. yd. of paving	Peerless	$1.05			$0.80 yd.
1908–1912	Appleton, Wis.			1:3:6			1:1½		Several Brands	$1.10 to $1.30	$1.13 to $1.25 yd.	$1.40 to $1.60 yd.	
1909	Bad Axe, Mich.					1:6	1:2		Huron				
1893 & 1894	Bellefontaine, Ohio					1:6			Buckeye				
1911	Bettendorf, Iowa			1:2½:4				Crushed limestone up to 1½″, Dust screened out	Medusa	$0.80	$0.60 yd.		

1911	Billings, Mont	1:2:4							Red Devil	$2.10	$1.50 yd.		$1.50 yd.
1908	Bozeman, Mont					·1:6	1:2	Clean sharp sand gravel 2" maxi-	Sunflower	$2.28	$2.00 yd.		$1.50 yd.
1911	Burlington, Wis	1:2:4						Sand passed ¼" screen gravel passed 1½" screen both clean, sharp	Marquette & Universal	$1.35	$0.75		$0.75
1912	California	1:3:6											
1912	Carlinsville, Ill			1:3:6	1:1:1			Sand ¼" or under stone ¼" to 1½"	Continental	$1.05	$0.80 yd.	$1.00 yd.	$1.50 yd.
1912	Centerville, Ia	1:2:4											
1912	Centralia, Wash	1:3:6	1:1:1					Clean washed gravel, ¼" to 2½"	Wash.	$1.83	$1.30 yd.		$1.30 yd.
1912	Chippewa Falls, Wis. (Alley)				1:1:1	1:6		Granite screenings used in top coat. ¼" to ½" pit run gravel, very clean. Granite screenings cost $3.10 per cu. yd.	Universal & Marquette	$1.10	$0.50 yd.		$1.00 yd.
1911	Clinton, Ia			1:2½:5	1:1:1			Torpedo sand was used with granite screenings in the top		$1.10	$2.00 yd.		
1912	Connersville, Ind					1:4		Gravel up to 2", clean, hard material	Universal	$1.02			$0.50 yd.
1912	Davenport, Ia			1:3:5	1:1:1			Crushed limestone in base up to 1½" Granite in top ½" & ¾"	Universal	$0.95	$0.75 yd.	$1.15 yd.	
1905 to 1910	Denver, Colo. (Alley)	1:3:6	1:2:4					½" to 1½" gravel					
1910	Des Moines, Iowa					1:6		Top course 1 part cement to 1 part granite Chips. and some sand Gravel clean		$1.20			$1.40 yd.
1910	Des Moines, Iowa					1:6		Same as above		$1.20			$1.40 yd.
1912	Des Moines, Iowa			1:2½:4						$1.15	$1.30 yd.	$1.00 yd.	
1910	Detroit, Mich			1:3:6									
1912	Detroit, Mich. (7 Alleys)			1:3:6				Top course 1 part cement to 1½ crushed granite or traprock	New Aetna Michigan Wyandotte Burt	$0.85 to $0.94	$0.69 yd.	$0.89 yd.	$0.69 yd.
1912	Detroit, Mich			1:3:6				Same as above	Same	$0.85 to $0.94	$0.69 yd.	$0.89 yd.	$0.69 yd.
1912	Detroit, Mich. (Alley)			1:3:6	1:1:3				Same	Same	Same	Same	Same
1912	El Dorado Springs, Mo							1 part cement to 5 parts Joplin chats	Sunflower	$1.30			
1910	Eldora, Iowa	1:2½:5					1:2		N. W. States	$1.20	$0.95 yd.	$1.25 yd.	$0.95 yd.
1911	Eldora, Iowa	1:2½:5					1:2		N. W. and Chicago A.A.	$1.23	$0.97 yd.	$1.25 yd.	$0.97 yd.

Concrete Paving---Table No. 2---Continued

When Laid	PLACE	CONCRETE PROPORTIONS: Cement to Sand to Gravel, Base	Cement to Sand to Gravel, Top	Cement to Sand to Stone, Base	Cement to Sand to Stone, Top	Cement to Gravel, Base	Cement to Gravel, Top	MATERIALS: Kind of sand, gravel and stone, as to quality, size, cleanliness, etc.	Cement	PRICE: Cement per barrel	Sand per yd. or ton	Stone per yd. or ton	Gravel per yd. or ton
1912	Eldora, Iowa	1:2½:5					1:2		Same	Same	Same	Same	Same
1911	Escanaba, Mich.			1:2:6					Atlas	$1.30	$0.50 yd.	$1.40 yd.	
1908 to 1910	Fond du Lac, Wis.			1:2½:5				Limestone and gravel mixed, used. Gravel poor, carrying some clay. Stone up to 2"		$1.25		$1.20 yd.	$1.10 yd.
1910 to 1911	Fond du Lac, Wis.			1:2½:5				Limestone, soft, Sand, good, sharp and clean		$1.25	$1.05 yd.	$1.20 yd.	
1910	Fort Dodge, Ia.			1:2:5	1:1:1			Bank sand and gravel—Crushed limestone ½" to 1½". Granite screenings for top ⅛" to ½"	N. W.				
1912	Fort Smith, Ark.			1:3:4				Coarse sand and crusher run stone					
1906	Gary, Ind.			1:3:4				Blome patent pavement	Universal				
1907–1908	Gary, Ind.			1:3:4				Blome patent pavement	Universal				
1910	Grand Forks, N. D.					1:7		Top course 2 parts cement to 3 parts Crushed traprock or granite under ¼". Gravel used clean and well graded. Blome patent.	Universal	$1.60			$1.50 yd.
1911	Grand Forks, N. D.					1:7		Same as above	Huron	$1.60			$1.50 yd.
1911	Grand Island, Nebr.			1:2:4									
1911	Grand Rapids, Mich.							Washed gravel and sand ¼" to 2½". Mixture, equal proportions fine sand and gravel with cement 5½:1	Newaygo	$1.15	$0.70 yd.		$1.18 yd.
1911	Greenville, Ill.			1:2½:5				Clean, sharp pit sand, Chester limestone under 2½"	Red Ring	$1 00	$0.80 yd.	$0.50 yd.	
1911	Harlan, Ia.			1:2:5				Platt River sand, limestone up to 2"		$1.17	$1.00 t.	$2.20 t.	
1912	Hennepin Co., Minn.	1:2:3						Screened gravel	Universal	$1.46	$1.45 yd.	$2.95 yd.	$2.15 yd.
1912	Highland Park, Ill., Lake Co.	1:2:3½						Washed gravel ¼" to 1¼"	Universal	$1.00	$1.00 yd.		$1.00 yd.
1912	Hudson, Mich.			1:4:2				This sand runs 60% sharp, fine material and 40 % small pebbles. Broken stone was used 1" to 2"	Wolverine and Peninsular				
1909	Huntington, Ind. (Alley)					1:6	1:2	Pit run gravel, very clean		$1.20			$1.25 yd.
1911	Huntington, Ind. (Alley)					1:4½		Pit run gravel—very clean		$1.20			$1.25 yd.
1911 1912	Huntsville, Ala.			1:3:5				Fine clean sand and broken slag. Blome patent	Coosa	$1.35	$1.25 yd.	$1.40 yd.	

1910	Independence, Mo			2:3:6				Stone was ½" to 2½", hard and clean		$1.30	$1.50 yd.	$1.40 yd.	
1910 to 1912	Kansas City, Mo			1:2½:4½				Crusher run stone ¼" up was used		$1.10 to $1.35	$0.80 to $1.10 yd.	$1.30 to $1.75 yd.	
1910 to 1912	Kansas City, Mo. (Alley)			1:2½:4½				Same as above		$1.10 to $1.35	$0.80 to $1.10 yd.	$1.30 to $1.75 yd.	
1904	Le Mars, Ia					1:6	1:2	Coarse screened gravel		$2.00			$0.75 yd.
1911	Liberty, Mo			1:2½:5				Kaw River sand and Breckenridge limestone up to 1½"	K. C.	$1.00	$1.25	$2.10 yd.	
1911	Lincoln, Nebr			1:3:6	1:1½:3			Limestone up to 1½" for base and ½" for top		$1.10	$0.60 yd.	$1.60 t.	
1912	Lodi, Cal	1:2:6						Sand and gravel, clean and hard		$2.80	$1.75 t.		$1.00 t.
1908	Lowell, Mass			1:4:11				36% voids	Grant	$1.63	$2.00 yd	$1.10 t.	
1907	Lynn, Mass							Stone up to 1", clean, sharp sand					
1910	Mason City, Ia. (Ada St.)			1:2:5				Concrete made very wet	N. W. States	$1.35	$0.70 yd.	$1.30 yd.	
1910	Mason City, Ia. (Adams Ave.)			1:2:5				Same as above	N. W. States	$1.35	$0.70 yd.	$1.30 yd.	
1911	Mason City, Ia			1:2:5				Same as above	N. W. States	$1.30	$0.70 yd.	$1.30 yd.	
1912	Mattoon, Ill	1:2:3						Coarse sand, good quality gravel ¼" to 2"	Universal	$1.10	$1.40 yd.		$1.40 yd.
1909 to 1911	Memphis, Tenn							Sand ⅛" to 50 mesh stone 2" down to ¼", dust out		$1.10 to $1.25	$1.25 to $1.50 yd.	$1.75 yd.	
1912	Menasha, Wis												
1911	Menominee, Mich							Beach sand, stone ½" to 1½", clean	Various Brands	$1.50	$1.75 yd.	$1.45 yd.	
1910	Milford, Del			1:2½:6				Crushed screened granite up to 2"		$1.49 average	$0.50 t. average	$1.20 t. average	$0.50 t. average
1911	Milford, Del			Same				Same	Nazareth & Lehigh	Same	Same	Same	Same
1912	Milford, Del			Same				Same	Allentown	Same	Same	Same	Same
1912	Milwaukee Co., Wis	1:2:4		1:2:4				Gravel and stone in sizes up to 2", cleaned and some of it washed	Universal			$0.60 Quarry	$0.40 Pit

Concrete Paving---Table No. 2---Continued

When Laid	PLACE	CONCRETE PROPORTIONS: Cement to Sand to Gravel, Base	Cement to Sand to Gravel, Top	Cement to Sand to Stone, Base	Cement to Sand to Stone, Top	Cement to Gravel, Base	Cement to Gravel, Top	MATERIALS: Kind of sand, gravel and stone, as to quality, size, cleanliness, etc.	Cement	PRICE: Cement per barrel	Sand per yd. or ton	Stone per yd. or ton	Gravel per yd. or ton
1912	Mitchell, S. D			1:3:5			1:1½	Sand 3½% of clay passing No. 4 screen, stone screenings not more than 10% passing No. 20 screen, all passing ½" ring. Stone in bottom course up to 2½"	Universal		$ .60 yd.		$0.60 yd
1911	Montesano, Wash.	1:3:6					1:2	Clean sharp sand containing pea gravel to ¼", in proportion about 1:1	Wash. and Golden Gate	$2.30	$1.50 yd.		$1.50 yd.
1911	Montesano, Wash. (Alley)	1:3:6					1:2	Clean screened river sand and gravel. Gravel up to 2½"	Wash.	$2.30	$1.50 yd.		$1.50 yd.
1912	Muscatine, Ia. (Alley)					1:5		Mississippi River pumped sand and gravel	Atlas–Iola	$1.20	$0.40 yd.		$0.70 yd.
1911	New Hampton, Ia.			1:2:5			1:2	Coarse, sharp, clean	N. W. States				
1908	New Haven, Conn			1:3:4				Top coat 1:1½ of cement and traprock, $\frac{1}{16}$" to ¼"					
1908 to 1912	New Orleans, La									$1.40	$1.00 yd.	$2.40 yd.	$1.60 yd.
1912	New York State	1:2½:5		1:2½:5				Clean, hard broken quarry or field stone, Nos. 2, 3 and screenings		$1.35	$0.20 yd.	$1.25 yd.	$0.10 yd.
1911	Niagara Falls, N. Y							"Hassam" patent	Various	$1.00	$1.05 yd.	$1.00 yd.	
1909	Norristown, Pa.			1:3:7				Bank sand, 1½" traprock	Egyptian		$0.40 yd.	$1.50 t.	
1910	Osage, Iowa	1:2½:5					1:2		N. W. States	$1.23	$0.97 yd.		$1.25 yd.
1910	Plymouth, Wis.	1:3:5					1:1½	Gravel ¼" to 1½" obtained at cost of screening					
1912	Protland, Me							See mention elsewhere in this issue, under caption, "Portland, Maine."					
1907 to 1911	Portland, Me							See above					
1911	Portland, Me							See above					
1912	Portland, Ore	1:3:5						See mention elsewhere in this issue, under caption "Portland, Oregon."		$1.65 to $1.85	$0.60 to $0.80	$1.00 to $1.25	$0.65 to $0.85
1912	Punxsutawney, Pa. (Alley)							1 part cement to 6 parts crusher run sand stone for base, and 1 cement to 2 sand for top. Stone passed 1" screen	Universal	$1.20		$1.40 t.	

1896 to 1912	Richmond, Ind.							See mention elsewhere in this issue, under caption, "Richmond, Indiana."				
1912	Rockville, Ind.					1:4½		Gravel is washed, nothing larger than 3", and carries 45% sand		$1.25			$0.90 yd.
1911	Sheboygan, Wis.							See foot note 1	Chicago	$1.25	$1.00 yd.	$1.25 yd.	
1911	Sioux City, Ia.			1:3:4½				Sand up to ¼", crushed jasper rock Passing 1½" screen	Iola	$1.30	$1.05 yd.	$2.00 yd.	
1907	South Omaha, Nebr.			1:2½:5				Platte River sand and limestone ¾" to 1½"	Various	$1.00	$1.20 t.	$2.00 t.	
1911	South Omaha, Nebr.							Same as above					
1911	South Omaha, Nebr. (Alley)							Same as above					
1911	Spokane, Wash.							Hassam patent pavement	Inland	$2.60	$1.50 yd.	$1.50 yd.	
1911	Spokane, Wash.	1:3:6			1:¼:1¾			The mixture consisted of 1 part cement, 1¾ parts crushed basalt and ¼ part coarse silicious sand	Red Devil	$2.60	$1.50 yd.	$2.00 yd.	$1.50 yd.
1911	St. Johns, Mich.				1:2:3	1:6		In bottom course gravel was used up to 2½"—top course crushed cobbles passing ¾" ring—clean	Huron Aetna	$1.05	$1.00 yd.	$2.60 yd.	$1.00 yd.
1912	Superior, Wis.			1:2½:5	1:1:2			Crushed traprock, clean and hard	Atlas	$1.35	$0.75 yd.	$1.75 yd.	
1910 1911	Tacoma, Wash.	1:3:6					1:2	Sand, clean, sharp, coarse. Gravel, clean, ¼" to 2½" In top ¼" to ½"	Various	$2.00	$1.50 yd.		$1.50 yd.
1911	Vancouver, Wash.			1:3:5				Columbia River sand, crushed rock, extra hard and clean, 1" to 2½"	Golden Gate	$2.25	$1.50 yd.	$1.50 yd.	
1912	Watertown, N. Y.					1:4		Bank gravel, 35% coarse sand used up to 3"	Universal	$1.20			$1.00 yd.
1909	Waukegan, Ill.			1:3:6				Limestone, medium hard and clean up to 1½"	Universal	$1.50	$1.50 yd.	$1.60 yd.	
1909 to 1911	Wayne Co., Mich.*												
1912	Wayne Co., Mich.	1:1½:3						Washed pebbles used passing 1½" ring	Universal				
1912	White Plains, West. Co., N. Y.			1:3:5				Bank sand, screened, and blue stone up to 1½" Hassam patent		$1.60			
1907	Wilmington, Del.							Penetration method. 1" broken stone—1" mortar on top, 1:2		$1.02	$0.98 yd.	$1.50 t.	
1908	Wilmington, Del.							Same as above					
1909	Wilmington, Del.							Same as above					
	Worcester, Mass.							"Hassam" patent					

*See more detailed mention elsewhere in this issue.

1—For bottom course; clean broken stone, bank sand—stone graded from ½" to 1½". For wearing course: 40% cement; 30% granite ¼" to ¾"; 20% of granite dust to ¼" and 10% clean, bank sand.

When Laid	Place	JOINTS					Curing and Protection of Pavement
		Transverse			Longitudinal		
		Spacing	Filling	Finish and Protection	Where	Filling and Protection	
1911	Aberdeen, Wash....	20′	Asphalt		None		Covered with sand for 10 days
1910	Aberdeen, Wash. (Alley)	20′	Asphalt		None		Same as above
1911	Alpena, Mich.	40′ to 50′	Sarco Asphalt	Baker Steel plates	Along curb lines	Asphalt, no plates	Cov'd ½″ sand. Sprinkled 8 to 10 days.
1906	Anderson, Ind. (Alley)	5′	Sand	⅜″ round edges	5′ apart	Sand and edges rounded	
1911	Ann Arbor, Mich.	25′	Bitumen, sand	Filled flush	At Curb	Bitumen and sand	Kept wet 7 days
1908–1912	Appleton, Wis.	40′	Asphalt	2½″ by 2¼″ angle irons	Along each curb	Asphalt	Covered from sun rays
1909	Bad Axe, Mich.	50′	Pitch	None	None		
1893 & 1894	Bellefontaine, Ohio	5′			5′	None	
1911	Bettendorf, Iowa	1″ joints 12′6″ apart	Asphalt	Rounded	Along curb	Asphalt	Sprinkled 6 days
1911	Billings, Mont. (Alley)	20′	½″ wood strips left in place	Edges turned to ¼″ radius	None		Sprinkled and covered with earth 7 days[6]
1910	Boise, Idaho	25′	Pitch		Along Curb	Pitch	
1910	Boise, Idaho (Alley)	50′	Asphalt		None		
1911	Boise, Idaho	50′	Asphalt[7]		Along Curb	Asphalt[7]	
1912	Boise, Idaho	50′	Asphalt		Along curb	Asphalt	
1908	Bozeman, Mont.	100′	Asphalt	None	Along curb	Asphalt	Sand covered 7 days
1911	Burlington, Wis.	30′	Asphalt	None	In center on 46′ roadway	Asphalt	Sprinkled 7 days
1912	California	None			None		Kept wet 5 days
1912	Carlinsville, Ill.	25′	Asphalt	Metal plate, ¼″ by 3″	Next to gutter	Asphalt	Watered 3 days
1912	Centerville, Ia.	25′	Asphalt	Angle plates	Center	None	
1912	Centralia, Wash.	25′	See note[11]		None		Wet 10 days, covered 1″ dirt
1912	Chippewa Falls, Wis. (Alley)*	30′	Pioneer and Sarco fillers	Corners rounded	None		Closed 10 days, sprinkled and canvas covered
1911	Clinton, Ia.	12½′	Asphalt	Tooled	See note [12]		Damp sand
1912	Connersville, Ind.*	30′	Asphalt	Baker Plate	Next to gutter	Asphalt	Straw cov. 3 days, sand 7 days
1912	Davenport, Ia.	20′	Creosote wood block		Along each curb	Asphalt	Kept wet 5 days
1905 to 1910	Denver, Colo. (Alley)	10′	Pitch		None		Sand covered, kept wet 6 days

*See more detailed mention elsewhere in this issue.

1—Our informant says: "We lay no pavement of any kind in alleys except 8-in. concrete as described, as we consider an alley a wet, dirty, dark place where bituminous pavement would be apt to rot. We find a concrete alley very easy to clean.

2—Probably will put transverse joints closer together in future to eliminate cracks entirely if possible.

3—So satisfactory that property owners have petitioned for an additional 140,000 sq. yds. The special feature is that the surface is covered with about ½ gal. of bitumen to the yd. and gravel to give footing, take up wear and give black surface with less reflection of light. It is now being promoted under the name Dolorway. It was developed in Ann Arbor by E. W. Groves, former city engineer.

4—Except slipperiness and wear at joints. [Note the time this pavement has been in use—since 1894, and also fact that there are many joints to wear.—EDITORS.]

5—Laid an average of 1,400 sq. yds. per day including curb. Curb cost 18c for 6″ x 12″ and 28c for 6″ x 18″.

Table No. 3

Curb Kind	Curb Cost	Kind of Traffic Using Pavement	How Satisfactory is Pavement	Changes in Specifications	Special Features	Engineer in Charge	Informant
Conc.	30c ft.	Residence	Good	None	Top Mixture	Chas. Ewart	Chas. Ewart, City Eng
....	......	Business	Very	None	See foot note [1]	Chas. Ewart	Chas. Ewart, City Eng.
Conc.	18c. ft.	Main street, heavy trucking.	So far perfect	None[2]	Smooth surface	Jos. W. McNeil	Jos. W. McNeil, City Eng.
Conc.	30c. ft.	All kinds	Joints have worn badly	.	.. ...	H. H. Rogers	Geo. A. Lamphear, City Eng.
Conc.	22c. ft.	Moderate	Satisfactory[3]	Minor	See foot note	E. W. Groves	E. W. Groves
Conc.	37c. ft.	All kinds	Very good for price	Slightly	No cracks, noiseless, dustless.	C. H. Vinal	C. H. Vinal, City Eng.
Conc.	.....	All kinds	Entirely	.... .	. .. .	....	Merridith & Murray Contractors.
Conc.	......	Medium	Satisfactory[4]	None	. .. . .	James C. Wonder	Clare A. Inskeep, City Eng.
Conc.[5]	......	Heavy farm vehicles & Motor trucks.	Perfectly	None	Speed in laying[5]	A. M. Compton	A. M. Compton, Davenport, Ia.
None	....	Heavy trucking	Good satisfaction	Note [6]		C. E. Durland	C. E. Durland, City Eng.
....	......	8hrs. 445 vehicles	Maintenance Cost $10	....	..	City Eng.	C. E. Stevenson, City Eng.
			No maintenance cost	....	.. .. .	City Eng.	Same
....	......	8 hrs. 311 vehicles[7]	No maintenance cost	.... .	... .	City Eng.	Same
....	......	8 hrs. 163 vehicles	No maintenance cost	....	....	City Eng.	Same.
Conc.	55c. ft.	All kinds[8]	Fair	See note [8]	See note [8]	C. M. Thorpe	Carl W. Widner, City Eng.
Conc.	27c ft.	See note [9]	See note [9]	See note [9]	See note [9]	P. J. Hurtgen	P. J. Hurtgen, City Eng.
None	......	Heavy auto traffic	... .	....	See foot note[10]	Loder	Asso'n Western P. C. Mfrs.
Conc.	44c. ft.	General	Very	None	Curb cost includes gutter	W. D. P. Warren	W. D. P. Warren, City Eng.
....	......	....	....	....	....	....	Hall & Adams, Eng's.
None	......	General country	....	....	Permanency & cheapness	John S. Ward	John S. Ward, Chehalis Co. Eng.
Conc.	50c.	Heavy business	Very	....	Low cost cleanliness	L. G. Arnold	L. G. Arnold, City Eng.
Conc.	45c. ft.	Ordinary town busineess	Very	Not material[12]	Shows no wear	Charles B. Chase	Chas. B. Chase, City Eng.
....	......	All kinds	....	....	Low cost	W. F. Redpath	W. F. Redpath, City Eng.
Conc.	30c. ft.	Residence	O. K. so far	....	High crown	A. M. Compton	A. M. Compton
None	......	Heavy	....	....	....	....	City Engineer

6—See further mention elsewhere in this issue under caption "Billings, Montana."

7—This job includes two pavements. In one asphaltic oil alone was used for filler and in the other asphaltic oil and pitch. Further information will be found elsewhere in this issue under caption "Boise, Idaho."

8—Only pavement in city. City engineer favors a rough broom finish; also concrete to be laid continuously between joints, because grooves and header block joints wear badly. The pavement put down in 1908 was laid in alternate 10-ft. blocks.

9—Includes concrete gutter. As to traffic, satisfaction, etc., see mention elsewhere in this issue under caption, "Burlington, Wisconsin."

10—See mention elsewhere in this issue under caption "California."

11—Barrett's Paving Pitch and sand used in joints; corners rounded to 1/4" radius.

12—Longitudinal joints are so spaced as to make, with the transverse joints, square blocks. As to possible changes in specifications, coarse granite screenings probably will be used.

Concrete Paving---

When Laid	Place	Joints: Transverse: Spacing	Joints: Transverse: Filling	Joints: Transverse: Finish and Protection	Joints: Longitudinal: Where	Joints: Longitudinal: Filling and Protection	Curing and Protection of Pavement
1910	Des Moines, Ia.	25′	Pitch	None	Along curb	Pitch	Wet sand 10 days
1910	Des Moines, Ia.	25′	3 thicknesses 3-ply Ruberoid		At curb	3 thicknesses 3-ply Ruberoid	Same as above
1912	Des Moines, Ia	20′	3 strips 3-ply rubber roofing in pitch		At curb	3 strips 3-ply rubber roofing in pitch	Sprinkled
1910	Detroit, Mich.	30′	Asphalt	Baker plate			
1912	Detroit, Mich. (7 Alleys)	30′	Asphalt	Baker plate			
1912	Detroit, Mich.	Same	Same	Same			
1912	Detroit, Mich. (Alley)	30′	Same	Same			
1912	El Dorado Springs, Mo.	50′	Paving pitch		At curb	Pitch	Moist 1 week
1910	Eldora, Iowa	25′	Asphaltum		At curb	Asphaltum	Sprinkled 1 wk.
1911	Eldora, Iowa	25′	Sarco filler		Same	Sarco filler	Same
1912	Eldora, Iowa	Same	Same		Same	Same	Same
1911	Escanaba, Mich.	25′	Asphalt		At curbs	Asphalt	
1908 to 1910	Fond du Lac, Wis.	50′	Asphalt[14]		At curb	Asphalt	Sprinkling 10 days[14]
1910 to 1911	Fond du Lac, Wis.	50′	Asphalt		At curb	Asphalt	Same as above
1910	Fort Dodge, Ia.	30′ to 50′	1½″ Pioneer asphalt		None		Sprinkled 1 week
1912	Fort Smith, Ark.	18′	None		At curb		Cov. with earth. sprinkled twice da
1906	Gary, Ind.	50′	Tar		At gutter	Tar	
1907 1908	Gary, Ind.	Same	Same		Same	Same	
1910	Grand Forks, N. D.	30′	Asphalt	None	At Curb	Asphalt	
1911	Grand Forks, N. D.	Same	Same	Same	Same	Same	
1911	Grand Island, Nebr.						
1911	Grand Rapids, Mich.	6′ See note [15]			At curb		Kept wet, closed 10 days
1911	Greenville, Ill.	25′	Pitch	Rounded edges	None		
1911	Harlan, Ia.	40′ to 80′	Asphalt	Rounded corners		Asphalt	Sprinkling occasionally
1912	Hennepin Co., Minn.	25′	Waterproof filler	Baker plate			Sprinkled 5 days
1912	Highland Park, Lake Co., Ill.	25′	8 thicknesses tar paper		At curb	8 thicknesses tar paper	Sprinkled 7 days
1912	Hudson, Mich.	25′ to 30′	Asphalt		At curbs	Asphalt	
1909	Huntington, Ind. (Alley)	No joints					None

*See more detailed mention elsewhere in this issue.
13—Concrete curb and gutter cost 55c.
14—Joint space made by using "drop siding" giving a tapered joint. Pavement protected by canvas from sun and rain. The 42c to 50c for curb also includes gutter—both concrete. As to special features and other comments see further mention elsewhere in this issue under caption, "Fond du Lac, Wisconsin."
15—Six-ft. sections were laid alternately and joints made in this way.

Table No. 3---Continued

Curb		Kind of Traffic Using Pavement	How Satisfactory is Pavement	Changes in Specifications	Special Features	Engineer in Charge	Informant
Kind	Cost						
Conc.	. . .	Residence	Good	*		John W. Budd, City Eng.	W. H. Maxwell, Office Eng'r
Conc.	. . . .	Same	Same	*	. .	Same	Same
Conc.	.	. . . .	. . .		. . .	Same..	Same ..
	. . .	Residence	Yes	. . . .		R. H. McCormick	R. H. McCormick, City Eng.
.	. . .	. . . .	. . . .	. . .		Same	Same
		Residence	. . .	. . .		Same	Same
		. . . . . .	. . .			Same	Same
Conc.	25c. ft.	Light	. .		Cheapness	D. L. Haggard	D. L. Haggard, City Eng.
Conc.	40c. ft.	All kinds	Very	. .	. . . .	S. B. Gardner	S. B. Gardner, City Eng.
Same	Same	Same	Same	.	. . . .	Same	Same
Same	Same	Same	Same			Same	Same
Conc.	55c. ft.[13]	Residence	Very good	. . . .	. .	J. A. Mac Killigan	D. A. Brotherton, County Eng.
Conc.[14]	42c to 50c. ft.	Medium	Very	. . . . . .	See foot note[14]	J. S. McCullough	J. S. Mc Cullough, City Eng.
Conc.[14]	44c. to 50c ft.	Medium	Very[14]	. . . . .	See foot note[14]	J. S. Mc Cullough	J. S. Mc Cullough, City Eng.
Conc.	20c. ft.	All kinds	Fairly	. . . . . .	. . . . .	C. H. Reynolds	C. H. Reynolds, City Eng.
Conc.	. . . . . .	All kinds	. . . .	. .	. . . .	Geo. Meyers	City Engineer
Conc.	. . . . . .	Heavy	Not satisfactory	. . . . .	. . . . .	W. J. Fulton	C. A. Williston, City Eng.
Same	. . . . . .	Same	Same	. . . .	. . . .	Same	Same
Conc.	60c. ft.	Residence	Sanitary, easily cleaned, looks well	No	. . . .	H. G. Lykken	H. G. Lykken, City Eng.
Same	Same	Same	Same	No	. . . .	Same	Same
. . . .	. . . . . .	. . . .	. . . .	. . . .	. . . .	H. .W Kibbey	H. W. Kibbey, City Eng.
Conc.	30c. ft.	Light	See note[15]	. . . .	. . . .	A. H. Pitz	A. H. Pitz, Assistant Eng.
. . . . . .	. . . . . .	Heavy	Very	. . . .	*	H. N. Baumberger	H. N. Baumberger, City Eng
Conc.[16]	45c. ft.	Farm	Very, except 1 block	See note[16]	. . . .	John P. Crick	John P. Crick, Omaha, Neb.
. . . .	. . . . . .	. . . .	. . . .	. . . .	. . . .	. . . .	Gen. Con. Co., Minneapolis
Conc.	24c. ft.	Varied	Think well of it	*	*	Jas. Shields	Jas. Shields, City Eng.
Conc.	. . . . . .	Medium	. . . .	. . . .	. . . . . .	. . . .	James L. Moloney, Mayor
. . . . . .	. . . . . .	Light	Very	. . . .	. . . .	John B. Vernon	H. H. Wagoner

As to satisfaction, our informant says: "Not old enough as yet to be able to judge. However, pavement is cracked longitudinally entire length of street and seems to be showing considerable wear at joints."

16 Combination curb and gutter. The change suggested is an expansion plate designed by our informant and illustrated in *Cement Age*, June, 1912.

When Laid	Place	JOINTS: Transverse: Spacing	Transverse: Filling	Transverse: Finish and Protection	Longitudinal: Where	Longitudinal: Filling and Protection	Curing and Protection of Pavement
1911	Huntington, Ind. (Alley)	No joints					None
1911 & 1912	Huntsville, Ala.	33′	Pitch		At gutter	Pitch	Covered with cotton seed hulls
1910	Independence, Mo.	None			At curb	2 thicknesses 3-ply felt	Street closed 10 days
1910 to 1912	Kansas City, Mo.	50′	Asphalt		None		Sprinkled, closed 7 to 15 days
1910 to 1912	Kansas City, Mo. (Alley	50′	Asphalt		None		Same as above
1904	Le Mars, Ia.	See note [19]					
1911	Liberty, Mo.	25′	Bitumen	Rounded edges	At curb	Bitumen	Covered with straw
1911	Lincoln, Nebr.	40′	Asphalt	None	None		Closed 10 days
1912	Lodi, Cal.	None			None		Kept wet 10 days
1908	Lowell, Mass.	None			None		Closed 8 days
1907	Lynn, Mass.	None			At curb	Pitch	
1910	Mason City, Ia.	25′	Asphalt		At curb	Asphalt	Sprinkled 1 week
1910	Mason City, Ia.	25′	Asphalt		At curb	Asphalt	Same
1911	Mason City, Ia.	25′	Asphalt		At curb	Asphalt	Same
1912	Mattoon, Ill.	30′—⅜″	Asphalt				Kept moist
1919 to 1911	Memphis, Tenn.	50′	Wood		At curb	Tar	Sand
1912	Menasha, Wis.						
1911	Menominee, Mich.	25′	Asphalt		At curb	Asphalt	
1910	Milford, Del.	50′	Wood and Asphalt		At curb	Asphalt	
1911	Milford, Del.	75′	Asphalt		At curb	Asphalt	
1912	Milford, Del.	Same	Same		Same	Same	
1912	Milwaukee County, Wis.	25′	Steel and asphaltic felt		None		Covered with soil, sprinkled 5 days.
1912	Mitchell, S. D.	12½′	Asphalt	Edges rounded	At curb	Asphalt	Kept wet 4 days
1911	Montesano, Wash.	⅝″ every 25′	Grade D Asphalt		Intersections only	Grade D Asphalt	Wet 7 days closed 28 days
1911	Montesano, Wash. (Alley)	25′	Asphalt		None		Same
1912	Muscatine, Iowa (Alleys)	20′	Asphalt				
1911	New Hampton, Ia.	16½′ [25]	Asphalt	Edges rounded	17½′ from curb	Asphalt	Sprinkled 10 days.
1908	New Haven, Conn.	50′	See note [26]				Closed 10 days
1908 to 1912	New Orleans, La.		Hassam composition		At curb		
1912	New York State	30′	Pitch	Sand	None		Sprinkled 2 days[27]
1911	Niagara Falls, N. Y.	None					Naturally

*See more detailed mention elsewhere in this issue.
17—Most of the concrete paving has been under "Hassam" patent.
18—See mention elsewhere in this issue under caption "Kansas City, Missouri."
19—See mention elsewhere in this issue under caption, "Le Mars, Iowa." Some of the pavement was cured at zero temperature.
20—Besides being a good wearing pavement, it is easily kept clean.
21—Cheapness, cleanliness, durability.

Table No. 3---Continued

Curb Kind	Curb Cost	Kind of Traffic Using Pavement	How Satisfactory is Pavement	Changes in Specifications	Special Features	Engineer in Charge	Informant
....	......	Light	Very			H. H. Wagoner	H. H. Wagoner
Conc.	56c. ft.	Heavy	Very			N. B. Buchanan	N. B. Buchanan City Eng
Conc.	35c. ft.	Light	Good	See note [17]		H. H. Pendleton	H. H. Pendleton, City Eng.
Conc.	30c. ft.	Medium	Very good	See note [18]	See note [18]	C. R. Mandigo	C. R. Mandigo, Ass't City Eng.
....	.....	Medium	Very good			Same	Same
Conc.	39c. ft.	General	Good		See note [20]	E. H. Collins	E. H. Collins
.	..	Light	O. K.			Adna Dobson	Adna Dobson, City Eng.
Conc.	35c. ft.	Medium	O. K.			J. W. Mc Afee	J. W. Mc Afee, City Eng.
Granite	...	Mixed	Is in 1st class condition		See note [illegible]	Wm. A. Favor	Stephen Kearney, City Eng.
.	..	Heavy teaming	Very		See note [20]	E. M. Trefeethern	J. F. Goldthwaite
Conc.	40c.	Residence	Very		See note [21]	F. P. Wilson	F. P. Wilson, City Eng.
Conc.	40c. ft.	Same	Very			Same	Same
Conc.	40c. ft.	Same	Very			Same	Same
Conc.	10 c. ft	Light	Very		.	J. E. Millar	C. L. James, City Eng.
Granite	....	Heavy	See note	Slight	See note [22]	J. H. Weatherford	J. H. Weatherford, City Eng.
..	.	.. . .	.			.	C. H. Vinal, City Eng., Appleton.
Conc.[23]	43c. ft.	All kinds	Good		Durability	Albert Hass	Albert Hass, City Eng.
Conc.	35c. ft.	Heavy	Very	See 1911 & 1912			Theo Townsend, Ch. Highway Com.
.....	......	Heavy	Very	*		Herbert Patton, Wilmington, Del.	Same
......	.....	Same	Same	Same		Alex Rosa	Same
None	....—	1,000 vehicle per day	.	.	.	H. J. Kuelling	H. J. Kuelling, Co. Highway Com.
Conc.	18c. ft.	....	....	.	...	S. H. Smith, Dan S. Craig	S. H. Smith
Conc.	27c. ft.	Medium	Entire satisfaction	See note [24]	See note [24]	Geo. W. Gauntlett	Geo. W. Gauntlett
See note [24]	....	Heavy	Very	....	....	Same	Same
....	....	....	... . .	. .	.. .. .	C. H. Young	C. H. Young
Conc.	27½c.	All kinds	Good, clean, best value for money	. ...	....	A. F. Kemman	A. F. Kemman, City Eng.
Stone	......	Heavy	Shows considerable wear	See note [26]	... .	C. W. Kelly	C. W. Kelly, City Eng.
....	....	....	....	....	. . . .	. . . . . .	W. J. Hardee, City Eng.
....	.	....	....	....	....	....	New York State Com. of Highways.
Stone	......	Medium	Fair	....	....	F. S. Parkhurst, Jr	F. S. Parkhurst, Jr.

22—With wood joints giving absolute satisfaction; tar joints in other streets a failure. Wood block joints are the thing. No repairs.
23—Cost includes 18" gutter; combination curb and gutter.
24—See further mention elsewhere in this issue under caption "Montesano, Washington."

25—Expansion joints 33' and contraction joints 33'.
26—Special pitch prepared by Hassam pavement patentees. Later paving same specifications cost $2.40 a yard—an increase of 20c.
27—Also closed 12 days and covered with thin coat of sand.

Concrete Paving---

When Laid	Place	JOINTS Transverse Spacing	Transverse Filling	Transverse Finish and Protection	Longitudinal Where	Longitudinal Filling and Protection	Curing and Protection of Pavement
1909	Norristown, Pa.	8'	2 solid & every third pitch		At curb	Pitch	
1910	Osage, Iowa	25'-½"	Asphaltum		At curb	Asphaltum	Sprinkled 1 week
1910	Plymouth, Wis.	40'	Pitchy cypress		At curb & each side car tracks		Sprinkling
1912	Portland, Me.				At curb	Waterproof bituminous mixture	Sprinkled 7 days covered.
1912	Portland, Ore.	None[30]					
1912	Punxsutawney, Pa.	½" joint spaced 20'	Tar		Next to buildings	Tar	
1896 to 1912	Richmond, Ind.	Blocks, 10' x 15'	Sand[32]	Edges rounded			
1912	Rockville, Ind.	33'	Tar Paper	Baker plate	None		Kept wet
1912	Sheboygan, Wis.	40'	Pioneer Asphalt		Along curb	Asphalt	Sprinkled several days
1911	Sioux City, Ia.	22½'	Asphalt	Edges rounded	In center on 52' streets	None	Kept wet 3 to 5 days
1907	South Omaha, Neb.	30' to 60'	Tar	None	At curb	Tar[34]	
1911	South Omaha, Neb.	30' to 60'	Tar	None	At curb	Tar	
1911	South Omaha, Neb. (Alley)	30' to 60'	Tar	None			
1911	Spokane, Wash[35]*	None			None		Kept wet and closed 10 days
1911	Spokane, Wash.	34'	Bituminous paving cement	Rounded edges	None		Kept wet 10 days
1911	St. Johns, Mich.	25'	Paving pitch		At curb	Paving Pitch	Wet season, closed 7 days
1912	Superior, Wis.	25'	Asphaltic cement		At curb		
1910 1911	Tacoma, Wash.	25' to 50'	Asphalt		None		Sprinkled
1911	Vancouver, Wash.	None			None		Closed 20 days
1912	Watertown, N. Y.	None			½" at curb	Asphalt	Sand
1909	Waukegan, Ill.	50'	Asphalt		At curb	Asphalt	No special precaution
1909 to 1911	Wayne Co., Mich.	*					
1912	Wayne Co., Mich.	25'	Asphalt felt, 2 strips	Baker plates	None		Earth covered sprinkled 7 days
1912	White Plains, West Co., N. Y.	30'	Pitch		At curb	Pitch	Sand covered, closed 8 days
1907	Wilmington, Del.	50'	Pitch		At curb	Pitch	
1907	Wilmington, Del.	50'	Pitch		At curb	Pitch	
1909	Wilmington, Del.	50'	Pitch		At curb	Pitch	
	Worcester, Mass.[38]						

*See more detailed mention elsewhere in this issue.
28—More attention should be given to joints.
29—Combination curb and gutter cost 46c per foot.
30—See mention elsewhere in this issue under caption, "Portland, Oregon."
31—Specifications of the N. A. C. U. were used. First time concrete has been used here for surface of pavement. Wm. M. Kinney, assistant inspection engineer, Universal Portland Cement Co., was on hand when work was begun. He reports aggregate not so satisfactory as desired. Contractor couldn't get hard, sharp gravel or stone. Crushed sandstone was used.

Table No. 3---Continued

Curb Kind	Curb Cast	Kind of Traffic Using Pavement	How Satisfactory is Pavement	Change in Specifications	Special Features	Engineer in Charge	Informant
Conc. & Stone	36c. to 42c.	All kinds	Expansion joints in bad shape	See note 28		S. C. Corson	S. C. Corson, Borough Eng.
Conc.	40c.	All kinds	Very	....		S. B. Gardner	S. B. Gardner
Conc.29	46c	All kinds	Very satisfactory	..		W. C. Kirchhoffer	W. C. Kirchhoffer, Madison, Wis.
....	....	....	In good condition			....	City Engineer
....	....	....	Satisfactory30	..			T. M. Hurlburt, City Eng.
...	.	Heavy	....		See note31	See note31	Wm. M. Kinney
.	.	....	Excellent condition			....	Fred R. Charles, City Eng.
Conc.	15c. ft.	Medium	....	....	Cost	H. L. Davies	W. E. Ireland
Stone	.	General	Property owners want more	None	Low cost, easy cleaning	C. U. Boley,	C. U. Boley, City Eng.
Conc.	40c. ft.	Residence	Very	See note33	1 course	Keyes C. Gaynor	Keyes C. Gaynor
Conc.	29c. to 43c.	Light	Ordinary	......	Cheapness	Herman Beal	Herman Beal, City Eng
Conc.	29c. to 43c.	Light	Ordinary	. .	Cheapness	Same	Same
.....		....	Ordinary	......	Cheapness	Same	Same
Conc.	48c. to 52c.	Medium	Fairly good	.	*	City Engineer	City Engineer
Conc.	40c. $1.85	Heavy		..		City Engineer	City Engingeer
Conc.	35c. ft.	Trucking	See note 36	See note 36	. .	E. G. Huke	E. G. Huke, City Eng.
Conc.	43c.	Light	. .	....	. . .	E. B. Banks	E. B. Banks, City Eng.
Conc.37	30c. ft.	Light	Good service, property owners like it.	. .	Cheapness & foothold	E. N. E. Drake	W. A. Raleigh, City Eng.
Conc.	34c. ft.	All kinds	Wears well but is rough	.	Doesn't get slippery	H. H. Lotter	B. L. Dorman, Ass't City Eng.
....	......	Medium	. ...	. .	....	E. W. Sayles	E. W. Sayles, City Eng.
Conc.37	60c. ft.	Light	Good	. .	....	B. P. Thacker	M. J. Douthitt
....	......	....			.....	....	Ed. N. Hines
....	......	Heavy	Very	*	....	.	Ed. N. Hines
Conc.	62c.	Heavy	. . ..		.....	J. Y. Lavery	J. Y. Lavery
....		Light	Good for light traffic		...	F. W. Pierson, St. Com.	City Engineer.
....	.	Light	Good for light traffic	. .	....	Same	Same
....	....	Light	Good for light traffic	. . .	.....	Same	Same
....	......	....	....	....	....	....	City Engineer

32—See mention elsewhere in this issue under caption, "Richmond, Indiana."
33—Mixture changed from 1:3:4½ to 1:2:3 for heavy trafficked streets.
34—Hereafter we will recommend longitudinal joints also at ¼ crown besides at curb and transverse joints every 25'.
35—"Hassam" patent pavement. As to features our informant says: "Monolithic, does not crack, and has roughened surface. The crushed rock receives the wear and not the grouting."
36—See mention elsewhere in this issue under caption, "St. Johns, Michigan."
37—Combination curb and gutter.
38—Hassam patent (no data).

Government Specifications for Experimental Jointless Road Are Completed

Readers of CONCRETE-CEMENT AGE already are familiar with the fact that Logan Waller Page, Director, United States Office of Public Roads, believes that concrete roads can be built successfully without providing expansion joints. The specifications for this "jointless road" are now completed and they are here presented, together with specifications also from the Office of Public Roads for oil concrete pavement and for bituminous surfaced concrete. Experimental sections are soon to be laid. The road will be 20′ wide. The specifications follow:

Specification "C"—Cement Concrete with Bituminous Surface

Upon the subgrade prepared as specified herein shall be laid a cement concrete pavement with a bituminous surface from Station 12+30 to Station 25+00.

All of the work done in laying the concrete shall conform to Specification "E" and the materials furnished shall conform to Specifications "I," "K," and "L."

Bituminous Surface—To the clean, dry surface of the concrete there shall be applied as hereinafter specified a coating of hot bituminous cement. The application shall be made at the rate of from ⅓ to ½ gallon per square yard as may be directed by the engineer. It shall be made preferably my means of an approved form of distributer. If made from a hose or pouring pots, the appliances shall meet the approval of the engineer, and the hot material shall then be thoroughly broomed over the surface in order to insure a uniform coating.

The application shall be immediately covered with a uniform layer of sand of sufficient amount to provide a satisfactory wearing surface. The surface shall be finished by a light rolling.

Several bituminous materials will be furnished by the U. S. Department of Agriculture and shall be applied as above specified where directed by the engineer.

From Station 12+50 to Station 15+0 the clean concrete shall be first treated with a thin, cold application of a refined tar in just sufficient quantity to paint the surface. This application shall be allowed to dry for a period of 24 hours, after which an oil asphalt shall be applied hot and the surface finished as hereinafter specified.

Specification "D"—Oil-Cement Concrete

Upon the subgrade prepared as specified herein shall be laid an oil-cement-concrete pavement from Station 25+00 to Station 38+50. Coarse aggregates conforming to Specifications "L," "M" and "N" shall be used, each 450′.

All of the materials furnished and the work done shall conform to Specification "E," except to the paragraph captioned *Concrete*.

Oil-Cement-Concrete—The oil-cement-concrete shall be composed of the following materials by volume: One part Portland cement, 1½ parts of sand, 3½ parts of gravel or stone, sufficient water to give the concrete a consistency commonly described as "quaky," and oil in the amount of five pints per bag of cement. The cement, sand, aggregate and water shall be first mixed together sufficiently to insure that every particle of the cement, sand and aggregate is wet, when the oil shall be added and the whole mixed until the oil is thoroughly distributed through the concrete. The concrete shall be mixed in a mechanical batch mixer. The measurements of all materials shall be made in a manner satisfactory to the engineer.

Specification "E"—Cement-Concrete

Upon the subgrade prepared as specified herein shall be laid a cement-concrete pavement from Station 38+50 to Station 52+00. Coarse aggregates conforming to Specifications "L," "M" and "N" shall be used, each 450′.

Materials—Cement—The cement shall conform to Specification "I." Sand—The sand shall conform to Specification "K." Stone—The stone shall conform to Specification "M." Gravel—The gravel shall conform to Specification "L." Water—The water shall be fresh and clean. Platforms—All sand, gravel and broken stone for concrete, when brought upon the line of the work, shall be placed upon platforms and kept there until used.

Subgrade—The subgrade shall be prepared as hereinafter specified and shall be parallel to and 6″ below the finished grade of the road. It shall be wet, but not muddy, when the concrete is placed upon it.

Concrete—The concrete shall be composed of the following materials by volume: One part Portland cement, one and one-half (1½) parts sand and three and one-half (3½) parts gravel or stone, evenly and thoroughly mixed, and sufficient water to give the concrete a consistency commonly described as "quaky." The concrete shall be mixed in a mechanical batch mixer. The measurements of all materials shall be made in a manner satisfactory to the engineer.

Placing the Concrete—Before placing the concrete, a plank 2″ x 6″ shall be placed on edge and firmly staked in line with the outer edges of the pavement, the upper edge of said plank to conform to the finished grade of the road. The concrete shall be placed between the lines of plank in such a manner as not to cause any separation of the materials, and to such a thickness that when it is thoroughly tamped it shall be slightly higher than the finished surface of the pavement and shall then be thoroughly compacted.

The concrete shall be handled rapidly and successive batches deposited as a continuous operation. Under no circumstances shall more than 30 minutes elapse between the mixing and the depositing of any batch and no concrete which has hardened shall be used. Concrete shall not be mixed or deposited when the temperature of any of the materials is below 35° F., and, if during the progress of the work the U. S. Weather Bureau should predict a temperature of 35° F. or less within 24 hours, the work of mixing shall stop and proper precautions taken to protect from freezing all concrete laid within the seven preceding days.

Finishing the Surface—The contractor shall employ at least two competent men whose special duty it shall be to use a properly designed strike board, and they shall, after the concrete has been placed and tamped as above described and before initial set takes place, "strike off" the concrete to true line, grade and cross-section. They shall give the "strike board" a slight sawing motion as it is moved forward and take such other care as the engineer may direct to secure a smooth and even surface. After the concrete is "struck off," as above described, the surface shall be finished to true grade, line and cross-section with a wooden float. The contractor shall furnish, and the men shall use, a "bridge" during the process of floating. No person shall be permitted to walk upon the concrete after it is "struck off" until after final set has taken place.

Protection of Concrete After Laying—After the concrete is laid and until it has thoroughly set, it shall be protected from sun and rain by a canvas covering. The canvas covers shall be at least 18′ by 24′, and shall be so placed as not to mar, dent or disturb the surface of the concrete.

When the concrete is sufficiently hard to warrant it—about 24 hours after it is laid—the canvas covers shall be removed, and the concrete covered with a layer of sand or earth, about 2″ in depth, which shall be kept thoroughly wet for a period of 8 days. The covering of earth or sand shall remain on the pavement for a period of 15 days, and during this time no travel shall be permitted upon it. It shall then be removed and disposed of in the same manner as were the materials of excavation.

Joints—Whenever it is apparent that the laying of the concrete will be interrupted for more than an hour and a joint is inevitable between the interrupted work and the work as continued, the joint shall be made as follows:

A plank 2″ x 6″ shall be placed, on edge, at an angle of about 80° with the line of the road and shall be firmly staked in position. The upper edge of the plank shall conform to the finished grade of the road. The concrete shall then be deposited, "struck off" and troweled so as to form a surface even with the edge of the plank. When the laying of concrete is to be continued, the plank shall be carefully removed so as not to break the edge of the pavement and the surface of the concrete which abutted against the plank shall be thoroughly washed with a broom and a 10% solution of muriatic acid. The concrete shall then be washed with clean water until all free acid is removed from the concrete, when the laying of the concrete may be continued.

Specification "I"—Cement

The cement shall conform to the "United States Government Specification for Portland Cement," as published in Circular No. 33 of the U. S. Bureau of Standards issued May 1, 1912. It will be insisted that all cement shall be held seven days, after sampling, before use in any part of the work, and if the cement satisfactorily passes all tests that may be made within that time then the 28-day test will not be insisted upon, but if it should not satisfactorily to pass any test, then the cement shall not be used until it has satisfactorily passed all tests, including the 28-day test. One bag of 94 pounds, net weight, shall be considered as having a volume of one cubic foot.

Specification "K"—Sand

The sand shall be clean, coarse, well graded, and shall not contain more than 5% of clay or silt, which, however, shall not be permitted if it occurs as a coating on the sand grains. The grains shall be of such sizes that all shall pass a ¼-inch mesh screen. Not more than 20% shall pass a No. 50 sieve.

Before acceptance, the contractor shall submit to the Office of Public Roads for examination, an average sample weighing ten pounds, taken from the proposed source of supply, and this sample shall be subjected to analysis and comparison with standard Ottawa sand.

When mixed with Portland cement in the proportions of one part of cement to three parts of sand according to standard methods, the resulting mortar shall develop a tensile strength of at least 75% of the strength developed in mortar of the same proportions made of the same cement and standard Ottawa sand. The cement used in these tests shall be an accepted sample of the brand of cement to be used in construction. In no case shall the mortar made with the sand under investigation fail at less than 150 pounds at 7 days, or 200 pounds at 28 days.

Samples of sand taken from the material to be used in construction shall be of the same quality as the preliminary acceptance sample.

Specification "L"—Gravel

The gravel shall be composed of hard, sound, durable particles of stone thoroughly clean and well graded in size between those retained on a screen having ¼-in. circular openings and those passing a screen having 1½-in. circular openings. Not more than 75% of the particles shall pass and not more than 75% shall be retained on a screen having ¾-in. circular openings.

Before acceptance the contractor shall submit to the Office of Public Roads for examination a sample of gravel such as proposed for use in construction.*

Specification "M"—Crushed Limestone

The crushed limestone aggregate shall be clean, sound, durable, and shall be composed of that part of the product of the crusher which is retained on a screen having ¼-in. circular openings and which passes a screen having 1½-in. circular openings.

The contractor shall submit to the Office of Public Roads for examination a sample of stone taken from the proposed source of supply.*

The sample of rock submitted in accordance with the directions shall be subjected to the physical tests practiced at the Office of Public Roards on rock for road building and described in Office of Public Roads Bulletin No. 44.

The sample before acceptance shall be required to satisfy the following limiting physical values:

LIMITING REQUIREMENTS FOR LIMESTONE TO BE USED FOR AGGREGATE IN CONCRETE ROADWAYS

		Resistance to Wear	
Hardness	Toughness	Per cent	French Cofficient
14.0 or over	8.0 or over	5.0 or less	8.0 or over

The stone to be used in construction shall be of a quality equal to that of the preliminary acceptance sample.

Specification "N"—Crushed Trap Rock

The crushed trap rock aggregate shall be clean, sound, durable and shall be composed of that part of

*Specific directions for submitting samples are here omitted.

the product of the crusher which is retained on a screen having ¼-in. circular openings and which passes a screen having 1½-in. circular openings.

The contractor shall submit to the Office of Public Roads for examination a sample of stone taken from the proposed source of supply.*

The sample of rock submitted in accordance with the above direction shall be subjected to the physical tests and petrographical analyses practiced at the Office of Public Roads on rock for road building and described in Office of Public Roads Bulletins Nos. 37 and 44.

The sample before acceptance shall be required to satisfy the following limiting physical values:

LIMITING REQUIREMENTS FOR TRAP ROCK TO BE USED FOR AGGREGATE IN CONCRETE ROADWAYS

		Resistance to Wear	
Hardness	Toughness	Per cent	French Cofficient
17.0 or over	18.0 or over	3.0 or less	13.3 or over

The stone to be used in construction shall be of a quality equal to that of the preliminary acceptance sample.

Reinforced Concrete in South China

(From Consul General George E. Anderson, Hongkong.)

There has been a notable change in the manner of constructing buildings in new work of this sort in Hongkong and other South China ports, particularly in the use of reinforced concrete. Formerly most buildings were built of stone or brick, or of stone for the foundation and lower portion and of brick for work higher up, in most cases later covered by mortar. Additions to older buildings are still being made to some extent in this manner. The use of steel in construction was exceptional until a few years ago.

Most business buildings in Hongkong and other South China ports until recently followed a model which provided arch-supported verandas over the sidewalks, which not only afforded a covered way out of the tropical sun but which also gave double strength to walls to resist the typhoons that characterize much of the summer season along the coast. The convenience of this plan of construction still affects architecture to a great extent, both from the standpoint of custom and utility and because it permits the use of cheap native material. A few years ago, however, steel commenced to be used to an increasing extent in the better class of structures, and numerous collapses of buildings of no great age, constructed according to the old model with native materials, have given a decided impetus to the use of steel and stone and cement.

In the past two years this tendency has been further marked by the increasing use of reinforced concrete. Few of the more pretentious buildings now constructed do not make use of these materials. Structural steel generally is employed more and more. For concrete reinforcement of heavier types, European metal is preferred, but the use of American reinforcement in floors, ceilings, nonbearing walls, and for bridges, galleries, verandas, and the like in first-class buildings is becoming all but universal. Plans for construction work of all kinds in both governmental and private enterprises under the new regime at Canton and in other ports call for an increased use of these materials. There are no reliable data as to the present volume of this demand, but it is considerable, and unquestionably will increase greatly in the near future.

These materials are handled by nearly all importing commission houses, but the names of those Hongkong firms which make a specialty of such lines may be obtained by application to the Bureau of Manufactures, Washington, D. C.

*Specific directions for submitting samples are here omitted.

Painting Concrete

(From Consul General Robert P. Skinner, Hamburg.)

The publication in Daily Consular and Trade Reports for January 3, 1912, of an article on building methods in Hamburg prompts inquiry in regard to the class of paint used on cement structures in Germany. It is claimed that large amounts of money are expended in the United States in painting cement and concrete, with unsatisfactory results, the paint either peeling or discoloring rapidly.

According to information obtained from builders and architects, the principal precautions taken in northern Germany to prevent the peeling of all paints is to defer their application until the cement is quite dry. When it is intended to apply color on outside walls which are still damp, water paints are used which are weather proof and which can be washed if necessary. These colors, necessarily, are not impervious to moisture.

In his textbook for 1910 Dr. Glinzer, director of the State Building School in Hamburg, says that to make oil paint adhere to cement the surface of the material should be coated with diluted sulphuric acid (1 part concentrated acid to 100 parts of water), which afterwards must be washed off and the surface allowed to dry. Or the surface may be covered with diluted silicate of soda (water-glass), the solution to be 1 to 3 or 1 to 4, and applied three times in succession. Still another method is to apply two coats of building "fluat" at least 24 hours apart. Practical builders state, however, that the applications of sulphuric acid are not made by them, and that such success as they have results merely from careful work and the use of good materials.

Dr. Glinzer also says that oil paint should be applied to cement in the following manner: The surface is given one coating of linseed-oil varnish, to which is added a first coat of white lead when the varnish is dry. A second coat is then added, also containing white lead together with more or less coloring matter, as the building laws forbid the use of absolutely white paint on the exterior of structures. In this climate the use of oil paints is recommended, as they are waterproof and present smooth surfaces which attract a minimum of dirt. Painting according to this method costs here about 10 cents per square yard.

The water colors so frequently used in Germany as a rule have silicate of soda as their base. These colors can be used on cement, plaster of Paris, brick, or glass. Liquid casein paints are easily worked and are said to be durable. The discoloration of cement buildings results very frequently from the class of cement employed rather than from the color applied afterwards.

The Use of Motor Trucks in Road Construction and Maintenance

BY ROLLIN W. HUTCHINSON, JR., M. E.

Those who have made a careful study of economic road maintenance have generally conceded that the neglect on the part of cities, towns and townships promptly to repair their roads has brought about an excessive maintenance cost. It is generally accepted as a truism that $50,000,000 is being spent for road building in the United States every year and not 1 per cent of this is expended for their maintenance.*

If two men with the proper equipment were kept constantly employed going over the roads in their territory equipped with materials and tools with which to properly repair trifling defects, the annual expense of such repair work would be considerably less than is now the case with the plan of periodical repair work.

From all information obtainable, it appears that a new piece of road is generally allowed to take care of itself for the first year or two, and at the end of that time the neglect properly to repair what were originally trifling defects has allowed the road to get in frightful disrepair, requiring a very considerable sum to restore it to its former condition.

Very many miles of road could be taken care of by a motor truck operating daily and covering all of the roads in the care of the city or county where it is to work. This truck could be provided with changeable bodies, one of these bodies to be of box construction to carry sand, gravel, crushed stone and top dressing as might be required; at other times tar kettle and material for building roadside fires. The other body could be for water for sprinkling.

A small hole or rut worn in a road, if neglected, will have its sides gradually torn down by continuous traffic and develop into a large hole, requiring the expenditure of a considerable sum to effect proper repairs.

With the advent of the motor truck and automobile it is believed that the business men in every community have come to realize the importance and economy in maintaining good roads.

Depreciation on all vehicles, both horse-drawn and motor-driven, is very considerable where poor roads exist, or where good roads are allowed to get in bad condition for the want of prompt repair.

A manufacturer in advertising the hill-climbing ability of its pleasure cars uses the winding road ascending Eagle Rock mountain in the Oranges, New Jersey, as a test climb, and many a car has attempted the ascent of this mountain and faded pantingly away before reaching the summit of a grade which runs from 15% to 17%.

Fig. 2—Dumping Broken Stone

Knowing these facts, one would hardly look here for a heavy vehicle of any kind operating otherwise than down hill. Modern transportation equipment must, however, meet and cope with local conditions, surmounting grades and other difficulties.

The Joseph Murphy Sons Co., Hoboken, N. J., employ at Eagle Rock quarry a 7-ton Mack truck with dumping body, on this steep mountain road, hauling broken stone from the Eagle Rock quarry to various points on both sides of the mountain.

The quarry is three-quarters of the distance up the road from the base of the mountain, at a point where the road verges into an abrupt curve, which adds to the difficulty of the ascent, which is here at its steepest.

In the summer of 1911 the truck averaged 55 miles in nine trips a day, hauling 63 tons, or more than five times the work possible with a team of horses

*Mr. Hutchinson evidently differentiates sharply here between maintenance and repair charges, as in some sections men are out with carts or wagons continuously looking after small holes and breaks so that general repair once a year is unnecessary.—The Editors.

Fig. 1—Distributing Asphalt With a 7-Ton Motor Dump Truck at Jamaica, New York

making four trips, carrying three tons per trip, or twelve tons in the same time.

There are a number of stone quarries in the vicinity of Baltimore which could use motor trucks to good

FIG. 3—LOADING CRUSHED STONE AFTER MODERN METHOD

advantage and with a considerable saving. MacMahon Bros., Mt. Washington, with 5-ton and 4-ton Mack trucks, with automatic dumping bodies, and the Schwind Quarry Co., with a 3-ton Packard, are using

FIG. 4—SHOWS HOW MOTOR TRUCK CAN SPREAD MATERIAL

the motor truck for hauling broken stone for road building. In order to show what could be done in this line, Messrs. Hook and Ford, engineers for MacMahon Bros., ran a week's test with a 5-ton Mack truck with automatic dumping body in competition with a four-mule-team wagon, hauling broken stone for road building from the Dickeyville quarry with the results given below. The truck had to make ten miles to a round trip, as against nine for the team, on account of having to go a mile out of the way on the trip from the quarry in order to avoid a bridge which was too weak to carry when loaded. One mile of the trip loaded was up a 14% grade. The average amount of gasoline consumed was 29 gallons; average amount of oil consumed, 2 gallons; average working hours, 10; average time loading, 3 minutes; average time unloading, 10 minutes; total load carried, 60,000 pounds; number of trips, 6; total mileage, 60 miles. There were three rainy days in the test period, so that most of the time the roads were soft and in bad condition.

Another advantage in the use of the truck is in the spreading of the stone. It took the truck ten minutes to spread the stone as shown, which the contractor stated was done better than could be done by hand and saved the labor of two men working with shovels for one hour. This spreading was regulated by opening the tail board the proper distance and thus letting the truck travel slowly over the road with the body in an inclined position. The results of the comparative tests of motor trucks and mule equipment as made are:

4-MULE-TEAM HAULING 4½ TONS PER DAY 27 MILES

FIRST COST		
4 Mules @ $325.00 each		$1,300.00
Harness		75.00
Wagon		250.00
		$1,625.00
MULES		
Interest on ½ investment @ 6%		$ 48.75
Insurance on team		32.50
Depreciation 20%		325.00
Fixed charges per day (assuming 225 working days per year)		1.85
Wages per day	$1.84	
Feeding @ 60c per head	2.40	
Stable man	.25	
Veterinary's service	.20	
Shoeing	.30	
*140 days' feeding @ 40c per head, $224.00	.99	
Total daily operating cost		$6.18
Fixed charges per day		1.85
Total charges per day		$8.03

5-TON DUMP TRUCK HAULING 5-TONS PER DAY 60 MILES

FIRST COST		
Truck		$5,300.00
TRUCK		
Interest on ½ investment @ 6%		$159.00
Insurance on truck 2½% on 80% of ½ value		53.00
Depreciation on truck (not including tires)		480.00
Fixed charges per year		$692.00
Fixed charges per day		3.07
Wages per day	$2.50	
Maint. 4½c per mile	2.70	
Tires 6c per mile	3.60	
Gasoline 4c	2.40	
Oil	.60	
Total daily operating cost		$11.80
Fixed charges per day		3.07
Total charges per day		$14.87

4-Mule team hauls 13¼ x 4¼=57.37 ton miles per day=13.9c per ton mile.

5 ton truck hauls 5 x 30=150 ton miles per day=9.9c per ton mile or a saving of 4c per ton mile or $6.00 per day.

*Due to the mules not working, quarry being shut down owing to cold weather.

Methods of Testing Concrete Pipe in Field and Factory*

BY ARTHUR N TALBOT† AND DUFF A. ABRAMS.‡

Recent developments in the manufacture of farm drain tile have emphasized the importance of having a simple standard portable testing machine which may be used for making tests of drain tile in the field or at the plant. The increasing use of tile of large size in farm drainage districts is well known. The competition between clay tile and the concrete tile has brought up new questions. What strength shall be required for tile of a given size in order that they may be considered commercially first-class tile? In the case of concrete tile, what thickness, richness of concrete, method of curing and age at laying are necessary to fill the requirements for a first-class article?

A number of elements enter into the choice of a suitable method of testing for physical properties of drain tile. (1) A definite and important quality should be determined by the test. (2) The test should be simple, easily and quickly made, and should not require the services of an expert laboratory man. (3) The test should be of such a character as not to give unduly diverse results for test pieces of the same grade. (4) The machine to be used should be simple and inexpensive, easily adjusted to different sizes of specimen, easily transported from point to point and easily made ready for use. It is believed that the machine described in this article satisfactorily fulfills the requirements for making field tests of drain tile. This machine was designed by D. A. Abrams for use in the Laboratory of Applied Mechanics of the University of Illinois.

The machine consists essentially of a simple framework and a lever for applying the load by means of dead weight. The load applied through the loading lever may be blocks of iron, or stone, sand or other suitable material. After the test the dead load is weighed. To obtain the load on the tile, this weight is mnltiplied by ten, and a constant quantity due to the weight of the loading lever (about 100 lb. in this particular machine) is added.

The accompanying sketch gives the principal dimensions of the different parts. The photograph shows the machine with a 30″ clay tile in place ready for loading. The machine measures 30″ between uprights and will take tile up to 42″ inside diameter.

The main members are of timber; metal plates and other shapes are used at points of concentrated load and for connections.

Metal knife edges are provided for the bearing of the loading lever on the top loading block and for taking the upward thrust against the top cross block. The knife-edge bearings on the block over the test tile are 5″ center to center, and a single knife edge takes the end thrust. This gives considerable freedom to the top loading block and allows the load to be fairly central, although the top and bottom elements may not be parallel.

The bottom loading block is provided with two small half-rounds of hard wood placed about 2″ apart which allow the tile to seat itself in place. The load is applied at the top along a single element. Cushions consisting of short lengths of flattened rubber-lined fire hose serve to distribute the load along the length of the tile and prevent any local concentration of the load due to irregularities in the top or bottom surfaces.

The top cross block can be placed and held in any position along the uprights to accommodate the machine to any diameter of tile up to about 42″. By this means the machine is adjustable to the greatest variation in the size of the test tile and will apply the load to any sizes under uniform conditions.

In order to check the dimensions of the loading lever, it was calibrated by setting a pair of platform scales in the machine and loading up to about 500 lb. on the machine. It was then placed in a 10,000 lb. testing machine and loaded up to 4,000 lb. The greatest error observed for this range of load was less than 1 per cent.

This machine weighs 225 lbs. It should not cost more than $15 to $18 in a shop equipped for wood and metal working.

Up to the present date about one hundreds tests have been made on this machine on concrete and clay tile in sizes 2″ to 36″ inside diameter. The breaking loads varied from 1,400 to 5,000 lb. per tile.

An examination of this testing machine will show that it is simple in operation and that it is easily adjustabel for different sizes. Tile which are out-of-round in different ways at the two ends will be easily taken by the machine and there is little chance for an unfair distribution of the load. The strip of hose

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†Professor of Municipal and Sanitary Engineering, in charge of Theoretical and Applied Mechanics, University of Illinois.

‡Associate, Engineering Experiment Station, University of Illinois.

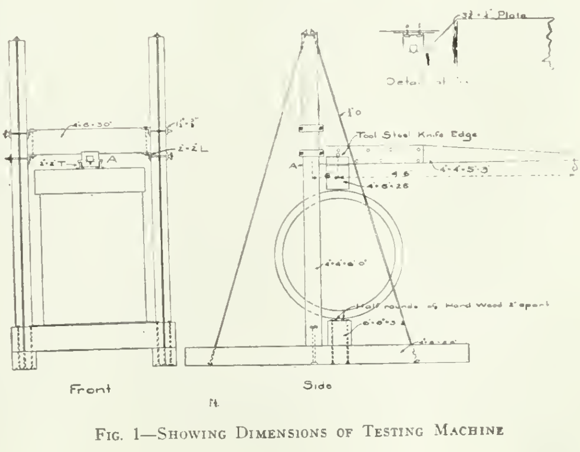


Fig. 1—Showing Dimensions of Testing Machine

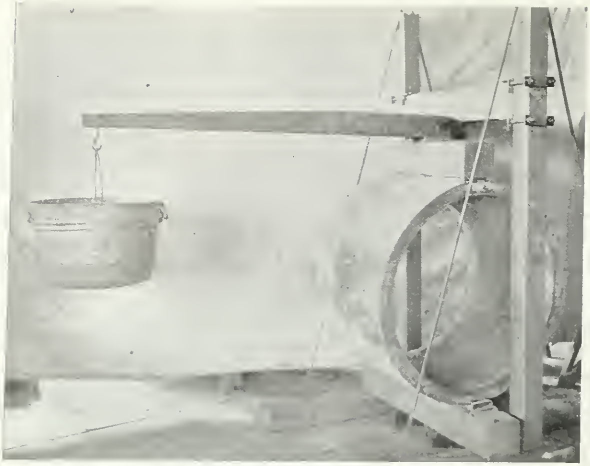


FIG. 2—TILE IN MACHINE READY FOR TESTING

gives some cushioning effect, and the load is practically distributed over the whole length in all cases. The method of loading along a line at the top and bottom was selected because of its simplicity. The arrangement of the machine allows a tile to be rolled into place and to be easily made ready for test. It is believed that the results obtained by different operators will agree quite closely.

If desired, the modulus of rupture of the material may be determined from the bending moment developed and the dimensions of the pipe. For general purposes it will be preferable to report the load per foot of length pipe for a given size. Possibly for some purposes it may be interesting to divide this load by the diameter of the pipe in inches and thus compare the results per inch of diameter for a pipe one foot long.

It has seemed the simplest way to fix at a definite distance apart the two strips on which the tile rests. An analysis of rings shows that when the bearings on these strips are 2″ apart, the formula for the bending moment will be cut 2½% different from that for a single support for tile 6″ in diameter, and ¼ of 1% for a tile 12″ in diameter, while for larger sizes this variation will be much less. Under the conditions of such tests and use a common expression for the formula for the bending moment for all sizes of tile to be test. It would seem that 0.16 Qd is a satisfactory expression for the bending moment when Q is the concentrated load applied at the crown and d is the mean diameter of the tile. For the modulus of rupture (f) of the material, the formula would be

$$f = \frac{0.96Qd}{lt^2}$$

where l is the length and t the thickness of the tile along the top and bottom elements.

This method of testing was selected in preference to a method involving the bedding of the tile in sand or other material, because of the difficulty in embedding large tile in sand in such a way as to obtain a fair distribution of pressure and in securing the same distribution of pressure in different tests, and

A. Summary of Tests of Clay Drain Tile.

These tile were selected from tile delivered on the site for a drainage job about three miles east of Urbana, Illinois.

Ref. No.	Average Internal Diameter (in.).	Average Thickness Top and Bottom (in.).	Length (in.).	Weight (lb.).	Maximum Load (lb.).	Modulus of Rupture lb. per (sq. in.).	Remarks
30—1	30.3	2.30	23.8	400	4,850	1,190	Hard burned
30—2	30.5	2.35	24.0	416	3,750	905	Black core.
30—3	30.2	2.35	24.0	406	2,830	660	Black core.
					Average	915	
27—1	28.0	1.90	25.5	308	3,180	988	
27—2	28.0	1.97	24.5	313	3,640	1,066	
27—3	27.6	1.93	24.5	314	3,840	1,180	
					Average	1,045	
24—1	24.6	1.78	25.5	238	2,360	737	
24—2	24.6	1.71	25.4	241	2,520	818	
24—3	24.5	1.72	25.4	242	3,030	1,055	
					Average	870	
18—1	18.9	1.30	25.8	145	2,040	917	
18—2	19.0	1.32	25.2	144	2,080	915	
18—3	19.0	1.30	25.5	143	2,240	1,025	
					Average	952	
12—1	12.7	1.10	25.8	79.7	1,835	760	
12—2	12.4	1.07	25.2	80.0	2,985	1,318	
12—3	12.6	1.12	25.5	79.3	1,745	713	
					Average	930	

B. Summary of Tests of Concrete Drain Tile.

This lot of concrete drain tile was selected from stock made for the Fountain Head Drainage District west of Champaign, Illinois.

Ref. No.	Average Internal Diameter (in.).	Average Thickness Top and Bottom (in.).	Length (in.).	Weight (lb.).	Maximum Load (lb.).	Modulus of Rupture lb. per (sq. in.).	Remarks
36—1	35.9	3.10	24.3	706	1,965	314	Wet concrete.
36—2	36.0	3.10	24.2	721	1,885	304	
36—3	36.0	2.93	24.0	700	2,495	451	
					Average	356	
27—1	26.7	2.81	24.3	454	2,135	311	
27—2	26.6	2.90	24.6	460	2,945	411	
27—3	26.6	2.84	24.5	475	2,305	321	
					Average	350	
22—1	22.0	2.24	24.4	321	2,665	500	
22—2	22.0	2.23	24.1	335	2,885	557	Wet concrete.
22—3	22.0	2.27	24.2	315	1,890	350	
					Average	469	
12—1	12.0	1.05	12.3	39.6	1,405	1,290	Machine made.
12—2	12.0	1.05	12.2	39.3	1,295	1,200	Machine made.
12—3	12.0	1.05	12.4	39.3	1,345	1,225	Machine made.
					Average	1,238	

The 36—, 27—, and 22-in. tile were made at a field plant about two miles west of Champaign, Illinois. Metal forms were used. The forms were removed immediately upon the completion of the tamping.

The 12-in. tile were machine made and had six circumferential corrugations about 0.10 in. high and 5/8 in. wide at base.

Details regarding materials used and storage conditions not furnished.

C. Summary of Tests of Concrete Drain Tile.

Ref. No.	Average Internal Diameter (in.).	Average Thickness Top and Bottom (in.).	Length (in.).	Weight (lb.).	Maximum Load (lb.).	Modulus of Rupture lb. per (sq. in.).	Remarks
36W1	36.7	2.95	23.8	690	4,310	770	See note below
36W2	36.0	2.98	24.0	700	4,080	819	
36W3	36.0	3.02	23.9	722	4,760	812	
					Average	800	
24W1	23.9	2.07	24.0	313	2,860	690	
24W2	24.1	2.00	24.0	312	1,900	492	
24W3	24.0	1.97	24.0	316	2,660	708	
					Average	615	
20W1	20.3	1.74	23.9	205	1,770	515	
20W2	20.3	1.63	23.9	209	1,640	539	
20W3	20.3	1.70	23.9	209	1,670	516	
					Average	527	
18W1	18.3	1.65	23.8	188	3,000	882	
18W2	18.3	1.65	23.8	186	2,920	859	
18W3	18.3	1.65	23.8	184	3,170	892	
					Average	878	
12W1	11.8	.95	12.2	30	850	939	
12W2	11.8	.96	12.2	31	820	887	
					Average	913	
					Average	913	

The 36-in. tile were reinforced with two 1/4-in. equare twisted bars, placed at middle of thickness of tile. Bars were welded into circular rings. The modulus of rupture for these tests was computed in the same manner as for the other tile, disregarding the reinforcement.

Concrete consisted of one part cement to 3½ parts washed sand and gravel. Concrete machine mixed.

The 12-in. tile were machine made, and were placed in steam chamber for twelve hours. The other tile were stored in the open air.

because the method of concentrated loads will give a more definite index of the strength of the material.

In tests of materials it is not essential that the material shall be subjected to the same action in the process of testing that it will receive in service. The cold bend test of steel is one of the most useful and instructive of tests, but it differs radically from any condition of service in which the steel will be placed. The value of a test will depend upon the properties determined. In testing drain tile the method of applying concentrated loads has many advantages over that of applying distributed loads. Whatever the method of testing used, it will be necessary finally to determine the relation between the strength of the test piece and the strength which is needed in the structure. In the case of tile to be used in a ditch of a given depth and a given soil the necessary test strength will have to be determined. Since the tests will have to be translated into the working conditions, it would seem not necessary to attempt to make the conditions like the conditions in the ditch. It is of much more importance that the tests should be simple, direct and uniform under varying conditions of tile and with different machines and different operators. Our own experience with this machine leads us to think that it would make a satisfactory means of determining the quality of drain tile.

The three series of tests (in tables) of drain tile have been selected as representative of the results obtained with the machine described above.

Compression Roll and Belt Machine For Hollow Concrete Poles

The possibility of producing concrete poles, piles and similar structures by a "turning" process has long demanded the attention of concrete engineers. A recent addition to development along this line is a belt and compression roll machine designed by R. M. Jones, an engineer of Denver, Colo. In this process the pole is formed around a mandrel, and carried, as shown in Fig. 1, in a belt as wide as the length of the pole. It is "slung" in there, as it were, supported by two bearing rolls below the center of the two compressing rolls. For a tapered pole, all the rolls are given the same taper as the pole. The heavy canvas belt is placed over the top compression rolls, and the reinforcement and the inner core, or mandrel, are laid on this and between the rolls. Each edge of the belt is weighted down with an iron bar along its entire width. These weights operate as a counterbalance and maintain a tightening effect throughout.

Operation: Fig. 1 shows a cross-section of the proposed plant arrangement. The concrete is measured in a long narrow box approximately the shape of the pole. The compression rolls are moved outwardly by the four pneumatic cylinders as shown and are rotated inwardly, the counterbalance weights rise, and the reinforcement and inner core which have been placed on the belt, are lowered to contact with the idler rolls below. The air is then reversed, imposing a compression upon the collars at each end of the reinforcement and core, and the concrete is fed in from the top by means of the measuring and distributing box. One compression roll is then driven very slowly, not exceeding 10′ travel per minute. The product is turned approximately 2½ revolutions in one direction, the driving power connecting this roll is then disengaged by clutch, and the other compression roll is driven in the opposite direction. This reverse operation continues until the product being formed is shaped and thoroughly compressed.

The vertical steel standards composing the frame, in combination with the pressure applied by the air cylinders and the tension constantly retained by the weights upon the belt, cause a more thorough compression effect than hydraulic press, because the aggregates composing the concrete mass receive their compression from different directions in succession, and the compression is maintained constantly by the belt.

It is found, in the experimental work so far conducted, that this peculiar rolling compression will cause water to come to the surface of a mixture so dry that it will not stick together when squeezed in the hand. The pole becomes a hard, true surfaced product within 5 min. from the time the concrete is applied.

In order to retain the moisture in the product during its original setting period, a sheet of canvas wide enough to encircle the product two turns and a lap, is first coated with a mineral rubber paint, and then fed between the belt and the outer surface of the product by placing its edge between them, and revolving the product two turns. Brads with small heads are then driven through the three thicknesses of canvas and into the concrete, and the product is discharged from the forming machine in the following manner: The air pressure is reversed, thus parting the top compression rolls. These top rolls are then turned in opposing directions and the counterbalance weights on the belt bring the finished product to the top of the rolls, whence it is rolled away to a

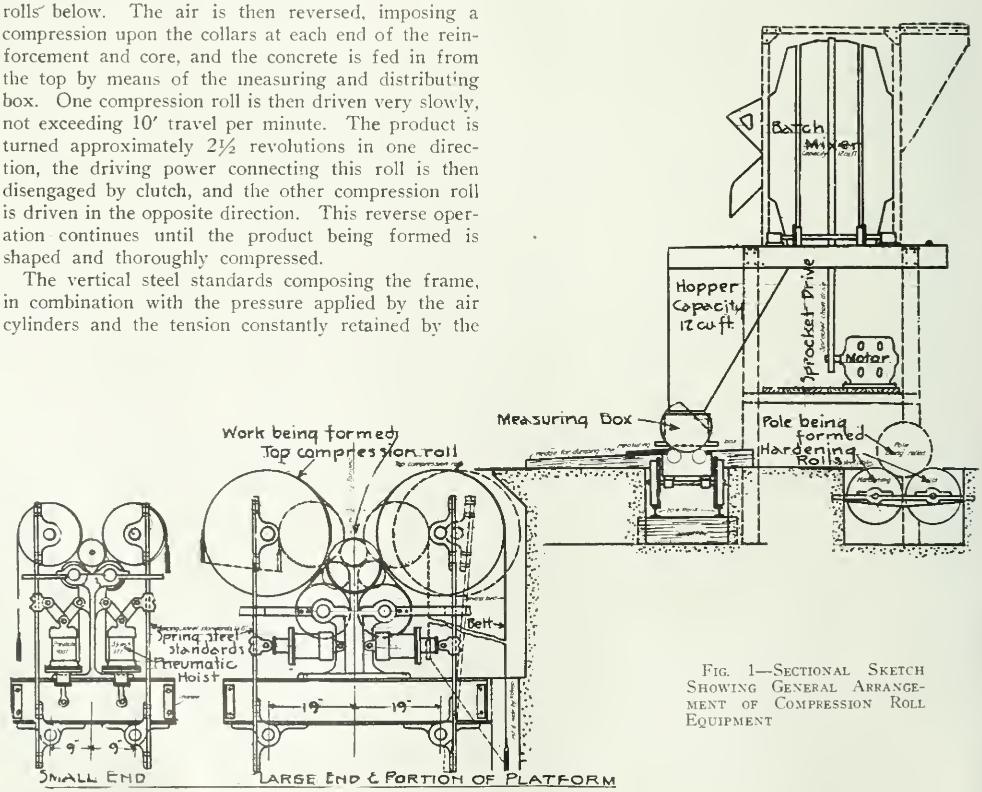


FIG. 1—SECTIONAL SKETCH SHOWING GENERAL ARRANGEMENT OF COMPRESSION ROLL EQUIPMENT

point on the circular curing table. After 24 hours have elapsed, the canvas cover is removed and the product is kept wet until thoroughly cured.

The mandrel, which is covered with sheet steel made in two parts, remains in the pole until the concrete becomes set. The mandrel and the sheet steel covering, which form the core, are then removed; the pole rests in an undisturbed position from five to eight days.

Reinforcement: For this work it is the plan of the inventor to weave the reinforcement on a tapered mandrel in a specially prepared loom. This, after being woven and taken from the mandrel, is placed upon the forming mandrel, and the warp which forms the circumference reinforcement is united by twisting one around the other. The warp may vary in size from No. 6 to No. 10 steel wire as required for producing the desired strengths.

The woven reinforcement is held centrally between the inner core and the outer circle by pole-step sockets woven between two bars of the reinforcement. There are also distance pieces provided for centralizing the reinforcements at other positions around the pole. Reinforcement fabricated in this way is somewhat of

Fig. 2—End View Showing Arrangement of Belt and Compression Rolls

Fig. 3—Detail Views Showing Arrangement of Projecting Rods

Fig. 4—Experimental Specimens, a Splice Ready for Pouring is Shown at the Left

a novelty, but if successful, might well be used in columns and similar members.

The Plant: A rather ingenious idea is developed in using an inclined semi-circular fan-shaped curing yard. This would apply to any tapered product. The general arrangement is shown in an accompanying sketch.

Splicing Poles: As any given machine could only produce poles of its own length and under, it was necessary to investigate a joint or splice. This joint was developed by having the reinforcement of any section project above the top of the bottom section, and also below the butt of the top section. Some of the extended rods are shorter and left in straight alignment. There will be cast in the interior, near the top of the butt section, a concrete diaphragm merely to hold the concrete required in the joint from passing below that point. The butt section is to be set permanently as intended in line construction, in its right position and straight up. To the top of this is connected a short gin-pole, a tool belonging to the line construction. From this suspension the top section is raised in a vertical position, and the reinforcement of both sections are then entered one within the other. The top section is then lowered to position.

The exterior jacket, consisting of two steel plates rolled to a curve, is then placed over the joint; each of these plates covers 240° of the surface. The jacket is then banded. The tightening of these bands should align each section of the pole perfectly one with the other, and will have sufficient strength to support the top section until the concrete forming the connection becomes set. The concrete, which should be pretty stiff, is then poured through the top of the pole, or through a side entrance above the jacket which may be provided if desired. The pole should be thoroughly wet in the vicinity of the joint before the connecting plug is cast. An iron rod suspended by rope could be used from the top of the pole to agitate and churn the new concrete mix which forms the plug and the connecting joint. The strength of the joint as described will be much greater than the strength of any other cross-section of the entire pole.

The joint might be made just as well while the pole is lying down, but the inventor's object in making long products in two sections is to facilitate in transportation, handling and raising them. In this manner a 72′ pole, 8″ in diameter at the top and 20″ in diameter at the butt, may be easily manufactured and erected.

The accompanying views show the experiments conducted to determine the practicability and value of this joint.

Fire Tests With Reinforced Concrete

While it is known that reinforced concrete is fireproof, it is not known in detail what aggregates increase the fire safety of concrete buildings, and at what depths the reinforcement must be embedded to give the greatest safety. To make tests it was decided to build special buildings, set them on fire and watch results. The tests were to establish the heat transmission of concrete, the resistance of concrete to fire and water, the determination of a standard of reinforcement depth for fire safety, the loss of strength after the fire. Aggregates used in the tests were sand-concrete, river-gravel, basalt rock and granite. Two houses were built; in one of them the reinforcement was embedded to a depth of 2 cm. (0.8 in.); in the other house only to a depth of 0.5 cm. (0.2 in.). In the first house the roof rested on two columns supported by a girder of gravel-concrete, mixed 1:4. In the second house the columns rested on a girder of limestone-ballast-concrete, mixed 1:2:2. The walls were partly finished, partly left unfinished. The houses were heated for several hours by a large wood fire, the temperature being continually measured. Then a fire engine played streams of water on the houses, directed especially against the construction parts. The floor beams carried a heavy load during the tests. The results show that the resistance of a reinforced concrete building is independent of the depth of reinforcement in the concrete. The limestone-ballast concrete is superior to the gravel concrete. Of special interest might be the fact brought out, that with proper construction, reinforced concrete buildings during fires can sustain a much higher load than that for which they were originally designed, and that the buildings are not destroyed by flames. Another fact brought out was the possibility of entering neighboring buildings, without fearing the effect of the fire in the concrete structure, which means that fire in a concrete building is forced to remain within its own boundaries and does not spread to adjoining buildings. These experiments were carried on in 1911 at the Royal Testing Station at Gross Lichterfelde.—*Armierter Beton.*

Sewage Disposal for Country Homes with Concrete Septic Tank

The general use in country homes of the modern conveniences of the bath and toilet has made necessary some effective and inexpensive means of disposing of the sewage. Otherwise the drinking water will be polluted and the health of the family endangered. Entire satisfaction is obtained by the use of the septic tank, which is nothing but a long water-tight cistern through which the sewage passes very slowly and evenly. Located underground, it is warm and dark—ideal conditions for the development of bacterial germs which eat up the sewage and render it harmless. The purified sewage, then merely clear water, may be discharged into an ordinary farm drain tile.

Size of Tank Required: Although the odor from a small septic tank is practically unnoticeable, yet it is best to locate it at least 150′ from the house. Choose a spot where it can be sunk to ground level and will be out of danger of flood waters. The tank should be large enough to hold the entire sewage for one day. For a family of eight to ten, plan a concrete tank of two compartments each 4′ by 4′ by 5′ long. Since the top and bottom are each 4″ thick and the division and sidewalls 8″, dig the pit 4′ 8″ deep, 5′ 4″ wide and 12′ long.

Making the Forms and Pouring the Concrete: If the ground stands firm, only inside forms will be needed. Make two, each 4′ by 4′ by 5′ long. Old 1-in. lumber will do for the siding. The compartment into which the sewage first enters is called the "charge tank." In each end of the wooden form for this tank cut openings for a 5-inch tile with the lower edge of the hole 16″ above the bottom of the form. Through each of the sidewalls of this same form, 18″ from the inlet end and 1½′ and 2′ above bottom, bore 1-in. holes and insert in them greased wooden pegs extending 4″ into the future sidewalls. Likewise, in the other form for the discharge tank, cut openings for a 5-in. tile, this time with the lower edge of the hole 2′ above the bottom.

Mix the concerte 1 part Portland cement to 2 parts sand to 4 parts crushed rock, or 1 part cement to 4 parts pit gravel. Place the 4″ of concrete in the bottom and trowel to an even surface. Immediately set the forms in place so as to leave room for 8-in. division and sidewalls. Fill the forms with mushy wet concrete. At the proper hights inesrt the 5-in. drain

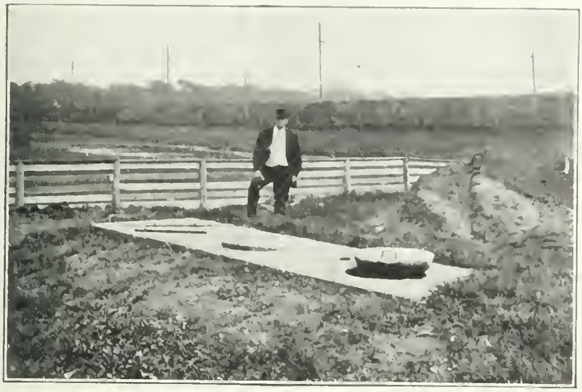


Fig. 1. Concrete Septic Tank for Country Home

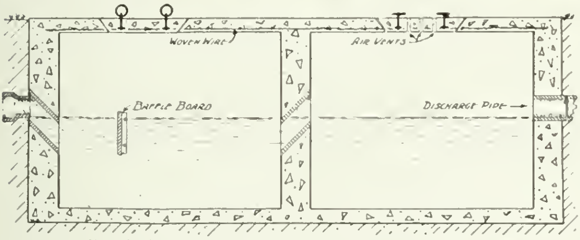


Fig. 2. Lengthwise Section Through Concrete Tank

tile through the holes in the forms. Be careful that the outside end of the inlet tile to the charge tank is 2′ and its other end 16″ above tank bottom. The pipe leading from the charge tank is also set at the same sharp slope. The outlet tile from the discharge tank is 2′ above bottom and with both ends level. By this arrangement of pipes, the sewage is kept in the tank to the depth of 2′ and the ends of the tile in the charge tank are trapped or air-sealed, which aids the activity of a certain kind of bacteria. Likewise, other bacteria are developed in the discharge tank by means of the free circulation of air through the discharge drain tile and holes in the manhole cover.

Reinforced Top and Manhole Covers: After the sidewalls are 3 days old, floor over the top of the forms and prepare to lay the 4-in. concrete top. As molds for the manhole covers, have the tinner make 2 round bottomless "dishpans," 18″ in diameter at the bottom and 24″ at the top. Grease these tin molds and set one on the wooden floor over each compartment. Bore 6 1-in. holes in the floor inside the one manhole mold over the discharge tank and insert in them greased pegs projecting upward 6″.

Place 1″ of concrete over the entire floor and at once lay on it, crosswise the tank, strips of heavy woven-wire fencing 5′ 2″ long, or 3/8 in. rods running in both directions and spaced 12″ on centers. Likewise reinforce the manhole covers. Immediately place the remaining 3″ of concrete and do not stop until the tank top and manhole covers are finished. Provide two lifting-rings for each cover by setting in them halves of old bridle-bits, or hitching-post rings, fitted with knobs of wire or with nuts and large washers. If a square wooden manhole mold is used, the concrete cover cannot be cast at once. In such case, carefully remove the wooden manhole form 5 hours after the top has been finished. Three days later mold the cover the same as for the tin form with this important exception—place heavy paper or cardboard around the edges of the opening to prevent the fresh concrete of the cover from setting to the old concrete.

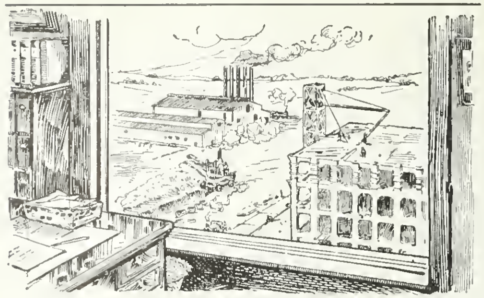
When the top of the tank is 10 days old, lift off the manhole covers, saw openings in the wooden top and remove the forms. In the holes made in the side-wall by the greased wooden pegs, insert 1/2-in. bolts and set them with mortar. To these bolts fasten the 1 by 12-in. wooden baffle-board which extends across the tank and breaks up the current of the inflowing sewage. To carry the sewage from the house to the tank, use 4-in. sewer pipe laid with tight mortar joints. Connect the discharge end of the tank with a string of drain tile.

Inexpensive Bill of Materialss The materials required for the tank described above are 5 1/2 cu. yds. of crushed rock, 2 3/4 cu. yds. of sand and 9 bbls. of Portland cement. If good pit gravel is used, no additional sand will be required.

When the septic tank is two weeks old it may be put to use. It will need cleaning at intervals of two to three years. By its use the health of the family will be protected and life in the country home will be made much more comfortable.

Reinforced concrete is to be used for the restoration of parts of the castle of Heidelberg, provided the concrete has no destructive influence on the sandstone of which the now ruined castle is built. The recent earthquake had no influence on the ruins or other buildings in the vicinity.

Space Number 123 is to be Concrete-Cement Age's at the American Road Congress on the Million Dollar Concrete Pier at Atlantic City, N. J., September 30 to October 5. Look us up.



C O M M E N T

Standard Paving Specifications

In presenting in this issue *more* data from *more* localities where concrete paving has been done than have ever before been published, CONCRETE-CEMENT AGE has no intention merely to create an impression of *quantity* of paving. The intent is to convey ideas of *quality*. Quality in concrete paving is a thing just as attainable as quality in any other construction. Consistent quality has been attained in other concrete construction in the standardization of engineering principles and practice and in the choice and manipulation of materials.

Consistent quality will be realized in concrete paving—and is now a realization in many localities—in the rejection of some factors and the acceptance of and insistence upon other factors. The details presented in this issue will make for the elimination of poor elements and the acceptance of the good elements in concrete paving construction. Concrete pavements described in the tabulated data and in the more extended paragraphs, represent a wide range of expenditure per square yard, a wide range in the choice of materials, in the proportion and quality of materials; a wide range in the method of construction, in the use of expansion joints and joint filler and protection; a wide range in surface treatment. There are one-course pavements and two-course pavements, plain concrete pavements and reinforced concrete pavements. While it is not at all likely that one specification will ever meet the requirements of every locality equally well, a certain degree of standardization is possible. The local requirements can be met within certain safe limits of variation from a standard. Standardization is sure to come out of the many different specifications.

It is therefore with considerable satisfaction that CONCRETE-CEMENT AGE presents the large amount of information contained in the tables in this issue. It does not constitute an exhaustive report on all concrete paving. It does come nearer a full, *representative* report than anything hitherto published.

Concrete Highways—Mechanical Haulage—Cheaper Food

Before the steam railway the people of the country were dependent upon roads and trails. The country was so new and these avenues of communication so rude and inadequate that communal existence was impossible. Families were isolated They grew their own food; grew and made their own clothes, and cut their own fire wood. The development of the steam railway came in before people had had time to build highways. The development of the railway has been so rapid that the country has become dependent upon it, has used it to the limit and has failed to develop the highway as a supplemental means of communication. Now comes the individual mechanical haulage—steam tractors, gasoline and electric tractors and trucks, and a similar array of passenger vehicles. The New York State Commission of Highways in its last report says: "The extension of the improvement of the highway system of the state has called into existence a class of traffic which was never contemplated in the original scheme. This is the use of traction engines in hauling heavily loaded cars and in the use of motor trucks. * * * Regular freight lines of motor trucks have sprung into existence between large towns, whose limit of load is simply the inability of the men in charge to pile on any more."

The New York State Commission of Highways proposes regulating the weight of load as related to the width of tire so that the roads will not be destroyed. Yet this is not the solution. While some regulation of mechanical haulage on public highways will doubtless be necessary, the main consideration is that *the roads must be made to serve*. This is not a matter of pleasure vehicles and picnic parties. It is an issue of bread and butter. Many millions of dollars in mud taxes are coming either out of the people's mouths or out of their pocketbooks—depending upon whether they go without adequate food or pay too much for it. Good roads and mechanical haulage will lift this mud tax, will lower the cost of living and will make community existence possible under new conditions. Community existence will be possible without having people huddled together with an ever increasing tendency of the population toward the cities.

This is not a local need. It is a national issue, on which the local and general governments must put their best thought and effort. Local effort is necessary that the work may be carried forward rapidly everywhere, and national supervision and aid that it may be a work which will be systematic and connecting.

The concrete highway is the solution. It affords the hard surface necessary to stand the wear of the heavy power vehicles and it insures permanence at the least cost.

* * *

Architecture at Panama

Léon E. Dessez, a Washington architect, has called our attention to a recent address by Senator Newlands before the Senate, urging that in completing the Panama canal, the nation's great men in art and architecture, who have done so much for the courtry's development, be called upon to help finish this great engineering and, if Senator Newlands' idea is carried out, architectural structure.

Senator Newlands pointed out that during the past few years there has been a great movement toward democratizing art. All over the country associations of architects, sculptors, engineers and artists of every sort have been formed; and with their national associations, their specialized journals, and their every day work, they are doing much to mold and develop public opinion. To quote Senator Newlands:

As this canal is now approaching completion, I have a suggestion to make to the committee in charge, and that is, that in finishing that wonderful structure we should take into our councils the great men in architecture and in art who have done so much in the way of the artistic development of the country since the Chicago World's Exposition. In ancient times no great structure of this kind was completed without utilizing great men in architecture, sculpture and painting, and their work has gone down to posterity with the work of the great constructors.

We have been utilizing in the construction of this canal a very plastic material—concrete—which can be molded into any form without additional expense and which can be made attractive in appearance as well as useful in purpose.

It seems to me this is an appropriate time to bring the Commission of Arts, recently organized by national legislation, into co-operation in an advisory way with the Panama Canal Commission, and that they should be called upon to make some suggestions which will enable us to crown this structure with an artistic demonstration so that it will be representative to the nations of the world and to future generations, not only of the constructive genius, but the culture of our time.

The suggestion is well worth careful consideration. A wonderfully broad and sincere architectural interpretation of the Panama canal structure, and its permanent expression in a series of great concrete structures at the canal would be a most inspiring monument to American art.

Given the plastic material and the construction organization at hand, imagine what it would mean to the culture of the world to give free reign to the hand and brain of the group of artist-engineers, the architects of the country, who have added so much to the country's wealth of art. An entrance way, an arched lagoon in permanent concrete, which would match the wonderful scenic effects of any of our world's fairs, is a practical possibility. And even in these structures, art could still serve utility, and with intelligent, comprehensive design and sympathetic interpretation, this great engineering structure could be shaped to most beautiful ends.

Such architectural structures would be America's gift to the world at the gateway of continents, and the material would be concrete.

* * *

Fire Test on Partition Construction

This issue records a test held to determine the comparative fire-resisting qualities of different types of partition construction. Metal lath, wood lath and plaster board were the three materials tried out, and the greater value of metal lath was demonstrated at every point. It is significant, in viewing broadly the circumstance of this test, to note that one branch of reinforced concrete development has reached the point where such a test can be held, attended by engineers of national reputation.

For plaster or stucco, with metal lath, steel and cement mortar, is a material very closely related to reinforced concrete, and its development has been closely co-ordinated with the growing use of concrete and steel. Such partitions are, as it were, a "parlor edition" of a reinforced, concrete wall, and the industry as a whole is to be congratulated on the successful outcome of these tests.

* * *

Porous Concrete Walls With Waterproof Coating

Peter Ellis, writing to *Progress*, the leading industrial magazine of New Zealand, presents an interesting theory on the subject of porous walls with exterior coating of impervious mortar. He first states that dampness generally comes from moisture rising from foundations by capillary attraction, the walls being absorptive. He continues as follows:

A common remedy to prevent moisture rising, is a damp-course laid just above the ground line, but it is evident that if the material of the walls will resist moisture either by being too dense or too porous to absorb it, the result will be much superior.

Capillary attraction can only act between the two extremes of density and porosity, therefore to secure dry walls without the expediency of damp-courses and the like, we have only to make them either sufficiently porous or sufficiently dense. At the first "blush" it seems entirely wrong to make walls full of holes to keep out wet, but in seeking a desired result we may often find it by pursuing a contrary course to our preconceived ideas. I well remember being taught by a practical man to keep the edges of the boards of a boarded roof 3/16 of an inch apart in order to keep out rain. As a novice I would have placed them close together.

I am at present building a ferro-concrete house with porous walls, no damp-course is at all necessary for the reasons mentioned, an impervious coating of rough-coat in the outside keeps out rain-drift, and the result is that I shall have perfectly dry walls, the body of the concrete being too porous either to absorb or retain moisture.

Another noteworthy point is, that a wall which is "absorptive" attracts damp from a humid atmosphere and holds it quite a long time, thereby causing a continual general dampness.

Mortar in brick walls may be "absorptive," while the bricks may be quite dense.

For the foregoing reasons I am of opinion that a porous non-absorptive ferro-concrete construction with an impervious skin of rough-cast or other waterproof coating on the outside walls, is a thoroughly good system, substantial, and comparatively cheap, and is likely to become very popular now that wood is getting scarce and dear.

At first thought Mr. Ellis would seem to be advocating an inferior and dangerous type of construction, but there is a practical side to his proposition that will appeal to many, provided his theory as to porous walls preventing dampness is correct. For example, a house could be constructed with piers to carry all weight with porous walls between them. The necessity for careful placing and tamping of concrete required in the case of a dense, weight-carrying wall would be eliminated and the wall could be erected by labor less skilled than in the case of dense, bearing walls.

Fireproof Construction and Death Proof Design

In the present day emphasis placed on fireproof construction, there is not, we believe, enough attention paid to *deathproof design*. A building may be fireproof, well and good; but if that building contains inflammable material and human workers, then, unless sufficient means of egress are provided, a fireproof building becomes a roasting oven, filled with fuel; and the poor workers can either roast or jump from the windows.

Fireproof construction is today an engineering and architectural achievement. Deathproof design is still a goal to be sought. In building reinforced concrete structures, apparently fireproof in themselves, the architect and engineer must remember that in this building people and combustible materials will in all probability be housed together; and in the design of that building ample provision must be made to empty the building of its human contents within the shortest possible time.

Fire escapes, fire towers, enclosed stairways and all means for bringing the occupants of an upper floor to the ground level have been developed and used to a high degree, and in most every case where tested under actual conditions such means have, to a greater or less degree, proved a failure. The ideal condition is one that would require no means of vertical communication, as in a one-story building, where the only requirement for safety from fire would be plenty of exits into the open air. To reproduce such an ideal condition in a many-storied building, that is, to provide sufficient exits horizontally, it has been suggested that a vertical interior dividing fire-wall should have a wider, if not compulsory use, in all construction where fire protection is necessary.

A fire-wall, continuous from basement floor to the roof, with several automatic fire doors at every floor, would practically make two buildings, absolutely protected, one from the other, as far as fire is concerned, but each offering the other every means of escape in case of fire. Elevators and stairways should, of course, be provided in each section.

Such "duplex" building construction would not only mean a greater safety from fire, as far as the occupants of the building are concerned, but would also offer the readiest and most convenient method of fighting a fire.

This method of construction was strongly and ably urged by H. F. J. Porter, consulting engineer, New York City, in an article in the *Survey* some time ago. We feel that more consideration could be given to this method by engineers and architects who are working to design and build fireproof and deathproof buildings.

A New Artificial Stone

The number of artificial stone varieties has recently been increased by the addition of one composed of cement and manganese dioxide (MnO_2). The combination of these two materials is not new; they make a stone which is very strong, compact and free from pores, but as it is hard to work and especially to bore it has not come into favor. It has also another bad quality in that it is a good conductor of electricity. For this reason it can not be used for electric switchboards, which as a rule are made of marble owing to the fact that slate is liable to contain metallic compounds. Slate which does not is very rare and dear.

Recently a mixture of cement and manganese oxide, a solution of glue in glycerine, and asbestos, has been brought out. This is said to more than equal in compactness and strength the usual cement and manganese mass, and to be more readily worked, as it does not split. What is more important, it is said to be a non-conductor of electricity, even of high tension.

The proportions given are as follows (by weight): Fine manganese oxide, 7 parts; fine cement, 100 parts, mixed well; then there is added a solution of 8 to 10 parts of glue in 40 to 50 of hot water, and after this is cool, 80 to 100 of glycerine are added. To distribute the asbestos well in this mass, one part thereof is mixed up with a little water and well stirred into the previous mixture. The mass is then poured into flat molds and given 24 hours to set. The casts are next removed and subjected to great pressure. Finally they are well impregnated with linseed oil, to make them resistant to water.

Removing Forms

As a guide to practice, the following rules are suggested:

Walls in Mass Work: One to three days or until the concrete will bear pressure of the thumb without identation.

Thin Walls: In summer, two days; in cold weather, five days.

Column Forms: In summer, two days; cold weather, four days, provided girders are shored to prevent appreciable weight reaching columns.

Slabs up to 7-ft. Span: In summer, six days; in cold weather, two weeks.

Beams and Girder Sides: In summer, six days; in cold weather, two weeks.

Beam and Girder Bottoms and Long Span Slabs In summer, ten days or two weeks; in cold weather, three weeks to one month. Time to vary with the conditions.

Conduits: Two or three days, provided there is not a heavy fill upon them.

Arches: If not small size, one week: large arches with heavy dead load, one month.

All these times are of course simply approximate, the exact time varying with the temperature and moisture of the air and the character of the construction. Even in summer, during a damp, cloudy period, wall forms sometimes cannot be removed inside of five days, with other members in the same proportion. Occasionally, too, batches of concrete will set abnormally slow, either because of slow setting cement or impurities in the sand, and the foreman and inspector must watch very carefully to see that the forms are not removed too soon. Trial with a pick may help to determine the right time.

In removing forms, one large builder—C. A. P. Turner—requires that a 20-penny spike driven into the concrete must double up before it has penetrated one inch.—*Building Age.*

INFORMATION DEPARTMENT

> **Inquiries regarding sand and all other materials are cheerfully answered, like all other questions, but in cases of importance it is best to invest in a laboratory analysis. Write to us for particulars, address, Laboratory Department.**

Reinforced Roof

I am erecting a block building 14'x26. The roof is to be of concrete slab construction using ¾-in. twisted rods for reinforcing. What mix of concrete should I use and how should I space the reinforcing? S., Pennsylvania.

If you will consult the last edition of Taylor & Thompson's "Concrete—Plain and Reinforced," page 512, you will find data there which will assist you in your work.

The following is a summary of some of those data as applied to your particular case: Assume a 16,000-pound stress on your steel with a 600-pound stress on concrete and the weight of a 6" slab as 77 pounds per sq. ft. A good live load for a roof is about 40 pounds; but we have gone the limit here and used 80 pounds, as you might want to build a higher building and use the roof as a floor. Your total load then is 157 pounds per sq. ft. The steel is to be placed 1" from the bottom, and according to the date you would need 0.482 sq. in. of steel per lin. ft.

As the area of a ¾" sq. rod is 0.5625 sq. in., to get the required area of steel, your rods would have to be spaced 14" on centers. As bar-spacing should not be greater than the depth of the slab, that is, 7", three-quarter-inch material is poor steel to use. Can't you use ½" or ⅝"? If you can't, then use ¾" steel at 7" c. to c.

* * *

Concrete Tile Floor

I should like some information on laying a concrete floor tile. We have a wooden building with two courses of concrete floor laid on joists 2"x8". This floor is rough and unsightly. Later on we intend to erect a concrete building, but in the meantime—as a temporary arrangement—we want the concrete tile floor. How should the tile be put down? Should the wood floor be torn out? H., New York.

It is not the best practice to lay concrete on top of a timber floor, and it is only a make-shift at the best. As you have, however, a rather heavy timber floor you can lay tile which ought to be satisfactory for a good many years, although in the final analysis it would be only a temporary job. Instead of tearing out the present flooring, it would seem to us better to lay a light mortar coating on top of the present floor. This pre-supposes, of course, that you can take care of the floor level in some other way. If it is necessary to lower the floor to take care of the level, the present flooring will have to be torn out.

In laying a concrete tile floor over wood, make the tile as light as possible, using not more than an inch of mortar and preferably three-quarter inch tile. Put some very light metal fibre of some kind in the mortar, laying it well to prevent cracks. The idea would be, of course, to make as light a concrete surface as possible and keep the dead load at minimum.

* * *

Stucco Application

Please give me some information as to methods and tools used in the application of stucco? P., Minnesota.

The subject is covered quite fully in the book "How to Use Concrete." Ordinarily rough-cast stucco is applied with a paddle. It is thrown against the wall with a quick motion of the paddle, the paddle being stopped in its movement toward the wall just before it reaches the surface which is to be covered. In this way stucco may be put on in almost any degree of roughness, depending upon the ability of the worker to control the movement of the paddle.

Sometimes splatter-dash coats of stucco are applied with small bundles of willow whips or coarse brooms and thrown in much the same way. In this work, however, no large pebbles or crushed stone can be used in the mixture, as in rough-cast work. Occasionally contractors who want to produce the effect of a rough surface without using large stones or throwing the mixture, employ a float which is covered with a Brussels carpet or similar material, which is pressed against the stucco surface and then pulled away, so as to cause a suction which pulls out the stucco from the wall.

In pebble dash, the pebbles are cast onto the wall while the mortar is still fresh and they are thus partially embedded.

All these things are better learned by seeing them done than by any amount of written explanation. Of course, we have said nothing at all about the first coat of stucco, which is made of good strong Portland cement mortar, well pressed on the stucco, and its application depends upon the kind of surface to which it is made to adhere. Conditions vary between masonry walls and walls which are covered with a metal fabric of some kind.

* * *

Concrete Surface Dusty

I laid a concrete pavement the surface of which is dusting and wearing badly. I used a very fine sand but I used a mixture of 2:3 cement and sand. A few days after the completion of the work the owner started in to wet the pavement with a stream of water from a hose. He did this every morning. The sun doesn't get at the pavement until about 3 o'clock in the afternoon. I believe the wetting under these circumstances made the trouble. Is there any coating I can use on this walk to prevent further dusting? M., Pennsylvania.

We wish we could conscientiously give you the kind of assurance you want about the concrete pavement. It is entirely possible that the repeated wettings which the walk got had something to do with the dusty surface, but it is not likely. A dusty surface on a concrete floor or sidewalk is usually due to the use of a material which is too fine, or to too excessive troweling, which brings the fine particles to the surface. You no doubt know that the value of Portland cement is not in its wearing quality in the sense of resisting abrasion. It is intended merely for a binder to hold the sand, gravel and stones together in a solid mass. You should depend upon the sand, gravel and stones for a hard wearing surface.

It is possible to lay a sidewalk in which the surface will consist of only 10% of cement to 90% of aggregate. This is accomplished by having a well graded mixture and by using a wooden float to smooth the surface and by not using the trowel any more than is absolutely necessary. Troweling has a tendency to float the cement to the surface with the water, which always comes to the top, under the trowel. If we knew more of the walk which you built and which you say is dusting badly, we might, of course, be of another opinion. It is very hard to form an opinion on work of this kind at long range.

There are a great many floor coatings on the market and we refer you to the advertising pages.

* * *

Keene's Cement

I should like to know the composition of Keene's cement. Can you give me the analysis or tell me where to get it? G., Kansas.

Keene's cement is one of the group of hard finish plasters which owe their hardness and slow setting not only to being burned at high temperatures, but to the fact that they have also been treated with alum or other chemicals. Keene's cement is distinguished from the rest of this group not only by its quality, but by its method of manufacture. A very pure gypsum is calcined at a red heat and the resulting dehydrated lime sulphate is immersed in an alum solution, and after drying is reburned at a high temperature. After this second calcination the product is again ground and is ready for the market. The point must be emphasized that only the very purest gypsum should be used.

Small vertical kilns are used, charged with alternating layers of fuel and lump gypsum. Some experiments have been made in using rotary kilns, but they have proven unsuccessful. The calcined product from a rotary kiln is of such shape that it cannot be treated satisfactorily in the alum solution. A 10% alum solution is used.

The product is a fine white powder, slow setting upon the addition of water. When working this, even after hardening has commenced, the material can be reworked with water and will still take a satisfactory set.

In regard to the analysis of Keene's cement, consult the report of the Watertown Arsenal, 1897, which gives the following:

Silica (SiO_2)	trace
Alumina (Al_2O_3)	trace
Iron Oxide (Fe_2O_3)	
Lime (CaO)	42.04
Magnesia (MgO)	trace
Sulphur trioxide (SO_3)	56.54
Carbon dioxide (CO_2)	1.37

We recommend that you study Eckel's "Cements, Limes and Plasters," from page 76, from which the above is summarized.

* * *

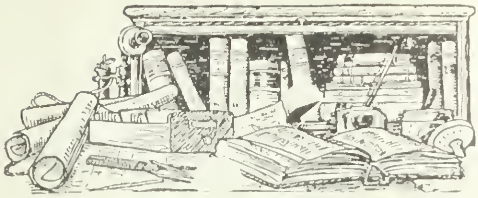
Curing Block

How long should concrete block be left to dry before being used?

How much more cement must be used to make a block made of fine sand as strong as one made with torpedo gravel? M. Michigan.

As to your inquiry as to how long it is necessary for block to dry before it may be used, this depends a great deal, of course, on the weather conditions, as you no doubt know it isn't the drying which crystallizes the cement and hardens the block, but rather the wetting. It is very important that concrete block are not allowed to dry out too quickly, otherwise the cement doesn't attain anywhere near its full strength. If you use the natural curing method, that is, without any steam treatment whatever, you should be careful to pile your block where they will be protected from the sudden changes of the weather, and from wind and sun for at least a week, and keep them sprinkled regularly during this period, so that they will have no opportunity to become dry. The moisture is absolutely necessary for the proper crystalization of the cement, and as most block are not made by the very wet process, for the reason that they will not stand up when removed from the molds, it is essential that all the moisture that the block does contain when made should be prevented from escaping by the liberal application of water on the outside. Ordinarily specifications require that block cured in this way must be stored in the yard for 28 days after being made before being used in construction work. In this connection we are sure you will be interested in the article which Concrete-Cement Age published on the advantages of steam curing in the August issue.

As to the quantity of cement it is necessary to use in making block with sand of various sizes, it is impossible to give an answer which will govern the matter. Everything depends upon the way the sand is graded. A sand which is uniformly fine, like much of our beach sand and river sand in this state, does not make good concrete block. It is important that the grains of sand be clean and graded from fine to coarse. The amount of cement doesn't so much depend upon the size of the grains as upon the voids left between the grains. If a strong and impervious block is to be made, it is necessary that the voids be filled with cement. Therefore, it is economy to investigate your sand very carefully and see if it is well graded, because a well-graded sand makes it possible to use much less cement.



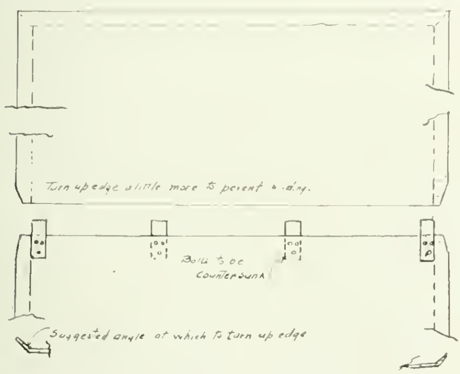
CONSULTATION

254. Steel Mixing Board

"We have been considering the value of steel mixing boards for hand-mixing of concrete, and have wondered if there were any data available as to the best size, etc."

DISCUSSION BY J. D. CAREY*

In regard to a steel board, a board 6'x10' is too small. Even in a one-bag mix you want to be dumping and spreading the dry material on one end while you are shoveling the wet mix off the other. For that



SKETCH SHOWING SUGGESTED ARRANGEMENT OF A DOUBLE STEEL MIXING BOARD

reason I would suggest two boards, 7'x10', with turned edges or with a beveled strip bolted to the upper side and the two joining edges arranged as in sketch which I am enclosing.

In that way you can work any number of men and turn out at least 40 cu. yds. a day with 10 or 12 men. Should you wish a board for very small jobs you need only use one sheet.

* * *

255. Action of Ammonia on Concrete

"In connection with a gas plant we have under consideration some vats for storing ammonia will be necessary. Is concrete liable to disintegrate when so used?"

DISCUSSION (EDITORIAL)

At Ann Arbor, Mich., in 1909 two storage vats for ammonia were built by the Ann Arbor Gas Co. The tanks were built below grade, and both quicksand and water had to be taken care of. The larger tank, with a capacity of 27,850 gals., was 40' long by 10' 1½" wide by 13' 2" deep. The smaller one, which was used for concentrated liquor, had a capacity of 18,000 gals. and was 30'x8' 1½", and of the same depth as the other thank, with which it had a common wall. In building the tanks a pit was dug all around and below the excavation and drain pipes laid below the site of the tanks. After the bottom was in, the sides and top were run without a break in the work.

The work was heavily reinforced, great care being taken to extend rods from the bottom up into the sides. The inside surface of the tanks was whitewashed and plastered with cement mortar. The total cost was $1,688.00 or about $.037 per gal.

At last report these tanks are satisfactory, which is indication that ammonia can have no very actively destructive effect on concrete.

* * *

256. Does Aging Make Cement Finer

"I note the following paragraph in a current technical journal:

> *'When cement is allowed to stand, either in a sealed jar or exposed to the air, the coarser particles become progressively finer. It is considered probable that the seasoning of unsound cement consists in the disintegration of the coarser portion (in which free lime may be present encased in glassy particles), caused or accelerated by heat and moisture, and that the moisture need not be in sufficient quantities to hydrate the free lime, but merely to render the coarser particles sufficiently fine to permit hydration before the cement has set.'*

"What further information is available on this?"

DISCUSSION BY C. W. BOYNTON*

Relative to cement becoming finer with age, I wish to state that this is a fact, but I do not consider this the best argument for aging cement. I am inclined to believe if there is any great change in the fineness it is pretty good evidence that the cement required aging to make it sound; in other words, the particles which might cause the cement to be unsound would break down by aging, thus affecting the fineness.

DISCUSSION BY E. W. LAZELL†

In reference to the effect of aging upon cement, it is a well-known fact that if cement clinker is stored in the open where it can be subjected to the action of weather, that the larger particles disintegrate or break down. This action is not, however, as extensive as is generally supposed. In fact, only a very small percentage of the particles disintegrate, provided the clinker was properly proportioned and properly burned.

It is doubtful what the action of aging is upon ground Portland cement. It is well known, however, that cement which is unsound when first manufactured may become sound upon sufficient aging, and it is generally stated that this is caused by the hydration of the free lime.

I am very doubtful if any material increase in fineness would be brought about by aging finished cement. I do know, however, that there is some absorption of water, and that if the absorption is too great the cement will not develop as much strength as before the absorption took place.

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*The J. D. Carey Co., Cleveland.

*Inspecting Engr., Universal Portland Cement Co., Chicago.
†Edwards and Lazell, Consulting Engineers, Portland, Ore.

Discussion by Albert B. Pacini*

As to the aging of cement being due to coarse particles disintegrating and becoming finer, I would say that, although I have not any facts at first hand concerning this phenomenon, I am convinced that this is at least a partial explanation. I have had a conversation with a chemist who has experimented upon this point and am satisfied that many cases of unsoundness are in a great measure attributable to coarse particles. By this I mean that although a cement may pass fineness specifications, the proportion of fine to coarse material in the portion passing the 200-mesh sieve may be such that an unsound cement may result. This shows the need of a more scientific fineness test, in which the material passing the 200-sieve may be graded and its correct proportioning be determined.

Albert B. Pacini, Sc. D.

* * *

257. Curing Tile and Some Recent Percolation Tests

"Kindly advise us what, in your opinion, would be the result of heavily sprinkling with cold water cement tile while they are in the steam-curing department, the temperature of which is about 80° to 90°. Anything else that you may have in the way of steam curing would be appreciated.

"It might be of interest for you to know that we have divided our entire floor space into compartments, which are covered and walled with oiled canvas, having curtains for doors. These make very successful steam curing kilns, and are economical as well as good condensers of steam.

"If you have any information on the subject of permeability or percolation in concrete tile, we shall appreciate same very much."

Discussion by C. M. Powell†

The inquiry is probably best answered by the following quotation taken from an address by the writer before the National Association of Cement Users in 1911 on "Steam Curing." This paper, in full, may be found in the 1911 proceedings of the association.

Because of an insufficient amount of water in the ordinary mixture used for making cement tile, every particle of moisture must be conserved. It is impossible to do this if the tile are cured under normal atmospheric conditions. The object, therefore, in steam curing is to create an atmosphere saturated by moisture, in a chamber sufficiently air-tight to eliminate all possible drafts. It is not the intention to supply moisture to the tile but to protect it perfecly against the loss of any moisture which was introduced when mixing the concrete.

As a saturated atmosphere is required, the use of dry steam or steam under pressure, is out of the question. Some plants are operated today by the use of such a steam and in parts of the curing chamber fairly good results are obtained because the steam is condensed in these parts, but the product placed near the point at which the steam enters the curing chamber is poor, owing to the drying condition of the steam. This condition is naturally increased in warm weather because the steam does not condense so rapidly. Only by means of saturated steam is it possible to obtain uniform conditions throughout the year.

The safest and most satisfactory way of admitting steam into a curing chamber is by a perforated pipe which is placed, perforations down, in a water filled trench in the concrete floor of the room; the steam passing through the water naturally becomes saturated. The floor of the curing chamber is sloped towards the trench so that the water in the trough is replenished by condensation. In this way there is little danger of excess heat, for as long as the steam passes through water, the temperature, no matter what its amount, will not have a drying effect. The nearer the temperature approaches the maximum possible with this method, the more efficient does the curing chamber become, for moist heat accelerates the hardening of the tile. With this scheme the exhaust steam will not furnish sufficient heat during cold weather, therefore it is best to take live steam directly from the boiler. The tile should be run into the curing chambers as soon as made, but it is not advisable to start the steam until the tile have stood about an hour, especially in cold weather, because condensation will be very great until the chamber and the tile become heated up, and the gathering moisture on the tile may be sufficient to damage them.

It can be readily seen from the above that a properly operated steam curing chamber does not need any addition of moisture in the form of sprinkling with cold water. Such practice would tend to lower very materially the temperature of the steam chamber and hence retard the hardening of the concrete. There was a time when it was common practice to sprinkle concrete products in the steam curing chamber, but it has long since been generally discontinued. We believe that a system of small compartments as described is an economical arrangement.

Percolation—Regarding the density or the permeability of concrete pipe, we can refer you to the enclosed copy of letter and also to the results of some tests which were made on concrete pipe by the Kansas City Testing Laboratory which we give below:

Hydrostatic Tests

(Hydraulic pressure applied internally.)

Date of these tests: March 23rd, 1912.

Laboratory number: R-1 1 5.

Dimensions of pipes:

	Pipe No. 1	Pipe No. 2
Internal diameter	12"	8"
Thickness of pipe	1⅜"	1⅛"
Age of pipe	33. days	96. days

Mixture (Composition) 1 part cement to 2½ Kaw River Sand. Results of Hydrostatic tests:

	Pipe No. 1 (12")	Pipe No. 2 (8.")
10 lbs. pressure, percolation	None	None
20 lbs. pressure, percolation	None	None
30 lbs. pressure, percolation	None	None
40 lbs. pressure, percolation	None	None
60 lbs. pressure, percolation	None	Fractured
75 lbs. pressure, percolation	Fractured	

Required by City Specifications:

No percolation up to 10 lbs. per sq. in. pressure—and no fracture up to 33 lbs. pressure per sq. in.—internal pressure.

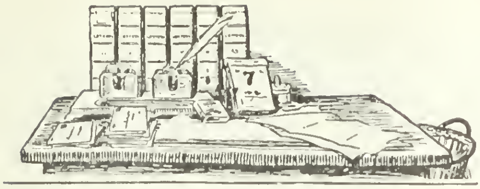
Examination of the broken pipe after the tests:

Both pipes broke or split longitudinally, from end to end at the two opposite sides.

Breaking open various parts of the walls of the pipes, *no percolation* had taken place, and at most, in a few places, showed wetting from the inside part of the barrel for a distance of an inch.

In other words, he pipes withstood percolation up to the bursting point, and the bursting point in both cases was more than twice that required by the specifications by the City of Kansas City, Missouri.

*Chemist, Bd. of Water Supply, New York City.
†Chicago, Ill.



CORRESPONDENCE

Shipping Cement in Bulk

[In regard to the comparative value of cloth or paper sacks as cement containers, the reader is referred to the rather complete discussion, pro and con, on this in the June issue of *Cement Age*.—THE EDITORS.]

In regard to shipping cement in bulk for use in construction work, I am of the opinion that it would not be good practice inasmuch as the laborers that we have on buildings are not usually of an educated or intelligent class, and as we have to rely to a greater or less extent on the man on the mixer platform, it is better to eliminate as far as possible all chances of mistakes being made in the amount of cement used. Then again it is expecting too much of the mixer man to ask him to judge as closely with a shovel the proper amount of cement used. The man would be a good one indeed if it were possible for him to stand on the platform all day long and shovel cement from a pile, which might be either loose or packed, and not vary any more than two or three pounds to the cubic foot, which, I believe, is the extreme variation in sacked cement.

Cement in paper is about the most economical in the long run, although the sacks tear easily in the handling. Still there is very little, if any, loss through caking and none at all in cement being left in the sack, as is the case where jute is used. Cement sacked in jute will absorb moisture and cake, and when you consider the cement left in sacks and the loss of sacks through being stolen and being torn, it is clearly evident that paper is the best all around.

H. M. FARRAND.

Cleveland, O.

* * *

Waterproof Compounds in Arabia

[In the July issue, page 41, mention was made of the need of better waterproofing methods for the flat-roofed houses in Maskat, Arabia. The letter below goes into the matter more broadly.—EDITORS.]

The number of replies, or rather responses, to my report regarding waterproofing compounds has been somewhat embarrassing, for Maskat is a very small and by no means busy place, and the total value of waterproofing paints or compounds which could possibly be sold here would amount to a very few dollars indeed, while this consulate has received dozens of letters and numbers of samples from various American manufacturers. The value of my report, if it had any, was that it presented a general condition which prevails all over this part of the world and not alone in this very small and backward country.

In view of the fact that American makers of concrete products are so very wide awake and ready to take advantage of foreign opportunities, would it not be a good idea to ask the Department of Commerce and Labor for a general report from all consular officers on the use and sale of such articles in their respective districts?

HOMER BRETT,
American Consul.

Maskat, Oman, Arabia.

* * *

Formulas for Oxy-Chloride Cement

[In the June issue of *Cement Age*, reference was made to certain conditions in the commercial development of artificial marbles, which have not been conducive to extended or permanent success. We will be glad to hear further from CONCRETE-CEMENT AGE readers giving personal experience and opinion of the situation.—THE EDITORS.]

I have been interested in the communication from A. G. Higgins, Kansas City, in CEMENT AGE for June, criticising the sales of artificial marble formulas. Having personally demonstrated artificial marble exhibits at the New York and Chicago Cement Shows, my experience, I believe, places me in a position to state my opinion in regard to fake sales of marble formulas. Having read almost everything that has been published on natural and artificial marbles, I have concluded that there are no artificial marble formulas sold but what are impractical for commercial use. The exception would be a material made from Keene's cement, generally known as scagliola. Its manufacture is classed as an art and more or less in control of Italian labor.

The "fake formulas" describe artificial marble as made from magnesia cements. Samples and demonstrations of small pieces attract the prospective buyer, who usually parts with from $50 to $500 for the "exclusive rights" to manufacture, when the formulas can be had for nothing at the public library, in Patent Office records on expired patents. Even at that, none of them will make a slab, say 2'x2', but what it is bound to warp. Facing brick, marble pedestals, clocks, statuary, etc., are some of the novelties which are manufactured, and the promoter of these wonderful fomulas usually "puts it over," and that is as far as it goes. This accounts for the black eye that is given to the legitimate manufacturers of artificial marble, which is an exceedingly difficult thing to contend with. Even scagliola is in bad repute among the architects of this country, and to see some of it in prominent buildings in the East would almost justify their feeling against its use. When the work is properly done it surpasses genuine marble in beauty and costs considerably less in price.

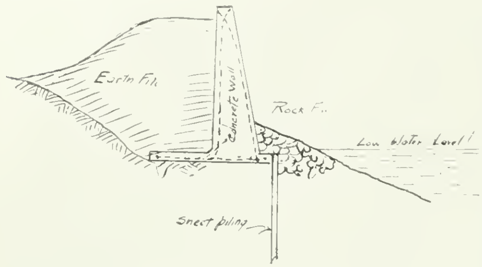
Another well-known artificial marble is also made from Keene cement, but under a new process by machine, and its finish is as hard as porcelain, smooth as glass and translucent, giving to it the same crystalline appearance as the quarried marble without any of its defects. However, when this product is shown to the building trades it is immediately classed with the magnesite product, and until such prejudice is overcome it will be difficult for any manufacturer to do a profitable business in the manufacture of an artificial marble, regardless of its merit, good qualities and cheapness in price.

J. E. PALLWORTH,

Cleveland.

Mississippi River Protections

Permit me to submit another idea for the protection of the Mississippi river levees. It is admitted that burrowing animals and the action of the current are the destructive influences to be guarded against. A reinforced concrete retaining wall on the side of the levee facing the river would be protection against both. The construction of the foundation will depend on local conditions, but should in any case include protection on the river side, either by concrete sheet pil-



SUGGESTED MISSISSIPPI RIVER PROTECTION

ing driven to a sufficient depth, or rockfill, or a concrete apron extending along the toe of the wall. I grant the first cost of such an undertaking would be enormous, but hardly prohibitive if we take into consideration the frequent failures of earth levees and then ensuing practically incalculable loss. We must also consider that the steady increase of the cultivated area in the Mississippi Valley means a proportionately greater loss every year.

CHAS. STUBNER.

Culebra, C. Z.

* * *

Concrete Cover on Tile Floors

Referring to an article in your issue of July, 1912, on the proposed building codes* for New York City and Pittsburg, the writer would very much appreciate it if you could give more definite information in regard to the construction of certain wide span slabs in a large building in Pittsburg, in which a 1-in. layer of cement mortar overlaid by a 6-in. layer of soft tile was used. I would like to know how soft these tiles were and what ultimate compressive strength they have; also, the span of slabs and the live loads they were figured for, together with the amount of reinforcement used. The writer of the article refers to certain tests made on similar slabs, and states that the construction used in this large building in Pittsburg was based on tests of slabs that included, in addition to the 1-in. layer of cement mortar overlaid with 6-in. soft tile, two or three inches of cement mortar above the slab. Does this mean that the two or three inches of cement mortar on top of the soft tile was omitted in the building referred to, and is it possible for the writer to find out the results of the tests which Mr. Godfrey states were made? I would like very much to have Mr. Godfrey give definite information together with his criticisms.

A PITTSBURG ENGINEER.

[This letter was referred to Mr. Godfrey, whose answer is given below.—THE EDITORS.]

I have before me a letter which asks for details regarding the tile and cement floor to which I referred in discussing the Pittsburg and New York building codes. I prefer to discuss engineering principles, where practical, without mentioning actual cases by name or any more definitely than to establish the fact that they exist. However, if details are wanted, here they are:

In November, 1906 (at least, this is the date of the note in my book), I watched the laying of floors in the Berger building, this city. A steel mesh of some kind (expanded metal, I believe), was laid on the forms with 3/8 in. round rods 4″ apart. This was bedded in cement mortar about 1″ deep. On this was laid hollow tile which I would class as soft. The tiles were 5½″ in extreme depth and ¾″ thick in the solid part. The span was about 16′. This was allowed to set.

The foregoing constituted the support of the floor. The wood sleepers were laid on this. Doubtless the spaces between them were filled in with cinder concrete.

I went to see the building inspector and asked him if he thought that floor was good. He told me that "their" literature showed tests of the floor and it was very strong. I went back to the office and looked up the literature.

One catalogue, called "Four Steps," contains a letter, from which I quote:

> Flooring was constructed of 8-in. hollow tile blocks, 12″ wide and 16″ long, laid flat in Portland cement, 4 to 1, with joints from ¾″ to 1″ wide; the under side of same being bedded in 1¼″ of Portland cement, in which was inserted a metal fabric of No. 7 steel wire strands, 5″ o. c., No. 14 steel wire mesh web, and 3/8-in. iron rods space 3″ o. c. * * Three inches of Portland cement concrete was placed on top of the 8-in. floor.

It is to be noted that this slab was supported on four walls in a 16-ft. square and not on two walls.

In another catalogue, called "One Hundred and Twenty-two Acres of Fireproof Floors and Roofs," I found comparative deflection tests. The floor consists of 1¼ in. of reinforced cement mortar, 8-in. tiles, 2 in. of stone concrete and ½ in. of 1:2 cement finish.

On the last page of the same catalogue a test is shown where the slab consists of 1½″ of reinforced cement mortar, 10-in. tiles and 2″ of stone concrete.

I believe this answers the above questions except the exact hardness of the tile. I did not test any of them. They were easily broken with a hammer.

As to criticisms I have none to offer. A mere recitation of the facts is criticism enough. One question might be asked: What takes the large compressive stress at the top of a lot of tiles laid like a brick pavement and with the joints "smeared" with mortar?

EDWARD GODFREY.

*"Proposed building codes for New York and Pittsburg," by Edward Godfrey, page 45.

BRIQUETTES

Monthly Comparative Table

IMPORTS AND EXPORTS OF PORTLAND, ROMAN AND HYDRAULIC CEMENTS

Imports of Cement

	Month of June 1911		Month of June 1912	
Country	Barrels	Value	Barrels	Value
United Kingdom	84	$ 140	..	....
Belgium	.	.	.	...
Germany	33,193	53,255	$ 11,639	$ 20,099
Canada	....		...	...
Other Countries	2,306	3,184	2,375	3,568
	35,583	56,579	14,014	23,667
Less Foreign Cement Exported	....	..	419	800
	35,583	56,579	13,595	22,867

Decrease in imports during the month of June, 1912, as compared with June, 1911.. .. .. 21,988 barrels

	12 Months Ending June, 1911		12 Months Ending June, 1912	
Country	Barrels	Value	Barrels	Value
United Kingdom	21,918	$ 24,987	25,123	$ 30,732
Belgium	77,501	96,515	5,147	5,935
Germany	112,279	171,356	70,338	113,229
Canada	1,359	2,865	122	261
Other Countries	20,187	29,226	12,265	18,645
	233,244	$324,949	112,995	$168.802
Less Foreign Cement Exported	19,386	26,316	5,548	10,794
	213,858	$298,633	107,447	$158.008

Decrease in imports during 12 months ending June, 1912, over 12 months ending June, 1911........106,411 barrels

Imports of Portland Cement into the U. S. During June, 1912, by Districts

District	Barrels	Value
New York	2,381	$ 3,551
Porto Rico	143	253
Key West	11,234	19,421
Chicago	128	221
Louisville	128	221
	14.014	$23,667

Exports of Cement

Exports of cement, month of June, 1911, 240,965 barrels, value	$ 383,896
Exports of cement, month of June, 1912, 369,183 barrels, value	523,163
Increase in exports, month of June, 1912, over month of June 1911, 128,218 barrels, value....	139,267
Exports of cement, 12 months ending June, 1911, 2,971,274 barrels, value	4,349,290
Eports of cement, 12 months ending June, 1912, 3,423,742 barrels, value	5,083,026
Increase in exports, 12 months ending June, 1912, over 12 months ending June, 1911, 452,468 barrels, value	733,736

A Pressure Boiling Test for Soundness of Cement

A prime necessity in erecting permanent concrete structures is that the cement should be *sound*. When it enters into combination with water as it is being mixed, a stable compound should be formed, and all active chemical changes should be completely furnished there.

The combination between the finely ground cement particles and the water will be just as complete as the cement is ground sufficiently fine to enter into combination. If concrete is placed in a wall, with its constituent cement containing grains with a central core that has not been hydrated, trouble may be anticipated in the future hydration of that core, with its consequent expansion, etc. Hydration must be complete. It is almost as though the cement should go into solution to produce the proper circumstance for an absolute set.

Heretofore free lime has been considered the cause of some of the incidental trouble in concrete structures, and boiling the pat as an accelerated test was considered sufficient to disclose the presence of this undesirable element.

In some of the work of the Eastern railroads, however, during the last few years some trouble has been experienced with concrete made from cements which had passed successfully the boiling test, and H. J. Force, in charge of tests of the Delaware, Lackawanna and Western railroad, at Scranton, Pa., developed what might be called a "third degree" boiling test. This consists of boiling the test specimen under pressure in an autoclave, a strong metal vessel, steam tight when closed. From the use of this equipment this method is known as the "autoclave" test. To quote Mr. Force in a recent issue of the *Engineering News*,* the test is as follows:

> Neat briquettes are made up in the regular way and after being in the moist closet for 24 hours are placed in an autoclave and well covered with water. Steam pressure is raised to 285 lbs. per sq. in., about 20 atmospheres, the time necessary to raise the pressure to this amount being about 3/4 of an hour. The pressure is then maintained for 1 1/4 hours longer, or a total time of 2 hours. The autoclave is then blown off and the briquettes removed (where their condition permits) and as soon as cool are broken in the standard cement-testing machine.

The autoclave test disclosed unlooked for variations in the characteristics of the different cements. Some briquettes would show a marked increase in strength, while others went all to pieces.

In the article referred to the results of many hundred tests extending over a year's time are published in detail, and from a careful comparison of results it is evident that the failure of the cement under the autoclave test, or even in the boiling test, was not due to free lime. The theory is advanced, on the other hand, that the failure to pass either the atmospheric or high pressure boiling test is probably due to coarse granules in the cement which are not hydrated as the briquette is made.

The autoclave test, it is believed, should show whether or not the cement contains an excess of coarse

*Engineering News, June 13, 1912.

granules which do not break up or become hydrated before the time of setting. It is also evident that a cement could pass the boiling test and still contain coarse granules that would threaten the permanence of the structure. In light of this, it is hardly fair to use on the same basis two cements, one of which would disintegrate under the pressure test and the other show a decided increase.

This pressure test seems to promise a most exacting and rigid test for soundness in cement and one easily applied.

Concrete Highways in New York State

(Continued from page 32)

from the bucket and the shoveling required is reduced to a minimum.

Two of the follow-up men handle the template, the scraping part of which is of sheet steel, cut to the crown of the road and adjustable on its wooden frame so that it may be raised or lowered depending upon the depth of the concrete and upon the height of the side rails. These rails are of 4-in. timber, firm and solid in their position and form an excellent track on which the wheels of the template move. This template is shown in Figs. 1 and 4.

The other two follow-up men help either directly behind the mixer in placing the concrete, or, working with long-handled shovels, follow behind the template, patting the concrete to an even surface. This is the only surface finish the concrete gets, no troweling or floating being done.

Foreman Caldwell, on the job, says that 20 men are exactly the number needed to get the gravel and cement to the mixer at the right time and in the right quantity and to dispose of the concrete properly as it leaves the mixer. The twenty-first man, generally employed, is a "filler-in." The foreman says this "filler-in" is needed. He picks up the shovel which one man drops for a moment, or wheels the barrow which another one of the gang leaves; he handles cement or does odd jobs. Such a gang frequently lays as much as 600′ of pavement 16′ wide in a day.

Men working on the sub-grade keep a considerable distance ahead of the mixer gang. Over most of the route the sub-grade has not required a great deal of cut or fill, but on the other hand in a few places some rather heavy cuts and fills have been necessary. One Pitts 10-ton roller, 1 Pitts 8-ton roller and 1 Pitts traction engine are used. A part of the hauling is done by the engine.

A provision of the New York State specifications is for retaining walls wherever the road comes close up to an embankment so as to endanger the gravel shoulders and drainage ditches.

An idea of Contractor Gipp and Engineer Rice, which is being used on this work in place of retaining walls at several points, is illustrated in Fig. 6. This is only a rough sketch to show the treatment of the shoulders and gutter and does not pretend to be an accurate section of the road. At the right in the sketch is shown the treatment of shoulders and ditches under normal conditions. At the left is shown the treatment where there is a slight embankment which might wash down on the road and into the ditch. Ordinarily a concrete retaining wall would be built to take care of just such a situation. Instead, Contractor Gipp has suggested and Engineer Rice has endorsed the plan of running the concrete clear over to the side, forming shoulder and ditch and cutting back and filling with concrete under the embankment as illustrated. This is done at much less expense than putting in an ordinary ditch and a gravel shoulder and building a retaining wall to protect them.

The outcome of this work with no expansion joints will be watched with considerable interest. Most of the concrete highways being built in New York state, according to the commission's report, have joints every 30′ filled with pitch.

New York state has been spending the proceeds of a $50,000 000 bond issue on highway improvements. Up to the first of this year all of this appropriation has been used excepting a balance of $1,045,000. In a report the first of this year the commission states: "At this time there are approximately 2,940 miles of completed highways and 710 miles under contract of which there will probably be a large percentage completed early in the coming year.

In this report at the first of the year something is said as to the change of policy of the commission. A statement of this change of policy is too important not to quote directly from the report.

> The former Commission, says the report, adopted a form of construction known as "bituminous macadam." It has been fully demonstrated that this class of construction has not given results such as would justify the increased cost. This Commission believes that it is impossible to obtain satisfactory results in highway construction until more attention is given to subsoil drainage, properly designed and constructed foundation, and a wearing course in which there is a more complete physical and chemical union of the units composing it; one which acts as a wearing course only and not constructed so that its main function is to assist an improperly drained and poorly designed foundation.
>
> Having these factors in view it seems wise, wherever possible, to construct a foundation of concrete and to cover this with a thin wearing course composed of bituminous material and screenings or sand which is economical in first cost and easily and cheaply renewed. The foundation of a road, so constructed, is good for all time and the wearing course serves the purpose of carrying all classes of traffic without rubbing, raveling or raising a dust.
>
> While the concrete-bituminous type of highway will probably be most generally adopted, owing to local conditions, the supply of proper material, and the fact that the traffic on some of the outlying highways does not, as yet, warrant the adoption of this class of construction, other classes and types of construction will be used.

The report shows that the state has been spending approximately $1,000 per mile for maintenance of roads.

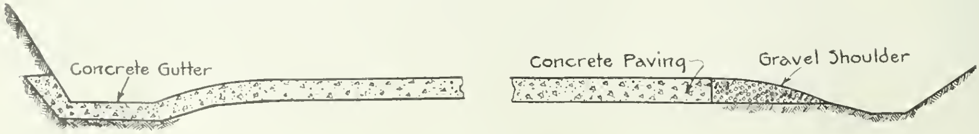


Fig. 6

Concrete Pavements---City, Town, Country

Some Further Information as to Pavements Which Are Described in Tables 1, 2 and 3

Anderson, Indiana

When first asked for a report on concrete paving at Anderson, Ind., City Engineer G. P. Lamphear replied that there were no concrete pavements in Anderson except a few alleys which had been unsatisfactory. CONCRETE-CEMENT-AGE asked for further information and it was pointed out by Mr. Lamphear that the failure of the pavement has been chiefly in the longitudinal joints which have worn into grooves. He says that the transverse joints are still in almost perfect condition. The work included only 480 sq. yds. in 20-ft. alleys laid in 1906. The pavement is laid with a 4-in. dip in the center and its joints are 5′ each way, so that the pavement when finished, appears as 5′ square blocks. These joints were rounded to a 3/8-in. radius at the edges and were filled only with sand. The concrete consists of a mixture of 1:5 cement and gravel which is said to have been clean and of medium size. This was put into a bottom course of 5″ and there is a finished course of 1″. The pavement cost about $1.26 per sq. yd.

Ann Arbor, Michigan

Readers of CONCRETE-CEMENT AGE already are more or less familiar with the bituminous surfaced concrete pavements laid in Ann Arbor, Mich., under the direction of E. W. Groves, who was, until recently, city engineer in Ann Arbor. Mr. Groves' idea in surface treatment of concrete is now being promoted, as "Dolarway" pavement. A description of this pavement will be found in *Concrete,* page 58, May 1911, and further reference to it in the issue of March, 1912, page 36.

In writing to CONCRETE-CEMENT-AGE, Mr. Groves said recently in describing how satisfactory the pavement is, "so satisfactory that property owners have petitioned for an additional 140,000 sq. yds." The pavement is laid in widths of from 24′ to 34′, 6″ thick, in two courses. The first course 4½″, the second 1½″. The engineer describes the gravel used on 64,800 sq. yds. of work in 1911 as "not so clean as it should have been." The transverse joints were placed every 25′ and filled with bitumen and sand. The street has a crown of 6″, both subgrade and finished pavement. On this 1911 work Peerless Portland cement was used at a cost of $1.05 per bbl., and sand at $1.00 per load of 1⅓ yards. The second course of the pavement was roughed with a wire broom to give a mechanical bond for the coating of bitumen and sand. One half gallon of Dolarway bitumen was used for each sq. yd. The feature of the pavement is, that it gives a pleasing wearing surface, with good footing for horses, and is black so that there is less reflection of light than with other concrete pavements. This 1911 work in Ann Arbor cost less than $1.00 per sq. yd. A total of 85,000 sq. yds. of the pavement have been laid in the last three years.

Bellefontaine, Ohio

Bellefontaine, O., is among the first, if it is not the first place to have tried Portland cement concrete paving. Details of the concrete pavement laid in Bellefontaine in 1893 and 1894 were published in the August, 1909, issue of *Concrete Engineering* and are re-printed below:

Concrete Pavements of Fifteen Years Ago

Cement Pavement—Section 1.—The lower strata of the cement pavement or grout must be 4″ thick, composed of 1 part of best Portland cement equal to the Buckeye Portland cement to 4 parts of clean sharp gravel and sand, in which the proportion of the sand is about ½ that of the gravel. This must be thoroughly mixed by a screw mixer and so much water thoroughly incorporated during the mixing process as will show on the surface of the concrete after it has been well rammed to place, which must be done as expeditiously as possible after the mixing, and the concrete must be made solid and complete at once after being dumped in place.

Sec. 2. After the lower strata has been placed and before it has thoroughly set, then the top, 2″ thick, composed of equal parts of the same, Portland cement first used and coarse sharp sand and gravel sifted to the size of a pea, then wet mixed and rammed the same as the grout, a very thin layer of pure cement must be well rubbed into the concrete surface, first to insure adhesion, then the entire coat must be added before the concrete is set.

Sec. 3. The entire concrete and top must be separated carefully and regularly into blocks 5′ square and the edges neatly finished, and the surface grooved in continuous lines from side to side and end to end and every 4″, the grooves being V shaped, 3/16″ deep and 1″ wide, to be troweled smooth by a specially prepared tool, the entire pavement being carefully built to the grade given by the engineer, must present a true crown, as represented on the cross section prepared for the same.

Sec. 4. A row of blocks on one side to have joints sloping in such manner that they can be raised without disturbing the other blocks.

Sec. 5. Curbs, one part cement to three parts sand, 6″ wide, of same material, to be raised on each side to a level with the sidewalks as per engineer's plan.

Sec. 6. The whole work, when completed, to be covered 2″ deep with wet sand and kept in that condition for one week after completion of the contract.

Sec. 7. The above specified work, when completed, is to be first class in every particular, and is to be guaranteed by the contractor to last a relative time longer than any brick paving, as the contract price exceeds the contract price of the brick or any like material of which there may be a competitive bid.

Sec. 8. All work to be in strict conformity to the plans, specifications and cross section of the improvement, and to be carried out under the general requirement as hereinafter specified.

Billings, Montana

Billings, Mont., laid 2,000 sq. yds. of alley paving of reinforced concrete in the fall of 1911. The pavement is 900′ long and 20′ wide. The concrete is in one course 7½″ thick and the pavement has a straight dip to the centre of 5″. Transverse joints are placed 20′ apart, and the joints are filled with ½-in. wood strips, which are left in place. The concrete is turned at the edges to a ¼″ radius. Red Devil cement was used in the mixture of 1:2:4, with bank run sand and with bank run gravel, the former a little fine. Gravel was used from the 5-in. size down. The pavement was reinforced with ½″ square twisted rods 12″ o. c. because a great deal of the pavement was laid over old trenches, where settlement was to be avoided. The surface was wood floated and then brushed transversely. The city engineer, C. C. Durland, in writing to CONCRETE-CEMENT AGE says that this brushed surface is not slippery, and is less expensive to make than grooving. With cement at $2.10 per barrel and sand and gravel at $1.50 per cu. yd., the pavement cost $2.25 per sq. yd., with additional cost of 4c per lb. for reinforcing steel. The price includes the subgrade preparation and a 6-in. sub-base of gravel. The engineer writes that in spite of the fact that the alley withstands very heavy teaming he would be in favor of making the pavement only 6″ thick, had he to build it again, thereby economizing in the first cost of the pavement.

Boise, Idaho

Concrete pavement in Boise, Idaho, cost from $1.04 to $1.15 per sq. yd., a very low cost considering the high price of cement in the locality. Cement cost $2.75 per bbl., sand $1.00 per cu. yd. and gravel $1.00 per cu. yd. Pavements are built in one course, and brushed with a wood float. It was required that the sad in the mixture have no more than 30% voids. The gravel ranged in size from ¼″ to 2½″. Specifications were prepared by the city engineer, and the contract was let to the lowest bidder in every case. The maintenance cost of the 2,800′ of pavement laid in 1910 has been $10 to date, and there has been no maintenance charge for the other concrete pavements laid since then.

Burlington, Wisconsin

P. J. Hurtgen, engineer, Burlington, Wis., in reporting on the 12,232 sq. yds. of concrete paving laid in Burlington in 1911, writes that on future work instead of laying concrete in two courses of 5″ and 1½″ he will put it down in one course, and that instead of using an unprotected asphalt joint every 30′ he will provide joints with the same spacing and will protect the joints with the Baker plate. The cost of the work in Burlington in 1911 was low, $1.06 per sq. yd., including grading, which amounted to about 10c per sq. yd. spread over the entire job. Concrete curb cost 27c per lin. ft. and the combination concrete curb and gutter cost 45c per lin. ft., using a 6-in. curb and a 2-ft. gutter. This low cost was obtained in spite of the fact that unusual care was taken in grading before the concrete was placed and in proportioning and mixing the materials. The mixture was 1:2:4 cement, sand and gravel, using Marquette and Universal cements. Sand passed through a ¼″ screen and gravel passed a 1½″ screen; both were clean and sharp. Cement cost $1.35 per bbl. on the job and sand and gravel 75c per yd. A steel street broom was used to finish the pavment surface. Mr. Hurtgen writes CONCRETE-CEMENT AGE that "after passing through the most severe winter that this vicinity has experienced in 40 years, this pavement has not a crack or check of any kind in it, and our teamsters prefer it to brick, because it is less slippery and because it is less dusty and less noisy. The pavement carries very heavy traffic from depots, lumber and mill yards and factories." Mr. Hurtgen says he believes that in laying a one-course pavement with a steel plate for the joints he could reduce the cost to about 85c per sq. yd. with materials at present prices.

California

The California State Highway Commission is preparing to spend the proceeds of an eighteen million dollar bond issue in completing good roads on the Pacific coast. These good roads for California are a part of a splendid scheme to welcome the world to the Panama Exposition in 1915, with unexcelled highways. Bids were to be opened by the State Highway Commission August 26 on approximately 56 miles of highway to be built of concrete with a bituminous surface. This work will be divided about as follows: Stanislaus county, 11 miles; Merced county, 10 miles; Fresno county, 9.5 miles; Madera county, 7 miles; San Diego county, 8.4 miles; Madera county, 10 miles.

In San Mateo county another stretch of pavement is being built from South San Francisco to Burlingame. This is the pavement described in the tables in this issue. It is an unusual road in its construction, 5.4 miles long, 24′ wide with 5″ base of 1:3:6 concrete, and 1″ of asphaltic wearing surface. The pavement will have no joints, and the concrete will be hand-tamped. The contract has been given to F. R. Ritchie & Co., San Francisco. A sectional view of this pavement is shown. This road will cost $1.035 per sq. yd.; the asphalt will cost 36c per sq. yd., which is included in the $1.035. In addition to this the excavation costs 37c per cu. yd. This road is an experiment undertaken by Austin B. Fletcher, the State Highway Engineer.

Chippewa Falls, Wisconsin

Chipepwa Falls, Wisc., is trying its first experiment in concrete paving this year, putting down 675 sq. yds. in alleys. The work was done early in the Spring. The pavement is 16′ wide and is laid close up to abutting buildings. It was put down on a heavy gravel subsoil and was given a 3″ dip to the center. The joints are 30′ apart transversely with no longitudinal joints and they are filled with Pioneer and Sarco fillers. The edges of the joints were rounded. The bottom course is 6″ thick of a 1:6 mixture of cement and gravel and the top course is 1½″ thick in granolithic finish. Pit-run gravel was used which was very clean and well proportioned. All sizes were used that passed a 2½-in. ring. The wearing course was of a mixture of one cement, one sand and one granite screenings, the last named being ¼″ to ½″ in size. With cement at $1.10 per bbl., gravel at $1.00 per cu. yd., sand 50c per cu. yd. and granite screenings at $3.10 per cu. yd. the pavement cost $1.28 per sq. yd. The pavement was sprinkled and protected from the sun with canvas and was opened to traffic after 10 days. The work was in charge of L. G. Arnold, city engineer, who is also in charge of 6,000 sq. yds. of concrete pavement being laid in Stanley, Wisc.

Connersville, Indiana

Connersville, Ind., is putting down 6,500 sq. yds. of concrete paving this year. It is on nine different streets and varies in width from 20′ to 32′. The total length of the work is about two miles. The pavement is being laid in two courses. The first course is 5″ thick on the sides and 7″ thick in the center. The top course is of a uniform thickness of 1½″. This gives the street a crown of 2″. The gutter has a further dip of 2″, giving the center of the street a rise of 4″ from the gutter. The streets are jointed every 30′ transversely and the joints are filled with asphalt and are protected with Baker plates. Longitudinal joints are placed next to each gutter and are also filled with asphalt. Pit-run gravel is being used and everything under 2″ in size goes into the mix. This gravel costs 50c per cu. yd. Universal Portland cement which is being used costs about $1.02 per bbl. The pavement is reinforced with No. 12 gauge 4″ wire mesh netting and the surface is floated and then broomed. The specifications require that in curing the pavement it shall be covered with straw for three days then with sand for seven days and kept moist all the time. The pavement is costing $1.02 per sq. yd.

Davenport, Iowa

In addition as to the Davenport paving laid in 1912, and described in tables 1, 2, and 3, A. M. Compton, city engineer, gives a list of the Davenport pavements laid in 1911 and the cost per sq. yd., and another list for the work being done this year, with the cost per sq. yd. This list is as follows:

In 1911 the following streets were paved with concrete: Alley between Kirkwood boulevard and Arlington court, single course, 159 yds. at 90c; East River street extension, single course, 5,440 yds. at 93c; Laurel street between Cherry street and Grand avenue, single course, 459 yds. at 93c; Ripley street between Lombard street and Norwood avenue, two course, 2,050 yds. at $1.29; Summit avenue between Eastern avenue and Kuehl street, two course, 3,200 yds. at $1.25; Vine street between Fifth and Sixth, two course, 1,000 yds. at $1.30.

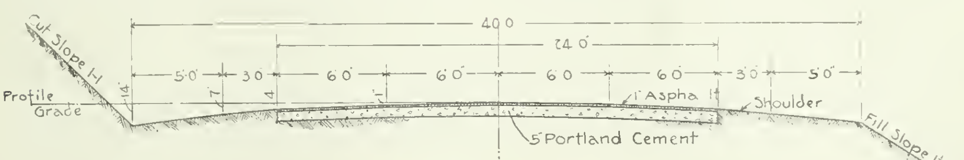
For the season of 1912 we have contracted for over 50,000 sq. yds. of concrete paving. The prices on two course work are from $1.00 to $1.17 per sq. yd. average about $1.00), and for the single course only paving averages about 97c per sq. yd.

Des Moines, Iowa

Des Moines, Ia., did its first concrete paving in 1910. This was two-course work and the details will be found in tables 1, 2 and 3 in this issue. The first course was 6½″ thick and the top course 1½″ thick. This year the city engineer is specifying a uniform mixture throughout the work and the thickness of the pavement varies according to the street and the traffic which it carries. This one course work is of a mixture of 1 part cement, 2½ parts sand and 4 parts broken stone. The change was made to reduce the cost of the pavement, believing that the quality would not be impaired. The two course work put down in 1910 cost from $1.57 to $1.69 per sq. yd. Last year the city did about 6,000 sq. yds. of alley paving, divided into several small jobs, putting in the concrete 6″ thick at a cost of from $1.25 to $1.30 per sq. yd. This year an 8″ thick pavement is being put down on 42nd street, including 3,700 sq. yds., at a cost of $1.24 per sq. yd. including curbing. Another job on Grand avenue of 12,700 sq. yds., 8″ thick, curb also included, cost $1.46 per sq. yd. Another job of 6 in. pavement on Beckwith street of 1,000 sq. yds., where the curb already is in place, is costing $1.22 per sq. yd. This paving is being given a float finish. These pavement prices are obtained with materials costing as follows: Cement $1.15 per bbl.; sand, $1.30 per cu. yd.; stone, $1.60 per cu. yd. This information was supplied by W. D. Maxwell, office engineer in the city engineer's office.

Fond Du Lac, Wisconsin

Fond du Lac, Wisc., has 17 streets and two alleys paved with concrete. These pavements total nearly 9 miles in length. This paving is divided into two types of construction: plain concrete and reinforced concrete. The earlier pavements were made of plain concrete and all the later ones were reinforced. City Engineer J. S. McCullough writs CONCRETE-CEMENT AGES "We reinforce all our work now and are more particular about getting clean aggregate than we were on our plain concrete paevments. We consider the reinforced type with the clean sand a big improvement over our first pavement." Of the plain concrete pavements laid in 1908 and 1910, there are a total of 106,-527 sq. yds., making about 6 miles of these streets with pavement from 27′ to 56′ wide. The sub-grade is crowned like the finished surface, which is 4″ for



TYPICAL SECTION OF ROADWAY.

SAN MATEO COUNTY, CALIFORNIA, ROAD

27-ft. pavements, 4½" for 30-ft., 5" for 32-ft. and 6" for 56-ft. The transverse points are 50' apart and are filled with asphalt; the space being made for them by using drop-siding. Two longitudinal joints are along each gutter, and are also filled with asphalt. The concrete is made of 1 part cement, 2½ parts gravel and 5 parts crushed stone. The gravel in these early pavements was rather poor and carried some clay; the limestone is rather soft. The gravel was pit-run material and contained about the right amount of fine sand. The base course is 5" thick. The top course is 1½" thick and is composed of 1 part cement, 1 part clean sand, and 1 part granite, under ¼" in size. The street was roughed with a broom after floating and slight trowelling. Cement cost $1.25 on cars, gravel $1.10 per yd. and stone $1.20 per yd. The pavement was cured by sprinkling from 7 to 10 days, and was protected from the sun by canvas coverings. The paving, including grading, cost from $1.10 to $1.375 per sq. yd. Combination concrete curb and gutter cost from 42c to 50c per ft. Mr. McCollough reports that the pavement has been evry satisfactory under moderate traffic, except for a few logitudinal cracks. He also says: "We consider the proper mixture of sand and granite or equally hard stone the best wearing surface; without the sand the pavement is likely to be slippery, and without the hard stone the surface is more apt to wear off." This specification has been changed slightly since the pavements were laid, by reducing the crown a little and by adding reinforcing. The pit-run gravel has also been eliminated because of the clay in it and clean sand is now used in concrete pavements in Fond du Lac.

Of the reinforced concrete pavement laid in 1910 and 1911 there are 34,740 sq. yds. from 27' to 40' wide and about 3 miles long. Crowns now used on these reinforced concrete pavements are as follows: 3½" on 27-ft. pavements, 4" on 30-ft. pavements, 4½" on 32-ft. pavements and 5½" on 40-ft. pavements. The mixture and thickness of courses is the same as with the plain concrete pavements, with the exception of the greater cleanliness in the aggregate. It is interesting to note from Mr. McCollough's report what a very slight increase there is in the cost of reinforced pavement as compared with plain concrete. When the reinforced concrete pavements were laid cement cost the same as with the plain concrete, and the aggregate has also cost about the same. Sand cost a trifle more than with the plain pavements, as it cost $1.05 on cars and it is more than likely that the cost in getting it to the job was more than 5c per yd. These pavements, laid in 1910 and 1911, cost from $1.20 to $1.27 per sq. yd., including crown. American Steel & Wire Co.'s No. 7 triangular mesh was used for reinforcement. It was placed between the base course and the wearing course in the center 18' of the street. This pavement was laid by G. H. Stanchfield, who was also a contractor for the previously laid plain pavements, and by J. Rasmussen & Sons Co., under a 5-year guarantee.* Mr. McCullough reports that the pavement is very satisfactory, that a few cracks have developed but they have not opened up enough to do any harm.

*See August 1912 Concrete-Cement Age, page 58, for cost data supplied by Mr. McCullough on cutting and replacing concrete pavement.

All the finishing of the pavement is done from a bridge so that it is not necessary for the men to get on the work; in no event are they permitted to get on.

Gary, Indiana

C. A. Williston, city engineer, Gary, Ind., reports that the concrete paving done in Gary in 1906, 1907 and 1908 has not been entirely satisfactory. In 1906 a mile of pavement was put down on a street 66' wide between curbs, using a 1:3:4 mixture of cement, sand and stone, with the pavement 7" thick. The first course is 5½" thick and the second course 1½" thick. Transverse joints were placed every 50' and filled to the top with tar. The surface was marked off like bricks. The combination curb and gutter was put down with the work, which cost from $1.65 to $1.90 per sq. yd. In 1907 and 1908, 1½ miles of paving were put down on streets 46' wide, other conditions were the same. These streets have had heavy teaming. Mr. Williston writes: "The pavement fails by intersecting cracks wearing out to the foundation, which disintegrates rapidly, making dangerous holes if not attended to promptly."

Greenville, Illinois

The concrete pavement put down in Greenville, Ill., in 1911 has had to stand severe tests. The pavement is 3000' long and 16' wide and the width of the road is extended with dirt shoulders. The pavement has no crown, the sub-grade and finished work both being flat. Joints were made every 25' with rounded edges and filled with pitch. The concrete is in a mixture of one part Red Ring cement, 2½ parts sand, and 5 parts stone. The sand is reported as clean and sharp and the stone as Chester limestone up to 2½". The cement cost $1.00 per bbl, sand 80c per yd., and stone 50c per yd. The pavement is 8" thick in one course, and was finished only by tamping. It was sprinkled 3 days. It cost 90c per sq. yd. The road is subject to a great deal of overflow in the spring freshets, and has stood up and given excellent satisfaction after one very severe season's test. The work was in charge of and reported to Concrete-Cement Age by H. M. Baumberger, city engineer.

Detroit, Michigan

Detroit, Mich., concrete paving has been expensive. The first of it was put down on Elmwood avenue in 1910 (then called Collins street). This paving was two course work, 5" and 2", with ½-in. joints every 30' filled with asphalt and protected with Baker plates. The job included 16,472 sq. yds. The pavement proper cost $1.39 per sq. yd., but excavating at 50c per cu. yd., stone curbing at 50c per cu. ft., and concrete backing for the stone curbing at $4.50 per cu. yd., brought the cost to $2.10 per yard. This pavement has given very good satisfaction, but no more concrete pavements were laid until this year, when the city issued new specifications for plain concrete pavement and for reinforced concrete pavement. Property owners on an east side street petitioned for some reinforced concrete paving. When the bids came in for the work they decided that some other kind of pavement would be used, as the low bid ran $2.61 per sq. yd. Seven alleys were paved this year with plain concrete covering, a total of 288 sq. yds., with the alleys 15′ wide. Another alley was paved with reinforced concrete and this cost $2.76 per sq. yd. Just why it is so expensive it is hard to say, because the city has material contracted for in advance and is able to buy any one of four different brands of cement at from 85c to 94c per bbl., bank gravel at 69c per yd., bank sand at 69c per yd., crushed stone at from 69c to 89c per yd., and river sand at 87c per yd.

Hennepin County, Minnesota

Hennepin county, Minn., is experimenting this year with one mile of concrete pavement on Superior Boulevard, out of Minneapolis. If this proves to be as satisfactory as officials in charge believe it will, more miles will be laid. The road is 14′ wide with 3′ of gravel shoulder on each side, constructed as shown in the typical section. It is being laid in one course, 7″ thick of a 1:2:3 mixture of Universal cement, sand and gravel. The pavement has a 1″ crown. The work is being done by the General Contracting Co., Minneapolis

Highland Park, Illinois

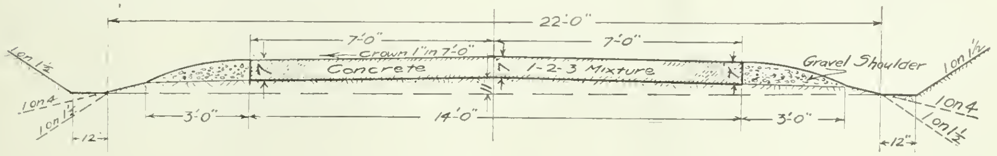
James Shields, engineer, Highland Park, Ill., reports that the concrete pavement put down on Williams and Dean avenues in that city this year cost just about the same as macadam. The pavement is 6000′ long and 20′ and 30′ wide, with a total of 13,000 sq. yds. The joints are placed every 25′ and in each joint are eight thicknesses of tar paper. Longitudinal joints are placed along the curb and are filled in the same way. The concrete used is made, one part Universal Portland Cement, two parts torpedo sand and 3½ parts washed gravel from ½″ to 1¼″. On the 20-ft. street the concrete is 7″ thick in the center and 5″ thick at the sides. On the 30-ft. street it is 8″ thick in the center and 6″ at the sides, laid on a flat sub-grade, thus giving a crown of 2″. The pavement was sprinkled for seven days after laying. The specifications called for ½ gal. of bitumen to each sq. yd. of surface. The contractors used Pioneer asphalt, and in this, torpedo sand was rolled. The engineer mentions as special features of this pavement, the low original cost, "being about the same as macadam, low cost of maintenance and low crown spreading travel over the street." It is proposed on future paving to use steel joint protectors and leave out the tar paper.

Independence, Missouri

H. H. Pendleton, city engineer, Independence, Mo., says that particular attention was given to the subgrade for pavements of that city. The street was subgraded 5″ below and parallel with the finished surface of the street, and was rolled with a 10-ton roller. The pavement referred to is on Pleasant street and was laid in 1910. The job covers 2,172 sq. yds.; it has a crown of 6″; there are no transverse joints; it was laid under the Hassam patent. Joints along the curb are filled with two thicknesses of three-ply roofing felt. The concrete base consists of two parts of Portland cement, 3 parts clean coarse sand, and 6 parts clean hard stone, passing 2¼-in. mesh and retained on a ½-in. mesh. This was spread on the sub-grade and tamped. Before it had set a thin coat of fine stone concrete composed of 1 part cement, 1 part sand and 3 parts stone, was put on. The stone consisted of chats from zinc mines. It was brought to an even surface by tamping and with the aid of a long-handled roller. The pavement cost $1.29 per sq. yd.

Kansas City, Missouri

Up to January 1, 1912, Kansas City, Mo., had a total of 65,433 sq. yds. (4.4 miles) of concrete paving in streets and 46,160 sq. yds. (5.66 miles) in alleys. The crown used on a 26-ft. roadway is 6″. The joints are placed 50′ apart and are filled with asphalt. There are no longitudinal joints. The mixture used is 1 part cement, 2 parts sand and 4½ parts crushed stone. All sizes of stone below ¼″ are screened out. The cost of the Kansas City paving has averaged $1.20 per yd. on streets, including sub-grade work, and 94c per sq. yd. is the lowest figure which has been reached. Clark R. Mandigo, assistant engineer, writes CONCRETE-CEMENT AGE that the pavements are very satisfactory for cleanliness, durability, low tractive resistance for sanitary reasons and because of the ease with which they may be repaired. Mr. Mandigo writes that specifications are to be changed so that the transverse expansion joints, now filled with asphalt, will be omitted. He says that these joints ½″ wide are the weakest points in the pavement, and it is now proposed to make a contraction joint filled with tar paper. This pavement laid in Kansas City has been under a maintenance bond to keep in repair for 5 years. Although in practically all of the streets the concrete has been laid 6″ thick in one course; pavements on some heavy trafficked streets are 7″ and 8″ thick. When these pavements were laid it is evident that they were regarded as somewhat of an experiment so far as the use of concrete for surface material was concerned, and curbs were left with an 8-in. face, so that an asphalt or bitulithic surface could be put on if desired.



HENNEPIN COUNTY, MINNESOTA, BOULEVARD SECTION

LeMars, Iowa

In 1904 a concrete pavement was laid in LeMars, Ia., by M. A. Moore and C. H. Kehrberg. The pavement is only one-half block long and is on one of the main streets, taking about the heaviest traffic in a city of 5000. The first course is 5″ thick, composed of 1 part Portland cement and 6 parts coarse gravel. On top of this was laid a 1½-in. course of 1 part cement to 2 parts coarse screened sand. The feature of this pavement is the treatment of the surface. It is marked off in squares diagonally, the squares being 4″ on a side. A 2-in. plank was used 2′ long with a handle attached, and pieces of steel ⅓″ x ⅜″ were put on the bottom of the plank to form the grooves. The pavement cost $1.25 a yard with gravel at 75c per cu. yd. and cement at $2.00 per bbl.

Milford, Delaware

The concrete pavements in Milford, Del., put down in 1910, 1911 and 1912, totaling 5,335 sq. yds., are in one course 6″ thick, all put down at one time. This was made of a mixture of 1 part cement, 2½ parts sand and 6 parts stone. The stone used was crushed screened granite. This concrete course was flushed over with grout. The pavement that was put down in 1910 is jointed transversely every 50′ and filled with wood and asphalt. There are longitudinal joints at the curb also filled with asphalt. In the 1911 and 1912 jobs the joints were placed 75′ apart filled with asphalt. In finishing the surface of the concrete after the grout was put on, the back of a rake was used, so that the surface is not entirely smooth. This pavement has cost an average of about $1.05 per yd. Theodore Townsend, chairman of the Highway Committee of the Council, writes CONRETE-CEMENT AGE that these streets stand very heavy traffic and have been so satisfactory that next year the city will put down about 6,000 yards of the pavement to replace an old macadam roadway.

Milwaukee County, Wisconsin

Sixteen miles of concrete roadway are being put down this year in Milwaukee County, Wis. The width of the road varies from 15′ to 18′. It is in 8 different localities. The pavement is crowned ¼″ to the foot and joints are placed every 25′ filled with asphaltic felt and protected with steel plates. The work is 7″ thick in 1 course made of a mixture of 1 part cement, 2 parts sand and 4 parts gravel: in some cases 1 part cement, 2 parts sand and 4 parts stone. Some of the concrete, where a good quality of bank gravel is to be had, is of a mixture of 1:4 cement and gravel. The pavement is smoothed off with a wood float. Curing is taken care of by covering the pavement with soil and sprinkling it for 5 days. The average cost of the work is 90c per sq. yd.

H. J. Kuelling, county highway commissioner, in writing to CONRETE-CEMENT AGE said that all the work is being done on contract and as it is 8 different jobs, the concrete used and methods followed are not all exactly alike. Several kinds of material are being used. Some aggregate is shipped in from outside and some of it is obtained from local gravel pits. In some cases the gravel is being used just as it comes from the pit with the addition of some larger stone and in other cases, the product of the pit is screened and re-mixed. Mr. Kuelling says "This last I believe to be much the best system as it insures a more perfect mixture."

Mitchell, South Dakota

Mitchell, S. Dak., is putting down 26,000 sq. yds. of reinforced concrete paving this year. This is on 6 different streets varying in width from 42′ to 56′ between curbs. The pavement crown is 5″ on the 42-ft. streets and 7″ on the 56-ft. streets. Alternate expansion and contraction joints are placed 12′ 6″ apart transversely of the pavement and are filled with asphalt. The edges are turned to a ½″ radius. Longitudinal joints are placed at the curb and are also filled with asphalt. Particular care has been taken with the mixture used in making the concrete. The bottom course of 5½″ is a mixture of 1:3:5 cement, sand and stone. The top course is a mixture of 1:¾:¾ cement, sand and gravel. This course is 1½″ thick. The pavement is reinforced with No. 7 triangular mesh in the center of the pavement only, and thus, on the 42-ft. streets, the mesh extends over the middle 15′ and on the 56-ft. streets over the middle 20′. The surface of the pavement is wood-floated and broomed. It is cured by being kept wet 4 days and is costing from $1.47 to $1.55 per sq. yd. including grading.

Montesano, Washington

The concrete paving in Montesano, Wash.,* is described by Geo. W. Gauntlett, city engineer. In Spruce St. 5,345 sq. yds. were put down in 1911, the pavement being 20′ wide, with ⅝-in. expansion joints every 25′ filled with grade "D" asphalt. The bottom course is 4″ thick of 1:3:6 cement, sand and gravel. The top course is 2″ thick of a 1:2 mixture of cement and sand. The sand used was clean and sharp and contained pea gravel up to ½″ in diameter, in proportion with the sand about 1:1. The pavement was kept wet for 7 days and closed to traffic for 28 days. It cost $1.32 per sq. yd., exclusive of curb and gutter. The combination curb and gutter of concrete cost 27c per ft.

Mr. Gauntlett writes that the pavement has given entire satisfaction, standing medium heavy traffic. He mentions as its special features, the fact that it is low in first cost, has a non-skidding surface and is less noisy than either brick or granite block and not so hard on the horses. The surface of the pavement was given a troweled finished and then was roughened by tapping with a sidewalk roughing brush. Mr. Gauntlett proposes to change the specifications for future work in the matter of filler for expansion joints. He says that he finds that the asphalt has a tendency to run toward the gutter when the pavement has a crown and he proposes mixing the asphalt with hot sand.

Montesano also has 7½ blocks of concrete alley pavement with a total of 2,063 sq. yds. This pavement has a 2-in. dip to the center with asphalt joints every 25′ and is in 2 courses like the street paving

*See *Concrete* June, 1912.

4" and 2". The surface finish is different. It is grooved by means of 3/8" ribbons tacked to the bottom of a plank. A space 1' wide was left in the center, free from grooves, this to serve as the gutter. The alley pavement cost $1.27 per sq yd.

New Orleans, Louisiana

The only concrete pavements in New Orleans, La., writes W. J. Hardee, city engineer, are those laid under the Blome patent. There are 12 of these pavements with a total of 154,726 sq. yds., at a cost ranging from $2.37 to $2.95 per sq. yd.

Portland, Maine

The city of Portland, Me., has 18,660 sq. yds. of Hassam patent pavement put down in 1907, 1908, 1909, 1910 and 1911 at a cost ranging from $1.65 to $2.06 per sq. yd. The city also has 14,848 sq .yds of straight concrete pavement with bituminous surface put down in 1911 at a cost ranging from $1.29 to $1.75 per sq yd. This year 16,627 sq. yds. are being laid on 5 different streets. On four of these streets, done entirely by contract, the cost per sq. yd. ranges from $1.19 to $1.33. On another street, totaling 3,150 sq. yds., the city supplies both sand and cement and the lowest bid for the work was 90c per cu. yd. for excavation, 60c per sq. yd. for concrete, 15c per sq. yd. for bituminous surface.

Hassam Pavement

Year.	Location	Length lin. ft.	Area sq. yd.	Total Cost	Cost sq. yd.	Maintenance.
1907	York St.	706.3	3,324.56	$5,485.52	$1.65	None
	Brown St.	276.8	631.13	1,041.36	1.65	"
	Exchange St	297.2	1,045.44	1,724.98	1.65	"
1908	Charles St.	128.0	147.75	304.13	*2.06	"
	Middle St.	1,129.0	3,406.55	6,147.36	1.80	"
	Monument Sq. ..	290.0	493.51	881.37	1.79	"
	Pleasant Ave. ...	561.86	846.70	1,488.98	1.76	"
1909	Atlantic St.	450.70	1,421.42	2,487.48	1.75	"
	Avon St.	404.30	652.50	1,171.40	1.80	"
	Free St.	556.85	1,889.39	3,313.18	1.75	"
	Temple St.	349.80	1,367.20	2,395.60	1.75	"
1910	Pleasant Ave. ...	699.80	1,038.66	1,817.66	1.75	"
	St. Lawrence St..	291.50	1,066.14	1,865.75	1.75	"
1911	Franklin St.	463.00	1,329.71	2,326.99	1.75	"
		6,605.11	18,660.66	$32,451.76		

Cement Concrete—Bituminous Surface

Year.	Location	Length lin. ft.	Area sq. yd.	Total Cost	Cost sq. yd.	
1911	Brighton Ave. ...	1,125.00	2,250.00	$ 3,167.50	$1.41	
					Hassam Base	
	Cumberland Ave.	2,460.00	11,237.64	14,459.18	1.29	
					(State Highway Mixed Concrete)	
	*Forest Ave.	440.00	1,361.35	2,382.36	1.75	
					Hassam Base	
		4,025.00	14,848.99	$20,009.04		

*Not laid by contract.

All of the above pavement is in good condition and apparently will not need repairs for some years.

Plymouth, Wisconsin

Plymouth, Wis., has 10,780 sq. yds. of reinforced concrete paving, put down in 1910. The street is 40' wide and has a crown of 8". Transverse joints are placed 40' apart and are filled with pitchy cypress wood. Longitudinal joints are provided along the curbs and at each side of the car track. The base course is 6" thick of 1:3:5: concrete, cement, sand and gravel, and the top course is 1½" thick of 1:1½ cement and sand, the reinforcement consisting of the American Steel & Wire Co.'s No. 7 mesh. It is placed just under the top coat. The pavement cost $1.235 per sq. yd. The specifications were drawn by W. G. Kirchhoffer, Madison, Wis. Mr. Kirchhoffer put down a similar job in Platteville, Wis., in 1911.

Portland, Oregon

T. M. Hurlburt, city engineer, Portland, Oregon, writes CONCRETE-CEMENT AGE as follows:

Up to the first of this year, less than 2 miles of concrete pavement had been laid, and this is so recent that we have not settled on any definite specifications or manner of construction. Our pavement so far laid has been confined almost entirely to hillsides where the traffic is light and where it is desirable to have pavement affording a good foothold for team traffic.

In the present year we will lay much more concrete pavement than heretofore, and some of this will have a thin bituminous surface coat, and some will be simply plain concrete. We use about the same crown as we do with other pavements, that is, a flat crown on steep grades and considerable crown on level streets. We do not use any expansion joints at all, as our experience with them has not proven successful.

The concrete paving heretofore laid, was composed of 1 part of Portland cement, 3 parts sand and 5 parts broken basaltic rock. We do not use any gravel with this pavement. The price of the cement, etc., at the present time, in this city, f. o. b. the bunkers, are about as follows: Cement $1.65 to $1.85 per bbl., sand 60c to 80c per cu. yd., gravel 65c to 85c per cu. yd., crushed stone $1.00 to $1.25 per cu. yd.

All of our concrete pavement has been 6" thick and this has been our standard. The pavement heretofore laid has been in 1 course only, but that laid this year will be in 2 courses as far as the composition is concerned, that is, a bottom course or mixture of 1:3:5 and a top course of 1:2:4. These mixtures are tamped together as 1 course.

The surface of the concrete is broomed with steel wire brooms and we aim to give a much rougher finish on the steep grades than on the flat grades.

We use an ordinary concrete curb, and do not use any special gutter.

The cost of the pavement heretofore laid has been about $1.40 per square yard, exclusive of grading, but this year we have received bids ranging from $1.45 to as low as $1.05 per sq. yd. and most of that to be laid will average about $1.20 to $1.25 per yd.

All of our pavement is laid on contract under the supervision of the city engineer. We have no board of public works in this city.

Our experience with the pavement has not been long enough to state how satisfactory it will be, but I have no doubt that on the steep grades with comparatively light traffic, it will be found entirely suitable. One objection to the pavement as compared with those of the asphalt kind is that it is more noisy and also shows dirt more plainly. After this year we will probably have a much more definite idea as to the merits of concrete pavement than we have now, especially those with the bituminous coating.

Richmond, Indiana

Among the oldest concrete pavements in this country are those in Richmond, Ind., and Fred R. Charles, city engineer, has supplied a list of these pavements together with information as to how they have worn. The statement also includes a record of cost per sq. ft. The first of these pavements was laid in 1896. No more concrete paving was done until 1901 and some paving has been done every year since that time. This is reasonable assurance of the satisfaction which concrete paving has given in Richmond. The bottom course of these pavements is from 5″ to 6″ thick and the top 1½″ thick. The paving is usually divided in blocks 10′x15′ and never exceeding this size. The joints are filled with sand only, the edges being turned with a small radius tool. Mr. Charles says that on some of the paving shown 1″ joints have been used filled with paving pitch, but they have been found unsatisfactory because of wear at the edges. The paving is given a floated finish and corrugating is not recommended.

Concrete Streets and Alleys

	Year	Cost per sq. ft.	No. of Yards
Alley	1896	26 8/10c	140
Alley	1901	14c	242
Alley	1901	17c	162
Alley (private)	1901	15c	222
Driveway No. 1, Hose House	1902	20c	88
Sailor Street	1902	14c	644
Intersection	1903	16 1/2c	481
Alley	1903	15 9/10c	333
Street	1904	13c	650
Alley	1904	15 1/2c	184
Driveway No. 3, Hose House	1905	15 1/2c	88
Driveway No. 4, Hose House	1906	15c	88
Alley	1906	15c	1,142
Alley	1906	13 3/10c	311
Alley	1906	13 3/10c	454
Alley	1906	15c	184
Alley	1906	14 1/2c	700
Alley	1906	15c	300
Street	1907	14 1/2c	600
Market Place	1907	15c	1,161
Alley	1907	15c	247
Driveway No. 2, Hose House	1907	16c	170
Alley	1907	13 3/4c	170
Alley	1908	11 4/5c	750
Alley	1908	11 4/5c	222
Alley	1909	12c	555
Alley	1909	12c	226
Alley	1909	11 1/2c	670
Alley	1909	11c	663
Alley	1910	15c	994
Alley	1910	16 1/4c	532
Driveway No. 5, Hose House	1910	15 1/2c	120
Alleys	1911		4,745
			18,238

Mr. Charles says of the wearing qualities:

As Richmond was one of the pioneers in the line of concrete paving, we have received dozens of inquiries for information. Our first concrete pavement was constructed in 1896, in an alley. Being a narrow alley, a heavy traffic was concentrated in a small space; nevertheless this pavement shows almost no signs of wear. A slight sinking of gravel around the foundation of a building has caused a little settlement in the alley, but this, which would be disastrous with other forms of pavement, has only resulted in a slight unevenness of the blocks, which have not even cracked. In 1902, Sailor street was paved with concrete, and now is in almost perfect condition. In 1906, it was necessary to cut a trench the length of this street to lay telephone conduits, and the concrete was found so hard that it could be cut with great difficulty. On completion of the conduits the pavement was very carefully repaired and now seems as good as new. In 1903, concrete was put down at North A. and Seventh street, a very busy intersection of two principal streets, and in 1904, in Elm place, a street adjacent to a hotel and several wholesale establishments, and carrying a great deal of heavy hauling, especially from the hardware and iron storage houses. These last two pavements were laid in large blocks with expansion joints 1″ wide, filled with pitch. These wide joints are a disadvantage, since the edges of the blocks begin to chip a little at these places. With the exception of these places and a few temperature cracks, which cause no serious trouble, the pavements are in excellent condition, and will apparently last for years with no repairs or maintenance charges. On our later work we do not use the wide joint, but find the ordinary sand joint satisfactory. In addition to those mentioned, we are constructing concrete pavements every year, more especially in alleys which are in the busy portion of the city. This travel concentrated in a small space constitutes a more severe test than on streets where it can be more distributed. Our citizens are very well satisfied with this pavement. Unlike asphalt and other materials, it is not damaged, but actually benefited by water. Consequently it can be flushed with a hose and is very easily kept clean, an important item from an esthetic and sanitary standpoint. The initial expense is moderate. It cost us about 30% less than vitrified brick. Repairs and maintenance charges apparently will be nothing for a great many years, and the life of this material will doubtless equal or exceed that of brick. It is somewhat slippery for horses; about the same as brick. Many drivers prefer it to brick. Even when wet it is not so slippery as asphalt. It is significant that those who reside on these concrete streets and use them most, and have the best chance to observe them, are the most enthusiastic in favor of concrete. At the present time these pavements are still in fine condition. Almost the only wear in evidence is at the joints as above stated, and even there it is slight in most cases. With the disadvantage of the joints overcome, the wear amounts to almost nothing.

Rockville, Indiana

The citizens of Rockville, Ind., are putting down 5,000 sq. yds. of reinforced concrete pavement 26′ wide and the cost of the work including sub-grade preparation is only $1.10 per sq. yd. Baker joints are being used every 33′ with tar paper between the plates.

(Continued on page 84)

THE MIXING GANG ON ROCKVILLE, INDIANA, PAVING

FIG. 2 FIG. 3
Rockville, Indiana, Street "Before" and "After"

(*Continued from page 82*)

The reinforcement is The American Steel & Wire Co.'s No. 7 triangular mesh. The concrete is 5" thick composed of 1 part cement to 4½ parts gravel carrying about 45% sand with no stone larger than 3". The concrete is put down in one course. Universal cement costs $1.25 per bbl. and gravel costs 90c per cu. yd. The concrete is laid on a clay sub-grade with a crown of 4" and is being kept wet to cure. The pavement is being laid on a private contract between citizens on the street on which the work is being done and Ireland Bros., contractors. There is another element in the cost which must be considered. Mr. Ireland has a township contract to put a certain amount of gravel on the streets and gets the benefit of this price in addition to the contract price of the pavement. J. M. Johns, an attorney at Rockville, who is in close touch with the work writes that "Mr. Ireland does not expect to make a big profit on this work as it is the first put in in western Indiana and the property owners are working with Mr. Ireland to get a first-class job and use it as a specimen of what can be done." Mr. Johns writes further of the pavement as follows:

Before contracting, a committee of property owners on Howard avenue, to-wit: Samuel Coble, J. M. Johns and Frank Adams, together with our county commissioners, Green T. Taylor and John May, and contractors, Ireland Bros., paid a visit to Detroit, Mich., and personally inspected the street improvements there of concrete construction. We also traveled over several miles of concrete county roads of Wayne county, Michigan, and witnessed the construction of country roads there, as well as street improvements of like material. Our committee and county commissioners were much impressed with the cheapness of this kind of improvement compared with any other road and street construction, and were also impressed with the stability of such work. We were all unanimous in our approval of concrete construction for both street and country roads. Our commissioners have under consideration the construction of a mile of the concrete country road for a sample, that our people may see and understand the stability and utility of this kind of work, and also the comparatively low cost—with no repair for a great many years. At Detroit we saw much of this work that had been in 4 to 5 years with no perceptible wear, although the streets and roads were much used for heavy traffic. The work being done here by Ireland Bros. is beyond the expectation of our citizens, who never saw such work before, and is meeting with the unanimous approval of all. This pavement was designed by and is being built by Ireland Bros., Bloomingdale, Ind. The engineer in charge of the work is H. L. Davies, Marshall, Ind. The sub-base is yellow clay, upon which gravel has been put from time to time. Very little excavation was necessary; after surfacing to grade, the base was rolled with a steam roller. The sub-grade was given a crown of 4".

Sheboygan, Wisconsin

In 1911 Sheboygan, Wis. put down 14,000 sq. yds. of reinforced concrete pavement for $1.20 per sq. yd. This price included the removal of an old cedar block pavement. There was no soil to carry away. The street is 30' and 40' wide in different places and for the 30-ft. width is crowned 6" and for 40-ft. width 8". Transverse joints are placed 40' apart and filled with Pioneer asphalt. Chicago A A cement was used and the mixture for the wearing course consisted of 40% Portland cement 30% crushed granite ½" to ¾", 20% crushed granite from dust to ¼" and 10% of clean bank sand. For the bottom course, clean broken stone from ½" to 1½" and bank sand were used. Cement cost $1.25 per bbl., sand $1.00 per cu. yd. and stone averaged $1.25 per cu. yd. The reinforcement consisted of American Steel & Wire Co.'s No. 7 mesh. This reinforcing was put clear across the street from curb to curb and is placed between the first course and the second course. The pavement is 8½" thick in the center and 6½" thick at the gutter, the first course varying in thickness from 6¾" at the center to 4¾" at the gutter. The top course is of a uniform thickness of 1¾". The top coat is given a brushed finish making it rough to prevent slipping.

Spokane, Washington

Spokane, Wash., has 23,778 sq. yds. of Hassam pavement put down in the fall of 1911. This is on four different streets and cost from $2.70 to $3.41 per sq. yd. including the preparation of the sub-grade. Exclusive of the sub-grade work the cost ran from $2.39 to $2.70. The work was done by the Inland Empire Hassam Paving Co., and the city engineer reports, in answer to the question "How Satisfactory," "Fairly good." As to the special feature of the pavement he says, "Monolithic, does not crack and has a roughened surface. The crushed stone receives the wear not the grouting." Spokane also has 26,775 sq. yds of straight concrete paving laid in the summer of 1911. This is on 7 different streets. The bottom course is 5″ thick of a mixture of 1:3:6 cement, sand and gravel and the top coat is 1¾″ thick of 1 part cement, 1¾ parts crushed basalt and ¼ part coarse silicious sand. In the bottom course no gravel larger than 2½″ was used. All this work was done on contract Four of the streets were put down by the R. S. Blome Co. and three of them by John Fife. The surface is cut in 4″ strips, carried completely across the pavement with longitudinal scorings 10″ apart. The scoring does not exceed ⅝″ in depth nor is it less than ⅜″ in depth. In addition to this, the surface was broomed to eliminate all smoothness. The pavement was kept wet for 10 days between sunrise and sunset, and the streets were closed from 10 to 12 days. The pavement, exclusive of the sub-grade work, cost from $2.29 to $3.65 and including the sub-grade work it ran from $2.71 to $7.24 per sq. yd.

St. Johns, Michigan

St Johns, Mich., has 1,213 sq. yds. of concrete pavement laid in 1911. It is just one city block on Spring St and put down as an experiment. The pavement is 36′ wide and is laid with joints every 25′ filled with paving pitch. Longitudinal joints are placed along each curb and are also filled with pitch. The pavement is 7″ thick in 2 courses. The bottom 5-in. course is of 1 part cement to 6 parts of pit-run gravel, screening out stones larger than 2½″. The top course is 2″ thick, 1 part cement 2 parts sand and 3 parts crushed cobbles passing a ¾″ mesh. Only clean material was used. Cement cost $1.05 per bbl., sand and gravel $1.00 per cu. yd. and stone $2.60 per cu. yd. The surface was floated. The pavement surface was covered with Tarvia and cost $1.333 per yd. This includes the following items: Excavation $100, Tarvia coat $60.65, curb $181.47, expansion joints $20.52, catch basin $75. The street stands a heavy traffic and according to the city engineer, E. G. Huke, the pavement is entirely satisfactory except that the Tarvia coat which was put on under adverse weather conditions is wearing off rapidly. Since this work was done, new specifications have been adopted which provide for the use of screened gravel in the top coat instead of crushed stone, and for the use of Baker expansion joints and mesh reinforcement. No tar or asphalt dressing will be used. A contract has been awarded under the new specifications to the Northern Construction Co., Traverse City, Mich., for 15,000 yds to be put down this year.

Superior, Wisconsin

Superior, Wis., has 14,315 sq .yds. of reinforced concrete paving put down this year at a cost of $1.25 per sq .yd., under the direction of the city engineer, E. B. Banks. The street is 24′ wide, joints are placed every 25′ and are filled with asphaltic cement. The concrete used consists of 1 part cement, 2½ parts sand, 5 parts crushed rock in the base, and 1 part cement, 1 part sand and 2 parts crushed rock in the wearing surface Wire mesh reinforcement was used. The bottom course is 6″ thick and the top course 1½″. The surface was wood-floated and brushed. The cement cost $1.35 per bbl., sand 75c per cu. yd and stone $1.75 per cu. yd.

Wayne County, Michigan

Wayne county, Mich., concrete highways are pointed out as examples of the possible and the desirable by good roads enthusiasts all over the world. Many pilgrimages have been made to them. Visitors have gone to them skeptical and returned home to urge similar construction. Many distant communities are now building concrete highways as a result of their officials having seen the work in Wayne county.

The Wayne county, Michigan, roads are not so cheap in first cost as concrete roads in some other places. Neither are they as costly as in some places where materials used are selected with less care and where methods are less painstaking. The results so far are all more satisfactory than were anticipated. It must also be considered in looking over Wayne county's column of costs that the costs include not only the concrete pavement but 6′ to 10′ of shoulders, or berm, and this cost is spread over the cost of the concrete yardage.

The first concrete road was put down in Wayne county on contract in 1909—approximately 1 mile long, 18′ of concrete and 3′ 6″ of gravel shoulders on each side. This pavement is on Woodward avenue—a continuation of the main artery of the city of Detroit. It is subjected to heavy, almost incessant, automobile and farm wagon traffic. This trial mile is in two courses 4″ and 2½″. Transverse expansion joints were placed every 25′, with various fillers, including Georgia pine boards, a mixture of asphalt, pitch and stillwax, tar paper, asphalt felt and angle irons with asphalt felt between. Tar paper seemed at first to be the most promising and was used in the construction of a little less than a half mile of road the same year on Grand River avenue and a little more than a half mile on the Wayne road—both these in 1909. The Wayne and Grand River work was in one course of a 1:2:4 mixture. The Woodward cost was $1.28 per sq. yd.; Grand River, $1.31 per sq. yd.; Wayne, $1.08 per sq. yd.

The 1910 work is as follows: Woodward avenue, concrete, 18′ wide (24′-34′*), 12, 814 sq. yds. at $1.287 per sq. yd., in 2 courses—1st, 4″ of 1:2½:5 mix using cement, sand and limestone and 2nd, 2″ of 1:2:3 mix using sand and crushed cobblestones. Van Dyke road, 15′ (24′), 8,800 sq. yds. at $1.027, 2 courses—4″ of 1:2½:5 and 2″ of 1:2:3, using washed sand and gravel in both courses. River road, 15′ (23′), 6,515 sq. yds. at $1.288 in one course 6″ thick using a 1:2:3 mix of washed sand and gravel. Mt. Elliott road, 12′ (23′), 5,733 sq. yds. at $1.44, in two courses—4″ of 1:2½:5 mix washed sand and limestone and 2″ of a 1:3 mix. Michigan avenue, 18′ (24′), 25,460 sq. yds. at $1.31, in one course 7½″ thick of a 1:2:4 mix using washed sand and gravel. On this work a great deal of filling was required, the roadway being too narrow on which to put in 18′ of concrete. Mack road, 15′ (24′), 2,717 sq. yds. at $1.347, 6″ thick in one course of a 1:2:4 mix of washed sand and gravel. Grand River avenue, 16′ (24′), 15,164 sq. yds. at $1.204 in two courses—4″ of 1:2½:5 mix washed sand and crushed cobbles, and 2½″ of a 1:2:3 mix. Gratiot avenue, 16′ (24′), 15,955 sq. yds. at $1.089,* in one course 7″ thick of a 1:1½:3 mix of screened sand and gravel. Fort street, 12′ (23′), 3,520 sq. yds. at $1.317, in one course, 6″ thick of a 1:2:4 mix of washed sand and gravel. Eureka road, 12′ (23′), 7,040 sq. yds. at $1.287, 6″ thick in one course of a 1:2:4 mix using washed sand and gravel. The joints in the 1910 work are 25′ apart, filled either with asphalt felt or with two thicknesses of 4-ply tar paper.

In 1911 a richer mix, 1:1½:3, on all work was used with washed sand and pebbles and Baker steel plates, an outgrowth of the angle irons used in 1909, were placed at all joints. The work done was as follows: Brand River avenue, 16′ (24′), 23,389 sq. yds. at $1.718,† in one course, 7″ thick. Gratiot avenue, 16′ (24′), 14,378 sq. yds. at $1.66, in one course, 7″ thick, built like the previous section of 1910 with the addition (in 1 mile) of Baker steel plates. Mack road, 15′ (24′), 2,318 sq. yds. at $1.75,‡ 7″ thick in one course, 18′ wide as far as Dearborn, 16′ wide Dearborn to Wayne and 20′ wide in front of County Poor Farm property, 73,061 sq. yds. at $1.676, 7″ thick in one course. Mt. Elliott road, 18′ (24′), 4,109 sq. yds. at $1.658, 7″ thick in one course. Van Dyke road, 15′ (24′), 9,253 sq. yds. at $1.619, 7″ thick. Wayne Road south, 15′ (23′), 4,400 sq. yds. at $1.12, 7″ thick. On the Mack road an experimental section 75′ long was put in, reinforced with American Steel & Wire Co.'s mesh.

The work laid out for 1912 included 40 miles of concrete road, which would give Wayne county a total of about 73 miles of this improved type of highway. Not all this work has been or will be completed this year, however, owing to a shortage of material. It is very hard for the commissioners to impress upon dealers in sand and pebbles that only washed aggregate is wanted. Many carloads of material have been rejected and in some cases have been used in building shoulders. This year more care has been taken in sub-grade preparation. In all earlier work the sub-grade has been crowned ¼″ to 1′ like the finished pavement. This year the sub-grade has been made flat and rolled and re-rolled. Yet there has been no reduction in the thickness of the concrete

*Widths given in parentheses are for total width of roadway, including shoulders.

*Compare this cost with $1.66 per sq. yd. for the work done in continuing the concrete on the same road in 1911 when steel joints were used and washed sand and pebbles instead of screened sand and gravel. An important element in the 1911 higher cost was the long haul, the work being much farther from the base of supplies. The average sq. yd. cost on Gratiot is $1.35 for the two years.

†This road was under heavy expense due to long haul and 35c per ton additional freight charges on cement, sand and pebbles. The subgrade preparation was at extra expense because of the removal of old logs and planks which formed the old toll road.

‡Price high because the job was small and the expense of getting equipment to the work just as great as on a large job.

even at the edges, with the result that the concrete is now more than 8″ thick in the center and 7″ at the edges. Joints have remained the same. An experiment will be tried on two miles of road, putting in the joints obliquely. (See sketch accompanying description of work on Cleveland boulevard.) There is a likelihood, as previously said in CONCRETE-CEMENT AGE, that joints will be placed farther apart—50-ft. spacing is suggested, and there is also a likelihood that the thickness of the concrete will be reduced, because the early work, put in much thinner, has given satisfaction. All the concrete highways have been put down by the commissioners' own employes with the exception of Woodward avenue in 1909, and Mack and Fort in 1910. The surface of the Fort street road was so unsatisfactory that the contractor at his own expense put on a dressing of tar and screenings.

The work mapped out for 1912 includes: River road (begun in 1911), 15′, 8 miles long; Jefferson avenue, 18′, 1.75 miles; Grand River, 16′, 7 miles; Michigan avenue, 16′, 12 miles; Fort street, 12′, 3 miles; Eureka road, 12′, 3 miles; Mt. Elliott, 12′, 1.7 miles; Van Dyke, 15′, 1.7 miles; Warren, 15′, 2 miles; Wayne south, width undecided, 2 miles.

The shoulders now constructed, are made of gravel and limestone, using most of the latter instead of all gravel. The result is practically a macadam strip on each side of the concrete pavement. On Grand River avenue some crushed granite which happened to be on hand was used for shoulders 4′ wide on each side.

Methods, costs and equipment have been described in earlier issues.*

In conclusion, there is this bit of comparison: In 1907 the commissioners put down 2 miles of tar macadam on Grand River. It was resurfaced in 1910, again in 1911 and will be resurfaced this year. In 1909 a little more than ½ mile of concrete was put down at the end of the tar macadam stretch. The concrete apparently is in perfect condition with no maintenance charge. If it lasts only 2 years longer, according to a statement to CONCRETE-CEMENT AGE by Commissioner Edward N. Hines, it will then be a cheaper road than the macadam even if the concrete is then entirely worthless and has to be torn up. And there is every reason to believe, says Mr. Hines, that it will last 15 to 20 years more and maybe longer.

Michigan Road Builders Meet

The annual meeting of the Michigan State Good Roads Association will be held in Kalamazoo Sept. 18 and 19. Many well-known men will be among the speakers and everything indicates a successful meeting.

A question box will be one of the features, and open discussion of important subjects cannot fail to make the meeting a profitable one. A school of instruction will be another feature. Manufacturers of road machinery and dealers in road material will be present to show road builders of Michigan their latest inventions.

*See *Concrete*, February, 1910, p. 69; October, 1911, p. 27; November, 1911, p. 47; January, 1912, p. 54; CONCRETE-CEMENT AGE, July, 1912, p. 51, and August, 1912, p. 32.

Construction and Maintenance Discussion at American Road Congress

Highway engineers, builders, public officials and manufacturers of road material and machinery will be present and enter into the discussions at the meeting of the construction and maintenance section of the American Road Congress at Atlantic City September 30 to October 5. Col. E. A. Stevens, State Commissioner of Roads of New Jersey, is the chairman of the construction and maintenance section of the congress. This section will deal with streets, roads, park drives, bridges and culverts.

The subjects discussed will be sub-divided in a manner unusual to road conventions. Instead of subdividing the subject under the headings of different types of roads, the division will be made on the different problems of road construction.

In one sub-section, for instance, there will be discussed location and grades. Question 1 will deal with surveys, question 2 with new location and re-location, while under another subdivision there will be a discussion of rights of way. Question 3 of sub-section A will deal with grades—tractive resistance of various surfaces ,relation to traffic, etc. The rest of the program of the construction and maintenance section is tentatively agreed upon by the directors of the congress as follows:

Sub-Section B—Foundation and Drainage.

Fundamental Considerations (Quest. 4).

Sub-Section C—Road Surfaces.

Earth, Sand-Clay and Similar Materials, Qualities and Methods of Application (Quest. 5).

Gravel and Stone—Qualities, Test and Selection (Quest. 6).

Bituminous Materials, including tars, asphalts and oils—Qualities and Tests (Quest. 7).

Construction of Gravel and Water Bound Macadam Surfaces (Quest. 8).

Construction of Surfaces with bituminous materials (Quest. 9).

Brick Roads—Materials, Construction and Maintenance (Quest. 10).

Concrete Roads—Materials, Construction and Maintenance (Quest. 11).

Experimental Surfaces and Special Surfaces Applicable under special conditions (Quest. 12).

Sub-Section D—Maintenance (Methods rather than Administrative System).

Earth, Sand-Clay, Gravel Roads (Quest. 13).

Water bound macadam (Quest. 14).

Bituminous Surfaces (Quest. 15).

Sub-Section E—Bridges.

Highway Brdiges and Culverts (Quest. 16).

Sub-Section F—Streets and Parks in Towns and Cities.

Street Paving (Quest. 17).

Park Roads (Quest. 18).

Sub-Section C—Adaptation of Surfaces to Traffic Requirements (Quest. 19).

Sub-Section H—Road Sides (Quest. 20).

Sub-Section I.

Road and Street Contracts, Essentials and lines of improvement (Quest. 21).

The Relation of the Contractor and the public officials (Quest. 22).

Pacific Highway Association Convention in San Francisco

At the third annual convention of the Pacific Highway Association, held last month in San Francisco, Acting-Governor Wallace in welcoming the delegates stated that the ameliorating of our locality differences would be advanced, as highways permitted closer intermingling by frequent touring. The agitation which would result in the great highway being passable every day in the year from Vancouver, B. C. to San Diego would wipe out state lines and permit the Pacific coast to be the playground of the world.

John Brisbane Walker, of the Panama-Pacific International Exposition, asked interest in the Lincoln Memorial highway, showing it to be another important link of a network of permanent highways presently to cover this country. The analysis of his forecasted method of economical transportation was amply substantiated by complete data demonstrating that the *great volume of passenger and freight traffic will eventually move over wide concrete highways drawn by powerful motor cars.*

Austin B. Fletcher, engineer of the California State Highway Commission, stated that the California Highway Commission was going to spend $18,000,000 in building the best possible system of state highways.

Approximately 2,300 miles of highway have already been tentatively laid out by the commission. Of this number, 1,500 miles of road survey have been ordered; nearly 800 miles of field work have been completed, and more than 200 miles in addition are in progress of survey. There are now 37 miles of highway under contract, fifty-eight miles having a concrete base are advised for contract, and each month will see an increasing mileage on which construction work will be actually begun this year. The quality of the road to be built will be the best obtainable within the limits of the appropriation which must be made to cover a total of 2,700 miles. The traveled way will be 21′ wide where possible and 16′ wide in the mountains, and the surface to be made hard and smooth under all climatic conditions.

The choice of surfacing of main highways is betwee oil macadam road and concrete road with a bituminous surface, the latter being extremely desirable because of quality and permanency. For 1,000 miles of road not less than 2,900,000 tons of broken stone and proportionate quantities of Portland cement, culvert pipe, lumber and steel will be required. Every effort is being made to have the main state highway routes completed before the great exposition at San Francisco opens its doors in 1915.

P. Austin Tomes, for a considerable time advertising manager of the Atlas Portland Cement Co., severed his connection with that company Sept. 1, and joined the staff of the Concrete Products Co., with offices at 35 West 32nd St., New York.

Charles S. Robbins has become associated with Wadsworth, Howland & Co., Inc., Boston, Mass. He has been made sales manager and is now a stockholder in the corporation.

International Association for Testing Materials Is In Session

As this issue of CONCRETE-CEMENT AGE goes to press, the sixth congress of the International Association for Testing Materials is in session at the Engineering Societies' Building, 39 W. 39th St., New York City, Sept. 2-12, 1912. A large number of delegates have been appointed and the indications promise that the occasion will bring together a larger number of people interested in the materials of construction than has ever previously gathered. Practically all the important countries of the world will be represented by scientists of the highest distinction. Among those who are expected at the sessions, and whose names are associated with concrete in its various forms are:

Austria: Ernst Reitler, Sec'y. of The International Association for Testing Materials, Vienna.

Dr. Paul Hansel, Director and Manager of Saxonian-Bohemian Portland Cement Manf'g. Co. in Tschischkowitz near Lobositz, Bohemia.

Belgium: Emil T. Camerman, Chf. Chemist of the State Railway Administration at Malines, representing the Dept. of Railways, Posts and Telegraphs., 31 Square-Guttenberg, Brussels.

China: Kuo-Chi-Loo, of the Chinese Consulate at New York.

Denmark: Paul Larsen C. E., representing Technical Assoc. Vestergade 33, Copenhagen, Denmark.

France: M. Le Chatelier, Mem. of the Institute, Inspector General of Mines.

M. Mesnager, Chf. Eng. of Mines.

M. Feret, Chf. of Roads and Bridges of Boulogne.

M. Cellerier, Dir. of the Testing Laboratory.

Germany: Prof. Heym, Sub-Director of the Royal Prussian Material Testing Bureau.

Prof. Gary, of the Royal Prussian Material Testing Bureau.

Dr. August Dyckerhoff.

Prof. Dr. Ing. A. Martens, Dir. of the Royal Testing Laboratory, Gross-Lichterfelde West.

Prof. Dr. Hirschwald, Privy State Councillor, Berlin, Grunewald.

Frederick Barth, Chf. Eng. of the Bavarian Land Office, Nurnberg.

Prof. F. Rich. Eichoff, Prof. of Metallurgy of Iron, Berlin, Charlottenburg.

E. Bieske, Eng. and Town Councillor, Konigsberg i/Pr.

Rolin, Chf. Eng. Dampfkessel-Revisions-Verein for Austria, Konigsberg i/Pr.

Rudolph Pfeiffer, Con. Eng. of Construction to the Royal Saxony Street Railways, Dresden A.

Th. Scharff, Inspector of the Department of Buildings of the Police, Hamburg.

Great Britain: Bertram Blount, F. I. C., Westminster, London.

Leslie S. Robertson, 28 Victoria Street, London, S. W.

E. O. Sachs, 8 Waterloo Place, London, S. W.

Holland: L. Beinfait, Mech. Eng., Director of Testing Laboratory of Koning & Bienfait, Amsterdam.

Hungary: Prof. A. Rejtö, Court-Councillor, Prof. at the Budapest University of Technical Sciences.

Const. Zielinszky. The Univ. of Technical Science in Budapest.

Italy: Prof. Carlo Parvopassu, Prof. of Engineering, Royal University of Padova, Padova.

Norway: N. C. Ihlen, Former Minister of State, President of the Norwegian Branch of the International Association for Testing Materials.

Russia: N. Belelubsky, Privy Councillor, Eng., Professor Emeritus of the Institute of Engineers of Ways of Communication of the Emperor Alexander I, who will at the same time be at the head of the Russian delegation.

M. Nicholas Lashtine, Engineer, Member of the Council of the Russian Society for Testing Materials; Instructor in the Imperial Engineering School at Moscow.

Spain: Don Rudesindo Montoto y Barzal, Commander of Engineers of the Laboratory of Materials of the Corps of Engineers.

Sweden: John Oskar Roos, Hjelmsater, Chf. Eng. and Superintendent. Dept. for Testing Materials, Technical High School, Stockholm.

Switzerland: Prof. F. Schule, of the Federal Technical High School, Director of the Federal Laboratory for Testing Materials.

United States: Calvin W. Rice, New York City, representing the American Society of Mechanical Engineers.

Edward M. Hagar, President, Chicago, representing the Assoc. of Amer. Portland Cement Manufacturers.

E. C. Shankland, 209 South La Salle Street, Chicago, representing the American Society of Civil Engineers.

Russell S. Greenman, representing the Albany Society of Civil Engineers, Albany, N. Y.

Richard L. Humphrey, Philadelphia, Pa., representing the National Association of Cement Users.

A. G. Patton, 123 William Street, New York City, representing the National Fire Protection Association, Boston, Mass.

James O. Handy, representing the Engineers' Society of Western Pennsylvania.

Prof Álmon H. Fuller, Dean of the College of Engineering, University of Washington, Seattle, Wash., representing the Pacific Northwest Society of Engineers.

J. R. Wemlinger, Secretary, 11 Broadway, New York City, representing the American Society of Engineering Contractors.

The opening day, Monday, Sept. 2, is set apart for the registration of members, acceptance of the credentials of delegates, assistance of foreigners and strangers in the city in securing lodgings, etc.

In the evening the program calls for an informal reception under the joint auspices of the American Society for Testing Materials, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers.

On Wednesday section sessions are held from 10 to 12 a. m. The afternoon and early evening will be occupied by an excursion to West Point.

On Thursday there are sections sessions beginning at 10 a. m. and 2 p. m. In the evening there is a reception tendered to the foreign members by the American Society of Civil Engineers, in its building at 220 West Fifty-seventh street.

On Friday there will be section sessions in the morning and early afternoon, and an evening excursion down the harbor.

On Saturday morning, at 10 o'clock, there will be a general session at which the sections will report, and resolutions upon their recommendations will be presented. The congress will adjourn at noon.

The Museum of Natural History will receive the members of the Congress for Testing Materials and of Applies Chemistry at 3 p. m. The Museum of Art will receive the members of the congresses at 8 p. m.

It is planned that during the congress ample opportunity will be offered to see many points of interest about the city and its environs. The ladies in attendance will find themselves in the hands of a committee which will arrange for their entertainment. Local foreign societies have extended invitations to the delegates of their respective countries.

For those who desire to see something of the country and its industrial development, there will be an excursion in a special hotel train, on which the party will live during the trip. The train will leave on Sunday afternoon, Sept. 8, at 2 o'clock, reaching Washington at 7 o'clock in the evening. A sufficient stay will be made in that city to visit the government buildings, and special facilities will be afforded for inspecting the Bureau of Standards and the testing laboratories of the army and navy. From there the party will proceed to Pittsburg, where the Chamber of Commerce has prepared a two days' program of visits to the large steel, electric and cement establishments to study the latest processes in these and other fields. The U. S. Bureau of Mines will give a special demonstration of explosives.

The excursion will then be continued to Buffalo and Niagara Falls, where the local committee has prepared another two days' visit to the special industries operated by the water power of Niagara Falls. In the evening of the first day, at Buffalo, there will be a specially conducted trip through the Niagara Gorge. The return trip will be via the Lehigh Valley railroad.

Abstracts of American Papers on Cement and Concrete to Be Presented at the Congress

C. M. Chapman. Test for Concrete.—The paper urges the action of the Congress to the end that a standard test for finished concrete may be developed and adopted, and enumerates and briefly describes some twelve possible forms of tests as follows:

1. Molded Specimen Compression;
2. Molded Specimen Tension;
3. Cut Specimen;
4. Penetration;
5. Indentation;
6. Duplicate Member;
7. Standard Member;
8. Tension;
9. Improved Tension;
10. Modified Tension;
11. Absorption;
12. Deformation.

Some of the advantages and disadvantages of most of these forms are mentioned, together with a statement of the details of carrying out the tests which it would be necessary to standardize in order that results shall be comparable.

The object of the paper is to set forth matter for discussion on the subject with a view to securing action by the Congress, which will lead to a proper investigation of the subject by a committee or committees duly appointed.

Cyril de Wyrall. Electrolytic Action in Unreinforced Concrete.—The paper cites cases where concrete containing no reinforcing metal and not exposed to salt water was injured

STEEL FORMS

The Morrill System Solves the Problem

No scaffolding required. Note the swing up for raising forms.

Every progressive builder realizes the loss and waste in forms, and the high cost of finishing walls. The MORRILL system of steel forms saves all this, and gives a better, smoother wall, at much less cost, than is possible in any other known material or construction. The MORRILL forms are simple, rigid and indestructible, all of pressed steel with only wedge connections—locked and unlocked by the stroke of a hammer—of standard unit plates, yet adjustable to walls, floors and partitions of any dimensions and any thicknesses; being water-tight allow a slush mixture with no loss of cement through seepage, resulting in a dense damp-proof concrete with straight smooth finished surface. The form work cost is less than ½ cent per surface foot, reducing the cost of reinforced concrete walls in many cases, to even less than that of frame.

Write today for circulars illustrating our steel forms, showing attractive designs of our poured houses. This system offers an opoprtunity to you. The success on the hundreds of houses and other structures already built has led to rapid adoption throughout this country and abroad, being the cheapest and most substantial building method to-day known. Investigate; it is worth your while.

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Artistic and Ornamental in appearance and is positively guaranteed to be Fire, Lightning, Rain, Storm and Wind proof.

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Manufactured from best quality Worcester Grade Terne Plate, furnished painted or galvanized (galvanized after formation) size 10 x 14 inches.

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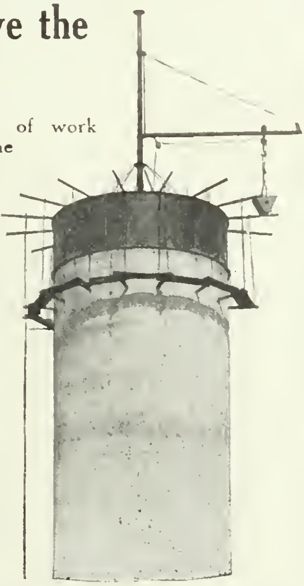
Send for New Free Roofing Book showing our complete line of Metal Roofing, Siding, etc.

You'll Get the Contracts--if You Have the Quality.

The quality of work done by the

Polk System Machine

is making every one of the thousands of prospective builders of grain storage, water tanks, silos and other work of circular concrete design want



The Polk System Machine on the Job because it Renders the Service.

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Send for Descriptive Booklet NOW

Making ready to Insert the floor beams.

Van Guilder Hollow Wall Concrete Machine---Contiauous Air Chamber from Celler to Roof

Steel Reinforced Throughout

Don't Waste Your Money

The labor employed for makiog building material such as blocks, brick, tile, etc., we utilize to erect the building.

Completely revolutionizing building methods.

OUR WALLS ARE STRONGER

being double and monolithic from footing to roof plate with a continuous air space everywhere between,—a house within a house. The walls are tied together, also steel reinforced horizontally every 9" high.

Our Buildings Are Warmer in Winter, Cooler in Summer.

Damp proof	Vermin proof	Cost less
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Exterior Finish, Up-to-Date Italian Stucco.

OUR SILO MACHINES

build the best silo walls in the world. No freezing of ensilage. No vermin. No repairs. Continuous air space Stand forever.

Send for Illustrated Folders.

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if wet, but remained intact if dry, observation showing electric potentials at the wet points.

J. Y. Jewett. Tests of Construction Materials by the United States Reclamation Service.—The United States Reclamation Service, a bureau of the Department of the Interior, is building irrigation works in arid parts of the country. Construction materials, especially for masonry construction, are used in large quantities. The service maintains a testing laboratory for cement and concrete aggregates. Its cement specifications are in line with those of the American Society for Testing Materials. Its tests of concrete aggregates have demonstrated the superiority of sands made from crushed rock, such as granite, limestone and basalt, over natural quartz sands. Sand-cement has been investigated and adopted for certain structures. Destruction of concrete by alkali is an important problem under investigation.

R. S. Greenman. Testing of Natural Concrete Aggregates.—Tests in the laboratory of the natural concrete aggregates (sand and gravel) may follow along theoretical and ideal lines. In the making of concrete, however, the fine results of the laboratory tests are often nullified by careless operation. Therefore practical tests in the field should be made to aid in securing the best results in the concrete.

I. H. Woolson and R. P. Miller. Investigations Made Upon Fire Resisting Construction in the United States.—The report embodies a brief history of the development of testing the fire resisting properties of building materials and construction in the United States, with a description of the various equipments now in use for this purpose and the general status of the work. Tabulated details of about eighty floor tests are given.

Cleveland Ohio, Paving

Cleveland, O., is experimenting with some concrete paving on the Lake Shore boulevard in Gordon Park. A trial mile is now in course of construction. The pavement now being laid is 30′ wide; some of it will be 40′. The original plans for the road, details of which are shown in connection with the this article, called for cinders under the concrete but it was found that the natural gravel bed along the shore of the lake furnished an excellent foundation. The sub-grade is given a crown of 1″, the finished pavement a crown of 2″. A diagonal joint is being used on the pavement as shown in an accompanying sketch. These joints are ½″ wide and 25′ apart. Joints are also placed longitudinally in the pavement at each curb so that the road is left in slabs 25′x28′. The joints are filled with Byerlite pavement filler and finished with rounded edges. The concrete is 6″ thick with a first course of 4½″ and a second of 1½″. The base is being made of a 1:2:5 mixture of cement, sand and gravel, both the sand and gravel being taken from Lake Erie, nearby, and the material is reported as being as clean as could be desired. The top course concrete is made of a mixture of 1 part cement to 2 parts sand and gravel with the idea that a rough surface will be obtained, which will wear better than fine sand if used alone. The work is in charge of the city engineer and is being supervised by Owen E.

(Continued on page 94)

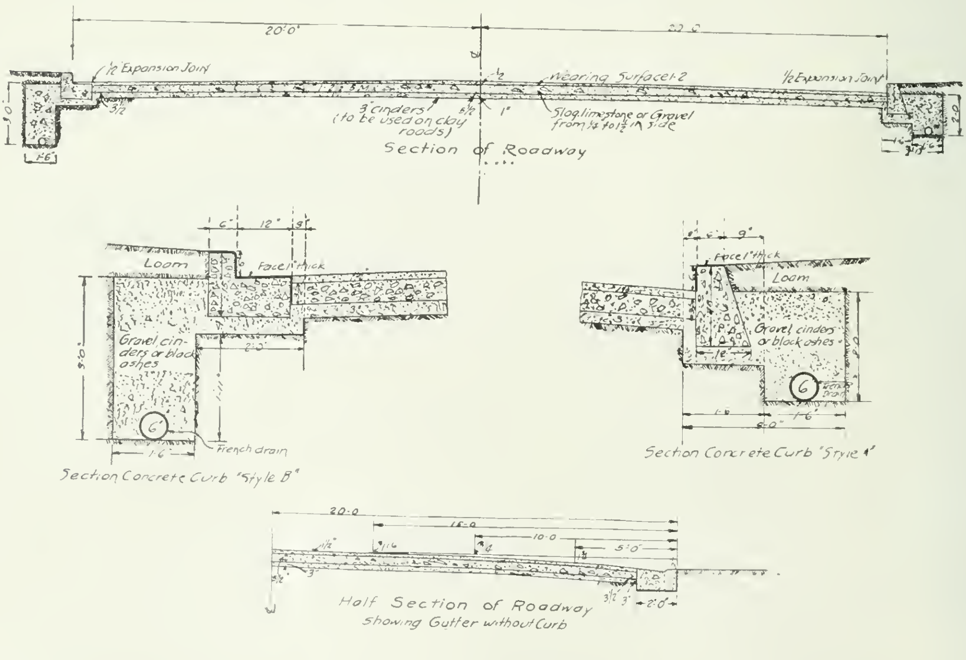

Fig. 1—Details of Cleveland, Ohio, Pavement

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Don't despair because your previous experiences have not been satisfactory. IMPERVITE works on a new principle.

A cellar 50 ft. below tidewater can be waterproofed by a 3-4 in. *INTERIOR* facing of cement mortar, treated with Impervite.

Insist on proof that a Water-proofing Compound will accomplish what is claimed. If you do this, you will use Impervite.

It is most assuredly worth your while to send a postal for Book B.

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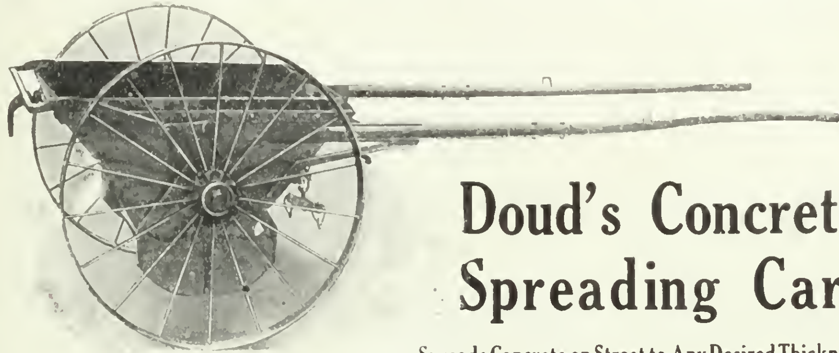


Doud's Concrete Spreading Cart

Spreads Concrete on Street to Any Desired Thickness

This spreading cart is equipped with an absolutely controllable discharge, making it possible to spread concrete any desired thickness. Made in one standard size, 21 cu. ft., level full. Body of cart 3 16 in. metal plate, reinforced with angles. Axle bearings trunnioned to sides—thus no shafts retard free discharge of material. Wheel, 48 in. dia.; truck gauge, 60 in. Top of cart stands 3 ft. above ground level. Top opening 3 ft. sq. Weight, 900 lbs.

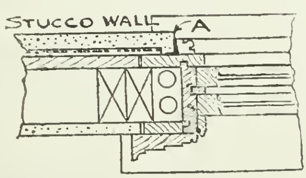
Ask for special circular describing this spreading cart.

THE ACME EQUIPMENT & ENGINEERING CO., CLEVELAND, O.

Doud's Concrete Spreading Cart represents the same high grade of mechanical perfection and workmanship that is manifested in Doud's Acme Center Dump Buckets.

McCOY'S ELASTIC CEMENT

is what you need in stucco work for pointing up cracks, caulking up windows, etc.



A permanent elastic cement or putty not affected by the ELEMENTS, ALKALIS or ACIDS. Packed in one, two or three gallon cans.

Special Trial Offer On receipt of $2.00 we will ship a one gallon can of McCoy's Elastic Cement to any part of the United States, express prepaid, with directions for use. WRITE TODAY.

HYDRO-BAR WATERPROOFINC CO.
579 West 19th St., NEW YORK

(Continued from page 92)

Conn. The surface is floated with a wooden float. Mr. Conn gives CONCRETE-CEMENT AGE some information as to the field work on the job as follows: There was very little to do in the preparation of the sub-grade. A 5-ton roller was used and considerable water to get the gravelly sub-grade worked down to a proper condition. Concrete is being used a little wetter than quaky mixed in a Smith batch mixer. A template is being used, the length of which is one-half the width of the street, cut out to shape the crown. In using this template it is necessary to put a plank in the center of the street. A board 6′ long is used for this purpose and when the concrete has been laid to the length of this board, the template run over the surface, and the concrete struck off, the plank is pulled out and the crevice which it leaves is filled with concrete. Steel plates are used to make the expansion joints. These are removed to put in the filler. The surface of the roadway is being darkened with 1 lb. of lamp-black per barrel of cement. It is expected that on part of this roadway a bituminous surface will be used, but just what it will be has not been decided.

There is a feature in the expansion joints which is best illustrated in an accompanying sketch. Instead of

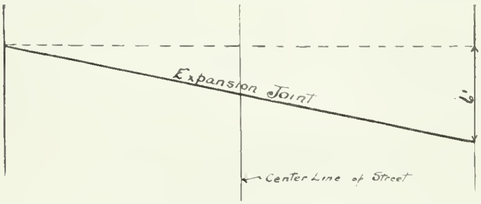


FIG. 2—DIAGONAL PAVING JOINT

extending across the street perpendicular to the axis of the street, they are at the angle illustrated.

The cost items on this Gordon Park road for one day are supplied CONCRETE-CEMENT AGE as follows:

COST OF ROAD 1 DAY

1 Finisher	$ 5.00
2 Helpers @ $3.00	6.00
8 Laborers @ $2.25	18.00
9 Laborers @ $2.00	18.00
1 Foreman	3.75
Labor	$50.75
58½ bbls. cement @ $1.50	$ 87.75
39 cu. yds. slag @ $1.15	44.85
20 yds. sand at 75c	15.00
Wear and tear on mixer	2.50
Incidentals	3.00
Coal	2.25
Materials	$155.35
Labor	$ 50.75
Material	155.35
	$206.10

In this one day paving done was 28′ wide and 75′ long or 233⅓ square yards. This makes the yard cost a trifle less than 89 cents. In addition to this is the cost of curbing.

CURB COST

Labor, 10 days	$ 507.50
Slag, 181½ cu. yds. @ $1.15	208.72
Sand, 91 cu. yds. @ 75c	68.25
Cement, 242 bbls. @ $1.50	363.00
	$1,147.47

This makes the curb cost per foot a trifle less than 32 cents.

The prices given are what things cost on the job. The sand and gravel comes from the lake, but getting it on the work requires five men, two teams and a hoist and engine.

Pittsburg and Chicago Cement Shows

Copies of the rules and regulations, floor diagrams and application blanks have been placed in the hands of the prospective exhibitors at the Pittsburg and Chicago Cement Shows. With these, announcement has been made that the first general drawing for space will be held in the office of the Cement Products Exhibition Co., 72 West Adams street, Chicago, on September 26, and that applications to be considered in this first allotment must be filed on or before September 24. Report from the office of the exhibition company indicates that interest in the coming exhibitions is undiminished.

Pres. Richard L. Humphrey is pushing vigorously the plan and program for the ninth annual convention of the National Association of Cement Users, which will be held in connection with the Pittsburg show.

Change in N. C. U. A. Arrangements

The Board of Directors of the Nebraska Cement Users' Association has made arrangements for the Auditorium for the dates Feb. 6-12 inclusive, 1913, for the annual convention and Mid West Cement Show. The Board of Directors in setting the dates have varied somewhat from the usual custom of holding the show during the week, having decided to open this show on Friday morning and running it until Tuesday night. The idea in making this change was that by holding the show on Saturday, the large Saturday afternoon and night crowds would be there that have heretofore been missed. Then by resting on Sunday it would give the exhibitors a chance to rest up and look around and get a line on prospects that had developed the first two days so that they could be closed up on Monday and Tuesday.

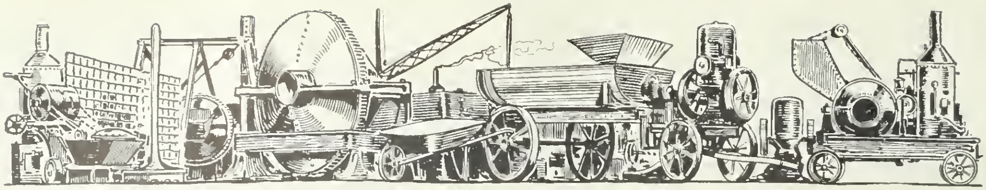
The arrangement of the Auditorium will be practically the same as last year and the prices will run about the same. The association will have a trunk line installed for electric power so that the cost of power and connection will be very small.

Highland Park and Hamtramck, Michigan

Highland Park, suburb of Detroit, Mich., has four streets paved with reinforced concrete in 1910, using Baker plates and the Thomas system. Hamtramck, also a Detroit suburb, has some pavement of the same type.*

Henry C. King has been elected president and general manager of the American Mason Safety Tread Co. to take that office made vacant by the death of William S. Lamson, who died at his home in Lowell, Mass., August 16. Mr. King has been treasurer of the company since its organization and in that time has made many friends among railroad officers.

*See *Concrete* February, 1912, p. 33, as to both these villages.



NEW EQUIPMENT, METHODS and MATERIALS

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

An Efficient Electric Hammer

The Awendou Electric Hammer Co., 121 Liberty St., New York, have recently placed in the market a light, easily-handled electric hammer. The construction is simple, and the hammer is nearly dust proof. The circuit-breaker as shown in cut, is newly patented and non-arching. A specially constructed 1/20th horse

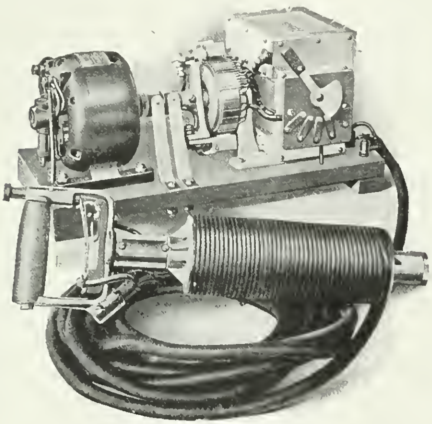


FIG. 1—NEW ELECTRIC HAMMER

power motor operates this machine and the contact brushes are made of standard motor-brush carbon, and are self-adjusting. The brush-holding mechanism is unique and insures good contact; automatically keeping speed uniform.

The hammer can drill holes in concrete up to 1" in diameter. Installation is readily accomplished by simply making connection with any ordinary lamp socket or otherwise as may be convenient. The control is in a push button in the handle. The hammer weighs 16 lbs. complete.

Adolph O. Krieger has resigned his position as publicity manager of the Busch-Sulzer Bros.-Diesel Engine Co., St. Louis, to open an office at 916 Victoria Bldg., St. Louis, for the sale of the "Tacchella" oil burning device, a new device which will be especially suitable for domestic heating purposes, japanning and annealing ovens, baking ovens and cooking ranges.

Concrete Crosswalk

The accompanying sketch and illustration from photographs show a new form of cross-walk construction of concrete. It includes a slab which gives a gradual descent from the curb to the level of the street and at the same time provides for an enclosed gutter

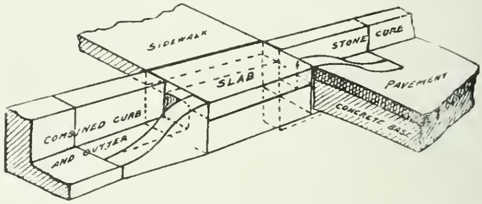


FIG. 1—CONCRETE CROSSWALK DETAIL

where it is out of the way. This crossing was designed by H. J. Fixmer, civil engineer, Chicago.

The advantages of the cross-walk are named as follows: The elimination of the use of street crossings; the elimination of the dangerous opening where a false gutter or unprotected gutter is used; the elimination of fractured curbs caused by the expansion of the sidewalk slabs; they insure dry and clean crossings for foot traffic. The top slab because of its weight is not easily displaced.

Ordinarily it is considered as a part of the pavement, and is included in the pavement bid at a cost not very

FIG. 2—A CONCRETE CROSSWALK IN PLACE

much above that of the paving which it displaces. A patent has been applied for on the crossing and it is controlled by the Siewert-Callsen Co., Chicago.

The Choice of First-Class Architects

THE better the building, the more certain that it will have a Barrett Specification Roof, because first-class buildings are the work of first-class architects and engineers and they know the relative values of the different types of roofing.

They know that a Barrett Specification Roof consists of five layers of Specification Felt cemented together with continuous layers of Specification Pitch, with a top surface of slag or gravel. It is built on the roof without the narrow joints or laps like tin or ready roofings.

They know that a Barrett Specification Roof is a substantial, fire-resistant roof, accepted at base rates by insurance underwriters.

They know further that its cost is less than that of any other permanent roofing and that its maintenance cost is nothing, making a net cost per foot per year of service, of about ¼ of a cent.

The Pittsburgh garage illustrated herewith is an excellent example of modern, fireproof concrete construction. Such buildings as this one are almost invariably covered with Barrett Specification Roofs.

A copy of the Barrett Specification will be sent, on request, to any Architect, Engineer or Property Owner. It formulates a precise and practical way of laying these roofs to secure the best results at the least expense. Address our nearest office.

Tar-Rok Sub Floors.

COST: Tar-Rok Sub Floors cost less than piers and heavy timbers and extra excavation necessary to provide required air space beneath.

RIGID: They provide for absolute rigidity. No vibration is possible, regardless of character of machinery.

STRENGTH: The load they will sustain is limited only by the earth underneath.

DECAY: They protect absolutely against decay from ground dampness.

ADAPTABILITY: They are suited for any heavy construction where wooden wearing surface is desired.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however the following is suggested:

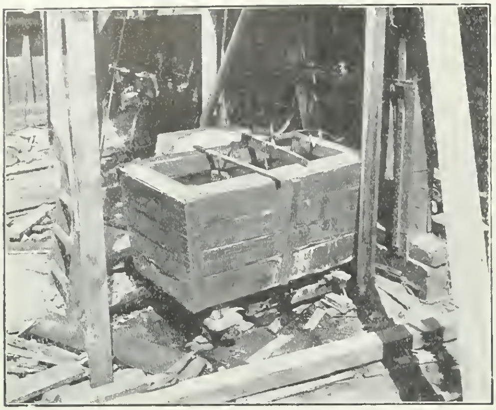
ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirement.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh New Orleans Seattle London, Eng.
The Paterson Mfg. Co., Ltd. Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S.

Waterproof Concrete for Rheostat

About a year ago, Pratt and Letchworth, Buffalo, N. Y., built a tank for a water rheostat. Before this time, several tanks built had failed, and in the concrete for this tank "Hercules" waterproofing compound was used in the proportion of 2 lbs. of waterproofing to 1 sack of cement. Wooden forms were used following accepted methods, and the concrete poured wet. The forms were not removed as they



A Concrete Tank Used for Water Rheostat.

were not in the way and the owners thought they might as well stay on. That the tank is waterproof and is standing up under particular trying conditions, is indicated by the following paragraphs of a letter from Pratt and Letchworth to the Hercules Waterproofing Cement Co., of Buffalo:

> This vat has been in operation practically 24 hours a day ever since it is finished. It does not show a leak of any kind and it certainly proves that the materials are absolutely waterproof.
>
> It may be of interest to note that the evaporation is great in this water rheostat, as it is necessary for us to fill the vat four or five times a day. When our welding apparatus is in use the water is practically at a boiling point an dat times does boil. With this tank we have had absolutely no trouble.

Steel Forms for Concrete Conduit Construction. Published by the Blaw Steel Construction Co., Westinghouse Bldg., Pittsburg, Pa., 6 x 9", paper bound; 39 pages; illustrated.

This booklet reviews the use of steel forms for conduit construction. Photographs of many conduits are shown, and the development in this field is strikingly shown.

ing structures recently completed in which this steel has been used.

Franklin Steel for Concrete Reinforcing: Franklin Steel Works, Franklin, Pa.; 8 pages; 7 x 9"; illustrated; paper bound.

An artistic booklet describing briefly the steps in the manufacture of Franklin steel; and showing some of the interest-

Steel Cores in Floor Construction

A development of more than usual interest is the use of a pressed steel core for two-way reinforced concrete floors. The Trussed Concrete Steel Co., Detroit, has recently put these cores on the market

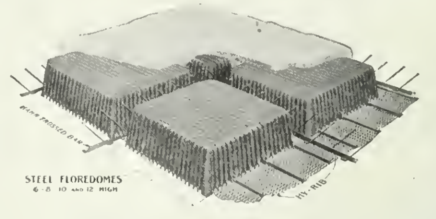


Fig. 1—A Steel Core Used with a Ribbed Mesh to Produce a Flat Ceiling

under the trade name of "Floredomes." These cores are pressed from 22 gauge sheet steel, and have a net dimension at bottom (without the flare) of 21½" x 21½". The sides taper upward at an angle of 7.5°, and the notches in the bottom are spaced 3.5" on centers. The area covered by base of tile is 3.2 sq. ft.

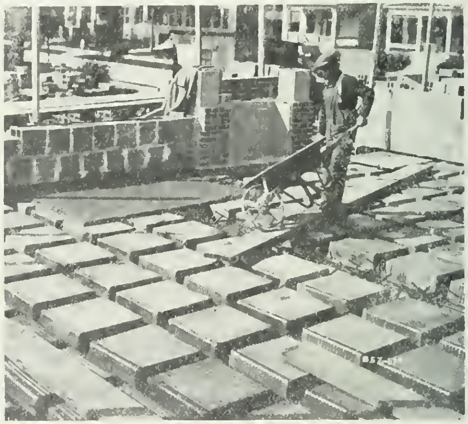


Fig. 2—A Reinforced Concrete Floor in a Detroit Residence, Using Steel Cores

L. C. SMITH BUILDING
SEATTLE, WASH

Gaggin & Gaggin
Architects

The Whitney Company
General Contractors

The highest building in the world, outside of New York City. Now being erected. Equipped throughout with The Dahlstrom Products.

PYRAMIDS

ANCIENT AND MODERN

REALLY fireproof buildings are as indestructable—by fire—as the pyramids. The modern type of building can be readily likened unto an Egyptian pyramid. Their stability is fact. Their endurance is not a matter of chance.

When a building is structurally fireproof and the possibility of a fire traveling from room to room or floor to floor completely obviated, it is an impossibility for the incipient fire to generate sufficient heat to cause a greater damage than consume the inflammable contents of the room, compartment or unit in which the fire originates.

The installation of The Dahlstrom Products totally eliminates the possibility of a fire from spreading by the simple method of starvation. A fire, will not, cannot travel, from its point of origin for The Dahlstrom Products offer no additional fuel for it to feed upon. To accomplish this final, necessary and absolute degree of fireproofing nothing of an artistic nature is sacrificed.

We would be pleased to show you samples of the inimitable Dahlstrom finishes. It is well to remember also, that their range is unlimited.

Particulars may be had upon request

Dahlstrom Metallic Door Company

Executive Offices and Factories,
72 Blackstone Avenue, Jamestown, New York

Branch Offices in All Principal Cities

DAHLSTROM PATENT DOOR ARTISTIC EVERLASTING SANITARY AND FIREPROOF

The tile is made in the following heights and weights: 6", 5.3 lbs.; 8", 6.3 lbs.; 10", 8.5 lbs.; 12", 9.7 lbs.

This core makes possible a very efficient two-way reinforced concrete joist floor. A flat ceiling is secured by laying the core on a ribbed mesh. The edges

Mt. Tabor School, Portland, Oregon
The arrangement of the centering and the ribbed mesh is shown in Fig. 4.

of the "dome" are notched to fit over the ribs of the mesh.

"Floredomes" save in labor in the field in time of erection. Being nearly 2' square and light in weight, they are handled as easily as an ordinary 12-in. square terra cotta tile which covers less than one-third of

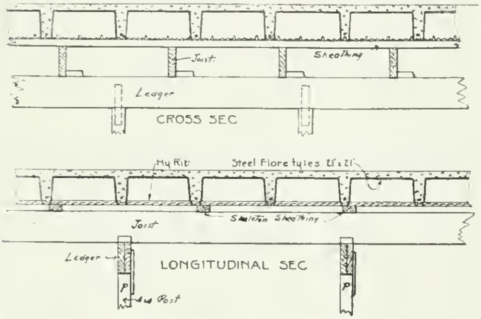


Fig. 4—Longitudinal and Cross-Section Sketches Showing Arrangement of the Centering

the floor space. The joists—over 2' apart instead of 16"—can be much more rapidly and economically filled with concrete.

These steel cores are water-tight, so there is little loss of concrete filling in between joints or in a broken part, as with terra cotta tile. The "Floredome" is tapered and can readily be crated for shipment to any part of the country, while clay tile is restricted in use to the neighborhood of the manufacturing plant because of its weight and consequent cost of freight.

In erection, a very simple centering can be used. A typical detail is shown in the accompanying sketches and photographs.

Tools & Supplies for Cement Workers. W. H. Anderson Tool and Supply Co., 14-16 Macomb St., Detroit, Mich.; 48 pages; illustrated; paper bound.

This is a complete though small catalog, illustrating and listing all the tools used by the cement worker.

Ontario, Canada

The Department of Public Works of Province of Ontario, Canada, is considering the construction of 35 miles of concrete highway between Toronto and Hamilton. A mile of concrete road has been constructed this year in York county, near Toronto. The road is 15' wide, 7" thick in one course, mixed 1:2:4, transverse expansion joints 40' apart filled with sand. The surface of the road is covered with Dolarway bitumen and stone chips and cost $1.75 per sq. yd. The work was done under the supervision of the county engineer, the specifications being approved by the Provincial Highway Department, the province paying one-third of the cost.

Winona County, Minnesota

Winona county, Minnesota, is beginning the construction of concrete highways similar to those in Wayne county, Michigan.

Bozeman, Montana

A description of the concrete pavement put down in Bozeman, Mont., in 1908, written by C. M. Thorpe, then city engineer, was published in *Concrete* in April, 1909. The sub-grade was first rolled with a 10-ton roller and 3" of gravel was put in wherever the subgrade did not already consist of gravel Forms were so set as to cast the pavement in alternate 10-ft. square blocks. Joints were filled with asphalt. Concrete was then put in to a depth of 5½" and tamped. This concrete was composed of 1 part cement to 6 parts clean, bank gravel, 2" maximum. Before this had set the 1½" top coat composed of a 1:1:1 mixture of cement, crushed boulders or pea gravel (under ½") and sand. This was marked off in blocks 4" x 8", and ¾" deep, using planks with bands on one side to make the grooves. The long way of these blocks is parallel with the length of the street. After this marking the surface was brushed and was closed to traffic for three weeks. With cement costing $2.40 per bbl., sand $2.00 per yd., gravel $1.25 per yd. and labor $2.50 per day, the pavement cost $2.28 per sq. yd.

Articles on Steam Curing

The award of $25 for the most valuable contribution on steam curing in concrete products manufacture has gone to Robert F. Havlik, Detroit, Mich., for the article published last month. Numerous other, and all valuable, articles have been secured and will be published in early issues.

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2804 Fifteenth Ave.,
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Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa., Convention, Pittsburgh, Dec. 12-18, 1912.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary. Land Title Bldg., Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Bldg., Washington, D. C.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Building, Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Nebraska Cement Users' Association, Secretary-Treasurer, Frank Whipperman, Omaha, Neb. Convention and Show, Auditorium, Omaha, Feb. 6-12, 1913.

Pittsburgh Cement Show, Exposition Hall, Dec. 12-18, 1912.

Chicago Cement Show, Colliseum, Jan. 16-23, 1913.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

In This Issue

Vol. 1 DETROIT and NEW YORK, OCT. 1912 No. 4

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(25)

Concrete-Cement Age

Vol. I | OCTOBER, 1912 | No. 4

Editorials

THE BEST THOUGHT and purpose of the Good Roads movement—with its many ramifications and elements of appeal—are finding expression at the American Road Congress at Atlantic City, N. J. The "better highways" idea does not so much need stimuli as it requires direction. It really isn't so remarkable that there are so many poor roads in the United States as that there are very many good ones, considering the way in which most states have carelessly relegated the important public function of road building and maintenance to a haphazard, local administration. The half-measures of highway provision even when well-intentioned (as in many cases of "working out road taxes" have not been the case) are in most cases without engineering supervisions or business management, due to influence of politics. It is to such situations of inadequate measures, penny-wise policies of temporary, road patchwork, unsystematic and unrelated construction as between counties and states—it is to the remedy of these failures that the American Road Congress is bringing engineering experience and business sense. The Congress has brought together—for the public welfare—the men who know. The building of roads is something more than dumping material into low spots and scraping it off the high spots. The speakers at Atlantic City are revealing the road problems in their every aspect—the need of roads for social and economic reasons; the highway laws which do or might make for the greatest public benefit; the organization and administration which makes most directly for efficiency; the construction under various conditions which gives the best service and the maintenance which insures security of investment. The Congress is developing road knowledge which will give definite direction to the purpose of highway improvement, aroused by new transportation needs the country over. The pith of the meetings being held as Concrete-Cement Age goes to press will be found in this and succeeding issues.

* * * *

AT THE SIXTH CONGRESS of the International Association for Testing Materials, held in New York, His Excellency, N. Belelubsky, one of the most distinguished engineers of Russia and the newly elected President of the Association, gave considerable information, in general conversation at the Congress, as to the conditions of the cement market in Russia. He said that the building conditions in Russia were so excellent and the demand for all building materials so great, that the cement manufacturers have not been able to keep up the supply at all and that in many cases work was being held up for lack of cement, and that there was a large field for the construction of new cement works and the development of new concrete industries in Russia. He expressed the general feeling that with the new harbor work on the Black Sea and on the Baltic now under contemplation, the Government would be a large consumer, and that all through Russia the demand for cement was beginning to awaken just as it did in this country ten to fifteen years ago.

Sixth Congress of the International Association for Testing Material

In another column will be found a full and extensive report of the proceedings of the Sixth Congress of the International Association for Testing Materials, especially that part of the Congress which relates to cement and concrete. The business of the Congress was divided into three sections. The section having to do with cement and concrete was largely attended by scientists and manufacturers from all parts of the world. As will be noted by the report referred to above, three important subjects were treated in groups of papers of singular ability and intelligence. The great—and one might almost say the burning—question of the hour was that relating to accelerated tests for constancy of volume for Portland cement, which occupied an entire day's session. The Le Chatelier test, adopted at the Copenhagen Congress, was strongly advocated by the English and French, and opposed by the Germans and the Americans. The basis of the attack was the lack of reliability of the test as shown in many series of experiments, while the value of the test was supported in a most interesting paper by Le Chatelier, read by Mr. Feret, citing the causes for the alleged inaccuracy of this test.

The important question of the use of Portland cement in salt water was the subject of another group of papers which treated the matter in a most lucid and definite way, going so far as to differentiate between the behavior of concrete in salt water of the North Sea and the Black Sea, owing to the difference in the percentage of salt contained in the water of these respective seas.

The world-wide opinion of concrete, as shown in Dr. Schule's report, with its co-related papers from such authorities as Talbot, Von Emperger, Sachs and others, made a profound impression upon the Congress, and Von Emperger's suggestion of a uniform method of reporting concrete failures in all nations was received with the greatest consideration. Other contributions to the manufacture and scientific testing of cement and to the accurate testing of concrete in plastic prisms, were read.

The field may be said to have been thoroughly covered in the important papers presented and the discussions that took place, and it was a noticeable fact that in the cement section the attendance was most active in its interest, and in taking part in the discussion of the various subjects presented.

The results of the Congress, so far as the actual final settlement of the various questions involved, is shown in the resolutions which were adopted and which represent the best conclusions of the many minds engaged in the settlement of the various matters presented for consideration. While the initial proceedings of the cement section presented many points of difference among the several nationalities represented, it is a cause for congratulation that on the final day of the section's work, all the resolutions presented by the committee were unanimously passed, and the participants in the work of the section joined hands in singing "Auld Lang Syne." All nations believed that they had received fair consideration and that all questions had been justly and rightly determined by the Congress.

Another feature of the Congress itself as relating to the various industries represented, and one entirely apart from the deliberations and proceedings, was the social intercourse which grew out of the presence, under a single roof, of so many scientific men from all parts of the world. The rubbing together of the best minds in the cement industry in this country and in Europe is certain to be productive of the greater development of the industry itself. The visit of the foreign cement manufacturers to the various cement works in Pittsburg, the Lehigh district and the Hudson River district, is bound to be instructive to the visitors, while those who opened their works for the inspection of the foreign guests were no less benefited. The interchange of experiences in manufacturing and testing and in actual work with concrete, was an endless one. It is needless to say that as a result of the Congress and of its attendant festivities and inspection tours, the cement industry has been greatly benefited, as well as the concrete industry and humanity at large, through the intercommunication of information of the most valuable character.

Imitating Other Materials With Concrete

The necessity of urging that concrete be allowed to stand upon its merits instead of employing it in imitation of other materials was essential at the time of its early development owing to attempts to reproduce things that were not only devoid of merit in themselves, but which looked even more deplorable when translated into concrete. We feel, however, that some of our concrete enthusiasts are carrying this theory a little too far, indeed, to a degree that will tend not only to restrict the legitimate field of concrete but to retard its sale when manufactured into certain products. The subject, we confess, is rather difficult to make clear, for we are bound to encounter a seeming contradiction or paradox now and then, but nevertheless we are convinced that many makers of cement products will welcome discussion calculated to enlarge opportunity, for the time has certainly arrived when there should be qualification if not entire revision of some of the statements frequently made.

The Rock-faced Block.

To go back to the origin of the discussion, we immediately encounter our old friend, the rock-faced concrete block, which will serve as a text in this instance. It has been the popular thing to condemn the rock-faced concrete block merely because it was an imitation. In reality the trouble was not that it was an imitation but that it *failed to imitate*. As a matter of fact here was a case where concrete deserved condemnation not because it looked like dressed stone but because it *failed* to resemble it in sufficient degree to become its exact counterpart. Block makers found it impossible to render a clean-cut, sharp and variegated surface through the medium of a plastic material and repetitive process, and, moreover, a surface not pleasing in its original form. On the other hand, if the rock-faced block cut from natural stone were really beautiful, and we were to cast blocks in concrete and then chip them with a chisel, producing exactly the counterpart of the dressed natural stone, we would not be doing violence to any law of art or good taste. Aside from a plain concrete wall, it would be difficult to make many things in concrete that would not imitate stone or wood. Plain concrete beams surmounting an ardor or pergola are an imitation of or rather a substitution for dressed timber beams, a perfectly justifiable reproduction, and one for which we need not apologize or offer explanations. At the same time we would not recommend the imitation of undressed, rustic beams or poles. The process would be too elaborate and mechanically complex and the result not pleasing. Concrete window sash made from a wooden pattern would be entirely proper. If we find a beautiful urn in terra cotta, cast iron, stone or marble, it would be right to use it as a pattern that we might have other examples in indestructible concrete. If the original chanced to be of stone, and we sought to reproduce not only its form but pleasing texture, thus making an exact duplicate of the original, why not? The same thing applies to a column with ornate capital copied after some stone masterpiece. *Concrete, in brief, offers a short cut to satisfactory results through economical processes.* Copy a cut stone urn and scrub and dress the concrete surface to the texture of the urn as carved from natural stone, and the result is a *vase of stone,* practically a replica of the original. If possible to obtain this texture by cheap and convenient means why not resort to them. If experts cannot tell the difference so much the better. *Each would be a stone urn.*

The thing to avoid is *false imitation,* if we may coin the term. For example, the man who plasters a wall with cement or lime mortar and then marks out joints in imitation of stone is a fakir. He deceives us. He is representing his work to be something durable and strong, when it is not as indestructible as the thing he imitates. On the other hand, if his structure were built of first-class concrete block with surface treated in exact counterpart of dressed natural stone, that is what we would have to all purposes and intents. We would not care whether he called the blocks concrete or stone. Some of the most beautiful buildings architects have designed are ordinary brick construction faced with terra cotta in imitation of cut stone. Nobody quarrels with them on this point. Then why criticise the concrete worker for making an admirable product in imitation of another material?

Sincere Construction.

Perhaps it would avoid confusion to say that where concrete *as concrete* holds its own with other products, never touch it. This, for example, would apply to concrete walls. It is our conviction that the public, influenced by artists and architects, will eventually grow to like the plan and untouched concrete wall as applied to dwelling construction—durable, fireproof, monolithic structures—untreated beyond the use of very simple decorative processes in form or color. It would be in cases of this kind that the admonition never to imitate would apply. And just as rude concrete may stand untouched in a house or engineering work, so it may stand in certain decorative designs. A coarse cinder concrete column in a vine-clad arbor would represent minimum outlay as to cost and at the same time be quite as beautiful as something more ornate and elaborate. Work of this kind need not pretend to be anything but the rudest type of concrete, something that would take its place in the landscape with the unobtrusiveness of a tree or rock.

In conclusion, the point we would emphasize is that we need make no hard and fast rules governing the use of concrete. Merely let people know that it *is* concrete. The success of the individual will depend entirely upon his good taste and skill. He should not suffer from the many restrictions certain to grow out of the unqualified and sweeping statement that he must never imitate, for, as stated above, he is merely taking a short cut to accomplish good results. Possessed of the knowledge to discriminate between good and bad things, and when to copy and when not to copy, his duty in the premise is to avoid deception as to the nature of the material and to claim nothing in the way of originality or artistic ability where he has appropriated the design of another. He should, however, receive full credit for good taste in selection and the skill which enables him to reproduce and distribute at moderate cost many beautiful things the world at large would have little opportunity to see or enjoy were it not for concrete. That is why it is such a wonderful material, embracing in its adaptability practically all of the virtues of other materials, thus providing the artist, craftsman and builder endless resources and opportunity for the exercise of his best talents.

CONCRETE-CEMENT AGE at the Pittsburg Cement Show

CONCRETE-CEMENT AGE will occupy space No. 28 at the Pittsburg Cement Show, December 12-18, 1912, and Space No. 21 at the Chicago Cement Show, January 16-23, 1913. At the shows, as elsewhere, we are at your service in every way. If you desire to have your mail addressed to you in our care at the Coliseum, Chicago, or at the Exposition Hall, Pittsburg, while the shows are on, we shall be happy to take care of it, and deliver it to you when you call for it. Both spaces are conveniently located for visitors and we shall be glad to see you. Plan to make your headquarters with us and to make use of us all you can. That is one of the things that takes us to the shows—the desire to be of service to our friends.

Concrete Homes in Suburban Development

Permanent Buildings Enhance Land Values in a Chicago Suburb

BY MILTON DANA MORRILL.*

Reinforced concrete has been rapidly adopted for all the larger types of structures, such as bridges, factories and the like, but up to the last few years the number of residences built of reinforced concrete has been comparatively small. In the field of domestic architecture, reinforced concrete can perhaps be of more use to the general public than in any other type of building, and the construction of suburban settlements of permanent fireproof dwellings will do much towards solving the problem for all classes of congestion of population. With the modern systems of fast interurban electrics, and with the development of permanent and attractive homes at low cost, there is no need for the tenement with all its resultant ill effects on future generations. Concrete is playing an important part in the solving of this great housing problem. It is today recognized that the timber frame construction is extravagant and costly when fire risk, up-keep, painting and repair are considered.

In the United States, statistics show that the fire loss for the year 1911 was $2.62 for every man, woman and child. In Germany, on the other hand, where permanent, fireproof houses are the rule, the fire loss was but $0.21 per capita. If statistics on the up-keep and repair were obtainable, it is probable that the comparison would be still more striking, as would also the figures showing the cost of municipal fire protection.

A disastrous fire in European cities is almost unknown, whereas in this country scarcely a month passes without one or more of our villages or towns being swept by a general conflagration. We must and more completely fireproof suburbs and cities, and to laws which will permit reinforced concrete buildings to be erected under more liberal regulations. In outlying boroughs of New York, for instance, regulations require that concrete residences shall have walls at least 12″ in thickness, while in the same districts, permits are easily obtained for the erection of a 6-in. frame construction, although the authorities recognize that a 6-in. reinforced wall is infinitely stronger and better than the construction generally permitted. Wherever it has been proposed to change regulations, requiring more permanent construction, the speculative builder has come forward with complaint that such regulations would curtail and paralyze house building. The speculative builder's interests generally terminate with the completion of his work. As the property passes out of his hands soon after completion, he is not further interested in the up-keep, repairs, fire loss, or unsanitary condition into which the buildings may lapse. Our most progressive builders and land development companies now realize that better and more permanent construction is of distinct value to them, as such structures tend to increase land values.

It is not uncommon to find that the land values in our suburbs built of frame, decrease when the "new" has worn off. As the frame houses become dilapidated, and out of repair, this is bound to occur, unless continued vigilance and expense are maintained in their constant up-keep.

Perhaps one of the most striking and interesting developments in the building of permanent homes is presented by the development at High Lake, a suburb of Chicago, in which the firm of E. A. Cummings Co.

*Read and Morrill, Brooklyn, N. Y.

FIG. 1. A CONCRETE BUNGALOW AT HIGH LAKE, NEAR CHICAGO

Fig. 2. Group of Concrete Bungalows in a Chicago Suburb.

is employing reinforced concrete homes in land development. Its success here shows that the public realizes the advantage and value of this type of residence. Reinforced concrete was adopted at the recommendation of W. L. Twining, who has charge of building and developing this unique suburb. It is attractively located on the Aurora & Elgin Electric Railroad, where acre and half-acre plots are grouped around a beautiful lake. The homes are for the most part of the bungalow type, since this appeals to the purchasers who are largely drawn from the city apartment, and who are accustomed to the comforts and conveniences of having all living rooms on a single floor level.

The houses built and occupied last winter give conclusive proof of the advantage of this material for home building. The owner of a 7-room bungalow reports that throughout the severe winter weather his home has proved warm and dry, and less than five tons of hard coal furnished heat from a hot air furnace from October 24 until the fire went out last spring. The company reports that the cost of concrete dwellings has been less than in similar buildings constructed by any other method, even as compared with the frame houses. Much public interest has been centered on the High Lake development, as it seems to point the way toward a better and more nearly permanent type of development. As a result, groups of reinforced concrete houses have been started within the past year near many of the cities of this country, as well as in Canada and in Europe.

In several of these undertakings, steam cinders have been employed, which, when mixed with cement and lime, make an extremely dense, damp-proof structure, light in weight, and forming an excellent insulation against heat and cold.

A group of 40 of these reinforced concrete houses is now nearing completion at Nanticoke, Pa., for the D. L. & W. R. R., where the walls, floors, roofs and partitions are entirely of cinder concrete built by the use of steel forms just as the High Lake houses have been built.

Later issues of Concrete-Cement Age will describe in detail the field methods used in this work.

Mine Tailings for Concrete in Missouri

During the past few years the chats or mine tailings produced in the Joplin and Flat River districts have become an important factor in the state industry of Southern Missouri. According to figures obtained by the Missouri Geological Survey, more than 1,500,000 tons of this material were used in 1911. In commercial work chats is used chiefly for concrete and as a road metal; it is also extensively used for railroad ballast.

The following tables indicates the tonnage of this material used for both railroad and commercial purposes since 1909:

	1909	1910	1911
Railroad purposes	355,901	1,009,533	865,011
Commercial purposes	472,934	610,789	638,592
Total	828,835	1,620,322	1,503,603

During 1911 there were approximately 1,015,800 tons shipped from the southwest zinc district, while the southeast lead district shipped approximately 487,000 tons. More than one-half of the total tonnage has been used for railroad ballast, being utilized chiefly by those roads traversing the various mining districts. The many miles of macadamized roads of Jasper county speak for the efficiency of this material as the cheap road metal. Although the limestone is rather soft, when mixed with oil or asphalt it results in an almost dustless road.

The various mining districts produce millions of tons of chats yearly and the great tailings piles offer an almost limitless supply of this material for constructional purposes. Since the material is already crushed, the cost of utilization is largely that of haulage.

The commercial use of chats could be greatly increased outside of the mining districts.

H. A. Buehler, state geologist, comments on this use of chats for concrete aggregates as follows:

No tests have been made as yet to determine the value of chats as compared with other materials for concrete aggregate. Occasionally one hears some complaint about the use of tailings in which there is a rather high percentage of marcasite or pyrite. Apparently the oxidation of these minerals affects the strength of the concrete which is probably due to the fact that through oxidation a portion of the sulphur forms sulphuric acid which would readily dissolve the cement binding. However, where the tailings are free from these minerals they are well adapted for commercial purposes and their use could be greatly extended in commercial work.

A Locomotive Coaling Station on the Philadelphia and Reading R. R.

In connection with the work of abolishing grade crossings on the line of the Philadelphia, Germantown & Norristown Railroad between Green St. and Wayne Junction, there has been constructed a reinforced concrete building in the Green St. yard of the Philadelphia & Reading Railway for coaling locomotives. The building proper is supported on 7 lines of reinforced columns and spans 7 tracks. Six of these tracks are for coaling and cleaning locomotives, while the seventh track is used exclusively for ashes. The floor of the bins are of such a height as to permit locomotives of the largest type to pass under, coal and dump ashes. One end of this building is carried on the end wall.

The main body of the building is provided with 12 coal pockets and each pocket has 2 coaling chutes. The 12 coal pockets have a storage capacity of 2,000 tons and the coal-handling machinery is capable of handling 100 tons per hour.

The coal is delivered on a track at the westerly end of the building at such an elevation as to be permitted to be dumped into a hopper below track level. From this hopper, it is carried up and distributed to the several coal pockets by buckets of the Link Belt Engineering Co. type. Machinery for handling ashes has a capacity of 250 cu. yds. per day of 10 hours.

The main frame of the building is structural steel

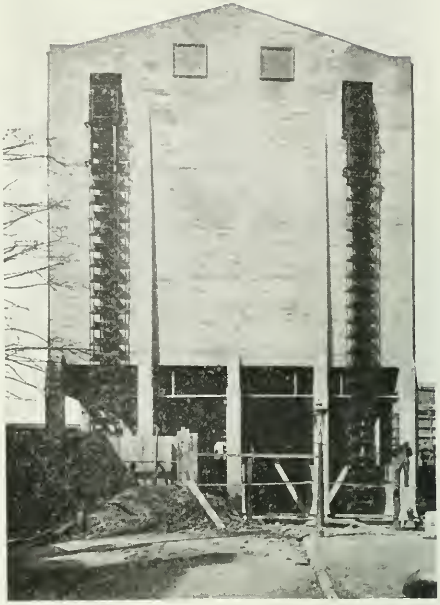


Fig. 2. Detail End View of Coaling Station

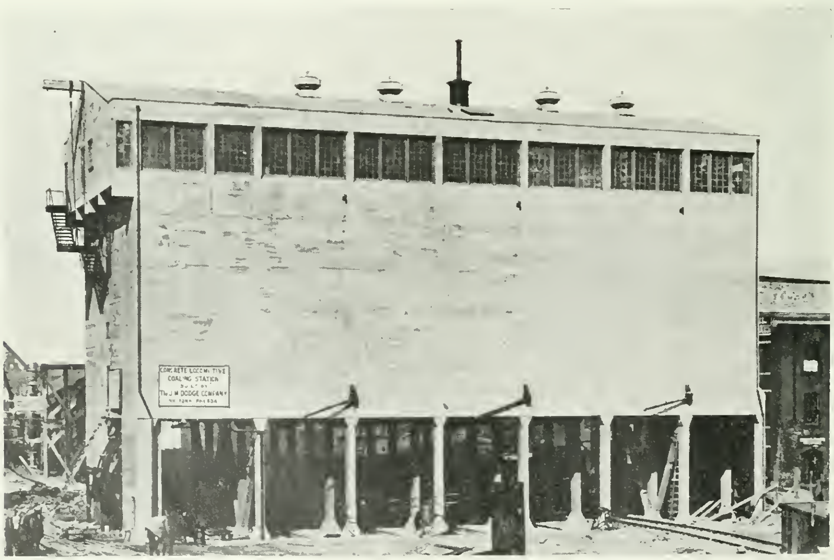


Fig. 1. General View of Locomotive Coaling Station of the Philadelphia and Reading R. R. in Philadelphia

work, while the walls, partition and floors of the pockets are of reinforced concrete construction.

The building has been tested to its full capacity, and no apparent settlement or cracks have developed.

Fig. 1 shows a general elevation of the building with the permanent coal delivery tracks at the west end of the building, yet to be constructed, and Fig. 2 shows the easterly end of the building and the coal-handling conveyors.

The building together with the machinery complete, ready for operation cost $96,700. The contractors were the Link Belt Engineering Co., of Philadelphia.

A Concrete Hotel in the Phillipines

The new Manila Hotel, just completed, is believed to be not only the biggest, but the costliest, reinforced concrete structure in the Far East. Certainly it is the largest in the Philippines, and next to the government ice and cold storage plant, is the most costly commercial building in the islands. The cost is upwards of one million pesos, or $50,000, and native labor, under the direction of American superintendence, was used to much extent.

The hotel building, besides its other distinctions, is also the highest in the islands, being seven full stories from the basement floor. It is constructed of concrete and steel throughout, except that the floors and some of the ceilings, in the larger rooms, such as in the dining rooms, the lobby, and the reception halls, are of fine Philippine hardwoods, highly polished. Also, the building is the first in the archipelago, and possibly the first in that portion of the Orient, to have electric passenger elevators and an inter-communicating telephone service throughout the structure.

The kitchens and grills have the very latest steam and electric cooking apparatus, and there are numerous steaming and refrigerating equipment on the roof-garden floors and in the reception halls for heating and cooling food and drinks.

The lower floor, besides a large lobby graced by colossal pillars and arches, has a spacious dining hall. This has a wide veranda running its full length. The veranda may also be used in good weather as a sort of auxiliary dining room, as the wall between the dining room and the veranda can be folded up out of the way. On this same floor are roomy reception halls, a barber shop, a bar, a haberdashery, and booths for news stands and curio shops. The pool and billiard halls are equipped with English and American tables.

The small towers at the corners of the roof-gardens give space for two unique accessories uncommon to most other hotels. In them are located the

Fig. 2. Detail of One of the Entrances, the New Manila Hotel

"Aeroplane Cafes," designed for use of the Manila Aero Club and the friends of the membership when aviation meets are being held on the Luneta adjacent to the building.

There are several roof-gardens, some covered and some uncovered, with suitable elastic "conolite" floors for dancing and other diversions. Besides the large, inviting verandas of the ground floor, the upper-story windows are provided with picturesque balconies, and the windows themselves are fitted with the "oyster-shell" windows common to that part of the world. All windows are shaded by permanent awnings to shut out the tropical high-lights so objectionable to residents in mid-day.

The building rests on a solid foundation of hardwood piling driven to a depth of 16 meters (52′ 6″), and covers, with the grounds, an area nearly two

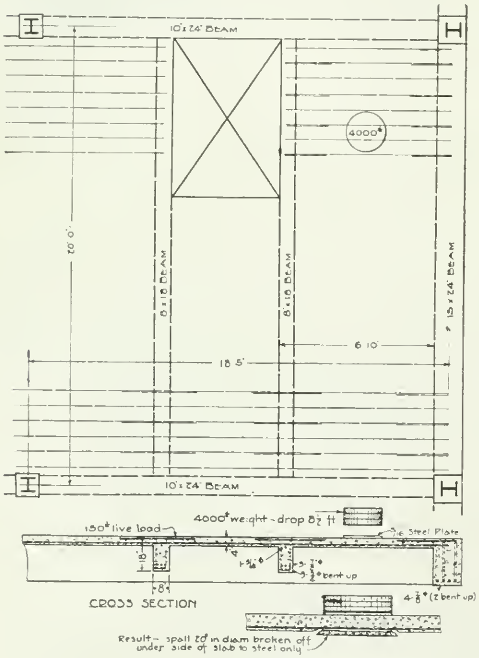
Fig. 1. General View of Reinforced Concrete Hotel Recently Built at Manila

square blocks in extent. The sumptuous grounds have a series of fine lawns, sunken gardens, fountains, and flowers. Graceful shelled drives are cleverly laid out, and the Cavite boulevard, skirting the bay shore for many miles, runs past the hotel. The building stands on land reclaimed from Manila bay. A few years ago big army transports rode at anchor over the spot. The hotel has 146 guest rooms, over half of which have modern baths and plumbing in direct connection. In addition to these there are several elaborate suites.

Manila, once notorious because of a lack of suitable hotel accommodations, now boasts of the best in this line, and in time the new structure will be known as one of the world's most attractive resorts.

Resistance of Concrete to Shock

The ability of reinforced concrete to withstand a sudden concentrated heavy load is shown by a recent accident at the warehouse of the New England Waste Co., Revere, Mass. This building is of reinforced concrete with steel columns and brick curtain walls. It is 180'x56' in plan, 4 stories high, and was designed by Lockwood, Greene & Co., Boston. The contractors were the New England Concrete Construction Co., of the same city.



Sketch Showing the Situation When a 4,000-lb Weight Fell 8½ Ft. with Negligible Damage to Concrete Floor

On the 2nd floor at one side of the building is located a baling press with plunger running through the 3rd floor and counterbalanced by a 4,000-lb. weight made up of pieces of cast iron. The floors are 4-in. concrete reinforced as shown in the accompanying drawing, and were designed for a 150-lbs. live load.

The weight was suspended from the 4th floor by a through bolt with hook and pulley attached. Soon afterwards the rope parted and the 4,000-lb. weight fell to the floor, striking a 3/16-in. steel plate which happened to be directly underneath. The floor struck was carefully examined and the only damage was a flaking off of concrete in a space about 20" in diameter on the under side of the floor and extending up to the surface of the steel. When one considers that over a horsepower of energy was applied to this 4-in. slab with so little injury, the incident becomes all the more remarkable. The proportion of concrete specified by the engineers was 1:2:4. The floor was 6½ months old at the time of the accident.

Portland Cement Production in Missouri

Portland cement has recently become one of the important mineral products of Missouri. In 1911, according to figures collected by the State Geological Survey, there were manufactured in Missouri 4,114,859 bbls. of Portland cement, valued at $3,349,312. The rapid development of the Portland cement industry is indicated by the fact that the first plant was constructed less than 10 years ago, while at the present time, with an output of more than 11,000 bbls. per day, Missouri stands fifth in the production of this important structural material.

Missouri is favored with an abundance of limestones and shales suitable for use in the manufacture of Portland cement. Many of the formations of the Ordovician, Mississippian and Coal Measures series have the proper chemical composition for use in this industry. The Ordovician limestones occur chiefly in the eastern part of the state, occupying a narrow belt extending from Pike county on the north to Cape Girardeau on the south. The Mississippian limestones occur chiefly in the northeastern portion of the state and the Coal Measures contain a number of limestones of commercial thickness. These are well exposed at Kansas City and along the bluffs of the Missouri river on the north.

The shales of the Coal Measures and Mississippian and clays of the Quaternary are used in conjunction with the limestones. Extensive deposits of shale occur in the northeastern and northwestern portions of the state. The dolomites occurring throughout the south central portion of the state cannot be used in the manufacture of Portland cement because of the high content of magnesia.

The distribution of the various geologic formations suitable for use in the manufacture of Portland cement is well shown upon the geologic map accompanying the report on Lime and Cement Resources, published by the Geological Survey of Missouri. This map and report may be obtained by addressing H .A. Buehler, State Geologist, Bolla, Missouri.

Comparative Strength of Tile and Concrete Wall Sections

The Robert W. Hunt Co. has recently conducted a series of tests on the comparative strength of tile and concrete wall sections. The tests were conducted for the National Fireproofing Co., at their new laboratory in Chicago.

This testing station is of modern construction and equipped with a 300-ton hydraulic testing machine, which will accommodate structural test specimens up to 12′ in height and 3′ wide. The cylinder and ram are set on a concrete foundation, and the ram has a spherical bearing for the lower (sliding) crosshead to insure uniform pressure. For handling the specimens and the upper crosshead, there is a traveling crane which serves the entire floor. At one side of the room the pressure pump is located.

The log of the test is as follows: The specimens included sections of a wall 12′ high and 36″x4″ and 8″ in section. All were tested to destruction except the concrete.

Concrete: A reinforced concrete wall section was tested on May 14. It was a 1:2:4 concrete of "Owl" cement, torpedo sand and ¾-in. crushed limestone. The wall was reinforced with eight ⅝-in. round rods, 4 on each side, 1″ from the exterior surface and ½″ from the ends, interwoven with No. 14 gauge wire netting. The specimen was 40 days old. It lacked the horizontal reinforcing usually found in practical construction. Upon this specimen loads of 10-ton increments were applied at two-minute intervals. The first deflection occurred at 10 tons and was .005″. The final load was 300 tons, the capacity of the machine. The deflection was .005″. The concrete refused to give even an indication of failure, the load being approximately 2,060 lbs. per sq. in. The load was released and then rapidly re-applied up to 275 tons. There was no indication of failure. All that happened was a slight loosening of the seating mortar from the sides of the concrete.

Another wall section of the same type was tested. It developed a compressive strength of 2,084 lbs. per sq. in. The load was allowed to remain 45 minutes and then slowly reduced to zero. It was again applied rapidly up to 275 tons, when the testing machine was broken. The specimen was removed without being crushed.

A third specimen of concrete without reinforcement developed a strength of 1,610 lbs. per sq. in. A small vertical crack occurred at 215 tons and advanced slowly up the center of the specimen until it failed in shear about 2′ from the bottom.

Brick: A brick wall was tested. It was laid in lime mortar in accordance with the Chicago building code. It failed after it had shown a compressive strength of 248 lbs. per sq. in. The bricks were so loose they could be picked out by the hand.

Tile: The following is a brief summary of the hollow tile tests:

A hollow tile wall 28 days old, set on end in cement mortar. Load applied in 5-ton increments. The load was applied at two-minute intervals. Elastic limit was reached without rupture, only a small crack running up center of the specimen. One tile in the fourth pier from the top cracked at a total load of 79 tons. Maximum load per sq. in., 570 lbs.

Another tile wall 28 days old was tested. Tile was laid on sides. Failed suddenly in shear at 42 tons. Compressive strength, 292 lbs. per sq. in.

A hollow tile wall 46 days old was tested, said to have been built of rejected material. This failed completely in the sixth and seventh courses at 195 tons. The tile was completely crushed. The compressive strength developed was 1,354 lbs. per sq. in.

Hollow tile, medium burned, were used in one wall, which failed suddenly at 175 tons. The fibre stress was 1,215 lbs. per sq. in. There was no preliminary warning of failure.

A column of tile 8″ square, 12′ high, failed at 93 tons, at a fibre stress of 2,911 lbs. per sq. in.

A section of tile wall 4″ thick, 36″ long and 12′ high showed cracks at 145 tons and failed at 175 tons. The fibre stress was 2,430 lbs. per square inch. One side of wall was completely crushed, the other standing. This wall behaved in a peculiar manner. It deflected horizontally .025 of an inch in one direction, came back vertically and then deflected an equal amount in the opposite direction.

A summary of the tests follows:

TESTS OF TILE, BRICK AND CONCRETE WALL-SECTIONS
Tests of Walls About 12 Ft. High.

Material	Age days	Horizontal dimensions inches	Unit stress at failure, lbs. per sq. in., gross cross section
Brick wall	47	8 x33¼	248
Concrete wall	49	8 x36	1610
Reinforced concrete walls	55	8 x36	2060* 1st loading / 1920 2d loading — no signs of failure
Interlocking tile wall; side	13	8¼x37	288
Monarch tile pier (laid up of 4x8x8 tile on end)	25	8¼x 8¼	2911
Monarch, 4 in. wall	25	4 x33¼	2560†
Monarch 8 in. wall	47	8¼x37	1354
Monarch 8 in. wall	35	8¼x37	1130
Monarch 8 in. wall	26	8¼x36½	1680
Natco 8 in. wall	28	7¾x35	570
Natco 8 in. wall	33	8 x 36½	1220
Natco 8 in. wall; side	28	7¾x36¾	292
Natco 10 in. wall; side	33	9¾x36¾	415

"The cross-questioning even of the man who makes up the estimates of costs for many builders will demonstrate that he is using costs not obtained from actual studies of his firm's work, but from the statements of other builders," says Leonard C. Wason, president of the Aberthaw Construction Co., Boston, in a recent paper. He goes on to say that the estimator often takes the word of a foreman in charge of some branch of work, or merely uses the cost with a hazy belief that it is correct without being able to tell exactly where he obtained it. An estimator of one of the progressive New York firms told Mr. Wason that he was tremendously handicapped by never knowing whether the work corresponded to his estimate. "'Their case is not exceptional," Mr. Wason, "and a bald statement regarding their cost data would excite no particular comment from average men engaged in the building business."

*Note that this is not unit stress at failure.
†Buckled.

Remarkable Resistance of Reinforced Concrete to Fire Attack

Any structure is fireproof to the extent that reinforced concrete enters into its construction. An interesting illustration of this occurred in a recent fire at the pulp-board mill of the Androscoggin Pulp Co., So. Windham, Me. This building, as shown in Fig. 1, was almost entirely of reinforced concrete construction. The exceptions to be noted are plainly apparent in the photograph of the building before the fire (Fig. 1); and by their absence in the views of the building after the fire, Figs. 2 and 3. The combustible parts of the building were the outside frame curtain walls, the large door and window openings at the end, the window frames, and the roof. The roof was of regular frame construction, carried on timber trusses. The building was built in 1906 by the Aberthaw Construction Co. of Boston. At the left of Fig. 2 is a timber and plaster gallery which was added to the structure after completion and after the photograph of Fig. 1 was taken.

The fire started about midnight May 20, 1912, in a pile of scrap paper below the main or machine room floor. This is on the level on which the men and teams are working in Fig. 2. This fire spread to the exterior frame panels shown above the team in Fig. 1, and from these the wooden sash in the story above caught fire, followed by the roof and gallery.

On this floor was stored a quantity of dry pulp board which proved an ideal fuel. *The heat was so intense that it bent and partly melted cast iron.* Fig. 2, taken from a point across the river from where Fig. 1 was taken, shows the end of the building after the fire. Every bit of combustible material has been burned away, leaving concrete standing, stripped, but a silent testimonial to the fire-resisting qualities of that material.

Fig. 3 is a detail view of the corner shown at the extreme right of Fig. 2. The frame sash, the boarded-up opening and the big end door have been entirely destroyed. The concrete is still standing in fairly good condition. The crane rail-girder is spalled somewhat,

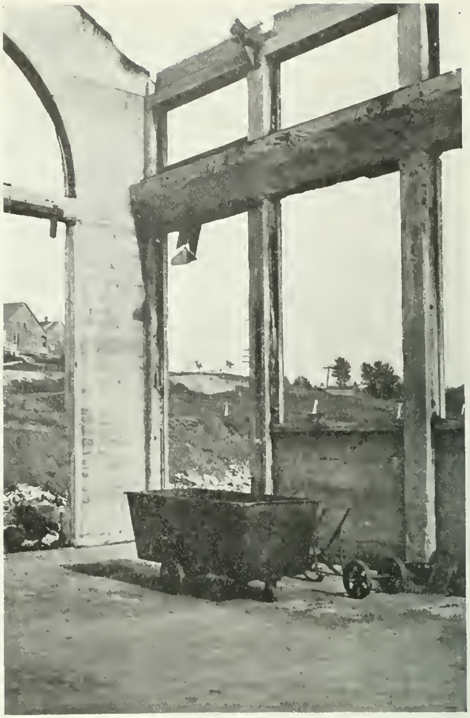


FIG. 3. AN INTERIOR CORNER OF THE STRUCTURE AFTER THE FIRE

Note the board-marks on the concrete

FIG. 1. THE PULP-BOARD MILL OF THE ANDROSCOGGIN PULP CO., SO. WINDHAM, ME., BUILT BY THE ABERTHAW CONSTRUCTION CO., OF BOSTON, IN 1906

Fig. 4. Reinforced Concrete Floor and Columns from Below. A Photograph Taken Just After the Completion of the Building

Fig. 5. A View Similar to That of Fig. 4, Taken After the Fire

but is structurally intact. A coat of cement mortar plaster would make it as good as ever. Note how distinct the board marks are on the concrete.

The fire started in the machine room below the floor shown in Fig. 3. The building is 40′ wide and the floor has a longitudinal depression 10′ wide and 4′ 6″ deep to accommodate special machinery. Fig. 4 shows a photograph, taken before the fire, of the underside of the floor, and the side of the depressed section. The floor beams are 12″ deep and 24″ on centers. The depressed section is carried on one line of heavy transversely bracketed columns.

Fig. 5, taken after the fire, shows a section similar to that shown in Fig. 4, and shows the condition of the concrete. In Fig. 6 is shown an extreme case of a beam on this floor so badly spalled that the steel was exposed. A view such as this indicates the absolute necessity of protecting the steel with ample concrete, although in this case the spalling was probably due somewhat to a buckling action caused by the expansion of the floor. Fig. 6 shows also the way in which the beamed ceiling withstood the attack.

It was very evident that the heat expanded the floor

Fig. 2. The Pulp-board Mill After the Fire

This view was taken from a point across the river from where the photograph shown in Fig. 1 was taken.

longitudinally. On the morning after the fire, the end wall was quite a little out of plumb, and the concrete was quite hot. Later, as the concrete cooled, the wall drew back into the perpendicular. This movement, of course, had its effect on the entire floor structure, most noticeably where girders and beams came onto a column head. A good many of the columns showed horizontal cracks at their haunches.

Fig. 6. An Extreme Case of Spalled Concrete, Steel Exposed

This expansion and subsequent contraction caused countless cracks in the floor structure. The position of these cracks, and that they were entirely through the floor, was made evident by the water working through the cracks onto the smoke-blackened ceiling below. The floor, however, is for all practical purposes, intact, and will be in service for many years.

An interesting example of the comparative fire-resisting qualities of brick, timber and cement mortars on ribbed metal fabric, was given in the fire attack on a stock house, shown in Fig. 7. The floor was of timber, carried on steel I-beams, with timber columns, carrying a frame roof. The walls at the base of the building were of brick, and the walls above were of ribbed metal* and mortar.

A careful examination of this building showed the remarkable fire-resisting quality of the upper wall construction. Fig. 6 shows these, in themselves, practically intact. The brick walls, on the other hand, were badly bulged, and cracked on the inside. The two inside courses of the 12″ wall were in such condition that they could be knocked out with a light hammer. The wall could not further be used.

*"Hy-rib," manufactured by the Trussed Concrete Steel Co., Detroit.

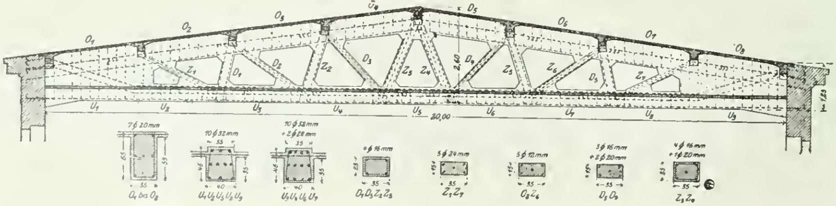
Fig. 7. The Stock House, After the Fire

The stone used in the concrete throughout was a crushed granite, and the work had been carefully done. It was apparent that where the concrete was richer in mortar, the spalling was less. The mortars seemed to act as a fireproofing agent. At points where the fire was hottest, the concrete, while seemingly intact, was still softened, so that it could be knocked out in some places to an average depth of an inch.

Such a fire demonstrates, probably more strikingly than in an all reinforced concrete building, the fire-resisting quality of this material. When everything is destroyed *except* the reinforced concrete parts of a structure, the lesson is very plain.

Reinforced Concrete Truss, Span of 66 Ft.

The accompanying illustration shows a 20 m. (66′) girder used in the construction of the new municipal abattoir of the city of Dresden, Saxony. Thirty-six of these girders are used to carry the roof of the building. The rafters are symmetrically constructed, although the load of one-half of the roof is increased considerably by the overhead rails of a large crane. The reinforcement is placed so as to keep the tensile stress on the steel within 1,000 kg. (14,200 lbs.)—*Armierter Beton.*



A Reinforced Concrete Roof Truss With a Clear Span of 66 ft.

Concrete Monuments

If there is any one thing on the face of the earth that is monotonous, it is the average churchyard or private cemetery. With the death of any member of the family there seems to vanish all artistic instincts so that where monotony does not reign, we have bizarre effects or a conspicuous attempt to impose on the living by overdone honor to the dead. Now, however, there seems to be a movement in favor of these factors in monument design and execution—novelty, variety and fitness.

One of the means by which this is being attained is by the introduction of concrete as a competitive material with marble, granite, sandstone, bronze, etc. As a rule, the result is pleasing, although of course one could not say that all concrete monuments are either beautiful or appropriate. In any case they make a pleasing break in the everlasting monotony—a monotony that is depressing. For there is a monotony which is elevating and inspiring from its very immensity and the grand lines in which it is executed.

So, away with Tradition, and welcome Innovation. Here we have it in the shape of four concrete monuments by the German architect Raabenhofer reproduced from *Der Betonbau*. One sees at once that both the general form and the details comport with the nature of poured concrete—which is more than can be said of many stone monuments in relation to their material.

These designs are not attempts to imitate stone work. They claim for concrete equal rank with the latter material. They are friendly, but not heavy and

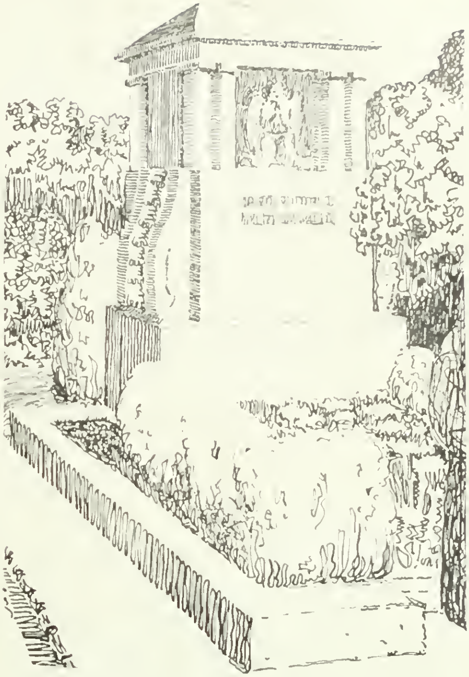


Fig. 1. Typical German Monument Design

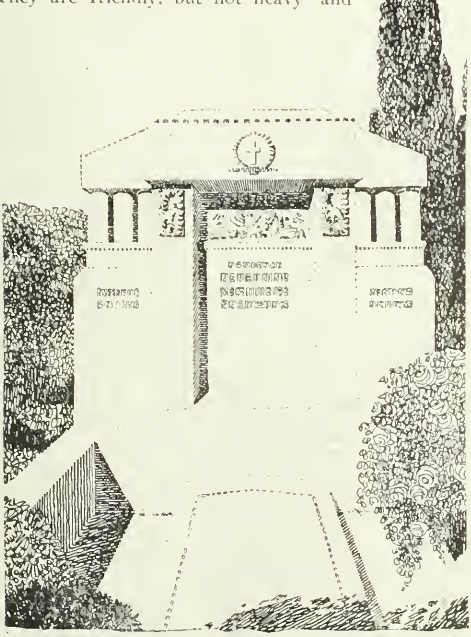


Fig. 2. Front Elevation of Recent German Monument Work

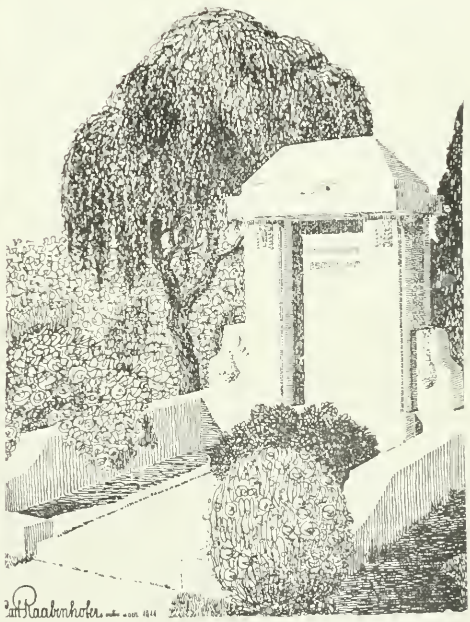


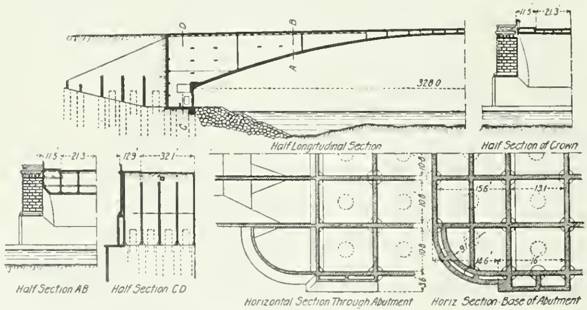
Fig. 3. An Example of Rather Plain but Thoroughly Artistic Work in German Monument Design

"faddish." The heavy cube at the base of one design (Fig. 1) may appear unduly coarse and rude, but the volutes for the side help do away with this effect. The large flat, unworked surfaces can be executed in suitably colored material and with proper regard to the effect of the coarseness or fineness of grain. It is intended that the decorative effect shall be carried out by actual work with mallet and chisel on the finished monument; an intention which lends itself well to designs which are executed more than once in the same neighborhood, as it enables variety to suit local conditions, personal elements and characteristics of the one to whom the monument is dedicated, and the individual taste of the customer.

American and European Design in Concrete Construction

Engineering and Contracting says that low wages of common labor in Europe make the cost of materials a relatively larger item there than in America, of the cost of reinforced concrete structures. European engineers design carefully to save material. This is one of the reasons why European reinforced concrete structures generally present a light and graceful appearance as compared with similar structures in the United States. Economy of materials is, however, not the only reason and perhaps is not even the principal reason for the less massive reinforced concrete structures observed in Europe. Engineers there exhibit a greater confidence in the material than do engineers in America. They exact value from the tensile strength, elasticity and resiliency given by reinforcing which the American engineer does not consider. Their reinforced concrete work, therefore, frequently exhibits a boldness in design which appears almost hazardous to the person who has studied only American examples. This is particularly true of arch bridges. Few American reinforced concrete arches show any boldness in using the thin sections, long spans and flat arcs which are of the most common occurrence in Continental Europe.

The statements quoted are illustrated by an article on the Tiber River bridge at Rome. This arch has a clear span of 328′ and a rise of 32.8′. It is not merely the long span and flat curve of the arch, however, which make the structure a bold one; the sections taking the thrust are exceedingly light and the abutments are carried on a construction which virtually amounts to a floating foundation.



General Structural Details of 328-ft. Reinforced Concrete Arch

German Consular Reports

The Consular Reports furnished by the State Department contain much valuable information to those desiring to do business in foreign lands, but good as they are they seem in point of detail to be rather surpassed by those put out by the German government. Recent publication of matters affecting the cement industry all over the world give information concerning cement works and cement markets in countries to us hardly known or thought of as cement producers. Dalmatia it appears has four cement works; in Greece, two works exist, while Montenegro and Crete have to depend on steamship arrivals from Italy and Austria. Algeria has one factory of considerable size, but Tunis and Eritrea, Italian colonies, are both minus cement factories. Egypt, however, has one, about twenty miles from Cairo, which is producing about 100,000 barrels a year, and in the South African republic, the Pretorian Portland Cement Works at Dasport is a large producer, though England and Germany both ship considerable cement into that market. These reports not only cover the manufacturing conditions in the various countries mentioned, as well as many others, but describe fully the actual requirements for Portland cement in each of the markets; the current prices and the countries from which imports principally come, together with the various steamship line, railroads and other methods of importation. In this connection it is of interest to note that only recently the German Export Commission met in London with the principal directors of the Associated Portland Cement Works and were the guests of the Englishmen for several days. General conditions prevailing in the Portland cement markets of the world seems to have been the principal topic of discussion and the adherence to a minimum price (which it is to be hoped is a living price) was formally decided upon.

In a summary of old and recent fire tests of concrete, R. Saliger says in *Tonindustrie-Zeitung* that the older the concrete the better it resists heat. In general, structures properly built of reinforced concrete cannot be destroyed by fire, though they may be superficially damaged. Floors, beams, and columns will carry more than their rated load through a fire, without its passing to the floor above, and combustible material in a room adjacent to the fire will not be ignited.

A Concrete Storage Cellar

On every farm in any locality there is need of a good outside cellar. In cold climates they afford the best and cheapest winter storage for fruit, vegetables, and bees. They are just as valuable in summer for keeping berries, milk, and butter. In the Southwest such cellars offer the only means of safety during cyclones. Because they can do all the work themselves, farmers everywhere are building their cellars of concrete.

The most popular size for the average farm is a cellar 10′x14′, inside measurements, with a self-supporting arched roof 5′ above floor at the sides, and 7′ 8″ in the center. All of the side walls are 8″ thick, therefore dig the hole 11′ 4″ x 15′ 4″ and to the depth desired, usually 5′. At one end cut out the earth to a width of 4′ 4″ and slope it upward for seven concrete steps with a rise of 8″ and a tread of 10″ and for a thickness of 4″ of concrete back of the steps proper. Arrange for an 18″ landing at the bottom the the stair.

Make the sidewall forms of 1″ siding on 2″x4″ uprights spaced 2′ o. c. As the concrete floor will be 4″ thick, set up the forms on 4″ concrete bricks. Above ground level use outside forms similar to the inside. To curve the end wall forms, lay them out with a 6′ string in the same way as described below for arch rings. At the entrance end, to provide for a doorway, set between the forms a frame of 2″x8″ stuff 3′x7′ in the clear. Mix the concrete 1 part Portland cement to 4 parts bank-run gravel, or 1 part cement to 2 parts sand to 4 parts crushed rock. A sack of cement

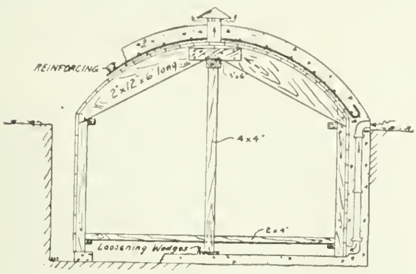


Fig. 1. Section of Storage Cellar; Centering in Place

equals 1 cubic foot. With the forms in place, lay the 4″ floor the same as a sidewalk, but without joints. Fill the wall forms in 8″ layers with mushy wet concrete, and 6″ from the top of the side walls and 1″ from the outside, place two ⅜″ steel rods the full length of the cellar. In the concrete 2″ above the door-frame, lay three 4′ lengths of ⅜″ rods. Roughen the top of the walls so as to insure a good bond with the roof. Build the stairway with a 4″ thickness of concrete behind the steps proper. Each step has a tread of 10″ and a rise of 8″. The sidewalls of the cellar hatchway extend above the door opening of the cellar proper, so that outside sloping doors may be added. In the top of the hatchway walls, while the concrete is soft, bolts are set heads down for holding the wooden sill to which the strap hinges are later attached.

*Courtesy Association of American Portland Cement Manufacturers.

When the sidewalls are one week old, begin on the roof. To give the roof a rise of 2′ 8″, arch rings are needed. For laying out the rings, choose a floor or a bit of level ground. To one end of a strong string fasten a pencil, and tie the other end to a nail driven firmly in the floor with exactly 5′ 11″ of string between the pencil point and nail. Mark out half a circle. Across the circle lay a board exactly 10′ long so that its ends just touch the mark. The part of the circle above the board represents the arched inside of the roof. Place boards for the arch rings over the mark on the floor and nail them together. Mark the curve upon them and cut them to the mark. Brace the arch well as shown in the drawing. Spacing the rings two feet apart, six will be needed. Fasten them securely in place to 2″x6″ liners spiked to the sidewall forms. Cover the rings tightly with 1″ sheathing.

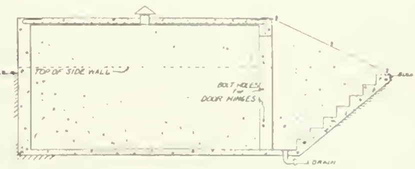


Fig. 2. Section Showing Steps, Drain, Etc.

With the roof form ready, place the reinforcement upon it. Use ⅜″ rods 14′ long. Space them 6″ apart crosswise and 12″ the long way of the cellar. Wire the rods together where they cross. The roof must be 5″ thick. Carefully work exactly 1″ of concrete between the rods and the sheathing. Tamp the concrete until the liquid cement flushes to the top and then finish the surface smooth by means of a wooden float and steel trowel. Do not stop for anything until the roof is finished. In two to three weeks the concrete roof, weather conditions being right for curing, will be strong enough to support itself; then the forms may be removed.

Ventilation is necessary for most cellars. While building the wall make one or more air-shafts (similar to a chimney-flue) of 3″ tile, by embedding them in the concrete wall, with an opening inside at floor level and another outside well above ground line. By this arrangement fresh air is admitted. Place a tile chimney in the concrete roof and cover it with a galvanized iron hood for removing the foul air. If built late in the fall, protect the fresh concrete from freezing by covering it with clean straw or with old carpet so suspended as to leave a dead air-space between the concrete and the covering.

Below is given a list of the materials required. Consult local dealers as to prices. The prices given are higher than in most localities. If good screened pit gravel is used, no sand will be needed.

BILL OF MATERIALS

Crushed Rock, 13 cu. yds. at $1.10	$14.30
Sand, 6½ cu. yds. at $1.00	6.50
Portland Cement, 22 bbls. at $2.50	55.00
Rods, 40 pieces, ⅜″ x 15′, 206 lbs. at $0.02¼	4.65
Total	$80.45

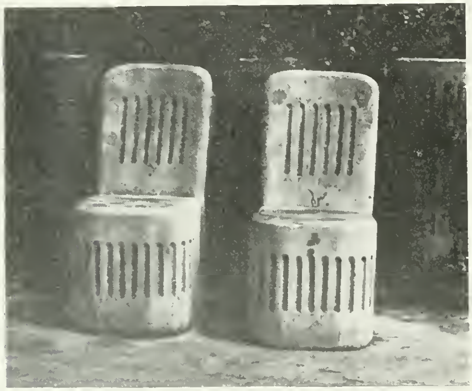
The cellar shown in the photograph is 18′x18′x8′

deep. It is located on an apple farm. The owner finds it a profitable investment as he has his own storage and keeps his apples until the market is no longer glutted with "wind-falls" and "seconds."

[NOTE: It might be well to suggest here that it would be good practice to extend some of the steel rods in the wall up into the arched roof. Also, the concrete should not be allowed to dry out too rapidly, but should be kept moist by sprinkling and covering.—EDITORS.]

Concrete Chairs With Solid Bases

In the January 1912 number *Concrete* published an article showing by detailed diagram and description that the idea of furniture made of concrete, after the plan of Thomas A. Edison, was really not so much of a joke as it had been made to appear in newspaper paragraph and cartoon. The manufacture in concrete of a number of household articles was shown to be perfectly feasible and practical from every standpoint and it was predicted that within less than a decade, perhaps, people would actually be using



CONCRETE SIDEWALK CHAIRS WITH SOLID BASES

furniture made of concrete as light as wood and as durable as time itself.

In the accompanying illustration of two sidewalk chairs it can readily be seen that concrete furniture is a sensible, practical matter and not a joke—conclusive proof, in fact, that Mr. Edison's scheme has already been put into practice.

These chairs—only two of a dozen—were made by a retired carpenter, the owner of a flat building, the lower floor of which is occupied by a corner drug store on one of Chicago's busiest north and south thoroughfares. The furniture was constructed mainly for the use of patrons of the pharmacy who desired to while away the evening hours of summer or await the coming of a street car, and for the flat-dwellers above who have little outdoor space at their command.

They were purposely made of solid concrete, reinforced with upright steel bars, to prevent their being carried away by youthful marauders on Hallowe'en or other occasions when piratical methods are commonly put into practice. Their weight is more than 200 lbs. apiece, but as it is never necessary to move them, the weight in this instance is a negligible matter.

The lower part of the chairs was made in a mold using a scant framework of steel bars, the upright standards for the chair back being allowed to protrude. The ornamentation was obtained by nailing to the inside of the mold a series of pieces of broomstick split in half. After the concrete for the seat had been poured, a wooden form for the back was slipped over the uprights and also filled with concrete. A simple form was used. The mix was about of the consistency of that used for sidewalks, though not too wet to be smoothed down with a trowel about the edges of the back and the top of the seat.

The four dark spots on the chair backs mark the holes which were made in the form for bolting a box to the back of the upright in which the owner has planted flowers and vines. The flower box was bolted to the chair back after the concrete had hardened and the holes were then filled with concrete. The attempt was more in the direction of practicability and service than of artistic effect, and ordinary ingenuity might easily do away with these marks as well as devise other improvements in appearance and lightness.

To the rear of the chairs may be seen a row of pots, which were made in a small tub lined with split broom handles for ornamentation and afterwards set upon pedestals. The entire area between the curb and sidewalk is filled with these pedestals and flower pots and the effect is at once striking and attractive.

Historic German Cement Plant

The cement factory Stern (Star) at Stettin, Germany, has just celebrated the fiftieth anniversary of its establishment. The celebration occurred on the 17th of July, 1912, and all the members of the firm of Toepffer & Company, who are the owners of the works, participated. The history of this factory is the history of the growth of the Portland cement industry in Germany. Established in a small way in 1862, the production in 1864 was barely 36,000 bbls. The reputation of the cement as one of the best in Germany caused the production to grow until in 1911 it produced 515,000 bbls. The total production of the works from the time of their establishment in January, 1912, was a little over 10,000,000 bbls. The Stern factory owners, together with the Dyckerhoffs, have been among the pioneers in the industry in Germany, standing for progress and scientific development in that field. It seems strange, in considering the enormous growth in short periods of our American cement works, some of which produce in a single year more than this old established German works has produced in fifty years, to realize how fast the development of the manufacture of Portland cement in this country has been, and how remarkable that, with its enormous growth, there have been so few failures of the material.

A Standard Sulphur Trioxide Content for Portland Cement*

The sulphur content in Portland cement has been the subject of contention for many years among experts and engineers, the addition of gypsum to Portland cement for the purpose of regulating the set being the element from which the controversy grew. Various governments in their specifications have adopted various standards for sulphur trioxide, as shown in the article below. The paper which follows is the production of the German Portland Cement Manufacturers' Association and is a valuable contribution to the discussion of this important subject.

The article contains the results of numerous tests made under the standard German specification with cements where the So_3 content had been raised to 2.50% by suitable additions of crude gypsum. The experiments were carried on over a period of two years and tables are given to show the behavior of the various test pieces under the different exposures. The paper follows:

Portland cement is known to contain small quantities of sulphatic salts, originating partly in the raw materials and coal, and partly added, in the form of crude gypsum (hydrated calcium sulphate), in the process of grinding the calcined cement, for the purpose of controlling the time of setting. The total concent of sulphates in a cement is generally stated in terms of sulphur trioxide (SO_3).

These small quantities of sulphur trioxide occurring in normal Portland cement are quite uninjurious to its practical application; and it is only when the amount exceeds a certain limit that, during storage under water, a supplementary expansion—which may sometimes be dangerous—occurs in the hardened cement, owing to the formation of calcium-aluminium sulphate. This substance is also formed when the amount of SO_3 is small, but in such event helps to increase the strength of the mass by making it more compact.

When the standard specifications of quality and testing of Portland cement were redrafted in Germany the maximum permissible limit of SO_3 was fixed at 2.5% on the basis of extensive experiments.

In other countries the following maximum limits are in force:

England	2.75% SO_3
Austria	2.50% SO_3
Canada	2.00% SO_3
United States	1.75% SO_3
Russia	1.75% SO_3

In the countries named below the limit differs, according as the cement is to be used in fresh or salt water:

	Fresh water	Salt water
France	3.0%	1.5% SO_3
Brazil	3.0%	1.5% SO_3
Japan	2.0%	1.5% SO_3
Argentina	2.4%	1.2% SO_3

There is, however, no reason why the amount of SO_3 prescribed for fresh water should act differently when the cement is hardened in salt water. In hardening in fresh water an amount of SO_3 slightly exceeding 2% produces a very small degree of expansion by the formation of calcium-aluminium sulphate; and the same process occurs when the hardening takes place in salt water. This minute expansion cannot have any injurious results. If, however, the sea water (containing magnesium sulphate) is able to penetrate into the cement mass permanently—which happens principally in the case of cement that is not compact—the result is that the cement is attacked. In the opinion of various investigators, the magnesium sulphate of the sea water combines with the lime in the cement to form calcium sulphate and magnesium hydroxide. This latter is deposited in the pores of the cement, while the calcium sulphate forms calcium-aluminium sulphate with the alumina of the cement, a large quantity of water of crystallization being absorbed. In the event of the action of the sea water being continuous, the considerable expansion resulting from the above-named reaction may lead to the destruction of the mass. Hence, it is not the small percentage of SO_3 in the cement which plays a part in the destruction of the mass, but the magnesium sulphate that penetrates continuously from the sea water into the porous cement mortar. This point has been always emphasized by the German Portland Cement Manufacturers' Association, and the late Prof. Dr. W. Michaelis also mentioned it specially at the last general meeting of the association.

We will not now go into other possible causes of the destructive action of sea water, wishing to confine ourselves exclusively to the action of sulphuric acid. We must not, however, omit to mention—as has, moreover, been insisted on frequently and by different authorities—that, in structures exposed to sea water, the mortar used must be as compact as possible in order to prevent the sea water from penetrating the structure, and to enable the latter more effectually to withstand chemical and mechanical influences.

In order to establish beyond doubt that the percentage of 2.5% of SO_3, as allowed in the German specification, is quite unobjectionable; and more particularly in view of the fact that the Argentine specification has recently increased the SO_3 limit from 1.0% to 1.2% in cement for marine structures; the German Portland Cement Manufacturers' Association in 1907 arranged with the Royal Laboratory for Testing Materials, Gross-Lichterfelde, for the performance of tests in this connection, over a period of 10 years, at the island of Sylt in the North Sea.

The materials used consisted of a Portland cement (S) containing 1.19% of SO_3 and employed for all purposes, marine structures included; and another Portland cement (B) which contained only a very small proportion of SO_3, namely 0.57%. Owing to this low percentage this cement is specially preferred in France for marine structures, e. g. in the harbor at Boulogne, and more particularly in Argentina. It was supplied to the Royal Testing Laboratory by the makers.

The following test pieces were prepared from these two cements, both in their original condition as re-

*Presented at the Sixth Congress of the International Society for Testing Materials.

ceived and after the SO_3 content had been raised to 2.5% by suitable additions of crude gypsum:

1. Compression-test cubes (7 cm. side) mixed in the proportions 1:2 and 1:4 with Sylt sand for hardening in sea water, fresh water and the open air. Length of hardening period: 28 days, 1 year, 5 years and 10 years.

2. Blocks of about ¾ cbm. capacity, composed of a mixture of 1 part cement, 2 of sand and 3 of stone chippings. After being hardened for 6 months in the air the blocks were let into the quay wall, where they are exposed to the chemical action and full force of the North Sea waves.

3. Plates measuring 50 by 50 by 8 cm., mixed in the proportions 1:2 and 1:4, half of them being hardened for 4 months and the others for 6 months in the air, and then laid in the harbor dam at Munkmarsch, where they are exposed to intensive action on the part of the water and weather in consequence of the semi-diurnal ebb and flow.

Summary of Results

1. The tensile tests showed that the presence of 2.5% of SO_3 (sulphur trioxide) in Portland cement is thoroughly harmless during hardening in sea water.

2. The examination of the large blocks immersed in the North Sea and of the plates in the Wattenmeer has shown that the cement, which was richer (1.19%) in SO_3, behaved well, both in its original condition and after enrichment to 2.5% of SO_3; while the cement with the lower SO_3-content (0.75%) and supplied specially for marine structure behaved badly, and was even improved by enrichment to 2.5% of SO_3.

3. The chemical examination of the plates failed to reveal more than slight alterations due to sea water in the case of the cement with the higher SO_3-content, whether in its original condition or after enrichment. The cement lower in SO_3 and used in its original condition was found to have sustained extensive chemical changes under the action of sea water, though only to a smaller extent when enriched to 2.5%.

From these results it follows indubitably that the presence of up to 2.5% of SO_3 in Portland cement produces no injurious effects of any kind, whether in sea water or fresh water.

Moreover, the favorable experience that has everywhere been gained in marine construction works with cements of this kind, namely containing a higher percentage of SO_3 than is prescribed in countries which issue special specifications for such works, demonstrates that the higher SO_3-content of the cements in question has not led to any injurious effects in practice, provided the cement has been properly used.

Consequently, the German Portland Cement Manufacturers' Association, on the basis of the material set forth above, requested the International Association for Testing Materials to lay the following resolution before the Sixth Congress of the International Association, in New York, for examination and adoption:

The Congress recommends that a uniform permissible maximum limit of SO_3, namely 2.5%. be generally adopted in Specifications for Portland Cement, whatever, may be the purpose for which the cement is intended.

Progressive Increase in the Strength of Cement Mortars

BY E. CANDLOT, PARIS
(Translated by C. Salter)

[Edouard Candlot ranks among the best known authorities in Europe on cement and cement mortars, limes and plasters. M. Candlot, a chemist of international reputation, became interested in the manufacture of cement in the early days of the development of the industry in France. His writings, and especially his book, "Ciments et Chaux Hydrauliques," published in Paris in 1906, are recognized authorities in Europe as well as in this country. From the scientific side of the cement industry to the practical manufacture of Portland cement was but a step, and the works by M. Candlot and his associates a short distance out of Paris, are recognized among the most progressive in the French cement industry. In addition to his writings and his manufacturing interests, M. Candlot has acted as expert in the establishment of cement works in various parts of Europe. Many of the Russian works, especially those in the region of the Black Sea and the Caspian Sea owe their success to his successful planning. His paper, which follows, takes advanced ground against a practice that has been gaining a foot-hold in cement testing within the past few years, its first marked development being in the specifications of the Rapid Transit Commission in 1903.—THE EDITORS.]

It is generally admitted that the strength of cement mortars should exhibit a constant progressive increase, and that if the strength is found to have diminished at the end of several days or weeks, this behavior is a sign of inferior quality in the cement used.

This idea has led to the insertion, in numerous specifications, of clauses relating to the increase in strength between 7 and 28 days.

In the official French specification in force between 1885 and 1902, it was made a condition that the strength of the cement must increase between the 7th and 28th days, and between 28th day and 3 months. In the 1902 specification the test at the end of 3 months was abandoned, but the clause relating to the increase in strength was retained, the increase being fixed at 3 kgs.† between the 7th and 28th days for pure cement, and at 2 kgs. for the same period in the case of 1:3 mortar.

The English specification goes still further in the same direction, the conditions to be satisfied being as follows:

The increase in the strength from the 7th to the 28th day must not be less than
25% when the strength at 7 days is between 400 and 450 lb.
20% when the strength at 7 days is between 450 and 500 lb.
15% when the strength at 7 days is between 500 and 550 lb.
10% when the strength at 7 days is between 550 and 600 lb.
5% when the strength at 7 days is above 600 lb.

At first sight it would appear as though cement mortars should evidently increase continuously in strength as time progresses. One can easily imagine these mortars hardening by degrees and only acquiring their maximum hardness after many years. A fall in strength, represented by a bend in the curve of rup-

*Presented at the Sixth Congress of the International Association for Testing Materials in New York, September, 1912.

†This unit refers to kgs. pr. sq. cm.

ture, strikes the eye and leads one to blame the product under examination.

If, however, the matter be studied a little, it will be easy to see that this impression does not rest on any serious basis, and that this idea of progressive increase in strength cannot be founded on any experimental data.

In an isolated instance a cement may exhibit decreases in strength, namely when it contains free lime which, by undergoing gradual hydration, destroys by degrees the cohesion of the mortar. Nowadays, however, it is such an easy matter to detect the presence of free lime by means of the hot water test, steaming, ets., that this contingency may be dismissed from consideration. A cement which is capable of undergoing disintegration, in the cold, at the expiration of a shorter or long period, will be immediately condemned by the hot test. If the Le Chatelier needles be taken as the measure of expansion, it will be found that cements causing the needles to separate by 30, 40 and even 50 mm. will give satisfactory results under the cold tests. A cement containing a really dangerous proportion of free lime would produce a separation of 70 or 80 mm., or even turn into sludge before the termination of the test.

Since the specifications prescribe 10 mm. of separation, at the maximum it will be evident that there is not the slightest possibility of a cement evading the proof afforded by the hot test.

Hence, tensile strength tests are applied to cements which are normal and certainly do not contain any injurious amount of free lime. What, therefore, is the significance of the fluctuations observed in the curves of strength?

In the first place it must be pointed out that the method of carrying out these tests is attended with a considerable amount of uncertainty. Whatever precautions be adopted in preparing the test pieces, it is almost impossible to make them all absolutely identical, and differences amounting to as much as 50% have been traced entirely to the preparation of the test pieces.

When dry mortars are in question and machines are used, fairly concordant results can be obtained: but in the case of plastic mortars, for which the use of any mechanical process is impracticable, considerable differences are frequently observed between the results obtained in different laboratories, and still more important fluctuations in the case of one and the same operator.

Consequently, it is inadmissible that rules, the precision of which is absolutely incompatible with the imperfection of the method of preparing the test pieces, should be introduced into guarantee tests.

It should, moreover, be noted that the so-called diminutions of strength are generally found in the case of cements of very high initial strength. These cements attain to nearly their maximum strength in a very short time, whereupon the fluctuations in strength, due to imperfections in the preparation of the test pieces, show up in a very decided manner.

This circumstance seems to favor the argument of contant progressive increase: but the answer to this is that if one cement attains a strength of 60 kgs. per sq. cm. in 7 days, while another cement will not attain this strength until the end of 6 months or 1 year, it is impossible to understand why the former should be inferior to the latter.

When one has tested a very large number of cements and over long periods, it is found that—of course, excluding inferior products—the strength of all cements is practically the same at the end of 1 or 2 years, whether the initial strength was high or not. Hence there is no reason for viewing with suspicion cements which exhibit considerable hardness between the limit of 7 and 28 days. In fact, these cements should be preferred to any others, because the work for which cement mortar is used requires to possess the highest possible strength in a very short time, this being particularly the case for works executed in cement mortar and for paving. How greatly would not one prefer a cement which would enable the false work to be taken down without danger at the end of 5 or 6 days.

Well, it is precisely against the production of such cements that the clauses of the specifications have operated. In fact, the manufacturer, to avoid the risk of rejection, seeks to produce cements of low strength; at least this is the case in several countries.

Where, on the other hand, he has no irrational clauses to fear, it is found that the quality of the cements is always improving. It is on this account that Switzerland and Germany, for example, are now able to make cements of increasing fineness, which give mortars of very considerable strength.

During a long period this apparent diminution in strength was regarded as dangerous, an impression still retained in some technical quarters. It has, however, been recognized that these diminutions in strength bear no relation to the intrinsic quality of the cement. The author has found cements that were manifestly in a state of decomposition to exhibit very constant increases in strength for several years. On the other hand, some very well calcined cements of perfect composition gave very considerable decreases in strength between 28 days and 2 months, and even between 7 days and 28 days.

The reason is because the crystallization of the salts in the cement proceeds more actively in sea water than in fresh water, and under the influence of this crystallization the cement paste becomes fragile, breaking like glass. Mortars, however, do not decrease in strength, thus proving that there is no alteration in the cement.

At present tests on cement are always performed by the aid of fresh water, and decreased strength no longer comes into question.

Hence, the author expresses the desire that all clauses insisting on an increase in strength between the 7th day and the 28th day should be omitted from specifications in future.

The Panama Canal Commission has announced that an extra million barrels of cement will be required. The original contract with the Atlas Portland Cement Co. for 4,500,000 barrels carried with it an option to increase this to 5,500,000 in case the government should require it.

Diatom Earth as Pozzolana for Cement

BY A. POULSEN†

In a "History of the Growth of the Portland Cement Industry," by H. Quietmeyer, much attention was given to the various materials used in ancient times in combination with lime and in modern times mixed with Portland cement. Besides the Italian pozzolana proper and several volcanic silicates (Santorin earth and trass), "brick clinkers," according to Vicat, have been used with good results as pozzolana for cement. Suggestions with various other materials have been discussed and Prof. De Smedt, the government chemist in Washington, in the early eighties, indicated that Tripoli powder (infusorial earth or diatom earth) might be an available material for cement making. This ingredient is found in large bodies in the peninsulas of lower Delaware and Maryland, but the suggestions of Prof. De Smedt found no followers and no use of the material has been made. The paper by Mr. Poulsen, one of the leading engineers in Denmark, gives actual results on the use of this material, which he states is found in the tertiary and quaternary periods deposited both by fresh water and salt water, and even at the present day large masses of diatom skeletons are being deposited in water and in damp places. Diatom earth is white, grey, or of a yellow tint, the latter color being due to a slight percentage of iron, and consists almost entirely of silicic acid, which is still in an easily active condition; it is dissolved by alkalis and combines easily with that part of the lime in the Portland cement which, on the admixture of water, leaves the more calcareous silicic compounds which the principal constituent of the cement clinkers.

Continuing, Mr. Poulsen states:

As is well known, the superfluous lime (CaO), which may be estimated to constitute 30% of the weight of Portland cement, causes bad exudations from concrete through which rain-water or other water can percolate. In water mains or water reservoirs it makes the water calcareous and the concrete leaky. In sea-water the lime becomes the direct cause of spoiling the concrete by attracting sulphuric acid (SO_3) and forming a double salt with the alumina of the cement (Al_2O_3). This aluminous salt Al_2O_3, 3 CaO, 3 (SO_3, CaO), calcium-sulpho-aluminate, crystallizes with quite a large quantity of water ($30H_2O$) and disintegrates the mortar as has been experienced in many concrete installations in salt-water

Volcanic pozzolana has hitherto been used in order to overcome these difficulties. But since this substance contains, in addition to the silicic acid, with its beneficial properties, a several times greater quantity of useless sand and other superfluous matter, it is impossible, with most kinds of vulcanic pozzolanas, to add the quantity of silicic acid necessary to neutralize the superfluous lime in Portland cement without overcharging the mortar with "dead," or ineffective, matter which impairs the mechanical strength of the mortar. It is therefore fairly customary to use only a fraction of the quantity of pozzolana which would be chemically proper, thus retaining a part of the free lime and its consequences, or not to use any pozzolana at all.

This is not necessary when diatom earth is used as pozzolana. Its great abundance of reacting silicic acid makes it possible to apply as much as is chemically desirable without thereby overcharging the mortar with useless matter; and since the silicic acid of the pozzolana, together with the lime of the Portland cement, forms a good binding element in the mortar ($SiO_2.CaO$), the diatom-earth cement has greater mechanical strength than the cement proper, and a still greater strength than trass-cement mixture. This is proven by the experiments which I have had made at the Danish States Testing Laboratory in Copenhagen in 1910 and 1911.

Many tables are given to indicate the results obtained by the use of this material during a period of several years, and referring to the actual experiments the author concludes his paper by stating:

The samples tested in 1910 and 1911 were taken from cements and mixtures used in molding concrete block for repairing the State works on the west coast of Jutland (at Thyborön), for which there have been delivered over 400 tons of diatom-earth mixture (Moler cement) manufactured according to my directions at the Aalborg Portland Cement Factory. For the sake of comparison, there were molded a few blocks of trass mixture and a few without pozzolana. In molding these blocks, there were used to each cubic metre of sand either 600 kg. of Portland cement or 640 kg. of trass-mixture, or 500 kg. of diatom-earth mixture, the power of the diatom earth to increase the strength being utilized; so that the consumption was decreased, but the strength maintained approximately unaltered. This can, without danger, be done in most sea-works,—as can be seen among other things from the fact that, in so many cases, trass-mixture has been used, notwithstanding the consequent weakening of the strength. In using diatom mixture, care should be taken to add it to the mortar by weight, in order to prevent its slight weight per cubic metre (which is only about 1000 kg.) from causing faulty measurement.

The use of diatom-earth mixture for reinforced concrete, especially for use in sea-water, would be very desirable, all the more so since concrete prepared with trass in proper quantities has not been considered satisfactory for this purpose, on account of the trass weakening the strength. An attempt in this direction was made in 1911, but was abandoned because a suitable dry mortar could not be rammed in between the necessarily small meshes of the iron reinforcement. On the other hand, the new product has been successfully usd in the usual way in casting iron-reinforced concrete pipes, as well as for pipes without iron reinforcement.

The use of this pozzolana-mixture offers, on the whole, no difficulties. But it should never be supplied in the form of fluid mortar, since, on account of the structure of the diatom-skeletons, it contains the amount of water requisite for normal concrete even in apparently quite dry condition. Therefore it should absolutely be kept so dry that it can be rammed. It is then suitably plastic to work with, about like mortar of fat lime. It will stand storage just like normal Portland cement.

Conclusion

In concrete for water reservoirs, water-mains, river and harbour works (sea-walls, etc.), especially such as are to withstand the action of seawater, the liberated lime (30% CaO) of the Portland cement should be neutralized by means of siliceous pozzolana; but this substance generally decreases the mechanical strength of the mortar.

In the foregoing paper it is shown that diatom earth not only is a chemically excellent pozzolana, but that it even increases the strength of the Portland cement, provided it be mixed according to the factory-like method developed by the experiments.

*An abstract of a paper read before the Sixth Congress of the International Association of Testing Materials, New York, September, 1912.

†Chief Engineer to Danish Government Maritime Works, Lemvig, Denmark.

SOME CONCRETE PAVING PICTURES.

1—Spreading Bitumen on Dolarway Pavement in Central Park, New York City; 2—A Finished Concrete Pavement, in Central Park; 3 and 4—Concrete Highway in Duval county, near Jacksonville, Florida; 5 and 6—Laying Concrete Pavement in Ada county, Idaho; 7 and 8—Greenville, Illinois, Concrete Highway; Spring Floods Appear Not to Have Injured the Road at all; 9 and 10—Business and Residence streets, Paved with Concrete in Eldora, Iowa; 11—A Country Highway in Wayne County, Mich., Before the Commissions Began Spending the Proceeds of a $2,000,000 Bond Issue for Concrete.

Photographs through courtesy Universal Portland Cement Co.

A Review of Concrete Paving - Methods In Various Places *

BY K. H. TALBOT

The first true concrete pavement, that is, a pavement with a concrete wearing course, was laid in Bellefontaine, Ohio, in 1893-94. Previous to that time, wide gutters had been placed at the sides of the streets and were subjected to the traffic due to teams driving up to the curb. These proved so satisfactory that it was decided to experiment with concrete pavement.

The pavement consists of a 4-in. Portland cement concrete base, and a 2-in. wearing surface, the base being a 1:2:4 machine mixed gravel concrete, and the top a 1:1 mixture of cement and bank sand. The concrete for the base and wearing surface was mixed quite dry, and thoroughly tamped into place; the men laying the top, following closely behind those laying the base. Starting at one curb, the concrete was laid in strips 5′ wide, extending the full width of the area paved; which were afterwards cut into blocks 5′ square, i. e., the pavement was really constructed in blocks with well defined joints 5′ apart, running at right angles and parallel to the axis of the street. No expansion joints were used. After thoroughly tamping the top, it was sprinkled with water and was given a smooth finish with a steel trowel. To afford foothold for the horses, the surfaces of two narrow streets were marked by V-shaped grooves about ½″ deep and ½″ wide. On the other streets the surface was pitted with a tooth roller giving it very much the appearance of a Nelson paving block. This pavement was laid by contract at a cost to the city of $2.25 per sq. yd. including grading, curbing and drains.

In 1900, the population of Bellefontaine was 6,550, and in 1910, 8,238, which gives some idea of the amount of traffic to which this pavement has been subjected. After 18 years' service, the pavements are, as a whole, in remarkably good condition, and with the exception of the wear along the longitudinal joints, the surface shows but little effect of traffic. Had these longitudinal joints been eliminated, the work today would be in first class condition, as the joints at right angles to the curb show no appreciable wear. The surface markings have been erased in places, but with this exception, the general surface is today as good as the day it was placed. The cost of maintaining these pavements for the last three years has been $63.03. This included the patching of some of the longitudinal joints. The Bellefontaine pavements were probably the first to be laid in this country and serve as an index of what may be expected as to wear from this type of pavement. The one objection to this pavement is that it is a little slippery in wet weather, due no doubt to the method of finishing and to the fact that an exceptionally rich mixture of cement and ordinary sand was used.

With the exception of the Bellefontaine pavement and a small yardage laid in other localities, very little concrete pavement, except for private driveways, was laid before 1904, but since then the amount of concrete surfaced pavements laid each year, has been steadily increasing.

*Read before the Iowa Engineering Society.

During the time when concrete pavements were passing through the experimental stage, every conceivable specification, method of construction, and character of material was given a trial. The thickness of the pavement shows wide variations. Practically every mixture from a 1:3:7 to a 1:2:4 hand or machine mixed, has been used. Pavements have been laid in sections from 5′ square up to sections covering the full width of the highway and 100′ long. In some cases, expansion joints have been placed across the street down the center and at the curbs, while in others, no expansion joints were used. Transverse joints have been placed from 20′ to 100′ apart. Wood, tar paper, felt, coal tar pitch, and specially prepared asphaltic compounds have been used for filling the joints.

The greatest variation is to be found in the construction of the wearing surfaces. Pavements have been laid with no special wearing surfaces, with wearing surfaces of small concrete cubes, of bitumen and sand, and with from 1″ to 4″ of every mixture from a 1:1 mortar with different sand and stone screenings, to a 1:2:4 concrete. The surface has been given a smooth trowel finish or a brush finish, or marked with grooves of various shapes, widths, and depths, these markings being perpendicular, parallel, or diagonal to the axis of the street.

Due to the great variation of methods and details of construction, it is not surprising that concrete roadways have proved successful in some localities and failures in others. Roadways that would not stand up under sidewalk traffic have been constructed and expected to stand the abuse of heavy teaming.

There are at present five general types of concrete construction being used in this country. A patented type known as the Hassam Compressed Concrete Pavement has been laid during the last few years in the states bordering the Atlantic coast. This pavement is constructed of broken stone of sizes passing through rings from 1″ to 2½″ in diameter, upon a well rolled and packed sub-grade. The stone is thoroughly packed by heavy rollers, thus reducing the voids to the minimum. After the base has been brought to the profile of the finished pavement, it is grouted with a grout consisting of 1 part cement to 2 parts sand. This is continued until the grout flushes the surface, when it is again rolled in order to make a solid, compact pavement. Upon the top of this pavement is placed a 2″ layer of pea stone which is thoroughly spread and rolled before the grout has taken its initial set, and this finished with a thick grout of 1 part cement, 1 part sand and 1 part pea-size trap rock brushed on.

Approximately 1½ miles of country road with a wearing surface of 2″ concrete cubes, have been paved in the last three years in Monroe county, New York, under the direction of J. Y. McClintock.* The rapid wearing away of the top of the macadam made some more durable wearing surface necessary. In order to make a satisfactory foundation for the cubes, a thin layer of screened gravel was spread on the old road and compacted with a steam roller, and the wearing surface was placed on this foundation. Additional fine sand was spread and brushed in, after which the

*See *Concrete*, April, 1909, p. 49, and March, 1912, p. 36, and CONCRETE-CEMENT AGE, September, 1912.

surface was given a final rolling and opened for traffic. The concrete roadway in this case was 14′ or 15′ in width, the sides being held in place by a 2-in. plank or a coarse gravel berm. As an experiment, a short stretch of pavement was finished by filling with a cement grout.

The cubes of this work were made in a machine or cast in special molds. With the machines making 68 cubes at one operation, seven men and a foreman could turn out about 26,000 cubes a day. Experience pointed to the fact that it was necessary to mix the concrete just wet enough to allow the forms to be removed without falling apart of the cubes, and that a ½-in. gravel gave a concrete that could be handled to the best advantage in the machine. For the cubes made in molds, a wetter concrete was used. The cost per sq. yd. in place on the road of these cubes, was from 52 to 57 cents. To this must be added 23 cents per sq. yd. for the cost of construction of the shoulders and foundations, bringing the total cost for a 22-ft. roadway with 4′ shoulders on each side, to about $1.00 to $1.10 per lin. ft., or between $5,000 to $6,000 per mile.

It is not to be expected that this type of concrete pavement will prove as durable or as satisfactory as a smoother pavement with a solid foundation. However, this class of construction has a considerable field in the surfacing of unsatisfactory macadam roadway.

A third type of construction consisting of a properly laid concrete base and a thin wearing surface of bitumen and sand has been extensively used on the main streets of Ann Arbor, Michigan, and to a somewhat more limited extent in a few other towns and cities. This type of pavement has been developed by E. W. Groves, city engineer of Ann Arbor. About four years ago, in order to prolong the life of the asphalt block pavement, which at that time showed considerable wear, Mr. Groves, as an experiment, tried covering the surface of the pavement with a thin coating of coal tar and sand. After being subjected to various conditions of traffic for two years, this wearing surface proved to be so satisfactory that it was decided to try it for new construction work on a concrete base. In the summer of 1909, one block of a residence street was paved with concrete having a coal tar and sand wearing surface. In 1910, approximately 18,000 sq. yds. of this pavement were laid, the same type of construction having been adopted for an additional 63,000 sq. yds. on nine main streets and alleys to be laid at a later date. During the last year, in the neighborhood of 100,000 sq. yds. of this type of pavement have been laid at Ann Arbor; petitions having been received asking for a greater yardage than was possible for them to construct.

The pavements as constructed, are composed of a 4½-in concrete base and a 1½-in. wearing surface mixed about 1 part cement and 2 parts clean, coarse sand. On side streets having no street car tracks, the concrete was laid in strips one-half the width of the street and 25′ long, an expansion joint from ¾″ to 1″ in width being placed 25′ apart across the street perpendicular to the axis of the street and at each curb. The surface of the concrete was given a wood float finish and roughened slightly by brushing with an ordinary street broom. After finishing the surface as described, the form at the center or crown of the street was removed, and the concrete for the other half of the pavement laid. The new concrete being deposited against that which had been previously placed so that while there is a joint at the crown of the street, it is hardly perceptible. This construction joint is not objectionable as it is protected by the wearing surface of bitumen and sand that is later applied.

After the concrete has hardened, the surface is covered with hot bitumen applied with a sprinkler wagon designed for the purpose, having a fire box under the tank to heat the materials. The bitumen is immediately evenly distributed over the surface of the concrete by brushing with an ordinary street sweeper broom, and the surface then covered with sand. From ⅓ to ½ gal. of bitumen per sq. yd. is required. A cu. yd. of sand will cover in the neighborhood of 230 sq. yds., making the wearing surface from ¼″ to ⅜″ in thickness. For the first pavement laid, Mr. Groves used ordinary coal tar obtained from the local gas works, and later tried distilled tar. He considers the latter to be more satisfactory than the crude product. He has experimented with Tarvia and with asphalt, but is now using a special bitumen, which he considers to be the best material on the market for this character of work.*

The work at Ann Arbor is done by the city, which has its own equipment, purchases the material and hires the labor. In 1910, at a cost of $1.75 to $2.00 per bbl. for cement and from $1.07 to $1.30 per cu. yd. for sand and 75 cents per cu. yd. for gravel delivered on the street, the cost of a concrete pavement with a 6-in. base and a wearing surface of bitumen and sand, was 70 to 88 cents per sq. yd. The total cost, including drainage, grading and a 6″ x 8″ x 14″ concrete curb on each side of the street, varied from 94 cents to $1.16 per sq. yd. of pavement on streets 30′ and 34′ wide. With bitumen at 8 cents a gal. and sand at 75 cents per cu. yd., the cost of material and labor for the wearing surface has been approximately 5 cents per sq. yd.

The types of pavement which have been described above, constitute by far the lesser part of the concrete pavements which have been laid in the United States.

The remaining pavements may be divided into one-course and two-course work. For a number of years, two-course work was more usual, but at the present time, the one-course work is gaining in popularity. The choice between the two types should be governed by the material available for the work. Where hard stone, such as granite, which is most acceptable for work of this character, is more expensive than other aggregate, the cost of construction will be lessened if the expensive materials are used in the wearing surface only, but where the common grade of aggregate is used, one-course work will probably give the best satisfaction, and it can be laid at less cost, the danger from a loose top will be eliminated, and a pavement of the same character throughout its entire thickness will be insured.

*Dolarway bitumen, Barrett Manufacturing Co.

A description of the methods employed in Fond du Lac, Wis., will give an idea of the way two-course work is handled. Since 1908 they have paved 8½ miles of their principal streets and alleys with a pavement consisting of a 5-in. 1:2½:5 concrete base and a 1½-in. wearing surface composed of 1 part cement, 1 part sand and 1 part granite screenings. Expansion joints ½″ wide are placed across the street every 50′ and along the sides between the pavement proper and the curb or gutter. The surface of these pavements was not corrugated, but after floating and finishing with a steel trowel, was roughened by lightly brushing with an ordinary street broom drawn over the surface perpendicularly to the axis of the street. Teamsters using these concrete pavements assert that they find them less slippery than brick. The citizens are well pleased with their concrete pavements and are insisting upon having this type for new work, as the cost is less than for any other suitable pavement.

In 1909, as an experiment, a small amount of concrete pavement was laid in Mason City, Iowa. The work proved to be so satisfactory that during 1912, 26,000 sq. yds. of pavement are to be laid. The pavement there consists of a 5″ 1:2½:5 concrete base and a 2-in. wearing surface of a 1:2 mixture of cement and sand. A 1-in. expansion joint is left next to the curb on each side of the street, and ½-in. expansion joints placed 25′ apart across the street. The surface is marked off into rectangular blocks of about 4½″x9″ by corrugations ⅜″ deep running in both directions diagonally across the street.

A small amount of reinforcing metal has been found to be very effective in preventing concrete pavements from cracking. In the last two years, reinforced concrete pavements have been laid in Fond du Lac, Plymouth, and Sheboygan, Wisconsin, and at Highland Park and Hamtramck, suburbs of Detroit, Mich.* The Wisconsin pavements have all been reinforced with triangle mesh woven wire reinforcement manufactured by the American Steel & Wire Co. The reinforcing fabric, which may be obtained in various widths, is cut into strips of the required length. These strips are laid upon and slightly pressed into the concrete base as soon as it is laid, and after placing the reinforcing, the base is immediately covered with the wearing surface. At Fond du Lac, on streets 30′ wide, the fabric is placed over the center 18′ of the pavement with the heavy or carrying wires perpendicular to the axis of the street, while at Plymouth and Sheyboygan, the fabric extends over the entire width of the pavement. At Detroit, the pavement is reinforced with ⅜-in. round bars placed perpendicular and parallel to the axis of the street, two feet center to center, and 1½″ from the finished surface of the pavement. In addition, ¼″ round bars are also placed directly beneath the ⅜-in. rods, but 4′ apart and 5″ from the surface of the pavement. Both systems of bars are well clamped together at their intersections and are supported and held in place by steel fasteners. This system of reinforcing was designed by the Thomas Steel Reinforcement Co., Detroit., which sells the material all fabricated ready to be placed in position on the street. All this reinforced concrete pavement is today in first class condition and is entirely free from objectionable cracks of any character.

The largest amount of one-course work to be done in one locality has been carried on by the commissioners of Wayne county, Michigan.†

In country road construction where the edges of the road are protected by gravel berm, no longitudinal expansion joints are necessary or advisable, as an expansion joint in the direction of the traffic forms a line which traffic tends to follow and as soon as this joint begins to break down, the life of the pavement becomes materially shortened. However, in the case of city streets and roads, where there is a curb and gutter along the side of the pavement, it will be found advisable to place a ½″ joint along the curb. Probably as satisfactory a way to form this joint as any other, is by the use of three tapered boards, the two outside ones set with the wide edge down and the middle one with the wide edge up.

The concrete pavement is the cheapest satisfactory pavement on the market today. The excessive cost for the wearing surface of brick, granite or wood block pavements is not found in concrete for a cheap, durable top of the same material as the base is available.

The cost of construction will depend upon local conditions, cost of material, labor and superintendence. However, the cost of the same class of construction will not vary more than 15% unless there is a special problem to be met.

The cost in Fond du Lac may be taken as representative of two-course work. In 1908, the contract price for pavements varied from $1.10 to $1.32 per sq. yd. on streets 27′ to 50′ wide. In 1910, reinforced concrete pavement was laid at a cost of $1.20 to $1.27 per sq. yd., while pavement laid that year without reinforcement cost $1.09 per sq. yd. During the last year, the contract price for reinforced concrete pavement was $1.25 per sq. yd. With combination curb and gutter at 46 cents per lin. ft., this brought the total assessment to $2.31 per ft. on streets 30′ wide. If the same rate were considered for country roads, the cost would be $13,200 per mile not including drainage or grading.

In Wayne county, Mich., the cost, including grading, drainage, bridges, and 4-ft. gravel berms on each side of the roadway for one-course work, has ranged from $10,000 to $17,000 per mile for roads with 14′, 16′ and 18′ of concrete.

Where the soil is a heavy loam, it must be expected that a considerable amount of mud will be carried onto the pavement from side roads, barnyards, etc. It has long been an argument against hard roads that they would sink out of sight in the mud of an Iowa or Illinois winter. But the concrete pavement answers in every particular the requirements for a first-class road easily cleaned and with a minimum maintenance charge which approximates in first cost that of a macadam road.

*See *Concrete*, February, 1912, p. 33.

†A portion of Mr. Talbot's paper as to Wayne county paving is omitted. See September issue. Also see *Concrete:* February, 1910, p. 69; October, 1911, p. 27; November, 1911, p. 47; January, 1912, p. 54; Concrete-Cement Age, July, 1912, p. 51, and August, 1912, p. 32.

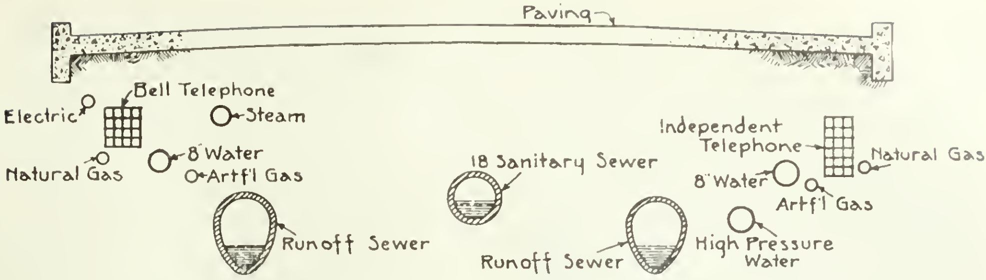


Fig. 1—A Typical Street Section

An Offense Against Public Continually to to Tear up Pavements

The construction of a public highway should mean more than the preparation of a durable surface for the passage of vehicles and pedestrians. The maps which may be seen in any city engineer's office reveal a network of public service systems of one kind or another lying under the pavement. The mere construction of a road did very well in the time of the Romans, who were good road builders, before gas, electricity, steam and water supply, together with telephones, sewers and other such construction, came to form a very large part of the street work in every city.

Tearing up a road surface for underground construction is an offense, not only against the contiguous community, but also against everyone in the city who benefits by a clear passage through a street. In the early days of sub-surface construction, it was comparatively easy to tear up a brick or block pavement and relay it again in almost, though never quite, as satisfactory a manner. With the growth in use of the asphalt, macadam and other sheet pavements, the difficulty of the problem has increased, and nowadays, when concrete is used as a base for practically every kind of pavement, no matter whether the surface is of concrete or not, it is highly important that when a pavement is put down, it be left alone.

In the end, it goes out of the public's pocket, whether directly or indirectly.

The point of the whole matter is this: To afford a complete and uninterrupted service, a highway should carry not only vehicles, but provisions should be made under its surface to carry all the service construction of every kind which is necessary in modern community life. The individual lamp, stove, well and cesspool are things of the past and the community is becoming more and more to be served as a unit from central sources of supply and inter-communicating systems of disposal.

The ultimate development of the concrete highway will force cities, sooner or later, to adopt some means of providing for this sub-surface construction, avoiding the public waste which results from continually tearing up the streets. The matter of concrete highways should be looked at broadly, whether the concrete is to serve as a surface material for the wear and tear of the traffic, or whether it is to be used merely as a base upon which a surface material is to be used. In either case it is a concrete highway and should be monolithic. It should not be disturbed and it should be so constructed at the outset that it will serve all the needs of all the people all the time and accomplish this with the least possible cost.

Figure 1 shows a typical section of a city pavement. It gives some idea of the sub-surface condition. It is not necessary to elaborate upon the need for a change

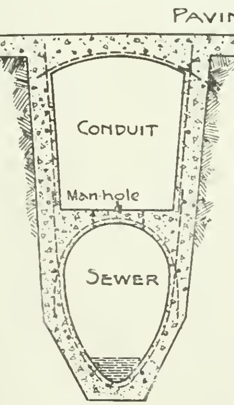


Fig. 2—A Street Section As It Might Be

It is a common thing to see a paving gang finish its work at one end of the street, while another gang of men working perhaps for another city department or for a public service corporation, goes to work at the other end of the street, undoing the construction which has just been finished. This is not only an offense to the public because it causes inconvenience, but it is a crime because it entails a useless waste. The taxpayer has to pay for the pavement in one way or another, and eventually he pays for the destruction and the reconstruction which is done by the public service corporation.

and Concrete-Cement Age does not claim any originality at this time in bringing the attention of engineers to the necessity of making some provision for sub-surface work when the pavement is made.

Figure 2 is a suggested section for a typical city street. In this section the needs of the city are anticipated by providing a concrete conduit under the center of the street of whatever size needed. With man-hole openings say, every 200′, and with transverse conduits of small diameter branching out to the curb line, the needs of the city could be met. Connections with these transverse conduits would not mean as much work as such connections mean nowadays, and the maximum amount of digging would never be more than half the manhole and transverse conduit spacing. If a city owned a system of such conduits, it would always have a fine means of combating monopoly in any public service enterprise. Space in these conduits could be rented or franchises could be offered, and without the necessity for a great deal of underground construction. The cost of installation of a new public service system of any kind could not be very great, so that there would always be an opportunity for competition. On the other hand, the idea is just as good if viewed from the angle of public ownership of these utilities.

This suggestion, which was submitted to several engineers and architects interested in such problems, brought in many interesting replies. A few of these follow. Further replies discussing this question will be found in the Correspondence Department of this and subsequent issues.

Comment by Walter Burley Griffin.*
Architect, Chicago.

The most remarkable thing about this suggestion of utilizing the whole of the sewer trench, the top of the sewer and a part of the sub-pavement to contribute toward the construction of a concrete utility conduit is that it is so simple and yet has not heretofore come into general use for ordinary streets. In that respect, however, it shares with a lot of possibilities that are being passed by constantly through following of habits rather than use of reasoning faculties.

Several advantages besides those enumerated occur to me, but possibly the most important of all is the facility afforded for the channel of an underground trolley wire to work toward eliminating still more poles and the preposterous network of wires which American electric railroads so generally impose on us as the only expedient.

The chief objection that may be brought up is the greater liability of freezing of the water pipes, a difficulty which is by no means insuperable, though in Northern towns necessitating some insulation.

Of course, for wide and important metropolitan streets similar utilization beneath the sidewalk area with double sewer and other service lines is preferable on account of greater economy in connection with private uses of the balance of the sub-sidewalk space, lesser grades at two level road intersections and to allow for possible subway for freight or passenger transportation.

Comment by Chas. W. Campbell.
City Engr., St. Joseph, Mo.

In the matter of public conduits in the streets to avoid repeated cutting of street paving and, what is quite as important, repeated excavation and poor backfilling under the replaced paving, I would say, in general, that the idea is all right with transverse or cross connections at proper intervals, depending much upon the longitudinal grade of street, especially as to sewer and drainage. With these cross or branch conduits properly located there would be no occasion for cutting into or under a pavement once laid, except upon rare and extraordinary occasions.

The location of this main conduit would be varied, possibly, where street car tracks are in the center of the street. Where the main conduits are laid along the main thoroughfares, those necessary to be constructed for the service of the intervening block or blocks of cross streets could be taken off so as to be extended along the sidewalk spaces on either side of such cross streets.

However, it must contemplate a very large (and apt to be burdensome) pre-investment to get these conduits (large enough for future use) placed prior to the street paving, which paving in some of our cities is laid out into the pasture lands and corn-fields ahead of building. To put these sufficiently large conduits ahead of the paving, even in sparsely settled sections, will involve an enormous interest account until the buildings and population become sufficiently numerous to require anything like the full service of such conduits.

In case of re-paving a street, already built up to its reasonable capacity, this idea would certainly apply, but by that time all the utilities will most probably have been installed.

It is quite a problem, crying for solution, but requiring the highest order of talent for its solution, and the principal function of this talent will be to encourage and provide the funds for its timely completion sufficiently far in advance of the city's growth. And then again, worst of all, suppose the city does not grow to require or use this conduit built so far in advance?

Comment by Frank R. Lanagan.
City Engr., Albany, N. Y.

In some of the business streets of Albany the area beneath the pavements is a network of pipes, sewers and conduits. The pavements have been and are continually being dug up to repair this or that break or to make some new connection, and the result is that many street surfaces originally well paved are now a sight to behold, and the city is facing an extensive repaving program.

A large conduit for pipes and wires in the center of the roadway will not, in my opinion, relieve the condition, for the reason that connections needed to be made from time to time from the central conduit to each building will be an excuse for tearing up a pavemetn for such connections.

In paving a street, with some vacant property, it is not possible to anticipate what kind of buildings are to be erected, or to know whether they will need gas, electricity, telephone, etc., or, in the case of a large frontage, what subdivision of lots might be made in the future. For these reasons, connections cannot be extended in advance of paving.

The remedy for this condition might be found in not allowing any underground work under a pavement except trunk sewers and large water and gas mains, and in putting duplicate conduits and sewer, gas and water pipes under each sidewalk where connections to property may be made direct. This has been done in some of the more recently paved streets in Albany,

*[Mr. Griffin won the First Premium, $8,500, in the international competition for a comprehensive plan for an entirely new city to be the capital of the Commonwealth of Australia. The awards were made May 23, last.—The Editors.]

and it is hoped that it may become general practice, although the public service corporations remonstrate on account of the extra cost to them for duplicate lines.

[Would not the transverse conduits do away with the necessity for cross-cutting?—Editors.]

Concrete Paving in Norwood, Ohio at $1.20 Per Square Yard

Norwood, Ohio, has laid 2,000 sq. yds. of concrete pavement, 30′ wide between curbs. A section of the pavement is shown in an accompanying sketch. One-half inch longitudinal joints are placed at each gutter, and transverse joints every 30′; all joints filled with an elastic material.* The concrete used was of a mixture of 1:2½:5 cement, sand and crushed boulders. The crushed stone runs from ¾″ to 2″ in size. With

Fig. 1—Mixer Gang on Norwood, Ohio, Paving.

cement at $1.20 per bbl., and sand at 90c and stone at $1.20 per yd., the pavement cost $1.04 per sq. yd., including all items. The pavement was finished by tamping.

Itemized figures of the successful bidder on the work are as follows:

Cinders, $1.00 per cu. yd.; Concrete, including grading, $4.75 per cu. yd.; Rolling, 2c per sq. yd.; Concrete curb and gutter, 60c per lin. ft.; Art stone walks, 10c per sq. ft.; Sand, $1.50 per cu. yd.; 12-in. drain pipe, 75c per lin. ft.; 3-in. drain pipe, 3c per lin. ft.; Catch Basins, $45.00 each; Outlets, $40.00 each.

Figure 1 shows a mixer gang laying the pavement. A Milwaukee mixer was used for the greater part of the work and with a force of 15 men, 70 yds. of concrete was laid in a day.

The cost of the pavement as given above includes rolling and sub grading, and also includes the sand covering.

Figure 2 shows the placing of the concrete over half the width of the street at one time. Figure 3 shows

Fig. 2—Laying Norwood, Ohio, Pavement.

the sand covering over part of the street. The line at which this work was stopped is distinctly shown by the difference in coloring of the pavement, the dark portion indicating where the sand is.

J. A. Stewart, civil engineer, who was in charge of the work, figures that this cost of $1.04 is to be con-

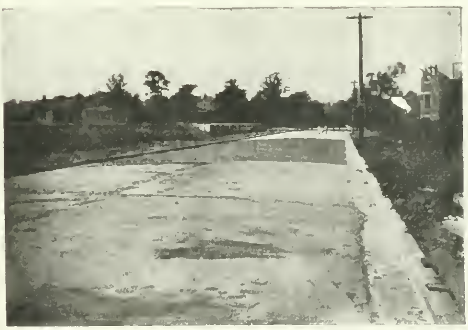


Fig. 3—Linden Avenue, Norwood, Ohio.

*The Philip Carey Co., Cincinnati, O.

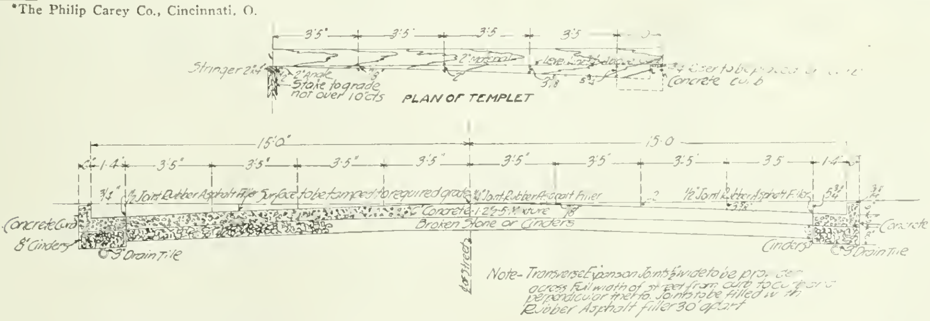


Fig. 4—Details of Norwood, Ohio, Paving.

sidered in comparison with 94c for macadam with tar binder and 80c for water-bound macadam. Fourteen years ago, Mr. Stewart says, Montgomery avenue (the main thoroughfare of Norwood) was improved with concrete curb and gutter and the roadway with macadam. Two and one-half years ago the roadway was paved with granite, but the original concrete curb and gutter were in such good condition that it was not disturbed and today anyone not familiar with the facts would suppose it had been constructed at the same time as the granite pavement.

Atchison, Kansas, Concrete Paving

Atchison, Kas., put down 9,500 sq. yds. of concrete paving this year 30′ wide with 6-in. crown. Three-quarter inch joints filled with paving pitch are placed 30′ apart. Longitudinal joints are placed next to the curb and are filled with asphaltic cement. The concrete on the bottom course of 5″ was made of 1 part Atlas cement, 2½ parts sand and 5 parts stone. The second course of 1″ was made of 1 part cement, 1½ part sand and 3 parts Joplin flints. This pavement cost $1.07 per sq. yd., with cement at $1.20 per bbl., sand at $1.30 per ton and stone at $1.20 per ton. The surface was broomed and the pavement was covered with ½″ of sand and kept wet for 5 days. The work was done on contract and was in charge of the City Engineer, S. K. McCrary. Some other alley paving has been done in which the second course has been omitted and the entire street laid of a uniform mixture.

Astoria, Oregon, Tries New Paving Method

Astoria, Ore., put down 3,000 sq. yds. of concrete pavement on Commercial St. in August, 1911, in a roadway 35′ wide. Sub-grade and finished pavement each have a crown of 4″. Transverse joints are placed 200′ apart, an unusually wide spacing. These joints are filled with sand. There are no longitudinal joints. The concrete is 6″ thick in 1 course composed of Mt. Diablo cement 1 part, sand 3 parts and stone 5 parts. The surface is roughened to give a better foot-hold. The pavement is reinforced in an unusual way, ½″ corrugated steel bars being put 1′ apart at right angles to and parallel with the length of the street. This pavement cost $1.50 per sq. yd. The city engineer advises that the reinforcement was put in to overcome cracking. He also reports that the traffic is heavy and that the pavement does not quite come up to expectations. A plan is shown on this page, of concrete pavement which is being put down under new specifications this year.

The "Akme" System

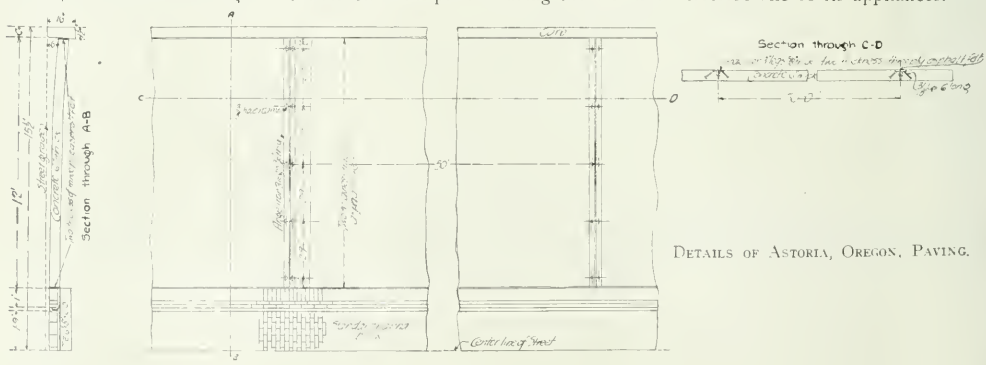
In the August issue reference was made to flat slabs in the Chicago building ordinance. The design standards referred to were developed to cover work under the "Akme" system, which is a two-way reinforced flat slab construction first used in the fall of 1908. The "Akme" system differs from other flat slab construction in having reinforcement placed in two directions only instead of in four directions. This results in having only two layers of bars instead of four layers of bars, and furthermore, in the "Akme" system, no bars or other reinforcement are used in the column heads, other than the floor bars already referred to.

The advantages gained by this system of construction over girder and beam construction are many and include improvement in lighting, reduction of the building, rapidity of construction, large saving in the cost of form work, and in general, a much more economical and better appearing structure. The system has been developed by Condron and Sinks, Chicago.

At the present time in Chicago alone, over 1,000,000 sq. ft. of "Akme" system floors, distributed between seven large buildings, are under construction.

Wm. B. Ruggles, president of the Ruggles-Coles Engineering Co., 50 Church street, New York City, has just returned from England and advises that the Electro-Metals Co., Ltd., London, have been appointed their sole agents for all of Europe, excepting Norway and Sweden. The Electro-Metals Co., Ltd., will appoint sub-agents on the continent.

A decision has been recently handed down by a New York court, upholding the right of the General Cement Products Co. and the New York Cement Gun Co. to the exclusive use of the trade phrase "cement gun" and restraining the Cement Appliances Co. from using the words to describe one of its appliances.



Details of Astoria, Oregon, Paving.

The International Association for Testing Materials

Sixth Triennial Congress, New York City, September 2 to 7, 1912

The Sixth Congress of the International Association for Testing Materials was held in the Engineers' Societies' Building, New York City, from September 2 to 7 last.

Every member in this country and in Europe had looked forward to this occasion with great pleasure. At the Fifth Congress, in Copenhagen, when the venerable Dr. Charles B. Dudley was chosen President, and it was decided to hold the next Congress in America, the proposition was met with genuine enthusiasm, which prevailed until the last hour of the Congress in New York. Europe was an old story to the foreign members. To a majority of them America was a new and unexplored world, and the American members, proud of their country and its achievements, were more than glad of the opportunity to entertain the distinguished representatives from abroad. Truly understood, this great Congress meant far more than a mere exchange of scientific knowledge and experience. There was attached to it quite as much of the spirit of comity as of scientific and industrial progress. With the President of the United States as patron, this feeling of international friendship and good-will became the keynote of the meetings.

That the Congress was international in the most literal sense, is shown by the following list of countries included in the membership:

Argentine Republic, Australia, Austria, Belgium, Brazil, Canada, Chili, China, Denmark, France, Finland, Germany, Great Britain, Greece, Guatemala, Hungary, India, Italy, Japan, Luxemburg, Netherlands, Norway, Panama, Portugal, Roumania, Russia, Servia, Spain, Sweden, Switzerland, United States of America.

The ranking countries from the standpoint of membership were the United States, 472; Germany, 424; Russia, 268; Austria, 226; France, 195; Denmark, 159; Great Britain, 138; Belgium, 126; Hungary, 114. The total membership in May, 1912, was 2,680. In Concrete-Cement Age for September, pages 89 and 90, are listed some of the world-famous engineers and scientists who are members of the International Association.

American representatives, both as individuals and in official capacity as members of various societies, had determined to make the occasion a memorable one for their foreign guests. Committees and sub-committees were appointed to look after every detail that would tend to enhance their pleasure and comfort.

The American Society for Testing Materials was officially the host of the International Association, but co-operating with it were the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Institute of Electrical Engineers.

Dr. Henry M. Howe, Columbia University, was acting President of the International Association.

Robert W. Hunt is President of the American Society for Testing Materials, the host society.

Robert W. Lesley was chairman of the Cement and Concrete section.

Dr. Edgar Marburg was Secretary of the host society and chairman of the Finance Committee.

The Reception Committee members were Robert W. Hunt, chairman; John Birkenbine, Philadelphia; Mansfield Merrimann, New York; Robert W. Lesley, and C. C. Schneider, Philadelphia.

Richard L. Humphrey was chairman of the Committee on Resolutions.

The formal reception of the official delegates from governments by the President and members of the Council took place at 9 o'clock Tuesday morning. The assembly room was decorated with the flags of all the nations represented, the American colors predominating. It was an impressive scene. Acting President Henry M. Howe occupied the chair. The first address of welcome to the delegates was delivered by Dr. Robert W. Hunt, President of the American Society. He extended a cordial welcome on behalf of the various engineering societies of America, and expressed the hope that the result of their labors would amply repay them for their journey, and closed At the close of Mr. Hunt's brief address Dr. Howe was unanimously elected President for the unexpired term. He then introduced Gen. Bixby, Chief of Engineers, United States Army, representative of Pres. Taft. Gen. Bixby presented the regrets of the President, who could not be present. The President, he said, had always taken great pleasure in attending and assisting Congresses which have for their object the promotion of peaceful arts among all the nations of the world. The President regarded that defence as best where manufacturing, commercial and personal interests are mutual. The United States, he said, desires to give assistance to all such work. We of the United States have already begun to realize that the best progress is secured only by extending the field of research beyond its local surroundings, thus combining the best work of all peoples and all countries. It was to be hoped that the foreign members would carry with them the conviction that this country is looking forward to a time when all countries shall have ideals equally worthy and in harmony with each other.

Gov. John A. Dix, of New York, then welcomed the Congress in behalf of the state. He said that it was through the combined efforts of such trained minds as were represented in this Congress that it was possible to maintain the health, the economic welfare and the industrial progress of modern civilization. In entertaining the Congress the country, and New York in particular, was aiding to disseminate knowledge of the utmost importance and to do so was, therefore, a great privilege.

Comptroller Prendergast welcomed the Congress on behalf of New York City. He described its function as of the highest importance, and as a practical illustration of the value of its work gave a list of the tremendous expenditures involved in the administration of the city, going on to show how research such as is conducted by the Congress would have its ultimate influence in bringing about the most efficient and economical results as applied to municipal government.

President Howe then welcomed the delegation of each country separately, the unique feature of his address being greetings in German and French, interspersed with remarks in English. Dr. Howe sounded the keynote of the Congress when he said its purpose was to serve humanity by distinguishing the fit from the unfit in such materials as are essential to industrial development. The Association, he said, is an open court for the deliberation of such subjects, giving to the world the result of its research and experiments. The international political parliament has yet to come, but the international industrial parliament finds itself exemplified in the meetings of this Association. Dr. Howe spoke of the gratifying increase in the membership in the last three years, which had been 27%, and of the noteworthy progress of the work of the Association.

Sections Begin Work.

Regular sessions of the various sections began Tuesday afternoon. Cement and concrete were assigned to Section "B." Robert W. Lesley, Philadelphia, Vice-President of the American Society, was chairman of the section. The honorary chairmen were F. Schule, Zurich, who translated the proceedings and discussions into French, or German; Prof. Gary, Berlin, who translated them into German, and A. Foss, Copenhagen, who made both English and German translations.

Fine Particles in Cement. The first subject considered at the cement section was a paper by M. Petersen on the determination of the very fine powder in Portland cement. He stated that

Comparative experiments with air sifting and sifting through sieves, on several different cements, showed that the sieve method may be used for ordinary compression tests, or wherever accurate results are not required. For accurate tests the air separating funnels should be used, which eliminate irregularities of test due to variations of sieves, and grade the fine particles more accurately. Tests to show the influence of fine grinding prove that the amount of medium material is little changed, the fine material increasing while the coarse material decreases. The percentage of water for normal consistency increases with the fineness. The tensile strength increases, though irregularly, while the compressive strength increases markedly and regularly.

Mr. Gary, in discussion, stated that great interest in this subject had been awakened lately, and that it was most important to know how much of the fine particles in cement were of value.

To facilitate discussion there had been grouped with the above paper, papers by Mr. Feret and Messrs. Schule and H. de Gottraû. Mr. Feret stated that:

Experimental study of air sorting was made to determine the controlling conditions. The size of the particles carried through depends on the atmospheric pressure and the velocity of the air current. The latter can be regulated at the exit end of the tube in which the separation takes place. Further study must be made of the dimensions of the cylindrical part of the separator, and of the collection of the total fine matter or the total residue.

Messrs. Schule and de Gottraû called attention to

Tests made on the material separated by the Gary-Lindner air sorting apparatus. With increasing fineness of fraction, the calcium sulphate percentage and the loss on ignition increased. The particles are separated not only by size but also by specific gravity, so that the method does not enable the fine grinding to be tested fully. Rapidity of set is increased by fine grinding. The second and third fractions from the air-sorting apparatus showed highest strengths, while the residue on the 30,000-mesh sieve showed poorest strength. The residue on this sieve is an important criterion of the quality of cement. For routine testing, air sorting into three or four finer fractions has little importance. There was no discussion of these papers.

Progressive increase in Strength of Cement Mortars. This was the subject of a paper by E. Candlot, of France. A complete abstract is presented on other pages of this issue.

A written discussion of this subject was presented by W. C. Hanna, accompanied by tables showing causes of retrogression in tensile strength. He stated that water, fine grinding and age, all have their influences. Dr. Schott, of Germany, agreed with Mr. Candlot. He regarded increasing strength from 7 to 28 days as of no value. The cement that gets its strength in the shortest possible time may be of the greatest practical value. Bertram Blount, of England, agreed with Dr. Schott. If a cement obtains its ultimate strength in a given time it is a good cement to use. Dr. Dyckerhoff, of Germany, stated that the best of results had been obtained with cement showing high strength in 10 days and no increase in 28 days, but, on the contrary, even a decrease in strength. Mr. Schule also referred to this, stating that it applied only in countries where tensile tests are used, but the subject is of greatest importance.

Mr. Lesley stated that in the construction of the New York subways, cement showing growth in strength had been required, but this requirement had been a descriptive clause rather than a specification. From this descriptive clause the specification had grown. H. F. Tucker urged that if the 7 days' tensile test be omitted, there should be substituted some other test. Tensile strength is some indication of cementitious value, upon which depends also compression strength. Mr. Feret stated that his paper did not relate to countries having merely the 28-day compression test, but had special significance with relation to salt-water construction. He cited the tunnel construction in New York City. Mr. Mueller explained that the German standard specifications consider the tensile strength of 7 days as only a preliminary test, but that the 28 days' compression test is a decisive one. Mr. Humphrey stated that there appeared to be some confusion about the American standard specifications. A few specifications require increase in 7 to 28 days, while the Standard Specifications require only that there shall be no retrogression in 28 days.

Distribution of Stress at the Minimum Sections of a Cement Briquette. This was the subject of a paper by E. G. Coker, who stated that

The method of polarized light effects in transparent bodies under stress was applied to celluloid models of cement briquettes of the three chief forms: English, American, and Continental. This permitted the ratio of maximum to mean throat stress to be computed. It was found as 1.75 for the English, 1.70 for the American, and 1.95 for the Continental standard briquette. These results confirm the belief that different test results would be shown in cement tests by the different forms of briquette.

There was no discussion of this paper.

Diatom Earth as Puzzolana for Cement. This was a paper by A. Poulsen, in which it was held that

In concrete for hydraulic works, especially in seawater, the liberated lime of the Portland cement should be neutralized by siliceous puzzolana. While this generally decreases the strength of the mortar, diatom (infusorial) earth has the opposite effect, provided it is thoroughly dried and ground with the cement. (The author has patented this method.)

This paper, with that of Mr. Candlot, on "Progressive Increase," is published in detail on another page of this issue.

Mr. Poulsen presented additional data on this subject which had been obtained since his paper was filed. They tended to show that the addition of diatom earth increases the strength and resistance of cement and concrete to sea water.

Mr. Humphrey stated that these increases in strength are not unusual. Any material finely ground will produce increases in strength. They are most valuable in sea-water construction. Dr. Scheit agreed with Mr. Humphrey that fine grinding has much to do with the subject, and that sufficient time has not elapsed since Mr. Poulsen made the tests to determine their accuracy. Paul Wagner thought the strength attained by using trass depends upon the way the mixture is made.

Edwin Duryea presented a brief summary of tests made for the Los Angeles, Cal., aqueduct and for sea-water construction. In the seawater tests, 1:3 briquettes with diatom earth had tested stronger than straight Portland cement.

Mr. Feret described a number of experiments, and stated that much depends on the good or bad quality of the trass itself. The real importance of Mr. Poulsen's paper was that it showed that cement could be improved in this way for use in salt water. Mr. Poulsen said that it was much easier to grind the diatom earth than trass.

Tests of Construction Materials by the U. S. Reclamation Service. This paper, by J. W. Jewett, was referred to in abstract in the September issue. The foreign members asked for information as to what is really meant by the term "alkali," and Mr. Humphrey and Mr. Bates explained the difference between the black alkali and the white alkali. Mr. Humphrey advanced the theory that rapid evaporation or crystallization of the double-salt alkali was the disrupting cause, just as in case of freezing. He added that there were many misstatements made concerning the effect of alkali.

Some Chemical Phenomena Encountered in Industrial Investigations. J. Bied was the author of this paper, in which certain observations made in special cement tests are reported.

The loss of water on heating, at particular temperatures, permits of drawing conclusions as to the nature of the cement. By calcination and then treatment with steam at 140° C. (284° F.) the amount of free lime, initial and after set, can be determined. By determining the free lime in this way, after determining the silica combined with lime (by dissolving the total insoluble silica in caustic potash), the composition of the silicate is obtainable. Dicalcic silicate calcined and chilled showed no hydraulicity, contrary to accepted views. Cement mixtures fusing at 1450° C. (2642° F.) to a liquid were produced, giving a slow setting but rapidly hardening hydraulic product, with no trace of unsoundness; it had the formula of monocalcic aluminate. A siliceous cement with 71½% lime has been produced by long burning, which was wholly sound in the hot-water test, though containing 10% more lime than neutralized by the silica, alumina and iron in tribasic salts.

In the discussion Mr. Spackman referred to several interesting observations made by him; for example, where a cement containing 2 of alumina to 1 of lime, in other words, a cement with less than 30% of lime, had proved to be sound cement.

Tests for Constancy of Volume of Cements. Under the above heading four of the most interesting papers of the Congress were introduced at the Wednesday morning session. They had to deal with the accelerated tests and were presented by Messrs. Blount, Gary, Schule and Bied. The following are extracts from the four papers:

Bertram Blount.—Although some cement may fail to meet the accelerated tests for constancy of volume and yet be sound, no case has been found where a cement which stood the test proved unsound later. Extensive tables show that since the Le Chatelier test was introduced in England there has been no difficulty in obtaining cement that easily meets the test. In 1911 only 3 tests out of 93 exceeded the reduced limit of 10 mm. spread. The international adoption and use of such a test is regarded as of the highest value.

M. Gary.—Full study of the subject of soundness tests by the Association of German Portland Cement Works in the past revealed no cement which proved unsound in use after passing the standard cold-water test. The boiling test rejected many cements which proved wholly sound in use. A new study was made after the approval of the Le Chatelier test by the Copenhagen (fifth) Congress. Comparative tests showed that the Le Chatelier test did not give concordant results in different laboratories, and that the material and make of the apparatus influenced the results. German cements do not fear the test, as 83 out of 88 passed the test, the average spread for all 88 being only 3½ mm. It is therefore proposed that the resolution of the Copenhagen Congress in favor of the test be rescinded as not well grounded, since the test is misleading; and that a new committee be appointed to discover an accelerated test for soundness.

F. Schule.—The boiling test is standard in Switzerland for cement used in dry exposure. Tetmajer's test-pats, observed for years, continued to confirm the reliability of this test. Of 2,200 Portland cements tested at Zurich 1893-1902, the cold-water test rejected 9, the boiling test rejected 193, and 129 proved unsound by 1908. From 1903 to 1908, 1,737 cements were tested; the cold-water test rejected 7, the boiling test rejected 84, and 44 proved unsound by 1910 (35 of those rejected by the boiling test, and 9 others). Cements which are to be used in dry exposure should be subjected to the boiling test; this test is a reliable means of rejecting doubtful Portland cements.

J. Bied.—The use of the hot-water tests with Le Chatelier needles during 20 years in France has given rise to no objections. To examine outside objections, tests were made on cement with gypsum additions, showing that cement with not over 2% gypsum became more stable by aeration, while cement with more than 2% showed increased swelling after aeration. Tests to reveal the variations caused by difference in make, age, and wear, of the needles, showed that these factors as well as the time elapsed between set and immersion in hot water affect the results of the Le Chatelier test. This time should be definitely specified. The details of the needles and their limiting length of use can be standardized. In the German tests there appear systematic errors between the different laboratories, which can be accounted for by difference of age of the cement when tested.

As in the case of the other papers, discussion was held on all of these papers, and at times became very spirited, owing to the difference of opinion that prevails in the several countries. W. C. Hanna, on Mr. Blount's paper, said he had no doubt of the great value of a clause providing for the passing of boiling test under very high pressure for important work. He also had the same thought as expressed in Mr. Gary's paper. At this point a paper by Dr. Le Chatelier was read by Mr. Feret. The point emphasized in this paper was the danger of the expansion of cement or concrete and that it was important to make safety rather than strength the paramount object. These experiments are not new, but date back some 15 years. He was glad to say that the English are now converted to the Le Chatelier theory, and Germany will eventually fall in line in order that her industry may not be discredited. Mr. Gary regretted that the paper by Dr. Le Chatelier had not been printed before the Congress met, as it was impossible to discuss it in detail. He regarded the test as being dangerous when applied to practical use, and inquired how we could use it when it gives different values at different times. Mr. Mueller regarded the Le Chatelier test as valuable in preliminary tests only. Under the test certain desirable cements had been excluded. Dr. Dyckerhoff had made and tested certain prisms that stood the test, but which showed changes in size and a slight checking. He is concluding a series of experiments to be submitted to the committee at a later date.

Mr. Blount discussed the subject at length, stating that special tests may be necessary, as the last word has not been said on this subject by any means. Cement should be made in such a way as to meet all tests, and he realized that the Le Chatelier test was not infallible. It is essential, however, to distinguish carefully between errors that are systematic and errors that are accidental.

Wednesday's Sessions.

Bertram Blount continued his discussion Wednesday morning, referring to the discrepancies in tests as influenced by term of storage, imperfect manipulation, etc. Dr. Schott referred to the statements of Mr. Feret, made the day before, and said that high temperature tests represent abnormal conditions. Mr. Humphrey introduced a resolution for unbiased consideration of tests by the Association. Mr. Bellelûbsky, Russia, said the world requires tests suitable for practical work, and they should be considered from that point of view.

The next paper was presented for the German Manufacturers' Association by Dr. Dyckerhoff, proposing a standard SO_3 limit for Portland cement. This paper is published in complete abstract elsewhere in this issue.

Mr. Humphrey offered a resolution providing for a commission to report on SO_3 content at next Congress. Mr. Feret presented a resolution questioning the advisability of the Association attempting to prescribe the amount of any element in a material to be tested. It should be left to the consumer, lest it should evoke commercial antagonism. Mr. Foss thought this suggestion too restrictive. Dr. Schott urged support of Mr. Humphrey's resolution.

Durability of Stone and Masonry. Under this title the report for the Commission of 50 by J. A. v. d. Kloes was presented.

Procedure and work of the committee are described. Analyses of some specimens of stone, mortar and efflorescence are given. Osmotic pressure is suggested as a possible factor in decay of masonry walls. Excess of lime in masonry and concrete is leached out, and it is probable that a relation exists between excess of lime in mortar and the production of efflorescence and wall disintegration, though the efflorescence may contain but little lime.

Combined with the above for discussion was a paper by A. Hambloch on the influence of faulty mortar composition.

The ratio of puzzolana to lime or cement recommended by Mr. van der Kloes at the Copenhagen Congress contains excessive trass, generally about twice as much as should be used. A table of proportions of trass-cement, trass-lime, and trass-lime-cement mortars and concretes for various uses is given. The claim that mortar is a factor in disintegration of masonry lacks proof, and if such relation exists it is of importance in rare cases only. Decay of stonework in the Cologne cathedral is chargeable to smoke gases and frost action.

In discussion Mr. Poulsen said, with relation to Mr. Hambloch's paper, that there might be a vast difference in the quantity of trass required for different purposes, for example, in the case of piles as compared with other construction.

Action of Seawater on Concrete. This subject came up Friday morning, when three papers were grouped for discussion, as follows:

V. J. P. de Blocq Van Kuffelers *The action of Seawater on Reinforced Concrete.*—Experience in Holland with concrete and reinforced concrete in seawater indicates that reinforced concrete is sufficiently permanent (though not eternal) to warrant its use for marine construction. The following rules should be strictly adhered to: Only slow-setting Portland cement should be used; mixing and ramming must be done with great care; trass or other puzzolanic additions are desirable; the mortar should be dense, and the mixture rich; setting in moist air before immersion in the sea is advantageous.

W. Czarnomski: *Condition of the Concrete Blocks Immersed in the Baltic Sea at Libau Harbor.*—Blocks of stone masonry and blocks of concrete deposited in Libau harbor in 1891 (8 blocks) and 1898 (7 blocks) were examined in 1905, externally and (after blowing apart with explosives) internally. All were in satisfactory condition, with some evidences of dissolving or disintegrating action. Chemical analysis of fragments showed that the cement in all the blocks had altered by decrease of lime and increase of magnesia and sulphuric acid. The concrete blocks showed greater chemical change of the cement than the masonry blocks. The analysis gives no guide for discriminating among the three cements employed, thought it is evident that the silica-cement proved fully as good as the Portland. Other blocks of the 1898 group are still in the water; their examination in 1918 is expected to give better information on the deterioration of the cement mortar and concrete.

LOMBARD & DEFORGE: *Action of Seawater on Hydraulic Limes and Cements.*—Study of hydraulic limes and cements in seawater was begun at La Rochelle in 1852 and has continued since then. The various tests made are described by the authors. A block of Vicat's maritime cement, neat, placed in 1859, was in good condition in 1911; sand-mortar blocks show slight change. Theil lime lasts 15 to 20 years. Portland cement undergoes three forms of change; high-lime cements check and break up from swelling, corectly proportioned cements decompose without appreciable expansion, turning pink, and low-lime cements develop surface cracking and disintegration. The experiments since 1880 are summarized: Light hydraulic limes show signs of alteration in 2 to 3 years, heavier limes in 6 to 7 years; quick-setting cements in 10 to 20 years; slow-setting cements in 10 to 30 years. While most binding media are liable to decomposition, Portland cement is to be preferred in this respect. The mortar should be rather rich.

The discussion was opened by Mr. Poulsen, who read the following:

In my account of "Cement in Seawater" presented to the Members of the Association at the Fifth Congress, Copenhagen, 1909, I have set forth a summary of the results attained so far by comparative experiments on mortar cubes and concrete blocks, instituted in the 1896 meeting of the Society of Scandinavian Portland Cement Manufacturers.

In 1909 the results of the 10 years *Experiments on Mortar* were published. Just now, in 1912, the 15-year specimens have come from the trial places Esbjerg (Danish North Sea coast) and Vardo (Norway, Arctic Ocean). But the crushing of the mortar cubes has only been begun in the State-Laboratory for Testing Materials in Copenhagen. Consequently there has been no new information gained in the mortar cube trials.

The concrete blocks placed at Thyboron (Danish North Sea coast) have been inspected in the summer of 1912.

Apparently these trial blocks have suffered but little alteration in the last 3 years and to a certain extent they might apparently even be estimated to be of a better nature than presumed in 1909, inasmuch as the little faults mentioned in the appendix 10 of the said report (1909) have not developed further in many of the blocks.

Some of the most damaged of the blocks, however, are now completely destroyed.

Mr. Foss did not regard the Libau tests as conclusive, because the salt content there is low. The Black Sea would be a better test. Mr. Belelubsky said that the Russian cement usually gave good results, due to the magnesium content of 1½ per cent. Work in the Black Sea showed certain defects after 15 to 30 years, but new work is better.

The following paper was presented without discussion:

M. GASSIER: *Comparative Strength and Resistance to Seawater of Crushed-rock Mortars and Sea-sand Mortars.*—Experiments on the strength of lime mortars to compare the value of sands made by crushing rock and natural sea-sand showed that the artificial sands are in general fully equal to the natural sand. Seawater exposure tests continued for a number of years showed the artificial sands to be the equal of natural sand in this respect also.

Prof. Schule had prepared a highly scientific discussion of the relation between the crushing strength and elasticity of concrete, but asked that it be passed without reading.

Waterproofing Concrete. The following papers were grouped for discussion:

A. GRITTNER: *Waterproof Concrete.*—The author attempted to make waterproof concrete as follows: By fluorating, by mixing with tar, and by mixing with soda and potash soaps. He obtained the following results: Fluorating yields waterproof concrete, but the process requires much work and time. An 8% solution of potash soap yields a waterproof concrete, completely satisfactory in point of impermeability.

J. BIED: *The Porosity of Mortars.*—A considerable decrease in the perviousness of neat cement paste and 1:3 mortar test pieces was secured by mixing in barium aluminate, transformed into barium sulphate. Slight effects were obtained by the use of fatty or gelatinous substances; heavy mineral oils gave the best results of this group.

Clody M. Chapman regarded the papers as valuable, but lacking in esesntial details. Mr. Gary had no faith in the theory of filling pores by admixtures except as a temporary expedient. Such waterproofing would not be permanent, he maintained.

Tests for Reinforced Concrete. Under this head the following were presented and discussed:

F. SCHULE: *Reinforced Concrete.*—The report discusses the principal subjects of investigation. It proposes a resolution favoring the adoption of a uniform form of report on accidents to reinforced concrete structures, this committee to draw up the standard form. It gives a proposed standard list of mathematical symbols for reinforced concrete calculations, stating that a modified list will be presented for the English-speaking countries. Reports on experimental investigations and tests of reinforced concrete in different countries are appended to the report.

H. SCHEIT & E. PROBST: *Tests of Continuous Reinforced Concrete Structures.*—A brief report of tests whose results have been previously published in book form. Where free rotation and displacement at the supports can occur, reinforced concrete continuous structures follow the same laws as similar structures of homogeneous material having constant modulus of elasticity. Reinforced concrete structures firmly connected to their supports are greatly influenced by the deformations in the supports.

F. v. EMPERGER: *Reinforced Concrete Building Accidents.*—Official reports on building accidents in reinforced concrete are necessary if proper instruction is to be derived from these accidents. Austria and Prussia have recently made provision for official reporting (May and September, 1911.)* The author recommends that at the next Congress the results of this official reporting be summarized. He also recommends his test-beam method† as a means of reducing the liability to accident in concrete work.

*Text of this report was published in August issue.

†This method was completely described in *Cement Age* for November, 1911; January, February and March, 1912.

Mr. Humphrey outlined briefly the work of the American Joint Committee. They will present a report at the close of the year which will embody practice in America up to that time. He endorsed Mr. Schule's suggestions as to tests on large structures.

At the afternoon session Prof. A. N. Talbot, University of Illinois, continued the discussion, outlining work that had been done with relation to hooped columns, methods of ending column reinforcement, footings, flat slabs, and tests of completed structures.

Mr. Probst, in discussing tests, said new methods in Germany had not been sufficiently systematized to warrant discarding present methods.

An impromptu discussion of electrolysis came up through the withdrawal of a paper on the subject by Cyril de Wyrall. Dr. Mueller stated that the last word on that subject will be found in a forthcoming book on experiments at Darmstadt. Mr. Bates, of the Bureau of Standards, stated that of all the reported failures from this cause the Bureau found the case verified in one instance only.

Another paper on tests for concrete was then considered, that of C. M. Chapman, of which an abstract was published in the September issue.

Discussion by Sanford E. Thompson was presented, in which he urged laboratory tests as the most reliable to determine the quality of cement, stone and sand before starting the work. Edward Suenson, Denmark, described tests in that country. Mr. Spackman spoke of the importance of considering segregation in wet concrete when poured by gravity. He had found a good 1:3:6 mix transformed into 1:11:11 through segregation.

Cement in Fireproofing. There were two papers not assigned to the Cement Section which had an important bearing on the fireproofing properties of concrete. Abstracts of the papers follow:

E. O. SACHS: *The Fire Risistance of Concrete and Reinforced Concrete.*—The British Fire Prevention Committee has made fire tests since 1899, to the number of nearly 200, reports on all of which have been published (in 125 "Red Books"). The plan of work and test procedure have been described. Resolutions are proposed to the Congress: that the Congress express appreciation of the need for fire tests of concrete and reinforced concrete, and for recording certain essential factors of such tests; that the "universal standards" for fire tests adopted at an international conference in 1903 be approved as the basis for all future fire tests (these standards provide for classifying into (a) temporary protection, (b) partial protection, (c) full protection, with specified temperature and duration of exposure for each class); and that a committee on fire tests be appointed by the Council.

I. H. WOOLSON & R. P. MILLER: *Fire Tests of Floors in the United States.*—The report embodies a brief history of the development of testing the fire-resisting properties of building materials and construction in the United States, with a description of the various equipments now in use for this purpose and the general status of the work. Tabulated details of about eighty floor tests are given.

Report of the Committee on Resolutions. The report of the Committee on Resolutions was presented by Chairman Humphrey, as follows:

RESOLVED, That the Council be requested to appoint a Committee to report at the next Congress on the effect of SO_3 in Portland cement.

RESOLVED, That the task of further examining all methods of accelerated tests for the constancy of volume of Portland cement be referred to a Committee and that it shall be an instruction to this Committee to invite experiments by various testing laboratories, but also to have some experiments made by an official testing authority in each country concerned.

RESOLVED, That the committee for determining a method for ascertaining the fine flour in cement be requested to endeavor to ascertain the approximate size to which the individual particles of cement have to be reduced in order that they may completely hydrate at short periods.

RESOLVED, That Committee 41 be instructed to report at the next Congress on the methods of controlling the qualities of concrete and reinforced concrete.

RESOLVED, That with a view to the prevention of accidents and facilitating the acquisition of the requisite knowledge of the properties of materials, it seems advisable that a uniform system of reporting on building accidents should be adopted in the different countries, in the same manner as is already done in the case of accidents to steam boilers. The Congress expresses a desire that Committee 41 shall endeavor to organize such an international system of reports and present to the next Congress the reports on building accidents, collected country by country, together with the deductions made therefrom as regards the prevention of accident.

RESOLVED, I. That it is advisable in the future investigations of the strength of concrete and of reinforced concrete as used in buildings to obtain reliable data on the effect of fire at high and at moderate temperatures upon these materials.

II. That the data required refer especially to:

1. (a) Loss of strength during fire.
   (b) Loss of strength after fire (both upon rapid cooling and natural cooling).
2. (a) The value of different aggregates and proportions of Portland cement to aggregate.
   (b) The value of different forms of reinforcement.

III. That tests conducted with a view to obtaining these data in different countries be arranged as far as possible on a uniform basis, the universal standards for fire tests of the British Fire Prevention Committee adopted at an International Conference in 1903 to serve as far as practicable as a basis for the testing conditions, these conditions having also been largely applied in the tests of the Columbia University testing plant at New York and elsewhere.

IV. That the Council of the International Association for Testing Materials create a special sub-committee (under Group B, Cement, Concrete, etc.) to deal with any problems arising from the above, to be known as the Sub-Committee on the Fire Resistance of Concrete and Reinforced Concrete, and that this Sub-Committee be requested to report at the next Congress.

RESOLVED, That Committee 42 is invited to continue its work with a view to obtaining a uniform method for tests of plastic mortars and to apply this method to the comparative study of various normal sands.

The general Congress met at 10 o'clock Saturday morning to receive reports of resolution committees, to take action on them, and to transact such routine business as might require attention. The Congress accepted the invitation of the Czar of Russia, extended by his Excellency, N. Belelubsky, to hold the next Congress in 1915 at St. Petersburg. Dr. Howe, who had been acting President of the Congress and President of the International Association since Dr. Dudley's death, was elected President at the beginning of the Congress and terminated his duties in that capacity on the last day of the meeting. Dr. Belelubsky, of St. Petersburg, was elected President of the International Association for Testing Materials to serve for the next three years and will have charge of the preparations of the Congress that is to be held at St. Petersburg in 1915. By his election as President of the American Society for Testing Materials, Robert W. Hunt became a member of the Council of the United States being elected to that office by the Congress.

As important as was the technical side in the establishment of international standards, it did not exceed in importance the spirit of co-operation established among the nations of the world. This was one reason why the official tour was devised, as it not only enabled the foreign visitors to see very important industrial and engineering works in this country, but happily combined practical observation with delightful social features. No effort was spared to make it successful in every detail. At Washington, for example, various government officials were members of the local committee, so that the delegates saw the national Capital under conditions otherwise impossible. At Pittsburgh the delegates were the guests of the Chamber of Commerce, while visiting in this most important industrial city. Visits to Buffalo and Niagara Falls were also extremely interesting.

A Better Method of Proportioning Concrete.

The U. S. Navy Department has recently issued specifications covering concrete work, in which an advanced method of proportioning concrete, quite worthy of careful consideration, is set forth. Method "A" below follows usual practice. It is to method "B" that attention is called. The specifications follow:

Method A. Fixed Volume of Sand and Stone.

(*a*) *Mass Concrete* (1:3:6).—Foundadations for buildings, including wall foundations, column piers, curtain walls, retaining walls in earth, abutments, wall footings, concrete foundations, and mass concrete similar to these shall be composed of one part cement (allowing 100 lbs. to the cu. ft), 3 parts by volume of sand, and 6 parts by volume of broken stone or gravel.

Method B. Fixed Volume of Stone and Variable Volume of Sand.

(*b*) *Reinforced Concrete* (1:2:4) in columns, beams, slabs, walls, etc., shall be composed of 1 part cement (allowing 100 lbs. to the cu. ft.), 2 parts by volume of sand, and 4 parts by volume of broken stone or gravel.

(*c*) *Proportions of Concrete* under Method *B*, which is to be used only when specially required by the specifications for the work, shall be as follows:

Class *A*.—One part cement (allowing 100 lbs. to the cu. ft.) to 6½ parts by volume of broken stone combined with a variable proportion of sand.

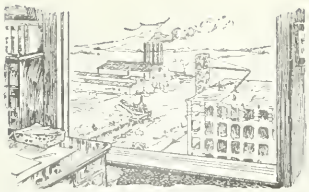
Class *B*.—One part cement (allowing 100 lbs. to the cu. ft.) to 4¼ parts by volume of broken stone combined with a variable proportion of sand.

(*d*) *Determining Amount of Sand*.—It is the intention with the given amounts of cement and broken stone to secure concrete as dense as possible. The amount of sand to be added will therefore depend on the actual character of the sand and broken stone, and the number of cubic feet of sand to be added will be determined by frequent experiments and tests of the material as actually delivered and accepted during the progress of the work. The proportion will be established from time to time for each class of aggregate used and will not be changed during any period of 24 hours, unless the contractor desires to use materials of different characteristics, and the proportion determined at any one time shall continue to be used until the next determination is made and the contractor has been ordered to change the previous proportions.

(*e*) *Tests for Amount of Sand* shall be conducted as follows: To a fixed volume (not less than 5 cu. ft.) of dry stone, which shall be a representative sample, add a fixed volume of dry sand. Mix these very thoroughly, so as to fill all the voids as uniformly as possible, and then measure and weigh the resulting mixture. Repeat the experiment with varying amounts of sand. The proportion of sand which gives the heaviest mixture per unit of volume shall be used in preparing the concrete. The labor and materials for the experiments shall be furnished by the contractor, but the experiment shall be conducted under immediate supervision of the officer in charge.

(*f*) *Run of Crushed Stone*.—The specifications elsewhere require the screening out of particles of broken stone and gravel below 1-5" in size. Under "Method B" of proportioning materials, this will not be necessary if it can be shown by tests that the amount of fine material remaining in the stone or gravel is such that with the addition of sand the resulting total of fine material below ¼" size will be at least equal to the most suitable grades of natural sand. Tests must be made to determine that there is not an excess of fine material beyond that required to give the densest possible aggregate. Permission to use run of crusher stone as described in this paragraph must be previously obtained from the officer in charge of the work.

This method of specifying only the ratio between the cement and a well-graded dense aggregate is to be commended. Too often the arbitrary ratio between the sand and stone, or other coarse aggregate, has been a contributing cause of poor concrete.



COMMENT

High Pressure Boiling Test. Efforts have been made for a number of years to devise a laboratory test which would anticipate in a cement any expansive action or change of volume which might take place after the cement had been incorporated into concrete. The great importance of such a test has been recognized by everyone interested in the cement industry, and it is a question which has been the more interested, the cement user or the cement manufacturer. Numerous methods for determining this change of volume have been advanced and, after fair trial, only two seem to have been generally adopted, the Michaelis boiling test, and the LeChatelier hot test; the latter being in great favor in England and on the Continent, with the possible exception of Germany, while the former has been included in all American specifications. Neither of these methods, however, seems to supply the satisfactory solution, and there are as many opponents of each theory as there are adherents. To the LeChatelier test objection is made that standardization of the instrument cannot be maintained, and that the error of personal equation enters too largely into the determinations.

The chief objection advanced against the Michaelis boiling test is that it rejects cements which, when used in actual structural work, apparently do not affect the strength or permanence of the concrete. On the other hand, many maintain that no instances are known where a cement which successfully pased the boiling test has failed under actual working conditions from want of constancy of volume. In spite of this some cement users claim that they have had concrete disintegrate when the cement which was used passed the boiling test satisfactorily, and that they have eliminated all causes for this disintegration except that of the cement. Such is the claim of the Lackawanna Railroad, and in an effort to guard against future trouble, its laboratory has devised a test for constancy of volume which is far more severe than the standard boiling test.

Neat briquettes, after remaining in a moist atmosphere for 24 hours, are placed in an autoclave and well covered with water. Steam pressure is then gradually raised to 285 lbs. per sq. in., the time required being about three-quarters of an hour. The pressure is then maintained for 1¼ hours, after which the autoclave is blown off and the briquettes removed. When cold they are tested for tensile strength. If they come out sound and show no retrogression in strength, it is considered that they have passed the test successfully, and that it is safe to use the cement in any kind of work. It has been observed that cements which have passed the boiling test successfully go to pieces in the autoclave test, and the question presents itself as to the reason for this behavior.

Formerly, a cement which did not pass the boiling test was believed to contain considerable "free lime" which hydrated on exposure to the hot water and caused expansion. Various experimenters have disproved this theory by adding increasing percentages of calcium oxide to a cement, and it was found that even as large a quantity as 15 per cent added to a sound cement did not cause it to fail in the boiling test. Search was then made for the true reason, and it is now generally conceded that in cements otherwise properly manufactured failure to pass the boiling test is due to coarse particles in the cement which did not hydrate when the mixing water was added, but do hydrate and expand under the conditions of the boiling test. These coarse particles are known to be nothing but small pieces of fused clinker which escaped being reduced to powder in the grinding process. Just as it is possible to expose a pile of clinker to the elements without affecting the hydraulic value of this material when finely pulverized, so it obtains that under ordinary conditions these particles of clinker will resist hydration for a considerable time.

There is much doubt in the minds of cement chemists as to the actual amount of active cement in the cement which passes the standard specifications. Much thought has been directed towards a method which would determine the relative amounts of active cement and finely ground clinker in our commercial cements, but to date no satisfactory method has been found. Every manufacturer knows that by increasing the fineness of his product he obtains a cement which has greater constancy of volume and greater sand-carrying capacity, which latter is the principal function of the cement.

The chemists of the Lackawanna Railroad have recognized the fact that a cement, while it may pass the ordinary boiling test, may contain material which is not hydrated in this test and which later may cause expansion and disintegration. To protect themselves they have devised this autoclave test. In order to pass this successfully, cement must not only be properly made and sufficiently seasoned, but it must be finely ground. That they are proceeding in the right direction cannot be questioned.

For every new demand there is not long forthcoming a supply. If the cement user demands a finer ground cement, the manufacturer will supply it. If he cannot economically do so with his present equipment, other machinery will be used. This may cause him considerable present inconvenience and expense, but if he will take the cement user into his confidence and tell him that he can supply a cement about which there will be no suspicion or complaint, and that he must charge a little more for this material, there is no doubt that the consumer will gladly pay this small premium for the protection which this better grade of cement will give him. American Portland cement must be the world's best, and it is significant of the development in concrete that it is the cement user who urges the best standards, regardless of cost.

* * *

Concrete Failure and Fire Damage. The recent failure of a dam near Gallipolis, Ohio, has, as usual, been charged to concrete by some of the daily papers reporting the accident. Nothing has developed to show that concrete, any more than in the case of the Austin dam, was responsible, but nevertheless "scare heads" and dispatches all proclaimed to the public that a concrete dam had failed. Perhaps it is natural that the press should take this view. The explanation is that concrete, in its modern development and speaking comparatively, is a *new* material. But in this connection it is interesting to compare concrete with other materials from the *danger* standpoint. This can best be done by taking a single type of construction, namely, buildings, in which all kinds of materials are used.

The last serious building failure charged to concrete occurred in Indianapolis, Ind., December 6, when press dispatches announced the collapse of a concrete building resulting in the death of four workingmen. The contractor attributed the failure of the unfinished building to the fact that the concrete had not set owing to cold weather. This accident, due to bad judgment or improper use of material, was charged against concrete. The opponents of concrete sought to impress upon the public mind that because concrete was used in the instance it followed that it is an unsafe material. Attention was focused upon the fact that this was a *concrete* failure rather than a failure of *judgment.* Had the contractor been using a more familiar material, such as wood, brick or stone, the first inquiry would have been: "What mistake of the builders was responsible for this accident?" We do not wish to be understood as urging that accidents of this kind be ignored. On the contrary, they should be the subject of rigid investigation in order that they may be prevented in future. But do we feel this way about disasters in which *other materials are at fault?* For example, builders everywhere will remember this concrete failure. But how many of them will remember that during the evening of the same day four persons were trapped on the upper floors of a Philadelphia apartment house and burned to death? Everybody knows that for each life placed in jeopardy through the use of concrete there are countless lives in danger from fire through the use of combustible material. Here is the record for Philadelphia for a single day—in fact, the very day the concrete building collapsed—a fire for nearly every hour struck by the clock:

7:30 A. M.—Store and dwelling of Morris Stein. No. 2732 North Front street.

10:32 A. M.—Dwelling of E. Board-man, No. 2115 North Ninth street.

10:45 A. M.—Dwelling of Dr. Cox, No. 418 South Eleventh street.

1.05 P. M.—Dwelling of N. Salinger, No. 849 North Ninth street.

2:50 P. M.—Dwelling No. 1422 East Columbia avenue, owned by George Weber.

3:30 P. M.—Building, No. 119 North Front street, occupied by Parke & Brice, dealers in oil.

4:50 P. M.—Dwelling of M. Wolfington, No. 2132 North Mervine street.

5:40 P. M.—Dwelling of M. Wumpsh, No. 2928 North Third street.

10:20 P. M.—The Marie Flats, No. 264 South Sixteenth street, and adjoining houses on either side. Trapped on the upper floors of the flat four persons were burned to death. A fifth woman was so badly injured by jumping from a second-story window that her life was despaired of. The bodies were so badly charred that neither clothes nor features were recognizable.

Nine fires in that many non-fire-resisting buildings in a single city from 7:30 a. m. to 10:20 p. m.! The fact that more lives were not lost and all the buildings destroyed was not due to any virtue in the materials of which the buildings were constructed. It would be a large undertaking to attempt to count the "Marie Flats" of this country. But nobody demands that they be closed or pulled down. New structures of the same type are not prohibited. This combustible type of construction costs the country $30,000 per hour—every hour in the day, all the year round, to say nothing of the sacrifice of life. It costs nearly a hundred millions a year just to maintain men and equipment to *extinguish* fires that start in these buildings. Many owners of reinforced concrete buildings do not carry insurance on the structures, but on contents only. If the situation were reversed, and familiar types of buildings had the good record of concrete from the fire-resisting standpoint and concrete were to be universally substituted for combustible construction, resulting in the sudden thrusting upon the country of the stupendous total charge of some 450 millions annually, the price we now pay for combustible construction, its use would be immediately prohibited.

But why this comparison between buildings destroyed by fire and concrete failures? Because a building in ashes is a far more serious failure than the collapse of an uncompleted structure through premature removal of supports or improper use of material. Every fire-trap in the country represents bad design and unsafe material. Their destruction is ample proof of this. The public would shudder at the very mention of concrete if as a *new* material it had the fire record of *old* materials. And when it comes to the remedy for these disasters, how simple is the problem as it pertains to concrete. Proper design and good workmanship are all that we need to prevent repetition of the Indianapolis affair. On the other hand, to remove the menace of fire due to the presence of combustible buildings is an undertaking so great that we can only attack it step by step, hoping in the meantime that eternal vigilance will save our cities from destruction.

* * *

Tests for Concrete. The question of tests for concrete was discussed from many sides at the Congress of the International Association for Testing Materials, recently held in New York, and there seems to be no doubt that the ordinary tests of Portland cement, as applied in this country, do not quite cover all the requirements that are demanded of the finished material, concrete. In this connection a very interesting paper by Cloyd M. Chapman*, entitled "Tests for Concrete," was presented at the Congress, and is of great value. Mr. Chapman advocates a number of new tests for concrete which are entitled to the greatest consideration. The matter of inspection of the materials entering into concrete, and of the concrete itself, by national and international regulations, is a vital one, and it was stated in the discussion of one of the papers presented at the Congress that it was essential to proper construction that an architect, say in New York, should be able to make such specifications and requirements of inspection for a concrete building to be erected under his plans as would be applicable in any part of the world. The only thing the architect should be assured of is that the inspection will be properly carried out, but the inspection of all the raw materials, the decision as to their use and the proportions required should all be regulated in advance of construction. Concrete, to be right, should be tested from time to time, in the course of construction, under specifications of a character uniform all over the world.

Cement Production in New South Wales. From a report of the German resident technical expert in Sydney, New South Wales—there seems to be one of these busy and competent gentlemen in every important city in the world telling Germans where to "jump in and get business"—we learn that until the introduction of the protective tariff in 1908 there was little or no cement manufactured in New South Wales. But how rapidly this industry has developed may be seen from the following figures, showing the value of the manufactured product before and after the tariff was in force:

1902, $226,000; 1903, $270,340; 1904, $268,240; 1905, $427,300; 1906, $622,800; 1909, $980,700; 1910, $1,218,000. (The figures for 1911 are not yet made public.)

The greater part of this production was used by the Government for railway, seaport and other public construction. The great dam on the Barren Jack took an especially great quantity. The order for this was given to the Commonwealth Portland Cement Co., which is the most important of all the Australian cement works.

Owing to the tariff of 25 cts. per gross hundredweight, which is reduced to 18 cts. for British cement, the importation of foreign— and especially of non-British—cement has not been able to keep up; and in 1910 it amounted to 18,800 tons only. Of this amount about 5,000 tons (about 28 per cent) came from Germany. In other Australian states, which have less domestic cement industry, the importations have been greater. In 1910 they bought abroad 61,615 tons, of which about 20,00 0tons (nearly one-third) were from Germany.

* * *

Concrete Tile Still Good. Used 87 Years. A recent newspaper clipping notes that the Spencer Yarn Co., in some recent work at its plant at Adamsdale, Mass., uncovered some concrete tile which had been in use beyond the memory of any of the present residents of Adamsdale. The newspaper reports had it that the concrete tile were 100 years old. The matter was referred to the Spencer Yarn Co., from whom the following letter has been received:

> In regard to the concrete pipe uncovered while digging for foundation for picking room extension, we think, from information obtained, that this pipe was put down anywhere from 1825 to 1830. It was 3' 6" beneath the surface and was used for irrigating farm land. It was about 8" in diameter inside and 14" outside. It was home-made and not the work of an artist. Its condition was apparently as good as when laid.

* * *

Concrete in Tunnel Construction. Henry Jopp, in an interesting paper on subaqueous tunneling, read before the Engineers' Club of Philadelphia, says in his opening paragraph that

> Subaqueous tunneling has always presented special difficulties to the financier, the engineer, and the contractor, and is generally postponed or avoided—like the doctor, whose acquaintance is not sought unless absolutely necessary.

We would like to add to this that had it not been for "Dr. Portland Cement" many of these cases would have been pronounced hopelessly incurable, while the advent of this remarkable physician made almost any sort of engineering project feasible.

Cinder Concrete. The old question of the disintegration of cinder-concrete comes up anew, and in a recent paper published in the *Journal of Industrial and Engineering Chemistry* considerable data are given showing the results of various experiments made with this material. Practically the same conclusion was arrived at that was reached in the discussion of the New York Building Code a few years ago, namely, that cinders with much sulphide and sulphate of sulphur are likely to give unsatisfactory results, especially if there is much porous material present. The suggestion is made that the cinders are better if allowed to weather, or are washed, so that the ferrous iron and sulphur may be oxidized and bleached out.

*Engr., National Fire Proofing Co., Pittsburg.

*Referred to in abstract in September, 1912, issue, p. 90.

INFORMATION DEPARTMENT

Inquiries regarding sand and all other materials are cheerfully answered, like all other questions, but in cases of importance it is best to invest in laboratory analysis. Write to us for particulars, address, Laboratory Department.

Concrete Block Storage Building

Can a building 100'x150' and 40' high be built of concrete block and be used successfully for the storage of chairs where a floor load of 50 lbs. to the sq. ft. is necessary? The building will be three stories high.—G., North Carolina.

A concrete wall 40' high would have to be backed with pilasters at convenient spaces. Such a building as you describe as a storage house for chairs should be, of course, fire-proof. This would require a reinforced concrete interior structure. In such a building it would probably be economical to build a reinforced concrete frame, that is, floors, interior and exterior columns, using concrete block simply as curtain walls. It would not be good engineering to use the concrete block as bearing walls with an interior concrete frame.

If burnable construction is used for the interior, concrete walls could be converted into bearing walls by the use of pilasters, as above mentioned.

It would be economy here, as in every similar case, to employ an engineer, as an engineer is the man who can do for $1.00 what anybody else can do for $2.00, and he would save his fees many times over. By employing a competent engineer you are assured of the safety and permanence of your building.

* * *

Glossy Concrete

Can you tell me how to make concrete look like marble (white) and have a smooth, glossy surface?—B., Maryland.

We refer you to an article, "Methods of Giving Concrete a Polished, Glossy Surface," by A. A. Houghton, in the November, 1910, issue of *Concrete*. One way to get a smooth surface is to get as close as possible to the desired result when the concrete is first cast. This is accomplished by using a very smooth surface on which to cast the concrete surfaces which are to be smooth. Glass may be used, or metal which has been smoothly and carefully enameled. Another way is to depend upon the treatment which is to be given the surface after the casting has been made. In this you must use an aggregate which will take a polish and you must have a well-graded mixture so that there will be a very small percentage of Portland cement on the surface. The aggregate which is to take the polish must be kept on the surface. The polishing is then done just as with any other stone, and of course the color depends upon the color of the aggregate. If you want a very white material, use White Portland cement, at least for the surface mixture. There may be a backing in which ordinary gray cement is used.

* * *

Weight of Concrete

What is the weight of a cu. yd. of wet concrete, made in the proportions: 1 sack of cement, 2½ cu. ft. of sand and 4 cu. ft. of screened gravel?—W., Michigan.

We quote from Taylor and Thompson's "Concrete—Plain and Reinforced," page 277, as follows:

The weight of concrete per cu. ft. in the vehicle that transports it from the mixer depends largely upon the consistency. If mixed very wet, it will settle down to very nearly the volume it has after it is placed, perhaps within 5% of it; but if of dry consistency, the volume of the rammed mass is apt to be as much as 25% less than the loose. A fair average weight of loose concrete may be estimated, then, at about 140 lbs. per cu. ft., or 1.9 tons per cu. yd. when mixed wet, and 120 lbs. per cu. ft., or 1.6 tons per cu. yd., when mixed dry. The weights and volumes vary, of course, with the proportions used in the mixture and the specific gravity of the stone in the aggregate, but for rough estimates these figures are sufficiently accurate.

* * *

Waterproofing a Basement

The concrete floor in my basement is uneven and it doesn't keep dampness out. How shall I go about it to make the floor dry.—S., Wisconsin.

We refer you to an article on making basement walls and floors watertight in the January, 1912, issue of *Concrete*. Basement waterproofing problems differ widely. If after reading the article referred to you want further suggestions, the subject may be taken up in the Consultation Department.

* * *

Cement Manufacture

As a member of a class in business organization at New York University, I should like to have you refer me to material which would be of value to me in the preparation of a thesis which is to constitute a report to a company which has under consideration the investment of capital in cement manufacture.—H., New Jersey.

We refer you to "The Portland Cement Industry from a Financial Standpoint," by Edwin C. Eckel; "The Modern Manufacture of Portland Cement," by Percy C. H. West, the December, 1911, issue of *Cement Age*, and to the reports of the United States Geological Survey on "Cement Industry in the United States." You will also find much of interest in past issues of *Cement Age* and *Concrete*.

* * *

Tank for Crude Oil

I want to build a round tank above ground for the storage of about 18,000 gals. of crude oil.—L., Kansas.

We refer you to replies as to concrete tanks in the Information Department of *Concrete*, July, 1911.

* * *

Septic Tanks

Can you refer me to articles on the construction of septic tanks, using concrete? —T., Montana.

Ernest McCullough, in an article in the June, 1911, issue of *Concrete*, described the construction of concrete septic tanks for country places, and another article along similar lines is published in the September, 1912, issue of CONCRETE-CEMENT AGE. Both articles are illustrated.

* * *

A Non-Waterproof Block Wall

A few years ago I built a concrete block house and it is not satisfactory because water comes through the walls. What do you recommend? The interior plastering was placed directly on the block, and I must do something to keep out the water. —D., Ohio.

We suppose from your letter that the concrete block walls absorb water to such an extent that the dampness strikes through to the inside. The real answer to your trouble of course is that the concrete block are not what they should be. We know of many houses, in which the interior plastering has been put on the wall without furring, and in which there never is any trouble from dampness. It is a good precaution, however, to insulate such walls by furring on the inside and leaving an air space, which provides an effective barrier against the further penetration of moisture. You must either fur the walls and plaster again or use some waterproofing preparation. One way would be to use some preparation on the outside of the house to keep the moisture out of the wall, and another way would be to use something inside to keep the moisture from coming all the way through. Many waterproofing preparations are manufactured for all sorts of treatments, and we suggest that you get in touch with reliable manufacturers* and let them suggest your remedy.

* * *

Fireproof Paint

Mix together 4 lbs. of asbestos powder, 1 lb. aluminate of soda and 1 lb. of lime. Stir in 3 qts. of silicate of soda. Tint with any desired coloring (mineral preferred); then reduce with water to the proper consistency for application.

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*See advertising pages.

CONSULTATION

206. Dustless Concrete Floors

"I want to lay a first-class concrete floor on some work now under contract. What steps can I take in order to make an absolutely dustless wearing surface? This will have to be laid over a reinforced concrete slab, which is thoroughly set."

206. Discussion by P. F. Balfour.*

In using the word "absolutely" I am afraid the question has been qualified too strongly, because an *absolutely* dustless floor may not be possible from an ordinary concrete mixture. The best floors built that I have seen have been constructed as follows:

1. *Preparation of Slab to Receive Top Coat.* The concrete slab is first thoroughly cleaned by sweeping and scrubbing. If any oil or bituminous material has been spilled on it, muriatic acid may be used to disintegrate it, after which it should be well washed. The thoroughly cleaned floor should be sprinkled with water until it is saturated. This may in some cases take from 24 to 48 hours. Just before the top is ready to be laid, any puddles that may exist should be swept away, or, better, mopped up. The floor is now ready for the top coat. If the slab is not saturated it will absorb water from the top layer, and leave it with too little moisture to satisfy the complete crystallization, and weakness will result.

2. *Consistency of Aggregate for Wearing Surface.* The mortar should be of such consistency that water will flush to the surface only under heavy, thorough working with a wood float.

3. *Thickness.* The wearing surface surface should have a minimum thickness of 1½". If conditions are such that the surface is to be less than 1", the top dressing should be reinforced with chicken wire or other suitable material.

4. *Finishing.* After the floor has been struck off with a straight edge it should be thoroughly worked with a wood float to work out all air-bubbles and compact the surface. Rubbing in one direction facilitates this. The floor should then be brushed lightly with a stiff broom, and finished to a smooth surface with a steel trowel. When the slab is thoroughly saturated with water, the top coat can be laid on dry enough to permit of the final troweling at a much earlier period, and no danger results from softness of surface due to disturbing the concrete after setting has commenced. In no case should excessive working with the steel trowel be permitted. If excessive moisture occurs on the surface after smoothing with steel trowel, the conditions to obtain the best floor have not been strictly kept, and more or less dusting may occur.

5. *Surface Film.* When the work is too wet, the water that comes to the surface contains among other things considerable hydrate of lime in solution. After the water evaporates it leaves the hydrate of lime and the other soluble materials along with the very finest particles of cement and aggregate held in suspension, as a film on the surface. This is always softer than a good wearing surface should be. The very finest particles of cement set very quickly, and if kept in their proper places as a matrix for the aggregate they serve the best purpose, but if they are flushed to the surface they get "out of their sphere of usefulness" and become a source of trouble.

6. *Fineness of Cement.* To the writer's mind the matter of the fineness of the cement is a very important one. Some may take exception to this. This article is being written with a view of the present and the future. Already most of the cement factories are working to produce a finer product. Thus a greater percentage of the cement passes a No. 200 sieve, and there is also a greater percentage of inpalpable powder. Let us take a sample of cement that comes from an ordinary tube mill. It has fineness of 94% through No. 100 sieve and 76% through a No. 200 sieve. It takes its initial set in three hours and its final in six hours. Let us regrind this same sample for from 20 to 40 minutes in a small ball mill in which iron or steel balls are used. We will probably find in every case that the finely ground cement is so quick-setting that it is useless. This cement may not show any startling differences in the Nos. 100 and 200 sieves, but it will show a marked increase of extremely fine dust, indicated by the elutriation test. If this is the case, the writer holds that in the future, when engineers from Winnipeg to New Orleans are requiring great fineness and the manufacturers are meeting the demands, the cement user must pay particular attention to the consistency of the mixture used on the wearing surface of a floor.

7. *Protection.* After the surface has obtained its final set it should be kept moist for at least four days. This may be done by laying a coat of wet sawdust, 2" deep, over the floor, or by spreading burlap over the floor and keeping it wet for the above specified period.

8. *Aggregate.* Natural sand, crushed igneous rock or limestone mixed in proportion of three parts passing a 1-in. mesh, and retained on ½-in. mesh, and two parts passing a ¼-in. mesh and retained on No. 50 sieve, give the best results. In all cases the dust passing a No. 100 sieve should be, if possible, entirely eliminated either by washing or by air separation.

9. *Procedure.* With regard to proportions, mixing, placing, coloring and temperature, the specifications as laid down by the National Association of Cement Users should be followed.

*Kansas City, Mo.

226. Bond Stress in Beam Design

"In a reinforced concrete beam with a number of the horizontal rods bent up to provide for diagonal tension, what is the bond stress along the remaining horizontal rods near the end of beam as compared with the stress which would exist along such rods if all the horizontal rods were continued straight to the end of the beam? What rules can one follow in regard to this part of beam design?"

226. Discussion by Albert M. Wolf.*

The horizontal bars in the bottom of a simple reinforced concrete beam are designed to take care of the maximum bending moment, at or near the center of the beam, as the case may be. The bending moment decreases from the point where it is maximum, toward the supports, thereby decreasing the tension in the bars, and making it possible to bend up some of the bars, to aid in taking care of the diagonal tension in the beam.

The shear at any point in a beam may be taken as a measure of the diagonal tension. The unit shear (vertical or horizontal) at any point in a beam, is equal to the total shear at the section, divided by the product of breadth, times the arm of resisting couple.

$$v = \frac{V}{bjd}$$

The Joint Committee recommends that in beams where the shear exceeds 40 lbs. per sq. in., diagonal tension reinforcement be used. For beams reinforced with with bent-up bars a shearing value of 60 lbs. per sq. in. is allowable if such bars are arranged with due respect to shearing stress; and if bent up bars and stirrups are used, a value of 120 lbs. per sq. in. is allowable.

Then in calculating web reinforcement, the concrete may be relied on to take a unit shear of 40 lbs. per sq. in., the remainder to be taken by bent bars, or by bent bars and stirrups.

The strength of a beam in resisting diagonal tension is not dependent simply upon the shear, but also upon the bending moment or horizontal tension, for a small deformation in the horizontal steel tends to aid the formation of diagonal tension cracks. Therefore if bars are bent up in a beam to take care of diagonal tension at points where they can be spared, keeping the unit tensile stresses in horizontal steel at all points the same, or nearly so, as at the point of maximum bending moment, the purpose of the inclined rods is in a way defeated, for, to reinforce effectively against diagonal tension, the concrete in regions where these stresses are greatest, should be relieved of tension as much as possible.

This can be done by reducing the unit tension in horizontal reinforcement, by providing enough horizontal steel to take the tension due to bending moment at reduced unit stresses at points of large shear.

At the ends of a beam the horizontal tension falls off rapidly, and this difference in tension per unit of length must be balanced by the bond between steel and concrete. Now the bond of the ten-

*53 West Jackson Blvd., Chicago, Ill.

sion steel per unit of length must not exceed its safe working value at any point, so that at the end of a beam the question of adequate bond becomes an important factor in the practice of bending up bars, to care for diagonal tension. The following formula can be used to determine the number of bars that can be bent up, and another formula involving the bending moment will be given, whereby the points at which bars may be bent up can be readily found.

U = bond required per lin. in. in lbs.

V = total end shear.

jd = arm of resisting couple = approx. ⅞ d.

u = allowable bond stress lbs. per sq. in.

= 80 lbs. per sq. in. for plain bars.

= 100 to 150 lbs. per sq. in. for deformed bars.

$$U = \frac{V}{jd}$$

$\frac{U}{u}$ = *sq. in. of steel surface required per lin. in.*

$\frac{U}{u}$ ÷ *perimeter of one bar = number of bars that must be left horizontal at end of beam.*

From the above, it will be seen that for a given steel area, bars of small section and deformed bars will allow better provision for diagonal stress than plain bars or bars of large cross-section.

As regards bond stress, in bars left horizontal when some are bent up, the following example ilustrates the point. In a simple beam reinforced with seven ⅞-in. plain round bars, the end shear is such that all bars are required in bottom at end of beam, so that the unit bond stress does not exceed 80 lbs. Now, if three bars are bent up, the bond stress at end of beam in the remaining four= $\frac{2.75 \times 7 \times 80}{2.75 \times 4}$ =140 lbs. per sq. in. or nearly twice the allowable (2.75=perimeter of ⅞ in. diameter bar in inches). The above applies to simple beams where most bent up bars run horizontally for a short distance in top of beam, and are then cut off, not all, or in some cases, none of them, being carried over the supports.

In any case the bent portion of bars should be long enough to develop the required bond strength; for some beam tests show that failure was caused by insufficient bond of short bent bars. In continuous beams, the steel in top of beam is in tension, and since the negative moment decreases quite rapidly, the bond stress in top of beam at the support demands more attention than at the center, and the bars bent up should be carried across the supports in the top of beam far enough to furnish adequate bond to develop the tension in the steel.

The points at which horizontal bars may be bent up can be found for uniform loading, by the parabolic formula, for the length required to resist the bending moment.

$$X_n = \frac{l}{\sqrt{A}} \sqrt{a_1 + a_2 \cdots a_n}$$

Xn=length in feet of n-th bar in order of length, that must be horizontal, number one being the shortest.

l=span in feet.

A=total area of steel at center in sq. in.

$a^1 a^2$ etc.=area of each bar up to n-th bar.

For unsymmetrical loads the maximum moments must be found at various sections and lengths obtained therefrom. The bars may be bent up at any desired point beyond where they are needed in bottom of beam, singly, or in pairs, to facilitate placing of steel.

Points to bend up bars can be found graphically by plotting a moment diagram for the beam. Then upon the same base superimposed upon each other, plot the resisting moment of each bar. Then the n-th bar may be bent up where the horizontal line representing the sum of the resisting moments of n-1 bars cuts the moment curve and so on for the rest of the bars. It is better practice not to bend up bars at the theoretical points as found above, but to continue them horizontally for a short distance, say six inches beyond these points, before bending up.

The number of bars that may be bent up according to this last formula depending upon the bending moment, may be more than allowable, by the formula involving the bond stress. In no case, however, in a simple beam, should more bars be bent up than allowable by the formula first given, which involves the shear and bond, which are the chief factors in the strength of a beam in diagonal tension.

258. Sawdust Concrete for Sub-floors

"The use of floor sleepers embedded in concrete offers several difficulties, and I have wondered if it would not be possible to use a mixture of sawdust and concrete for a sub-floor. Has this been done, and how?"

[In the Springfield Public Library, the cork carpet was placed on a sub-floor of sawdust concrete. This was referred to in Consultation Item No. 160, discussing "The Decay of Floor Sleepers," in *Cement Age*, October, 1911. The following discussion covers in detail the procedure. —Consultation Editor.]

258. Discussion by E. J. Ruxton.*

In regard to the sawdust concrete floors laid at Springfield Public Library, the conditions and results in this work are approximately as follows:

Several preliminary samples were made up of cement, sand and sawdust in the following proportions: 1:2:2, 1:2:3, 1:4:½, 1:3½:½, 1:3:½, and 1:2½:½.

The cement used was both Lehigh and Iron Clad cement on which no previous tests had been made. The sand was a clean, sharp sand secured locally, and the sawdust was that obtained from a local box factory consisting of the sawdust from native pine wood, most of which probably was green wood. These samples were made in a box 1′ square and 3″ high, having no bottom, and resting directly on reinforced concrete floors that had been installed. After allowing these to set about two weeks, it was found that of all the samples made the only two which seemed at all possible to use were the mixtures 1:2:1 and 1:2:2, although the architect had specified at 1:2:3 mixture.

*E. J. Ruxton is a member of the firm of Birnie, Adams & Ruxton Construction Co., Springfield, Mass., who were the contractors for the work.

In laying the floors a 2-in. base course of cinder concrete, mixed in proportions of 1:3:5 was first placed on the reinforced concrete floor, and on this was placed a 1-in. finish course of 1:2:2 sawdust mixture. The first day's run we installed about 265 sq. yds., but because of rainy weather, we had to discontinue operations for about four days. At the end of this time, it was seen that this original 265 sq. yds. had not hardened sufficiently to sustain any weight, and also showed no holding power for nails, which were to be driven into it finally. It was then decided to change this top mixture to 1:2:1, and when the operations were continued this mixture was used, which gave better results.

However, it was seen that this top mixture might possibly be made still better by changing it to the proportions of 1:2:¾, this latter mixture being used for the remainder of the 5000 sq. yds. installed.

The writer would state that in laying this floor it was not the intention to construct a floor which would stand the ordinary wear on its surface, as it was the intention to produce a surface on which a cork carpet could be laid, providing strong holding power for the nails, and at the same time producing a softer surface for a carpet than the ordinary 1:2 cement-sand mixture would produce. It was found that with the mixture, of 1:2:½, it was practically impossible to drive nails in it, but in the mixture 1:2:¾ no difficulty was noticed in driving the nails and at the same time they had good holding power.

In working this top finish, it was the intention to place it not later than 50 min. after the bottom cinder concrete was placed. This result, however, could not always be obtained because of rainy weather, so that in the event of a longer time having elapsed between the placing of the finish coat on the bottom course, a wash of cream cement and water was first applied, before the top or finish coat was placed.

In regard to the troweling or finishing of this coat, 1″x2″ screeds were placed on the bottom or cinder concrete, and leveled, and the top course placed and screeded down with a straight edge having a steel face. The object of this was to secure a smooth surface requiring no troweling, as this top course set very slowly, thus delaying any opportunity for troweling. Wherever there were any rather rough spots these were usually rubbed down the next morning, the top course having set sufficiently to sustain the weight of a man and allow troweling.

For the troweling, we used an ordinary wood float instead of a steel trowel. This gave a smooth enough surface for laying a cork carpet, and prevented unnecessary travel over the green floor to secure this. About two weeks after this surface of sawdust concrete was laid, the interior decorating and plastering of the library building was done. This necessitated the floor carrying heavy horses for platforms, and heavy traffic, and at the end of the plastering period it was necessary to remove all surplus plastering from the floor. Even with this hard usage very little patching had to be done before the cork carpet could be laid.

It will be two years this fall since this floor was installed, but as it is covered with the cork carpet, we have no way of telling in just what condition it may be. We have, however, heard no complaint in regard to the carpet becoming loose or the nails pulling out.

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259. Sound-proof Tile Partition Walls

"In building a fireproof terrace at Youngstown recently the question came up of the best method of obtaining maximum sound-resisting partitions. Tile are being used for division walls, and we have wondered whether a tile laid with web vertical or web horizontal would make a better sound-resisting partition. The direction of the web would, of course, determine the direction of the column of air whether vertical or horizontal. Which would be the better way?"

259. Discussion by J. H. Toupet.*

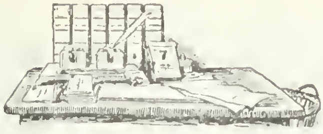
My personal opinion of this matter is that the more sound-proof wall would probably be the one built with webs horizontally, for the reason that there is less chance for air currents to develop in a horizontal trough than there is in a vertical one, since the difference in temperatures provokes the air currents. However, as a building proposition, all tiles should be laid vertically, as they are able to carry much heavier loads in that way, and are designed to be erected in that way. As a matter of fact, I think very little difference wil be found in the sound-proofness of the wall built either way.

I would think that a sound-proof wall could be built of two layers of tile, or of a thicker tile which would provide two separate compartments, while the usual partition tiles have only one cell on account of its being thin. If the tile had two cells, it is very likely that the sound waves would be broken, or more so than with a single web. While not an acoustician, this is my belief in the matter.

* * *

Ideal Contracts Are Rare.

"In putting a price upon any sort of work one realizes that there is a price at which under the most favorable conditions one can do the work," remarked Leonard C. Wason, president of the Aberthaw Construction Co., Boston, in a recent paper. There are contingencies which arise in the course of a job which are not included in the ideal program. Some of these can be removed by foresight and good management, others seem to come under the class of "unavoidable." The bidder must not only decide the cost under average conditions, but must judge whether the conditions of the proposed job are average or special. He must balance the probabilities of unforeseen circumstances and decide how narrow a margin he dares to leave between the actual possible cost of the work and a living profit. The wisest heads are not commonly those who disregard difficulties.



CORRESPONDENCE

One-Course Concrete Sidewalk

In regard to the wearing qualities of one-course or "monolithic" sidewalk as laid in this city during the year 1911, I desire to state that this class of construction did not prove as satisfactory as was at first anticipated. The failure was, in our judgment, due to several causes, some of which are as follows:

1st. The walks were laid late in the fall and had not become thoroughly "set" before freezing and wet weather.

2nd. The nature of the mixture is such that it is necessarily more or less porous even after it is "set," and this adds to the liability of its being damaged by frost.

3rd. Great difficulty was experienced in finishing the surface, as it was next to impossible to work the coarse material down from the top and edges, leaving the surface uneven with ragged edges and joints.

The result of last year's experience has been that about 75% of the "monolithic" walks had to be torn up and rebuilt or resurfaced; and the 1912 specifications call for 3¾" base with ¾" topping of 1 to 1½ mixture troweled to a smooth surface.

We have this year received bids as low as 8 cts. per sq. ft. for sidewalk under the latter specifications, which is cheaper than was paid for "monolithic" mixture last year.

D. H. Blossom.
City Engineer, Salt Lake City.

A Patent Decision in Reinforced Concrete Construction.

About five years ago the Ransome Concrete Co. brought suit against the German-American Button Co., Rochester, N. Y., for alleged infringement of Patent No. 694,580, granted March 4, 1902, to Ernest L. Ransome. The defendant had constructed a building in Rochester, N. Y., of monolithic reinforced concrete construction. This building had reinforced concrete belt courses, which were cast in one piece with the floor slab, and which formed the lintels over the windows. The building also had reinforced concrete curtain walls, the ends of which were rabbetted into the columns and which extended upward to form the window sills. With reference to the floor, this extended over the tops of the exterior columns, so that the floor formed a cap on the top of each exterior column.

The building thus constructed formed, according to complainant's bill, an infringement on claims 5 to 10 of the patent in suit, which claims are published below.

Under date of June 26, 1912, Judge Hazel, sitting in the District Court of the United States, Western District of New York, rendered the following decision:

"A decree may be entered, with costs, holding claims 5 to 10, inclusive, valid, and infringed by the defendant corporation."

After that time an injunction was granted. An appeal has been taken by the defendant, which will be heard probably in October, and in the meanwhile the injunction will not be effective until the appeal has been decided. It will be noted that all the claims in the suit have been found valid and infringed.

Following are Claims 5 to 10 referred to:

5. A reinforced concrete floor extending to the exterior face of a building, and there forming a belt course with a downward extension forming heads or lintels to the windows below, substantially as described.

6. A reinforced concrete floor extending to the exterior face of a building and there forming a belt course, capping the piers and windows below, substantially as described.

7. A reinforced concrete floor extending to the exterior face of a building with an upward window-sill extension, substantially as described.

8. A reinforced concrete floor extending to the face of a building and there forming a belt course with an upward window-sill extension, substantially as described.

9. A reinforced concrete floor extending to the face of a building with downward and upward extensions, substantially as described.

10. A reinforced concrete floor extending to the face of a building and there forming a belt course and with downward and upward extensions, substantially as described.

Alexis Saurbrey.
New York.

Comparative Tests on Concrete and Clay Pipe.

Appended hereto is a copy of a report on tests made at Colorado Springs on concrete pipe. The concrete pipe was not sufficiently aged, but the tests sufficed to show to those present, including representatives of both the Denver and Pueblo clay manufacturers as well as members of the City Council of Pueblo and Colorado Springs, the superiority of concrete pipe over salt glazed vitrified pipe for sewer purposes.

It has been my endeavor to secure statements from responsible engineers and observers regarding the merits and demerits of both concrete and clay pipe for sewer purposes, with a view of eliciting information from many sources, which could be tabulated and some conclusion arrived at. It is of the greatest importance in this connection that any statements shall be complete and include all the circumstances affecting failures, where failures were reported, including elements of manufacture and laying, and all conditions attendant upon the failure. It will be of the greatest possible service to officials of communities, to engineers and contractors to have this information and to have it complete.

We had a visit recently from a committee appointed by the council of the City of Vinita, Okla., to examine our concrete pipe plant, our concrete pipe, etc. Some of the expense of these examination trips might well be devoted to compiling such information. So far from tests that we have had access to and those we have had made for us, it would appear that there is no ordinary vitrified salt glazed pipe that will compare with the concrete pipe in withstanding hydraulic pressure.

E. C. VAN DIEST.
Sec. The Colorado Concrete Mfg. Co.,
Colorado Springs, Colo.

COLORADO COLLEGE.
July 18th, 1912.

REPORT ON COMPARATIVE TESTS ON COLORADO SPRINGS CONCRETE PIPE AND PUEBLO CLAY PIPE.

Compression Tests.

	Concrete.		Clay.
Size	6″	12″	6″
Age (Days)	67	90	
Mark	B4	A	11
Length (over all)	26″	32″	26″
Wt. top box and sand	100	190	100
Crushing weight	3960	3190	3920
Crushing wt. per ft.	1830	1470	1810

Hydraulic Pressure Tests.

	Concrete.	Clay.
Size	6″	6″
Age (Days)	67	
Mark	H	8
Length (over all)	26″	26″
Pressure	54 lbs. per sq. in.	16 lbs. per sq. in.

NOTES:

Concrete Pipe—At the pressure of 54 lbs. the pipe did not break. Air was forced out and water was seeping through the pipe, but there were no streams of water leaving the pipe.

Clay Pipe—At the pressure of 16 lbs. the pipe broke longitudinally. Before that time no water seemed to be passing through the pipe.

Drop Tests (the weight of ball used was 11½ lbs.)

Concrete.

Size—6″.
Age—67 days.
Mark—B3, B and B2.
Length—26″.

Drop—	6″	12″	18″
Blow 1	No effect.	No effect.	Dented.
Blow 2	No effect.	Cracked lengthwise.	Smashed.
Blow 3	No effect.	Crack increased.	
Blow 4	Small hole.	Smashed.	
Blow 5	Cracked.		
Blow 6	Crack widened.		
Blow 7	Hole increased.		
Blow 8	Large hole.		

Clay.

Size—6″.
Mark—10, 2 and 9.
Length—26″.

Blow 2	Cracked	Smashed.	
Drop—	6″	12″*	18″
Blow 1	No effect.	No effect.	Smashed.
Blow 2	Cracked lengthwise.	Smashed.	
Blow 3	Cracked across.		
Blow 4	Smashed.		

(Signed) GEO. E. MARTIN,
(Professor in charge).

*With the consent of the interested parties a length of Denver Clay Pipe was used for the 12″ Drop Test.

An Interesting Failure of Concrete Footings.

We had a concrete failure last fall and winter which we think of interest. We had dug a basement and encountered a small spring, which flowed part way through the basement and then disappeared into the shale bottom of basement.

We placed the concrete footings and they dammed up the flow so that the water backed up. We covered the footings with tarred paper and manure, being afraid of freezing. The second day the footings were entirely covered with water. The footings did not freeze, as we examined them every day.

In the spring, when uncovered, the concrete was a complete failure, being a mass of gravel with only small portions partially set. Concrete was discolored with the manure and we believe that the ammonia in the manure, which was soaked out by the water flooding the footings, was responsible for the failure. Concrete placed same day and covered the same way, but on a higher level, came out in good shape.

THE PIPER CONSTRUCTION CO.,
E. F. Piper.
Great Falls, Mont.

[In regard to the possibility of any action of ammonia solutions on concrete, the reader may be interested in the discussion under Consultation Item 255, published in this issue.—THE EDITORS.]

Concrete Tank Construction

This tank is 18′ in diameter, 32″ high, and has a capacity of 175 bbls. The bottom is made the shape of a saucer, with a drain pipe in the center. The cost of building this is about one-half the cost of a square tank of the same capacity with the same material.

After selecting the site for the tank the first thing to do is drive a long iron rod exactly in the center. Drive it solidly enough so that it cannot be easily moved out of place.

As the tank is 18′ in diameter, take a board about 10′ long and bore a hole in one end of it big enough to go over the iron rod. Then 8′ from this hole drive a large spike, and another spike at 9′ from the first hole.

By placing this board on the iron rod and swinging it around on the ground, we get the circle for the plan of the tank. After getting this circle dig a trench about 2′ deep and 1′ wide and fill with concrete for a solid foundation.

The posts for the form should be driven about 3′ apart around the circle, using the board already spoken of to get them in a perfect circle. These posts must be braced at the bottom to make them firm, so they will not give. Then level from the stake in the center to each post to get the tank level. The boards used for forms may be ½″x4″ and 18′ long. This material, when placed in water over night, can be easily bent in a circle.

On the inside, the form is inclined, the wall being 12″ wide at the bottom and 8″ at the top. This gives the ice a chance to heave without breaking the tank.

To get the circle for the inside form the stakes may be driven into the ground; and after the boards are nailed on. We ran a long brace through the center, laid on the ground, and ran a short brace from each post to the center. We also ran one from the top of each post about 5′ in on the bottom brace.

The stakes are then sawed off and the form can be lifted out while laying the floor.

For reinforcement we used woven wire fencing 30″ high, made so that it rested about 4″ from the outside of the form. The ends must be capped and wired. This tank has given great satisfaction, having passed through a winter with the mercury 40° below zero. It is the only tank being built in this part of the country.

HARRY B. GILL.
Independence, Iowa.

The Cement Market in Finland

Up to about 15 or 20 years ago, the consumption of cement in Finland was but slight; for building purposes there were used only lime, clay and sand—of all of which that country has inexhaustible supplies. But the introduction of reinforced concrete construction has caused a great demand for cement. Most of that used in the country comes from Germany and Denmark; a small proportion from Sweden; and more recently, Russian has been imported.

According to the governmental statistics, the importations of cement in the last decade have been as follows:

	Tons.		Tons.
1902	20,700	1907	61,900
1903	22,500	1908	53,400
1904	25,000	1909	66,900
1905	30,500	1910	78,400
1906	43,700	1911	98,600

This shows nearly a five-fold increase. Of course the general industrial conditions of the country have had an influence. In 1908 the strikes and lock-outs which occurred in nearly every town affected the cement imports.

Since 1909 there has been much building in Helsingfors, Abo, Tammerfors and Wyborg. This is due to the constant influx of the rural population to these cities, and the efforts of the middle classes of the population to own their houses. The latter cause has been the means of founding innumerable stock companies and other corporations, for the purpose of building dwellings; and now these occupy whole quarters of the large cities.

As regards the countries which have delivered cement to Finland in 1910 and 1911, the following figures will be of interest:

	1910. Tons.	1911. Tons.
Germany	38,528	45,250
Denmark	27,297	40,355
Sweden	10,479	8,978
Russia	884	2,380
Norway	774	1,139
*Total	78,439	98,581

One cause of the increase in Russian shipments was the building of garrisons for Russian troops in Finland, the use of Russian cement being stipulated—which was rather "rubbing it in." The total annual consumption of cement in Finland is now between 485,000 and 500,000 bbls.

The cement is usually bought by commission agents who have business connections with the building societies, municipal corporations, the management of the Finnish railways, etc. The cement is sold delivered at the port of arrival or the nearest railway station; usually "C. O. D.," through a bank or against a three months' draft on a London or a Berlin bank. The Swedish firms sell heavy consumers against a three months' note.

*Scattering not given.

The Charles River Bridge, Boston, Looking Westward.

The Charles River Bridge, Boston.

We are glad to publish the following letter, with the accompanying illustration; and will say in explanation that it has been almost impossible to get a clear, detailed view of the Charles River bridge from the point selected by the photographer in the August issue. The letter follows:

In your issue of August, 1912, page 44, you published an illustration of the concrete bridge over the Charles River, Boston, which was built by the Boston Elevated Ry. Co. It seems to me that the illustration does not do justice to the structure, and I therefore send you the accompanying photograph, showing the bridge from the Boston side looking westward, toward Cambridge.

George A. Kimball.

Ch. Engr. Bureau of Construction, Boston Elevated Ry. Co., Boston.

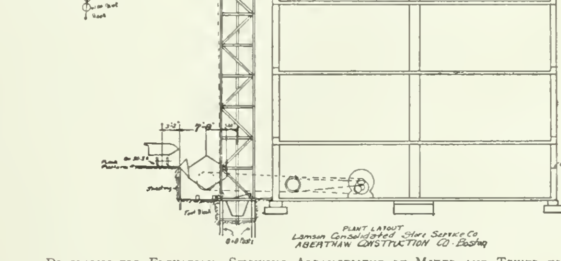
A Concrete Plant for Cold Weather Construction.

Within a few weeks now, precautions will have to be taken when running concrete, and some of the methods used successfully during the past winter are of interest.

During the winter of 1911-12, the Aberthaw Construction Co., Boston, erected a 4-story reinforced concrete machine shop at Lowell, Mass., for the Lamson Consolidated Store Service Co. This reinforced concrete building is 150′ by 50′ in plan and has brick curtain walls. The general policy of the contractors is to heat both the sand and the stone in freezing weather. However, on this, only the sand was heated as the owners who provided the heat had not sufficient steam capacity to heat the stone also. The stone was received in cars and while the car was on the siding precautions were taken to keep snow out of it by canvas covering. The sand was delivered in wagons and dumped directly onto steam pipes laid on the ground and furnished with a continuous supply of steam during the day time only at about 12 lbs. pressure. To supplement this the contractors used flexible rubber steam hose and iron pipes which were thrust into the sand heaps in specific places where there was reason to doubt the temperature of the sand. The water was heated by having a steam-pipe reaching to the bottom of the water barrel, and salt was added generally in the proportion of about 2 per cent of weight to the amount of the cement used, the percentage being varied slightly as the temperature changed.

After examining the ground it was decided to place the mixer and hoisting tower at the north side of the building and to omit the building of one bay at the west end of the ground floor, so as to allow industrial cars with the coarse aggregate to be pushed through at the proper grade. Quick unloading chute, extending from the side of the standard gauge cars, was used, the material being dumped into a square-bodied dump car.

After being mixed, the concrete was dumped into a hoisting bucket which is standard with this concern in all its construction work. A steel hoisting tower was used with the boom moving the steel and centering to the upper floors. The distributing of the concrete was done with V-shaped Koppel cars, the length of carriage from the mixer to the point where it was placed on the job in question averaging less than 100 feet. The method of distribution with cars, which take an entire four-bag batch at one time, is very much more conservative in retaining the heat in the mass than when concrete is distributed in barrows. It should be added that salamanders were used after placing the concrete in each floor and the building enclosed in canvas floor by floor. The building was designed by Lockwood, Greene & Co., Boston.



Diagrammatic Elevation, Showing Arrangement of Mixer and Tower for Handling Concrete Work in Cold Weather.

Annual Meeting of the American Highway Association

With the program of the American Road Congress at Atlantic City only about half finished as CONCRETE-CEMENT AGE goes to press, the meetings are very generally felt to have been successful in fulfilling the purpose for which organization was made. From an official standpoint the attendance and representation at the Congress have been remarkably good. A majority of the states are officially participating in making the meetings truly national in scope and in the influence which may naturally be expected to result from so important a convention.

The Exhibition

From another viewpoint—that of the exhibitors at the Congress—there is not unanimity in endorsement of the event. Men who have gone to the pains to make elaborate exhibits of road-making equipment and materials and of allied products have not discovered a great number of definite business prospects for the reason that contractors and unofficial engineers are not attending the Congress in large numbers. There is a further feeling that Atlantic City has not afforded ideal opportunities for such an exposition. In the first place, it is not centrally located. It is not readily accessible to the many prospective buyers of road equipment in the Middle West, where so much work is being and is to be done. Further, Atlantic City is a playground and not a market-place, nor is it conducive to sober thought. The exhibits in the big hall on the Million Dollar Pier are not even accorded *first place*. The central part of the hall is reserved for dancing and moving pictures. The evening scene is a miniature Mardi-Gras—a storm of confetti, a swirl of dancers, a mistiness of colored lights and festoons—all this brushing by 15-ton road rollers, rock crushers and the like, to the great inconvenience of manufacturers. Pink-gowned creatures in suede pumps are inimical to the sale of road equipment. All this is very unfortunate. The Congress — the papers, the discussions, the academic features—is a success and practically everyone present is convinced that much public good will result; but the exhibitors must to a great extent count their profits in the satisfaction of having aided a worthy movement, the continuance and spread of which will ultimately give them their reward.

Concrete the Recognized Road Material

With the leaders in the administration of public road work in this country on hand at the meetings, with experts from other countries as well, it is really a remarkable fact that concrete, among the very newest of recognized road-making materials, is on every hand the predicted road of the future. It is unhesitatingly endorsed as the most economical road material in this new era of the motor car. In the days of the horse-drawn vehicles' predominance, when the disintegrating wear was mostly that resulting from horses' hoofs, and when the straight-down pressure of wheels had a tendency to bind the road materials more closely, with a minimum of attention to upkeep, the more or less loosely bound road surfaces are felt to have answered very well. But, as pointed out by W. A. McLean, Toronto, Provincial Engineer of Ontario, the disintegrating tendency of the automobile is entirely different. A shear force is exerted and not a straight compressive force, and it is a shear force which multiplies in squares so that a motor car going 40 miles an hour, as is now common, is tearing at the road surface with a force 16 times as great as that exerted by the 10-mile-an-hour car. Thus are the road experts being converted to concrete as an economical material sufficiently well-knit in its nature to resist the increasing wear.

J. E. Caron, Minister of Agriculture and Roads for the Province of Quebec, in his address at the Wednesday morning session, in which he spoke chiefly of Canada's portion in the work on the Quebec to Miami highway, told of the mile of concrete which is being put down as an experimental section of the road, nearly all of which is completed. He said:

> I am particularly interested in the Portland cement concrete road and I believe that it is the economical and lasting highway.

Henry G. Shirley, Ch. Eng. State Roads Commission of Maryland, delivered an address Thursday morning in which he kept exclusively to the topic assigned him—that of "Road Accounting." Off the platform, however, he discussed several stretches of concrete road which are being put down in his state this year at about $1.00 a sq. yd., and he is tremendously enthusiastic over the material for main roads where the severest conditions are to be withstood. This is not merely prophecy without basis with Mr. Shirley, because 4 years ago he put down a 100-ft. section and 3 years ago a 700-ft. section of 2-course concrete, consisting of 5" of 1:3:5 cement, sand and stone and 2" of 1:1½:2 cement, sand and stone chips, allowing no more than 20 minutes between courses. This was done by the commission at a cost of 97 cts. per sq. yd., and Mr. Shirley says the result is a piece of perfect road. This work is at the outskirts of Whitehall, Md., and is subjected to heavy wear.

S. Percy Hooker, former New York State Highway Superintendent and now State Superintendent of Highways of New Hampshire, delivered an address Thursday morning on "Administrative Systems of Road Maintenance." Mr. Hooker was asked, at the close of his address, in which he laid down an excellent plan for the partial and quick repair of highways, at what he estimated the maintenance cost per mile of bituminous macadam. Mr. Hooker, taking roads at $12,000 a mile as a basis, put the maintenance charge at $600 per mile. He said good-naturedly: "Bituminous macadam men will try to make you believe there is practically no maintenance charge, and I am looking at one of these men at this minute, and yet on one of his roads we spent $700 a mile in maintenance."

Such are a few developments of the Congress which reveal in a measure the trend of thought as to the future highway.

The Work of the Congress

The business of the Congress has been taken up in two main divisions. The first two days, Sept. 30 and Oct. 1, were allotted to road users and the meetings were under the direction of the American Automobile Association. There were few lapses in the program as announced, and a large amount of valuable discussion and many thoughtful papers and addresses were the results. Logan Waller Page, Director, United States Office of Public Roads, and President of the American Road Congress, called the convention to order, also making an address which outlined the purposes of the Good Roads movement, as expressed in the Congress, and which sketched the various branches of the convention work to be undertaken. Mr. Page has found much satisfaction in the fact that the second day's sessions found 25 state highway departments officially represented, and 56 states, provinces and countries represented by official, semi-official and citizen delegates.

Following Mr. Page on Monday, introductory remarks were made by Robert P. Hooper, presiding officer of this section and President of the American Automobile Assoc. Charles Thaddeus Terry, chairman of the A. A. A. legislative board, made an address on "Making Automobile Law," and N. P. Hull, of the National Grange Legislative committee, on "The Farmer and His Road Using."

Gov. Woodrow Wilson, Democratic nominee for the presidency, delivered an address at the Monday afternoon session, in which he welcomed the Congress to New Jersey. He took a decided stand for the Good Roads movement and for federal aid in the work, and dryly remarked that he considered that such a position on his part was merely correlative with being a rational human being. Other Monday addresses were: "A National System in Marking the Roads," by Powell Evans, President Automobile Club of Philadelphia; "Organized Effort vs. Individual Effort," by H. L. Vail, county commissioner, Cleveland, O.; "Why New Jersey Opened Her Gates," by Walter E. George, a state senator identified with the Good Roads movement, which had some of its earliest state organization in New Jersey; "How to Work for State Aid," by Joseph H. Weeks, chairman, Good Roads Committee, Pennsylvania Motor Federation.

Highways from the Road Users' Standpoint

Tuesday's sessions were occupied with a continuation of the road users' special interests and included a paper, "The Maine Plan," by J. C. Scates, Sec'y. Maine

Automobile Association; "National Old Trails," a paper by Judge J. M. Low, National Old Trails Road Association, which was read in the author's absence; an address by Mrs. Donald McLean, Honorary President-General, Daughters of the American Revolution, expressing sympathy with the movement to restore and maintain these old national highways. Judge H. C. Gilbert, Kansas City, Mo., who became ill after reaching Atlantic City, and D. W. Shackleford, Congressman from Missouri, who did not appear, failed to present their papers touching upon federal aid in road work. Tuesday afternoon "Business Organizations as Good Roads Accelerators" was discussed by G. Grosvenor Dawe, chief of the editorial division of the Chamber of Commerce of the United States. "How to Encourage the 'See America First' Idea" was the general subject of a symposium to which interesting contributions were made by Preston Belvin, Pres. Virginia State Automobile Assoc.; Dr. Joseph Hyde Pratt, Pres. Southern Appalachian Good Roads Assoc.; S. S. Ballard, Sec'y. Automobile Club of New York; Dell M. Potter, Vice-Pres. Ocean to Ocean Highway Association, and Frank D. Lyon, Sec'y. New York State Automobile Assoc. George C. Diehl, Buffalo, chairman Good Roads Board of the American Automobile Assoc., presided at this session, which developed the idea of good roads as a national asset in affording better means of intercommunication and a consequent interstate understanding and mutual interest.

Ways and Means at Wednesday's Session

With these two days' sessions lending impetus to the Good Roads movement in its popular aspect, esthetic consideration and general interest, the more intimate discussions of ways and means began Wednesday morning, with Logan Waller Page presiding. In the absence of Pres. Taft, whose name was on the program, and of Sec'y. of Agriculture Wilson, who was to have represented him, the first address was made by M. de Pulligny, Eng. in Ch. of Bridges and Highways of France, generally regarded as one of the most important figures at the Congress, not alone because of the excellent road system of France, which he explained, in its administrative features, but because of his general standing in the profession. He officially represented the French government at the Congress. He was followed on the program by J. E. Caron, Quebec, whose address has already been mentioned, and by W. A. McLean, Toronto, Provincial Engineer of Ontario, who outlined the roads systems of all the provinces of Canada. W. W. Finley, Pres. Southern Railway Co., made an interesting address on "Good Roads and the High Cost of Living."

L. V. Boughner, chairman of the Highway Improvement Committee of the Civic and Commerce Assoc., Minneapolis, made a very interesting address in which he revealed the importance and the methods of publicity in getting public opinion for Good Roads aroused to the point of standing a tax increase of $1.00 on $1,000. The work along this line in Minneapolis and in Hennepin county has been highly successful. Better street work is the result in the city and the beginning of concrete road work in the county on an important boulevard. Henry W. Anderson, Richmond, Va., spoke on "Needed Reforms in Road Legislation," making the interesting point that many things are possible sometimes in highway development in using the laws already in force but putting particular emphasis upon the urgency of state control of all important roads; county control of secondary roads only, and as an ultimate interstate development, federal control and aid in road construction on highways which have great interstate value.

The Wednesday afternoon session was in charge of an American Bar Assoc. committee consisting of Frederick E. Wadhams, Albany, N. Y., chairman; William D. Sohier, Boston, and Henry D. Estabrook, New York City. Mr. Sohier, who is chairman of the Massachusetts Highway Commission, presided and made the opening address, in which he discussed numerous features of modern highway problems: the importance of the best engineering service in planning and carrying on road construction and maintenance; the fact that the greatest change which has ever taken place in transportation is practically upon us, entailing long freight hauls by motor trucks and necessitating new highway conditions to make possible the highway development. He presented many interesting figures showing the trend of horse traffic downward and motor traffic steadily upward in Massachusetts, where a census has been taken in many localities.

Mr. Sohier was followed by Jas. H. MacDonald, State Highway Commissioner of Connecticut, and by Clarence A. Kenyon, Indianapolis, who showed up the folly of "working out road taxes"—a system which still prevails in several states. Gordon Reel, State Supt. of Highways, of New York, who was scheduled for an address on "Trunk Line Highways," was absent.

Finance and Construction

Thursday morning the Finance Section held sway in charge of and led with an address by Lee McClung, Treas. of the United States, and followed by the Administrative Section in charge of Col. E. M. Bigelow, State Highway Commissioner of Pennsylvania.

Construction details are yet to be taken up in later meetings, as outlined in the September issue.

Change of Name

At the Thursday evening session the Association re-elected all the officers of the past year except that W. W. Finley, Pres. Southern Ry., succeeds W. C. Brown, Pres. New York Central Lines, as Vice-President. The name of the Association is changed to American Highway Association.

Investigation into the use for building of concrete brick, reinforced with steel reinforcement, have shown that these bricks resist the atmospheric changes remarkably well, and have a longer life and better appearance after many years of service.

Accelerated Tests for Constancy of Volume.

Many years ago the subject of "Torturing" Portland Cement by [illegible] methods of hot and boiling tests to determine its constancy of volume was the subject of discussion at leading engineering and scientific meetings. The "kiln" test, the "ball" test, the "boiling" test, the LeChatelier test, the steaming test have all had their advocates and their opponents. Many of them have come and gone and the International Congress of Testing Materials whose proceedings are fully reported in another column, has adopted the sensible plan of referring the whole matter to a committee with instruction to invite experiments by various testing laboratories, and also to have experiments made by an official testing authority in each country concerned.

This country through the standard specification of the American Society of Testing Materials, concurred in by the joint committee on concrete and reinforced concrete, has its steaming test for constancy of volume and the government board in its recently issued specification has also adopted the test. While other methods of testing such as the autoclave and similar means may be spasmodically suggested, it would seem that before adoption generally or in particular they should come before some of the regularly constituted tribunals for consideration and adoption. "Too many cooks spoil the broth," and this is especially so in the case of methods of testing.

In dealing with the question of accelerated tests, both the specifications cited recognize the possible unreliability of the steaming test by guarding it with the severest restrictions, making it *not* an absolute test for the rejection of the cement but one on which it may be rejected merely. With this judgment before us, the question arises whether the steaming test of exposure to steam at atmospheric pressure above boiling water should "right off the bat" be superceded by treatment under 20 atmospheres as described in the newest of these methods, and without further examination or corroboration on the part of any of the recognized authorities in the art.

A CORRECTION.

On page 35 of this issue, the second or maximum deflection of the 8-inch wall was .055" instead of .005" which was first deflection under a load of 10 tons. The maximum load, causing the .055-in. deflection, was 300 tons.

Frankfurt on Main has recently seen the completion of a large theatre of reinforced concrete. This building has been a striking demonstration of the possibilities of using concrete for buildings where architectural beauty and artistic interpretation are the greatest requirements, aside from the fireproof construction.

To prevent concrete slabs from atmospheric attack, they should be dried after leaving the press, and then coated with a layer composed of benzine or benzole with 1 pint beeswax. Then they should be washed clean in water and left exposed to the air for several days, after which time they are stored to cure in a dark, dry place.

Sprinkling and Steam Treatment Combined in Concrete Products Curing Rooms.

BY A. E. CLINE.*

In the plant of the Perfection Concrete Co., Ltd., Winnipeg, Man.,† there are eight curing rooms or kilns, varying only in width, so that a typical one may be described as follows:

The kiln is 88′ long, 9′8″ wide between walls and 7′ between floor and ceiling. The walls are built of 8″ concrete block on a 24″x6″ footing, only the outside walls going down below the grade line. The roof of the kilns forms the floor of the ornamental stone room above, and therefore is a flat reinforced concrete slab 6″ thick.

The floor is built as follows: First 6″ of gravel, in which is laid a 4″ tile drain running from rear to front where it connects with the sewer. (By front of kiln is meant the end next the machines.)

The ties of 3″x6″ tamarack are leveled on this, and the three tracks of 12-lb. rails spiked to them, then 4″ of concrete are run in, covering the ties and holding the rails firmly in place, but not high enough to interfere with the car wheels. A small catch-basin at the rear of the kiln connects with the tile drain and the floor is graded to it. The floor drops 4″ in its entire length to give easier grade for the cars and drainage for the surplus water.

At the rear or outside end of the kiln there are two sets of double swing doors, hung on heavy hinges only 1′ apart, one set opening outward and the other in; the latter being used in the cold weather only. These doors are made of two thicknesses of ship-lap with a layer of insulating paper between, and are made to close tightly. At the inside or front of kiln there is a 10-oz. duck curtain, well oiled, and simply hung from the top and fastened to a round stick at the bottom, for weight and to roll it up on. At the sides it is held between two boards, the outer strip being hinged and held in place by a wooden button as shown by sketch. There are transfer tracks at either end of kiln.

*Superintendent of the plant described.
†See Concrete-Cement Age, July, 1912, p. 35, for description of plant. The information here has been supplied since and treats particularly of curing methods.

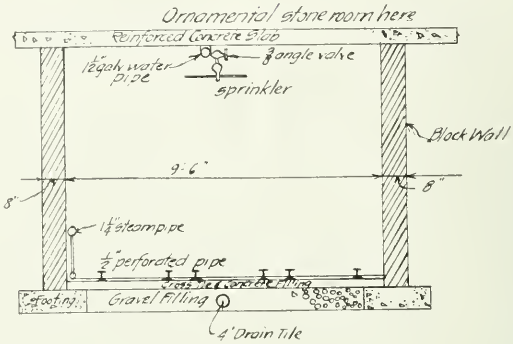


Fig. 2. Cross Section of the Kiln.

Steam is taken from a 60 h. p. boiler, which is located 70′ from the nearest kiln, in a 1½″ main pipe which runs across the top of the front end of kiln. From this, by a tee and valve, a 1″ pipe is taken off and goes down the side wall to within a foot of the floor, where it turns and runs nearly the full length of the kiln. Beginning 8′ from the front, a ½″ pipe is taken from this every 16′. This ½″ pipe is 8′ long and perforated with 1/32″ holes every 6″, with a cap on the end of the pipe.

Steam pressure at the boiler is usually about 40 lbs., but a reducing valve in the main pipe lowers this to 5 lbs., which is just enough pressure to drive the steam the full length of the kilns, so that it comes from the pipe just as wet steam and condenses on the block, tile or pipe. The temperature averages about 100° Fahr.

Details of Application.

Along the front of the kilns, close to the main steam pipe, is a 2″ main water pipe with city pressure. At the center of the kiln this connects by tee and valve with a 1½″ galvanized pipe, which runs nearly the full length of the kiln and is fastened to the underside of the roof by wires embedded in the concrete. Every 10′ beginning 5′ from the front, there is fastened to this by a tee and ⅜″ angle valve, a common 3-arm revolving lawn sprinkler—that is, the head and arms only are used and are put on upside down. In the arms all holes but one in the ends are closed and three new holes put in on top of each arm, so that the water will be sprinkled evenly all over the kiln. Thus with these valves at the sprinklers the entire kiln can be sprinkled at once, or only such part as is desired.

For the products, the regular 3-deck block cars are used. The kiln will hold eleven of these on each track or 33 in all, so that each kiln will hold the day's run in block.

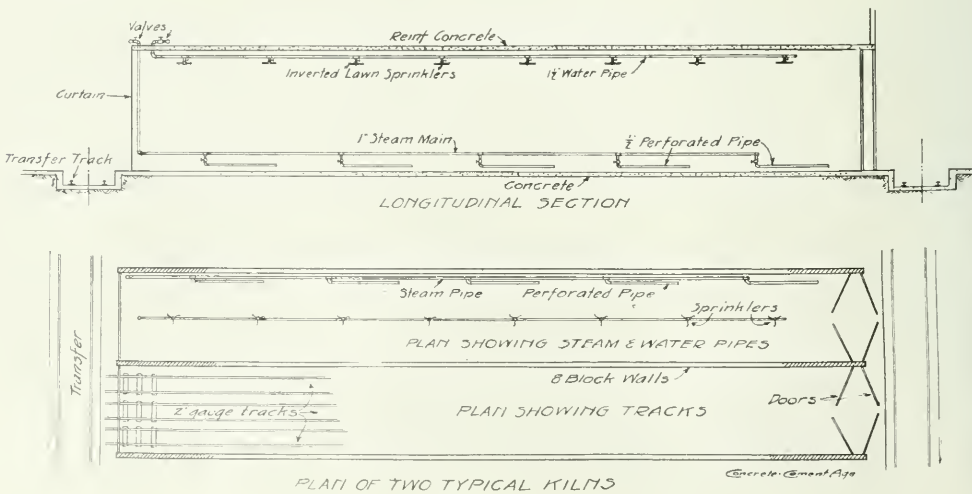


Fig. 1. Plan and Longitudinal Section of the Kilns.

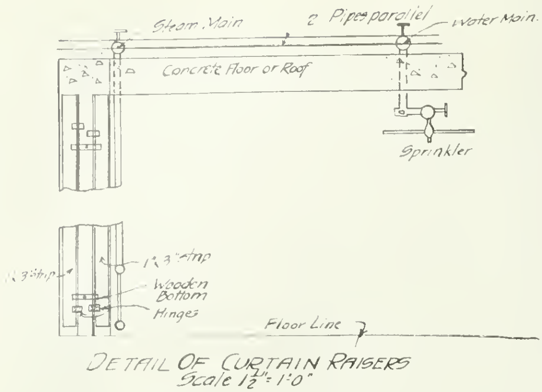


FIG. 3. DETAIL OF CURTAIN ARRANGEMENT AT DOOR OF CONCRETE CURING ROOM.

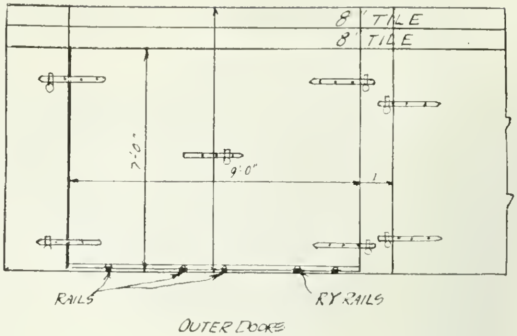


FIG. 4. THE OUTER DOORS, CONCRETE CURING ROOMS.

The block are left in the kiln for two days; steam is turned on at night or as soon as kiln is filled, and kept on continuously for 24 hours and then turned off to let the block cool before going to yard. After the first day, the block are sprinkled every 6 hours.

With the concrete tile made by the Pauly system, the tile are placed in kilns as fast as cars are filled, the steam being turned on as soon as the first car is put in, and these are sprinkled every 4 hours and steamed continuously for 3 days.

In regard to "double system of curing" I may say that I regard the steam and sprinkling together as one system and use it on all products going into the kilns.* There was at one time considerable discussion as to whether or not watering a block after steaming did any good. I found by actual tests that a block thoroughly sprinkled after coming from the steam room, showed 50 lbs. per sq. in. greater strength at the end of 3 months than one not sprinkled.

This double system was primarily installed for the hollow tile and sewer pipe, but on trying it on the block, it seemed to work so well that I have adopted it for all. While the sprinkling may not be necessary, I am satisfied that it gives a better product on all semi-wet mixtures, and the expense is small. Water drips from the flat roof of the kilns, but I have yet to see any product spoiled; it is merely additional water. If coming from nail heads or rusty pipe it might stain them, especially in white faced work. In such cases, I would cover each car with insulating paper and depend on steam curing alone.

A real case of the destruction of a building by cement was recently noted in one of the daily papers. This was the case of a large brick warehouse in a New England city, which was loaded to the roof with bags of cement. The building collapsed, and here there was no doubt that cement *was* the cause of the failure.

*These last two paragraphs were sent on after the foregoing description in response to a request for further information as to the double system.—EDITORS.

A New Clinker Cooler.

In the July issue, page 62, the clinker cooler at the plant of the Inland Portland Cement Co., Metaline Falls, Wash., was shown. This cooler was designed by Raymond R. Bear, Ch. Engr. of the Lehigh Portland Cement Co., and while comparatively new, has demonstrated its efficiency.

It consists essentially of a series of superimposed hoppers, as shown in Fig. 2, carried on light vertical uprights. The upper edge of each of the hoppers is above the angle of repose of the material fed into the hopper. No material can be lost by overflow.

An internal air-cooling arrangement is provided by a vertical pipe, as shown in Fig. 2. The openings in this pipe at each hopper are protected by a suitable hood. Cold air under light pressure is forced through this pipe.

The hot clinker, or other granular material, is fed into the top from a chute, and under normal conditions, forms conical piles in each hopper as it is fed down; it is rapidly and thoroughly cooled.

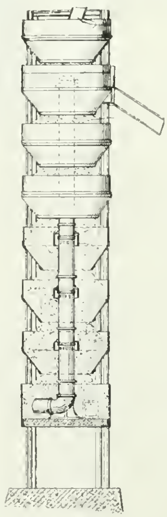


FIG. 2. CLINKER COOLER IN VERTICAL SECTION AND ELEVATION

While presiding over the Cement Section of the Sixth Congress of the International Association for Testing Materials in New York, Robert W. Lesley made a few remarks on the subject of newspaper attacks on concrete as a new material. Mentioning the recent accident at Dam 26 on the Ohio River, where, according to all reports in the daily and scientific press, the whole dam floated down the river without any evidence whatever that concrete was in any way at fault, he stated that investigations had shown that this dam was simply a concrete boat, not properly anchored, which floated down the river with all the wickets and other construction upon it. Cement was in no way responsible except for holding the boat together.

FIG. 1. VERTICAL CLINKER COOLERS AT PLANT OF THE INLAND PORTLAND CEMENT CO., METALINE FALLS, WASH.

A new addition to the Grand Rapids Refrigerator Company plant, Grand Rapids, Mich. This, as well as all their other buildings, is built of concrete blocks made on IDEAL machines.

Judge it by Output and Quality—

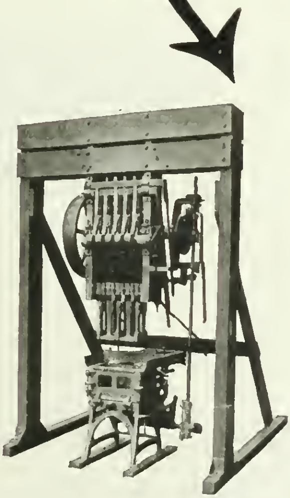
That is what measures your profits

From the standpoint of production, Ideal Concrete Machinery is without an equal. Repeated tests give it an average output 25% higher than that of any other type of machine. It makes seven more blocks to a barrel of cement without sacrificing an ounce of strength.

In fact, Ideal blocks have unusual strength. An 8x8x16 block, crushing at 60 tons, will stand a pressure in a wall equal to 1600 feet high. Best of all—from the standpoint of form, Ideal Blocks excel—perfect in design with no crumbling or chipped edges.

A perfect product is the first advantage of Ideal Machinery, but there are many others well worth considering

For instance—its construction is on the unit plan. Each machine is complete in itself, each feature of each machine is complete in itself. Yet the different machines and different features dovetail together perfectly. This enables you to add to your equipment as you grow, having a unified plant all the time, and the smallest possible investment. This is especially advantageous to the man with small capital who is just entering the business of concrete block making.



IDEAL BLOCK MACHINE
equipped with Automatic Tamper, Scraper and Finisher and Core Actuator. This combination is unequalled.

The Combination That the Ideal Concrete Maker Logically Comes to:—

The IDEAL Interchangeable Block Machine.
The IDEAL Automatic Power Tamper.
The Automatic Scraper and Finisher.
The IDEAL Automatic Core Actuator.
The IDEAL Automatic Material Conveyor and Feeder.
The IDEAL Continuous Proportioning Mixer.

A 160-page text book on Concrete Block Making—the latest authority on the subject

We have just published a large valuable book that covers the subject of modern concrete block making completely. To keep it out of the hands of curiosity seekers, we send it only on a request accompanied by one dollar. The book, however, really costs you less than nothing, for with your first order amounting to ten dollars or over, we credit you with two dollars. A dollar pinned to a letter will bring it. Send it on today.

Ideal Concrete Machinery Co.

London, Ont., Canada **South Bend, Ind., U. S. A.**

We extend a cordial invitation to visit our factory and office, to give buyers an opportunity to advise with us in selecting equipment.

STEEL ARCH RIBS AND GRAVITY CONCRETE EQUIPMENT ON THE ATHERTON AVE. BRIDGE, PITTSBURG.

Steel Centers on the Atherton Ave. Bridge, Pittsburg

Work on the Atherton Ave. bridge is being pushed forward rapidly, and without the least hindrance to the traffic on the main line of the Pennsylvania R. R. The bridge spans the railroad just a short distance from shadyside station.

The contractor for the bridge is the Cranford Construction Co., of Pittsburg. The steel ribs used in the frame work of the structure are being furnished by the Blaw Steel Construction Co., also of Pittsburg.

The use of the steel ribs eliminates any possible interference with the heavy railway traffic that passes beneath the bridge. The archway opening is about as clear during construction as it will be even after completion.

The illustration shows the work as it stands today and gives an estimate of the size of the bridge and the work that is being done on it.

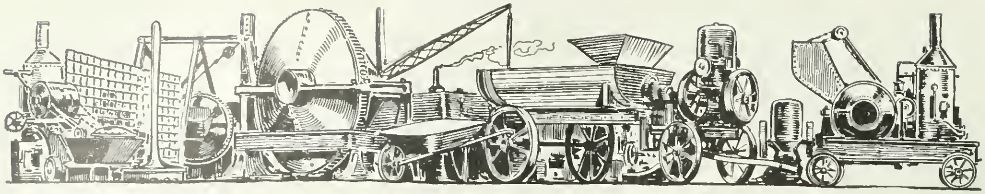
Resistance of Concrete to Shock.

The interesting case of the resistance of concrete to shock was noticed while the Severs hotel in Muskogee, Okla., was being built. The contractor was the Selden-Breck Construction Co., St. Louis, Mo., Albert Cornish, field superintendent. The sidewalk lights were Berger's "Raydiant," manufactured by the Berger Manufacturing Co., Canton, O. Dewey Portland cement was used.

Sewer contractors were working recently in a sewer ditch adjacent to the hotel building. A railroad tie 8" x 10" was blown from the ditch about 60 feet in the air (to the fifth story of the hotel building) alighting on end on a panel of the sidewalk light. It did not break through, but made an indentation on the sidewalk about three inches deep, and broke the glass and concrete for an area of about eighteen inches square, as shown by the accompanying snapshot pho-

DETAIL VIEW SHOWING EFFECT OF FALLING RAILROAD TIE ON SIDEWALK LIGHT.

tographs. This indicates high tensile efficiency of reinforced concrete for sidewalk construction. About half the pieces of glass were broken, the remaining pieces being intact. The surprising part of the matter is that the whole panel of sidewalk light was not disturbed, nor the reinforcement completely broken.



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

Magnetic Separators for Handling Crushed Rock

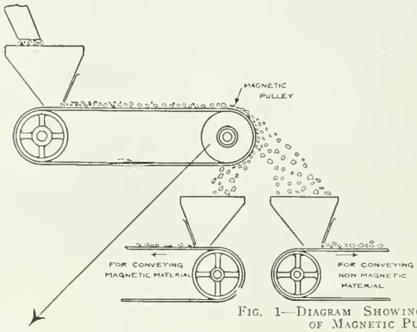


FIG. 1—DIAGRAM SHOWING ARRANGEMENT OF MAGNETIC PULLEY

The modern Portland cement plant has furnished a field for the use of magnetic separators to remove stray iron, steel, etc., from the rock and coal. The Southwestern Portland Cement Co., El Paso, Texas, has recently installed the separator, shown in the accompanying illustration, which is built by The Cutler-Hammer Clutch Co., Milwaukee. In this particular case an *I*-beam frame was used on which is mounted the magnetic pulley at the right end, the wooden tail pulley at the left end, and two idler pulleys between. The mixture on which the separation is to be effected is fed by a suitable hopper onto the conveyor belt; and by this it is passed over the magnetic pulley. The material that is magnetized, is drawn strongly toward the face of the pulley, and this hugs the belt closely up to the point at which the belt leaves the pulley at the lower side. At this point the magnetic field is broken; it is snapped off by the belt, and falls into a chute or other arrangement for conveying it away. The non-magnetic material is projected some distance in front of the pulley, thus being widely removed from the magnetic material and making a very clean separation.

The magnetic pulley consists of alternate coils and steel discs concentric with the shaft. The coils are wound on steel spools doweled to the discs, which are in turn keyed to the shaft. Each coil is enclosed and protected by a cylindrical brass coil shield, tightly fitted to each of the two adjacent poles. Current for the coils is obtained through carbon brushes held onto a pair of "slip rings" by self-adjusting holders.

These pulleys are regularly built 12" in diameter, in lengths from 16" to 36" having a current consumption of 325 to 750 watts per hr. and capacities of 1340 to 3000 cu. ft. per hr. Standard pulleys are designed to operate on any direct current voltage up to 250.

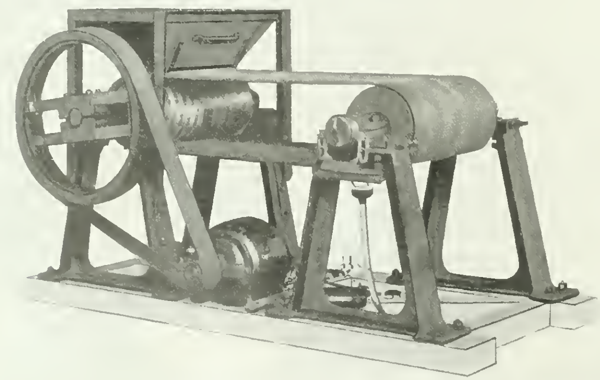


FIG. 2—A MOTOR-DRIVEN MAGNETIC SEPARATOR BELT

The Blaw Steel Construction Co., with general offices in the Westinghouse building, Pittsburgh, has bought 10 ocres of land at Hoboken, Pa., on the West Penn Railroad, about 10 miles from Pittsburgh. On this site the company will build a new plant for making its present line of steel centers for all kinds of concrete work, and will also do a steel fabricating business in structural work, making a specialty of building galvanized steel towers for carrying high tension transmission lines, also power houses and steel buildings, besides making specialties for other concerns that do not have manufacturing facalities. F. M. Bowman, Wayne Rawley and Alexander H. Bovard, formerly with the Riter-Conley Mfg. Co., have connected themselves with the Blaw Steel Construction Co., and the company has decided to enlarge its lines of product by including structural steel work.

Leroy A. Kling, who has been connected for some time past with two well-known crusher companies in Cedar Rapids, Ia., is now with the Wheeling Mold & Foundry Co., Wheeling, W. Va., as department. This concern has built much of the important machinery for the Panama canal, and will eventually manufacture a complete line of road building machinery, including a modern crusher, pulverizers, rolls, screens, elevators, trucks and graders. It is needless to speak for the quality of these products, as the company has a reputation for turning out high grade machinery.

Tarmac Limited, Wolverhampton, England, have purchased from the Ruggles-Coles Engineering Co., 50 Church St., New York, a Class AG dryer for treating crushed slags, the machine having a capacity of 30 tons per hr.

An Unusual Batch Mixer

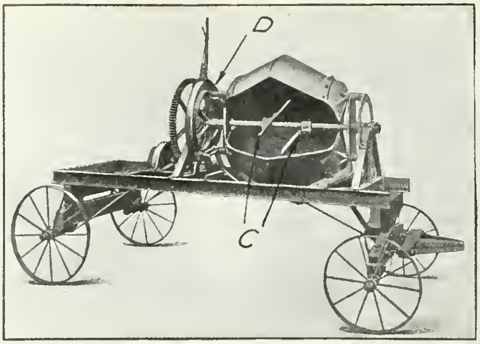


Fig. 1. General View of Sterling Batch Mixer

The Sterling Pattern Works, Sterling, Ill., has recently put on the market a small batch mixer possessing rather unusual features. Two open drums revolve around a common axle, and the concrete in mixing is poured from one drum into another.

The mixing drums are two double-cone shaped, half-sections, pivoted at each end to arms keyed to main shaft. Each drum has a working capacity of 4 to 5 cu. ft. of material.

The main shaft revolves continuously in one direction, carrying the upper drum toward the side of the machine shown in Fig. 1. In their motion around the main shaft, the drums empty from the upper to the lower, the material being deflected from one side and the other by the blades attached to the shaft. In the position shown in Fig. 1, the upper drum has discharged its material into the lower one. In the further revolution, controlled by the cam shown at the left, the drums close past each other, opening on the opposite side. The further revolution of the drums discharges the material into the lower drum. This motion in connection with the blades, brings about a thorough shifting and a rapid mixing of the material, the water being added while the machine is in motion. The drums make 10 revolutions per minute and a batch is thoroughly mixed and wet in 5 revolutions, or one-half minute.

Mixing Operation

Fig. 2 shows the position of the two drums at different stages of the process. The wings or deflectors marked *C* in Fig. 2. The first position in Fig. 2 shows 1 are not shown on the diagram in Fig. drum *A*, after having discharged its load into drum *B*. In the second positon is shown drum *A* swinging on its axis in its independent motion of closing over opposite edge of drum *B*. This independent motion is controlled by cam *D* shown in Fig. 1. In the third position, drum *B* is shown in the act of discharging its load into drum *A*.

The motion of the main shaft, shown in solid black in Fig. 2, is uniform and continuous. The diagram shows the positons through which the drums pas sin the cycle of rotation. In the dumping positon the opening of the drums at the point shown is controlled by cam *D* to which the dumping lever is attached.

Fig. 1 shows the loading positon of the machine. A low platform, built to rest on the frame, which is 30″ from the ground, enables a wheelbarrow to be unloaded directly into the lower drum. In discharging, a wheelbarrow or cart is run under the hopper, and the operator, standing on this side of the machine, pulls toward him a lever attached to the cam, thus changing the opening position of the drums to a point where the material will discharge through the hopper directly into the wheelbarrow, the machine continuing in motion. By pushing the lever only part way down, the whole batch will be discharged. If pushed entirely down, the whole batch will be discharged. After discharging, the lever should be thrown back into working position as in Fig. 1.

The machine is provided with a simple and strong clutch for starting and stopping, and when stopped in the loading position, the drums are automatically locked.

Construction

The frame is of 4-in. channel steel, strongly riveted, and extending towards the rear of the machine for the engine mounting. The frame as shown is 9′ 2″ long, and of regular wagon box width outside, which enables the machine to be

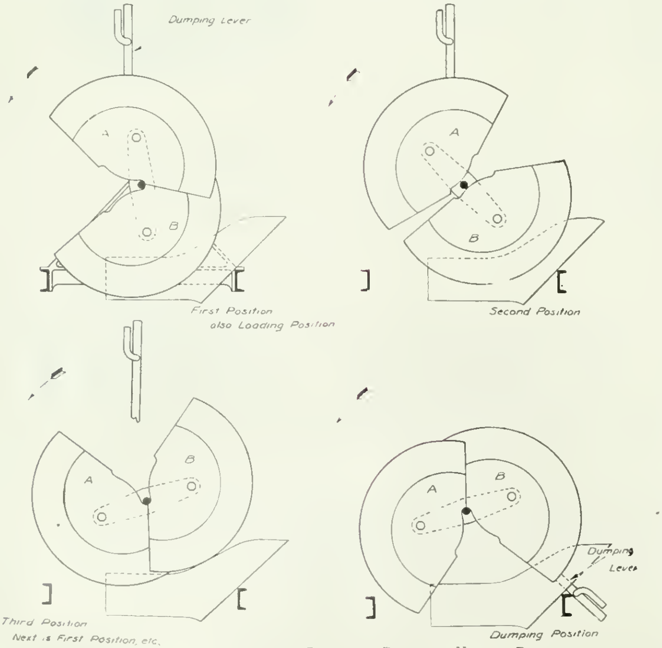


Fig. 2. Sectional View Through Center of Drums at Various Positions.

Barrett Specification Roofs

Shore Mills, Fall River, Mass., roofed along the lines of the Barrett Specification in 1876.

LOW COST—LONG SERVICE

METAL roofs require painting every few years, most ready roofings require coating regularly, but with Barrett Specification Roofs *there is no maintenance expense.*

Barrett Specification Roofs are roofs of coal tar pitch and tarred felt, with a top surface of slag, gravel or tile, *laid according to the Barret Specification.*

This specification is simply the standard formula for building a first-class roof of this character.

It is possible, of course, to make an inferior roof of these materials either by poor workmanship or by using insufficient and poor goods. But if the Barrett Specification *is followed absolutely and the materials called for are used,* you are certain of getting the best value in roof coverings.

Such roofs usually last twenty years and over without leaks or repairs.

Barrett Specification Roofs are almost universally used on factories and buildings of large roof areas and where costs are carefully figured. They are equally good for city dwellings, warehouses, railroad buildings, etc.

Copy of the Barrett Specification, with diagrams, mailed free on request to nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

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New York, Chicago, Philadelphia, Boston, St. Louis, Kansas City, Cleveland, Cincinnati, Minneapolis, Pittsburgh, Seattle, Corey, Ala.
THE PATERSON MFG. CO., Ltd:—Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B. Halifax, N. S.

TRADE B MARK

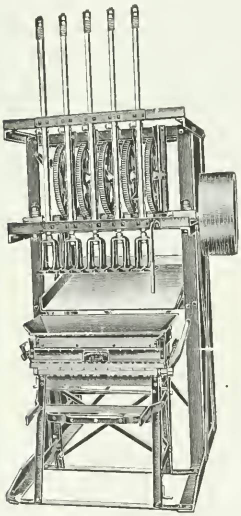
mounted on an ordinary wagon truck if desired.

The wheels are 30" and 25" in diameter and of wagon track width between centers. The driving pulley is 10" in diameter with 3½-in. face and should be run not to exceed 325 revolutions per minute. The total weight of the machine is 1,200 lbs.

A New Power Tamper and Brick Machine.

Modern methods are being applied at every possible point in concrete products plants, and power tampers are coming into very general use. A new type of tamper for concrete brick machines has been brought recently onto the market by C. S. Wert, Kendallville, Ind. This machine, marketed under the name of the "Perfect" power tamper, is adaptable to either brick or block machines of any standard type. Five tampers operate from a single shaft, and the operation is controlled by one lever. All parts are of steel and malleable iron. The drive shaft is actuated by a 1 h. p. motor or gasoline engine, at a speed of 380 rev. per. m.

The model "B" brick machine developed by the same firm presents a number of valuable improvements. A sliding hopper, operated automatically, removes the surplus of concrete left on top of the brick after tamping, to the rear of the machine onto a platform which serves as a bottom to the adjustable hopper. When starting a new operation, the hopper comes forward again and replaces the surplus concrete over the molds. With this operation, neither effort nor concrete should be lost. A traveling blade is attached to the front edge of the hopper, which serves to smooth the surface of the brick. The hopper is moved both forward and back by a pedal lever. The weight of the tampers, uncrated, is 375 lbs.; the brick machine weighs 300 lbs.



A NEW POWER TAMPER AND BRICK MACHINE.

Trade Literature

Metal Building Materials. Berger Mfg. Co., Canton, Ohio. 6" x 3½", 15 pp., paper bound, illustrated. This is a neat "vest-pocket" catalog, giving a concise description of the various well-known Berger products.

Bulletin No. 51. Asbestos Protected Metal Company, 100 Broadway, New York City, 7" x 4½", paper bound, 11 pp., illustrated. This describes "Asbestostell," which is the rather expressive trade name adopted for a corrugated asbestos-coated steel sheathing. An ingenious way of truss-reinforcing this steel sheathing is shown in detail.

The Blayney Collapsible and Telescoping System. The Standardized Steel Form Company, Niagara Falls, New York. 10¼" x 7", 8 pp., paper bound, illustrated. Steel forms for sewers and conduits are shown, and the interesting toggle-jointed collapsing principal is explained in detail.

Cabot's Protective Paint. Samuel Cabot, Inc., Boston, Mass. 6" x 3½", 3 pp., paper bound. After reigning supreme for ages, linseed oil, it is now claimed, has recently been proved to be poor protection for iron and steel. This booklet describes a protective paint which has an enviable record in protecting iron and steel.

The Crescent Mixer. Raber & Lang Mfg. Co., 802 Mill St., Kendallville, Indiana. 32 pp., 10¾" x 7½", paper bound, illustrated. "Crescent" mixers are made in a variety of styles to meet different needs. They are, however, all continuous mixers, and all use the well-known "Crescent" proportioning principle. The essential details of the different features of "Crescent" mixer construction are carefully set forth in this interesting booklet.

Cabot's Damp-proofing for Direct Plastering on Brick and Concrete. Samuel Cabot, Inc., Boston, Mass., 6" x 3½", paper bound, 2 pp. This leaflet describes a material to be used to prevent dampness from working through walls. It is designed to penetrate and thoroughly impregnate the surface, and form not only a damp-resisting course, but also offer a bond to plaster or cement mortar coat used on the wall.

Rib-Trus. By Berger Manufacturing Co., Canton, Ohio. 5½" x 3½", paper bound, 11 pp., illustrated. Another "vest-careful presentation of "Rib-Trus." This a carefully manufactured expanded metal, siffened with a rib.

Phillips' Spring Hammer. Daugherty-Smith-Phillips Company, 500 Division St., Chicago, Ill. 6½" x 3½", 5 pp., paper bound, illustrated. A very ingenious band drill in which the "pound" is produced by turning a notched wheel which engages the chuck and brings it in against the spring. The blow is delivered by the released spring. Ten blows to a revolution mean efficiency in band drilling. The booklet is of interest and value.

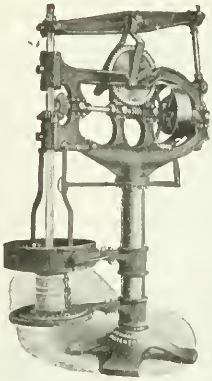
The Modern Wall Material—BESTWALL. Bestwell Manufacturing Co., First National Bank Bldg., Chicago, Ill. 8" x 4¾", paper bound, 14 pp., illustrated. The interior finish of fireproof, hygienic, low-cost houses demands careful consideration. This wall board is an ingenious composition of pulp-wood and plaster. The booklet describes the material, and shows many of its interesting uses.

A New Expansion Joint

In the concrete paving work at Norwood, O., described on page 53 of this issue, an expansion joint was used which presents new and rather effective features. This joint, developed by the Philip Carey Co., Cincinnati, under the trade name "Elastite," is made of a high-grade felt, thoroughly impregnated, coated and bonded with a special waterproof asphalt compound. It comes onto the work as a compact board, usually in 5-ft. lengths, easily handled. An evident advantage in using such a joint is that the board can be furnished in any required width and thickness, to fit any depth of pavement slab or width of expansion joint.

Such a joint takes the place of wood strips, and saves not only the cost of the strips, but the labor of their removal. The labor cost of filling the crack with pitch is removed, and an accurate, well-placed expansion joint should be assured.

This asphalt board filler is also well fitted for the longitudinal expansion joint at the curb, as well as for sidewalk joints.



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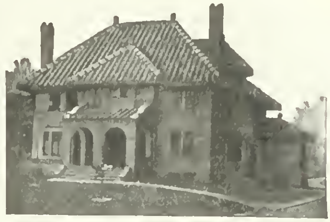

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Artistic and Ornamental in appearance and is positively guaranteed to be Fire, Lightning, Rain, Storm and Wind proof.

Its extreme lightness (about one-eight that of slate), durability and moderate cost commend it to those wishing something out of the ordinary in roofing.

Manufactured from best quality Worcester Grade Terne Plate, furnished painted or galvanized (galvanized after formation) size 10 x 14 inches.

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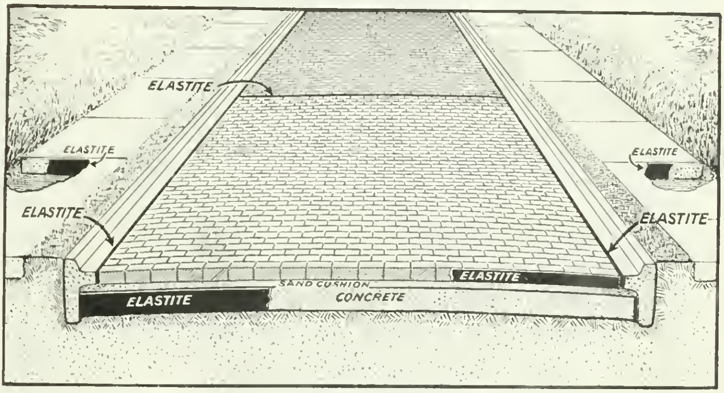
The Carey *Elastite* Paving Joint



saves time and labor in the construction of brick, concrete and wood block streets and concrete sidewalks, and makes a far better job than is possible with the old time pitch expansion joint.

Elastite is applied in the same manner as wooden spacing strips (see illustration), but unlike them *it becomes a permanent part of the street or sidewalk,* equalizing expansion strains and absolutely preventing bulging or buckling. No need of wood spacers—no pitch filling—a perfect joint is completed when **Elastite** is laid. GET A SAMPLE.

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MAKERS OF THE FAMOUS *Carey Flexible Cement Roofing*

An Improved Type of Continuous Mixer.

The economy of machine mixing where a large amount of concrete is handled is unquestioned, and no hand-mixed concrete is laid in large quantities today. The use of mixers on smaller work is a newer development, but with a light and easily moved machine the saving is very great. Hand mixing is unreliable, non-uniform, and often incomplete. Proper machine mixing cuts the labor cost and reduces the labor problem; and if the machine is designed on correct principles, the mixing is far superior. In fact, a great many concrete failures may be avoided by proper proportioning and mixing of the concrete.

The Aurora Concrete Mixer Co., Aurora, Ill., has placed on the market a small continuous mixer, which is claimed to have a number of important advantages. Mixing is done on an open revolving disc, in which the concrete is agitated by stationary plows or blades. The desired proportions are delivered to the center of the revolving disc in continuous streams. Sand and gravel are delivered at one side of center, while the cement is delivered at the opposite side, onto the gravel. As the pan revolves, the dry material meets the first plow, which turns the stream over. Plow No. 2 (Fig. 2) meets the material in the center and again turns it over, one-half going to either side. The mixture thus continues gradually to work outward, being mixed and turned over and over by the ten plows and blades, and finally discharged at one point in a continuous stream. Water is added from four pipes to the dry mixture, about half way from the edge of the pan, so that the concrete is first thoroughly mixed dry and then wet. Whether the machine is runing light or full capacity, not a particle can be discharged without being turned at least twenty times, and the large stones are required to take exactly the same course around the pan as the finest grains of sand.

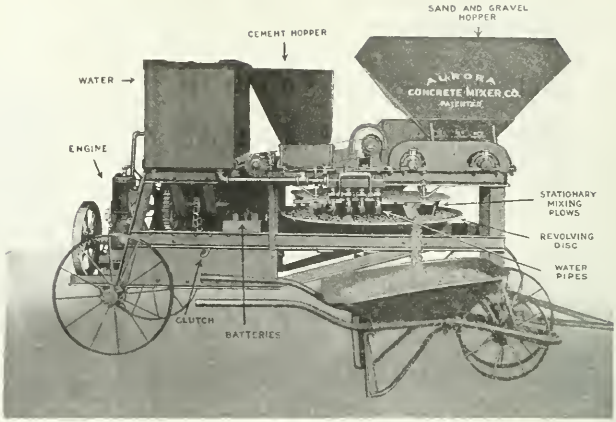

Fig. 1. General View of the Aurora Continuous Mixer

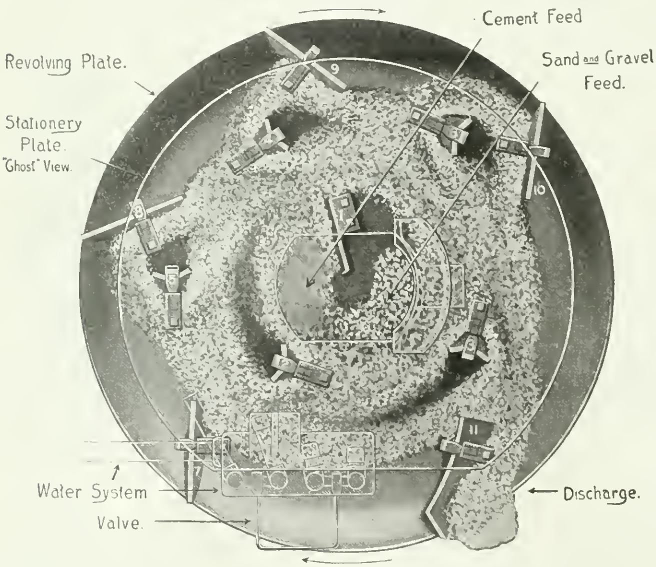

Fig. 2. Plan View of Mixing Pan, Showing the Arrangement of Plows and Blades

The "Aurora" mixer is provided with an automatic feed, easily adjustable, so that the proportions are always exact, and perfect results can be obtained with green labor, say the manufacturers. The machine is light, weighing only 1,500 lbs., and can be easily moved about to various jobs. Many contractors arrange this machine so as to deliver directly into the forms with no carrying or shoveling. To facilitate this, a steel chute is provided with each machine, enabling the concrete to flow into the forms.

This machine is equipped with a 2-h. p. gasoline engine, which at normal running speed delivers 6 cu. yds. per h. If the aggregates and the mixer are placed so as to eliminate carrying of material, 4 men can operate the machine—2 to shovel gravel, 1 to feed cement, and attend the water, and 1 to spread the concrete in the forms. As it is claimed that the machine costs but a few cents per day to operate, the cost of mixing 60 yards per day with 4 men is very low. A considerable number of the machines are already in use, and the experience of the contractors is bearing out the claims of for this machine that the mixing is far more perfect than can be obtained from hand imxing as it is absolutely uniform and no part of the work can be slighted.

Additional Catalogs Received

Below are listed with a brief summary, the catalogs and trade hand-books which have come in during the last month. The manufacturers are glad to send these upon request to interested readers.

The "R. I. W." Red Book. Toch Brothers, 320 Fifth Ave., New York. 62 pages, 6¼ x 3½, illustrated. The book, vest pocket size, in stiff covers, fully indexed, is a reference work on the waterproofing subjects embraced in the use of the line of materials manufactured by Toch Brothers.

Metal Lumber. Berger Mfg. Co., Canton, O. 112 pages, 9 x 6, illustrated. This is a pretentious book which presents adequately the subjected matter indicated by the title.

Medusa Waterproofing. The Sandusky Portland Cement Co., Sandusky, O. 32 pages, 6 x 9, illustrated. The book tells how to use the waterproofing material; how it has been successfully used and quotes many users.

The Fireproofing Hand Book. Published by The General Fireproofing Co., Youngstown, Ohio. 6 x 9"; paper bound, 80 pages; illustrated.

Architects, engineers and builders will find in this booklet a clearly presented and fully illustrated discussion of the use of ribbed and trussed steel mesh in wall, floor, partition and roof construction. Sketch and photographic details are given and the text is well presented.

Steel Forms for Concrete Construction. Published by The Blaw Steel Construction Co., Pittsburgh, Pa. 9½ x 6½"; paper bound, 7 leaves; illustrated.

This is the title of a new loose-leaf cover, which has recently come in with several inserts, showing mainly the use of steel arch ribs in bridge construction. This development promises a great future, and bridge designers and builders should find these illustrations of much interest.

Percoproof. The Philip Carey Co., Lockland, Cincinnati, O.; 15 pages; illustrated; paper bound; 4½ x 7".

"Percoproof" is a dampproofing for masonry walls, recently placed on the market, and has been successfully used on concrete structures. The booklet describes this material and its recent use on the General Hospital buildings, Cincinnati.

Standardized Sectional Steel Forms for Bridges. The Illinois Concrete Machinery Co., Oklahoma City, U. S. A., 39 pages; illustrated; paper bound; 4½ x 7".

Steel forms make for better and cheaper concrete, and this catalog, describing complete forms for arch and wing walls, is of special interest. The forms shown are made to conform to the standards of the Oklahoma State Highway Commission, and have been used extensively for that work.

Standard Specifications for Rail Steel Concrete Reinforcement Bars, adopted by The Association of American Steel Manufacturers. Published by the Franklin Steel Works, Franklin, Pa.; 6 pages; 3½ x 6"; paper bound.

This is a convenient pocket size edition of the standard specifications for rail carbon steel.

The Cement Industry in the United States in 1911. By Ernest F. Burchard. Advance chapter from "Mineral Resources of the United States. Calender year, 1911." Published by the Government Printing Office, Washington, D. C., 6 x 9, paper bound.

This is a timely and interesting review of the progress of the cement industry during the past year, and sums up in a valuable pamphlet complete statistical information, as well as an able interpretation of what the developments of the past year mean. Several references are made to *Cement Age;* and an editorial from *Cement Age* for December is quoted in full.

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Devoted to the manufacture and uses of Portland cement

New York DETROIT Chicago

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Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa., Convention, Pittsburgh, Dec. 12-18, 1912.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Bldg., Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Bldg., Washington, D. C.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Building, Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Nebraska Cement Users' Association, Secretary-Treasurer, Frank Whipperman, Omaha, Neb. Convention and Show, Auditorium, Omaha, Feb. 6-12, 1913.

Pittsburgh Cement Show, Exposition Hall, Dec. 12-18, 1912.

Chicago Cement Show, Colliseum, Jan. 16-23, 1913.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

In This Issue

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(25)

Concrete-Cement Age

Vol. I NOVEMBER, 1912 No. 5

Editorials

A JUST estimate of the value of the concrete block cannot be based upon the achievements of the majority engaged in manufacturing the product. The advance in quality of the output of those plants which have coupled mechanical advantages with approved methods and high purposes, is apparent in many places. The success of such establishments is so marked in having their work accepted by the public for its architectural and structural value, it must very soon become apparent that there is a big place in the world for such enterprises, that discouragement and failure will be the lot of those who took advantage of the public's temporary lack of knowledge to choose between the good and the bad. The good product makes a place for itself—it advertises itself and gathers its own momentum—so that the manufacturer who is striving for anything less than the best results, finds he has mapped out an up-hill climb, where the grade grows steeper all the time.

* * *

SUCH examples of the possibilities that lie in concrete for the pleasing ornamentation of grounds and buildings as are found in the Chicago park system, illustrated elsewhere in this issue, go a long way toward encouraging a greater employment of the material in such work. The tendency, perhaps, of most makers of lawn ornaments and builders of more pretentious works which chiefly serve an ornamental purpose in a landscape, is to over-ornament. The temptation is to do this very thing in concrete. The material is so obedient to the touch of the worker that he must be guided by a restraint which is born of rare taste, lest he fall into a complete debauch of ornamentation. Whether or not some of the creations in this field of work are rather more grotesque than artistic is, however, beside the point. The material must not be reproached with the artist's lack of taste. When concrete in its ornamental uses is not so new a toy and those who play with it are not tempted to "do stunts," the conscientious worker will have learned the characteristics and the best employment of a material which is worthy of his best efforts, not only for its expressiveness, but for the permanence which it gives the expression.

* * *

AN ENTERPRISE of unusual magnitude which is being undertaken with every prospect of success because of the energetic character of the men behind it, is the establishment of a coast to coast highway between New York and San Francisco. The plan is backed by men prominent in the automobile industry, chief among whom is Carl G. Fisher, Indianapolis, who is an enthusiastic motorist and a man of wide business and executive experience.

In a general way Mr. Fisher and his associates in the undertaking have enlisted financial support from manufacturers of automobiles and accessories on the basis of one-third of 1 per cent for 3 years or one-fifth of 1 per cent for 5 years, of the gross business done by the contributors to the fund. At the present time, it appears that an amount of money something in excess of $10,000,000 will, in all probability, be raised. Whatever money is received from any source will be devoted solely to the purchase of material for the road. No construction work will be understak.n by those interested in the plan, but contracts will be made with the states and counties through which the right of way will run to have the material delivered on the road under government specifications. A national committee, to be selected later, will be charged with the selection of the route.

Under present plans, all subscriptions are to be signed and closed before January 1st, 1913, the work to be completed by May 1st, 1915, so that the finished highway may be the route for automobiles to the Panama Exposition at San Francisco, which will be held in the summer of that year. For this reason the co-operation of all automobile owners is being enlisted in the cause. Two classes of membership will be created in the organization; one at $5.00 and one at $100.00.

Mr. Fisher estimates that a war fund of $10,000,000 would allow, roughly, $5,000 per mile for material along the roadway. Several other organizations, notably the Lincoln Memorial Fund, are possible contributors to this trans-continental road.

The plan is certainly an ambitious one. Even at the comparatively low figure that Mr. Fisher puts for a thoroughly first-class road ($12,000 per mile), a total cash expenditure of more than $24,000,000 is required. Whether or not the automobile interests can raise and will spend this amount for the purpose named is an open question. It seems to us that additional help will be required.

The widespread interest in the project as a whole and the certainty of very wide publicity arising from the work suggest an opportunity to manufacturers of Portland cement, quarrymen, road machinery manufacturers and others to take a hand in the proposed highway building. Contributions of Portland cement, the most essential element in constructing a road that is worthy the name, will be just as welcome to the promoters of the enterprise as is money. The Portland cement companies have here an opportunity to demonstrate on a vast scale how well adapted concrete roadways are for high-speed automobile traffic.

The Nebraska Cement Users' Association is sending out notices of its coming convention and mid-west cement show which is to be held in the Auditorium at Omaha February 4 to 8, inclusive. It is believed that the general interest in concrete construction in the Middle West will make the show this year an interesting one. Peter Palmer, Oakland, Neb., is President, and Frank Whipperman, Twenty-eighth avenue and Sahler street, Omaha, Neb., is Secretary.

A reinforced concrete coaling station, constructed so that 4 locomotives can be coaled at the same time, has been built at Warwick, near Toledo, O., for the Baltimore & Ohio R. R.

American Cement Co. Reorganization

The *New York Journal of Commerce* publishes a statement of the plan of reorganization of the American Cement Co., which went into the hands of receivers last February. The plan provides for the merger of the parent and subsidiary companies into one corporation to own and operate the properties of the American Cement Co. of New Jersey and of Pennsylvania, Reliance Cement Co., Central Cement Co., Norfolk Portland Cement Co., Vindex Land Co., United Building Material Co. and the Lesley & Trinkle Co.

The new corporation will have $2,000,000 common stock, $2,000,000 7% preferred stock, which is to be cumulative after July 1, 1916, and $750,000 first mortgage 6% bonds maturing $50,000 annually after three years until retired in 17 years. These bonds will be a first lien on the entire property, except for a nominal amount of bonds on one subsidiary. The issue has been underwritten and will be offered at par to present stockholders with a 25% bonus of new common stock. Holders of the present funded and floating debt of the old companies, parent and subsidiaries, which aggregates approximately $1,500,000, will receive preferred stock in the new company in exchange; holders of the $2,100,000 common stock will get 25% in the new common stock.

It is calculated by the committee in charge of the reorganization that present tangible assets are $3,100,000 including net quick assets, largely cash, of $700,000. Under the reorganization about $400,000 will be raised for new working capital and $110,000 for improvements and alterations. It is hoped that under the present more favorable trade conditions, the execution of the plan will enable the company to resume its former prosperous condition. The American Cement Co. was one of the so-called "Big Six."

The Atlantic and Gulf Cement Co.

At a meeting in Birmingham Oct. 19 of common creditors of the Atlantic & Gulf Portland Cement Co., whose mill is at Ragland, Ala., J. H. Carter, W. S. Lovell and H. C. Stiles were elected trustees to succeed J. H. Carter and W. S. Lovell, receivers. The receivers' report showed that the company had made good profits during the receivership and recommended that the mill be operated for the benefit of the creditors.

The cement company has had financial difficulties due to over-capitalization and lack of working capital. Because of the low sales price for its product on orders taken last winter and spring, the company was unable to pay its July interest and receivers in equity were asked for by northern bondholders. Immediately following this a petition in bankruptcy was filed by several Birmingham creditors and the above mentioned receivers were appointed by Judge Grubb of the Federal Court July 30.

The company has a large property and modern mill with an output of 1,500 bbls. per day and it is predicted that it will soon be able to satisfy the claims of its creditors, after which a reorganization will be effected. Clarence N. Wiley who has been general manager of the company for the past year, has been retained in the same capacity by the trustees.

Coming Concrete Gatherings.

An encouraging sign for a large attendance at the Pittsburg and the Chicago cement show is the fact that at the drawing for spaces more than 50% of the total floor area in each exposition hall was reserved. This amount compares favorably with space secured in advance by exhibitors in former years.

Since the first allotment of space, a number of firms have secured locations and plans are generally being made for unusually elaborate displays. The management of the shows announces that the coming exhibits will, in all probability, exceed in value and attractiveness former shows at Chicago and elsewhere. The exhibitors as a class appear to represent the substantial and influential operators in the field, and there is every indication that the exhibits will be representative in every particular.

Active support of the Pittsburg Chamber of Commerce and other civic organizations in Pittsburg has been enlisted. The exhibitions are being widely advertised. In the neighborhood of 1,500,000 booklets will be sent out and the Cement Products Exhibition Co. is utilizing full-page space in the cement industrial press.

Richard L. Humphrey, President of the National Association of Cement Users, which will hold its convention in Pittsburg at the same time as the cement show, Dec. 12-18, announces that the programs to be presented at the meetings will be of unusual interest and value. The N. A. C. U. has always proven a very strong drawing card in connection with the cement shows, since its members are among the most alert and progressive of the men connected with the industry.

Concrete-Cement Age.

Statement of Ownership, Management, Etc., of City.

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W. H. Denney, 30 Church St., New York
There are no bonds, mortgages or other securities issued.
WALTER C. BOYNTON, Publisher,
Concrete-Cement Age Publishing Co.
Sworn to and subscribed before me this tenth day of October, 1912.
ARTHUR E. LOCH, Notary Public.
(My commission expires February 28, 1915.)

FIG. 1—A VIEW OF THE ITALIAN GARDEN, WASHINGTON PARK, CHICAGO, ADMINISTRATION BUILDING IN BACKGROUND
Concrete is the Material Used in the Construction of the Beautiful Building and in the Ornamentation of the Grounds

Attractive Use of Concrete in Chicago Parks

Beautiful Buildings and Effective Ornamentations Are Made of Lasting Material

BY MARC N. GOODNOW

Those builders of our cities and park systems who have had only half an eye to the artistic harmony between nature and man-made things have not for a moment lagged behind in the use of concrete. Ornamentation as well as building construction such as was not dreamed of ten years ago is being successfully accomplished today as a consequence.

The Chicago park system, which is recognized as one of the most beautiful chains of inter-city breathing spots and recreational grounds in the world, offers a splendid and striking example of what may be accomplished by modern municipalities with crushed stone and cement in designing and executing artistic buildings, ornamental ground pieces and flower receptacles.

There are few spots within the confines of any large American city more pleasing to the eye or more attractive to one's sense of the natural fitness of things than the Italian garden and terrace with their concrete ornaments and balustrade stretching out in a lovely combination of green and white before the monolithic concrete office building of the South Park Commissioners in Washington Park. For a perfect unity in concrete of artistic balance, proportion and architectural dignity the structure and its surrounding grounds commend themselves above all others of like nature in that city.

The commissioners' headquarters had the initial advantage of being designed by the late Daniel H. Burnham, an architect of international standing, who early recognized the value of concrete as a basic material and was among the pioneers in adopting it for ornamental design. The artistic conception and execution of its designers have been lavished on this beautiful structure with its fluted square pillars, its ornamented facade and its surmounting urns for flowers. Capable of standing out conspicuously among even a thousand concrete structures, its ornate richness has been still further enhanced by the stretch of green lawn and ornamental ground pieces of white laid out before it.

The exterior texture of the concrete walls of the building presents a unique and attractive appearance because of the uniform proportion of the mixture with its ¼-in. screened stone. The walls were erected with the usual lumber forms, but the mixture was dry enough to be well tamped, its composition being 2 parts cement, 3 parts sand and 9 parts stone, carefully selected. The result was a very porous wall which was treated with Hydrolite. Four-inch partition tiles were used for furring, the thickness of the concrete varying from 8" to 12". Despite the porosity of the concrete there has been no difficulty from moisture absorption, because of the waterproofing and the partition tiles. The tiling was plastered and kalsomined. The principal reinforcement used was that placed about the windows. Being a building of one story and basement, the overhead weight is proportionately light. Mottled green tile forms the roof.

The balustrade, urns and other ornamentation of the building were constructed in the park shops and set in place after the completion of the building. The interior is finished in cherry, the central lobby or rotunda being of marble.

It is in the construction of the two fountains in front of the building that

FIG. 2—A VIEW OF THE WASHINGTON PARK, CHICAGO, ADMINISTRATION BUILDING WHICH EMPHASIZES THE VALUE OF CONCRETE IN ITS ORNAMENTAL VALUES IN BOTH BUILDING AND APPROACHES—STEPS, BALUSTRADES, URNS

the park engineers and employes have accomplished something really notable. These fountains are entirely of concrete, except for the brass fountain head through which the water spouts and for a certain amount of reinforcing. The lower basin of the fountain, which rests on a 9″ foundation of cinders, measures 17′ 4″ inside diameter, and is lined with 3″ of terra cotta, the joints being waterproofed with Hydrolite. (Hydrolithic Cement Co., Chicago.)

The composition of the basin is 1 part cement, 3 parts sand and 6 parts 1-in. limestone. The only reinforcement used was placed in the bottom and consisted of ⅜-in. rods spaced 6″ on centers. The basin is provided with a brass overflow and a combination plug and drain. An octagonal pedestal base sets in the center, with two 1″ water pipes leading to the jet in the fountain head. The cost of this lower basin is given as $7.65 per cubic yard in place. The cost includes tamping and flooding and placing the reinforcement.

The curb for the lower basin of the fountain was cast from a mixture of 1 part limestone screenings, 2 parts pink granite screenings, with 1 part cement to 2 parts of limestone and granite. Sixteen sections were made in one form. These sections were joined by pouring cement grout in between the curb and the terra cotta. The sections were cast upside down so that the face of the curb was perfectly smooth when finished.

[The "patented acid" used was a mixture of 1 part of muriatic acid and 8 parts of water. Any patent covering this method of treating concrete surfaces has probably expired, or is very generally disregarded.—Editors.]

That the pink granite might be brought out and a smoother, more polished surface result, the curb surface was treated with a patented acid which, after 10 to 15 minutes, was washed off with clean water and a brush. All surface cement was removed and the granite grain of the mixture brought out to the best effect. The park engineers and workmen have obtained the same grain effect on their steps or other flat surfaces, doing away with any dullness of surface, giving the artistic touch of fine pink granite interspersed with the white and gray of the cement.

The cost of this curb, including labor and materials, was figured at a little over $48. The item of expense, of course, is not always figured by a park board as it would be by a private concern. Because of the large number of men employed throughout the year and the natural desire to produce by experimenting a good many artistic effects which could not be otherwise obtained, the expense was perhaps of secondary consideration. However, it is a fair indication of the average cost.

In the construction of the pedestal the same mix was used as in the curb and basin. This mix was placed inside two sections of a gelatine mold cast from the object to be reproduced and bound firmly together by rope. The four faces of the pedestal being alike, it was possible to cast the concrete in two gelatine sections made from only one original mold. The cost of the ped-

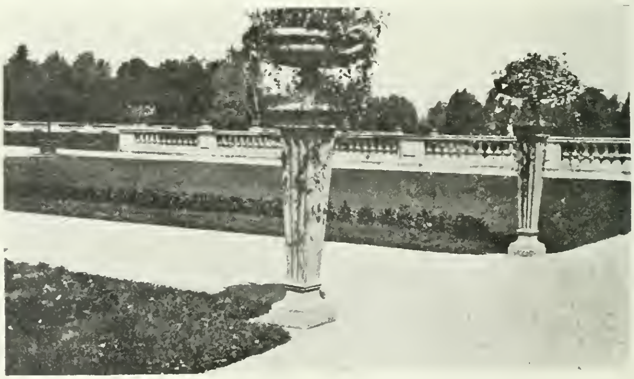

FIG. 6—CONCRETE FLOWER POTS AND PEDESTALS IN WASHINGTON PARK
These Were Cast in Gelatine Molds

estal, which contains about 4 cubic feet of concrete, is divided as follows: 1 molder employed 4 days, $18.40; 1 helper 4 days, $12; materials and cost of mold, $6.50; total, $36.90.

The upper basin, constructed in the park shop of the same material as the curb and pedestal, produces an even more artistic effect, being of a deep, rich granite hue which contrasts pleasantly with the background of green and white. The outside diameter of the upper basin is 7′ 6″, the depth over all 11″ and the water depth at the center 6″. A brass fountain head extends several inches above the rim of the bowl and is connected through the pedestal with the two 1-in. water pipes at the base. The fountain head throws a jet of water 8′ high.

Terre cotta lining was not used in the bowl's construction, but it was reinforced about the top with 3/32-in. wire netting, and about the bottom with 1/2-in. rods spaced 10″ apart. A 1-in. finishing coat was applied later, the mixture being composed of 2 parts sand, 1 part cement and 1 1/2 gallons of Hydrolite to each barrel of cement.

The cost of the upper basin was $31.60, including such items as one carpenter one day, $4.60; a molder 2 1/2 days, $11.50; helper 2 1/2 days, $7.50; materials, $8.

A description of the mixture and molds used in the construction of the basin and pedestal of the fountain is practically a description of the mixture and molds for the construction of the other ornamental pieces which decorate this garden spot. The lion-head and horse-head urns which stand in the gravel paths were cast in specially designed gelatine molds, formed by making an impression in plaster of the object to be reproduced, then coating the impression with glue. The impressions were made in two sections and bound together, as in the construction of the fountain pedestal. The ornaments for flowers, as well as the

FIG. 7.—GRANITE CONCRETE FLOWER URN IN WASHINGTON PARK

FIGS. 3, 4 AND 5, TOP TO BOTTOM—VIEWS OF ITALIAN GARDEN, WASHINGTON PARK, CHICAGO.
The Illustration at the Top—Fig. 3—Gives a General View of the Approach to the Administration Building, Through the Italian Garden. The Fountain Basin in the Foreground Is of Concrete
The Middle Picture—Fig. 4—Gives a Detailed View of the Upper Concrete Fountain and Numerous Urns and Flower Pots of the Same Material
The Third Picture in the Panel—Fig. 5—Gives a More Intimate View of the Ornamental Treatment in Concrete of the Administration Building

fountain pieces, present a rich surface with the granite particles smooth and distinct.

A fountain which throws a much higher stream of water, but which has no upper basin, is in the center of the sunken garden. Its basin is the same size as those of the fountains which have bowls, and the curb was cast in the same mold of the same material. The glory of this entire creation would have been crowned by the construction of concrete pergolas, but this is one feature which has not as yet been taken up.

While the Italian garden in Washington Park is easily the most artistic and attractive bit of concrete construction the commissioners have designed, the recreational park buildings scattered through the city are not far behind.

Chicago has a total investment of $10,000,000 in recreational parks and equipment, and the lion's share of this enormous investment the commissioners have seen fit to put into concrete buildings, benches, wading and swimming pools. Of ten park buildings used entirely for play and recreation nine are constructed of cement and crushed stone or granite, costing more than $90,000 each.

The design of these newer buildings is much the same as that of the commissioners' headquarters in Washington Park, though they are not always set in such lavish stretches of green lawn and concrete ornamentation. They are approached by broad flights of concrete steps extending almost the full length of the buildings. On entering these structures one is struck by the color scheme and the harmonies of the reds, browns, greens and blues used in their interior decoration. The walls of the club rooms, assembly halls, reading rooms, refectories, gymnasia and swimming houses are for the most part of rough concrete, and they are quite as attractive as plaster or kalsomine. Though the exterior surfaces of these buildings are rough and very porous, they have been treated with waterproofing and no difficulty has ever been experienced from the presence of moisture.

Fig. 8—Flower Pot in Washington Park, Supported by Lion's Head and Forefoot, Cast of Concrete in Gelatine Molds.

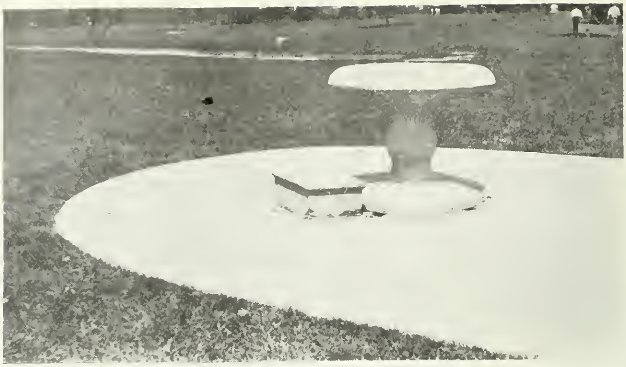

Fig. 9.—One of Many Concrete Drinking Fountains in Jackson Park, Chicago
Fig. 10—Concrete Retaining Walls, Pillars and Rails in Jackson Park.
Fig. 11.—Concrete Arch Bridge and Ornamental Concrete Lamp Posts, Lincoln Park

Wading pools and swimming tanks abound in these parks and are surrounded sometimes with concrete benches. Fuller Park boasts not only of a magnificent building of three stories with every recreational feature and a fountain court and corridor or cloister of four sides in concrete, but also of a concrete swimming tank and bathing house which accommodate 225 persons at one time. McKinley Park harks back to Roman days and has a beautiful hanging garden suspended from concrete pillars set about a shower room of concrete. Fuller Park's swimming tank is lined with white terra cotta, but McKinley Park's swimming pool is lined with concrete and is large enough to accommodate three or four hundred bathers at one time.

The entrance to Sherman Park is marked by six heavy reinforced concrete pillars or gate posts of ornamental design. Just inside the gate one comes to an attractive pebble-concrete arch bridge spanning a lagoon. The top of the bridge wall or guard rail is capped with concrete slabs made in sections.

The roadway is covered with asphaltum. There are two of these bridges set in the foliage of this park. No one could cross them without remarking instantly upon their beauty. In Lincoln Park the commissioners have erected a large concrete bridge with rough balustrades and have ornamented the bridge and park with concrete lamp posts set on the curb line.

A concrete breakwater with railing distinguishes Jackson Park, the old World's Fair ground on Lake Michigan, in the use of a permanent material. The entire body of the breakwater, which also acts as an inlet to a chain of inner lakes, as well as the heavy, short pillars and double bar railing, are of reinforced concrete. Also in Jackson Park the golf course is specked with small fountains of running water cast in concrete. These fountains are 2' 6" in height and are reinforced about the basin and pedestal and surrounded at the base by a wide platform of concrete pavement. The interior of the basin has been finished with a coating of cement, but no terra cotta is used to line these small fountains.

The use of concrete in the park has been found to be particularly advantageous because of the dampness about heavy clusters of foliage where buildings are often erected. For this reason, if for no other, the widespread use of the material is rapidly increasing. The natural result will be that as the years come and go all the frame construction which rots away will be replaced by permanent concrete structures upon which time and damp have no effect. At least, this is the established sequence in Chicago. In a number of instances, moreover, the commissioners have had the foresight to eliminate the possibility of rot and decay by the original use of cement and crushed stone. Thus they have not only done away with the cost of flimsy and temporary construction, but they have built for all time. They have not only built substantially they have built artistically and beautifully.

Figs. 12, 13 and 14, Top to Bottom—Views in Fuller Park, Chicago

The Field House or Recreation Building of Reinforced Concrete Throughout Is Shown at the Top, Fig. 12. The Inner Surfaces of the Concrete Walls Were Given No Supplemental Treatment Whatever. This Is One of Nine Such Buildings in Chicago Parks

The Inner Court of Field House, Fig. 13—Fountain, Benches, Pillars and Building of Concrete—Shown in the Center Picture

The Picture at the Bottom, Fig. 14, Is of the Swimming Pool of Concrete

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In a recent paper on concrete bridge design, Daniel B. Luten, Indianapolis, Ind., states that the ideal highway bridge must include among its qualifications the following:

1. Permanence, eliminating repairs.
2. Artistic appearance to harmonize with its surroundings.
3. Strength increasing with time and traffic.
4. Safety, meaning not merely security, but slow failure in case of defects.
5. Stable on insufficient foundations and under extreme flood conditions.
6. Effective waterway providing maximum discharge.
7. Efficient and economical in use of materials.
8. Employing home labor and materials.
9. Providing a roadway continuous over bridge and approaches.
10. Easily widened to provide for increasing traffic.
11. Easily modified in design to conform to improvement in surroundings.
12. Simplicity in design and erection.

It is evident that reinforced concrete as a bridge material fully meets every requirement. Its present almost universal use is proof of its wonderful efficiency as a bridge material.

The Cement Products Exhibition Co. announces that space will be set aside at the Pittsburgh and the Chicago Show for the exhibition of interesting articles made of concrete. Everybody is invited to offer for display, free of cost, any interesting thing of concrete which he has made or can secure for exhibition purposes. To each such object the management of the shows will attach cards, giving information as to the maker and so on.

Some Concrete Roads in New York State.

The New York State Commission of Highways, which, according to a report which it made to CONCRETE-CEMENT AGE, contracted this year for about 200 miles of concrete roads, has more than 50 miles under construction in the Highway Department division of which Rochester is the headquarters. The work under way this year in this division is as follows:

From Olcott to Wright's Corners in Niagara county, 8 miles; concrete 16′ wide with 3-ft. shoulders at either side. The concrete is put down 5″ thick in a 1:6 mixture of cement and gravel.

On Grand Island, Erie county,* 4.67 miles.

Barre Center to West Barre in Orleans county, 4 miles, 14′ wide for all but 700′ of the distance which is 16′ wide, 5″ thick.

*See September issue.

Sea Breeze to Nine-Mile Point in Monroe county, 6 miles, 14′ wide and 5″ thick, concrete all laid.

Java to Wales in Wyoming and in Erie county, 3½ miles, 14′ wide for most of the distance, with 16′ of concrete where the road extends through a village, 6″ thick.

Geneseo to Piffard, Livingston county, 2 miles, 14′ wide, 6″ thick, under construction.

Avon, Livingston county, 1 mile, in various widths from 16′ to 30′, 5″ thick.

North Conesus to Websters, Livingston county, 8 miles, 14′ and 16′ wide, 6″ thick, which is being graded.

Otto to Cattaraugus, Cattaraugus county, 2 miles, 12′ wide, 6″ thick.

Otto to East Otto, Cattaraugus county, 4 miles, 12′ wide, 6″ thick.

Rutledge to Leon, Cattaraugus county, 3½ miles, 14′ wide, 5″ thick, under construction.

Randolph to Rutledge, Cattaraugus county, 3½ miles, 14′ wide, 5″ thick.

Poland Center to Waterboro, Chautauqua county, 4 miles, 16′ wide, 6″ thick, under construction.

The information sent to CONCRETE-CEMENT AGE in response to a request of the New York State Commission of Highways for details for the September issue on this concrete highway construction, was to the effect that expansion joints were being used every 30′. It now appears, in the Rochester division at least, that expansion joints are not called for in the specifications and that the pavement is being put down in a continuous stretch. It has been found impossible to follow up the concrete work with the bituminous surface work as soon as might be desired, and it may be that the concrete roads will stay without any surface covering for a time, at least. On such roads as have already been treated with the two applications called for in the specifications (one a ¼-gal. per sq. yd. application of tar with ¼″ screenings, and the other a ¼-gal. per sq. yd. of heavy asphaltic oil with another ¼″ of screenings), it has been found that the two applications do not seem to work well together, and it may be that one or two courses will be followed in avoiding the difficulty; either the road will be left with the first tar application and the screenings, or some other oil preparation will be used which will give more satisfaction in combination with the tar than the one now being used.

These roads are costing $9,000 to $12,000 per mile on the 16-ft. wide basis, depending upon the sub-grade work. The cost is approximately 68c per sq. yd. for concrete foundation (6″ thick), 22c per sq. yd. for limestone screenings (½″ thick) and 4c per sq. yd. for oil, a total of 94c per sq. yd., exclusive of sub-grade.

Supervisors of Jackson county, Mich., have appropriated $74,585 for good roads. The money will be used in constructing about 25 miles of highway and the work will be started this fall.

FIGS. 15, 16 AND 17—TOP TO BOTTOM—VIEWS IN SHERMAN PARK
At the Top, Fig. 15, Are Shown the Concrete Posts at Park Entrance
In the Center, Fig. 16, and at the Bottom, Fig. 17, Are Views of a Pebble Concrete Bridge

A Concrete Stadium for a Public School Athletic Field

Concrete is Rapidly Becoming the Standard Material for Grand Stand Construction

BY HAROLD L. ALT.*

On its largest athletic field in Brooklyn, N. Y., the New York Board of Education is erecting a reinforced concrete grandstand for the observation of athletic events on school field days. It is so arranged that each school has there its own allotted day. The design and construction of this stand present many features of more than unusual interest. The construction work is being carried on by the Concord Construction Co., New York City, which has the contract for the concrete work on the stadium, and by the Joseph Balaban Co., also of New York, which has the contract for finishing up and equipping the building, laying the pavements and erecting the surrounding fencing.

Design Features

The design was developed by C. B. J. Snyder, who has charge of all the school building architectural and construction work in Greater New York, and shows the result of much special planning and serious thought. The first point of interest, and a radical departure from the customary lines for a structure of this character, is the concaving of the side of the stadium towards the track (as is plainly indicated in the general location plan, Fig. 1), so as to render the whole width of track and thus the entire number of contestants visible to those seated in the front and forward rows of the grandstand at their approach and after their passage.

Depressed Standing Area—The second marked innovation is an arrangement for preventing the contestants' friends, coaches, rooters and various hangers-on (who always congregate along the fence on the outside of a track), from obstructing the vision of everyone back of them in the stand on account of the standing position they assume. This is accomplished, as may be plainly seen in Fig. 2, which is a typical cross-section of the stand, by dropping the level between the track and the stand a distance of 4′ 6″, thus bringing the heads and shoulders only of the standees above the track level, and thereby permitting a practically unobstructed view of the entire width of track by all the spectators in the stand.

This seems to be a very ingenious arrangement for securing an unobstructed vision for those in the forward rows, thus making it unnecessary for them to stand up in order to view either the approach or the passage of the contestants. It it is a well-known fact and a common grandstand experience to have a few in the front rows rise to see something, and thus force those behind to rise also, and so operating backward until everyone in the rear is forced to stand in order to see anything at all. It is hoped

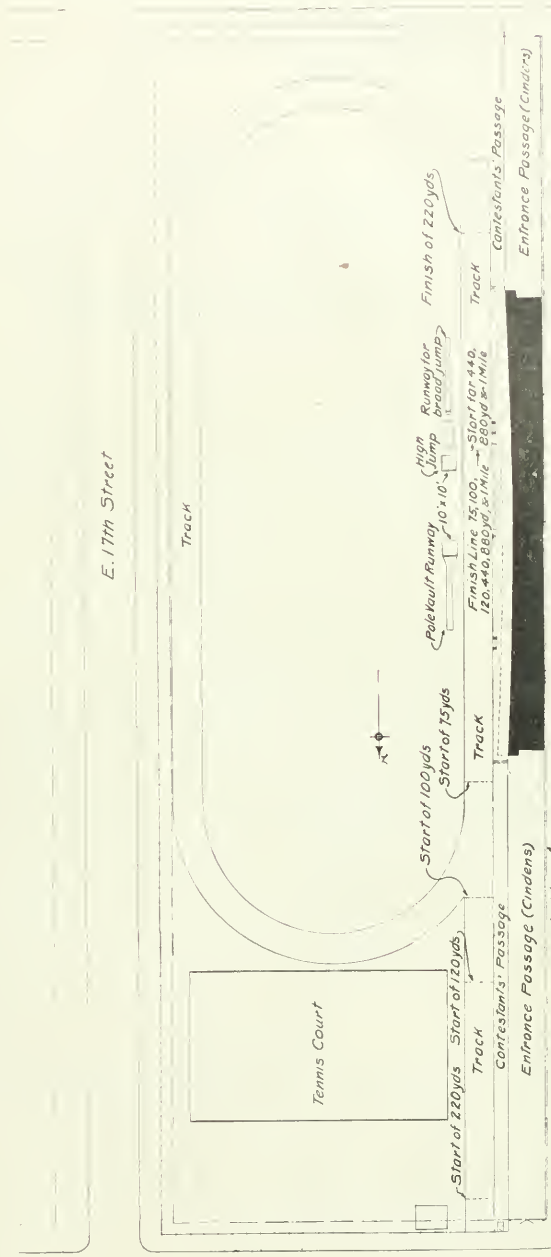


Fig. 1. Plan Showing General Lay-out of Public School Athletic Field and Grandstand, Brooklyn, N. Y.

*The Alton Engineering Co., New York City.

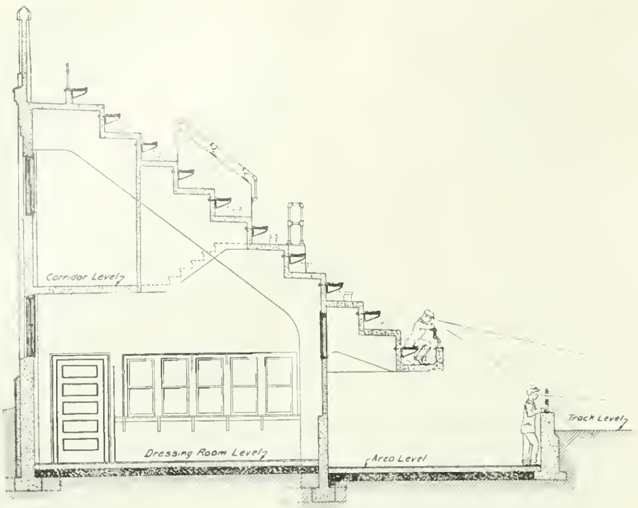


FIG. 2. TYPICAL SECTION OF GRANDSTAND, PUBLIC SCHOOL ATHLETIC FIELD

by thus giving an unobstructed view, and making the rising of the forward rows quite unnecessary, that this inconvenience will be abolished. The curvature of the front face was suggested by the observation stand used at the Olympic Games, but the dropping of the level between the stand and the track is distinctly an original idea of Mr Snyder's, being, it is believed, applied in this case for the first time.

Judges' Stand—The judges are located on 3 steps, one above the other, so that their angle of vision rises vertically from the finish line in each of the three individual cases. This should be a great help in close decisions, as in the old method they were forced to stand in line, one exactly opposite the finish line in a correct position, one on one side of him in an incorrect position *before* the finish line, and the other on the other side of him *behind* the finish line, resulting in each judge viewing the line from a different horizontal angle and giving rise to grounds for differing on decisions.

The track is enclosed on either side with concrete curbing into which brass markers are cast at starting and finish lines for distances of 120 yds., 220 yds., 440 yds., 880 yds. and one mile. The locations of these are shown in Fig. 1. The marks are located with absolute accuracy by surveyors.

The space below the stand is utilized for locker rooms, check room and toilet rooms and is so arranged that the check room separates the two sexes, their locker rooms and their toilets on days when co-educational pupils are present, but by means of the connecting passage the rooms may be joined and used in common by either sex on days when this is desirable. Fig. 3 shows a half-plan of the rooms below the stand, and Fig. 4 a half-plan of the seating arrangement and steps on the stand proper, while Figs. 5 and 6 show the typical half portions of the front and the rear elevation.

Construction Features

The main concrete element consists of the compound simple and cantilever beam shown with its reinforcement in Fig. 7. The iron post shown at the outer end of the cantilever is not intended to make a continuous beam out of this girder, but is placed there simply to make assurance doubly sure. There is probably no more uncontrollable assemblage in the world than several thousand school boys out for a holiday, and while the section of the cantilever is alone amply strong for all reasonably probable loads, there is no way of knowing just what the maximum load will be. Suppose, for instance, a favorite school boy trick is begun of stamping the feet in unison. How much of a blow would this give on the end of the cantilever? Therefore, the small iron posts were located under the overhang and will do much to prevent vibration from any such cause.

All walls of the building (except those of the boiler and the coal room), the partitions, piers, girders, floor or top of structure, stairs and gallery front are of reinforced concrete. The walls of the boiler and the coal room and the retaining wall in front of the stand are of monolithic construction and are not reinforced.

The partition separating the connecting passage from the checking room as indicated in Fig. 7 is not of concrete, but is formed of panels of No. 8 wire of 1½" mesh set in ⅞" channel frames with wrought iron pipe posts and flanged caps and bases secured with expansion bolts.

Centering—The lumber used for the forms was in general of ⅞" matched and planed stuff with stiffeners of 2"x3", 3"x4", 3"x6" and 3"x8" in size spaced 16", 18", 20" and 24" on centers, according to the various spans of slab. They are constructed of sound, mill-worked timber, driven tightly together to prevent leakage, and securely braced and supported to insure smooth faces and true lines on all work. It can be realized that great rigidity was required since the variation from the figured sizes shown on the plans was limited by the specifications to not greater than ⅛". To keep these forms in the proper position, wooden spreaders were used. These were removed as the concrete was placed and small concrete struts about 2"x2" in size and of a length exactly equal to the wall thickness were substituted. The concreting was then continued, casting the struts permanently into the wall

For cutting the larger timbers used in the formwork, and whenever the centering could be handled conveniently to the cutting table, a small circular saw driven by a 5 H. P. Fairbanks, Morse gasoline engine was used.

Surface Treatment of Forms—Various expedients were tried on the forms to produce a smooth finish on the surface of the concrete and to prevent sticking. Crude oil, soap and oiled paper all answered fairly well as far as

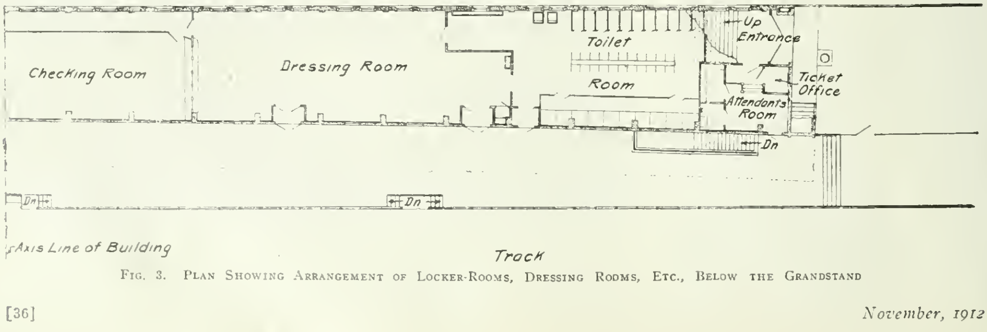


FIG. 3. PLAN SHOWING ARRANGEMENT OF LOCKER-ROOMS, DRESSING ROOMS, ETC., BELOW THE GRANDSTAND

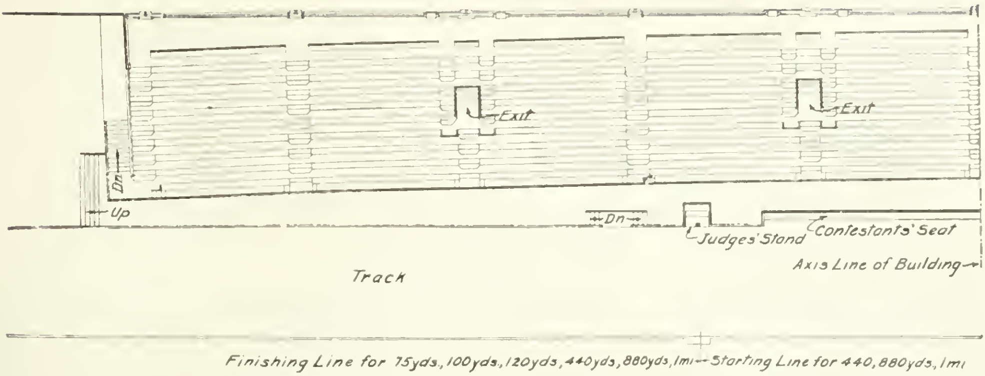


FIG. 1. PLAN SHOWING SEATING ARRANGEMENT OF THE GRANDSTAND, JUDGES' STAND, ETC.

the sticking was concerned, but did not do much toward covering the joint marks between the form boards. Covering the inner surface of the forms with galvanized sheet iron seemed to be the most satisfactory method of overcoming the board mark trouble, and after considerable experiment was finally adopted.

After the completion of the foundations the piers were carried up to the under side of the girders and allowed to stand for 24 hours before the curtain walls, girders and top of the grandstand were put in place. The girders were notched or halved together, and where curtain walls, panels and so forth were fitted into adjoining work, short rod iron dowels were used. These were thoroughly greased and were built into both sections of the concrete.

The casting of the skeleton and walls of each section extending from the foundations to the top of the walls was temporarily suspended at night, but for no period of greater duration, and when thus stopped the work was brought up and finished to a metal strip so as to leave a sharp, even and fine hair joint when the additional concrete was added. On resuming work after a suspension of any sort the surface of the previous work was roughened, cleaned, thoroughly wet and then flushed with a cement mortar compound of 1 part Portland cement and 2 parts sand, immediately after which the work was continued.

Each panel of the grandstand floor was built to lap with the next and was extended half way over each girder. Where rods were used as connection dowels between panels here, they were also greased, as before mentioned. The floor panels were cast in sections which

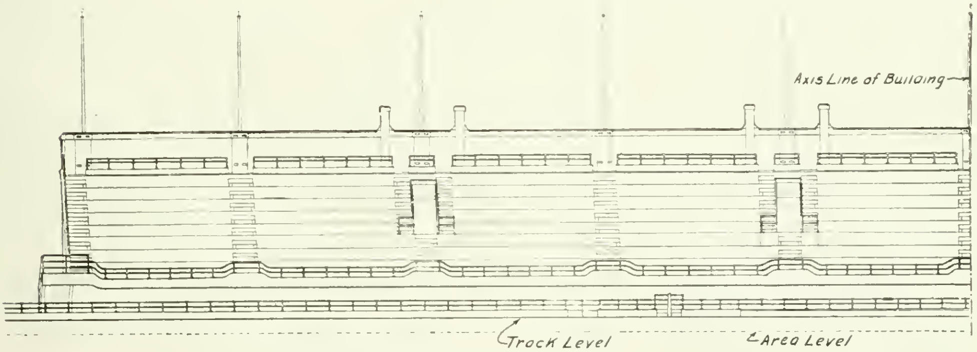


FIG. 5. FRONT ELEVATION OF THE GRANDSTAND.

FIG. 6. REAR ELEVATION OF THE GRANDSTAND.

covered the placing of panels extending from the front of the stand to the rear and sideways from expansion joint to expansion joint, and no cessation of work was permitted in any case while casting an individual panel extending from girder to girder The back columns and pilasters were built separately and the panels filled in later.

Two vertical expansion joints were formed the entire length of the building and ten in the floor slabs over the girders about 24 ft. apart. All of these were filled with mineral wax and oakum.

The concrete in all piers, walls (including the retaining wall in front of the building), the floor and roof slab construction, and the curbs around the running track is composed of 1 part Portland cement, 2 parts clean, sharp, medium coarse sand, and 4 parts of ¾" and ⅝" stone. The ¾" was used in the vertical walls, and the ⅝" in the grandstand floor. The stone used is trap rock, and the size given does not refer to the longest dimension but to the size of screen through which the stone will pass. The concrete used for curbs, trap pits, piers, etc., is composed of similar mixture, except that broken stone is used which passed over a ⅜" mesh screen and through a 1" mesh.

The pavements laid in the area in front of the grandstand as indicated on the plot plan (Fig. 1) consist of a 7" bed of clean steam cinders, 4" of broken stone concrete and 1" of top dressing, which is carefully troweled, roughened with a toothed wheel, laid off and scored. The concrete used for this portion of the work is a 1:2:5 broken stone mixture, the stone passing through a 1½" ring, while the top dressing is composed of a 1:1 mixture of Portland cement and sand.

The cement used throughout on the stand was Pennsylvania Portland, and was required to stand a tensile test of 200 lbs. per sq. in. without rupture after 24 hours' exposure in air when mixed neat. After 24 hours in air and 6 days in water the requirement was 500 lbs. It also had to show an increased strength at the end of 28 days over the 6-day test.

Concrete was mixed dry in a batch mixer until the dry materials were thoroughly and evenly mixed, after which water was added and the mixing continued until a batch was produced that was of uniform character and color and the mortar evenly distributed throughout the mass of stone This concrete was not allowed to stand, but was deposited as soon as mixed, and any ex-

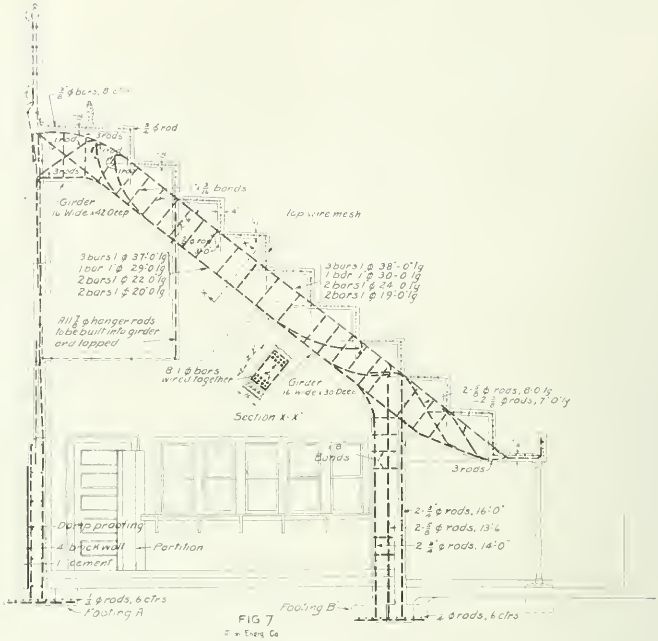


FIG. 7. TRANSVERSE SECTION SHOWING REINFORCED CONCRETE INCLINED GIRDER AND STRUTS

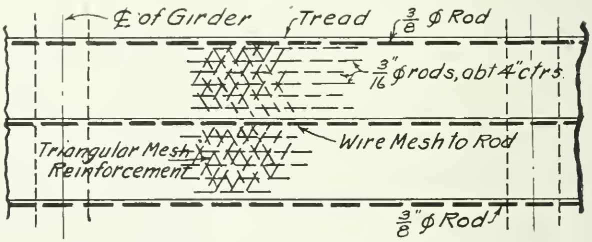


FIG. 9. DETAIL PLAN OF CONCRETE SLAB FOR RISERS AND SEATS

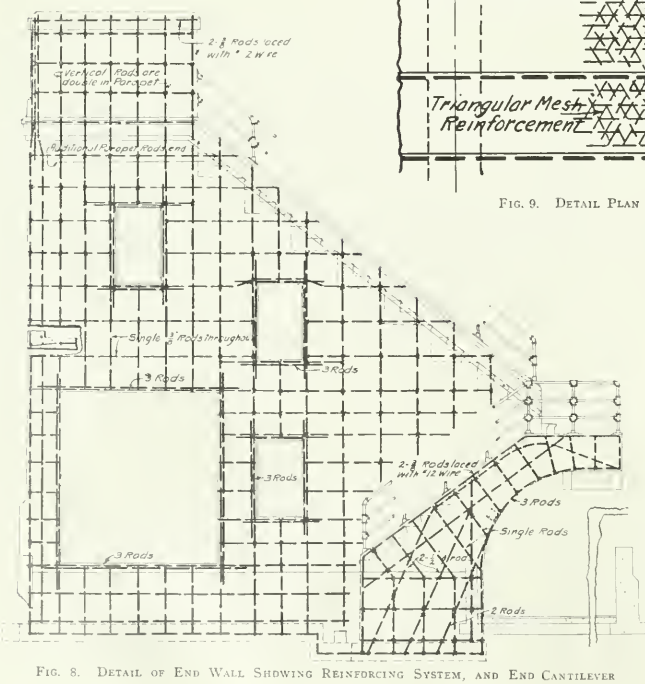


FIG. 8. DETAIL OF END WALL SHOWING REINFORCING SYSTEM, AND END CANTILEVER

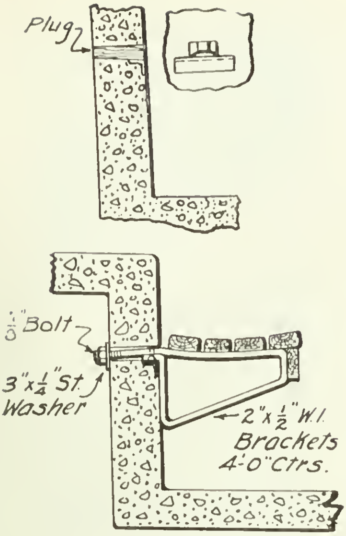


Fig. 10. Detail Showing Bracket for Seat and Method of Attaching

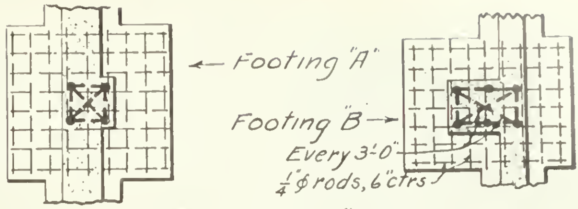


Fig. 11. Detail Plan of Footings

cess that was left over night or even for a period of two hours was not allowed to be re-tempered or re-used in any way.

Concrete was poured into the molds at just such a consistency that it would quake in the barrows but not thin enough to allow the stones to settle to the bottom. In the thicker walls it was puddled into place with a puddling bar. In the 4" walls, however, the settling of the concrete into place was accomplished by hammering the forms on either side, while the mixture was being placed.

For handling concrete, inclined runways were used, and the concrete wheeled up in barrows. The only hoist on the work was used in running the high columns and back wall of the grandstand. For this part of the work, the concrete was raised by means of a pail and a rope run through a single sheave. The sheave was hung on a timber swung across from the forms for one column to the forms for the next. The pail was raised and lowered by hand. A ½-yd. "Standard" mixer (The Standard Scale and Supply Co., Chicago) was used, driven by a 5 H. P. "Novo" gasoline engine (Novo Engine Co., Lansing), mounted on the same truck.

After placing the concrete, the top surfaces were protected from the sun by being covered and were well sprayed. Particular attention was given to this during the first 24 hours.

Reinforcement used on this work consisted of unpainted rods, free from rust and scale and of the sizes shown, and triangular wire mesh (American Steel and Wire Co.) for the stand floor. This wire is of 4" mesh with No. 6 longitudinal wires and No. 12½ diagonal or tension wires. An end elevation showing the reinforcement in one of the end walls is shown in Fig. 8 and a detail of the risers in the stand floor with the mesh reinforcement in Fig. 9.

The steel reinforcing rods were furnished by the Corrugated Bar Co., Buffalo.

All necessary smaller holes in the concrete for any purpose were formed by the use of tapered wood plugs, dipped in paraffine to make them easily removable and to prevent absorption of water and swelling of the plug. The railing supports consist of round bar anchors threaded and provided with nuts and lock nuts, which were cast into the concrete in places where required. A detail of the method of attaching the seats and the wooden plugs used to form the necessary openings is shown in Fig. 10. All holes for braces, seats, etc., were filled with a 1:2 mixture after the erection of the braces and seats. During this operation the surrounding surfaces were kept well wet. Fig. 11 is a detail of the typical column footings "A" and "B," which are shown in Fig. 7 with rods running in both directions.

The top dressing of the passage and entire grandstand floor, including the risers of the steps, is a 1 in. thickness of 1 part cement, 1 part sand, and 1 part grit, which was put down at the same time as the floor was laid, and floated true and smooth. As soon as the forms were removed and before the initial set the entire surface was troweled to a polish and the corners and edges slightly rounded.

Surface Finishes: The outside walls and piers, including those occurring within the grandstand seating enclosure, area walls, etc., were floated down with a wood float, the burrs and inequalities removed, and (after the window frames were pointed up) were given a heavy coat of white lead and Rockaway Beach sand.

The window frames were set in a good bed of roofer's cement, extending well under the sill and after setting were pointed all around with the same material.

The inside walls and ceilings were rubbed down with a wire brush ready to receive a paint finish. As shown in the cross-section (Fig. 7) damp-proofing is applied to the rear wall from the bottom up to some distance above the grade. As the wall which was waterproofed stood on the line of the property, and as encroachment on the other side was not permissible owing to the Long Island Railroad operating trains immediately past the rear of the stand, some difficulty was found in placing the waterproofing. It proved to be necessary to build the brick wall first, when a coat of tar was applied to the inner surface, after which felt was placed upon it and more tar applied. Then the concrete form for the inner face of the wall was placed on the inner side and the concrete placed

Fig. 12. General View of the Grandstand Under Construction

Fig. 13. Detail View of Column and Wall Forms

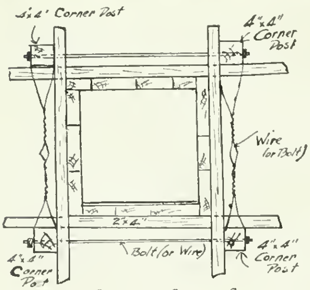


Fig. 14. Sectional Sketch Showing Forms Used

between to form the building walls. Great care was taken to prevent the brick wall from being forced out of position by the pressure of the mixture.

This 4 in. brick lining wall along the rear of the stand, as shown in Fig. 7, was plastered with 1" of Portland cement mortar, floated true and smooth, and is finished off at the top with a sloped concrete cap.

In Fig. 12 is shown a view of the front of the stand taken from the north end. This view is especially plain in showing the way the brick wall was run along the embankment supporting the railroad in the rear, and how the concrete back wall followed next after the brick was waterproofed. Then farther toward the left is shown the erection of the forms for the cross girders and still farther toward the left, the completed cast girders. It is interesting to see in the extreme right of the picture and upon the railroad embankment concrete utilized for fence posts, the fence being constructed of black iron pipe railing as shown.

Column and Girder Centering.—The centering used for the large columns is shown in Fig. 13 A. Note that in this column centering, the bolts or wires are not attached directly to the end of the yokes. Four vertical 4x4's are used, one at each corner, and the horizontal yokes, or rather stringers, short pieces of 2-in. timber (usually 2"x4") are held in place by these. The accompanying sketch (Fig. 14) makes this detail plain.

B of Fig. 13 is taken looking toward the back of the stand and shows a section of the curtain wall between the columns with the forms still in position. This indicates how these sections were braced and the method of form construction pursued for the larger wall areas.

These views make plain the statement that the columns were cast individually, and all curtain walls and grandstand floors later.

The different stages in the construction of the main inclined girder are shown in Fig. 15.

A shows the reinforcing for one of the inclined girders in position ready for casting the girder, but with the form on the side toward the observer removed. The rods projecting above the grandstand floor along the rear line of columns are also plainly indicated. These rear columns will be continued up after the completion of the flooring.

The view in *B* (Fig. 16) is taken from the bottom of the stand looking up toward the top at a portion where the flooring has been placed, but the forms not yet removed. The forms for the risers and steps are plainly discernible upon close inspection. *C* is taken a little farther along the stand where the forms shown in photograph *B* have been removed, leaving the concrete bare for

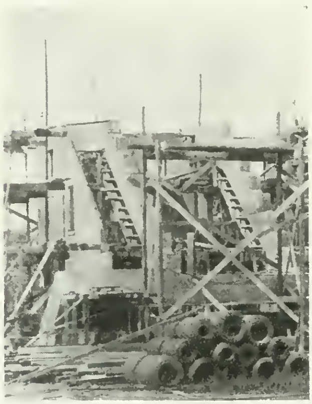


Fig. 16. Detail View Showing the End of the Grandstand Under Construction
This shows the end wall and cantilever steps detailed in Fig. 8

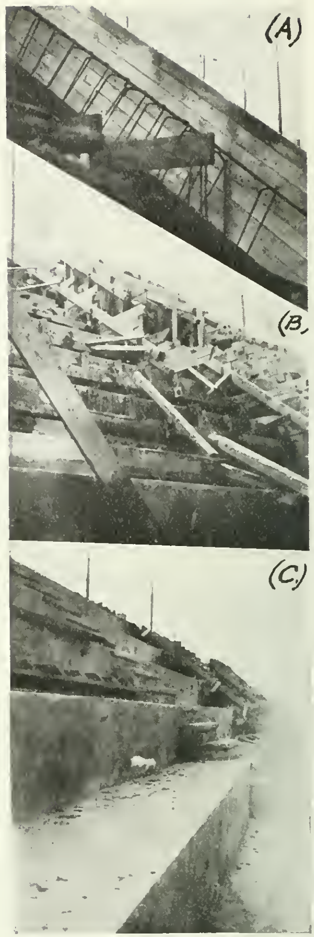


Fig. 15. Detail Views Showing Progressive Steps in the Construction of the Inclined Girder

good idea of what the appearance of the inspection. This picture gives a very floor, seat risers and steps will finally be.

It is of interest to note here the manner in which the inclined girders were centered. The photographs show the use of 2 heavy stringers, or carrying horses, placed on edge somewhat further apart than the width of the girder. Across these are placed short pieces of 2-in. lumber which carry the bottom boards of the girder. The vertical cleats holding the side boards in place are carried down and inside the 2 stringers first placed.

The running track is enclosed between concrete curbs and is composed of a filling 9" thick at the outer edge and 12" at the inner, placed on a well-tamped bed of earth. This filling is composed of 2-in. screen broken stone running from 3" to 6" thick, covered with 3" of

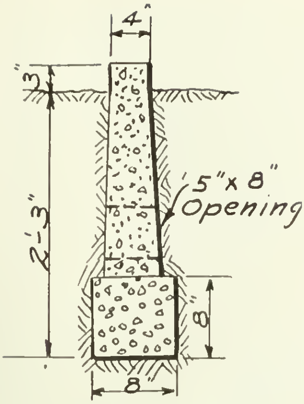


FIG. 17. CROSS-SECTION OF CONCRETE CURBING AROUND RUNNING TRACK

clean steam cinders, which were thoroughly rolled and then covered with 3" of clean ¼" screen cinders mixed with clay in the proportion of 2 of cinders to 3 of clay. The entire filling was then rolled with a steam roller to a firm and even surface, after which it was well sprinkled. A cross-section showing the concrete curbing that is run around both sides of the track is shown in Fig. 17.

Production of lime in the United States for the year 1911 showed a decrease from 1910, according to a report of the Geological Survey, by Ernest F. Burchard. The 1911 figures were 3,392,915 short tons, valued at $13,689,054, as against 3,505,954 short tons, valued at $14,088,039 in 1910. The decrease in quantity is 113,039 tons, and in value $398,985. The average price per ton in 1911 was $4.03, an increase of 1c per ton over the 1910 price. The total number of producers reported in 1911 was 1,089, a decrease of 38 from the figures given for 1910.

Pennsylvania, Ohio, Wisconsin, West Virginia and Missouri were the five leading lime-producing states in 1911, in the order named.

Hydrated lime produced in 1911 amounted to 304,593 short tons, valued at $1,372,057, with an average price of $4.50 per ton, as compared with 320,819 short tons, valued at $1,288,789, an average price of $4.02 per ton in 1910.

The Survey reports lime as one of the country's practically inexhaustible natural resources. Available limestone rock deposited in the United States cannot be estimated even in millions or billions of tons.

A little more than half the lime manufactured in the United States is used as structural material in lime mortars, Portland cement mortar, concrete, gypsum plaster and whitewash. Very large quantities find a use in the manufacture of chemicals, for filtering and clarifying, in the milling and paper industry, in sanitation, in smelting and tinning and in the manufacture of beet sugar.

Concrete Highways in California

Contracts were let August 27, by the California State Engineering Advisory Board, for 56 miles of concrete roads in Madera, Merced, Fresno, Stanislaus and San Diego counties for a total of $277,206.*

Alternative bids were received on three different surface treatments, which are described by paragraphs from the specifications published below. A mastic surface was considered ⅜" thick, a bituminous gravel surface ¼" thick, and an asphaltic oil surface.

The asphaltic oil surface, cheapest of the three, has been adopted for the roads mentioned.

The figures of the successful bidders on the various parts of the work are given below. In this connection, the low price is more apparent than real because the State furnished the cement at the nearest railroad siding. The State Highway Department has arranged further, for the benefit of the contractors, in order to get good highways as cheaply as possible, for special freight rates of ½ cent per ton per mile for all concrete material and equipment and ¾ cent per ton per mile for oil for surfacing. The Warswick Street Paving Co., Fresno, Calif., successful bidder for most of the work, owns gravel pits. Water for practically all the work has to be taken from wells, bored along the route, and pumped to the places of operation.

Items in the Madera county (Madera City to Fresno county line) lowest bid (by the Warswick company), are as follows:

9.9 miles grading and shaping, @	$900.00
90 lin. ft. 12" cor. pipe, @	1.25
30 lin. ft. 18" cor. pipe, @	1.50
7 cu. yds. class "B" concrete, @	8.00
9,720 cu. yds. class "B" pavement, @	3.35
87,500 sq. yds. "mastic," @	.26
50 monuments, haul and set, @	2.00
Alternatives.	
520 bbls. asphaltic oil, @	$2.10
720 tons screenings, @	1.95
580 cu. yds. coarse sand, @	2.20
87,500 sq. yds. bituminous gravel, @	.42
Totals on Concrete Base.	
Mastic surface	$64,535.50
Oil surface	*45,557.50
Bituminous surface	78,535.50

Items in the Stanislaus county (between Merced county line and 1½ miles north of Ceras) lowest bid (Warswick company), are as follows:

11.07 miles grading and shaping, @	$1,100.00
10830 cu. yds. class "B" pavement, @	3.80
97,450 sq. yds. "Mastic," @	.30
72 monuments, hauling and setting, @	2.00
Alternatives.	
580 bbls. asphaltic oil, @	$2.20
800 tons screenings, @	1.95
650 cu. yds. coarse sand, @	2.25
Totals on Concrete Base.	
Mastic surface	$82,710.00
Oil surface	*57,773.50

Items in the San Diego county (San Diego to Eucinitas) lowest bid (M. L. Curtis & Co., So. Pasadena), are as follows:

8.6 miles grading and shaping, @	$675.00
134 lin. ft. 12" cor. pipe, @	1.60
76 lin. ft. 18" cor. pipe, @	2.10
186 lin. ft. 24" cor. pipe, @	2.70
6 cu. yds. class "B" concrete, @	10.00
15 cu. yds. class "A" concrete, @	12.00
8,250 cu. yds. class "B" pavement, @	4.30
66,753 sq. yds. "Mastic," @	†0.039
2,720 lin. ft. guard rail, @	.55
214 monuments, hauling and setting, @	1.00
Alternatives.	
450 bbls. asphaltic oil, @	$5.00
600 tons screenings, @	2.85
500 cu. yds. coarse sand, @	2.75
Totals on Concrete Base.	
Mastic surface	$70,133.47
Oil surface	*49,434.80

Items in the Merced county (Stanislaus county line to Arena) bid (Warswick company), are as folows:

9.6 miles grading and shaping, @	$1,100.00
494 lin. ft. 12" cor. pipe, @	1.25
14 cu. yds. class "B" concrete, @	8.00
9,400 cu. yds. class "B" pavement @	3.75
84,570 sq. yds. "Mastic," @	.26
70 monuments, hauling and setting, @	2.00
Alternatives.	
550 bbls. asphaltic oil, @	$2.15
700 tons screenings, @	1.85
565 cu. yds. coarse sand, @	2.10
Totals on Concrete Base.	
Mastic surface	$68,667.70
Oil surface	*50,343.50

Items in the Fresno county (City of Fresno to Madera county line) bid (Warswick company), are as follows:

9.6 miles grading and shaping, @	$900.00
52 lin. ft. 24" cor. pipe, @	1.75
4.5 cu. yds. class "B" concrete, @	8.00
9,348 cu. yds. class "B" pavement, @	3.20
84,130 sq. yds. "Mastic," @	.26
44 monuments, hauling and setting, @	2.00
Alternatives.	
500 bbls. asphaltic oil, @	$2.00
700 tons screenings, @	2.00
550 cu. yds. coarse sand, @	2.00
Totals on Concrete Base.	
Mastic surface	$60,642.40
Oil surface	*42,268.60

Items in the Madera county (Califa to Merced county line) bid (Warswick company), are as follows:

6.8 miles grading and shaping, @	$900.00
234 lin. ft. 12" cor. pipe, @	1.25
52 lin. ft. 18" cor. pipe, @	1.50
11 cu. yds. class "B" concrete, @	8.00
6,670 cu. yds. class "B" pavement, @	3.40

*This proposed work was briefly mentioned in the September issue, p. 76.

*Contract price.

†This figure, it would seem, should be 0.39 instead of 0.039.

60,020 sq. yds. "Mastic," @..... .26
44 monuments, hauling and setting, @........................ 3.00
Alternatives.
360 bbls. asphaltic oil, @..........$2.10
490 tons screenings, @............ 1.90
400 cu. yds. coarse sand, @....... 2.00
Totals on Concrete Base.
Mastic surface $44,949.70
Oil surface *31,831.50

Some essential features of the specifications for the 56 miles of road and for the alternative surface treatments, not adopted thus far owing to cost considerations, are as follows:

Concrete Foundation—(a) Upon the sub-grade as hereinbefore specified, and while it is thoroughly damp and firm, there shall be laid a concrete foundation of the thickness, width and form shown on the typical cross-section, composed of Class "B" Portland cement concrete, mixed and placed as specified under the heading "Concrete."

(b) The upper surface of the foundation shall be finished parallel to and ⅜" below the grade of the finished pavement by thorough hand-tamping until the mortar flushes freely to the surface. Before the surface has set, it shall be slightly roughened with short-tined rakes, brooms or other appliances, and no asphaltic material shall be placed thereon until the foundation is satisfactory in all respects to the engineer.

(c) The contractor shall supply crown grade templets for use as directed by the engineer.

(d) The concrete foundation shall be protected from direct rays of the sun after being placed and shall be so protected and kept wet for a period of at least 6 days. The concrete shall also be protected against traffic until thoroughly set, after which sufficient time shall be allowed for the concrete to become thoroughly dried out before receiving the wearing surface.

(e) The fine aggregate shall consist of an approved material of siliceous granitic or igneous origin, hard, durable and free from mica in excess of 5% by weight. It shall be free from oil or organic matter, and must not contain more than 6% by weight of clay, silt and other material passing a No. 100 standard sieve. It shall all pass a No. 4 standard sieve, and at least 50%, but not more than 85% by weight, shall be retained on a No. 30 standard sieve.

(f) The coarse aggregate shall be sound gravel or broken stone, having a specific gravity of not less than 2.6, which shall be clean and free from all foreign matter, uniformly graded, and shall range in size from ¼" up to 1½" for Class "A" concrete, and from ¾" up to 2½" for other classes of concrete.

(g) The water used in mixing the concrete shall be clean, free from oil, acid, alkalies or vegetable matter.

(h) Class A concrete shall consist of 1 cu. ft. (94 lbs.) of Portland cement, 2 cu. ft. of fine aggregate and 4 cu. ft. of coarse aggregate.

(i) Class B concrete shall consist of 1 cu. ft. (94 lbs.) of Portland cement, 2½ cu. ft. of fine aggregate, and 5 cu. ft. of coarse aggregate.

(j) Class C concrete shall consist of 1 cu. ft. (94 lbs.) of Portland cement, 3 cu. ft. of fine aggregate, 6 cu. ft. of coarse aggregate.

(k) The ingredients of the concrete shall be thoroughly mixed, sufficient water being added to obtain the desired consistency, and the mixing continued until the materials are uniformly distributed, and each particle of fine aggregate is thoroughly coated with cement, and each particle of coarse aggregate is thoroughly coated with mortar.

(l) When a mechanical mixer is used, the materials must be proportioned dry in separately measured batches, and all deposited at the same time. The mixer must produce a concrete of uniform consistency and color, with the stones thoroughly mixed with the water, sand and cement.

(m) Sufficient water shall be added during the process of mixing to produce a wet, plastic mixture which will flush readily under light tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar. The quantity of water used shall be modified as directed by the engineer, to meet the conditions of the work being placed.

Mastic Wearing Surface—(a) When the concrete foundation is thoroughly dry, it shall be cleaned to the engineer's satisfaction, and a paint coat, consisting of "D" grade asphalt cut with benzine or other solvent aceptable to the engineer, shall be applied by means of brushes to its entire surface.

(b) Upon the foundation thus prepared there shall be laid a mastic wearing surface composed of asphaltic cement and filler. The asphaltic cement shall be between 40% and 60% by weight of the entire mass, but this percentage shall be varied as the engineer shall direct. The mixing shall be done in a machine approved by the engineer, the asphaltic cement being heated to a temperature of 325° F. and the filler then added, and the whole stirred and cooked to the satisfaction of the engineer. A temperature of 250° F. shall be maintained during the operation of mixing and cooking, which operation shall be continued for such time as the engineer shall direct, but at no stage shall the temperature of the asphaltic cement or of the mixture be permitted to rise above 350° F.

(c) The mastic surface mixture prepared as above, when placed upon the concrete foundation, shall be at such temperature that it will flow readily. It shall be spread uniformly over the entire concrete surface.

(d) The mastic material shall be spread as the engineer shall direct, to a depth of ⅜" and so that 1 cu. yd. of the mastic shall not cover more than 100 sq. yds. of the pavement. The receptacles and appliances used by the contractor for the purpose of spreading said material shall be satisfactory to the engineer.

(e) After the mastic has been brought to an even surface, and before it shall have cooled, if ordered by the engineer, it shall be rolled with a hot hand roller weighing not less than 250 lbs. per foot width of tire. Any inequalities of surface which may develop during the rolling shall be immediately worked out and corrected. The resulting pavement shall show an even surface, true to grade and cross-section.

(f) The finished mastic surface shall be covered with a thin layer of clean, coarse sand, and the pavement maintained for a period of not less than 15 days after acceptance, and wherever the mastic surface softens so as to be picked up by wheels of vehicles passing over it, additional sand as above specified shall be spread in a thin layer over it, as directed by the engineer, without additional compensation.

Bituminous Gravel Wearing Surface—(To be used in lieu of mastic wearing surface, if at any time in the progress of the work the Commission shall so elect.)

(a) When the concrete foundation is thoroughly dry it shall be cleaned to the engineer's satisfaction and asphaltic cement, as hereinafter specified, shall be uniformly spread over its entire surface to a depth of ¼". The asphaltic cement shall be of such consistency when applied that it will not flow from the concrete base, and it shall be brought true to section and to depth by hot iron templets dragged over its surface, the templets being fitted with lugs on the under side, ¼" deep.

(b) The asphaltic cement must be prepared from California products. It shall be a mixture of a refined liquid asphalt with a refined solid asphalt, or be an oil asphalt, and must be free from admixture with any residues obtained by the artificial distillation of coal, coal tar or paraffine oil.

(h) Upon the asphaltic cement spread as hereinbefore described, and before it shall have become cold, there shall be spread to a uniform depth of 1" an aggregate of hard gravel or hard crushed stone of such size that it will all pass a No. 2 sieve and from 40% to 60% will be retained on a No. 4 sieve.

(i) The aggregate shall be heated in a rotary drier to a temperature of not over 500° F. and spread immediately thereafter. No aggregate shall be spread when its temperature is below 300° F.

(j) After the asphaltic cement has penetrated the aggregate so that it shall be visible from the surface, the whole mass shall be rolled to the satisfaction of the engineer with a roller weighing not less than 10 tons.

Asphaltic Oil Wearing Surface—(To be used in lieu of the mastic wearing surface if at any time in the progress of the work the Commission shall so elect.)

(a) When the concrete foundation is thoroughly dry, it shall be cleaned to the engineer's satisfaction and its entire surface area coated with heavy asphaltic oil of the quality hereinafter specified. The oil shall be applied under pressure by means of approved spraying machines, at the rate of from ¼ gal. to ½ gal. per sq. yd. of pavement, in the discretion of the engineer.

(b) Immediately after the oil has been applied, it shall be covered with a thin layer of broken stone screenings, in quantity sufficient to absorb the oil and prevent its adhesion to the wheels of vehicles passing over it, and wherever free oil shows through the surface dressing additional screenings shall be applied to absorb it, the roadway to be so maintained until 15 days after acceptance.

(c) The completed pavement shall present a true and even surface and a uniform bituminized appearance.

(d) In applying the oil, no gravity machine shall be used except by permission of the engineer.

Sand and Broken Stone Screenings for Wearing Course—(a) Sand for the mastic wearing course shall be sharp, clean and coarse, and free from dirt, clay, loam and all adventitious matter, and otherwise satisfactory to the engineer.

(b) Broken stone screenings shall be that portion of crusher run that passes through a circular screen opening ½" in diameter and is retained upon a screen having meshes ⅛" in diameter.

*Contract price.

Hennepin Co., Minn., "Tries" Concrete Roads.

The decision of Hennepin County, Minn., officials, after seeing the concrete highways in Wayne County, Mich., and elsewhere, to "try" one mile of concrete on Superior boulevard, makes the work now being done of considerable interest because it is on an important drive out of Minneapolis. Portions of the specifications, which follow rather closely those in use in Wayne County, except that the mixture of concrete is a trifle less rich, are published here:

Fine Aggregate.—Fine aggregate shall consist of clean, coarse sand, well graded from fine to coarse, all of which will pass when dry a screen having ¼-in. diameter holes. Sand shall be free from loam and vegetable or other deleterious material, and not more than 5% shall pass a sieve having 100 meshes per lin. in.

Coarse Aggregate.—Coarse aggregate shall consist of clean, hard, durable screened gravel, graded in size from material retained on a screen having ¼-in. diameter holes to that passing in its largest dimensions a 1½-in. ring.

Measuring.—The method of measuring the materials for the concrete, including water, shall be one which will insure separate, uniform proportions at all times. A sack of Portland cement (94 lbs. net) shall be considered 1 cubic foot.

Mixing.—The ingredients of the concrete shall be mixed to the desired consistency in a concrete batch mixer of an improved type and the mixing shall continue until the cement is uniformly distributed and the concrete is uniform in color and homogeneous.

Retempering.—Retempering, that is remixing with additional water, concrete that is partially hardened will not be permitted.

Proportions.—The concrete shall be mixed in a proportion of 1 sack of Portland cement, 2 cu. ft. of fine aggregate, and 3 cu. ft. of coarse aggregate.

Consistency.—The material shall be mixed wet enough to produce a concrete of a consistency that will flush readily under light tamping.

Depositing Concrete.—Upon the properly rolled and drained sub-grade shall be deposited 7″ of the hereinbefore specified concrete. The concrete shall be deposited in strips extending across the full width of the area paved and shall be deposited as soon after mixing as is practical, but in no case shall more than 30 minutes elapse between the mixing and depositing of the concrete.

Expansion Joints.—Three-eighths in. joints shall be placed across the roadway at intervals of 25′, perpendicular to the center line. All expansion joints shall extend through the entire thickness of the pavement. The expansion joints shall be filled with a suitable elastic, waterproof compound that will not become soft and run out in warm weather or hard and brittle and chip out in cold weather. The concrete at expansion joints shall be protected with metal. The type of metal plate used shall be that known as Baker's plates or some design equally as satisfactory to the county surveyor.

Finishing.—After the concrete has been brought to the required grade by means of a suitable template, the surface shall be worked with a wood float in such a manner as thoroughly to compact it and to produce a smooth, plain surface. Before the concrete surface is thoroughly hardened, it shall be slightly roughened by brushing with a stiff vegetable fiber brush or broom. On grades of over 5 per cent the surface shall be corrugated if directed by the engineer.

Protection.—After finishing, the surface shall be kept well sprinkled with water, and as soon as the concrete has hardened sufficiently, the surface of the pavement shall be covered with a thin layer of ordinary dirt, which shall be kept wet for at least 5 days by sprinkling with water. Under the most favorable conditions for hardening, in hot, dry weather, the pavement shall be protected from traffic for at least 7 days, and in cool, damp weather, for an additional length of time to be determined by the engineer.

Gravel Shoulders.—After the concrete has set and the earth blanket has been removed, the garvel shoulders shall be constructed of a clean, well-graded gravel, ranging in size from coarse material, 1″ in its largest dimension, to fine material, not less than ¼″ in its small dimension. The gravel shall be thoroughly tamped in place with suitable hand tamps and shall then be covered with a 1-in. layer of sand and clay mixed in equal proportions and again thoroughly tamped, all to the satisfaction of and according to the plans filed with the county surveyor.

High-Cost Paving in Detroit.

As stated in the September issue, concrete paving in Detroit is expensive, with no apparent good reason. Cement and aggregate are cheaper in Detroit than in many places where concrete pavements have been put down for about half the cost. Portions of the specifications for reinforced concrete pavements adopted in Detroit last winter are as follows:

Foundation.—When the roadbed has been prepared, it shall be covered with a layer of concrete not less than 5″ in thickness, immediately applied to the roadbed and rammed until the surplus cement mortar appears upon the surface, which latter shall be made smooth and parallel to the roadbed and in exact accordance with the diagram. No teaming will be allowed on the concrete until it is thoroughly set and covered with plank. All defects in this foundation, no matter from what cause, must be repaired or corrected before the work will be allowed to progress. Concrete shall consist of 1 part Portland cement, 3 parts sand and 6 parts stone, slag or trap rock.

Sand.—Whenever sand is specified, it shall be clean, sharp, bank, lake or river sand, free from clay, loam or vegetable matter.

Stone.—Stone for concrete may be of crushed or broken boulders, granite, trap rock, syenite, slag, or hard limestone; pieces not to be larger than 2″ nor smaller than ½″ in any dimension. The broken or crushed stone or slag is to be clean, and must be screened if necessary to free it from dirt or stone refuse, and shall be wetted before being placed on mixing boards.

Mixing.—The sand and cement shall be thoroughly mixed while dry to a uniform color and then just enough water shall be added during the mixing process to make a good mortar.

After being wet with clean water, the crushed or broken stone shall be thoroughly mixed on boards with the cement mortar until every piece of stone is completely enveloped in mortar. The proportions shall be fixed by actual measurement, if so ordered by the Department of Public Works.

Reinforcement.—The reinforcement in the mass of the concrete is to be placed in the following manner: The ⅜″ round steel bars to be placed longitudinally and crossways 2′ center to center and 1½″ from the top surface of the finished concrete. The ¼-in. round steel bars to be placed longitudinally and crossways 4′ center to center and 5″ from the top surface of the finished concrete, and both systems of bars to be well clamped together at their intersections. The two reinforcements to be properly supported in their respective places before any concrete is laid, and in proper lengths and widths so as to be embedded in concrete panels 30′ long by the whole width of the road. The top and bottom bars to be held firmly at intervals of 4′ by an upright steel member, which will make a positively connected unit of the top and the bottom bars through the whole pavement.*

Wearing Surface.—Top surface 2″ thick of 1 part Portland cement, 1 part sand, and 3 parts crushed granite or trap rock (50% in ¼″—30% in ⅛″, and 20% in 1/16″ sizes). This mixture is to be placed within 30 minutes after placing the concrete foundation to insure a perfect bond between the wearing surface and the foundation. Surface to be spread by means of a steel-shod strike shaped to conform with the desired crown of completed pavement, then lightly tamped with template made of 2″ plank shaped to conform to the curvature of the surface of the finished pavement, and having a length of not less than half the width of the roadway, to give a uniform surface with a slight marking thus made transverse to the street. In no case shall the workmen be allowed to walk on this surface.

Expansion Joints.—Expansion joints ½″ wide shall be placed at right angles to the curb line at intervals of 30′. Joints to have edges protected by means of soft steel plates 3/16″x3″ rolled to conform to the established crown of the pavement and said steel plates to be securely attached to the reinforcing bars of the pavement so that the concrete between the expansion joints works as a unit. Expansion joints without steel plates shall also be placed along the side of the curb ½″ wide and the whole length of the paved street, the opening to extend to the bottom of the concrete base and space to be filled with tar or asphalt filler of an approved brand. This filler is not to be placed until the wetting of the pavement after installation has been stopped. Pavement to be thoroughly wet two or three times a day for 4 consecutive days after being laid. In the fall, when the temperature is lower, this may be reduced to 2 days.

In the new 1912 specifications for plain concrete pavement the requirements for *Wearing Surface* and for *Expansion Joints* differ from those in the forego-

*The Thomas system of pavement reinforcement is the evident intent of the specifications.

ing specifications for reinforced concrete as follows:

Wearing Surface.—Top surface, 2" thick, composed of 1 part Portland cement and 1½ parts crushed granite or trap rock (50 per cent in ¼", 30 per cent in ⅛", and 20 per cent in 1/16" sizes). This mixture is to be placed within 30 minutes after placing the concrete foundation to insure a perfect bond between the wearing surface and the foundation.

Expansion Joints.—Expansion joints ⅓" wide shall be placed at right angles to the curb line at intervals of 30', joints to have edges protected by means of a soft steel plate ¼"x2½", rolled to conform to the established crown of the completed pavement, said plate to have shear members punched from body of same ½" wide by 6" in length, which are to act as a tie and can be embedded in concrete base when in place. The opening to extend to the bottom of concrete base and the space to be filled with asphalt filler of an approved brand. This filling not to be placed until the wetting of the pavement after installation has been stopped.*

Blome Paving in New Orleans.

City specifications under which Blome patent pavement was laid in New Orleans† at a cost of from $2.37 to $2.95 per sq. yd. are in part as follows:

Granitoid Concrete Blocked Pavement.—(a) Granitoid concrete blocked pavemen shall be the kind known and constructed as the R. S. Blome Co. Granitoid Concrete Blocked Pavement. (b) The pavement shall be formed of a concrete foundation and a granitoid wearing surface. (c) The granitoid wearing surface shall be formed of 1 part cement and 1½ parts screened crushed granite, or trap rock, or other similar hard stone, and shall be placed on the concrete foundation while the same is freshly laid and before it has begun to indurate. (d) The granite or trap rock shall be crushed into sizes ⅜", ¼", ⅛" and 1/16"; all dust and finer particles shall be removed and these sizes shall then be mixed in the approximate proportion of 25%, 25%, 30% and 20% respectively. (e) The granitoid wearing surface shall be worked into brick shapes of approximately 4½" by 9" with rectangular surface, to form the superficial appearance of paving blocks, such "blocking" to be accomplished as per special method by using the grooving apparatus employed by the R. S. Blome Co. (f) An expansion joint ¾" wide shall be provided along each curb; transverse expansion joints of such widths shall be provided at such intervals as the contractor shall deem necessary and he shall be responsible for the number, width and position of such expansion joints; expansion joints shall extend through the granotoid wearing surface and the concrete foundation and shall be filled with the R. S. Blome Co. expansion joint composition. No direct compensation shall be allowed for expansion joints; the price bid, in the proposal, for granotoid wearing surface shall include compensation therefor. (g) The granotoid wearing surface shall be paid for by the square yard, at the price bid, in the proposal, for that item, which price shall include all the materials, labor, tools and service employed, concrete foundation excepted in completing the wearing surface in position as herein prescribed; concrete foundation shall be paid for, by the cubic yard, at the price bid, in the proposal, for concrete.

Concrete.—(a) Concrete shall be formed of mortar and an aggregate of crushed stone, or clean gravel; the mortar shall be formed by intimately mixing 1 part cement and 3 parts sand; the aggregate shall be free from all foreign substance and shall be small enough to pass through a ring 2" in diameter. Run-of-bar gravel may be used, provided the proportion of sand and gravel shall be the same as herein specified. (b) If the mixing be done by hand labor the cement and sand shall be first thoroughly mixed dry on an approved watertight platform; the aggregate shall be drenched before being placed in the wheelbarrows, and shall be added to the cement and sand in such quantity that the mixture shall contain not less than 20% more mortar than the volume of voids, determined by saturation, in the aggregate. The mass shall be continued to be turned over with shovels or hoes until every particle of the aggregate is completely enveloped with mortar. (c) Concrete will be mixed by either hand labor or by approved machinery in the most expeditious manner possible; it shall, at once, be placed, as the city engineer may direct, and thoroughly rammed into position. A larger amount of concrete than can be made with 1 barrel of cement shall not be mixed in one batch by hand. (d) Concrete shall be paid for, by the cubic yard, at the price bid in the proposal for that item, which price shall include all the materials, labor, tools and service employed in completing the concrete in position as the city engineer designates.

Materials in New Orleans cost about as follows: Cement, $1.40 per barrel; sand, $1.00 per cu. yd.; gravel, $1.60 per cu. yd., and crushed stone $1.40 per cu. yd.

*The Baker plate joint is here the evident intent.

†See September, 1912, issue.

Good Quality of Roman Concrete.

That there was some standard specification used by the Roman army is claimed by A. T. Bolton in a recent paper before the Concrete Institute, London. In every part of the world it will be found that Roman methods are remarkably uniform. The great Roman fortress, 1½ miles from Sandwich, Eng., known as Richborough Castle, and covering several acres, is still surrounded by a great Roman wall, one of the best preserved outside of Italy.

It was in this fortress that the Romans packed up on their departure from England. The walls there are about 30 ft. high and 10 ft. thick, and of great length. When the railways were being constructed the barbarians destroyed the wall which faced toward the sea in order to use the material for the purpose of the railway. They began to destroy the return wall to this sea front by excavating a great cavity at the base of the wall. It is more than high enough to walk into and it extends 8' 6" in depth, and so leaves only 18" of walling beyond. The span of that opening is about 50 ft. There is, therefore, a concrete girder, say, 20 ft. in depth and 50-ft. span and 8 ft. 6 in. in thickness without the slightest sign of a crack. It has stood since the time, probably 50 or 60 years ago, when the cutting was made. In itself that is sufficiently wonderful, but consider of what the wall is constructed. So far as one can see, it is constructed of nothing but the materials on the spot. There are seen the gravel from the beach, flints from the chalk, and the rough class of half stone, any kind of inferior Kentish rag, which could be obtained near the spot, while the mortar binding these miscellaneous aggregates together appears to be made with the ordinary chalk or stone lime.

What is of especial interest, therefore, is what did the Romans mix with that mortar which transformed it into a material as hard as modern Portland cement? Because, inside this enormous wall, 10' thick, the setting and consequent hardness of the concrete are just as good as they are on the outside. That is contrary to experience with ordinary lime mortars.

When the Romans left England, something or other which had been mixed in concrete and mortar or some method of preparation was no longer used, and the Normans, attempting to erect buildings of the Roman character, made a fearful mess of it. Most of their central towers collapsed, owing to the mortar being bad, as it became like sand, and the piers collapsed in consequence. Whether the Romans carried about with their armies puzzolana or volcanic ash, or something equivalent to that in its effects, is not known, but it is a subject worthy of investigation by chemists and societies. To raise the level of the lime mortars, concretes and plasters in common use would confer a great benefit on the building trade of England, particularly in the country districts.

Reinforced concrete structures shall be so designed that the stresses in the concrete and steel shall not exceed the following limits.

	Per sq. in.
Extreme fibre stress on concrete in compression	650 lbs.
Concrete in direct compression	500 lbs.
Shearing stress in concrete when all diagonal tension is resisted by steel	150 lbs.
Shearing stress in concrete when diagonal tension is not resisted by steel	40 lbs.
Bond stress between concrete and reinforcing bars	80 lbs.
Tensile stress in steel reinforcement	16,000 lbs.
Tensile stress in cold drawn steel wire used as column hooping	20,000 lbs.

In continuous beams the extreme fibre stress on concrete in compression may be increased 15 per cent adjacent to supports.—*Building Regulations of Greater New York.*

The Kansas City Freight and Passenger Terminal

General Layout of Work and a Detailed Description of Unit Subway Construction

BY A. D. LUDLOW*

One of the most important pieces of construction work under way at the present time, and one about which the readers of CONCRETE-CEMENT AGE probably have heard very little for the reason that but little has been published on the subject, is the new Union Station and terminals at Kansas City, Mo. This work, which when completed will have cost about $38,000,000, was started about three years ago, although a great deal of preliminary work had been done before that time. The actual construction work has been under way for about two years.

The object of the work is to furnish an entrance for all of the railroads entering Kansas City into a new union passenger station, which is being erected between Main Street and Broadway at about Twenty-third Street, about 12 blocks south of the center of the retail district of the city. The station itself, including such auxiliary structures as are required for mail, express, baggage, etc., will cost about $5,750,000, and will only be exceeded in size by the new Pennsylvania Station in New York.

Grades: One of the most difficult parts of the undertaking is the changing of grade of the tracks for about 6,000 ft. east from Grand Avenue from a 1.5% maximum to a 0.9% maximum. The Kansas City Belt Ry., which was absorbed by the Kansas City Terminal Ry., and which was essentially a switching enterprise, serving numerous industries along its line, extended from Kansas City, Kans., on the west, in an easterly and northeasterly direction to a point beyond the Blue river just outside of the eastern city limits, and connected either directly or indirectly with every railroad in the city. To convert this from a freight line with pusher grades to a passenger line over which a large number of trains could run at a high rate of speed, it was necessary to make a cut of 38' at Woodland Avenue, which was practically the summit. The total cut from the original surface at that point is about 80 ft.

It was also necessary to provide for an increased number of tracks, so that at the same time that the grade is being reduced the roadbed is being widened. Meanwhile the ordinary traffic is not being seriously interfered with. In reducing the grade of the tracks, two things are accomplished. First, it is made possible to operate the heaviest passenger trains in and out of the new station at high speed without the use of pusher engines. Second, a number of grade crossings are abolished.

Construction: On account of the change of grade and the increase in the number of tracks, the construction or reconstruction of a large number of viaducts and subways becomes necessary. According to the provision of its franchise, the Terminal Co. is required to construct these various structures at its own expense. At the present time work is under way either in the office or in the field on the reconstruction of 13 viaducts, the construction of 9 new viaducts, the construction of 9 subways, the changing of 2 viaducts to subways, the changing of 2 subways to viaducts, and the reconstruction of 1 subway. When the work of grade revision is completed, and the numerous viaducts and subways constructed, no passenger train entering the city from any direction will encounter grade crossings.

Four sub-freight stations are to be constructed in different parts of the city, at which freight in less than carload lots will be handled for all of the railroads entering the city.

Aside from the station building, the largest single piece of work is the construction of O. K. creek sewer. O. K. creek, which is really the continuation of a circular brick sewer, 15' 3" in diameter, flows in a southwesterly direction through the station site and directly underneath the station building. Several blocks further west it also flows by a tortuous channel through the site of the proposed coach and engine yard.

As one of the considerations for its franchise, the Terminal Co. agreed to build a sewer large enough to take the entire storm-water flow of this creek from a point about 900 ft. east of the center of the station building in a southwesterly and westerly direction to an outlet into Turkey creek, a distance of about 6,200 ft. This sewer, which is being built entirely of concrete, both plain

*Asst. City Engr., Kansas City, Mo.

FIG. 1—VIEW OF CASTING YARD
Finished slabs are shown at either side of the runway. The mixing plant is shown in the center

and reinforced, and which will cost about $1,000,000, is at the time of writing (Sept. 1, 1912) approximately 50% completed.

Throughout the entire work concrete is being used wherever possible. All foundations, retaining walls, sewers, subways and viaducts are being built wholly or in part of concrete. The entire projects calls for the construction of about 500,000 cu. yds. of concrete.

Unit System of Subway Contruction

Mention has been made of the fact that 12 new subways are being constructed. In the construction of these subways what might well be called the "unit" method is being followed. The columns, cross-girders and floor slabs are being cast in a slab yard several

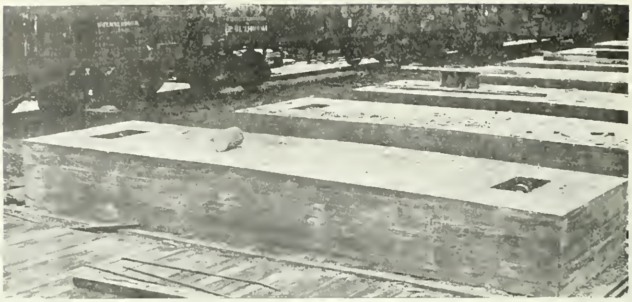


Fig. 2—A Nearer View of One of the Slabs

Fig. 3—Special Slab With Parapet Wall

miles from where they are to be used, and transported on flat cars to the various subways. A view of the slab yard is given in Fig. 1. The building in the center of the view is the mixing plant. The platform, which extends each way from the mixing plant, is a runway for the carts in which the concrete is conveyed from the mixer to the forms. The forms are arranged along each side of the runway. The large blocks on either side of the runway are finished slabs from which the forms have been removed, but which are not yet old enough to be transported to the storage yard.

Fig. 2 is a nearer view of some of the finished slabs, showing the stirrups by which they are lifted. The small cylinder lying on top of the first slab is a test specimen. One of these cylinders, which are 8″ in diameter and 12″ long, is cast at the time that the slab is made and is exposed to the weather on top of the slab until ready to be tested. They are then sent to the University of Kansas and tested on a 200,000-lb. Reihle testing machine.

The mixing plant consists of one "Chain Belt" mixer (Chain Belt Co., Milwaukee, Wis.) of 1 cu. yd. capacity, and one conveyor for hoisting sand and rock. The power is furnished by an electric motor. The sand and rock are dumped from the cars into a pit under the track on the left-hand side of the mixing plant, and are raised by means of the hoist into bins in the upper part of the building and above the mixer. The hoist can be shifted so as to discharge into either bin. The rock bin has a capacity of 2 car-loads and the sand bin of 1 car-load. The bins discharge by means of chutes into a hopper above the mixer. The hopper is filled with sand from the sand chute up to a certain height, which is indicated by a line. Rock is then admitted to the required height and both sand and rock dropped through the hopper into the mixer. The cement is dumped in by hand by a man stationed on the floor below. The sand and rock are measured into the mixer by means of the hopper with such accuracy that in the year that the plant has been in operation the actual quantity of cement used in any month has varied from the theoretical amount by not more than ½ of 1%.

Fig. 3 is a picture of one of the special slabs showing the parapet wall and the paneling at the portal. As the tracks cross on a skew all of the streets where the subways are being constructed, there are several of the special slabs in

Fig. 4—Unit Column for Subway Construction
The steel forms and the reinforcement used are shown at the right

each subway. Most of the floor slabs are rectangular, however, and are set with the axis of the slab at right angles to the cross-girders. The forms for the floor slabs and inside cross-girders are built of wood. The forms for the columns and end cross-girders are built of steel.

Fig. 4 shows a group of columns and just behind them the steel forms, in which they were cast. The forms are made to separate into 4 pieces, although usually they are taken off in 2 pieces. As the length of columns varies in the different subways, and in fact in the same subway, the column forms were made for the shortest columns and short sections provided, which are put on at either the top or the bottom, for the longer columns. The addition of one section adds 9″ to the length of the column. The form for the cap, which is shown in place on one of the column forms, is also made in quarters and is held together and fastened to the column form by means of bolts.

Fig. 5—Steel Form for An End Cross Girder

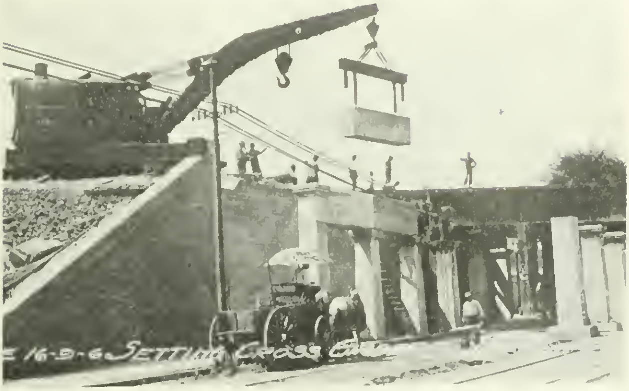


Fig. 6—Setting Unit Girders in Place

In order to increase the apparent height in some of the subways, the caps for the end columns are cast as a part of the end cross-girders. The tall columns without a cap in Fig. 4 is an end column. Stirrups similar to those used for the floor slabs are set in the end of the columns in order that they may be readily handled.

Fig. 5 shows the steel form for the end cross girders. This form is built of plates and angles and all inside rivet heads are countersunk. It is interesting to note that although this form is very substantially built, it has been found necessary to brace it strongly on the outside with timbers in order to keep it from bulging under the weight of the fresh concrete.

Referring again to Fig. 4, it will be observed that the tall column is the same size at the top as the shorter columns are under the cap. The intermediate cross-girders are the same thickness as the width of the caps on the columns supporting them. In order to make the end cross-girders fit onto the columns having no caps, it is necessary to draw the outer end of the cross girders in to the same thickness as the outside columns. This is accomplished in the form shown in Fig. 5 and is the reason for the flare shown at the top of the form.

In Fig. 6 are shown several of the columns and two of the cross-girders in place for the Jackson Ave. subway and a third cross-girder being swung into place. The largest floor slabs are 5′ 0″ in width, 27′ 0″ in length and 3′ 0″ thick and weigh approximately 40 tons. The cross-girders average about 14′ 0″ in length, 2′ 6″ in thickness and 4′ 6″ in depth. The columns average about 9′ 0″ in height and are 30″ square at the

Fig. 7—Completed Jackson Ave. Subway

base and 25" square under the cap. The units are allowed to season in the storage yard for about 90 days before being assembled. The wrecking crane used in handling the units is a 120-ton crane and is capable of handling and setting the largest units within a radius of 34'. The abutments for these structures and also the column footings are built in place in the usual way and present no unusual features. The columns are set in place and a concrete hub guard cast around them as shown in Fig. 6. The cross girders and floor slabs are set in a bed of mortar. The sides of the floor slabs have a batter of ½" in the depth of the slab, so that when the slabs are in position the crack between adjacent slabs at the top is about 1 in., tapering to almost nothing at the bottom. Oakum is driven in between the slabs to seal the crack at the bottom and the crack is then filled with mortar to the top. The bottom of the cracks and all other joints are pointed up in the usual manner. After the structure has all been assembled and the joints filled in the manner described the deck of the subway is waterproofed by being covered with several layers of burlap and asphaltic cement over which is laid a sand asphalt mastic 1" in thickness.

Fig. 7 is a view of the completed subway at Jackson Ave. This is one of the smallest of the subways and is the only one completed at this time. It replaces an old through girder steel bridge.

The design and general supervision of these structures is in charge of G. E. Tebbetts, Bridge Eng. John V. Hanna is Chf. Eng. and A. C. Everham, Asst. Chf. Eng.

According to the regulations covering concrete construction adopted by the building superintendents of Greater New York, the compression on the concrete in reinforced concrete columns may be increased 20% when the fine and coarse aggregates are carefully selected and the proportion of cement to total aggregate is increased to 1 part of cement to not more than 4½ parts of aggregate, fine and coarse, either in proportion of 1 part of cement, 1½ parts of sand and 3 parts of stone or gravel, or in such proportion as will secure the maximum density.

"Out of nine firms specializing in reinforced concrete in New York City some three years ago I have been told that only three survived the year," remarked Leonard C. Wason, president of the Aberthaw Construction Co., in a recent paper. Mr. Wason further stated that in the field with which he was most familiar only two concerns which he had known in the past seven years have continued to specialize in reinforced concrete. He believes that the losses in this particular trade, aside from the lack of knowledge of job costs, can be explained because of the large overhead and lack of proper accounting.

A Plant Making Enamel Concrete Brick

The Enamel Concrete Brick company's plant at Des Moines is interesting in that it is one of four plants operated in the United States and Canada which make enamel, pressed and moss or matt faced brick from concrete using the Enamel Concrete Brick machine and auxiliary equipment.

The accompanying diagram shows, in a rough way, the layout of the Des Moines plant. In actual practice the entire time consumed, from the time of starting the material on the conveyor in the sand and gravel storage pit to the time it is rolled on cars into the curing tunnels in the shape of brick is only 3 minutes.

The sand and gravel pit at this plant is built of concrete and is 44'x100' in plan and 14' deep and is planned to hold 180 cars of sand and gravel. Above the pit and over it, it is the intention to erect stanchions and a roof for the protection of the material from the elements. Cars of sand and gravel will then be run in over the pit and the contents discharged directly into it.

Through the center of the gravel pit runs a conveyor in a space 4' wide for delivery of material into the boot of the

Fig. 2—Cottage at Brigham City, Utah, Built of Enamel Concrete Brick

Fig. 3—Chapel in Which the Walls are of Enamel Concrete Brick

conveying elevator; and thence it is conveyed to a bunker on the roof of the plant.

This is done so that the feeding and discharging of materials is accomplished by gravity. For a similar reason, cement is taken into the plant and elevated by the conveyor to a storage bin. From the bunker above mentioned and from the cement storage space the materials are fed into the body and the facing mixer, which are located on the second floor of the main building. In passing through the backing and the facing mixer, which are of the continuous proportioning type, the various materials are measured and are then mixed dry, and wet to the proper consistency; and are then discharged into chutes and receiving hoppers directly over the automatic brick machine located on the first floor of the building.

For enamel face brick, liquid material is used which is run into a special container and is there automatically picked up by gangs of cups containing exact quantities; and the liquid is automatically delivered into the mold box for 8 brick, each cup containing the requisite amount of facing for each brick.

For pressed and moss- or matt-face brick, semi-wet facing material is delivered into the mold box from a special feeding device and this same material is used as a cushion on top of the liquid facing material when making enamel face brick.

The next operation involves the delivery of mixed and coarser backing material through an agitator device, entirely to fill the mold box; following this an enormous pressure is applied and subsequently a gang of release tamps descends onto the mold box, holding the pressed brick firmly on the face plate or pallet while the mold box is elevated from the brick, thus stripping them, after which the release tamps are raised and the 8 brick resting on the pallet or face plate are delivered to discharging position ready to be placed on the brick car.

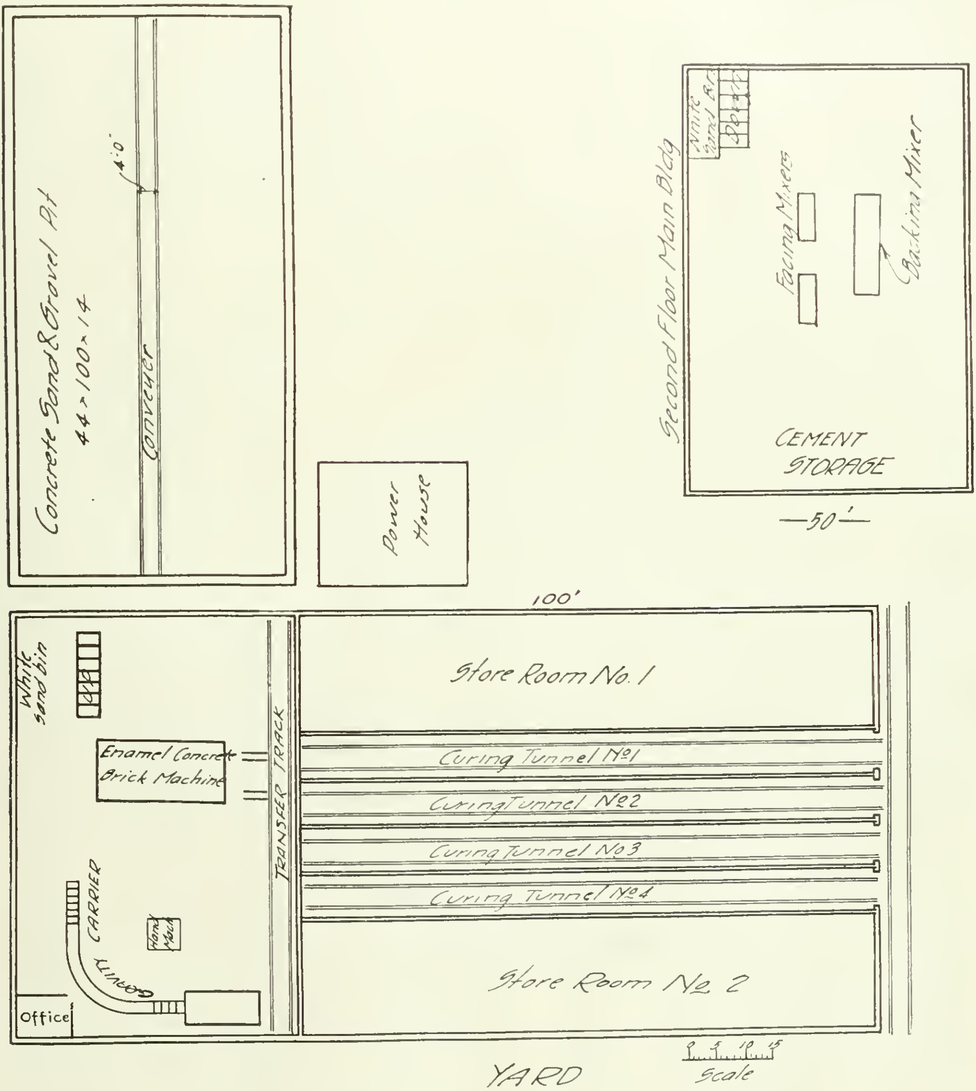


FIG. 1—GENERAL PLAN OF DES MOINES PLANT WHERE ENAMEL CONCRETE BRICK ARE MADE

There are 30 brick molds, each for 8 brick, connected to and moving forward by means of an endless chain. These molds automatically stop each 10 seconds or faster if desired to allow for the 9 different operations which occur simultaneously, as noted:

1. Insertion of specially milled, polished steel pallet or face plate and automatically locking it to bottom of mold box.
2. Deposit of liquid facing under constant agitation by gangs of cups, containing exact quantities, directly into mold on the polished face plate.
3. Deposit of fine concrete mixture acting as a cushion before receiving the coarser backing aggregate.
4. Deposit through an agitator receptacle of coarse backing concrete mixture, completely to fill the mold box.
5. Automatic scooping out of small amount of backing concrete from center of each brick to give a slight excess of material around the 4 edges before applying the pressure.
6. Exercise of 3,200,000 pounds pressure on each brick in the mold box.
7. Automatic action of device for cleaning pressure tamps after each pressure is applied to brick.
8. Operation of release tamps, elevation of mold box for stripping brick and raising release tamps to place.
9. Automatic delivery of 8 perfect faced brick on steel pallet ready to be placed on brick car.

Twenty-nine men are required to operate the entire plant.

The man stationed at the front of the machine places the steel pallet or face plate in position. Two men at the opposite end take off the brick alternately and place them on the car.

At the discharge end of the machine, there are two tracks upon which are placed special folding deck brick cars, each carrying 576 brick. As fast as each car is loaded with the concrete brick resting on the steel pallets, the car is pushed onto a transfer car and is then removed to a steam curing tunnel. There are 4 of these tunnels, each having a capacity of 36 cars which means a total capacity of 82,944 brick. This excess capacity over the daily minimum capacity of machine, 30,000, allows ample leeway in curing and transfer of brick to yard from steam curing tunnels.

A vapor-curing process is used. Just enough steam is turned into the curing tunnels to cause condensation and keep the brick in a continuously moist condition and at fairly even temperature. The brick are left in the curing tunnel for 48 hours; and after a day or two in the yard, are ready for shipment. When unloaded from the pallets or face plates, the latter are returned on cars to a special pallet cleaning machine where they are cleaned and burnished and are then delivered by a gravity carrier to the brick machine to repeat their operation.

A special hand pressure machine is used for making headers, quoins, double headers, octagon, bull-nose and various other special face brick. With this machine, it is possible to place the facing or color wherever desired.

One of the chief advantages claimed for this process is the fact that high-grade face concrete brick in any color or variety can be made and are ready for shipment in a short time. The idea is to mix color facing material and waterproofing to give an impervious face to the product. Mineral colors and oxides only are used, thus insuring permanency and non-fading qualities.

The equipment required to operate the one-unit plant under this system is as follows:

1 large automatic brick machine.
1 hand pressure brick machine.
125 steel folding deck brick cars.
2 transfer cars.
1 large automatic mixer.
2 small automatic mixers.
1 pallet cleaning machine.
10,000 large steel face plates for automatic machine.
10,000 small steel face plates for hand machine.

The weight of the automatic brick machine alone is 76,000 pounds, which gives some idea of its strength of construction.

In addition to the equipment mentioned there are the necessary conveying machinery, steam boiler, rails for cars, shafting, belting, pulleys, etc., and the power apparatus. There are other similar plants installed and operating at Winnipeg, Canada; Salt Lake City, Utah, and Seattle, Wash.

In connection with this article, we are showing illustrations of the use of these enamel concrete brick.

Efflorescence on Masonry.

A report presented to the International Association for Testing Materials at the Seventh Congress in New York, by Prof. J. A. Van der Kloes, Delft, chairman of Committee 50, in charge of this subject, gives a resumé of the work accomplished. Research was conducted by members of the committee and a list of questions prepared that would tend to throw light on the subject. From the data on hand the chairman formulated the following conclusions:

1. *Excess of lime:* All that exudes from buildings in brickwork or concrete and hardens on the surface into crusts and stalactites is almost pure carbonate of lime. Extraction of lime takes place both with Portland cement mortar and lime mortar, with each separately as well as with mixtures of both and also with trass mortar too rich in lime.

Lime is dissolved by water as hydrate of lime and conveyed by it to the surfaces of buildings, where, during the evaporation of the water, lime absorbs carbonic acid from the atmosphere and forms with it carbonate of calcium.

Therefore, special attention should be given to binding the lime in mortar and concrete by an excess of puzzolana.

2. *Efflorescence and "Wall-Cancer":* Probably a connection—not yet definitely established—exists between the presence of an excess of lime in mortar and the formation of efflorescences and "wall-cancer" on the surface of buildings; yet lime itself often seems to have little or no share in the composition of such efflorescences.

3. *Corrosion of stone and bricks:* Building stones and bricks may be attacked:

(a) By products formed in the mortar. There are certain very soluble constituents of mortar which, in intermittent periods of dryness and moisture, alternately crystallize out in the pores and on the surface of stone and are dissolved again by rainwater. Scaling off (wall-cancer) caused by this is to be explained by osmosis.

(b) By constituents of the bricks themselves. Bricks may contain highly soluble matter, which have the same effect as those treated under (a).

(c) By constituents of the atmosphere. In the case of the trachyte from the Drachenfels, we see that the stone from the cathedral of Cologne contains 2.4%, that from the quarry but 0.5% of sulphuric acid.

Corrosion of natural stone by atmospheric sulphurous acid producing exactly the same effect as the products of mortar treated before, there is reason to express the opinion that the action is osmotic in this case also. There is also reason to put the question whether, in spite of the trifling solubility of lead-hydroxide in water, osmotic action may not likewise take place wherever joints in masonry are sealed with molten lead instead of with mortar.

Overhead Expense in Construction

Due to the fact that overhead charges in construction work are not chargeable directly to a given job, and also because a builder thinks of his work as divided into separate jobs and does not group his work into a whole as does the merchant or retail dealer who thinks of his day's business and not of the individual sales which he has made, the item of overhead is very apt to be overlooked. Leonard C. Wason (Aberthaw Construction Co., Boston) relates, in this connection, the story of an old builder in Boston some years ago who used to open a new bank account each time he got a new job. He deposited all money received for the job in this bank and paid all bills from this account. When the work was completed the bank balance minus his original deposit showed him his profits; and according to his belief the addition of all such balances showed the profits of his business. This would have been true if he had not run a separate personal account from which he bought tools, paid office rent and other general expenses of the business. His method probably had the advantage over many builders' accounts, of employing accurate addition and subtraction, if it did neglect the items which are so commonly neglected.

Where adequate bond between slab and web of beam is provided, the slab may be considered as an integral part of the beam, provided its effective width shall not exceed on either side of the beam 1/6 of the span length of the beam nor be greater than 6 times the thickness of the slab on either side of the beam, the measurements being taken from edge of web.—*Building Regulations, Greater New York.*

The Past and Future of the Concrete Block

BY W. P. BUTLER*

[The author in his estimate of the future of the concrete block reviews, of course, the past of this building unit. He bases his views on his observations in about 2,000 concrete block plants which he has visited in 40 states and in Canada and Cuba. Even to those who do not agree with him this estimate will be interesting. The concrete block business requires rejuvenation. Evidences of a new progress in this line of manufacturing, and consequently of a new interest in the product by architects and owners, are to be found in many places, but the block manufacturer generally must appreciate the possibilities of the material more fully than he has done and give more serious attention to the demands of architects before he can make the most of his business. CONCRETE-CEMENT AGE will publish other estimates of the future of the concrete block. The paper by Mr. Butler serves to direct attention along some of the lines of thought which focus in a broader and better use of concrete in small building units.—EDITOR.]

There are three phases of the concrete block business which deserve special consideration, each being equally important and each of which should develop equally, but have not done so. First, there is the mechanical part of the business—the part relating wholly to the machinery or devices used in making the product. Second, there is the constructive phase which relates only to the *use* of the machinery or devices in making the product. Third, there is the business side, which relates to the sale of the product, placing it, and the education of the public in its use.

Multifarious Equipment

In the early days of the block business its mechanical phase overshadowed everything else. From the crude moldbox which had to be taken apart and put together every time a block was made, the block "machine" developed gradually along many divergent lines. Inventors were both ingenious and legion and so-called "machines" multiplied by the score and, as would naturally be the case, many machines were "freaks," wholly impractical and in no way suited to the practical, enduring, and efficient service which must be demanded of the block machine. At first all machines were of the side-face type. The cores were pulled up or down or were dropped out. Later, the block was lifted off the stationary cores. Still later there came the down-face and horizontal-core type of machine. Here, too, the core-action developed from the dropped-in type, through the shoved-in type, to the mechanical-action type; and from the single and double to the multiple-core types.

There were "single-piece" and "double-wall" types of machines of innumerable forms, some of which attained the height of impracticability in their ingenious possibilites of "cellular-wall" construction. There were staggered-core machines of many types which sold better than they worked. There were many "slush" or "wet-block" molds made, which made good block but no money; and in the field of pressure machines there were dozens of devices from the small hand-lever types, on through the great toggle-action types, to the stupendous hydraulic types wherein, as in one machine, the end-doors weighed 1,500 lbs. each, and one part weighed 40 tons.

In the matter of face-plates there was a like development from the early, crude, rock-face plates cast from models gouged out of plaster or wood, to the high-grade plates cast from molds taken from the finest chipped or pitched natural stone; and, later still, the superior art-stone face-plates cast direct from the stone itself and made not of iron but of magnesium oxide. Tons of literature were spread broadcast telling of the fortunes to be made by the use of each. The greater the freak or the fake, the louder were its praises sounded.

The would-be purchaser knowing nothing of the business, or of its mechanical requirements, usually bought the first thing he saw and learned his lesson later. The writer once sat at the home of a man who had a bushel basket full of cement block-machine literature, none of which he understood, and he wanted advice as to what machine to buy. I have had scores of similar experiences and have found not one man in 50 in the business who could even define Portland cement.

Men in all the walks of life rushed into the business; clerks, farmers, common laborers, bankers, capitalists, all equally ignorant of it and, like the gold-hunters, seeing in it a quick way to fortune. The inevitable result of this craze for profit-making through the sale of machines and the making of block was the failure of thousands who entered the business. Gradually the universal law of the survival of the fittest operating through the selective judgment of the workers caused the elimination of the freak machines, and of such as operated in the wrong way, and resulted in the continuance and improvement of the later and better types of machines.

I have seen over 175 different kinds of block machines at work and of that number not over 30 are manufactured today, and it is a safe prediction that not over 10 of that number will be made five years hence. What is true of block machines is equally true of concrete brick machines, of which I have seen over 50 varieties, and also of all other concrete-products devices.

The Best Has Survived

The old and poor, the weak and defective, have gone into the junk heap, though many such are still used by men who value scrap-iron more than they value efficiency and profits; while the new, the strong, the best, have survived and are being improved, and we may, with certainty, say that out of the vast number of devices there will yet be developed a few excellent machines which will be perfectly constructed on approved mechanical principles adapted to the particular purposes to which the machine is to be put. A few such machines are now made, but there is yet much field for improvement. Let each maker of block machines study the history of such machines; let him see how much of bad and how much of good there is in his device and seek to adapt it to the latest and most approved ideas and, if need be, cease to make it if it cannot be thus adapted. He must do this or the public will "junk him" with scores of others. In the mechanical field, therefore, I clearly see the sun of a brighter day rising above the wreck-strewn surface of the troubled sea of the past.*

Let us now consider the constructive phase of the block business, which is of equal importance. As the demand arose for a building material to take the place of extensive stone and increasingly expensive wood, there developed the concrete block, stone, and monolith. The monolithic construction called for mechanical skill, engineering ability, and financial strength and therefore the "mob of little fellows" could not get into the game and hence it has had a steady legitimate growth.

The making of concrete *stone* as a high-grade art-product likewise called for mechanical ability, artistic taste and some capital and it, too, was not "rushed by the rabble" and hence its growth has been steady and its success pronounced. But the block business required nothing but the price of a machine. Mechanical skill, technical knowledge, constructive ability, artistic taste, and financial strength were uncalled for. Even common honesty and business acumen were not required. The block machine makers themselves were largely responsible for the decline of the business for they, in order to boom sales, told the prospective purchasers that there were fortunes to be made in the business; that: "If you buy OUR machine you can use 6 or 8 or 10 parts to 1; hand-mixing is as good as or better than machine-mixing; and a dry block is as good as a wet one."

Thus, by false statements, the poor, the incompetent, the ignorant, the unbusinesslike among men were lured into the business only, in the end, to fail, as nine out of ten have done from ocean to ocean. "Plants" were started by all manner of men where the clouds were the roof; or where a few sticks supported a canvas or a few old boards served as a roof; or where some convenient shed or cellar housed the outfit. Thus, not one plant in a hundred was planned or constructed or arranged with reference to efficient work, and, I regret to say, that this same condition prevails

*Minneapolis.

*William Alden Smith, please note.

today all over the country, to a large extent.

Again since knowledge was not a requirement for entrance in the business, the value or importance of *efficiency* was not recognized or even thought of; with the result that inefficiency was universal and it is largely so today. The material used was handled too often; it was lifted many times; the machinery was dumped any-old-place instead of being arranged so as to conserve efficiency. The mixing was done by hand in most cases, and done badly in nearly all cases. The machines were badly run and badly attended to, and the tamping was not properly done, and the block were badly finished. They were set out in the hot sun to "dry out," or were improperly cured. The amount of cement was cut to the lowest possible point in order to meet competition. The value of water to the mass was not known, and, in 99 cases out of 100, the mass was made too dry because it could be done so more easily.

Poorly Made Block, Poorly Laid

Finally, the block was laid in a slovenly, unworkmanlike manner, the face being all daubed up with mortar, the joints were uneven and the edges ragged. In short, the making of the block from start to finish was marked by a succession of errors; by rank incompetency and with the inevitable result that it became an utterly discredited product. Underwriters would not give it an insurance rate to which a properly made block is entitled. Good architects refused to specify block or to associate their names with their use. The public discriminated against it because of its manifest artificiality and undoubted structural defects. They were weak, crumbly, absorptive and cheap, so that they were discarded by discriminating builders and were discredited generally.

The demand for concrete block fell to the level of its use for the foundations of cheap buildings. Again, the abominable real-estate, contract-building system wherein everything of merit is eschewed and everything that is cheap is adopted, has done a world of harm in discrediting the concrete block. Such contractors demanded something cheap that would "stand up" until it was sold. Some block men made what they wanted.

Again, the eager competition among block-makers has tended steadily to depress the business and discredit the product, and to disgust and discourage the few who have sought to do good work. How poor, and how cheap, became the slogans of the block-maker, and not—how good!

I am speaking here of general tendencies which were the natural result of the incompetent personnel of the business in its earlier years. These tendencies are still in operation notwithstanding that there are many inspiring exceptions to the rule, and in spite of the fact that there are thousands of beautiful buildings made of block, which are well made and well laid.

But the tendency has been downward, and thousands have "gone broke" in the business, while hundreds now in the business will go the same way.

This is but a brief review of what I know to be the conditon in 40 states where I have observed the business. Now, what of the future? The concrete block has a future. It has come to stay because it is needed; because it will be needed more and more. But it must be a better block, made with better machinery, by better men, in a better way. The "plant" out under the clouds with the horizon as its side-walls must go and give place to the properly designed plant wherein is a full and proper equipment, designed to work efficiently and to turn out a fine product in form, appearance and quality, and at a minimum cost.

Ability and efficiency must displace the old incompetence and inefficiency of ignorant men; while quality must rise above cheapness as the slogan of the manager. That day is coming, and when it comes the concrete block will come into its own as the first-class building product it can be made to be.

A first-class block can be made to support a building half a mile high,* and a better stone can be made of cement than any that God ever put in the ground, but the ingredients of such a stone will have to be good clean aggregates, just enough cement to coat them, enough water to spread and crystallize the cement, and a sufficient amount of ability, efficiency and honesty to cause their proper union in the proper way.

Machinery Manufacturers Can Help

It can and will be done. I am not a pessimist because I see all of the multitudinous ills of the business. I am an optimist, a missionary, a preacher, going from state to state preaching the gospel of doing good work, and showing men how to do it. If the leading manufacturers of block machines would spend a little less time booming sales and a little more time booming good work, the coming of the better day would be hastend.

Efficiency and quality must be the slogan of the new order or the concrete block business will soon be but a memory.

Finally, what of the business phase of the block industry? We have equipped our plant and made our product, now we must sell and use it. As stated before, the personnel of the business was generally low because of the fact that no experience, no mechanical or constructive ability, no technical knowledge, and very little capital, were necessary to get into it. The result was that the business ability, artistic taste, and the discriminating conscientiousness of the workers were low.

To make block and to get rid of them was about all they cared about. It mattered not how they were made, what they were made of, how they looked, whether they were or were not a proper size or shape or were a satisfactory architectural unit or whether they were properly laid or not. I regret to say that even yet this indictment is true in a large proportion of cases. Then and now the mental attitude of a large number of block-makers was and is low. They did not care then and they do not care now whether they do good work or bad—there are, of course, many exceptions to what I here state to be the rule—and in most cases they did not know the difference between good work and bad.* They had not seen other machines than the one they used and therefore they thought that theirs was the best to be had. They had not traveled and thus seen the large, good plants where good work is turned out, and therefore they knew not what good work was and how it was made. They felt insulted if one criticised their work and suggested its improvement. They knew nothing of the real cost of their finished product since they kept no proper cost-system accounts, and hence they made prices based not on cost but on the exigencies of competitive demand, and if, on Saturday night, there was not enough on hand to meet the pay-roll they cut down the cement and labor the next week, depressed the quality of the output and thus helped to ruin the business for themselves, and for their more honest competitors.

I once met on a street of one of our largest cities a man at the head of a very large block plant and later the building commissioner of the city. I said: "Well, Mr. So-and-So, how are you making it?" He replied, "I now have the balance on the right side of the ledger." "How?" I asked. His reply actually startled me. "By making a block just good enough to hold together until I get them on the job," was his reply. Today there are in that city the rusting remains of dozens of down-and-out block plants. Such was the low business attitude of a leading manufacturer of block and of block-making devices.

Just as it then was and now is true that a majority of block-makers did not and do not realize the business necessity of doing first class work, and of refusing, under any circumstances, to do poor work, so, too, have they failed to recognize the business necessity of improvement; of "junking" worn-out or obsolete machinery and of adopting new or improved processes. Hundreds of plants today are equipped with old, worn-out, obsolete machinery which it does not pay to use and

*The author's enthusiasm is interesting. Allowing 144 lbs. to the cubic foot of concrete—a column half a mile high would weigh 2,640 lbs. to the sq. in—not an excessive requirement of good concrete in compression but allowing perhaps in actual usage a rather low factor of safety.—EDITORS.

*We are inclined here to take issue with the author. We prefer to cling to the belief in most men's good intentions and to attribute failures more to their lack of knowledge than to purposeful knavery and enjoyment in poor results. We are confident that when block makers know how to do better work and gain the skill and equipment with which to do it they will see much more fun and vastly more profit in turning out creditable products.—EDITORS.

which ought to be sold for scrap iron. Yet the owners will not spend a moment to figure out where they are losing money daily. They will not see that money put into new and better machinery that will turn out more and necessity of doing first clas work, and better work would be a wise and profitable investment.

Plan Plants for Efficiency

Again, the business necessity of considering efficiency does not occur to them. Not one plant in 100 is designed to conserve efficiency of time and motion, of labor and power. Every motion takes time and costs money, hence the arrangement of bins, of mixers and machinery, of tracks and steam rooms, and of storage and yard space should be carefully considered with reference to the conservation of motions. Many a plant which now is a failure would be a success if its units were properly arranged and it were properly managed.

Again, few block-makers ever see the business necessity of constantly criticising *their own* products so as to find and correct defects. They fail to see that a poor product means a poor price and a small profit, or no profit at all. They fail to see that they must advertise and that the only advertisement that will aid them is to do good work which will stand as a visual proof of their competency. They fail to go to the public and talk good work, to show good work, and to explain to architects, contractors and prospective builders the difference between good work and bad and the necessity of charging a good price for good work. They fail to see that it would pay them to refuse to do poor work and thereby build up a reputation which will, in the end, bring success.

Thus they fail to educate the public up to a higher standard of work which alone can bring to themselves a higher, better, richer, and hence more profitable class of customers. It is a business axiom that if you want to make money you must go where money is and deal with the men who have it. Block-makers must learn to know that it does not pay to make a cheap product to sell to cheap men to use in the foundations of cheap houses.

Also that it will pay to make a superior product for use in good buildings from the water-table to the roof.

Members of web reinforcement shall be so designed as to adequately take up all involved stresses throughout their entire length. They shall not be spaced to exceed ¾ of the depth of the beam in that portion where the web stresses exceed the allowable value of concrete in sehar. Web reinforcement, unless rigidly attached, shall be placed at right angles to the axis of the beam and carried around the extreme tension member.—*Building Regulations, Greater New York.*

A Concrete Sundial.

By C. H. Miller.

The concrete sundial shown in the illustration is an interesting example of what an amateur can accomplish in working with cement. The time required to make it was less than a day and the total cost of material probably not over two dollars. I first made a scale drawing of what I desired to accomplish and by means of wooden forms cast the two square sections that form the cap and base. The round sections were also cast separately in wet sand. The large round base is not concrete, but is an old stone mill wheel that had been used to cover a well. These old mill-stones are very common through the eastern states and may be seen doing service as stepping-stones or in forming a portion of old fences. Mine was really the inspiration for the sundial. The main shaft of the sundial was built up around a wooden core, wound with chicken wire. For all the work I used a fairly rich mixture of cement and sharp, clean sand, probably about 2 parts of sand to 1 of cement.

An Attractive Lawn Ornament Made of Concrete

After the various members were complete I joined them together by means of cement, and after patching up some places where the work was crudely done, I gave the entire sundial a coat of stucco, using a pail of wet concrete and a whisk broom. This final coat covered up the defects of workmanship and gave a finished effect. Ultimately I hope to have English ivy growing over the sundial.

Relative to the consistency and volume of grout, A. W. Ransome states that for lining tunnels and similar work a 1:1 mix, with sufficient water to lift it into place, should be used wherever possible. The sand is an important factor in clogging large leaks. Where fine seams carrying water are encountered, 1:0 mix should be used, and quick settling Portland cement is recommended.

A Concrete Mattress for a River Bank.

B. Okazaki, a Japanese engineer, describes in *Engineering News* the above novel construction built by him on the Yubari river. He believes his reinforced concrete mattress to be the most economical, durable, flexible, and altogether effective bank protection and that it is particularly adapted for the protection of those river banks where caving is most severe and where the now prevailing log mattress cannot keep its stability when forced to take a steep slope.

The main body of the mattress consists of reinforced concrete blocks of suitable size knitted together by passing metallic wire of the proper diameter through two holes previously made in the middle plane of each block, thus forming a flexible stone mattress, each block being so set as to break joints.

Text and drawings describe the mattress in detail. The actual cost of the mattress is 3 yen ($1.50) per square yard in the experimental work, but in the later work of the Ishikari river improvement work, the cost of the mattress has been reduced to 2 yen ($1) per yard, owing to the employment of the skilled labor and the slight improvement made on the apparatus and yard arrangement. This is cheaper than the prevailing log mattress.

Note: This is very similar to a bank protection designed and developed by Mr. Decauville, a French engineer. The Decauville system has been used extensively abroad.—Editors.

Each job should be charged with its proportion of the premiums on employers' liability and public liability insurance, to prevent an unforeseen increase in overhead expense. This item should be allowed for in the estimate at the proper percentage of the payroll.

Pre-Cast Units for Sawtooth Construction

Efficiency is the watchword of the day, and in the mind of the manufacturer the slogan "Efficiency" is expanding in meaning and now covers the service he receives from his buildings as well as from his machinery and from the "studied motion" operations of his men.

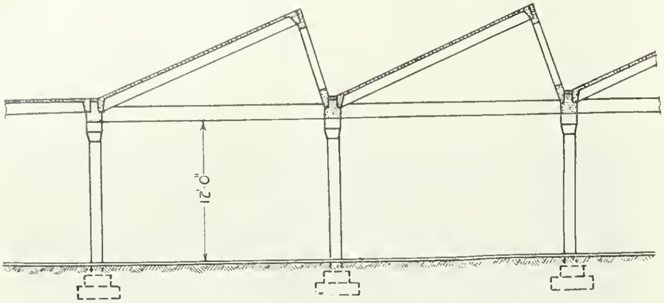


Fig. 1. Cross-Section Showing Typical Arrangement of Units in Sawtooth Construction

And why should this not be so? The interest on his investment and the upkeep on his plant are just as truly manufacturing costs as is the payroll. The keenest minds in the manufacturing business today know that pleasant surroundings, with plenty of light, and proper sanitary arrangements increase the efficiency and morale of the entire organization.

It is but natural, therefore, that a type of construction, which in itself embodies the highest efficiency in design and erection, and which gives maximum service to the owner, should be rapidly recognized and adopted.

Sawtooth roofs of reinforced concrete construction, erected under the old method of putting up forms, and then filling them with concrete, have been used to a limited extent only, on account of their excessive cost. Resort has, therefore, been had to various substitutes. Metal lath, plastered on both sides, has been used extensively for this portion of the work. In fact some builders, owing to the cost of sawtooth work, have used wood construction for the sawtooth portion even though the rest of the building was made of reinforced concrete.

Concrete Sawtooth Construction

A sawtooth roof construction of solid reinforced concrete, using pre-cast units, has been developed by the Unit Construction Co., St. Louis. In this construction no metal is left exposed, but every particle is surrounded by the requisite thickness of concrete. The result is an absolutely permanent construction, and the cost is reasonable.

The full sawtooth construction used in the buildings for the Sturges and Burn Mfg. Co. is a development of the isolated sawtooth type first used in the construction of a tin plate inspection warehouse for the National Enameling and Stamping Co., at Granite City, Ill. The accompanying illustration, showing the interior of this building, gives a good idea of the lighting effects. In these skylights, which are constructed entirely of concrete and wire glass, the glass is placed at an angle flatter than is usually employed in sawtooth construction and therefore admits considerably more light.

The reinforced concrete and wire glass type of skylight is permanent construction. No sheet metal is used. This construction has been used on various buildings recently erected, notably on the classing or f. o. b. sheds and compress buildings in the cotton handling plant of the Memphis Terminal Corporation, Memphis, Tenn. Sixteen acres of unit-built buildings are now being constructed.

The plant of the Sturges & Burn Mfg. Co. is situated at Bellwood, Ill., 18 miles west of Chicago, and comprises 3 buildings. The main building is 703′ 0″ long, and 101′ 6″ wide, with a wing at the west end extending back 142′, and a two-story wing at the east end. The other buildings are the tin room and the boiler room.

Typical column spacing for all the buildings is 17′ 6½″ x 20′ 0″, and the clear height under the beams is 12′ 0″. The floor is carried on an earth fill at car level. Excluding the grouted connections, the only concrete that was poured *in situ* were the footings. The columns, girders, sawtooth frames, roof and wall slabs were made in the casting yard adjacent to the work and set as units.

The wall slabs average 4″ thick with bands around openings as shown in illustrations. There is one expansion joint in the 703-ft. length, steel rollers and plates being used to insure free movement.

Roof drainage is provided by means of cinder concrete crickets which direct the water to wrought iron downspouts placed within the columns.

Details of the sawtooth construction are shown in the accompanying views taken while the work was in progress. The reinforcing bars project into a grout "box," as it were, over the column cap. The inclined frames and the roof slabs rest at their lower ends on a shelf on the girder and at their upper ends on a shelf

Fig. 2. Interior of Building Showing Arrangement of Sawtooth Skylights

in the frame; the frame itself rests on the shelf on the girder and the tie beams are intended to take the thrust of the triangle thus formed. In this building the tie beams have also been designed to carry shafting; malleable iron inserts have been cast in to facilitate the connection of shaft hangers, etc.

The skylight frame consists essentially of a large flat plate, into which the window frames were cast, extending from column to column. The lower end is detailed to rest on the girder ledge with projecting bars which overlap stirrups projecting from the girder and from the roof slabs resting on the other side of the girder. Three or 4 inches of grout on top of the girder forms the valley and completes the connection.

At the top the frames are notched to provide a shelf for the support of the roof slabs; this is clearly shown in the illustration, where the bars projecting from roof slabs and frame can be seen.

The roof slabs themselves are of the unit type generally used by the contractor, and there are 3 roof slabs to each panel. All the units were set on mortar beds to insure proper bearing

Fig. 1 Detail View of Saw Tooth Roof Under Construction

and the connections grouted with a 1: 1½ :2 concrete.

As has been stated before, the casting yard was adjacent to the building site; the concrete was handled by a tower and 3 chutes in the usual manner. The yard was served by a McMyler locomotive crane, a 48-ft. boom, which picked the units from the forms and placed them in the storage pile, or as was the more usual case, on flat cars, and then pushed the cars to the erecting derrick. The traveler consisted of a stiff-leg derrick with a 76-ft. trussed boom, carried on a square tower 20' high. The tower was carried on trucks with flanged wheels running on regular track.

Erection was started at the east end of the main building, the traveler setting the full width of the building and backing away as the work progressed. After the main building was set the traveler was again moved to the east end, completing the east wing, the boiler house, tin room, and west wing successively.

In order to give some idea of the rate of progress, it may be stated that the erection of the units in the main building proceeded at the rate of 1 bay per day, which means 18' of building 100' wide per day. The boiler house was set in 2 days and the tin room in 3 days. When it is remembered that the tin room covers an area approximately 100' x 160' it will be understood that the erecting was carried out with reasonable rapidity.

General plans of these buildings were prepared by the owners under the direction of John Perry, but covered wood and brick construction. The reinforced concrete design which was finally adopted, was prepared by the Unit Construction Co., who also carried on the construction. This method of unit construction is patented and controlled by the Unit Construction Co., Liggett Bldg., St. Louis.

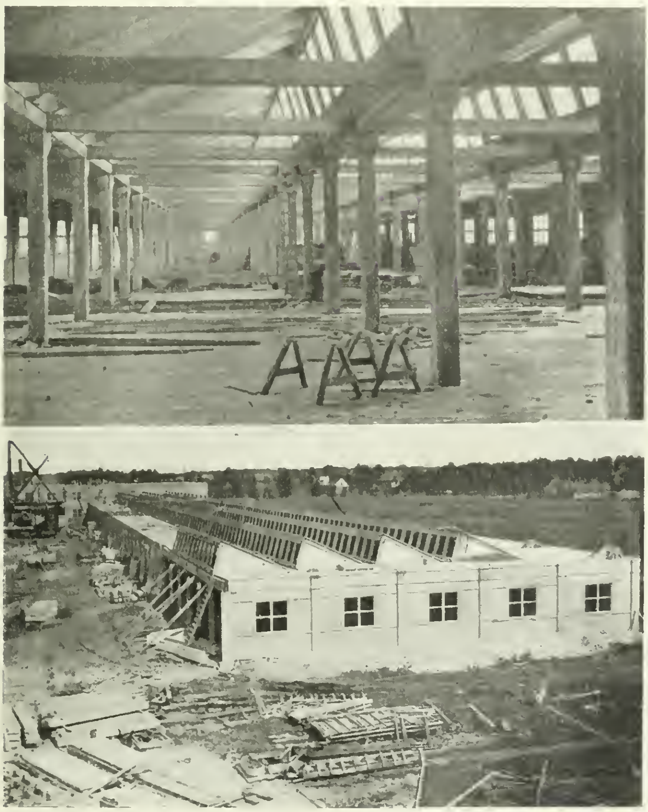
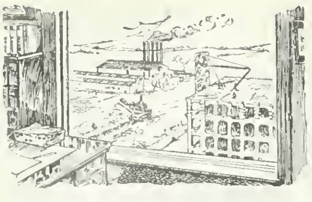


Fig. 3. The Upper View Shows an Interior of a Sawtooth Building Under Construction. Below is Shown the Exterior View

At the left in the lower view can be seen the traveling derrick. The various units are shown in the foreground.



COMMENT

New York Tries Concrete Roads. Not a little bravado is being shown by the New York State Commission of Highways. It is to be hoped that the rather extensive experiment being tried in concrete road construction will not result in a failure of the material, because in the case of failures it will be recounted that the highways were of concrete and the circumstances will be inquired into by a few only.

Readers of CONCRETE-CEMENT-AGE will remember that in the September issue there was published a description of a jointless concrete road which was being constructed on Grand Island in Erie county, N. Y. In this description attention was called to what was then believed to be a fact—that in the omission of expansion joints the Erie county work differed from "the course being followed in the construction of the 200 miles of concrete highway on which the State Commission of Highways furnished information." This statement, quoted from our September issue, was based upon the report believed to be authentic which came in response to a request for information which we made of the commission. In gathering the information as to concrete pavements and highways, published in September, CONCRETE-CEMENT-AGE sent out printed blanks, one of which was addressed to the New York State Commission of Highways, Albany. The blank was filled out under date of July 1, 1912, and in the space provided for "Signature of Informant" was written "New York State Commission of Highways." The information contained in this report was published in the tables in September. The report said that transverse expansion joints were being provided every 30′, filled with pitch and protected with sand.

Elsewhere in this issue mention will be found of concrete roads built by the New York State Commision in the counties for which Rochester is the division headquarters. It appears that the Erie county jointless construction is typical of more than 50 miles of concrete highway work being done this year in the Rochester division.

CONCRETE-CEMENT-AGE wrote C. Gordon Reel, state superintendent of highways, several times in August in an effort to get some information as to the venture in jointless road construction. No information came correcting the idea that expansion joints were being used every 30′.

It appears, however, that the roads in the Rochester division were under the same set of specifications of the State Commission which were abandoned in Erie county. These specifications are quoted in part, page 32, September issue. We have been unable to learn who is the author of the specifications, requiring among other things that: "The concrete shall be mixed with only a sufficient amount of water so that when the mass is rolled with a 10-ton roller the mortar will not be forced through the stone to the surface, but enough so that there will be a slight appearance of moisture on it." Such a specification is unusual, to say the least. The local engineers have had to exercise their discretion in making radical changes in this regard. Yet, so far as we can learn, they have not had the temerity—so far as their superiors are concerned— to provide expansion joints where expansion joints are not specified. Such specifications, necessitating dickering with contractors for substitute methods, make for loose administration. Unfortunately it is the taxpayer who wants, uses and pays for the highway, who suffers most.

We sincerely hope that New York state's jointless concrete roads with their tar, screenings and heavy asphaltic oil applications (many of the roads being as yet without this bituminous surface) will be successful. Yet we cannot but consider that enthusiastic as is Director Page, of the Office of Public Roads, on the possibilities of jointless road construction, he is undertaking a trial stretch of it only, while New York state is building many miles of such road and isn't hurrying about putting on the bituminous coat which is specified. While we are glad to see any new work along this line which may make possible good concrete roads at even a lower cost than they can now be constructed for, we deplore a wholesale construction after a purely experimental method. There are proven methods of concrete road construction.

* * *

Concrete Gatherings at Pittsburg, Chicago. In every line of development concrete is commanding attention. The time is fast approaching when the reinforced concrete building will be the standard, the accepted type. From one convention of the National Association of Cement Users to another, the interval is an epoch in concrete development. Portland cement construction has risen from comparative obscurity to its wonderful present status in a little over a decade. A year is to concrete development what a score of years is to the older materials. There is no man working in any way in this field who cannot find something of interest and real value in the coming concrete gatherings.

In all parts of the country during the past decade, men have been working out in concrete their own ideas in their own way. Every year sees new developments in methods, material and equipment which are of the greatest interest. And the concrete industry today, great though it may be, yet offers many open lines hardly realized today for successful development.

Not only will the uses of concrete extend farther and more successfully in the fields already occupied, but new fields will open. Every year we see changes in practice, new methods and equipment, which, although important in themselves, forecast developments of far greater importance. In the field of block manufacture, important changes have taken place. Plain-face block, well made, are being more widely used as a structural unit. Special aggregates are being used to produce beautiful effects in poured surfaces. Constructors are recognizing that better proportioning and careful mixing are prerequisites for water-tight concrete, and are essential in all work. In road work, wonderful possibilities have been opened.

In architecture, engineering and construction, concrete is today the peer of any material. The average man, engineer, architect, concrete products manufacturer, or builder is, personally, in touch with but a limited part of his field. His direct interests are in the main local. Through the trade and the engineering papers he keeps informed on what is going on, but the annual gatherings, the convention of the National Association and the cement shows offer the best possible medium for the exchange of experience and ideas. They are an educational force, which, second only to the trade papers, have done a great and far-reaching work, in spreading broadcast a better knowledge of concrete, and fireproof, hygienic, permanent, economical construction.

The great work that the National Association of Cement Users is doing, need not be dwelt on here. It is an efficient clearing house of ideas, methods, practice and theory in the uses of concrete. It is a university to which all workers in concrete can come. Engineers, builders, professors, manufacturers and mechanics, all can bring to the Association their personal experience, and as teacher or student, add to the better understanding of concrete. The ultimate success of concrete depends on the mechanic, on the worker, who with his own hands, is putting in the concrete. In this work the engineer serves the workman, and in discussions before the convention very often the most valuable contribution has been made by a member who spoke from personal, we might almost say, manual experience. He had done the work with his own hands.

The winter months should be a time for study and investigation, for picking up the loose threads of the past season's experience, and, adding the new strands of the best development of the past year, the best of theory and practice, weaving well for the coming year.

Pittsburg and Chicago offer good fields for study. Notable concrete work has been done in both cities. Time spent in attendance at and co-operation with the sessions of the National Association of Cement Users, at its coming convention in Pittsburg (Dec. 12-18); in a careful study of the exhibits at the Cement Show in Pittsburg at the same time, and in Chicago in January, will be time well spent.

* * *

Practical Men Needed in Products Plants. One of the reasons the concrete block has not yet filled the position which rightfully belongs to it as a splendid building unit is because it has suffered exploitation at the hands of impractical men. There comes to us a story of a concrete products business, and we publish this story because it carries a moral. The actual facts in this case are just sufficiently disguised in the telling so that the persons will not be readily recognized. Here is the story:

Not very long ago a business man who had about $15,000 to invest outside of his own enterprise thought that the most promising "get-rich-quick" investment would be in the concrete business. He saw how much construction of this kind was actually going on; he had heard of one or two patented machines for manufacturing concrete specialties, and it seemed to him that the business was a veritable gold mine. He decided to "get in the game," with the idea of being able in a short time to sell out his own concern, which was making about $4,000 a year net, and devote all of his time to concrete.

He organized a company with $40,000 capital stock, and was aggressive in selling stock to his friends, who were convinced also of the prospects for "big money" in the business. They paid nearly the entire amount into the treasury. Plans were then drawn for a building—an imposing structure—which was built at a cost of about $15,000. It occupied a large site, and was well located, with good railway facilities. Nearly as much was spent in the equipment of the plant, so that by the time everything was ready for operations, the amount of working capital left was rather small.

Several of the men who had invested money in the company had secured the appointment of themselves or relatives to important positions. The sales manager had had a long and successful career in the millinery business, and the general manager had been an expert accident insurance salesman before he saw the immense profits to be gained in the manufacture of concrete products. The man in charge of the plant, which was to make block and other specialties, had had some experience in street work, but block were new to him. However, he was certain that he knew how to make them, so the company started with confidence to burn.

The first jobs that turned up were bid on, the bid including construction as well as delivery of the material. They didn't get the contracts, however, for they found that there were others in the business in that locality, and that they were making prices which were so low as to insure no great margin of profit. The members of the company began to realize for the first time that possibly the "game" did not differ much from other businesses in the amount of profit produced, and that merely getting a contract was not necessarily going to lay the foundations for a handsome fortune for each of those holding stock.

Armed with the knowledge of competitive conditions, the next orders were gone after with the determination born of desperation. They made prices which they figured would certainly get the orders—and they did. Then they were up against the construction question, and had no end of trouble getting the buildings erected, even though they were comparatively simple jobs. The superintendent explained that as soon as he had had a litle more experience he would be able to handle that class of work without any difficulty. When they got through with these initial jobs, it was found that they had lost a little money, but not much, and they concluded that with the experience behind them they should be able to do much better "next time."

Meanwhile a few notes had to be made and discounted at the banks, and pay-rolls had to be met every Saturday night. Stocks of goods were being made and stored, and sales were comparatively slow. In order to meet the notes and keep things moving, block were sold to other contractors at a price low enough to get their orders, and these, of course, did not produce any profit. The millinery man was by this time longing for a return to chiffons and silks, while the accident insurance solicitor was convinced that there was as much "easy money" chasing commissions as construction jobs.

A few months passed and the outlook was still rather gloomy. Money was needed and a stockholders' meeting was called to consider making an assessment and providing funds to go ahead on. One irate stockholder arose, very red of face and flinty of expression, and declared that he didn't intend to throw good money after bad, and that he would refuse to stand for an assessment. Some of the others indicated that their hopes had been blasted, and that they were perfectly willing to retire from the business. The meeting concluded with the decision to dispose of the business and liquidate the company.

This was done. The property brought a little less than $10,000, and a new company, composed of practical men thoroughly experienced in the business, took it over; and while it has not been in existence long enough to determine the final result, it seems safe to predict that dividends will be paid. With the small capital investment, compared with the actual cost of the plant and its equipment, there should be no difficulty in making it a paying proposition.

* * *

Impress Method for Decorating Green Concrete. All of us have probably noticed at some time or other the impress of children's feet in the surface of a concrete walk. More often, probably, dog tracks are left on a walk, and many a sidewalk contractor would joyfully consign the canine population of the vicinity in which he may be working to some place quite remote, to put it mildly.

These imprints from certain points of view might be called "natural decoration." Genius is that quality which can see, combine and take advantage of ordinary everyday doings; and in a southern California home, the possibility of impress decoration has been worked out in a most interesting way.

As the lady of the house was watching the cement finishers work in one of the sun porches, she took the plume-like branch of one of the graceful shrubs growing in the yard, laid it on the newly-troweled surface, near the border, and instructed the finisher to "pat it down" with his trowel. With some natural hesitation at seeing his newly-finished work apparently disfigured, he complied. In a few minutes, the plumed branch was lifted out. The stem end was raised first, and the entire branch "peeled out." The impress of the branch broke up in a pleasing way the monotony of the surface. The workman saw the natural beauty of the decoration, and took it up enthusiastically, repeating the impress as a border completely around the sun porch.

This opens up an interesting possibility in concrete surface decoration. Of course, under many conditions this method would result in depressions which would collect dirt, and be unsightly and undesirable in many ways. On the other hand, there is no reason why this same idea could not be developed further by filling any desired impress in concrete with a colored cement and sand mixture.

Inlaid tile are used with most excellent results to decorate concrete. A similar end might be arrived at by leaving in the concrete finish openings of various shape and design which could be filled with a mortar of any color or texture. The matter merits consideration.

* * *

Repair of Concrete After Fire Attack. The effect of fire on concrete was illustrated in a most interesting way in the fire at the mill of the Androscoggin Pulp Co., So. Windham, Me. This fire, described in detail in the October issue, demonstrated the fire-resisting qualities of concrete, even more so than a fire in an all concrete building would have done, for the composite nature of the building exposed concrete to a most severe fire attack. The inflammable contents, the wooden roof, trim, doors and window frames, were completely burned away, leaving the wall and floors as mute testimony to the fire-resisting quality of concrete.

In considering the repair of the building, particular attention, it seems to us, should be given to the floor of the building. As noted in the October issue, the intense heat developed considerable expansion in the entire structure, and numerous fire cracks could be seen in the floor. These wer made plainly evident on the under side of the floor by the leakage of water through the cracks leaving a light streak in the soot-coated, blackened ceiling.

Structurally, the floors are practically intact, and would probably hold up under any required loading. The danger lies in the future insidious attack on the steel reinforcing, of rust caused by moisture percolating into these cracks. Would it not be possible to prevent such rust attack by washing the floors with a thin cement and water mixture? The mixture used should have a long continued agitating mix, so that some of the cement, entering practically into solution, would develop colloidal action. Lime might be used with the cement to good effect. The suggestion is a practical one, and could be well considered in the preliminary repair of all reinforced concrete surfaces after severe fire attack.

* * *

A Possible Cause of Dusting Floors. Concrete floors sometimes "dust" under wear. The dust is produced by an abrasion of the surface, and when stirred up by traffic, is thrown in the air. A good concrete surface should *not* dust in this way, and in examining the matter, we must look for causes which may produce an unduly soft surface film. The construction of dustless floors was discussed in the October issue under Consultation Item 206.

Dustless floors have been a matter of much study and experiment. It has seemed to be a fact that dusting invariably appeared to be more serious on work finished in winter where salamanders had been used to keep the temperature above freezing. In an effort to find an explanation of this, it was suggested that the presence of salamanders produces a concentration of carbon dioxide in the air. This is a gas, heavier than air, and spreads out over the floor. Being acidic in its nature, carbon dioxide reacts with the calcium hydrate liberated in the process of solution of the cement, and forms calcium carbonate on the surface. This compound is chemically analagous to our regular limestone, but the physical conditions surrounding its formation, in such a case, result in a product that is soft and affords no great resistance to abrasion, with the result that a floor shows a very serious tendency to dust.

With the coming of winter, salamanders will be used to keep construction work above freezing; and constructing engineers will do well to keep in mind the possibility that salamanders may affect the surface finish.

* * *

Fixing the Responsibility for Fire. The fire regulations of European cities place the responsibility for a fire on the individual who should have followed the regulations and made the fire impossible. The culpable person is not only required to bear the expense of extinguishing the fire, but he must also indemnify innocent persons who may have suffered through his carelessness in permitting conditions on his premises likely to result in fire. *Fines* are imposed under some conditions, as a reminder that the laws are to be obeyed.

Such procedure might well be followed to some extent in this country. Extreme paternalism in the shape of wholesale fire protection, unaccompanied by attempts at regulation, has probably done much to develop a carelessness in personal fire protection.

Any procedure promoting individual responsibility is commendable, and fireproof construction and maintenance must be enforced. Life and property will not be safe from fire until the individual feels his personal responsibility to his fellowmen.

* * *

Municipal Conduit for Public Utilities. An interesting comment on a suggested public conduit, as published in the October issue, is made by Bishop C. D. Williams of Michigan in a recent letter to CONCRETE-CEMENT-AGE. Bishop Williams is a noted student of social conditions, and his opinion is of value in bringing to the problem a point of view entirely separate and apart from engineering and construction circles. The comment follows:

The plan is admirable—

(1) as a piece of engineering economy.
(2) as a public convenience, putting all miscellaneous and multifarious "subways" into one.
(3) as preventing the abomination to the public and the iniquitous expense of continually tearing up pavements.
(4) as giving the city control over public utility corporations, preventing private ownership in public streets, and providing facilities for the municipal ownership and operation of public utilities. It is a plan bound to come.

* * *

Fences for Sidewalk Protection. In coming down one of the main streets the other day we noticed some cement sidewalk work which was being protected in rather an interesting way. Empty cloth cement sacks had been filled with sand and into the mouth of the bag a stake was thrust. The bag was then tied tightly around the stake, which was used as a corner or intermediate post to support the chicken wire which protected the fresh concrete walk. This appears to be a rather ingenious way of building temporary fence for sidewalk protection.

At a recent meeting of the Russian Cement Congress, it was stated that as compared with 7 factories in Russia 25 years ago, there are now 38, and, according to the figures given at the meeting, their total production for the year 1911 was 8,371,000 barrels. With the additional capacity which has been brought into being in 1912 it is expected that close to 13,000,000 barrels will be produced.

In the year 1911 the demand for Portland cement grew to such an extent in Russia that the works were unable to meet it, and considerable importations of cement were required from other countries. Owing to the development of the Russian Cement Association and the interest taken in the production by leading engineers, the quality of Russian cement has been greatly improved of late and meets fully the requiremnts of practically all other countries; in fact, the Russian government specifications are really more severe than those of most other countries in the world.

Concrete in Cool Weather.

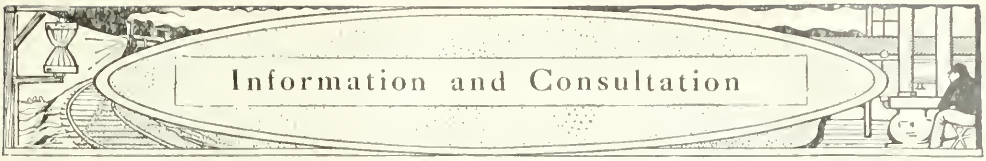
At this season of the year the greatest care must be exercised in using reinforced concrete. Cool weather, with its attending atmospheric conditions, even though not freezing, has a bad effect on concrete. The following, compiled by the Trussed Concrete Steel Co., Detroit, is worthy of special consideration:

1. *Delayed Set:* During cool weather, even though not freezing, the setting of cement is delayed. Sometimes two weeks or more after placing it is possible to drive a nail into the concrete, which indicates how serious is this delay in the set. The only sure way of knowing when the cement is fully set and the concrete properly hardened is actually to test it with a hammer for hardness. To do this it is necessary to remove small portions of the form work in each section of the structure to be certain that there are no soft spots. Bear in mind, this delay and indefiniteness in the setting of cement are not due to freezing, but merely to medium cold weather and attending atmospheric conditions.

2. *Avoid Freezing:* Be careful to avoid freezing of the concrete. While the days may not be particularly cold, the nights are often below freezing temperature. Therefore, protect all freshly laid concrete by covering it with some material that will prevent freezing. Be especially careful to protect this concrete at night. It is said, and may be true, that frozen concrete will re-set under certain conditions, but it is not advisable to depend upon such an uncertainty. The safest plan is entirely to avoid freezing. If absolutely necessary to place concrete in freezing weather, the materials, such as sand, stone and water, should be heated and the concrete so protected as to keep its temperature above freezing.

3. *Careful Work Necessary:* Workmen are apt to become careless in cold weather. They have a tendency to shirk their duty, especially when it exposes them to the cold. Therefore, particular care should be used by the superintendent in charge to see that the forms are properly braced, that the bottoms of beam and column boxes are clean before pouring concrete, that the steel is accurately placed, concrete thoroughly mixed and the workmanship in general the best possible. Special vigilance is required of the superintendent at this season of the year.

4. *Removal of Forms:* The most important point, and one whose importance cannot be over-estimated, is *caution in the removal of the form work.* Don't remove any forms until absolutely certain that the concrete is thoroughly hardened and that no portion is either soft or frozen. Even after you are certain that the concrete is hard, remove the forms very carefully and without shock to the structure. Always leave in place a few intermediate posts so as not to place the entire dead weight too suddenly on the beams and columns.



Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking of our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation

section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

This issue marks the merging of the two departments, "Information" and "Consultation," which for many years have been of particular interest and value to readers of *Concrete*, *Cement Age*, and *Concrete Engineering*, and in the last four issues to readers of CONCRETE-CEMENT AGE. The subjects in these two departments, however, have paralleled to such an extent that it has seemed best to combine them. The new title,' "Information and Consultation," retains the identity of both departments. We want CONCRETE-CEMENT AGE readers to know that this is *not* a new department, but simply a combination of the two old ones for more effective work. The Editors.

244. Concrete Vats for Fruit Storage.

"How can concrete surfaces be protected against the acidic qualities of fruit juices, so that concrete vats can be used for storage?"

244. DISCUSSION (EDITORIAL).

Vice-Consul Smith, of Beirut, Syria, in a recent issue of the Daily Consular Reports, describes the manufacture of apricot paste, and suggests that in view of the abundant apricot yield on the Pacific coast it might be of profit to American farmers in that region to utilize that portion of the yield which is too ripe, or is otherwise unfit for transportation to the fruit markets or canneries, in the manufacture of apricot paste, known in Syria as "kamereddin." He describes the methods of manufacture as follows:

A basin two or three ft. deep and of a circumference proportionate to the crop to be treated, is dug by the farmer and lined with cement mortar. The ripe apricots are stoned and thrown into this basin and beaten into a pulp with tampers. The primitive method of kneading the fruit with bare feet is still often resorted to. The pulp is then spread out on thin boards and placed under trees and in shady places to dry. These boards are of uniform size, and the paste is so spread out as not to be thicker than 1/10" when dry. The sheets thus manufactured when dry weigh 1 rottle (about 5½ lbs.) and look like sole leather. The orchardist can produce this paste on the farm and, with little cost and labor, place on the market an article which is easy to ship and which meets a growing demand.

Further details as to the construction of these vats were requested of the Consul General at Beirut, who writes as follows:

The materials most generally used are broken rock, sand and lime. The lime is always freshly burned, and makes a very strong concrete. Fresh burned lime is always to be had here, as Syria abounds in limestone, and lime kilns are to be found all over the country.

In some instances, small quantities of cement are mixed with the lime. No cement is made in this country. Most of the cement used here comes from Germany and other continental countries.

257. Curing Tile and Some Percolation Tests.

"Kindly advise us what, in your opinion, would be the result of heavily sprinkling with cold water concrete tile while they are in the steam-curing department, the temperature of which is about 80° to 90°. Anything else that you may have in the way of steam curing would be appreciated.

"It might be of interest for you to know that we have divided our entire floor space into compartments, which are covered and walled with oiled canvas, having curtains for doors. These make very successful steam curing kilns, and are economical as well as good condensers of steam.

"If you have any information on the subject of permeability or percolation in concrete tile, we shall appreciate it very much."

257. DISCUSSION BY E. B. ROSA.*

Relative to the effect of sprinkling concrete tile with cold water while curing in the steam room, I would state that we have had no experience with sprinkling tile with water while curing in steam, but cannot see how it would have any beneficial effect. On the contrary, it would tend to cool the tile, which would defeat the object of using steam as a means of curing or accelerating the chemical action which occurs in the hardening of cement. Contrary to the opinion of many, it is our experience that the higher the temperature the more rapid the curing, providing, of course, that moisture is not removed from the concrete.

*Acting Director U. S. Bureau of Standards.

262. Long Span Girder Bridges for Interurban Railway

"We have a request for reference to concrete bridges which have been built for interurban or railway use, using girder design, with a 50 to 80-ft. span. Could you let us have any information on this?"

262. DISCUSSION BY H. G. TYRRELL, CONS. ENG., EVANSTON, ILL.

In reviewing this subject, it is, in the first place, difficult to say how many bridges of this type have been built, or to give their dimensions, as comparatively few of the great number of concrete structures now being erected are ever reported in the technical journals.

It is certain, however, that in America, concrete girder bridges with spans exceeding 50' are not in favor, preference being given to arches, which are not only lighter, but have a better appearance. But in Europe, the girder type has been more often used, and a few examples will be given herewith. In his "Engineer's Hand Book," L. J. Mensch states that concrete girder bridges can compete with concrete arches in spans up to 70', but not for longer ones. Since the arch is preferred in America for spans exceeding about 40 ft., it will be seen that in the author's book "Concrete Bridges and Culverts," beam and girder bridges are tabulated with dimensions up to that length only. Instructions issued by the U. S. Office of Public Roads, for building concrete bridges and culverts, specifies beams and slabs for lengths up to about 30 ft. In the State of Illinois, all spans of 50' or less, must hereafter be made of concrete, in one form or another.

Concrete girder bridges as built in Europe are usually either of the Hennebique or Moller types. The first consists of a floor slab supported on a frame of beams and girders with parallel chords; the Moller bridge uses fish-belly girders beneath the deck slab. An interesting illustration of Hennebique construction is seen in the extension to Pont d'Jena over the Seine at Paris. The extension was completed in 1900. The span has a clear length of 46', and has a center rise of nearly 2 ft.; the 12 lines of beams or ribs extend over the abutments to act as cantilevers. The bridge is 98' wide, and the floor is formed of concrete slabs from 5" to 7" thick. It is known as Quay-Debilly bridge.

Other long concrete girders in Paris are over the subway of the Metropolitan Electric Railway, where the clear span of girders is 52′. They were proportioned to sustain a live load of 200 lbs. per sq. ft.

A bridge over the Ouche at Plombiere-les-Dijon, has two spans of 68′, supporting a highway 15′ wide, while another of the Moller type, over the Ocher at Brunswick, has a clear span of 75′ and a total width of about 28 ft. The exterior girder faces in this latter bridge are quite ornamental.

A 3-span bridge over the water at Milan has a center opening of 83′, with approach spans of 34′ at either side. The side girders stand 1 meter above the grade, forming a substantial parapet, the inside width of which is 23′. In this case the side beams are 2′ wide and 6½′ deep, and the 5″ floor slab is supported on a system of intermediate concrete beams 10″x16″. At the time of building it was reported to be the longest concrete girder span in Europe.

A longer concrete span than any yet mentioned was completed some years ago in America at Memphis, Tenn., from a design by the city engineer. It had a clear opening of 100′, with a center rise on the under side of 4′, and in some respects was similar to the Quay-Debilly bridge at Paris. The two main girders, standing above the roadway, were carried far enough beyond the abutments to act as cantilevers on the shore side. The sidewalks were on brackets outside of the main girders, and the total width of the structure was 31′. Its cost with pavement was $17,500.

Most or all of the above bridges were essentially to carry highway traffic, though some were proportioned for heavy street cars. Very few concrete girder bridges wholly for railroad purposes have been reported in the technical journals. One, however, was completed a few years ago at Richmond, Va., for the Richmond & Chesapeake Bay Ry. Co. It consist of a series of concrete trestle spans on concrete bents. In this viaduct there is one span with a length of 49′ feet between centers of columns. The two side girders are each 20″x54″, and they are connected at the top by a 3½″ horizontal concrete slab.

This type of bridge is hardly worthy of extensive use for spans exceeding about 40 ft., because, as previously stated, the girder type is clumsier and heavier than an arch and has a less attractive appearance.

263. Combination Trolley Pole and Light Standard.

"Our city engineer is investigating the possibility of using concrete to make a combination trolley pole and light standard. Can you offer any suggestion along this line?"

263. Discussion by A. G. Higgins.*

In a combination of this kind, which is strictly a utilitarian idea, one must hide or cover the iron pole in some way, and make it part of the whole scheme, instead of, as is usually the case, having an ugly bare pole sticking up into the landscape "like a sore thumb."

In this suggested design the covering, which is of concrete, consists primarily of three parts: lower post (which may be plain or fluted), a cross arm (carrying 2, 3 or 4 lights), and an upper post, which has a single light on top and also carries the cross wire.

In practice the light wires are brought up inside the iron pole and the cross arm is served through holes in the pole and the wires continued up to the top light.

The posts used are hollow, and are large enough to slip over the iron pole. In setting, the lower post is first slipped over the pole and plumbed. Then the hollow space between the concrete and iron is filled with grout. As a precaution against expansion of the iron pole causing trouble, it should be first tightly wrapped with a heavy tar paper from top to bottom. Then the cross arm is slipped into place, the wires brought into the cross arm to the outlets and the arm grouted in place. Then the upper post is slipped over the pole, and the trolley-carrying wire connected to the pole before grouting. This makes the whole pole rigid and stable. The different parts of the concrete work can be shop-made and have a beautiful finish that could not be secured in field work.

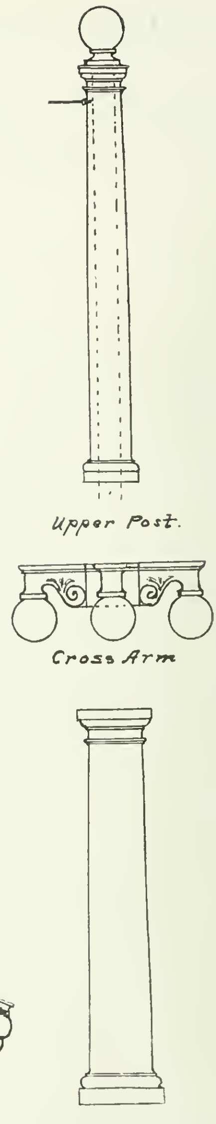


Fig. 1—Sketch Showing Arrangement of Sections for Combination Light and Trolley Pole

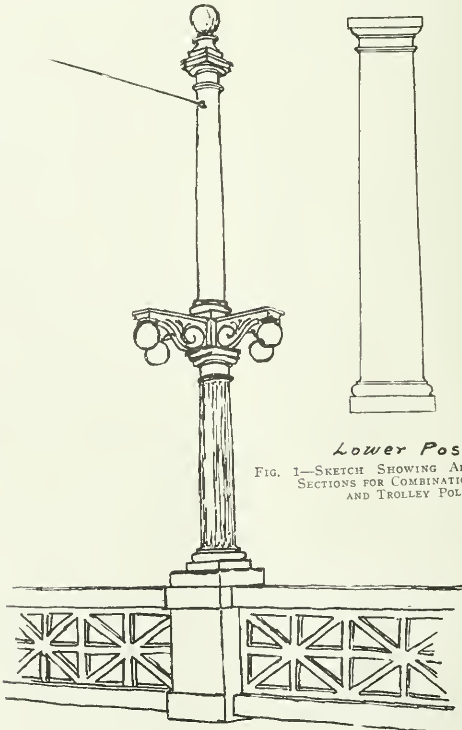


Fig. 2—Sketch (Perspective) Showing Suggested Trolley and Light Pole

*Trusswall Mfg. Co., Kansas City, Mo.

264. Waterproofing a Basement Floor.

"The specifications of a contract call for a 2-in. floor, 1:3, with waterproofing added, which I had to guarantee to be waterproof. This held for 30 days and then heaved down the center and cracked. I would like to know if it is possible for a 2-in. floor to hold back a 3-ft. head of water in a 20'x40' basement, when the old floor was bad concrete and the walls were poor. What thickness should this have been?"

264. Discussion by A. L. Fridstein.*

We do not believe that a 2-in. concrete floor can possibly be made strong enough to hold back a 3-ft. head of water in a basement 20'x40', even if reinforcement is used. This floor, placed on an old floor of bad concrete, should have been not less than 4" in thickness, if of plain concrete; and 3", if containing not less than 1/10 of 1% of wire reinforcement. The concrete in any case must be a 1:2:4 mix, well tamped and carefully troweled.

It is our opinion that you should not have assumed any responsibility for the waterproofing quality of the floor, if installed with the specifications described by you.

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265. Concrete for Chemical Tanks.

"Can we use concrete to build tanks for some of the chemicals we have on hand all the time? For what chemicals could concrete storage vats be used?"

265. Discussion by Edgar F. Billings.†

I have long been of the opinon that concrete could be used much more extensively than it was in the chemical industry. I had a good chance to prove this some time ago, and my experience may be of interest in connection with the above question.

The company with which I was connected was manufacturing a compound in which a large amount of liquid bromine was added to another liquid in a 300-gal. iron tank. Bromine is one of the most corrosive chemicals known, and the tank "ate" out very quickly. The last time it started to leak (pin holes develop while the main part of the iron is still good), I suggested lining the tank as it was with a 3-in. neat cement lining. The company scoffed at the idea of such a lining being able to stand the bromine, but the cost was so trifling that it was tried.

I made a board shell, that allowed 3" between the side of the tank and sides of shell, and had this ready to put in as soon as the bottom was laid.

Then I took 6 of our men and went to work. None of us had ever mixed a batch of cement, and I felt some doubt of getting a decent-looking job, much less a sound one. I won't take up space with the details of how a "greenhorn" went to work to lay a "monolith" before any part could set. The fact is, however, that the job was sound and did not crack. As a result of the care used to prevent too rapid drying, and to allow a good "set" before using, I made out of that old rusted-out iron shell a tank that has been in use three times as long as the iron one lasted, and is, so far as can be seen, just as good as ever.

A new tank would have cost $75, and three of them would have been used up by this time. My lining cost was: 10 bags cement, a few gallons of silicate, and some second-hand boards that were lying around. The labor cost was: 2 men 1 day making the frame, and 6 men for 7 hrs. doing the work. Of course, I personally superintended. It cost less than $30, and we still have the tank.

*First National Bank Bldg., Chicago.
†Chemical Specialist, Boston, Mass.

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266. Hydrated Lime, and Its Use.

"Will you please tell me exactly what hydrated lime is? How is it made and how used? I understand that it is used with Portland cement in concrete to make a whiter and more dense material. What detailed information can you let me have on this?"

The Material and Its Manufacture

266. Discussion by H. S. Spackman.*

Hydrated lime is a dry pulverent powder produced by slaking ordinary quick lime, only sufficient water being added to supply the waste by evaporation during slaking, and to hydrate the lime. While hydrated lime can be made by simply adding enough water to reduce it to a dry powder, its practical production requires careful chemical supervision and rather extensive machinery. The quick lime is crushed to pass ¼-in. mesh or finer and delivered by elevating and conveying machinery to a bin over the hydrator, which is either of the batch type as typified by the Clyde hydrator or of the continuous type as typified by the Kritzer hydrator. The amount of water is carefully regulated and the material is discharged from the hydrator as a powder. This is then passed through a suitable grinding apparatus, generally of the beater type. The coarse particles are then taken out either by an air separator or by screening, and the resulting product should have a fineness of at least 95% through the No. 200 mesh sieve, and should not contain over 1% of calcium oxide, and preferably none.

Hydrated lime is chemically identical with lime produced in the ordinary way by slaking with an excess of water, and has the formula of CaO_2H_2. Hydrated lime is largely used for waterproofing concrete, in the proportions of 100 lbs. of hydrated lime to 400 lbs. of Portland cement. The effect is mechanical, the hydrated lime filling the pores in the mortar. The results of tests made by the Bureau of Standards indicate that hydrated lime is one of the best waterproofing materials known.

Hydrated lime is also used mixed with cement in about the proportions indicated above for bricklaying, etc., the effect being to make the mortar more plastic and easily worked under the trowel.

*Henry S. Spackman Engineering Co., Philadelphia.

Hydrated Lime as Waterproofing.

266. Discussion by S. B. Newberry.*

Hydrated lime, clay and other finely divided inorganic materials act simply by filling the voids of concrete, and thus to a considerable extent delaying or reducing the penetration of water. I know of no authority for considering hydrated lime as anything but an inert material in this connection, so far as its chemical or physical action is concerned. Hydrated lime doubtless improves the strength of concrete exposed to dry air, but does not, I believe, improve its strength when kept moist. I believe competent cement engineers will agree with me that its effect in reducing penetration of water is mechanical only, and that in this respect it may fairly be considered an inert substance, acting exactly in the same manner as clay or other finely divided material.

Hydrated lime is a commercial product, widely sold under various names. It consists of ordinary lump lime slaked, dried and powdered, and is in the form of a fine white powder, which is sold at a price of $5 to $6 per ton at factory. Addition of 25% to 50% of hydrated lime to cement gives increased strength and greater density to concrete. There is no gain, however, in using hydrated lime in concrete which is to be kept constantly wet, and the benefit of the addition is confined entirely to concrete exposed to air, such as concrete block, etc.

Lime Solution for Gauging Concrete

266. Discussion by Milton Dana Morrill.†

Hydrated lime is lump lime, water-slaked and re-ground. As it is in powder form, it is easily mixed in the concrete. The advantage of its use is that it assists in filling voids, making a more dense and damp-proof wall. It also gives the concrete more of a plastic consistency, preventing settling and separation of the heavier aggregates, giving a whiter and more perfectly finished surface.

The writer has in several contracts used lump line in another way, which is also less expensive and has given good results. Adjoining the mixing-boards 3 barrels of water are kept filled. Into each of these is put from 2 to 3 shovelfuls of lump lime. This is allowed to stand and slake for a time, being occasionally stirred. The lime water is continually dipped off for use in the concrete, and any unslaked lumps are allowed to settle in the bottom of the barrel. At the end of a day's work, the barrels are emptied into a box or other receptacle and allowed to slake further. In this way the lime water is like whitewash, and, through the slaking of the lime, is heated several degrees, which assists in the quick setting of the cement, particularly in cold weather.

*Sandusky Portland Cement Co., Sandusky, O.
†Read & Morrill, Inc., Brooklyn.

267. Composition Floors for Office Buildings.

"They are making the floors of big office buildings in Germany of a mixture of magnesium chloride, pulverized magnesia and sawdust, laid from 2" to 4" thick. Consul-General Robert P. Skinner reports from Hamburg that such floors are waterproof, almost fireproof, free from cracks, warm under foot, elastic, sound-proof, and cheaper than pine flooring, tiling or stone.

"I am building a reinforced concrete monolithic residence, and I would like to try the experiment of laying some of the floors of the above material. Can you refer me to more detailed accounts published in Germany, or elsewhere, covering this method?"

267. Discussion by A. G. Higgins.*

Composition floors made of the above mixtures have been used in Germany and other European countries for some time, and in certain cases are quite successful. These floors have also been used and are being used in the United States to quite an extent, and when properly handled are successful. Probably one reason that the Germans are making such good floors is that they are more painstaking than are the Americans who try to use this material. Magnesium oxy-chloride cement requires the most careful attention to proportions and methods of handling; and Americans generally are less careful than are the Germans.

The writer has not seen floors made wholly of the composition, that is, floors from 2" to 4" thick, and he questions the success of using the material in that manner. This material is so liable to check, warp and change shape that it is more successful to lay it over some other substance, such as a wood floor or a rough floor of concrete; and the layer should not be over ½" or ⅝" thick. In laying over wood floors, expanded metal well nailed to wood before laying composition, will tend to keep floor from warping and checking. Laid over concrete, the concrete should be thoroughly cured, roughened and left so that the composition will be of uniform thickness.

The writer questions whether or not it is wise for a man without experience with the material to try to lay his own floors. It is hard in this country to secure the materials that are of good quality, and the expense of the material when shipped in small lots is prohibitive. Then if the mixture is not properly made the floors will be wet or "greasy" in damp weather. The chloride must be properly combined, or any free chloride in the mixture will attract water in damp weather and the result will be a damp, disagreeable floor. Some firms in this country have put down floors of this kind that are very satisfactory, but usually when successful floors of this material are found, a man of considerable experience put them down.

In *Cement Age* for June, there is some information along this line, under the title, "Selling Formulas and Oxy-Chloride Cements," which is of interest in this connection.

*Trusswall Mfg. Co., Kansas City, Mo.

268. Ornamental Rubble Posts.

"What is the best way to build ornamental posts of rubble concrete—posts 2' square and 6' high? I want to use cobble-stones about 3" in diameter for facing."

The Le Chatelier Test for Soundness

In discussing various methods of determining the relative soundness of cements, reference is frequently made to the "Le Chatelier needles." This apparatus is often employed to determine soundness, and is said to be more easily operated than any of the other forms. It is described by Le Chatelier as follows:

A much more simple and yet sufficiently precise measurement of the expansion can be made by letting the cement harden in cylindrical molds of a diameter equal to their height, constructed of metal, slit along the generatrix and provided on either side of the slit with two long needles, which serve to magnify any widening of the slit. The widening is equal to the enlargement, not of the diameter, but of the circumference of the cylinder of cement.

This apparatus may be employed not only on specimens kept at normal temperatures, but also on specimens which have undergone some form of accelerated test. The method of making this test, recommended by the Engineering Standards Committee in the British Standard Specifications, is as follows:

The apparatus for conducting the Le Chatelier test consists of a small split cylinder of spring brass or other suitable metal of 0.5 mm. in thickness, 30 mm. internal diameter, and 30 mm. high, forming the mold to which on either side of the split is attached an indicator 165 mm. long from the center of the cylinder, with pointed ends.

In concluding the test, the mold is to be placed upon a small piece of glass and filled with cement gauged in the usual way, care being taken to keep the edges of the mold gently together while this operation is being performed. The mold is then covered with another glass plate, a small weight is placed on this and the mold is immediately placed in water at 58° to 64° F., and left there for 24 hours.

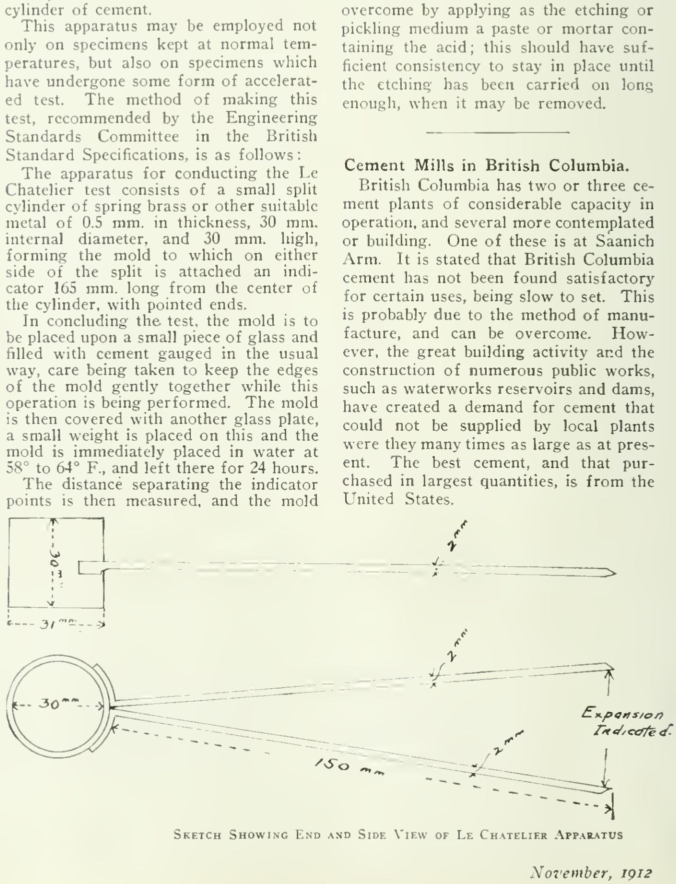
The distance separating the indicator points is then measured, and the mold placed in cold water, which is brought to a boiling point in 15 to 30 min., and kept boiling for 6 hours. After cooling, the distance between the points is again measured, the difference between the two measurements representing the expansion of the cement.

Roughening or Graining Colored Artificial Stone.

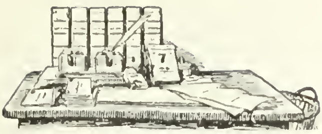
The usual method of bringing up the color or the grain, or both, on artificial stone in which the aggregate or filler has a coarse grain, is to pickle the surface with a more or less strong acid. This dissolves the cement on the surface and brings to the surface the coloring matter or the grains of the aggregate. This is, however, practicable only where the surface to be treated is horizontal; as on vertical planes the acid would trickle down and attack the lower portions of the surface more strongly than the upper; and on ceilings, etc., the operation would be very unpleasant for the workman, and risk spotting the floor. This is to be regretted, because where the surface has been made by casting or troweling in place there is proportionately more cement in the surface layer than where slabs have been made and set up. The difficulty may be overcome by applying as the etching or pickling medium a paste or mortar containing the acid; this should have sufficient consistency to stay in place until the etching has been carried on long enough, when it may be removed.

Cement Mills in British Columbia.

British Columbia has two or three cement plants of considerable capacity in operation, and several more contemplated or building. One of these is at Saanich Arm. It is stated that British Columbia cement has not been found satisfactory for certain uses, being slow to set. This is probably due to the method of manufacture, and can be overcome. However, the great building activity and the construction of numerous public works, such as waterworks reservoirs and dams, have created a demand for cement that could not be supplied by local plants were they many times as large as at present. The best cement, and that purchased in largest quantities, is from the United States.



Sketch Showing End and Side View of Le Chatelier Apparatus



CORRESPONDENCE

One-Course Concrete Sidewalks

The ordinary term used to describe a concrete sidewalk is "a granolithic walk," but this term in most cases in incorrect; the word "granolithic" being a word of compound derivation, "grano" for granite and "lithic" from the Greek for stone. This word then would be interpreted to mean an artificial stone composed partly of granite.

Finely crushed granite mixed with sand and cement is sometimes used in surfacing a concrete sidewalk, but usually the surface is composed of sand and cement only, mixed in the proportion of 1 part of cement to 2 parts of sand, or if an exceptionally smooth wearing surface is desired the mixture might be 1 part of cement to ¾ part of finely crushed rock and ¾ part of sand.

This surfacing material is usually 1" thick applied on a concrete base 3" or 4" thick, before the base concrete has acquired its final set.

I wish, however, to show that the general method of constructing concrete walks in two operations is not so desirable for permanency, practicability or economy as a monolithic concrete, properly laid.

A mortar composed of sand and cement alone does not have the wearing qualities that a concrete has in which the same richness of mortar is used. The abrasion caused by traffic over the surface liberates the grains of sand which under the feet of the public assist in grinding down the mortar surface much faster than they would the stone aggregate in concrete if the top finish were not put on.

The smooth finish ordinarily sought for, because it looks nice and glossy when first laid, increases the liability of accidents to pedestrians in snowy or icy weather, and especially when laid on steep grades. A concrete walk in which there is a large proportion of not too coarse stone wears to a hard surface, not too rough nor too smooth, a surface on which the danger of slipping or falling is reduced to a minimum. What is the good sense in endeavoring to obtain a glossy surface on walks or steps, and then inserting strips of some rough material to prevent slipping, when the material itself could have been so laid so as to get the same result?

A walk of concrete alone with troweled top can be laid more cheaply than a walk composed of a concrete base and separate topping of fine material.

As a comparison take 100 sq. ft. of surface laid with 4" of 1:2:4 concrete, troweled. This would reuire 1 cu. yd. of stone, ½ cu. yd. sand and 2 bbls. cement, costing, say, for

Stone	@ $1.75 per yd.	$1.75
Sand	1.00 per yd.	.50
Cement	1.25 per bbl.	2.50
Labor placing concrete	1.25 per yd.	1.56
Labor troweling	.01 sq. ft.	1.00
Total cost		$7.31

or $.07⅓ per sq. ft. after foundation is provided. If the same area is laid with a concrete base 3" thick of 1:2½:5 concrete and a 1" top mixed 1:2 cement and sand figured on the same basis as to cost of material the 100 sq. ft. will cost

Stone, .85 sq yds. @	$1.75	$1.49
Sand, .85 sq. yds.	1.00	.85
Cement, 2.29 bbls.	1.25	2.86
Labor placing concrete	1.25 per yd.	1.16
Labor placing topping	2.50 per yd.	.80
Labor troweling	.01½ sq. ft.	1.50
		$8.66

or a saving of one and one-half cents ($.01½) per square foot between the two methods.

I have placed the labor cost of the ordinarily called granolithic surface higher than for the surfacing of the 1:2:4 concrete, as a cheaper grade of labor can be used for the latter.

There is, however, difficulty in troweling concrete to a good surface unless the right tools are used in tamping and compacting it.

Crushed stone or gravel, either of which may be used, can be bought at ordinary prices, screened through a 1½" screen and retained on a ½" screen so that the dust is screened out.

When concrete is mixed and placed with the intention of finishing its surface some method must be adopted which will press down the larger stones from the surface and allow the smaller stones with the surrounding mortar to remain at the top, so that a trowel will float easily over it. Tampers are on the market designed for this purpose. In one the tamper face is composed of pyramidal projections, which press the larger stones down and allow the fine stones and material at the surface to fill the spaces between the projections. All walks not specially designed with reinforcing steel should be jointed into squares not over 6' either side to prevent shrinkage cracks. These joints must be completely through the concrete, and the best method of making them is to use some of the steel forms that are on the market.

H. B. Andrews,
Boston. Mem. Am. Soc. C. E.

Why Concrete Block?

Having read and heard a great deal about the subject of sprinkling and steam curing and kindred methods of procedure in the production and perfection of concrete block, none of which appeals to my ideas along the line as laid out, if I may judge from the final results, I feel called upon to venture one or two assertions which are based upon my own personal observations and upon remarks of others who have seen the same results.

I claim and firmly believe that concrete to be good, sound, durable and waterproof (and it must be waterproof in order to attain the other qualifications) must primarily (in the course of mixing) be made sufficiently wet so as to flow. Otherwise, there will be voids, which are not conducive to any of the qualifications necessary in good concrete.

In consideration of the expense of the requisite number of molds to make any considerable number of concrete block per day for each workman so engaged, the majority of operators who would engage in the concrete block business very naturally balk at the wet process, and use the semi-dry process which enables them to make a fair showing in output of block, and trust to sprinkling, steam curing, etc., etc. With the semi-dry process they can throw off the molds as soon as the block has been tamped and the top edge struck off even with the upper edge of the mold.

It has been and always will be my claim, that the water which is not introduced into the concrete in the first or primary mixing of the concrete, will never get into the concrete (to do any good) after the block has been stacked in the yard, shed or elsewhere, even though the block be sprinkled periodically for a year or more. Imagine that it did (for the sake of argument), would, or might it not encounter some perfectly dry cement within, and would not this dry cement swell and break the block? I base this assertion on the fact of the gripping power of the concrete, so very important to the engineer of today. If there is shrinkage, there certainly must first be expansion, that there be room for the shrinkage. If there be no shrinkage, then are all our formulas for bond strength in vain; we do not know what we do. Why use 80 lb. for plain rods and 150 lb. for the best mechanical bond or deformed bars?

Assuming that the water does not do the block any good, after the block has been stacked up to cure, is not here an unnecessary expense, that could be put to better use by investment in extra molds, etc., and then using the wet process, establishing a name for good block?

The results have shown that nine out of ten block houses are wet as shown by appearance after a rain—even for several days.

As a matter of fact, the public will judge concrete work by the poorest work done in the concrete line and will not stop to consider: Why is this thus and so; was the work done correctly, was there sufficient cement used, were the supports, forms, etc., left in position long enough, was the designer capable in his work? Except by the trained mind, these questions are never considered at all.

Is this not a detriment to concrete—the best and most substantial material (in proper hands) that was ever employed for the habitation of man?

C. W. Pomeroy.
St. Louis, Mo.

Architecture at Panama.

Once more we have reason to be thankful for Senator Newlands, of Nevada, of constructive imagination and great ideals, who has done so much for our national architecture.

Not only the constructive qualities but the artistic possibilities of concrete have now been demonstrated, here and there, in isolated and more or less obscure examples, but sufficient to show far greater opportunities than have been afforded for the expression of our art since its beginnings.

The great national Panama undertaking affords a chance for scientific architectural design, utilizing esthetic opportunities in the same unacademic, untrammeled and straightforward way in which the structural advantages have been worked out by the engineers. This would have a greater and more permanent value for architectural development of a new order than had the Columbian Exposition, which stimulated interest in the fruits of an old order, whose expression, magnificent as it was, represented the development of needs, materials and building facilities now both foreign and obsolete.

WALTER BURLEY GRIFFIN.

Architect, Chicago, Ill.

Septic Tank Construction.

It may be of interest to note that the tank described in the September issue is located at the Iowa Agricultural College, Ames, Ia. Of course, there are thousands of these tanks in use in all parts of the United States. This septic tank is patented, but the patentees have never thus far interfered with private individuals who make use of the septic tank for their own home uses.

If one intends to build such a tank where the treated sewage will not be removed through a long string of drain tile, it may be advisable to build a gravel filtration bed at the outlet end of the septic tank, and drain this bed from the bottom by means of a farm drain tile.

The nitrification of the sewage will then be completed in the gravel filtration bed instead of in the long string of drain tile.

PERCY H. WILSON.

Sec. Assoc. of American Portland Cement Manfrs., Philadelphia.

Steam Curing—Low Temperatures

Referring to steam curing of concrete block, I am not able to give any suggestions based on practical experience, except with free steam, in curing chambers at comparatively low temperature, not exceeding perhaps 130° F. This we have found a decided advantage, hastening the hardening and improving the appearance of the block. I should think it probable that curing by high pressure steam would prove expensive and complicated and that no corresponding benefit would be secured. I note also that sudden changes of temperature, in bringing block cured at high temperature into the cool atmosphere, have in some cases resulted in cracks and lack of soundness in the product. It appears reasonable that the most advantageous conditions for hardening of cement mixtures are those not far removed from ordinary atmospheric conditions and temperatures.

S. B. NEWBERRY.

Sandusky, O.

Concrete Fish Ponds Failed

The cold weather last winter has proven that cement concrete is worthless for fish ponds, because the intense cold cracks it by contracting it, when the water runs out and the fish die. I spent $225 last fall on three cement concrete ponds located on a side hill, and I put 300 goldfish into them. The cement concrete was made of the best sand 50%, and Portland cement 50%, with some small field stones in the mixture. It cracked badly when the thermometer reached 6 below zero, the water all filtered out through the cracks, and the fish all died. The side walls of these ponds are 11" to 14" thick.

I think that I have discovered the remedy for that trouble, which is to make the concrete mortar of 1 part best lime, 1 part Portland cement, and 2 parts good, sharp sand. The foundation of brick and stone under my home, built three years ago, did not crack where the cement and lime mortar was used, while where cement and sand only was used the foundation cracked badly last winter, but I shall not spend any money on the fish ponds to try that new mortar on them, as I am discouraged from pushing that experiment. It is clear that there remains very much to be discovered as to the effect of intense cold on concrete. Many of the sidewalks in this county laid with concrete also cracked in the cold of last winter.

This is a subject of the greatest possible interest to cement manufacturers, for, when everybody is as strongly convinced by an actual big loss as I am that cement is worthless for the purpose it was bought for, the use of it will fall off. It behooves the manufacturers to make experiments and find a remedy for this cold weather cracking of concrete. The old Roman cement did not crack that way in the aqueducts of Rome, but perhaps that was because the Roman climate never falls as low as 6 below zero, and anyway, the secret of making Roman cement appears to have been lost. I shall not spend another penny for water-pond work until I am assured of a method for a combination of materials that will make the concrete elastic enough to stand the contraction and expansion of the weather and not crack.

Yours respectfully,

G. A. HOLLINGER.

West Hoboken, N. J.

[Editor's Note.—It was so apparent in the above letter that Mr. Hollinger felt aggrieved, even though he put the blame for the accident in the wrong place, that we asked him for additional information, which he gives in the following letter:]

The ponds are three in number, built in oblong shape, from 5' to 8' deep. They are all near the top of a steep side hill. They were dug through yellow clay down to a hard top rock bottom, impervious to water. Their side walls are built as straight walls, the same as the foundation wall of a house. Planks were set up at their four sides, distances varying from 11" to 14" from the clay sides of the excavation, then the concrete was poured in between the planks and the clay sides of the banks. The concrete was made of 50% of the best domestic Portland cement, and 50% of the best sharp sand. After a few inches had been filled up with that concrete, the masons set some small stones into it to stiffen it and make it less liquid. These small stones vary from egg size or smaller to double egg size. They were taken from the fields and were completely covered with the concrete mortar at least 2" thick before another layer of them was put in. The cement and sand were thoroughly mixed dry, and then water added sufficient to make a thick mortar. As fast as the wall rose more planks were added until the top was reached. Then the work was allowed to dry and harden for three or four days, and then the planks were removed, the top nicely finished and all imperfections of the wall were smoothed and pointed off with concrete. After one week more some water was let in the ponds. The walls were scrubbed and the dirty water pumped out to prevent any injury to the goldfish from the cement. Then the ponds were filled up with water to the top and the goldfish put in. The work was done in October and early November, 1911. The ponds at first held the water beautifully, and remained constantly full with the rain that fell on the roofs of two sheds and into a concrete gutter on the ground, running along the sides of the sheds. This yielded clear and pure rain-water.

We got our first severe cold weather in January, 1912, and the ponds froze over solidly with ice 6" thick. In order to give air to the fish, we cut through that ice, and then it was found that the ponds were only half full of water and that the side walls had heavy cracks in them. The water kept on sinking until it was all gone, and the goldfish died from lack of water. Several cracks running the whole length of the ponds were found one above the other and at the junction of the rock bottom and the concrete wall, which showed plainly the means of exit that the water had found, and which made those ponds a failure, with a loss of all they cost and the loss of the fish in them.

The mason who did the work is an old experienced man who has done work for the city of New York in laying concrete sidewalks in Central Park and the Battery Park many years ago when only imported cement was used.

It is clearly proved that the contraction caused by extreme cold weather causes cement concrete work to crack. It is not elastic enough. I think that the addition of lime in the proportion of say 25% lime, 25% Portland cement and 50% sharp sand would give us a concrete elastic enough to stand the cold weather, but I am so utterly discouraged by my losses that I cannot spare any money for further experimenting. I will leave those three ponds as they are and call it a total loss.

Such ponds may be a success in a valley where the land is level, or on the border of a swamp; but on a side hill the water pressure will cause a leak from any crack that will empty the pond in a few days. I have some ponds at the foot of a hill on the border of a swamp where a similar concrete wall on only one side of the pond holds the bank of earth in place and the pond stayed full of water, though the other three sides of it have no concrete wall to hold them, and the bottom is clear sand, but, unfortunately, those ponds are not available for fish raising because they are located at too great a distance from the house to be watched, and both boys and men have continually stolen every fish that I have ever put into them.

G. A. Hollinger.

[Editor's Note.—The foregoing letter is published because it contains what are some more or less popular notions about concrete. Fortunately for the material concrete, Mr. Hollinger is mistaken in his conclusions. The whole trouble is not with the contraction of the concrete even in severely cold weather. Beyond any doubt whatever, the walls were broken by the expansion of the ice. The side walls should have been so constructed as to have presented a battered surface to the ice, so that when the water expanded in freezing the ice would slide upward and not exert a straight disrupting force against straight walls. The reason the tanks built in the marsh, with a concrete wall only part way around, proved successful is because the ice had an earth wall against which to push in expanding. There is no analogy whatever between the walls of the fish ponds and the foundation walls of the house. We hope that some of our readers who have built concrete tanks which have to resist or rather avoid ice pressure in winter will write to Mr. Hollinger. Concrete tanks or fish ponds may be made just as satisfactory on a side hill as in a swamp.]

The U. S. District Court for the district of New Jersey has sustained the Canniff patent covering the compressed air concrete mixers manufactured and sold by the Ransome Concrete Machinery Co. and known to the trade as "Ransome-Canniff Grout Mixers." In a suit commenced against the Cockburn Co. in 1912 by the Ransome Concrete Machinery Co., for infringement of the Canniff patent, a decree was granted Aug. 13, 1912, by Judge Relstab, of the United States District Court for the District of New Jersey, stating in part

that the defendant, the Cockburn Co., has infringed the claims of said letters patent and the exclusive rights of the complainants under the same by making, using and selling pneumatic grout mixing and discharging apparatus, embodying the said invention and improvement, patented as aforesaid, as charged in the said bill of complaint.

BRIQUETTES

Monthly Comparative Table.

Imports of Portland, Roman and Other Hydraulic Cements

	Month of July 1911 Bbls.	1911 Value.	1912 Bbls.	1912 Value.
Imports of cem't.	4,081	5,514	2,398	3,391
Less foreign cement exported.	136	199	273	431
	3,945	5,315	2,125	2,960

Decrease in imports in the month of July, 1912, as compared with July, 1911, 985 bbls.

	Seven months ending July, 1911 Bbls.	Value.	Seven months ending July, 1912 Bbls.	Value.
Imports of cem't.	93,836	145,921	41,345	58,312
Less foreign cement exported.	6,313	10,052	3,169	6,983
	87,523	135,869	37,876	51,329

Decrease in imports in 7 months ending July, 1912, over 7 months ending July, 1911, 49,647 bbls.

Imports of Portland Cement into the U. S. in July, 1912, By Districts.

District.	Bbls.	Value.
Baltimore	248	393
Georgetown	128	212
New York City	1,131	1,654
Philadelphia	413	518
Galveston	300	290
San Francisco	50	103
Louisville	128	221
	2,398	3,391

Exports of Cement

	Bbls.	Value.
Exports of cement month of July, 1911	202,335	317,060
Exports of cement month of July, 1912	529,589	719,956

Increase in exports July, 1912, over July, 1911, 327,254 bbls.

	Bbls.	Value.
Exports for 7 months ending July, 1911	1,779,305	2,637,396
Exports for 7 months ending July, 1912	2,394,891	3,490,753

Increase in exports in 7 months ending July, 1912, over 7 months ending July, 1911, 615,586 bbls.

Sale of Los Angeles Cement Plant

Whether or not it is right and proper, or even profitable, for a government or municipality to own and operate a manufacturing plant that does not come under the head of public utilities, is still a moot question. It would appear, however, judging from newspaper dispatches concerning the proposed sale of the Los Angeles cement plant at Monolith, Calif., that there is a wide divergence of opinion among officials as to the value of the property and the economy of operation in future. These different views in the matter of value range from a little over a half million to a million dollars. The officers of a private corporation or company could certainly get closer to the real value of a plant erected and operated by them for the same period of time. In the case of the Los Angeles mill it has been finally decided to fix the minimum price at $550,000. In response to a question by Frank G. Henderson, president of the Public Service commission, Engr. William Mulholland of the aqueduct stated that the plant turned out 500 bbls. of cement at a net cost of $1.50 a bbl., the present cost of cement being about $2.10 a bbl. Mr. Henderson figured from this that the city could operate the plant at a profit of $150,000 a year.

"Under present conditions, possibly so," replied Mr. Mulholland, "but the chances are that after the aqueduct work is ended, the plant would degenerate into a refuge for aged and decrepit politicians and prove a liability instead of an asset." He also stated that private capital could run it at 80% less cost than the city could after the aqueduct turned it over.

Gen. Chaffee figured the plant as it stands at present representing $775,497.31 in cost, and declared that the city would be fortunate if it could find a buyer who would pay 70% of its cost for it. He recommended the minimum price quoted above.

A "Grinding" Business

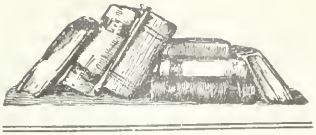
That the cement industry is literally a grinding business is shown in the following paragraph taken from a paper read before the Am. Inst. Chem. Eng. by Richard K. Meade:

Into the manufacture of Portland cement, the question of power enters quite largely. In the manufacture of 3,000 bbls. of cement per day, there must be ground approximately 1,650 tons of material to an almost impalpable powder every 24 hours. Nine hundred tons of this represent the raw material which must be reduced from pieces of stone as large as a man can handle to such a degree of fineness that from 90% to 98% of the powder will pass a 100-mesh test sieve. Six hundred tons represent the slag-like clinker which must be pulverized so fine that at least 92% of it will pass this sieve, while the remaining 150 tons consist of the coal for heating the kilns, which is pulverized to about the foregoing degree of fineness. The power required to run this amount of machinery is probably greater than that which would be utilized in the manufacture of a similar value of any other commodity.

Mr. Meade discussed the distribution of power in Portland cement manufacture and closed with the following statement:

In selecting the type of machinery to be installed in a cement plant, it is not sufficient to consider merely the relative power consumed by the different types per barrel of the product obtained, but also the repairs. The mechanical engineer has often shown a tendency to make selections based solely on power-efficiency tests made in the machinery manufacturers' experimental plant, only to find out on actual operation that the cost of repairs more than offset any saving in the coal bill.

The concrete members of floor construction in which hollow tiles, concrete block or other fillers are used, in combination with reinforced concrete, shall be designed in accordance with these regulations, except that the slab portion cast on top of the fillers may have a minimum thickness of 2½", provided the fillers do not exceed 60% of the construction.—*Building Regulations of Greater New York.*



NEW BOOKS

Contractors and Builders Handbook. By William Arthur, author of the "New Building Estimator." Published by the David Williams Co., New York. 7¼x4¾ in. vi.+378 pages. Flexible cloth. Price $2.00.

Mr. Arthur has made another contribution to the literature on building which he has divided into three sections: "The Contractor as a Business Man, The Contractor as a Constructor, The Contractor as a Taxpayer." The text of the "Building Estimator" gave very good evidence that its writer had some such command of the English as is especially rare among those afflicted with literary desires. In addition, Mr. Arthur has had some experience as a contractor; he has likewise watched some others gain experience. In this book he has set forth much common sense, the way to do many things, and, what is still more important, he tells of those things which should not be done and ways which should be avoided.

The business directions supplied are well selected and cover in a non-technical way the business relations between the contractor and those with whom he must do business. The language is well chosen to make the subject perfectly clear. Many legal points are covered and the book is well calculated to save some small portion of the amount that one lacking the book might expend for legal services, probably in going up against a sure thing for the other side. On this score alone the contractor will find it a good book to have handy.

In the second section of the book there are many useful hints upon designing coupled with lucid explanations of the various formulas for bending moments and the strength of beams, etc. A large number of useful tables are given. The reviewer possesses most of the standard handbooks, but some of Mr. Arthur's tables are new to him, and aranged in such a manner that he has found them useful. The practical suggestions are of a kind dictated by a wide acquaintance with different lines of building construction, many of them are the kind that contractors in the past have had to buy with experience, for it is a peculiarity of many that when they have been "bit" they hold their knowledge secret and have sort of an unholy glee in watching to see the next one "get his'n." Mr. Arthur has departed widely from this accepted rule and the results of his broad-gauged policy will be welcome to many builders.

The portion covering the contractor as a taxpayer is crisp and to the point. It must be read to be appreciated.

Mr. Arthur's book is an extremely difficult one to review. There is such a wealth of material in it that it is difficult to pick out the one particular subject he has failed to cover in some way. However, as the reviewer should make at least one criticism, he will ask why Mr. Arthur has omitted to epitomize the United States bankruptcy law. Many contractors get up against this, and it seems to be about the only point that is not treated of to some extent. To the prospective builder this book will be as valuable as it is to the contractor. It will help him in getting value received both from the architect and from the contractor and provide him with a basis from which he will be able to appreciate the reason why the contractor cannot supply thirty cents worth of house for a quarter.

* * *

The Elements of Structures. By George A. Hool, S. B., Asst. Prof. of Structural Engineering, University of Wisconsin. Published by McGraw-Hill Book Co., New York, N. Y. Cloth bound. 9½x6¼ in. ix.+188 pages. Illustrated.

In his preface, the author states that this book has been developed solely with the idea of using it in correspondence-study. With this end in view, he has made his arguments covering the fundamental principles of such elementary simplicity that it would be difficult to conceive a line of treatment which would provoke fewer questions on the part of the student. Mr. Hool's idea has been to foresee every possible question from the student and to answer it in the text before there is time to ask it. A certain amount of preliminary training is naturally required in order to understand this book, and from this groundwork the student is gradually led through the design considerations involved in the simpler class of structures, the class in which the largest majority of structural designing will be found in practice. The difficult and complicated structures which fill so many text books, to the great delight of their authors and the mystification of the would-be student, are extremely rare in the regular work of the structural designer. Mr. Hool has very wisely neglected them. One feature which tends to clarify the subject is the use of isometric projection in diagrams and drawings. These figures, showing in one view all the members that exist in structure, avoid the distraction of the student's attention, which is inevitable when he has to search through the different views shown in the conventional structural diagram to locate the relative positions of the different members.

The problems presented for the student to solve are well selected to show the application of the principles stated in the text immediately preceding them. This method of grouping the problems brings them to the attention of the student in their logical order, while their underlying principles are fresh in the mind.

The book is a most desirable one to those who desire to secure an understanding of the elements of structures and will supply them with that knowledge which it is very difficult to obtain from many of the more pretentious works on this subject, except with the assistance of a competent instructor.

* * *

Mathematics for The Practical Man. By George Howe, M. E. Published by D, Van Nostrand Co., New York. 5x7½ in. Cloth bound. 143 pages. Illustrated. Price $1.25 net.

A comprehension of the elements, at least, of mathematics is an essential requirement in the study of engineering subjects. In this volume the author presents a valuable, brief, direct treatise on the useful points of higher mathematics. The book, to quote the author, "begins at the beginning, assumes no mathematical knowledge beyond arithmetic on the part of the student, and endeavors to gather together in a concise and simple yet accurate form those fundamental notions of mathematics without which any studies in engineering are impossible."

The volume is more of a guide-book than a student's text. It takes the reader through the principles of mathematics as a kind mentor would lead a more or less timid explorer through a dark wood which had always been dreaded. True, the reader is not required, as a college student is, to stop and examine each tree, and to chop a few down to find how old they are; but rather he is shown the path through the woods, and is taught to recognize the different kinds of trees. He is made to realize that the trees are there within reach, and not a dark unknown, to be dreaded.

Such a treatment of mathematics will be of the greatest value to those men to whom previous careful instruction has been denied, and the author is to be congratulated on having accomplished so well his purpose.

* * *

Concrete Beater Tubs for Paper Mills.

In making paper the main operation in preparing the material is working up the pulp with water in what is called a "beating engine." This is a long wooden tank with a sort of "water sheel" revolving in the center which "beats" up the pulp into a mass suitable for the paper. Large amounts of water, boiling hot, steam and chemicals are being used in these beater tanks all the time, and wood, even when sheathed with metal, is not able to stand the action very long.

The Milton Leather Board Co., Milton, N. H., has just realized that concrete is the proper material to use for these tanks, and are putting into a new mill a set of beater tubes made of reinforced concrete. These are, it is believed, the first ever made. The tanks are to be 26′ long and 13′ wide and 30″ to 40″ high. The paper trade is much interested in seeing how they are going to work.

One more opportunity has been found for concrete to replace materials long used for special work. Reinforced concrete seems to offer many advantages for this purpose, and developments will be watched with interest.

Reinforced Concrete Chimney Construction

BY R. L. DOWNS

For chimney construction reinforced concrete is rapidly coming into very general use, and the following notes cover in detail some of the interesting features in the construction of a chimney at Traverse City, Mich.

The stack, which is about 90 ft. high, stands on a base ("A" in Fig. 1) 11' square. The base is 1' thick at the outer edge ("a," Fig. 1) and 3' thick where the stack rests upon it.

For a chimney away from a building the base should be larger, at least 15' square, in order to carry the wind strain. In this case the wall of the engine and boiler rooms, into which one side of the square section of the stack is built helps to take the wind strain.

The first 19' of the stack above the base is 6' square, with walls 1' thick at the sides. At the smoke entrance ("c"

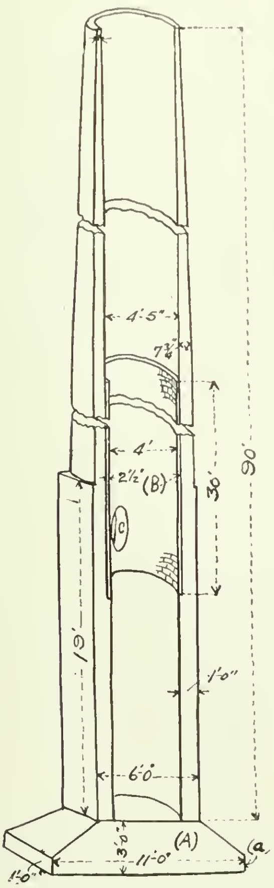


FIG. 1—PERSPECTIVE SKETCH SHOWING DETAIL OF CHIMNEY CONSTRUCTION

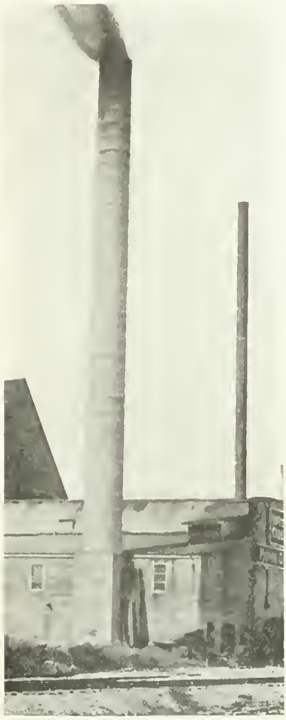


FIG. 2—THE FINISHED CHIMNEY

in Fig. 1) the walls are reduced 2½" on the inside to receive a 2½-in. lining ("b," Fig. 1) of fire-brick, which extends up 30'.

Above the 19-ft. section the stack is circular in form, as seen in Fig. 1. The walls of the circular portion are 7¾" thick at the start. This is gradually reduced to a 4-in. thickness at the top by reducing the circumference of the outer form.

The flue proper is 4' 5" in diameter inside the concrete from the top of the brick lining to the top of the stack, the 30' which is lined being reduced to 4' in diameter by the brick, which protects the concrete from heat at the point where the gas is deflected by the change in its course.

The concrete for the stack is mixed 1 part of cement to 4 parts sand, while for the base it is mixed 1 to 6. Both were mixed with a batch mixer. A cube mixer (Municipal Engineering & Contracting Co., Chicago) was used.

The reinforcements in base are of ½-in. twisted steel rods, 1' on centers, and are laid in four directions—i. e., parallel with the sides and parallel with the two diagonals of the base. The vertical reinforcement of the stack for the first 30' consists of 48 ⅜-in. twisted steel rods, placed 3 in a group. The rods in the clump are 1" apart, and the clumps 1' apart. In the second 30' there are 32 rods with only 2 in the clump. The last 30' has 16 single rods only.

Horizontal reinforcements of the stack consist of ⅜-in. twisted steel rods, bent to the circle of the stack. They are placed 1' on centers and are wired to vertical rods. The steel was furnished by the Inland Steel Co., Chicago.

All the scaffolding is placed on the inside of the stack; each time 15' of the stack is completed an equal section of scaffolding is put in. Both outer and inner forms are handled from the inside.

The forms for the inside of the stack are made in sections, as shown in Fig. 3 (a), each section forming a segment of the circle. The sections are covered with galvanized iron.

Two complete sets of these sections are used, the lower set being taken out and placed above to extend the mold. One section in each set is made ¾" or 1" shorter than the other sections, and a strip of wood the thickness of the opening left by the shorter section is used to complete the circle. All that is necessary in removing a form is to pry out the strip of wood and the sections

FIG. 4—THE CHIMNEY UNDER CONSTRUCTION; THE WAGON WHEEL IS SHOWN HOLDING THE STEEL IN PLACE

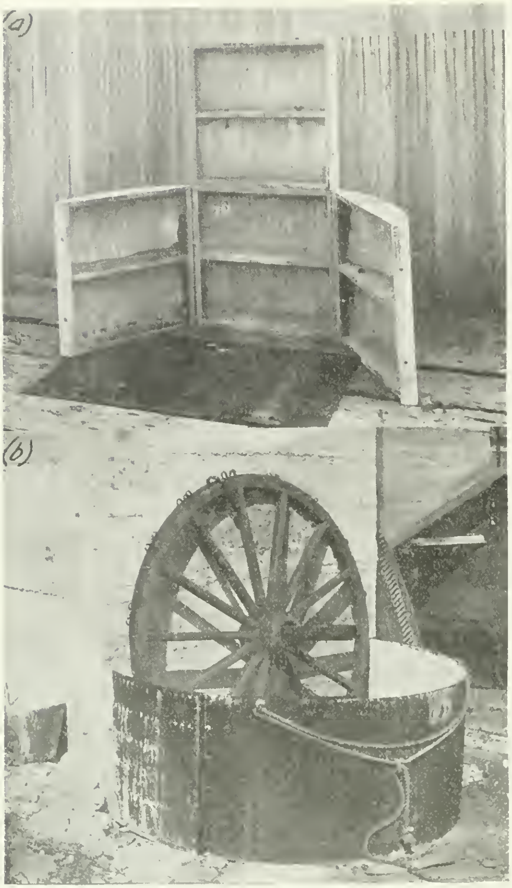


FIG. 3—THE FIELD-MADE INTERIOR SECTIONAL FORM IS SHOWN ABOVE (a); THE SHEET STEEL EXTERIOR FORM AND THE WAGON WHEEL ARE SHOWN BELOW.

are loose. Bolts are, of course, used to bind sections and sets together.

It is not necessary to use scaffolds to support either the inside or the outside forms, as the pressure of well-tamped concrete against the circular forms will hold them in place. The inside form will also easily hold up the workmen and the planks they require to work on. The cross-pieces of the sections form convenient rests for the planks.

The outer forms are each made of two strips of heavy sheet iron 26" wide by 10' long. One of these strips is shown in Fig. 3 (b). As in the case of the inner forms, two sets are used alternately to extend the mold.

The rows of bolt holes apparent at the left end of form section in Fig. 3 (b) shows the method of reducing the circumference of the outer form in making the taper of the stack.

The wheel with the hooked bolts through the rim is used to keep the vertical reinforcements in position. The wheel is elevated in a horizontal position by a vertical shaft passed through the pipe in the hub. Clamps and guy wires are used to keep the shaft and wheel in place. The vertical rods of the reinforcement are passed through the eyes formed by the bolt hooks in the rim of the wheel.

A plank fastened across the wheel and projecting past the rim furnishes a convenient support for the hoist by which the concrete is elevated to the workmen.

Setting Properties of Portland Cement.

G. Hentschel, in *Tonindustrie-Zeitung,* states that in his opinion the change of cement from slow to quick setting is due to the presence of alkali carbonates, which as positive catalytic agents have an accelerating influence on the setting process. The addition of only 0.01% of sodium carbonate in one case reduced the time of setting from about 6½ hrs. to 20 min. On the other hand, the addition of varying amounts of calcium sulphate retards the time of setting, and the cements remain slow setting. The power of catalytic agents should be determined by comparative experiments; sodium and potassium carbonates exert an extraordinarily strong positive effect, while calcium sulphate possesses a relatively smaller negative catalytic effect. The positive effect also is much more marked with finely ground cements. By the burning, any alkali present in the raw materials is converted into an alkali silicate which exerts no effect on the setting, but by exposure to the air these silicates after the clinker has been ground, are slowly decomposed into silicic acid and carbonate, especially under the influence of heat. Experiments on a particular cement showed that the time of setting was accelerated by heat, with free access of air, but when carbon dioxide was excluded, the time of setting was unchanged after heating the cement on a water-bath for an hour. The pronounced effect of carbon dioxide and heat expxlains why rotary kiln cement changes much more easily than cement burnt in other kinds of kilns, and often leaves the mill in a quick-setting condition. Rotary kiln clinker tends to be hard, and is consequently heated to a considerable extent by grinding—a temperature of 87° C. has been noted—and on cold days there is less danger of producing a quick setting ceide and heat explains why rotary kiln cement also generally contains a rather larger amount of alkali than cupola-furnace cement, probably derived from the ash of the fuel, of which a larger amount is required in rotary kilns. The change in the time of setting produced by the addition of calcium sulphate is independent of the presence or absence of water of crystallization in the calcium sulphate In order to test the likelihood of change in the time of setting, a brisk stream of carbon dioxide is passed for 10 min. over 200 grms. of cement contained in an Erlenmeyer flask, provided with a ground stopper. The cement and gas are shaken well, and the operation repeated three times. Finally the closed flask is heated for 1 hr. on a water-bath, care being taken that no condensed water can enter the neck of the flask. The cement is spread in a thin layer to acquire the room temperature and the setting test applied in the usual way. If the time of setting is less than an hour, the cement is open to suspicion. In order to avoid this fault in cement the content of calcium sulphate should be raised to the permissible limit, and also the content of lime, so that the clinker will crush easily and, not being steel-hard, will not become so hot during grinding; for the same reason the use of still moist clinker must be avoided, and in some cases the grinding must be coarse only.

The city of Pittsburgh has awarded the contract for the building of the farmers' market on the Duquesne Way wharf, on the Allegheny river, to William T. Powell, 508 Fourth Ave. The shed will be a one-story affair, made of concrete and structural steel.

Final Sessions of American Road Congress

In the later sessions of the American Road Congress at Atlantic City, held after CONCRETE-CEMENT AGE had gone to press last month the program rounded out a broad treatment of the subject of road building, so that when the Congress ended those in attendance could not help feeling that its work had been remarkably successful in bringing together those competent to speak upon practically every angle of the road movement.

In the section meeting devoted to economics, with Dr. Joseph Hyde Pratt, state geologist of North Carolina, presiding, much attention was given to "Convict Labor in Road Improvement." This was the subject of an address by Dr. Pratt in which he explained that, in view of a growing sentiment against the use of convicts in contract labor, he believed convicts should be and might be used successfully in road construction, putting tractable prisoners upon an honor basis where their employment is in scattered groups and the more dangerous convicts in quarries and crushing plants where they can be under adequate guard. Prof. E. Stagg Whitin, general secretary of the National Committee on Prison Labor, supplemented Dr. Pratt's remarks. "The Benefits and Burdens of Road Improvement" was the subject of an address by Jesse Taylor, secretary Ohio Good Roads Federation. P. V. McGraw, fourth assistant postmaster-general, exxplained how the Postoffice department, with rural carriers covering more than a million miles of road every day, is aiding in Good Roads work with the Office of Public Roads. Howard D. Hadley, president Quebec-Miami International Highway Association, told how the various communities along the line are being interested and connecting links being constructed.

Highway Engineering Education.

Prof. Frank P. McKibben, Lehigh University, presided over the section on Highway Engineering Education, which was under the auspices of the Society for the Promotion of Engineering Education. Arthur H. Blanchard, professor of highway engineering, Columbia University, read a paper in which he said that eminent highway engineers and educators are of the opinion that the highway engineer of the future requires the broad foundation given him by the 4-year course in civil engineering. Prof. Blanchard called attention, in connection with the increased interest in highways, to the fact that an examination of the latest catalogs from 92 educational institutions shows that 78 of these include a text-book-lecture course in highway engineering in the curriculum; 15 give instruction in laboratory work and 10 include special courses in highway surveying. This the speaker contrasted with the condition in 1909, when Logan Waller Page read a paper on "Highway Engineering" in which he stated that 50% of the institutions investigated did not include any work in highway engineering. Other papers on educational methods in highway engineering were read by Prof. Stuart A. Stevenson, Rutgers College; Prof. E. B. McCormick, Kansas State Agricultural and Mechanical College, Manhattan, Kans.; and Prof. Hugh Miller, Clarksston School of Technology, Potsdam, New York.

Resolutions Adopted.

The Committee on Resolutions of the American Road Congress, consisting of Dr. Joseph Hyde Pratt, North Carolina, chairman, and T. G. Norris, Arizona; W. S. Keller, Alabama; A. G. Spalding, California; J. H. MacDonald, Connecticut; W. A. McLean, Canada; Prevost Hubbard, District of Columbia; L. D. Smoot, Florida; David Beecroft, Illinois; C. A. Kenyon, Indiana; L. H. Nelson, Maine; H. G. Shirley, Maryland; A. W. Dean, Massachusetts; G. W. Cooley, Minnesota; H. O. Gilbert, Missouri; F. E. Dunbar, Michigan; Fred F. Smith, New Jersey; C. Gordon Reel, New York; A. H. Huston, Ohio; W. P. Cantwell, South Carolina; George McBride, Nebraska; S. D. Foster, Pennsylvania; G. E. Gordon, Philippine Islands; Gervais Lombard, Louisiana; W. D Beers, Utah; Hon. Ed. R. Kone, Texas; J. B. Wilbur, Vermont; Preston Belvin, Virginia; J. A. Sheppard, West Virginia; F. G. Simmons, Wisconsin; submitted the following resolutions, which were adopted unanimously:

1. *Federal Aid.*—Whereas, it has been the policy of our central government to aid in the development of our national resources; and whereas, one of the main factors in the development of these resources is the public roads; and whereas, the money appropriated and expended by the various states for this purpose is, in many cases, largely wasted on account of the lack of knowledge of those entrusted with its expenditure in regard to the location, construction and maintenance of roads; and whereas, if the federal government were in a position to give to the several states the necessary advice and instruction regarding these road problems large sums could be saved to the states: Be it resolved, that this Congress herewith commends the action of the Congress of the United States in inaugurating Federal aid to the several states of the Union for the purpose of aiding and encouraging them to build and maintain good roads; and that this Congress herewith memoralizes the Congress of the United States that Federal aid be further extended and that, in order that such appropriations as may be made shall be expended to the best interest of the federal government and the people of the several states, Congress hsall establish a separate Department of Roads, and that to this department shall be transferred the present Office of Public Roads.

2. *Engineering Education.* — Whereas, we recognize the scarcity of properly trained and skilled road engineers to superintend the construction and maintenance of the public roads throughout the nation: Be it resolved, that this Congress recommends to the several states not already provided therewith, the importance of establishing and maintaining proper schools for the education and training of such engineers in order that public road funds may be economically and efficiently expended; and we also recommend that every state not already provided therewith establish an efficient highway engineering department under the proper officials.

3. *Maintenance.*—Whereas, the question of the maintenance of the public roads still remains perhaps the most important problem of road improvement: Be it resolved, that this Congress again emphasizes the need of the states and the counties of the several states providing adequate funds for the maintenance of their public roads after construction, and it is the senes of this Congress that for every appropriation that is made for the construction of a public road there should be made at the same time a suitable provision for the maintenance of said road.

4. *Uniform Laws.*—Whereas, there is at the present time practically no uniformity in the laws of the several states pertaining to the construction, maintenance and use of roads: Be it resolved, that the President of this Congress be instructed to appoint a committee of three to confer with and interest the American Bar Association in regard to formulating uniform laws relating to the construction, maintenance and use of roads.

5. *Convict Labor.*—Resolved, that this Congress emphatically recommends the enactment of proper laws, by all the states, which will provide for the employment of prison labor in the improvement of the public highways.

6. *Ocean-to-Ocean Highway.*—Whereas, there has been created, through the influence of the Daughters of the American Revolution, a widespread interest in preserving the location of the old roads and trails which opened up and led to the development of the western sections of our country; and whereas, nearly all these have been definitely located and marked; and whereas, it has been reported to this Congress that motor vehicle and accessory manufacturers and dealers have agreed to contribute a sum of money equal to one-third of 1 per cent of their gross earnings for the years, 1913, 1914 and 1915 toward the cost of construction of a highway along the said trails: Be it resolved, that this Congress highly recommends the proposition that has been made that an "Old Trails, Ocean-to-Ocean Highway" shall be built, following as closely as possible along the line of these old trails from the Atlantic to the Pacific and most heartily commends the proposition of the manufacturers and others to support and aid in the construction thereof.

7. *Office of Public Roads.*—Resolved, that this Congress heartily commends the work and efforts of the Office of Public Roads in the Department of Agriculture for the betterment of the public roads of this country.

8. *Highway to National Cemetery.*—Whereas, the attention of the Congress has been called to the deplorable con-

dition of a portion of the public highway leading from Washington to the National Cemetery at Arlington; Be it resolved, that this Congress herewith requests the Congress of the United States to make a suitable provision for the construction of a beautiful highway leading from the city of Washington to this cemetery.

9. *Thanks to Jersey.*—Resolved, that the sincere thanks of this Congress be extended to the State of New Jersey for its most cordial welcome to the Congress as expressed by His Excellency, Governor Woodrow Wilson, and it especially appreciates the patriotic and inspiring address of Governor Wilson endorsing the good roads movement; and it also tenders its thanks and gratitude to the several exhibitors for the splendid displays that they made, which have been one of the most interesting, attractive and instructive features of this Congress; and that the Congress acknowledges and appreciates the courtesy of the press for the reports that they have made of the Congress.

10. *Gettysburg Road.*—Resolved, that in the opinion of this Congress a great highway with architectural approaches and adornment from the battlefield of Gettysburg to the nation's capital and ultimately extending to Richmond would serve as a fitting memorial to Abraham Lincoln whose fame demands a tribute unlike that accorded to any other great American.

Construction and Maintenance.

The Construction and Maintenance Section of the Congress began its sessions October 4, with Col. E. A. Stevens, state commissioner of roads of New Jersey, presiding. The first paper was by Col. Spencer Cosby, Corps of Engineers, United States Army, who outlined the army's part in road building and spoke of some historic roads. Prof. E. B. McCormick explained methods and results in making extensive tests of tractive resistance of various road surfaces with a specially equipped dynamometer wagon. W. S. Keller, state highway engineer, Alabama, explained the construction of earth, sand-clay and other inexpensive types of road in his state and how these can be made to give good service with the material usually at hand along the road. C. Gordon Reel, superintendent of the state commission of highways, New York, read a paper in which he outlined his state's plan of trunk line construction and also a system of posts with conspicuous bands of color for the guidance of tourists. Albert Goldbeck, testing engineer, United States Office of Public Roads, spoke on "Gravel and Stone—Qualities, Tests and Selections." He exxplained how government tests for hardness, toughness, cementitious quality and resistance to wear are made. Dr. A. S. Cushman, director, Institute of Industrial Research, Washington, D. C., read a paper on "Bituminous Materials, Including Tars, Asphalt and Oils."

In explaining in considerable detail the method of constructing gravel and waterbound macadam roads in Connecticut, James H. MacDonald, state highway commissioner of that state, laid great stress upon foundation and made the statement that the chief responsibility for road destruction is not the automobile but poor construction.

Prof. A. H. Blanchard, Columbia University, read a paper on "Construction of Surfaces with Bituminous Materials."

Three illustrated lectures were given in the evening, October 4. One by Theodore A. Randall, secretary of the National Brick Manufacturers' Association, was on "Brick Roads." It was pointed out by Mr. Randall that in the lasting qualities of brick paving the concrete foundation and the cement grout filler are of the utmost importance. Glenn Brown, secretary of the American Institute of Architects, showed by means of beautiful colored lantern slides the value of proper road ornamentation in the use of attractive bridges, retaining walls, trees, shrubs and flowers. Linn White, engineer of the South Park Commission, Chicago, spoke upon the subject of "Park Roads."

Concrete Roads.

The first paper of the morning session, October 5, was by A. N. Johnson, state highway engineer of Illinois, on "Concrete Roads." Some of the interesting points made by the speaker are:

No particle of aggregate should be loosened when once in place and for this reason a rich concrete should be used, with plenty of cement mortar entirely to cover the aggregate. Under ordinary circumstances this should be 1:2:3½. The excess of mortar should be from 10% to 15%. When the concrete is deposited on the sub-grade, there is a tendency for the mortar to run out from the sides, leaving the aggregate without sufficient mortar in the center. To prevent this and to secure an even mixture throughout, it is desirable to have two men, one with a shovel and one with a rake, to turn over the mixture after it is dumped. The aggregate should not be more than 1" in its largest dimension. Owing to the fact that the surface of a concrete roadway moves with temperature changes, transverse expansion joints are desirable every 40' or 50'. These joints should be protected by steel plates. It is often desirable to put these joints in at an angle of 60° instead of perpendicular to the line of traffic.

Longitudinal cracks which sometimes develop in concrete pavements after two or three years may be traced usually either to the drying out of the crown of the road caused by water in the concrete flowing away to the sides, or to the action of frost at the shoulders, where water has settled. To obviate this, great care should be taken with drainage and in some cases transverse reinforcement is to be recommended.

Mr. Johnson thinks the one course method of concrete roadway construction best because it removes the possibility of a plane of weakness between the two courses. The speaker recommends placing moist canvas over the concrete as soon as it is in place and leaving it until the concrete is sufficiently hard to bear the weight of a layer of sand or earth covering. This covering should be left on for fully two weeks. Mr. Johnson pointed out that it was not enough to trowel over uneven spots and depressions in the concrete, but he advised digging out such places and refilling with concrete and then finishing with a float. Mr. Johnson also explained in connection with expansion joints that the expansion in warm weather squeezes out a part of the mastic filler so that when the road again contracts a space is left in the joint which should at once be filled with more mastic filler, to prevent the filling of this space with such unelastic material as collects on the road surface.. With cement at $1.00 a barrel and aggregate at 75c to 80c a ton on the job, Mr. Johnson estimated the cost of concrete pavement for a road 16' wide, at $1.00 a sq. yd., including contractor's profit.

In a discussion which followed Mr. Johnson's paper, Logan Waller Page called attention to experimental roadways being built just outside of Washington, under direction of the Office of Public Roads.* There is one section of 600' of bituminous macadam on a 6" foundation, 600' Topeka specification roadway and 4500' of concrete jointless roadway being built with various aggregates, and also sections of oil-concrete roads using 10% of oil, pavement to be covered with a bituminous paint. There is also a section of vitrified brick on concrete foundation.

"Experimental and Special Surfaces Applicable Under Special Conditions," was the title of a paper read by William H. Connell, chief of the Bureau of Highways, Philadelphia. George W. Cooley, state highway engineer of Minnesota, described practice in his section of the country in the construction of earth, sand-clay and gravel roads, and he also described the "straw road" used in very sandy locations. James Owen, consulting engineer, Montclair, N. J., made an address on "Water-bound Macadam," in which he described himself as a stand-patter as against the adoption of oil-macadam roadways. George W. Tillson, consulting engineer, Borough of Brooklyn, outlined New York City's street paving situation. C. A. Crane, secretary of the General Contractors' Association, New York City, spoke on "The Relation of the Contractor to the Public Official."

At the annual meeting of the American Association of Highway Improvement, which, as mentioned last month, changed its name to the American Highway Association, officers and directors were chosen. Logan Waller Page, Director of the United States Office of Public Roads, was re-elected president of the Association, while W. W. Finley, president of the Southern Railway Co., was elected vice-president in place of W. C. Brown, president of the New York Central Lines. J. E. Pennybacker, Jr., secretary; Charles P. Light, organizer and field secretary, and Lee McClung, Treasurer of the United States,

*Specifications for concrete sections were published in the September issue.

as treasurer of the Association, all were re-elected.

Newly elected directors of the Association are James H. MacDonald, state highway commissioner of Connecticut; George W. Cooley, state highway commissioner of Minnesota; A. G. Batchelder, chairman, executive committee of the American Automobile Association; C. A. Kenyon, president of the Indiana Good Roads Association, and Dr. Joseph Hyde Pratt, state geologist of North Carolina.

There was a lively discussion at this business session of the Association on the subject of just how far the organization should go in a resolution in favor of United States government aid in road construction. It was pointed out by President Page that the Association had already been asked by a committee of Congress for its co-operation in the investigation of the subject of federal aid, and that it was his belief that, should the Association go on record definitely in favor of some plan of its own for federal aid, it would at once become partisan in the matter and lose its standing as an advisory organization. Finally a resolution by J. W. Howard, New York City, was adopted as follows:

This Association looks with favor upon the investigation by the present joint committee of Congress toward giving federal aid in the construction, reconstruction and maintenance of highways in the United States, and pledges itself to co-operate with and assist that committee in every way possible toward an early decision and the preparation and presentation to Congress of an appropriate bill looking to the immediate or ultimate granting of federal aid for highways for vehicle traffic.

American Road Builders Prepare for Cincinnati Meeting.

Arrangements for the American Good Roads Congress and ninth annual convention of the American Road Builders' Association at Cincinnati, O., Dec. 3, 4, 5 and 6, have been practically completed. The plan adopted last year of considering certain specified subjects each day will be adhered to this year, although a somewhat greater subdivision of the main topics has been made. The first session, Tuesday, Dec. 3, will be devoted to the usual addresses of welcome and responses, and a presidential address by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York city. Six of the seven remaining sessions will be devoted to the presentation of technical papers and their discussion, and one session will be used for the annual business meeting of the Association.

The tentative program of the technical sessions includes three papers on the organization of highway departments of states, large cities and small cities, respectively. The first will be presented by Maj. W. W. Crosby, consulting engineer of the Maryland State Roads Commission; the second by William H. Connell, chief engineer of the Bureau of Highways, Philadelphia, and the third by a speaker yet to be announced. The development of a plan for a state or county road system will be treated in a paper by an authority yet to be announced, as will also the construction of stone and brick pavements. The building of earth and gravel roads will be treated in a paper by Robert C. Terrell, State Commissioner of Public Roads of Kentucky. The subject of bituminous pavements for cities will be presented in a paper by George W. Tillson, consulting engineer, Borough of Brooklyn, New York City, and Ellis R. Dutton, assistant city engineer, Minneapolis, will describe the construction of wood block pavements by the day labor plan now in force in that city. Three papers on questions of importance to all engaged in other road or street work will be presented by Col. Wm. D. Sohier, chairman of the Massachusetts Highway Commission, who will speak on the importance of the traffic census as preliminary to planning road improvements; Clifford Richardson, consulting engineer, New York City, who will discuss the economics of road and paying construction, and Arthur S. Lewis, secretary and superintendent, Lincoln Park Commission, Chicago, who will discuss the value and importance of cost data. Contractors will hear the matters with which they are especially concerned discussed by Hugh Murphy, a well-known public works contractor of Omaha, Neb., who will present a paper on the general subject of the problems of a road contractor, and by F. E. Ellis, manager of the Essex Trap Rock & Construction Co., and a prominent road contractor of Peabody, Mass., whose subject will be plant equipment. It is probable that the technical program will also include two or three other papers dealing with specific work of interest to road builders and with general questions with which they are concerned.

In addition to the day sessions, at least one evening session will probably be held, at which illustrated addresses will be made. This, together with other features incidental to the convention, will be announced later.

Show Illinois Farmers Concrete Road Construction.

The Illinois State Highway Commission has been energetic in furthering good roads among the counties of Illinois. The services of state engineers have been gratuitously furnished for the design and construction of bridges and highways and, while every type of road has been experimented with, yet the feeling of the State Highway Commissioner, A. N. Johnson, has been that a permanent solution must be found rather than the temporary expedients which have been offered in macadam and the various special macadam roads.

On the State Fair grounds at Springfield is an experimental section of road consisting of several types of pavement each of which is built to sufficient length to show the relative merits. There is one section of Dolarway which was built prior to the fair of 1911 and which shows absolutely no wear. Sections of plain macadam and bituminous macadam are on either side.

This year Mr. Johnson has extended his demonstration work out the Peoria road toward the laboratory of the State Live Stock Board. Believing that the concrete highway is the most economical solution and following the experience of Wayne county, Mich., and of other counties which have found concrete to be most satisfactory and economical, he has built ¾ of a mile of concrete road 6″ thick at the sides, 8″ thick at the center and 18′ wide. It was to be a demonstration road to show the farmers, not only of Sangamon county, but all who should visit the State Fair, the practical value of concrete for the country highway.

The road was started about two weeks prior to the opening of the fair, October 5, and was completed while the fair was in progress.

For its construction the Universal Portland Cement Co. donated 1,000 bbls. of cement, which was almost sufficient for the entire road. The balance of the cement was bought on contract.

Within the grounds, and but a few feet from the demonstration road, the Universal Portland Cement Co. showed by means of moving pictures the construction methods in use in Wayne county in building concrete highways. The film also showed the early conditions in Wayne county, typical scenes along macadam roads (both new and after a few years of travel), and the later results showing automobiles traveling at high rates of speed along the concrete highways without a particle of dust, and teams heavily loaded, trotting along at speed impossible on the average country highways. It was a popular presentation of a technical matter. The farmers were interested and many left with the intention of further investigation of concrete highways.

It was particularly fortunate that a road could be under construction and partially completed at the time when the moving picture exhibit was given. Those who showed an interest were invited to inspect the road outside the fair grounds, and parties of inspection were made up at intervals. That the farmers are fully alive to the need of better road facilities was proved by their intense interest in the moving picture exhibit and in the actual road construction.

The demonstration road was made under the specifications of the State Highway Commission, which differ in minor points only from those commonly used in Wayne county and other counties where a large development has already been made. It is without doubt the forerunner of much concrete highway construction in Illinois.

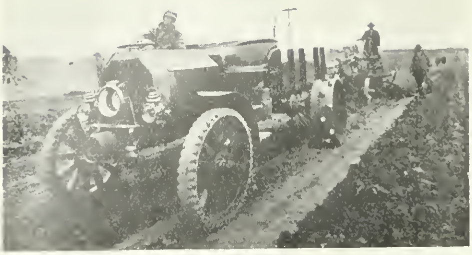


Fig. 1—Motor Truck Hauling Grader

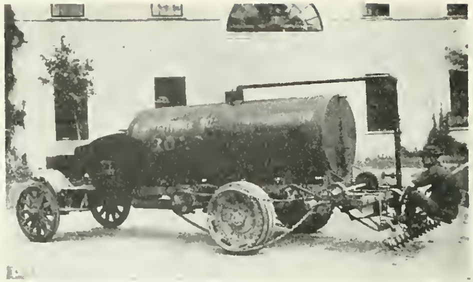


Fig. 2—Auto Sprinkler for the Application of Hot Oil Under Pressure

Data on Two Uses of Motor Trucks in Road Work.

Data as to the use of the motor truck in road work are furnished by the Avery Co., Peoria, Ill. Fig. 1 shows an Avery 3-ton farm truck pulling a King road grader in Lyon county, Kans. In a letter to the Avery Co., by R. B. Shepperd, E. Morehead, and J. E. Clemmer, commissioners of Lyon county, they say: "We attached it to a heavy road King grader and put them in the worst half-mile of gumbo road we had. We must say that with the assistance of Mr. Denny, the King grader man, we put up the finest piece of road to be found in the state, and the truck did its work to perfection."

County Engineer K. Max Yingling supplies data as to the cost of the truck compared with 4 teams on this Kansas road. One man on truck, $2.50; one man on grader, $2.50; 12 gallons of gasoline, $1.44; 1 gallon of Polerme oil, 60c; total for truck one day, $7.04. Cost of 4 teams and man for each, $16.00; cost of man on grader, $2.50. Total cost one day, $18.50.

Mr. Yingling says in addition: "I can do one-half more work with truck in same length of time, than with 4 teams and grader."

Figure 2 illustrates a truck especially built and equipped for application of oil to roads under pressure. This equipment is used by the M. C. Whitmore Road Improvement Co., Dayton, O.

A double action pump is attached to the rear of the truck—one run by means of sprockets and a chain. There is a large sprocket on the rear wheel and a small one on the pump. The oil is unloaded from the car by means of gravity into an underground tank. Then the truck is backed up to the tank and the back wheels are jacked up; the motor is started and the back wheels going around pump the oil out from the underground tank over a fire which heats the oil to 200° F. It pumps the oil into the tank on the truck. The truck then makes a quick delivery to the roads which are to be oiled, and while the truck is moving along the road to be oiled, the pump is again used to force air into the top of the tank. This air pressure forces the oil out through the distributor in tiny streams with considerable force into the heart of the road bed, in place of delivering it on the top of the road or just on the surface as was done when teams were used and an ordinary sprinkler. With teams, before the use of trucks, it was found impossible to deliver the oil with any heat at all on the road; now with the truck it is easy to deliver the oil on the road surface at about 160° F., losing only about 40° of heat in traveling the distance from the oiling station to the outskirts of the city where the roads are to be oiled. Mr. Whitmore says the truck does away with 4 teams and 6 men and does the work at very near 50% less cost and does it better than with the teams. It also does away with all night work of taking care of the horses and all Sunday work.

Concrete Pipe Culverts in Railway Work.

At the convention of the American Railway Bridge and Building Association, held in Baltimore, Oct. 15 to 17, 1912, the uses of reinforced concrete for pipe were discussed at some length. The committee in charge reported that concrete pipe is much used in sizes from 12″ to 48″; it generally proves to be about 25% cheaper than cast-iron pipe, in place. Lengths used are 3′ to 8′. The C., M. & St. P. is using 6′ but regard 8′ as cumbersome. Circular pipe is preferred to oval pipe because easier to handle and place, and stiff "cage" reinforcing is preferred, as it can be easily made of wire mesh for small sizes of pipe, and of light bars wired together for the larger sizes. The most generally used thicknesses of pipe are: 4″ to 5″ for 24-in. pipe, 5″ to 6″ for 30-in. pipe, 6″ for 36-in. pipe and 48-in. pipe. The bell-and-spigot joint is generally used. Where longitudinal tying is thought desirable to keep joints from pulling open, the longitudinal reinforcing bars have been extended out into pockets or a groove formed between the adjoining sections; the bars were wired together after the sections were placed, and the groove then filled with cement mortar.

A description was given of the C., M. & St. P. pipe-making plant at Tomah, Wis., where 1,000 lengths of pipe were made in 1911 and over 2,000 lengths in 1912.

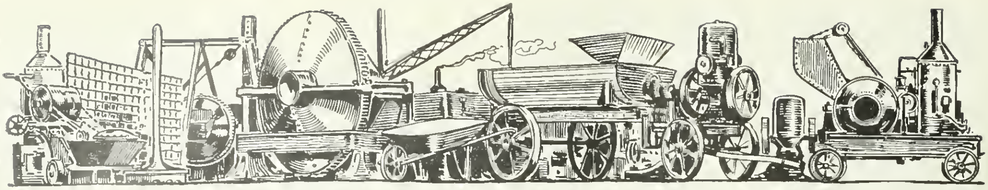
The report stated in part that—

pipe can be unloaded by skidding from cars with snub lines and can be rolled down embankments with less danger of breakage than cast-iron pipe.

Some discussion developed opposite opinion, that reinforced concrete pipe may be more fragile than cast-iron. As to cost, the concrete pipe, on insecure foundation, may require a concrete bed, where cast-iron pipe can be laid on the ground. The economy of pipe as against built concrete culverts disappears, it was stated, at a 48-in. diameter.

On the Lake Shore & Michigan Southern R. R., 60-in. pipe is made with a vertical diameter of 66″ and a horizontal diameter of 60″. The reinforcement, bent to circular shape, then comes to the proper location for the tensile stresses set up in the pipe in service. These pipes, 6″ thick, are rather expensive and delicate to handle, but have given no trouble. They are now made with a hole in the top, through which the hoisting rope can engage a rail put inside the pipe for setting the pipe in place. These pipes are considered cheaper than 60-in. cast-iron pipes.

One of the important industries in the United States of which comparatively little is written is the production of sand and gravel. In 1911, according to a report by E. F. Burchard, just issued by the United States Geological Survey, the production of sand and gravel amounted to 66,846,959 short tons, valued at $21,158,583. The production of sand of all kinds was 40,253,977 tons, valued at $14,438,500, and that of gravel was 26,592,982 tons, valued at $6,720,083. The production of glass sand was valued at $1,547,733, an increase over the figures of 1910; the sand used for building in 1911 was valued at $7,719,286, a slight decrease as compared with 1910. This was accounted for by less activity in 1911 in the building trades, including that of concrete construction. The production of molding sand in 1911 was valued at $2,132,469, a marked increase as compared with 1910. The production of all other sands in 1911, such as sand for grinding and polishing, fire sand, engine sand, and filtration sand, was valued at $3,043,012, an increase of over a million dollars in value as compared with 1910.



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

"Rapid Fire" Hand Drill.

A new hand drill has recently been put on the market by the Diamond Expansion Bolt Co., New York. This drill is designed to reproduce the same action in the drilling of holes in stone, brick or concrete as is produced with the ordinary hand-hammer and drill, with greatly multiplied speed.

Speed: It is an acknowledged fact that the best results obtained with the old method of hammer and drill are produced by comparatively light blows, properly timed and struck. The "Rapid Fire" drill was designed on this theory to strike according to the speed with which the crank is rotated from 8 to 20 times the number of blows that are regularly delivered with an ordinary hand-hammer, and a corresponding increase is produced in its rapidity in drilling holes. Its action is percussive and its mechanism is so constructed that practically no vibration or concussion is felt by the operator.

Utility: Its combination of handles is so arranged as to adapt the drill to use in any position that may be required. By the loosening of a screw underneath the "D" handle the handle is thus allowed to rotate and may be used as a breast-plate, permitting the drill to be rotated in the hole to insure perfect clearance of the drill when in action. The drill points are standard.

Regulating Blows: Each "Rapid Fire" drill has 3 adjustments, hard, medium and soft, controlled by a spring lever at the side of the housing, and each is furnished with two springs of different power, thus allowing 6 gradations to the force of the blow that can be delivered by the hammer. The springs are easily changed by removing the cover of the housing without disarranging or unfastening any of the parts of the mechanism.

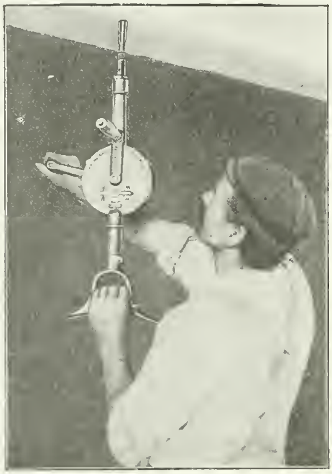


FIG. 2. DRILLING A HOLE IN THE CEILING WITH A "RAPID FIRE" DRILL.

FIG. 3. USING A HAND POWER DRILL AS A BREAST DRILL.

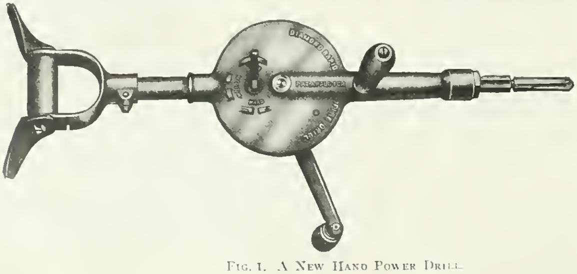


FIG. 1. A NEW HAND POWER DRILL.

Holes drilled with this machine are reported to have a smooth bore and a sharp edge, and there is little danger of cracking the wall at the surface.

McCoy's Elastic Cement.

Almost every contractor doing work in cement stucco has realized the difficulty of caulking windows satisfactorily, and has also been confronted with the problem of pointing up cracks in stucco work. A preparation known as "McCoy's Elastic Cement" has been put on the market for just such purposes. It is an elastic cement or putty for use wherever an elastic joint is necessary and, it is claimed, is not affected by the elements or by acids and alkalis. Some of its varied uses are in caulking around window and door jambs (as stated above), pointing up small holes in brick or stone walls, pointing around metal flashings, pointing cracks in stucco, repairing roofs, pointing expansion joints in cement floors, for plastic joints in swimming pools, shower baths, urinals, etc. This elastic cement is manufactured by the Hydro-Bar Waterproofing Co., 579 West 19th street, New York City.

Artificial Marble.

Artificial marble, like concrete, must be properly compounded, mixed and handled, if perfect results are to be obtained. The process consists of more than mere formulas, and the necessary knowledge has, in the past, been difficult to obtain. This difficulty has been to some extent removed, however, by the publication of a book, known as "A Treatise on Artificial Marble and Sanitary Flooring," which not only contains approved formulas for various purposes, including marbleized surfaces for concrete block, brick, etc., but complete and practical instructions for every branch of this industry.

The Artificial Marble Supply & Equipment Co., 374 Market St., Newark, N. J., has acquired the exclusive selling agency for this book, and reports that it is in demand among contractors and

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Don't despair because your previous experiences have not been satisfactory. IMPERVITE works on a new principle.

A cellar 50 ft. below tide water can be waterproofed by a 3-4 in. INTERIOR facing of cement mortar, treated with Impervite.

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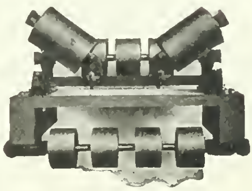

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Will not break or flake in Tube Mill.

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HIGHEST GRADE GRINDING PEBBLES FOR TUBE MILLS
PORT ARTHUR, ONTARIO, CANADA.

manufacturers of concrete products. As a direct result of the hundreds of these books which have found their way into the hands of the more progressive cement users, it has been necessary for this company to add an entirely new department, that of supplying "ready mixed" compostiion for the use of beginners. They have also added an instruction department for those who lack sufficient confidence in their ability to branch out into a new industry without personal instructions.

Salamanders on Construction

Drying stoves or salamanders provide a means of heating buildings in process of erection and help in drying out masons' and plasterers' work. For concrete work in cold weather they are widely used to keep the temperature of the green concrete above freezing.

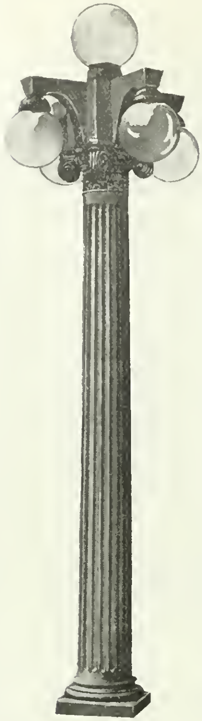
A Salamander with Cover Above and Pan Below.

A drying stove manufactured by G. Drouvé Co., Bridgeport, Conn., is strongly built and comes in 15-in. and 20-in. diameters. Coke or coal can be used. A shaking and dumping grate is provided with a pan of sheet iron, conical in form, to receive ashes and prevent fire and ashes falling outside on the floor. The total height of stove is 3'. The stove can be readily moved from place to place, an opening being left for insertion of rod for carrying.

Concrete Lighting Standards.

Owners of estates, officials of colleges and universities, as well as civic commissions, are recognizing the many advantages which the concrete lighting standard possesses over the not always sightly iron post.

One reason for this deserved recognition can be traced to the fact that the possibilities for artistic construction in the concrete standard are unlimited. Concrete standards are not confined to any one style, but on the contrary many attractive designs can be produced. The one shown in the accompanying illustration is one of the designs manufactured by George W. Edgcumbe, general contractor at Benton Harbor, Mich. It is a clean-cut example of what can be produced, and while it is shown as supporting five lamps, the number can be reduced to meet any requirements by changing the form of the arm which holds the lamps.



Artistic Concrete Light Standard.

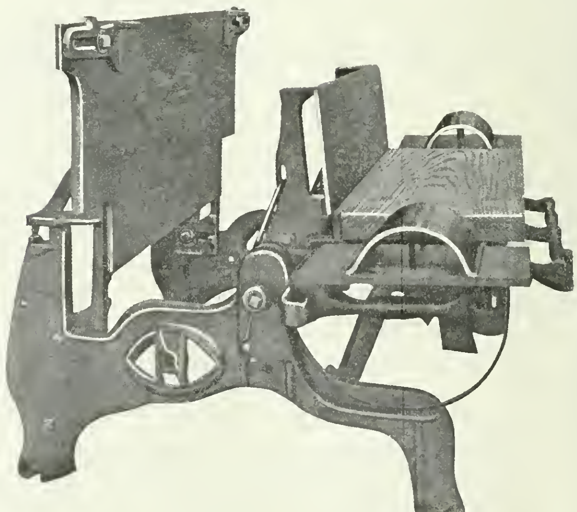
The cost of production is considerably less than that of the iron post, and as the expense of painting is entirely eliminated, the cost of maintenance is materially reduced. There is no question as to the durability of the concrete posts when properly constructed. They lend attractiveness to campuses, parks, boulevards and drives, and by their commanding appearance they are in a class by themselves. The molds used in making the posts, of which the one illustrated is a sample, were furnished by the Architectural Mold Co., Detroit.

The Nicolai Concrete Block Machine.

The St. Johns Foundry Co., St. Johns, Mich., is now manufacturing the Nicolai concrete block machine shown in the accompanying illustration. The machine is the outgrowth of many years' experience in handling block machinery and presents many interesting features. It is apparently simply and substantially built. For various sizes of block, the end-plates, hinge-core plates, and back walls are easily adjusted. In releasing the block from the machine, it comes over to rest on a spring which takes up any possible jar and to a great extent eliminates breakage at that point. The machine is equipped with a simple device, the "Eccentric Pallet Adjuster," which permits the use of pallets from 1" to 2" in thickness. Pallets of any size can be used.

The New Zealand Portland Cement Co. announces that all of the cement and lime manufacturers in the Dominion have agreed to pack cement in bags weighing 18 to the ton. The new bag is already in use, the gross weight of each being about 127 lbs., or practically three bags to a barrel. This change was made at the request of the laborers' organizations, who have to handle this material.

Lime will, as hitherto, be put up in bags of one cwt. each, or 20 to the ton.



The Nicolai Block Machine.

Barrett Specification Roofs

Shore Mills, Fall River, Mass., roofed along the lines of the Barrett Specification in 1876.

LOW COST—LONG SERVICE

METAL roofs require painting every few years, most ready roofings require coating regularly, but with Barrett Specification Roofs *there is no maintenance expense.*

Barrett Specification Roofs are roofs of coal tar pitch and tarred felt, with a top surface of slag, gravel or tile, *laid according to the Barret Specification.*

This specification is simply the standard formula for building a first-class roof of this character.

It is possible, of course, to make an inferior roof of these materials either by poor workmanship or by using insufficient and poor goods. But if the Barrett Specification *is followed absolutely and the materials called for are used,* you are certain of getting the best value in roof coverings.

Such roofs usually last twenty years and over without leaks or repairs.

Barrett Specification Roofs are almost universally used on factories and buildings of large roof areas and where costs are carefully figured. They are equally good for city dwellings, warehouses, railroad buildings, etc.

Copy of the Barrett Specification, with diagrams, mailed free on request to nearest office.

Special Note

We advise incorporating in plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired however the following is suggested.

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

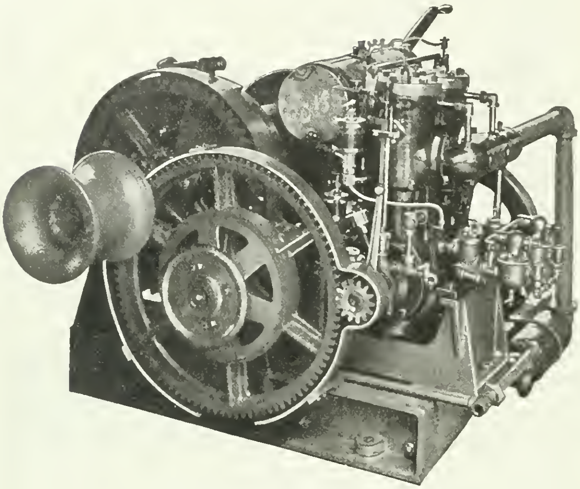
BARRETT MANUFACTURING COMPANY

New York, Chicago, Philadelphia, Boston, St. Louis, Kansas City, Cleveland, Cincinnati, Minneapolis, Pittsburgh, Seattle, Corey, Ala.
THE PATERSON MFG. CO., Ltd:—Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B. Halifax, N. S.

TRADE B MARK

A New Type of Gasoline Hoist.

It is many times impossible for a contractor to make use of a steam hoist unless he can carry onto the work a boiler to furnish the steam. It is also frequently impracticable to use electric power, because no adequate source is conveniently at hand. In such a case as this, where more power is required than can be easily obtained by manual labor, the gasoline engine hoist fills a real need. A hoist just being put on the market by the American Engineering Co., Philadelphia, contains among other features a patent friction drum arrangement; all the control levers are located on one side of the machine within easy reach



CONTRACTORS' HOIST DRIVEN BY GASOLINE MOTOR.

of the operator, and the spur gears are properly protected by guards. The machine carries a winch head also on the outside end of the drum shaft, so that a separate rope can be handled from this without using the drum.

The engine shown herewith was designed for developing 8 h. p., running at 550 rev. per min. on the 2-cycle principle. The two cylinders measure 4½" by 5" and the capacity of the machine is 3,000 lbs. handled at the rate of 50 ft. per min. The speed of handling the rope, together with the lift of the machine, can be changed to suit any condition desired, gearing having been designed for speeds up to 1,000 ft. per min. This high speed is desired by some contractors for operating material elevators on very tall buildings, to eliminate the delays incident to slow travel. With this high speed of lifting, the capacity is usually limited to 500 or 600 lbs., which comprises ordinarily the elevator and 2 wheelbarrows.

The American Engineering Co. does not favor the use of 2-cycle engines for this work, although the engine illustrated happened to be that type. Four-cycle engines are recommended, largely because of their greater reliability for continuous operation and less danger of breakdown. The company is ready to install on the hoist any engine of well-known make which will satisfy the conditions.

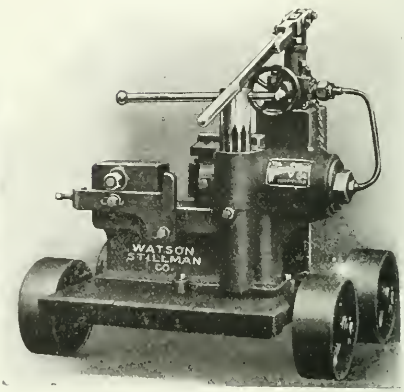
The machine shown in the illustration has a motor pinion with 14 teeth meshing in a gear with 100 teeth. The second drive includes a pinion with 13 teeth and a spur gear with 59 teeth. The compound ratio is about 65:1, thus giving the engine 550 rev. per min. and the drum and winch head about 8½ rev. per min. If desired, the winch head may be placed upon the intermediate shaft, which would give it about 77 rev. per min. This would enable the handling of a rope at very much higher speed and might be desired for some purposes.

This machine illustrated has a length over-all of 6' 5¾". This includes the winch head at one end and the control handle at the other. The width over-all is 4' 3", while the height to top of control handle is 3' 8". It is thus seen to be a very compact machine, taking up small space for the power there is in it. The winch head has a diameter of 7" and is 10" long.

The Alpha Portland Cement Co., Manheim, W. Va., has placed an order with Tate-Jones & Co., Inc., Pittsburg, Pa., for special "Kirkwood" natural gas burners for its rotary kilns. Seven kilns were similarly equipped some time ago, and the present order calls for 5 burners for 5 other kilns. "Kirkwood" burners are used almost exclusively in rotary cement kilns where natural gas is available.

An Hydraulic Shear for Reinforcing Rods.

Contractors who do much reinforced concrete construction work find the cost of cutting the reinforcing bars to be an important item, especially where the bars are so large that they cannot be sheared readily by ordinary methods Little difficulty is experienced in cuttting rods of ½-in. or ¾-in. diameter, but for cutting the larger sizes there are many methods, varying from hand hammer and cold chisel to hack-saw or oxy-acetylene blow torch. A forge can be used for heating the bars to a red heat; and the bars are then cut with top and bottom "hardies." Most of these methods are responsible for much



AN HYDRAULIC SHEAR FOR CUTTING STEEL RODS.

St., New York City, has recently placed loss of time and money and should be eliminated.

The Watson-Stillman Co., 50 Church

(Continued on Page 82.)

Trade Literature

Standard Specifications for Rail Steel Concrete Reinforcement Bars, adopted by the Association of American Steel Manufacturers. The Interstate Iron & Steel Co., Chicago. Six pages, 3½" x 6"; paper bound. A convenient vest-pocket edition of these specifications, which should be of interest to users of reinforcing steel.

Steel Wall Forms. Blaw Steel Construction Co., Pittsburgh. 32 pages, 9" x 6"; paper bound, illustrated. This bulletin describes in detail the form units and their use. Steel forms are rapidly replacing wood for form work, producing better concrete walls at less cost.

Concrete Tie. Flood Concrete Tie Co., Bridgeport, Conn. 12 pages, 9" x 6"; paper bound, illustrated. This describes a concrete tie with heavy reinforcing, molded in an iron form. A complete layout of the plant for manufacturing the ties is shown.

Hand Power Bending Tools. Wallace Supply Co., 108 N. Jefferson St., Chicago. 16 pages, 9" x 6"; paper bound, illustrated. In this catalog is shown in detail all the hand power bending tools manufactured by the Wallace Co.

Under Fire. The General Fire-Proofing Co., Youngstown, O. 16 pages, 9" x 3¾"; paper bound, illustrated. This bulletin describes graphically the fire test conducted under the supervision of the Dept. of Public Safety, Cleveland, to determine the comparative fire resisting quality of various partitions. The pamphlet is fully illustrated.

The Sterling Way to Success. Izard-Warren Co., 136 N. 12th St., Philadelphia. 51 pages, size 9" x 6"; paper bound, illustrated. Transits and levels are coming into very general use on construction work, and probably rightly so, for their intelligent and accurate use means much in laying out work. This catalog shows in detail the "Sterling" line of transits and levels, together with some interesting notes on the care and adjustment of instruments in general.

Skeleton Construction. Wilson System Co., New York City. 19 pages, 7" x 4½"; paper bound, illustrated. This booklet describes a structural concrete skeleton form construction for industrial buildings. Heavy timber flooring is used.

Fireproof School Buildings of Reinforced Concrete. American Concrete Steel Co., Newark, N. J. 46 pages, 7" x 10"; paper bound, illustrated. This is an exceedingly interesting description of fireproof school buildings erected in New York and New Jersey by this company. Fireproof school buildings are today recognized as absolutely essential, and reinforced concrete is the recognized structural material.

Fireproof Houses. National Fire-Proofing Co., Pittsburg. 64 pages, 12" x 8"; paper bound, illustrated. This interesting booklet illustrates a great number of modern fireproof homes. Different kinds of wall finishes are shown in color illustrations and structural details in reproduced blue prints.

Shore Protection. Paul Decauville, Blvd. Bausejour, Paris. 16 pages, 8½" x 5½"; paper bound, illustrated. This describes a mattress for shore protection formed by threading small concrete blocks on wire cables. The illustrations show the use of this method in France and in Egypt. The machine for making these blocks is also described.

Ideal Ideas. Ideal Concrete Machinery Co., London, Canada. 16 pages, 9½" x 6½"; paper bound, illustrated. This is an interesting booklet describing in detail the experience of men who have taken up the manufacture of concrete block.

Laboratory Testing Apparatus. Howard & Morse, 1197-1211 DeKalb Ave., Brooklyn. 6" x 9"; illustrated. This describes, among other apparatus, a gang mold for briquettes, and also a sieve agitator.

Concrete Roofing Tile. Otto Walter, patentee and manufacturer, De-Kalb, Ill. 16 pages, 9" x 6", paper bound; illustrated. Concrete roofing tile is rapidly becoming a standard building unit, and this booklet describes a concrete tile which has many points of interest. The machine for making the tile is also described.

Clinton System of Concrete Reinforcement. Clinton Wire Cloth Co., Clinton, Mass. 47 pages, 12" x 9"; paper bound, illustrated. This booklet describes the electrically welded fabric used, shows typical structural details of different floor systems, and illustrates buildings in which this material has been recently used.

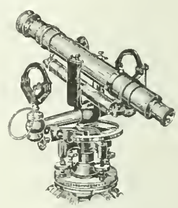
A Compact Grinder

A new machine, just put out by the Luther Grinder Mfg. Co., Milwaukee, Wis., fills a long-felt demand for an efficient sharpening machine that can be packed into small space. This new "Dimo-Grit" grinder No. 35 incorporates these points in a unique and interesting way.

All the mechanism of the machine is contained within the wheel itself. The wheel is hollowed out to contain a series of four driving gears and pinions. These produce a speed of 20 revolutions of the grinding wheel to every turn of the handle. The machine is finished in red and black enamel. The wheel is of "Dimo-Grit," the new "diamond" sharpening substance.

The space required for carrying this grinder is scarcely greater than the wheel itself. The wheel is 5½" in diameter, and the entire machine packs in a box 5½" long. All the different parts, including the handle, clamp, tool rest, etc., can be easily and quickly taken apart for packing. Its particular use is to be found with carpenters for their tool chests, for miners, surveyors, prospectors, woodsmen and sportsmen; in fact, all who have tools to be kept sharp, but who cannot have them in a permanent workshop.

A Builder's Level and Transit

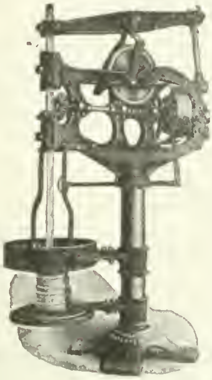

THE STERLING CONVERTIBLE LEVEL

The "Sterling" convertible level, as illustrated herewith, has been designed by the makers, Izard - Warren Co., Philadelphia, to fill a long-felt want for an inexpensive instrument, by means of which sights above or below the horizontal could be readily taken. This instrument is simply a level with the addition of a small U-shaped standard into which the trunnions at either side of the telescope are adjusted.

The instrument can be used as an ordinary level, and the small standard carried in the pocket to be used only when required. The change requires only a few moments. This level is provided with the tangent or slow motion screw to the plate clamp, also a shifting center.

With this instrument the vertical lines of foundations, intersections, columns, chimneys, etc., can be accurately checked, often saving costly mistakes and delays. The ease with which the convertible attachment is put into place, and the facility with which, by its use, lines of stakes can be accurately located, have made this a valuable addition to the equipment of every up-to-date builder.

THE PLANT MANAGER



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Says:

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This remark was made in connection with recommendation for the

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by one of the best cement Tile Makers in the country.

Guaranteed to make more and better drain tile than any other machine on the market. This is where the purchase is not an expense, but is an investment that will yield 100% returns.

Shipped on trial, with settlement when satisfied.

Improvements in Jackets, Pallets and Packer Heads make the game easier for **MONARCH** users.

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WILL OUTLAST YOUR BUILDING

Artistic and Ornamental in appearance and is positively guaranteed to be Fire, Lightning, Rain, Storm and Wind proof.

Its extreme lightness (about one-eight that of slate), durability and moderate cost commend it to those wishing something out of the ordinary in roofing.

Manufactured from best quality Worcester Grade Terne Plate, furnished painted or galvanized (galvanized after formation) size 10 x 14 inches.

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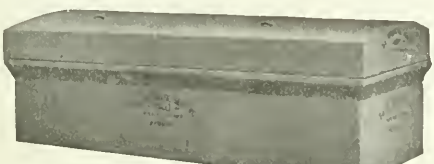
MORE BEAUTIFUL THAN STONE OR STEEL



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AS ENDURING AS THE AGES

Adjustable Steel Burial Vault Molds and The Automatic Sealing Burial Vault

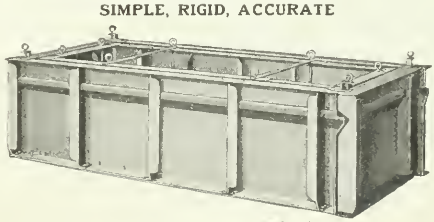
Why should you not have the many HUNDREDS OF DOLLARS that are constantly escaping you because you are not making and selling The Automatic Sealing Burial Vault in your locality? A big lucrative business is waiting to be picked up and you should consult your own interests so that you do not let any time pass between now and starting in this business. You can make cement pay big profits all winter long and with your experience with cement and our Adjustable Steel Molds you have the right combination to pile up profits that would otherwise escape you.

Once you have introduced the Automatic Sealing Vault in your community you can place them at the greater per cent of the mortality rate.

You have the cement, you don't need any investment in plant—and you know about cement. There isn't anything to learn that you could not learn immediately. You don't have to do any experimenting and with the manufacture of the first vault you will make a success of it.

Write today and get our catalogue and prices.

SIMPLE, RIGID, ACCURATE



ADJUSTABLE STEEL MOLDS

The Automatic Sealing Vault Co.,

Peru, - - Indiana

on the market a hand-operated hydraulic shear. This shear, which is especially adapted to cutting reinforcing bars, represents many years of experience by the company in making hydraulic shears for cutting all kinds of steel and iron. But this tool is also useful for cutting any kind of bar iron of section similar to that of the reinforcing bars. The diameter of the ram is 4½"; its stroke is 2½"; it exerts a pressure of 75 tons, and will cut material up to 1¼" square, averaging about 3 cuts per minute.

This tool is claimed by its makers to be better for its purpose than the vertical type of shear, in that the bar is dropped in from the top and is held at a much more convenient height for handling.

The cutting blades are another feature worthy of comment. Both are square in section, are dressed on all 4 edges and are placed and held so that by turning the blades the 8 cutting edges can be used before resharpening is necessary.

The pinion for returning the ram is mounted upon a spring, so that the reaction which comes from cutting hard steel will not cut or break the teeth of the ram or pinion.

The pump is entirely independent of the cylinder, hence the valves are much more accessible than in tools in which these parts are within the cylinder. Troubles within the pump are further obviated by making the valves extra large. Should power drive be desired, a belt or motor driven pump can easily be substituted for the hand-operated pump shown. The weight of the shear complete is 550 lbs.

The Blaw Steel Construction Co., Pittsburg, announces that Herman Nieter, recently general sales manager of the Kennicott Co., Chicago, is now associated with it at its eastern office, 165 Broadway, New York City.

The Ruggles-Coles Engineering Co., 50 Church Street, New York City, has just received from the Alpha Portland Cement Co. the order for a second clay dryer and rock dryers.

Concrete-Cement Age

Devoted to the manufacture and uses of Portland cement

New York DETROIT Chicago

Entered as Second Class matter at the post-office at Detroit, Michigan, under the Act of Congress, March 3, 1878.

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Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa., Convention, Pittsburgh, Dec. 10-14, 1912.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Bldg., Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Bldg., Washington, D. C.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Building, Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Nebraska Cement Users' Association, Secretary-Treasurer, Frank Whipperman, Omaha, Neb. Convention and Show, Auditorium, Omaha, Feb. 6-12, 1913.

Pittsburgh Cement Show, Exposition Hall, Dec. 12-18, 1912.

Chicago Cement Show, Coliseum, Jan. 16-23, 1913.

Canadian Cement and Concrete Association, William Snaith, Secretary, 57 East Adelaide St., Toronto, Ont.

In This Issue

Vol. 1 DETROIT and NEW YORK, DEC. 1912 No. 6

Subscription, $1.50 a year; single copies, 15 cents. Canadian subscription, $2.00 a year; Foreign subscription $2.50 a year.

The Editors invite your correspondence on all matters relating to the industry which the magazine represents. Discussions, notes and inquiries will be gladly received.

Advertising rates upon application. Complete information regarding size, character and distribution of circulation cheerfully furnished upon request.

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Concrete-Cement Age

Vol. I DECEMBER, 1912 No. 6

Editorials

WITH THIS ISSUE the first volume of CONCRETE-CEMENT AGE is completed and there is assurance from many quarters that the new publication is serving the industry which it represents far better than any publication has been able to do before. It is not enough to do that, however. It rests with every one of you into whose hands this issue comes to make his magazine a more serviceable magazine than it is now. Only with the most complete co-operation can a publication become thoroughly efficient in an industry as large as the one for the betterment of which CONCRETE-CEMENT AGE stands. The descriptive matter, correspondence, reports of investigations and detailed information which are published from month to month should be supplemented by a greater amount of personal correspondence, more inquiry, more notes, more discussions of individual experience.

* * *

WITH THE issue of November we changed our "make-up." This was not a mere whim. You are keen enough to have seen that it makes it possible to get more matter on a page—very nearly fifty per cent more. And as to pages: *Concrete* published 233 editorial pages in the six issues from July to December, 1911; *Cement Age* published 288 of its smaller editorial pages in the same period and CONCRETE-CEMENT AGE in the six months from July to December this year publishes more than 335 pages. We are reasonably sure too, that not only in quantity has this magazine grown, but that the quality of its published matter has shown even greater progress.

* * *

THAT ISN'T ALL. For a long time we have felt that there is another field to which CONCRETE-CEMENT AGE should devote more attention—the problems of manufacture of Portland cement. At the same time we also felt that most *users* of Portland cement—the men who build with concrete, no matter what particular branch of concrete construction they represent, could have only a casual interest in the technical problems of cement manufacture. Therefore it would not be fair to devote even a limited portion of the regular editorial section of CONCRETE-CEMENT AGE to those things which are of interest to cement manufacturers and chemists only. The solution is The Cement Mill Section of CONCRETE-CEMENT AGE. This section, a monthly feature, is first published this month. Bound in the back part of the magazine, it is being sent to all those readers, so far as we can learn, who will be interested and to whom it will be valuable.

* * *

WE ARE trying to be broadly and yet definitely useful. Editorial work under way now will mean some splendid articles in the year 1913. But to you, who are out on the firing line, we look for knowledge. Write us of those problems which you solve, as you write us of those problems which you want help in solving. CONCRETE-CEMENT AGE is a bureau of exchange. It is an institution through which one reader says to another: *You help me and I will help you.*

In presenting matters editorially it is often difficult to offer a clear and forceful discussion without at times giving an impression of "taking sides." On a great many questions, say for instance the comparative structural value of burnt clay or concrete, we have very decided opinions and never hesitate to express them; while on many doubtful questions we endeavor to present the essence of the best knowledge and opinion that can be brought to bear on the subject, contributing our mite toward the clearing up of the matters involved.

Many problems face the cement industry to-day, and all of them are to CONCRETE-CEMENT AGE open questions to be considered in the best and broadest way. Primarily, this paper stands for the best and most permanent concrete construction, the best cement, the best steel, the best and safest methods of concrete construction, and for the development of everything that will lead to those ends. All that pertains to any of these questions has, from time to time, been treated in these columns and treated with an open mind and a desire to consider all points of view. Differences of opinion and practice naturally arise and, in time, will work themselves out, especially when aided by open-minded, impartial and aggressive research, followed by proper observation and discussion, and in this direction CONCRETE-CEMENT AGE pledges its best efforts.

From time to time new methods of manufacture, new methods of use, new methods of testing, arise, and in all cases of this kind this paper opens its columns for discussion,—discussion, however, in which the paper is neither for nor against any of the things that are suggested. This applies especially to the autoclave test—a new method of testing cement under high steam pressures. The test is one which has recently been brought to the attention of the engineering profession in this country and which, in Germany, was discarded many years ago. This is one of the class of subjects where CONCRETE-CEMENT AGE can "take no sides" until further research has demonstrated the practicability of the test and its scientific value ascertained by the test of time. A recent editorial on this subject may have been misconstrued to convey the impression that this paper favored this particular test. On the contrary, it proposes to treat it, and all other new methods of testing cement, in the broad view that it treats all questions and when convinced, in the proper light of scientific research, that the test is correct, it will do all it can, as it will in every other case of right substantiated by fact, to give the fullest weight of its influence on the side of right.

National Association of Cement Users Convention Program

The program of the ninth annual convention of the National Association of Cement Users to be held at the Fort Pitt hotel, Pittsburgh, Dec. 10-14 inclusive, thus merging into the dates of the Pittsburgh Cement Show (Dec. 12-18), is announced by President Richard L. Humphrey as follows:

Tuesday, December 10

10:50 a. m.

Meeting of the Board of Direction.

2:00 p. m.

Meeting of sectional committees on: Aggregates, Building Blocks and Cement Products, Education, Exhibition, Fence Posts, Fireproofing, Form of Specifications, Insurance, Measuring Concrete, Nomenclature, Reinforced Concrete and Building Laws, Reinforced Concrete Highway Bridges and Culverts, Roadways, Sidewalks and Floors, Specifications and Methods of Tests for Concrete Materials and Treatment of Concrete Surfaces.

8:00 p. m.

Formal opening of the Convention, Fort Pitt hotel.

Address of welcome to the City of Pittsburgh.

Response by the President.

Address of welcome on behalf of the engineering interests.

Address of welcome on behalf of the contracting interests.

Business Session — Announcement of Committees, Nominations and Resolutions.

*"The Use of Concrete in Irrigation Work," F. H. Newell, Director, U. S. Reclamation Service, Washington, D. C.

Wednesday, December 11

9:00 a. m.

Meeting of Sections on: Reinforced Concrete and Building Laws, Measuring Concrete and Nomenclature, Topical Discussion on Design and Construction in Concrete and Reinforced Concrete.

10:00 a. m.

Report of the Committee on Nomenclature, Peter Gillespie, Chairman.

Annual address by President Richard L. Humphrey.

*Illustrated with stereopticon.

*"The Present Status of Unit Methods of Reinforced Concrete Construction," John E. Conzelman, chief engineer, Unit Construction Co., St. Louis.

*"Concrete Grain Elevators," R. P. Durham, vice-president, John S. Metcalf Co.. Montreal, P Q.

"Concrete Grain Elevators," Barney Weller. purchasing agent, James Stewart Co., Chicago.

3:00 p. m.

Report of the Committee on Reinforced Concrete and Building Laws, Alfred Lindau, Chairman.

Report of the Committee on Measuring Concrete, presenting proposed standard method of measuring concrete construction, R. A. Cummings, Chairman.

*"Method of Design and Results of Tests on Girderless Floor Construction of Reinforced Concrete," T. L. Condron, president, Condron Co., Chicago.

*"Measurement of Actual Stresses in a Cantilever Flat Slab Reinforced Concrete Floor Having Rectangular Panels," Arthur R. Lord, structural engineer, Chicago.

*"Rigid Frames and Arches of Reinforced Concrete in Building Construction," Sanford E. Thompson, consulting engineer, Newton Highlands, Mass.

8:00 p. m.

Opening of Cement Show.

Thursday, December 12

9:00 a. m.

Meeting of Sections on: Roadways, Sidewalks and Floors, and Reinforced Highway Bridges and Culverts.

Topical Discussion on Design, Materials and Methods of Construction of Concrete Roadways, Highway Bridges and Culverts.

10:00 a. m.

Report of the Committee on Roadways, Sidewalks and Floors, C. W. Boynton, Chairman.

Report of Committee on Reinforced Concrete Highway Bridges and Culverts, Willis Whited, Chairman.

*"Vibrolithic Concrete Pavements," R. C. Stubbs, contracting engineer, Dallas, Tex.

*"The Concrete Roads of Wayne County, Mich.," Edward N. Hines, Road Commissioner, Detroit.

3:00 p. m.

Report of the Committee on Concrete Surfaces, Presenting Proposed Standard Specifications for Portland Cement Stucco.

*"Tests of Waterproofings for Concrete," Cloyd M. Chapman, engineer in charge, Westinghouse, Church, Kerr and Co., New York City.

*"The Effect of Electric Current on Concrete," E. B. Rosa, assistant director, Burton McCollum, associate physicist, and O. S. Peters, United States Bureau of Standards, Washington, D. C.

*"Fire Test of Cement Stucco Partitions," L. H. Miller, engineer, Bethlehem Steel Co., Cleveland.

*"Discussion on Metal Lath Construction," H. B. McMaster, commissioner publicity bureau, Associated Metal Lath Manufacturers, Youngstown, O.

7:30 p. m.

Annual banquet. The speakers will be announced later.

Friday, December 13

9:00 a. m.

Meeting of Sectional Committees on Aggregates and Specifications and Methods of Tests for Concrete Materials.

Topical Discussion on Aggregates and Methods of Tests of Materials used in Concrete.

10:00 a. m.

Report of the Committee on Standard Specifications on Methods of Tests for Concrete Materials, Sanford E. Thompson, Chairman.

Report of the Committee on Aggregates, William M. Kinney, Chairman.

"The Constitution of Portland Cement—Some Results Obtained at the Experimental Cement Plant of the Bureau of Standards," P. H. Bates, Chemist, Bureau of Standards, Pittsburgh.

"The Progress of the Work in Cement and Concrete of the Bureau of Standards," Rudolph J. Wig, assistant engineer, Bureau of Standards, Washington, D. C.

3:00 p. m.

Report of the Committee on Building Blocks and Cement Products, P.

(Continued on Page 102)

FIG. 1—CAST CONCRETE FRIEZE, HUDSON COUNTY PARK. RECREATION PAVILION

Ornamental Use of Concrete in Playground Structures

How Rich Effects Were Obtained Economically in Hoboken Park Improvement

Even more striking—in the richness with which concrete has been applied to decorative purposes—than the Chicago Park structures illustrated last month are the buildings in Hudson County Park, Hoboken, N. J., here illustrated.

The work was designed by Arthur Ware, New York City, who had the problem to provide such rich ornamentation as is fitting for playground structures and yet keep within a rather limited appropriation.

The work includes a Recreation Pavilion and Band Stand — separate structures, though really united in one —and a bath house and swimming pool.

At the outset the architect was informed by Charles N. Lowrie, landscape architect for the Hudson County Park Commission, just what might be spent and at the same time made plain the requirements of suitable richness in treatment. Mr. Lowrie had been landscape architect for West Side Park, Jersey City, N. J., and he showed Mr. Ware buildings which had been erected there—all in stone. A band stand, alone, no larger than the one attached to the recreation pavilion in Hudson County Park, and constructed entirely of stone, with simple Doric columns and no ornamentation, cost as much as the entire recreation pavilion, band stand and pool, together with the gardens, newels, vases, etc., which were later designed in cast concrete for the Hoboken park. It was apparent, therefore, to Mr. Ware that architecture in stone, or even terra cotta, was out of the question. Mr. Ware explains that had stone been adopted, it would not only have been infinitely more expensive, but would have eliminated entirely the

FIG. 2—LOOKING OUT OF PAVILION ON LILY POND—FOUNTAIN IN CENTRAL FOREGROUND

FIG. 3—OUTSIDE VIEW OF CONCRETE FOUNTAIN
Columns were cast in place in plaster molds; smaller ornamental parts cast in gelatine molds; afterward hand-tooled

use of rich ornamentation which is essential to give a beautiful playful character to a recreation park and that terra cotta would also have been very much more expensive, although it would have lent itself to a rich ornamental treatment. However, the very character of the building designed, which is somewhat Italian, seemed to lend itself better to a treatment in concrete than in any other material.

"I firmly believe," says Mr. Ware, "that there is an enormous field for ornamental cast cement concrete. Very beautiful effects can be obtained at comparatively reasonable figures, and by contrasting the ornamental surfaces with certain plain surfaces, a highly decorative result is achieved at a cost well within the limits of economy, and while producing a pleasing work, gives a lasting one."

The contract figure for the recreation pavilion and band stand, together with the lily pool, and all the embellishments about it, was $17,822. Some extra work gave additional cost of

FIG. 4—CONCRETE PAVILION, FOUNTAIN AND POOL—FLOWER BOXES AND URNS ALSO OF CONCRETE

FIG. 5—SIDE VIEW OF BAND STAND AND PAVILION

$377.50—or a total expenditure of $18,199.50.

The contract figure for the bath house and swimming pool was $19,008; extras for additional waterproofing and reinforcing brought the total to approximately $20,000.

It is safe to say, that if the recreation pavilion had been executed all in stone with the same ornamentation as detailed for concrete, it would have cost from $60,000 to $75,000, using Indiana limestone. This is probably a moderate estimate, as the cost of carving all of the richly ornamented frieze and the Ionic caps, together with the very ornamental fountain, would have been a very large item.

At a very slight additional expense, cast cement concrete ornaments when taken from the molds can be gone over with hand-tooling, and when finished have all the beauty of natural stone. If the materials used in casting are first class, they will have lasting qualities as good as stone, or better, as there is no possibility of shaling or disintegrating, the only imperfections being the possibility of slight crazings, which can be overcome by giving the ornamented surface a light brush coat of some approved cement wash or a weak solution of waterproofing cement.

The modeling in clay and casting the concrete architectural and orna-

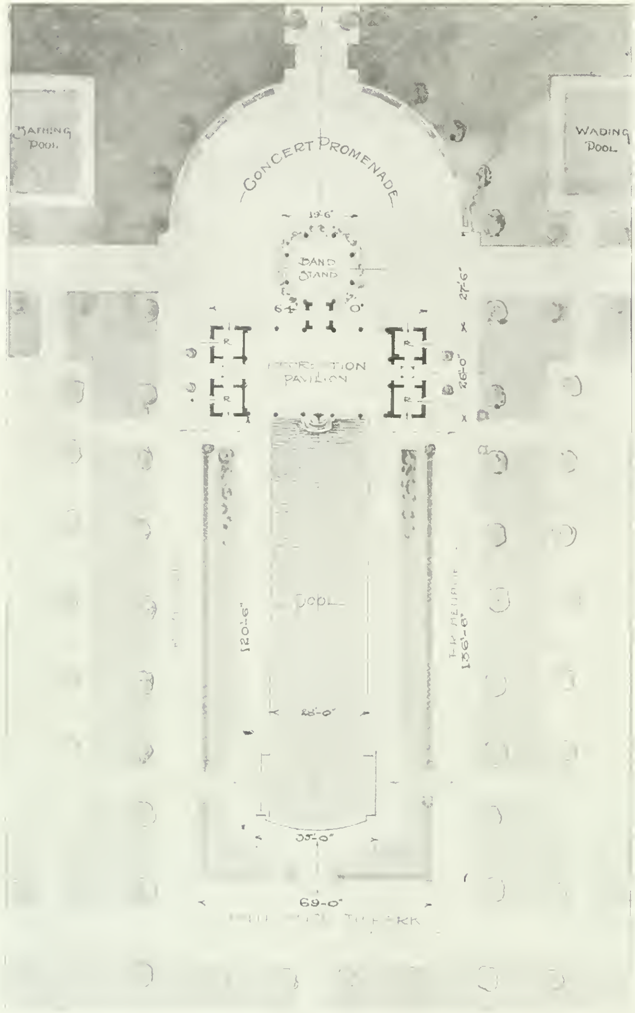


FIG. 6—PLAN OF STRUCTURAL AND LANDSCAPE IMPROVEMENT—ARTHUR WARE, ARCHITECT; CHARLES N. LOWRIE, LANDSCAPE ARCHITECT

mental parts of the building made one of the most interesting features of the construction. After all the detailed drawings were made, a thoroughly first-class modeler was employed to make all the models throughout. This is a most important matter, as it is in the modeling that the refinement and beauty of the detail are brought out and studied in all their proportions from the architect's drawings. In the case of the recreation pavilion all this work was done by a young sculptor, B. L. Zimm, a student of Carl Bitter. Mr. Zimm has exhibited sculptural work at the Paris Exposition of 1900, and at the Louisiana Purchase Exposition. The modeling, therefore, was in thoroughly capable hands. All the models were made in clay, not only for all the purely ornamental pieces, but also for such molded work as columns, bases, balusters, balustrade caps, rail, etc. After the models in clay were approved by the architect, molds were made for casting. All molds for the purely molded parts were made in plaster, and those for the ornamental parts were of gelatine. The concrete mixture used was Franklin sand, which is a crushed white granite with considerable grit, and Atlas Portland cement mixed in the proportion of 2 parts sand to 1 part cement. In the column shafts and in some of the larger parts some coarse building sand was used, mixed with the granite sand. The shafts of the columns were cast at the building, the bases were set in position, and the shafts were cast in plaster molds in place. After the molds were removed, the columns were gone over by hand to remove all imperfections.

The ornamental work on the fountain was reinforced, as all these parts were within reach of the public and would be subject to rough treatment.

The infants ornamenting the vase were thoroughly reinforced with iron rods and well anchored with rods to the vase. The two basins connected with the fountain were molded in position in plaster. They are cantilevered from the building with "I"-beams and are heavily reinforced with rods and twisted wire mesh. Part of the ornamental stalactite work on either side of the basins was molded in place in connection with the molding of the basins. When the concrete was sufficiently hard, some parts, among them the fountain, were gone over slightly with hand-tooling which added much to the effect of the work. The richly ornamental frieze was given a suggestion of tooling in the clay modeling, and as it is some distance above the eye, the effect, when in position, was entirely satisfactory, having all the beauty of carved stone.

"A little tooling greatly adds to the character of cast concrete," comments Mr. Ware, "and it is possible to indicate a tooled surface on the clay model and retain this tooled effect very well in the casting. Where the surfaces are some little distance above the eye, it is not necessary to go over them with any hand-work whatever. It is only where the cement work is close to the eye, as in a balustrade, or parts subject to close inspection, that tooling is necessary, and it may then be omitted, if expense will not permit, as it is possible simply to rub the surfaces with a piece of concrete, producing a very excellent rubbed stone surface.

"If I had this building to execute again, I should undoubtedly use colored cement tiles in place of the clay tiles which are employed in the frieze and introduce color into the concrete ornamentation. There are several concerns now doing excellent work in colored concrete, and it has stood the test of weather conditions for 3 or 4 years without any appreciable fading out of the color or disintegration of the material. Colored cement concrete can be most effective, and will undoubtedly be used very largely in the future. The next opportunity offered me of executing a building in cast concrete work in which ornamental castings are features, I propose to make a study of the use of color in cement. It must, however, be handled by experienced workers only and the coloring matters must be those which will not in any way affect the quality of the cement and which will not fade. Although all this work is still in somewhat an experimental stage, I believe that the permanent coloring in concrete ornamentation is thoroughly practical."

All vases, flower boxes and everything of an ornamental character connected with the building, is of con-

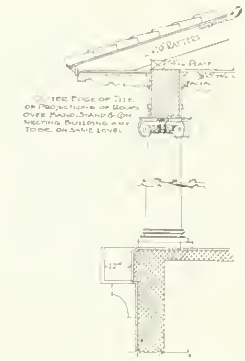


Fig. 8—Section Through Band Stand Cornice—Scale 3/16″ to 1′

Fig. 9—Section Through Connection Building, Looking Toward Band Stand—Scale 3/16″ to 1′

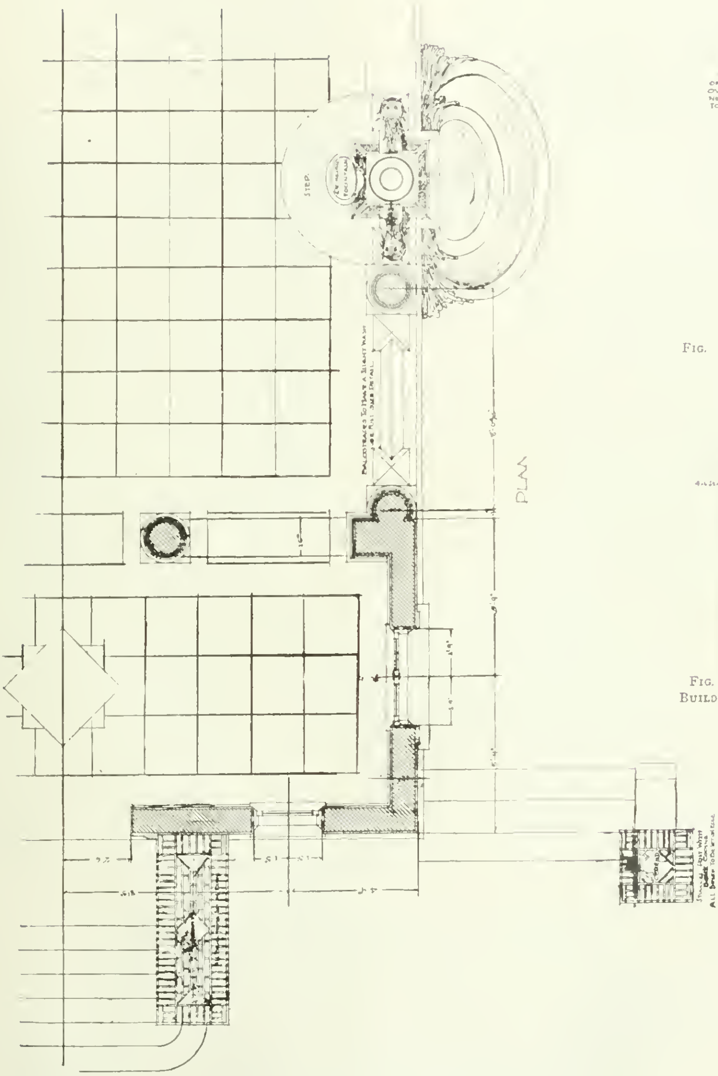


Fig. 7—Partial Detail Plan of Work—Scale 3/16″ to 1′

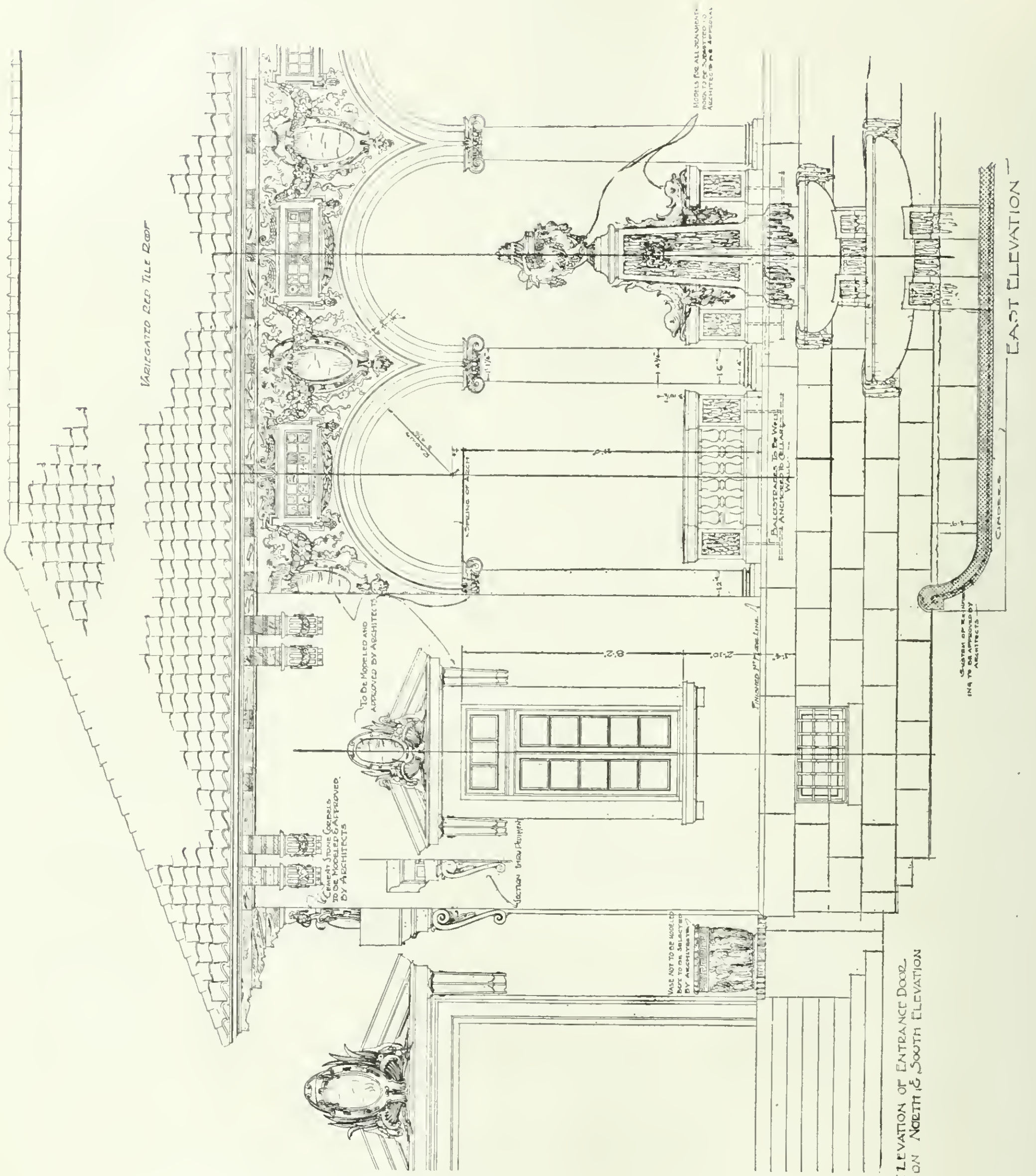


FIG. 10—ELEVATION OF ENTRANCE DOOR, NORTH AND SOUTH SIDES AND EAST ELEVATION—SCALE 3/16" TO 1'

crete. The flower boxes are reinforced with light iron rods and galvanized Clinton* wire. Some of the ornamental parts were made in a shop, boxed and shipped to the building, and put in place there, being securely anchored to the wall. Other parts, however, such as pediments of windows, window sills, architrave moldings, etc., were cast on the premises and built into the wall, which makes a very much more secure piece of work. Considerable patching and retouching of the ornamental parts was done directly in place and proved most satisfactory.

The lower portions of the walls of the buildings as shown in the detail drawings are of concrete; the upper walls of hollow terra cotta tile, covered with rough-cast stucco and the floors are of reinforced concrete slabs. The roof is covered with kiln-run, dull, unglazed red Spanish tile.

The concrete band course, running around the building, was given a rubbed finish.

The lily pool and the swimming pool are constructed with concrete sheets 8" to 10" in thickness, reinforced with heavy galvanized iron wire with rods placed at intervals of 2'—no expansion joints. Inside, the pools are waterproofed with 5-ply felt and tar waterproofing and over this is a 3-in. wall of concrete, this in turn covered with ¾" of Hydrolithic waterproof cement.†

The bath house is not of poured concrete. Terra cotta tile were used, covered with cement stucco. The Doric columns are built in the same way.

The spalling frequently observed when reinforced concrete floors are attacked by fire, is generally due to the production of steam from water held in the pores of the concrete. If the concrete has time to become fully dry throughout the mass before being attacked by fire, the danger of spalling is greatly reduced.

The British Fire Prevention Committee reports that for fire-resisting concrete floors, the reinforcing metal should have a protection of at least 1" at the bottom of the floor panel, 1½" at the bottom of beams and 2" at the bottom of girders.

*Clinton Wire Cloth Co.

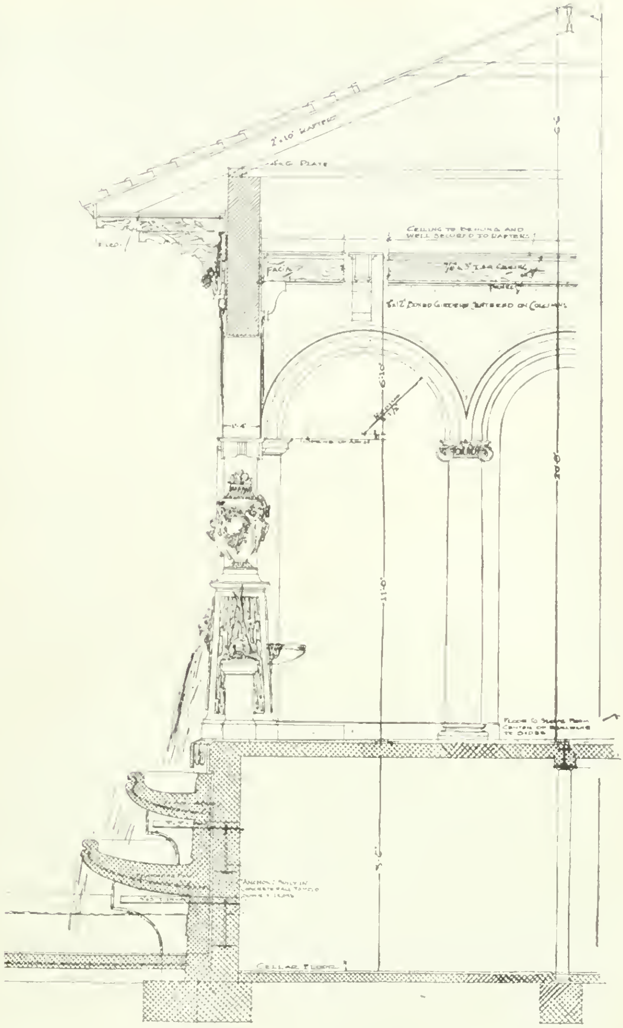


Fig. 11—Half Cross-Section—Scale 3/16" to 1'

Fig. 12—The Swimming Pool

Cement exports from Germany for the seven months ended July 31, 1912, were nearly 1,250,000,000 pounds, or an increase of 250,000,000 pounds over the first seven months of 1911, and an increase of 400,000,000 pounds over the same period in 1910.

In the tabulation of responses from 7,500 companies out of 40,000 who were sent invitations to attend last winter's Motor Truck shows, 482 were from the building and contracting field—this classification leading the list. The annual national exhibition of commercial motor vehicles will be held Feb. 10-15, 1913, occupying the second week of the Thirteenth Annual National Automobile show in the Coliseum, Chicago.

Fig. 1—Paulins Kill Viaduct on Line of Delaware, Lackawanna & Western Ry., in New Jersey
This structure has solid deck rings with open spandrel construction

The Present Status of Bridge Building

Concrete Plays Important Part in Expressing Public Pride in Bridge Construction

BY FRANK P. McKIBBEN*

The public has come to realize to a larger extent than ever before that its bridges should constitute an important part in civic development and it is more common to hear of instances where not the cheapest is "good enough," but the best is none too good. This is indeed gratifying, for there is every reason to demand the most artistic treatment of bridge structures. One day communities will realize that in many places a great opportunity to display fine architecture exists not only in public libraries or other public buildings (which are frequently so miserably placed as to lose all the pleasing effect intended), but that because of their commanding positions, bridges should be monuments to civic pride. Then, and not until then, shall we find lavish expenditures on bridges for the purpose of creating beautiful as well as utilitarian structures. Improvements in the design and construction of bridges have been largely confined to the structures themselves and little has been done towards beautifying the approaches thereto, and for the engineer interested both in the advancement of a great art and in municipal betterment here lies a field wherein he can do much. In the treatment of bridge approaches exist some splendid opportunities for enhancing the pleasure and comfort of the community.

To possess architectural beauty does not mean that a bridge must be highly carved or otherwise ornamented; nor is it necessary to burden the structure with statues. Simplicity, usefulness, grace and truth are fundamental requisites, and no bridge which lacks these qualities can be said to be an architectural success, even though it be staggering under highly ornamental balustrades, copings and piers. What can be more pleasing than an arch of graceful lines so placed that its design and material harmonize with its surroundings; that in its very simplicity are rest and pleasure? Truth is of prime importance, for if one material is so used as to represent another, or if a part is made to appear as if performing a certain function when, in reality, it is performing another, entirely different, the result can be only a dismal failure.

To produce a bridge which is serviceable and pleasing in appearance at a reasonable cost is now possible in most places through the combined use of concrete and steel. The extent to which reinforced concrete is now used is remarkable, especially when one recalls that less than 25 years ago, in Golden Gate Park, San Francisco, the first bridge of this material was built in America. From that small beginning of a 35-ft. span to the 281-ft. arch recently completed in Spokane is a wonderful development, and even this latter structure is far surpassed by the 328-ft. span in Rome, the longest single masonry arch span in the world. The adaptability of concrete to bridge construction is due primarily to its permanency. It does not rust. It requires no paint. In short, maintenance charges are reduced to a minimum when a well built concrete bridge is in place. This quality appeals strongly to engineers, but more so to taxpayers.

Highway bridges are notoriously neglected and these structures, when made of steel, are frequently very short-lived. The examination of nearly 700 highway bridges, many of which are of steel, has convinced the writer of the truth of this statement. Some structures receive no attention from the time the contractor leaves them until conditions are so bad as to force action, for steel cannot resist corrosion when in contact with damp earth, or over railroads where locomotive gases are active, and even in ordinary bridges, where neither of these agencies is at work, but where dirt and acids pass through the floorings to the steel below. Cases are on record in which parts of steel bridges have been completely eliminated by corrosion in less than 15 years and in extreme instances 10 years have been the term of service of some steel parts exposed to undue corrosive influences. The average life of steel highway bridges is, of course, longer than the periods given, but continuous maintenance is the price paid to insure it.

Concrete for Highway Bridges.

Concrete reinforced with steel is admirably adapted to highway bridge construction. For short spans, flat slabs, supported by beams and girders, give excellent results, for they are easily built and maintained. It is too early to predict the life of these structures, but in this respect they are certainly superior to steel spans, having an average life of probably not over 30 years, and far surpass wooden bridges, the exposed parts of which last about 10 years. These flat bridges can be used for spans* up to 50′ or 60′, but beyond that limit the arch form is generally more suitable. And it is here that concrete finds its greatest usefulness, for the arch is

*Professor of Civil Engineering, Lehigh University.

*Note Consultation Discussion, 262, P. 59, November issue.

FIG. 2—STATE HIGHWAY CONCRETE BEAM BRIDGE IN MARYLAND

a structure in which the stresses are largely compressive and as concrete so well resists these stresses, it is being extensively used in arches. The arch is a beautiful form of construction, and the ease with which concrete can be molded into graceful curves appeals alike to engineers and to the general public. To this one thing, more than any other, is due the present desire to secure beautiful bridges. One community sees a splendid structure erected by another at a reasonable cost; it sees a monumental construction that reflects credit on its designer, but to a greater extent on the civic pride of the people, and it feels the necessity of replacing some ugly monstrosity with a structure which not only serves the purpose of passing traffic over an opening, but also stands as a thing of beauty to be admired by all. These wonderful works of art cannot but reflect themselves, to a certain extent, in the lives of the people in whose midst they are placed. Who will say, for example, that the inspiring arches at Walnut Lane, in Philadelphia, at Rocky River, in Cleveland, and at Monroe Street, in Spokane, are not inspiring additions to their respective localities? These are structures of concrete, and concrete has made them possible. Were concrete not available, stone could have been used, but it probably would not have been.

One feature in connection with concrete bridge construction, whether it be a flat bridge or an arch, that appeals very strongly to many people in every community, is that the labor and most of the materials can be furnished locally. In most cases the sand, the stone and the labor can be secured without going beyond the local supplies. Only the cement and the steel need be brought in, and in not a few places these may also be obtained within a short distance of the bridge site. Here, then, the structure becomes largely the product of home talent, and correspondingly greater is the feeling of pride and interest in it. There is a very great difference between buying something already produced and having the ability and ambition to produce it.

Concrete Bridges of Definite Type.

Every building material possesses certain qualities which make it peculiarly adapted to some one type of design. Concrete is no exception. The arch wherein concrete is so especially useful can also be built either of steel or stone, but there are certain types of design best fitted to each of these materials. Concrete demands a treatment architecturally very different from that of stone and the best concrete arch bridges are those in which this important principle is recognized. To show what is here meant, it is necessary briefly to review the progress of concrete bridge construction from the first plain concrete arch, built in Fontainebleau Forest in 1869, to carry the Paris aqueduct from Vannes. This structure has a span of 115.8′. In 1871, in Prospect Park, Brooklyn, the first plain concrete arch was built in America, but it was not until 1879 that reinforced concrete arches came into use in Europe and still later, in 1889, when first used in America, in Golden Gate Park. Not until the later

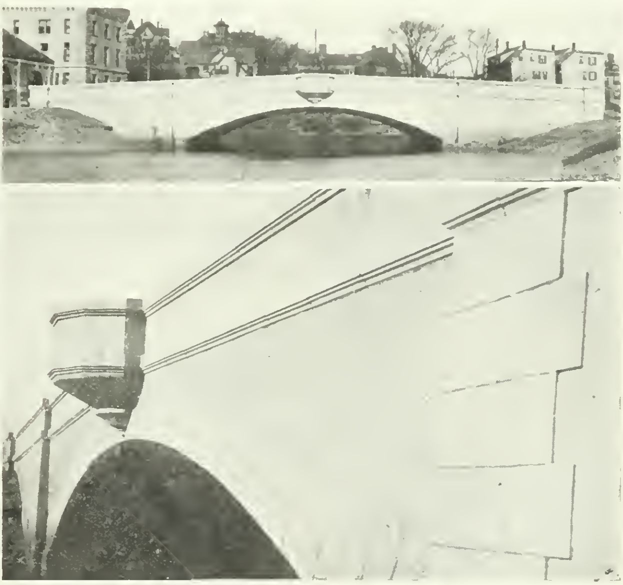


FIG. 3—GENERAL VIEW AND DETAILS OF SURFACE TREATMENT OF AN ARCH BRIDGE AT MEDFORD, MASS.

This bridge, known as the "Armory Bridge," was constructed by the Metropolitan Park Commission. The span is 60′, rise 8′, width 60′. A solid filled spandrel arch is used

'90's, however, did reinforced concrete begin to be much used in America. At first, arch design followed closely the types used for so many centuries in stone masonry arch construction, consisting of a solid arch ring with solid spandrel walls between which was earth filling carrying the roadway. It was perfectly natural for builders to follow this type in the new material and today there are many places where it is best even for reinforced concrete. This solid filled spandrel type is necessarily used where the span is short or where the rise is small. It was not long, however, until it was recognized that placing many tons of earth filling upon the arch was not a logical procedure, for it not only entailed considerable expense for the filling, but it required further expenditures in the arch ring and abutments. It was simply adding weight on weight to be further provided for in the design. This realization led to the use of open spandrel construction, where the roadway is carried on a flat slab supported on longitudinal beams resting on cross-walls. The spandrel walls carry the weight down to the arch ring, which in this type consists of a solid arch ring the entire width of the roadway. Open spandrels decrease the loads and permit a design approaching that distinctly peculiar to concrete. While spandrel cross-wall construction is a decided advance over the solid filled type, yet even this is improved upon by replacing the walls with a series of columns and the wide solid rings by several arch ribs side by side. In this style, therefore, the roadway is carried on beams supported by columns which in turn rest on arch ribs. These ribs are usually made square or rectangular in cross-section, but it is probable that a more pleasing design may be obtained in circular columns and circular ribs, although at present their use would no doubt increase the cost of construction. Nothing seems less scientific than a solid filled spandrel arch with a wide arch ring extending the entire width of the roadway. Compare this with a ribbed structure having a few ribs to support the roadway deck which is extended by cantilever beams to carry the sidewalks. It is this form that is so well adapted to concrete, because this material can be so easily molded into any desired shape and size. Of course, all these beams, columns and ribs require more forms, but in reducing the cost of forms lies the present problem of concrete engineering. Ribbed arches permit additional saving in the use of hollow abutments.

This minimizing of materials in superstructures and substructures means more care in designing. Rules-of-thumb cannot be resorted to if the most is to be gotten from a given quantity of material. Scientific analysis and careful construction of all parts are equally important, but they both are a great deal more necessary than in the older form of solid filled spandrel construction. It takes a good deal of confidence in one's methods and a very careful builder to attempt such structures as the recently completed Ponte del Risorgimento over the Tiber in Rome, which has a crown thickness of less than 12" for a span of 328.1'. Assuming that this structure has a proper factor of safety, it is a very creditable bit of design and construction.

Although the use of three hinges in the arch ring is not new, yet only in

Fig. 4—The Upper View Shows An Arch at West Medford, Mass. Below is Shown An Arch Built By the Metropolitan Park Commission to Carry the Boston and Maine R. R. Tracks Over the Parkway

Note that the lower view shows the highway bridge of the upper view in the background. The bridge shown in the lower view has a span of 56', rise 9.65', width 30.17', and head-room 28'

Fig. 5—Two Views of a Highway Girder Bridge at North Andover, Mass. The Span is 18 ft.

the last decade has this device been adapted to an appreciable extent in concrete work. The use of hinges has three advantages. First, the line of pressure through the arch ring is more definitely located; second, the settlement of the abutments may take place without affecting the arch stresses appreciably; and third, temperature stresses are eliminated. As early as 1873, in Erlach, Germany, asphalt joints, intended to serve as hinges, were used. In America today there is a growing tendency to use three-hinged arches, especially where foundations are not of the best. Hinges are usually made of cast or structural steel with steel pins and are rather costly, but in France there is a design in use whereby considerable saving in cost is effected. This arrangement consists simply in reducing the arch ring thickness to a very small amount at the crown and springing points and heavily reinforcing with steel rods at those sections. The design of these French hinges is open to some criticism and tests on full-sized pieces would prove interesting. It is to reduce the bending moment to zero that the hinge is used and the ordinary American design does this very well, for while there is friction at each hinge, resulting in some bending moment, yet this must be small and the advantage gained by using hinges is worth while. It is only in fairly flat arches, however, that this type of construction is especially applicable. So far as the writer knows, the only trouble experienced with the use of hinges was in the Maximilian Bridge at Munich, a stone masonry arch of two spans each of 144'. Owing to an error in design, both spans of this structure slipped off the abutment hinges in the course of construction and dropped vertically about 12 in.

Progress Needed in Erecting

There is every reason to believe that in the near future greater progress in concrete arch building will be made in erection methods, for there is now a tendency to simplify the centers by the use of steel forms. By standardizing designs wherever possible, steel centers might be used to better advantage, especially in the rib type, but it is difficult at first thought to see how such standardization can be brought about. The problem is one, however, that is worthy of consideration for, like most difficulties, it will probably be overcome.

In steel highway bridge construction progress can be seen in long spans only. Great advancement is taking place in the manufacture of alloy steels which, because of greater strength, permit simple truss spans of extraordinary lengths to be built. The new municipal bridge, spanning the Mississippi river at St. Louis, has a span of 668', the longest simple truss span in the world, though there are other forms of steel spans that surpass this in length. The manufacture of vanadium steel, nickel steel and other alloy steels for structural purposes is as yet in its infancy and it appears probable that this is the most promising field for progress in the near future.

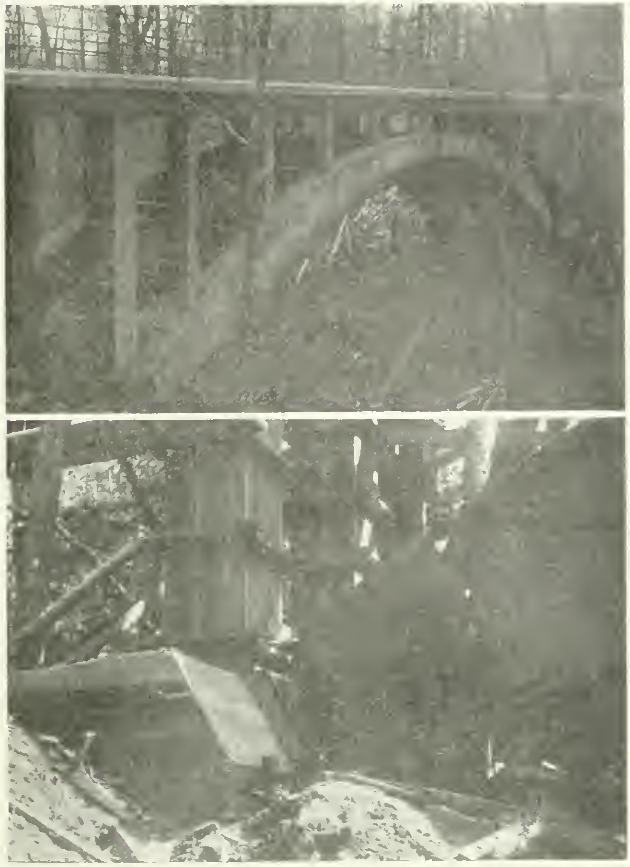


FIG. 6—THREE HINGED CONCRETE RIBBED ARCH, ROCK CREEK, WASHINGTON, D. C.

The upper view shows the arch ribs, connecting streets, spandrel columns, and floor system. Below is shown a detail view of the hinge at the springing lines

No notable advances have been made recently in the type employed for long steel spans, but many wonderful structures similar to those tried and not found wanting are now being erected. The cantilever and the suspension type are most commonly used for great spans, but there is an increasing tendency to employ steel arches of considerable length. The cantilever truss came into some disrepute for a time, owing to the failure of an important structure of this kind, but engineers will not let the pendulum swing too far because the cantilever has certain well-defined advantages which should not be completely ignored on account of one failure of one of its truss members. Lamentable as was this failure, it has been the cause of inaugurating a searching investigation into methods of design founded on empirical knowledge that has proved very beneficial.

One hesitates to predict what improvements science may bring forth in bridge engineering in the future, but it seems probable that advancement will be along three lines—the more extended manufacture and use of alloy steels so that greater strength can be secured with less weight; the wider use of simple structural shapes which are free from the many shop details; and finally, the combined use of concrete and steel in such forms as to produce not a reinforced concrete structure, but one of protected steel.

In the regulations covering reinforced concrete recently adopted by all the boroughs of Greater New York, it is required that the vertical steel bars in reinforced concrete columns shall bear squarely on steel plate or casting bedded on top of the footing.

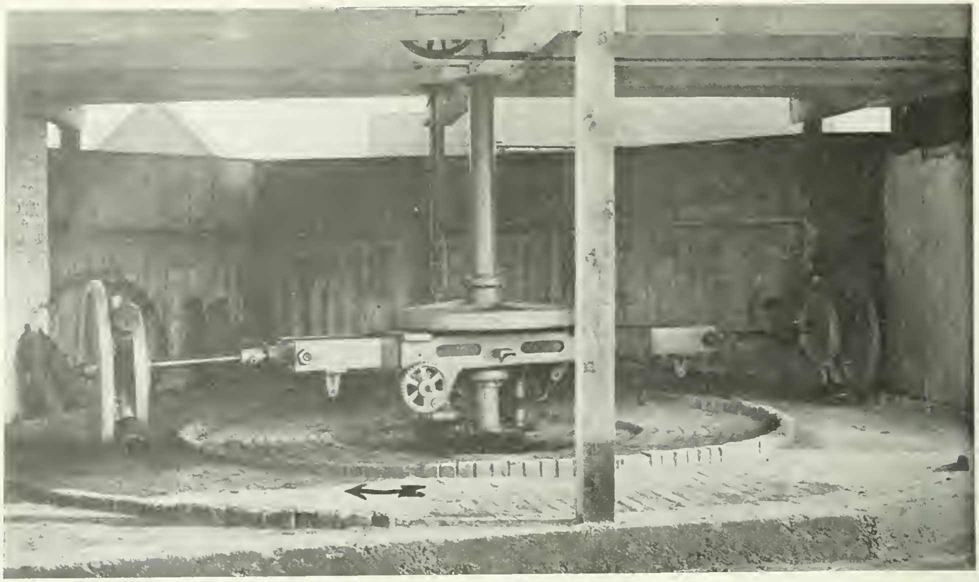


Fig. 1—A General View of the "Paving Determinator" and the Track, Consisting of One Section Each of Eight Different Pavements on Which It Has Been Operated

Concrete—A Superior Pavement Under Hard Traffic

Demonstration with "Paving Determinator" Simulates Actual Conditions of Street Wear

The Department of Public Works of the city of Detroit has made a most remarkable test of the quality of paving materials under heavy abrasive influences, with a new machine called the Paving Determinator, designed by John C. McCabe, with the idea of subjecting sample pavements to conditions of wear as near like those on the actual pavement as possible. The machine itself is mounted over sample pavements as illustrated in Fig. 1, and one of the wheels, together with the device intended to reproduce hoof beats of horses, is shown in greater detail in Fig. 6.

The Determinator is designed to show six different paving facts:

1. Comparative durability of various kinds of paving material.
2. The best way in which to lay pavement to obtain the best results.
3. The actual wear of brick as compared with the abrasion encountered in the rattler test.
4. The best method for cushioning pavements.
5. The safe limit of load and speed.
6. The best mixture for concrete roads.

When the original test had been made under the direction of Mr. McCabe and officials of the Department of Public Works on eight sections of pavement laid in a circular track, as shown in the illustration, the concrete section, laid under the specifications of the Board of County Road Commissioners of Wayne County, Mich., showed, by far, the best resistance to the severe test to which the pavements were put.

The determinator consists essentially of an upright column fitted with a large gear, by means of which the shafts bearing the testing apparatus are made to revolve about the column in a horizontal position, at a rate of speed governed by the rapidity with which the gasoline engine furnishing motive power is run. The engine is of 6 h. p. and speeds varying at the wheels from 3 miles to 12 miles per hour are developed.

Fig. 1 gives an excellent general idea of the apparatus as it is installed. The double wheels at the extreme ends of the horizontal shafts weigh 1,400 lbs. each, and by means of a simple connection, the exterior discs may be removed and similar discs of varying width, comparable to the widths of different wagon tires, may be substituted.

One of the most ingenious features of the apparatus is the fidelity with which the effect of horse-drawn vehicle traffic is simulated. Between the outside disc, which represents the wheel of a wagon, and the inside ribbed disc, which encloses the mechanism, are placed 5 plungers, each bearing on its end a plate shaped like the bottom of a horse's hoof. These plates are furnished with 4 steel points similar in appearance to the calks worn by draft horses on their shoes in winter. As the wheel revolves the hoof-shaped plate strikes the pavement at a pressure of 150 pounds, produced by a cam geared to the horizontal shaft. As soon as the hoof-shaped plate has passed the point of contact it is released and a spring at the back reproduces the ankle motion of a walking horse. The effect of this is to reproduce with surprising exactness the wear to which a pavement would be subjected if shod horses only were driven over it.

In order to avoid making a single track for each wheel, which would result in all the wear coming on a definite circle drawn upon the pavements under test, Mr. McCabe has installed the worm gear shown at the left of the column in the bottom of the illustration. This is geared to a crank attached to the horizontal shaft. As the apparatus revolves one of the wheels is at the outside of the path to be tested and the other at the inside. As the wheels travel around, the crank draws one in toward the center and pushes the other out from the center, with the result that at the end of a given number of revolutions, the wheels have changed places as regards their distance from the center.

The measurement from outside to outside of wheels is 19′ 8″. The greatest wheel radius is 10′ 10″ and the least radius of travel of inside edge of wheel is 8′ 7″. It requires 333 revolutions about the circle to move the wheels across the pavement, 2′, which is the limit of travel. Several inches of pavement are left outside and inside this path of travel, making it easy to determine the exact extent of wear or the movement of the sand cushion.

Mr. McCabe has applied for a patent on his machine.

The original test was made at 9 revolutions per minute about the circle, which gave a speed of 6.96 miles per hour at the outside and a speed of 5.51 miles per hour at the inside of the track.

The eight sections of pavement put down for this test are, or were (because some of them can scarcely be said still to exist) as follows:

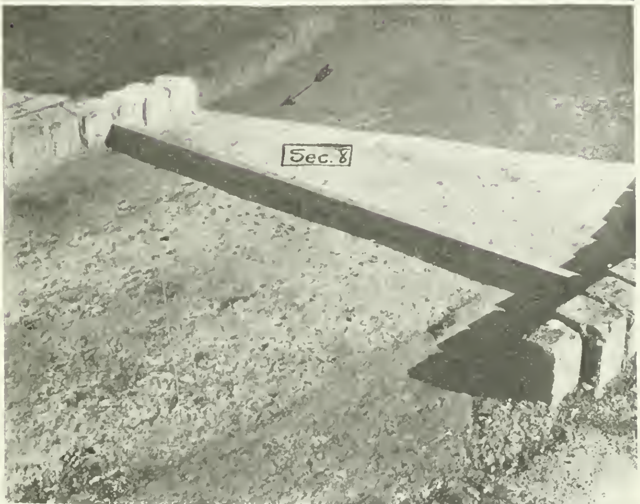
Sec. 1—brick.
Sec. 2—granite block.
Sec. 3—creosote block.
Sec. 4—brick.
Sec. 5—cedar block.
Sec. 6—brick.
Sec. 7—brick.
Sec. 8—concrete.

The whole track is underlaid with 8″ of concrete, the foundation for all experimental pavements. The block pavements were put down under city specifications. All the block and brick were cushioned on 2″ of sand which had previously been thoroughly compacted with hand tamps. The spaces between the cedar block were filled in with gravel, and the brick and granite were well minator, is city boiler inspector, but has grouted. The concrete was laid 6″ thick of a mixture of 1:1½:3, using washed sand and pebbles, according to the Wayne county specifications. The sam-

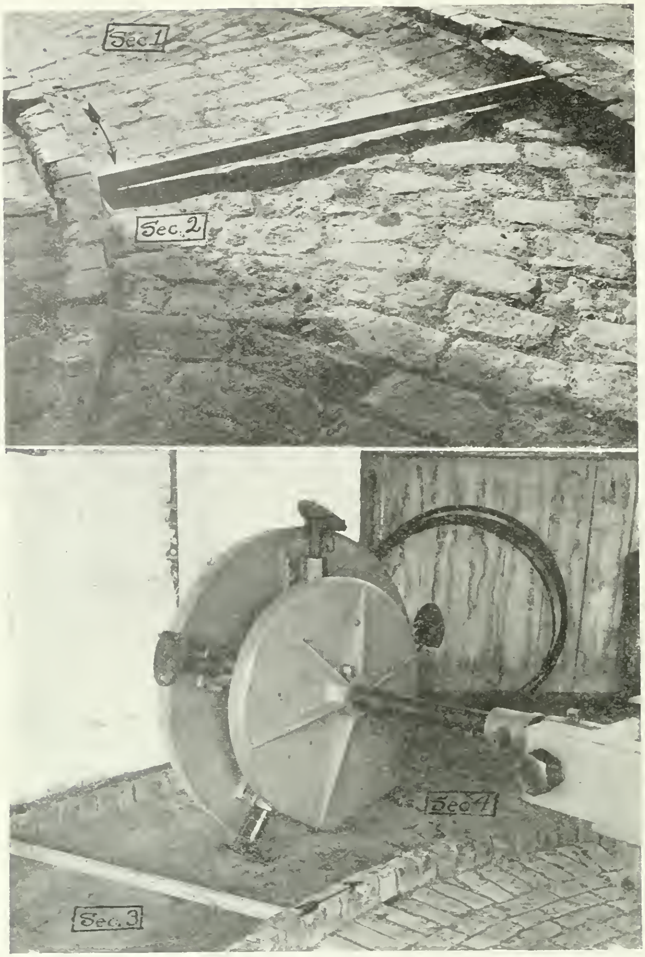
At the Top in Fig. 2 is shown a portion of Section 7, brick, and also a part of Section 8, concrete. Note how the breaking of the brick has caused the only bad break in the concrete—just to the right of the center of this view. Note also the gap under the straight-edge—the width of the path of travel is plainly seen.

In Fig. 3 the concrete section is shown. The dark portion is the result of a shadow cast by a partition wall. Note the slight abrasion as compared with other sections and observe also under the straight-edge how uniform this abrasion is over the entire path of wheels and hoofs

In Fig. 4 is shown Section 1, brick, the best of the 4 brick sections, yet note how defective brick produce an increasing tendency toward failure over comparatively large areas. Surely "joints" (so commonly mentioned as the weak spot in concrete pavements) must also be considered in other types. Again note the straight-edge. A part of Section 2, granite block, is also shown, but will be seen more in detail in Fig. 5.



Figs. 2, 3 and 4—Top to Bottom—Showing Sections of Pavement After Test. Arrows Show Direction of Movement of Wheels and Hoofs



FIGS. 5 AND 6—SHOWING SECTIONS OF PAVEMENT AFTER TEST AND ALSO GIVING AN INTIMATE VIEW OF THE TESTING APPARATUS

In Fig. 5 a part of Section 1, brick, is shown and a good view of Section 2, granite block. Note the bad breaking down at the edges of the granite and again observe the testimony of the straight-edge

In Fig. 6 the view serves chiefly to show the 3-in. rimmed cast iron wheel and the "hoofs." Note in the shoe just leaving the pavement the fidelity with which the ankle movement is reproduced. The first evidence of failure in the creosote block—Section 3—was in the flow of the sand cushion. The block are severely pitted by the calks. A part of Section 4, brick, is also shown

ples were not disturbed for 60 days, when the test was begun.

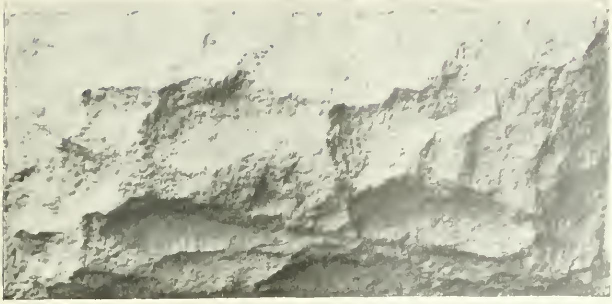
Strangely enough, perhaps, the first section of pavement to give way was the granite block (Section 2—see Fig. 5), which very soon loosened up in the grouting under the impact of the wheels. The failure of the granite was passed along to the next section (Section 3—see Fig. 6), which was creosote block, and under this pavement, the sand cushion caved considerably, causing the pavement to sink in the track 2′ wide, which was covered by the wheels. The next brick section (Section 4—see Fig. 6) shows considerable wear and chipping. The cedar block were severely mashed and forced down into the sand. The brick section, next in the path of the improvised traffic, was completely destroyed, and part of this section had to be replaced before the test could be continued, because the destruction had gone so far as to interfere with the progress of the mechanism. The next section, also brick (Section 7—see Fig. 2), shows severe wear, and not all of this is due to the failure of the section before it, because where the worst break came did not follow the worst break in the preceding section. Next in line was the concrete section (Section 8—see Figs. 2 and 3). The only bad break in the concrete is contiguous to a very severe break in the preceding brick section, where the impact of the heavy wheel, coming from the broken brick pavement, could not help but do considerable damage. The abrasion of the concrete surface is regular and is not more than ¼″, while the granite is worn down more than 1″, and some of the brick fully 2″. The brick section, which had to be replaced while the test continued, was down more than 3″. The next section (Section 1—see Fig. 4) is brick, and this stood up better than any of the other brick sections. The extent to which this is worn and depressed, however, is clearly shown in the illustration, by the space under the straight-edge laid across the pavement. Remember that this is the best section of brick pavement, and then note the straight-edge on the concrete pavement.

Mr. McCabe, inventor of the Determinator, is city boiler inspector, but has devoted much of his time to pavement investigation—a side line—for the Department of Public Works. He finds that the "rattler test" does not give results in determining the quality of brick which are closely indicative of results in actual pavement wear. While the per cent of abrasion on the rattler may conform to a certain standard and nine brick be good with low abrasion, one brick may be soft and while the average for the rattler may be good, the one bad brick will make a hole in the pavement which communicates destruction to surrounding good brick.

Mr. McCabe visited many brick plants and made tests and analyses, and he found a wide range in several of the important constituents of the materials being used. In this connection Mr. McCabe says it indicates "that the brick manufacturers can with profit follow the methods of the cement manufacturers" in turning out a product uniform and consistent in quality. He says further that careful inquiry made into the coefficient of expansion of brick used in Detroit developed that it ran from 0.000002 to 0.000006.

Mr. McCabe's investigations also seem to indicate that the brick manufacturers' own specification of a 2-in. sand cushion is not good, and he points out further that the expansion of this sand cushion when moisture-laden and then frozen is a productive source of trouble. Longitudinal cracks in brick pavements stand almost everywhere to testify that the last word as to expansion and contraction cracks has not been said when only concrete pavements have been discussed. This difficulty is practically solved in concrete paving.

Edwin O. Sachs, London, Eng., in a recent paper calls attention to the common mis-use of the term "fireproof," and says that the use of the word should be avoided and the term "fire-resisting" used generally, as this term describes more correctly the varying qualities of different materials and systems of construction intended to resist for short or long periods the effect of fire at different temperatures.



How to Produce Realistic Stone Facings

BY CHARLES H. DOUBLER

There is no feature of the concrete industry that presents so many attractive possibilities and so much profit, as the production of strictly high class concrete stone of artistic finish—a stone that equals or excels natural stone in beauty as well as quality.

No one qualified to judge disputes that concrete, rightly made, is superior to stone for building purposes and it is a simple thing to emulate the aesthetic feature of Nature's best offerings if we go back to first principles and start right.

It is to be deplored that cement was not better understood or that it did not fall into better hands at the beginning, for there is no question that it is the inherent ugliness of the concrete block, as commonly made, that bars it from the best structures and it is for the progressive block men to remove this fault if we are to elevate the industry to the plane where it belongs. The task is an easy one, and pleasant, if we but give heed to Nature and follow her teachings. She was the first stone maker and is worthy of praise. If we surpass her it is because we can gather her scattered forces and unite them to suit our individual tastes.

The people of the present generation, while they are not looking for rat-holes to chuck their money into, are more willing to pay the price for what appeals to their aesthetic tastes than any that have preceded them, and this sentiment is growing rapidly. They recognize the many desirable qualities of concrete as a material for home building but frequently turn it down for its lack of beauty,* and the block-maker foolishly tries to reduce the cost to make competitive price the issue in marketing his wares,—a great mistake! It is safe to say that if one half the energy expended in reducing the cost of concrete (and incidentally its quality) had been intelligently brought to bear on the production of a better concrete of artistic finish, concrete would today reign supreme, to the exclusion of stone.

* As they — unfortunately — frequently see work poorly done.—EDITORS.

What popularity concrete products enjoy today is due solely to their inherent merit and in spite of much of man's foolishness Why not stand on our dignity? Lowering the price belittles the standing of the product. Concrete is better than stone! Let us make it more beautiful also and the price will take care of itself. Every cent added in this direction will bring three or more in return.

There has been a decided tendency in this direction in the last two years, chiefly through the advent of white cement, which is a good starter but does not go far enough. The fault does not lie with the cement alone—we must look to the aggregates for relief and eliminate as far as possible all traces of cement. Here Nature has come to our aid by supplying us with everything necessary to reproduce her handiwork. We have at our command such aggregates as red, white and gray granite, various colored marbles, limestone, trap rock and silica sand in white, cream, yellow, orange, red, brown, and purple, all in natural colors that never fade. By judicious use of these, separately and combined, an endless variety of color effects can be produced in realistic stone facings.

It may be well to avoid misunderstandings by stating that while all sand contains more or less silica, that termed silica sand, or simply silica, is nearly pure silica and is much harder than bank, lake, or river sand which contains more or less granite, trap rock, limestone, etc., and it also has more life and sparkle as each grain is a crystal. The granite, trap rock, etc., have little color influence over the concrete until the surface has been treated with acid. On the other hand the colored silicas (excepting the white and cream), especially the red, brown and purple, have great coloring properties, so much so that even when used with twice their volume of other aggregates they dominate the color, but they should be used alone as an aggregate when a deep color is wanted.

It should be borne in mind that while the surface cement—that which coats the exposed surface of each grain of the aggregate used in the facing—is removed by the treatment given below, the cement that binds the mass of aggregates together is sure to show more or less in the interstices, and will influence the color scheme of the finished stone in proportion to the size and number of these cement-filled spaces

It is obvious, therefore, that while coarse aggregates are essential for the body of the stone on economical principles, it is equally essential to use fine, but well-graded aggregates for the facing, that the cement-filled spaces may be as small as possible. Accuracy in reproduction also demands this, as natural stone is fine-grained unless it is a conglomerate. Furthermore the aggregates and cement must be thoroughly incorporated so that the facing will not be like Pat's pig, "a strake of lean and a strake of fat" or have "hunks" of neat cement to mar the finished job. It is likewise apparent that judgment should be exercised in choosing a proper cement for each aggregate. Where the color of the aggregate is not pronounced, as in granite and most stone and in the white, cream and yellow silica, white cement should be used, or it may be advisable to use white and gray mixed in various proportions. Gray cement may be used with orange, red and purple, but white cement gives clearer and more cheerful tones. With brown silica the gray cement has an undisputed field. If it proves too dark, a portion of fine bank sand may be used to cut down the color and cost.

Concrete is in reality nothing less than stone as all its components are found in natural stone, but it is made according to scientific principles which give it the properties to defy fire and frost and to improve with age, qualities few stones possess. It can be substituted advantageously for all kinds of ordinary stone work and in the same style. We should not, however, abuse this privilege by miserable *imitations*, as has been the custom. Take for example the so-called "rock-faced" block, made to imitate pitched stone. While pitched stone is the cheapest product of the stone cutter's art, it is also one of the most effective and popular for general use A wall built of it owes its catchy, picturesque beauty to the diversty of "faces" wherein monotony cannot exist (for no two stones are alike) and to the clean fracture and sharp edges. To imitate such a wall with mud-colored block all of one size and all made from one mussy, round-edged, cast-iron face plate is not only a travesty but a crime against nature and art that cannot be too severely censured by those who have the future welfare of the business at heart. We may *reproduce* (exceptions are taken to the term imitation being applied to this class of work) this wall, however, and even improve on the color scheme, all within our rights and in good taste. To do this we have but to make composition face plates in good variety, both in sizes and design, that we may follow nature and rid our work of that stereotyped effect caused by repetition. Composition plates should be the only kind used for "rock-faced" bush hammered, tooled blocks, etc., if you wish to secure the aesthetic trade. Metal will do for plain, smooth surfaces only.

Have a stonecutter cut as many patterns as you want. They must be the exact size of your mold box. Have as many lengths as your machines will make and some fractionals. The "pitched stone" should have plenty of draft so the impression will pull away from the stone freely, and they should be in good variety—some bold, others less so, and others quite flat but well marked by the cleavages. Select stone for these patterns that break with a sharp, well defined fracture and good grain, as you are going to reproduce it exactly. Be very particular in this, for only good, well defined demarcations and sharp edges can give character to your work.

Have patterns made—one for each size—for cast iron trays, or frames to hold and support the composition. These patterns must be the right size, allowing for shrinkage, so that the casting will exactly fit your machine, or better still, have them a trifle large and machine them to size—then they will be exact.

Fig. 1 is a sectional view of an inside corner of a finished tray. The

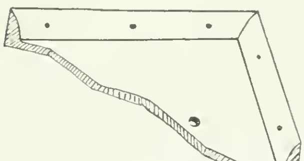


Fig. 1

dots on the sides are countersunk holes ⅛" deep to give a good "key" for the composition, and the one in the bottom is a ½-in. hole to allow the air and excess composition to escape when under pressure. There should be three of these as shown in Fig. 2. The sides should be from 1" to 1½" high inside, ⅜" thick at bottom and

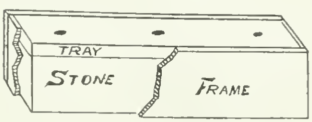


Fig. 2

rounding up to an edge at the top as shown in cut. The bottom should be 3/16" thick.

Make frames exactly fitting around these trays and the stone patterns out of 1" lumber and wide enough so that the top edge will be flush with the inverted bottom of the iron tray when it rests in position over the stone pattern. (See Fig. 2.) Oil the stone and place face up in this frame and mix enough Artura composition* to a fairly thin batter entirely to cover the face of the stone, and pour at one place in a small stream, allowing it to spread over the stone by gently shaking. This will prevent "air bells" forming on the surface and insures a perfect impression. Back this up with the same composition mixed considerably thicker and fill the frame nearly full. Then invert the tray over this mass and force down into position on the stone by pressure. The excess composition will be forced up through the holes and can be used in the next mold. Allow the mold to remain on the stone for 48 hours in a warm place, when it may be removed. The mold or face plate should be allowed to cure for 6 or 7 days in a warm room, without water, and then thoroughly shellacked and, when dry, oiled. If it is necessary to have the plate in use on short notice much time may be gained by using heat to cure the plate. In this event, raise the temperature to 125° to 150° F. after it has stood 2 or 3 hours and keep it at that temperature for 4 or 5 hours, when it will be quite hard and may be removed from the stone, and a further curing at same temperature for 5 or 6 hours will suffice to render it fit for use as soon as it has been treated with shellac. If properly made it will be a perfect negative of the cut stone. It will last a long, long time under ordinary usage, as it is hard and tough and will withstand tamping by hand or machine, but should not be hit with the tamper unless covered with concrete. Keep the patterns and you can reproduce the plate at any time. For the facings use 1 part cement to 2 parts aggregate; if a little extra sparkle and life are wanted add a little finely ground mica. Mix thoroughly while dry and temper with clean water to a point where a ball of it, when squeezed together in the hand, will not crumble when the hand is opened. Cover the face plate at least ½" thick with this facing and before tamping cover it with several inches of the common concrete. If a coarse concrete is used for the backing it is best to screen out the coarsest pieces for the first layer of 1" that goes on to the facing for fear of tamping these through the facing. Use as wet concrete for the body as your machine is capable of handling.

There are two treatments for removing the surface cement, i. e.—spraying and the acid wash. The former is cheaper and more quickly done, but the latter is more effective, while the two combined are ideal. The expense in any case is too trifling to be considered if good results are desired.

*Of this composition the author explains: "This is a composition for face plates which I worked out about 5 years ago. I would gladly give the formula were it not for conditions relative to the ingredients which make it impossible for the block maker to prepare it for his own use. Two of the ingredients —controlled by a monopoly—can be had only in packages of 1,400 lbs. Only a few pounds are needed at a time and the materials deteriorate after exposure to the atmosphere. I have given the formula to a company which will put the composition on the market in small packages."—Editors.

Fit a fine spray to a hose which also has a stop-cock so the water can be cut off instantly. Direct this spray without too much force against the face of the block when it comes from the machine, but no faster than the block absorbs it, and stop before it begins to run or it will "muss" your facing. The water washes the surface cement back into the block, to the advantage of the appearance and quality of the block. The acid should not be applied until the block is sufficiently cured to be safely handled. Have a wooden tub, and place in it 4 or 5 parts clean water (soft preferred) and 1 part of the cheap, commercial grade of muriatic acid. Place the block face up on the edge of the tub and at an angle, so that the surplus acid solution will drain back into the tub, and wash the surface with a jute brush dipped into the acid solution. Brush gently but do not scrub or you may flatten and round the sharp points. The acid will attack the cement and foam vigorously. When it ceases to foam, the surface cement has been transformed into chloride of lime and this should then be thoroughly washed off under a tap or hose, the whole operation requiring but a moment. The aggregates being relieved of this cement coating will now shine and sparkle in their original beauty and your work will be a credit to you and your business.

If the work is done with skill the result will be such that when seen in the wall no one will know, *or care*,* whether it is natural or artificial stone, in fact, expert stone cutters have remarked that the reproduction was so perfect, the appearance of a fracture so exact and natural, that no one would suspect it to be other than real stone. Architects have declared themselves as prefering it to stone, as it can be modified to carry out any color scheme.

If an impervious facing is desired, apply a colorless, transparent waterproofing. This not only fills any voids and excludes water, but brightens up the color as well, and the block will be about the same shade in wet or dry weather. Remember that either stone or concrete is much darker wet than dry, so never judge the color until dry.

Block made as described are not to be classed with the ordinary concrete block, nor do they have to compete with them in price. Stone is their only competitor.

Besides the satisfaction of producing an article that will advertise your business, there is twice the profit in it for less work, all to the betterment of the concrete industry.

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*The italics are ours. This is the nub of the whole matter of reproduction. It isn't to deceive—it is to satisfy in itself.—Editors.

How to Build a Reinforced Concrete Smoke House

Many people continue the practice of smoking and preserving meats on their own premises, preferring the appetizing results of the old way to the modern chemically treated product. And when it comes to ways and means to insure the best results, concrete, as usual, takes first place. A smoke house should retain the required quantity of smoke, exclude flies and other creatures and should be fireproof. The building shown has all these good qualities and is practically thief-proof.

Smoke House Built of Concrete.

It does not represent massive construction and was not difficult to build.

In constructing such a house, say 5 ft. x 8 ft., ordinary lumber may be used for forms, the 4½-in. walls resting on a foundation 8' wide and 2' 6" deep. Roof and floor may be 3½" thick. With the inside form in place the outside form is erected, layer by layer as the concrete is placed, thus avoiding much heavy lifting and giving perfect control of the reinforcement. The wall reinforcement consists of ⅜-in. rods 8' long, spaced 18" in either direction. Similar rods laid flat in the concrete, and upon the inside and against the other rods are carried around the building, being bent around the corners and hooked together where they meet, thus making a very secure job. In constructing the roof, nail 2 in. x 4 in. rafters to the uprights of the inside forms, placing them 1" below the bottom of the concrete roof, the pitch being 1' 6". The rafters are sheathed with 1-in. boards and the work of laying the concrete begins at the cornice. Boards and studs must not be too close-fitting, so as to avoid damage from swelling of the lumber when it comes in contact with the water in the concrete.

To build a smoke house of the dimensions given would require approximately 10 bbls. of cement, 3 cu. yds. of sand, 6 cu. yds of crushed rock or screened gravel and 55 pieces of ⅜ in. x 8 ft. rods.

Heavy woven wire fencing might be used for reinforcing the side walls and for the long way of the roof.

Traprock, as found in the vicinity of New York, is the best fire resisting aggregate for stone concrete; it is much superior to limestone or quartz gravel.

Fig. 1—Concrete Cottage at Rosslyn Farms, Pa., Cost $4,000. This House is 30' x 40' in Plan. Designed by W. H. Parrish

Some Attractive Dwellings Near Pittsburgh

On this and succeeding pages are demonstrations, in illustrations, of the use of concrete in the construction of attractive low-cost dwellings. All these houses are in the vicinity of Pittsburgh at Rosslyn Farms—and were designed by and built under the direction of W. H. Parrish, other of whose houses have previously been described in this magazine together with details showing Mr. Parrish's method of wall construction. These details together with some floor plans also are shown on succeeding pages, together with the illustrations from photographs.

While this work does not represent the last word in desirability with concrete construction, inasmuch as it does not make the house fireproof—the work does stand for progress, and attractive progress too, and since it cannot be hoped that everyone is going to come at once to what he ultimately will demand—permanent fireproof houses at low cost—the designs are sure to carry valuable suggestions.—Editors

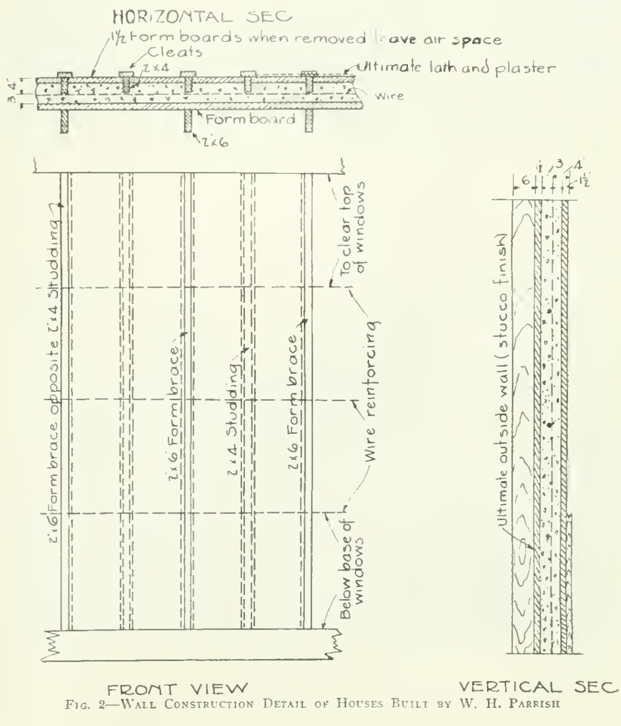


Fig. 2—Wall Construction Detail of Houses Built by W. H. Parrish

FIG. 3—BUNGALOW AT ROSSLYN FARMS, 32′ x 42′ IN PLAN, COST $3,500

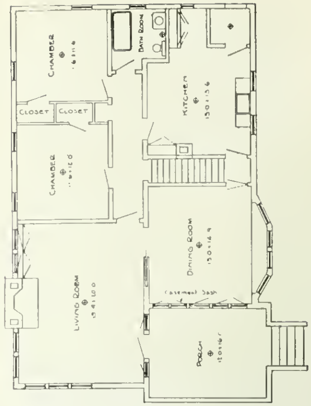


FIG. 5—FIRST FLOOR PLANS OF C. L. MUNROE HOUSE

FIG. 4—HOME OF C. L. MUNROE, AT ROSSLYN FARMS—COST TO BUILD, $4,600

This bungalow is 30′ x 48′ in plan with eight rooms and two baths. It is one of the W. H. Parrish concrete houses with 5-in. concrete walls—with 2″ air space. Can be heated with soft coal in hot water furnace for $25.00 a year. The interior trim is exceptionally fine.

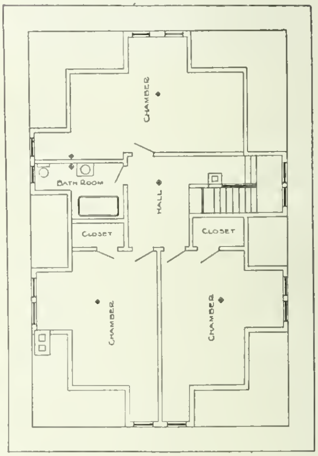


FIG. 6—SECOND FLOOR PLAN

FIG. 7—HOME OF W. I. KINGS, ROSSLYN FARMS—DESIGNED AND BUILT BY W. H. PARRISH AT A COST OF $4,300

The bungalow is 34′ x 53′ in plan with 6 rooms on the first floor (illustrated in Fig. 8) and 2 rooms above. Interior trim is in chestnut, red gum and birch

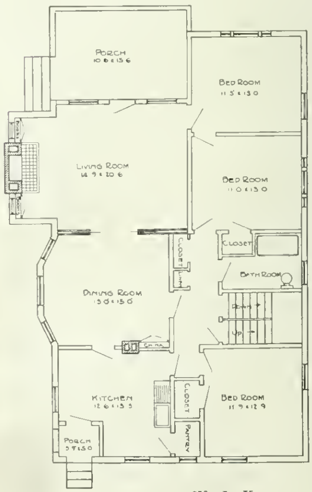


FIG. 8—FIRST FLOOR PLAN W. I. KINGS

Fig. 9—Concrete and Shingle House of Sayre Millen, Rosslyn Farms. Cost, $4,000
This house is 34' x 42' in plan with 8 rooms

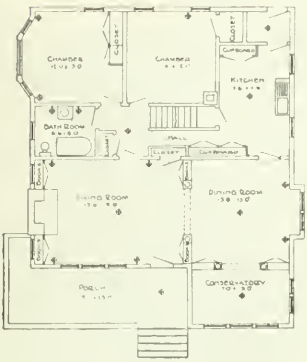


Fig. 10—First Floor Plan Millen House

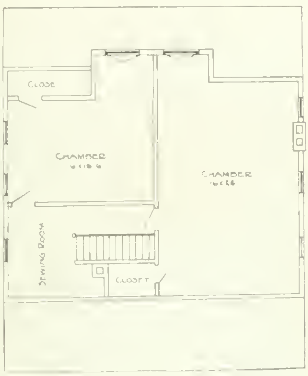


Fig. 11—Second Floor Plan Millen House

The Importance of Minor Details

BY W. J. BITTERLICK*

In a large and growing industrial concern, having erected a number of buildings of concrete construction recently, we have always expended considerable money, because, in the construction, we have overlooked small details. This could have been avoided with a little foresight.

The building plans were executed in our own drafting room and it is in the drafting room that this money can be saved. Of course we saved money on every new building erected over the previous building due to the experience gained. The extra cost in the earlier buildings was due mostly to drilling holes in the concrete floors, ceilings, walls and columns for fixtures such as pipes, conduits, door tracks, overhead tracks, etc.

When designing a building there are so many small details to look for that it is almost impossible to catch them all, and some of them are overlooked. Our drafting department has always been very busy, and, moreover, when building plans have been approved, the management usually want the building erected within the shortest possible time. Owing to the desire to see building operations started at once, fixture and equipment plans have not always been ready in time to incorporate in the working drawings. This has necessitated extra labor in making alterations in the building itself, resulting in more or less extra expense.

It has occurred to us, however, that a list, which we have prepared and placed in the hands of each draftsman, of all those points which have been overlooked on previous buildings, would insure that the plans cover a number of minor details which have been in many cases forgotten. The points outlined cover minor details only and may prove helpful in other drafting rooms. The items mentioned are those which in our experience are generally overlooked and cause extra expense. We have never experienced any difficulty in providing for the important details, as these latter were always outlined in a preliminary report of requirements. This report was usually

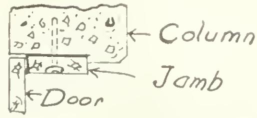


Fig. 1—Section of Column at Door

our authority to proceed with the plans. The notes follow:

Minor Details to be Noted on Concrete Building Plans

1. Provide bolts in accordance with Underwriters' Standard, in door columns for door frames.
2. On door frame details specify that door frames shall be delivered to job knocked down, so that they can be fitted to bolts as called for in No. 1.
3. Show rabbet in outside door columns for door frames, to keep out weather. (Fig. 1.)
4. Provide bolt holes or inserts for hinges or for sliding door tracks to save cutting concrete and reinforcing steel.
5. Wherever concrete or gypsum blocks are used, provide lintels over windows and doorways.
6. Provide nailing blocks in concrete for window frames.
7. Wherever a brick wall is to be built between columns, call for bolts in columns so that walls can be tied to columns.
8. Provide inserts in columns for fastening wood or metal partitions.
9. Provide inserts for sprinkler pipes, electrical conduits and miscellaneous piping, always providing for extras for future installation. (See special layouts for location.)
10. Provide holes in floors for roof drain pipes, sprinkler risers, water mains, steam mains, conduits and all special pipes, and always provide extra holes for future installations.
11. Provide holes in roof, for roof-drain boxes and pipes, and a wood frame to nail copper drain box to.
12. Wherever water is to be used in manufacturing process, provide floor drains in floor of building and pitch floor towards drains.
13. Provide inserts in ceiling of pipe tunnels for electric lights, iron bars on sides for hanging pipes to, and fibre duct in walls for electric cables.
14. Provide manholes in roofs of tunnels large enough so that 20-ft. lengths of pipe can be gotten into tunnel.
15. See that a sufficient number of openings is provided to allow pipes to enter tunnel from the building.
16. In beam construction buildings, provide pipes in beams to act as holes for bolts for hanging apparatus, pipe conduits, etc.
17. If only a portion of a building is to be erected and the remainder finished at some future time, provide reinforcement or inserts, in walls, so that when the addition is put on it can be tied to existing building.
18. In all tunnels and pipe trenches, provide drains and pitch bottom of tunnel toward drain.
19. Provide holes in side walls of tunnels where underground pipes are to enter tunnel.

*Watertown, Mass.

How to Build Concrete Hot-Beds and Cold-Frames

There is nothing which pleases the appetite so much as delicacies out of season. As for vegetables, such delicacies are not costly luxuries and are within the means of anyone who will take the time to build and run a hot-bed or a cold-frame. By this means, one can depend on having good hardy plants for spring planting in the garden.

Proper Time to Build Hot-Bed

To avoid annual repairs, and to secure the best results, build it of concrete. Locate the bed on the sunny, wind-protected side of a building. A four-sash bed is usually large enough except for commercial purposes. A standard hot-bed sash is 3'x6'. Lay out the bed 6' 8" wide by 12' 10" long. The concrete walls are 6" thick. Dig the foundation trenches 2' 6" deep within the lines given above. Make forms of 1-in. lumber to carry the south (front) wall 6" and the north (back) wall 14" above ground. Forms are not required below ground level. The tops of the end walls slope to the others. Before filling the forms with concrete, test the dimensions of the bed by means of the sash. See that the sash lap the forms 2" on all sides.

Mixing and Placing the Concrete

Mix the concrete mushy wet in the proportion of 1 bag of Portland cement to 2½ cu. ft. of sand to 5 cu. ft. of crushed rock, or 1 bag of cement to 5 cu. ft. of bank-run gravel. Fill the forms without stopping for anything. Tie the walls together at the corners by laying in them old iron rods bent to right angles. While placing the concrete set ½-in. bolts about 2 ft. apart to hold the wooden top-framing of the bed to the concrete; or make grooves in the top of the concrete for counter-sinking the sash to the level of the walls with an allowance of one-quarter inch for clearance. This can be done by temporarily embedding in the concrete wooden strips of the necessary dimensions. During this operation, by means of blocks nailed to the strips, make provision for the center-bars described below. Remove the strips as soon as the concrete stiffens. Take down the forms after 5 days. The extra 2⅝" in length of the bed is allowance for the 3 center-bars between the sash. These sash-supports are of dressed 1-in. stuff, shaped like a capital "T" turned upside down. The length of the stem of the "T" is equal to the thickness of the sash and the top is 3" wide. Sufficient materials for the concrete will be supplied by 14 bags of Portland cement, 1¼ cu. yds. of sand and 2½ cu. yds. of crushed rock; or 14 bags of cement and 2½ yds. of pit gravel at a cost of $10.

Preparation and Care of the Hot-Bed

If the bed is to be used as a cold-frame, it is finished when covered with glass. For a hot-bed, dig out the dirt to the depth of 2', tamp in 18" of fresh horse manure well mixed with leaves or bedding and cover it with 4" to 8" of rich soil. Bank the excavated earth around the outside of the bed. Put the sash in place, hang a thermometer on the inside and allow the bed to heat up. After a couple of days, when the temperature has dropped to 85° or 90°, planting may safely be done. Seed catalogs contain valuable information as to the length of time necessary to produce the different kinds of plants.

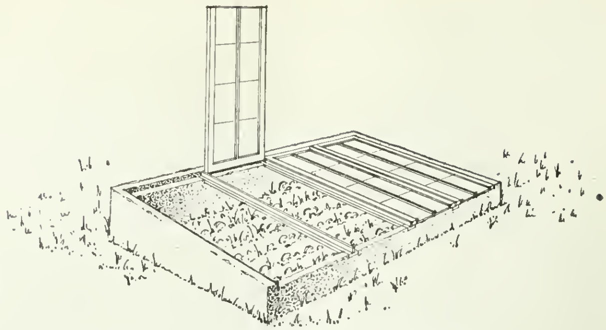


Fig. 1—Cold-Frame Grooved for Sash

At midday, in bright weather, the bed will become too hot and must be ventilated for a short period by raising the sash on the side away from the wind. Water the plants in the morning only and ventilate later to remove the moisture from the foliage. On winter nights it will often be necessary to cover the bed with old carpets and boards.

It is a genuine pleasure to grow winter vegetables and flowers for home use. If the supply exceeds the needs, there is always a profitable market for such products.

Where Field Tests Should Supplement Laboratory Experiments

Concerning reports of the recent government tests of the waterproof properties of concrete, *Engineering News* writes editorially in part as follows:

Undoubtedly water-tight concrete can be made in the field, if laboratory conditions in regard to material and methods prevail. Undoubtedly such concrete has been made in the field where those in charge have had a proper regard for the nice adjustment of men and materials that water-tight concrete demands.

If what we may term the "laboratory view" of waterproof concrete is to prevail, the laboratory experts must produce something more than small-size tests to impress the average concrete user. They must build some fair-sized walls with journeymen labor and stock material and compare the water-tightness of such walls, where some extra waterproofing mixture is added, with conditions of aggregate, mixture and similar walls built under their very best men, but with no additional protection against water percolation. Furthermore, they must produce evidence that the careful precautions that they recommend are possible under ordinary field conditions of cost, materials and plant.

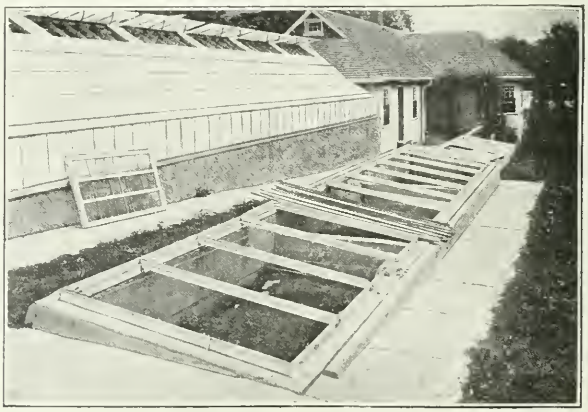


Fig. 2—Well Located Concrete Hot-Bed

Church Built of White Concrete Block

An excellent example of concrete stone construction is illustrated on this page—the German Evangelical Lutheran Church, Sacramento, Cal., built by the American Art Stone Co., Cleveland. L. O. Volk, Los Angeles, is the architect. The work was begun in October, last year, and completed in April. All the block were made on Hercules* machines and the special work in the American company's own molds. The block are brown-faced from grade to water table. All work above the water table is white-faced, the facing mixture used being of white clam shell beach sand (2 parts) and Blanc white Portland cement (1 part), waterproofed with Medusa compound.** The backing is a 1:2:2 mix. There are 30,000 cu. ft. of stone in the structure and its total cost was about $70,000. The cost of the mason work was $29,000. The next best bid on the work to that of the American Art Stone Co. was $6,000 higher and called for the use of an ordinary pressed brick. The cost of natural stone when the church was built was about $2.50 per cu. ft. and of artificial stone about $1.25, this price including the ornamental work.

*Century Cement Machine Co.

**Sandusky Portland Cement Co.

FIG. 1—FRONT AND SIDE VIEW OF GERMAN EVANGELICAL LUTHERAN CHURCH, SACRAMENTO. BUILT OF CONCRETE BLOCK AND CONCRETE DIMENSION STONE

FIG. 2—SIDE AND REAR VIEW OF SACRAMENTO, CAL., CHURCH

The Use of Motor Trucks in the Delivery of Cement

CONTRIBUTED*

The use of the motor truck has begun to find its way among the dealers handling cement and building materials, and while its progress has been a little slow, there are one or two cogent reasons to account for this backwardness. The first of these reasons is that the dealers have been somewhat reluctant to try delivery with trucks, both because of the necessary immediate outlay and because of their lack of familiarity with numerous small details concerning delivery by automobile.

The second reason, and of course the most important, is that motor manufacturers have not pushed the sale of motor trucks in the cement field. And the latter is naturally the cause of the failure of more dealers to adopt the later means of transportation.

Cement dealers have been peculiarly educated in advertising and this to a great extent has had its influence in restraining them from the purchase of motor trucks. In the cement field, advertising is always of the educational variety. The dealers themselves are aware of the advantages of this kind of publicity because they see actual results from educational booklets which they send out to their prospects and which are furnished them by the cement manufacturers. Their advertising education has been along these lines and to them it is an absolute necessity that publicity carry instructive information. Wherever possible, whether it be at Cement Shows, or State or County Fairs, they expect to see actual demonstration of processes of construction with the view to showing the public how cement is handled. They look upon this demonstration as a natural sequel to the educational booklets.

Naturally enough they expect the same sort of publicity themselves when they consider the purchase of a truck. And the two most powerful means of selling to dealers have been overlooked by motor manufacturers. The dealers do not receive educational literature. They are not reached through the usual publicity channels and they have had no occasion to see actual demonstrations of the advantages of motor delivery.

That the motor truck would be of advantage to cement dealers in their retail deliveries is quite as much a certainty as is the fact that motor trucks are advantageous to grocers, hardware dealers and coal men. The deliveries are very similar to those in the above mentioned trades.

The cement dealers often carry various lines in stock. Besides the usual lines of brick, sand, gravel and lime they often handle lumber, coal and

*This article comes from within the cement industry and is an interesting view of motor truck use in the field.

FIG. 1—MOTOR TRUCK USED BY BUILDING MATERIAL DEALER

wood, hay, grain and feed and a variety of other materials. During the building seasons of the year their business is confined chiefly to handling building materials. In the winter months, months, however, their business is chiefly in selling coal and wood. At this time of the year they are in a position to make deliveries by motor trucks just as conveniently as the city coal dealers. Again, numerous dealers are required to make long hauls into the country delivering grain, seed and other materials to their farm trade. Manufacturers of concrete products, some of whom are already users of motor trucks, meet with some entirely different hauling problems. The delivery of concrete block is largely a city proposition. On the other hand, the delivery of concrete fence posts, for example, is a farm proposition and requires an entirely different method of figuring transportation costs.

Thus it is difficult to compile a table to show the advantages of motor delivery that will cover each dealer's individual needs.

The following table shows a means of figuring the relative costs of hauling by motor trucks and by teams. In this connection the increased cost of maintaining horses, the necessity for speed in delivery and the comparatively narrow limits of team delivery compared to mechanical methods must be considered.

AVERAGE DAILY COST OF OPERATION OF THREE-TON TRUCK

Fixed charges—valuation—$3500.00	
Interest	$ 0.70
Storage at $7.50 a month	.25
Insurance (Fire and Liability only)	.84
Amortization, 20 per cent	2.83
Variable charges on basis of 50 miles a day.	
Driver	3.00
Gasoline	1.63
Oil	.22
Tires	2.17
Repairs	.82
Total	$11.96

DAILY COST OF OPERATION OF PAIR OF HORSES AND WAGON TRUCK

Feed	$1.02
Shoeing	.085
Wagon and harness repairs	.20
Veterinary	.015
Insurance	.075
Rent and barn expense	.525
Interest	.20
Loss and depreciation	.26
Driver's wages	2.25
Total	$4.63

With the truck cost at $11.96 a day and a two-horse team cost at but $4.63 per day it is evident that the motor truck must do almost three times the amount of work that is required by a two-horse team in order to show a greater profit and warrant the greater initial expenditure.

As a matter of fact a motor truck can do from three to five times the amount of work that a team of horses and a truck can accomplish. The economy of the truck is demonstrated particularly in long hauls. Forty to fifty-mile trips are negotiated easily by motor trucks under load, an undertaking which is impossible with teams. The dealer who submitted these figures tells of making 5 trips a day with a truck over 5 miles of very bad road with 4,500 lbs. of cement on each load. With horses on the same job he found that one team could make only 3 trips in 3 days or 1 trip a day.

In the delivery of supplies for general construction work a New Haven, Conn., dealer discovered that he could save $1,600 a year by the operation of a 4-ton truck instead of using the three 2-horse teams which he had previously used for delivering.

COST OF OPERATING TRUCK IN GENERAL TEAMING

Three double trucking teams	
Cost of six horses at $300.00	$1,800.00
Cost of three wagons at $450.00	1,350.00
Cost of six harnesses at $35.00	210.00
Cost of keeping horses at $25. per month	1,800.00
Repairing harnesses	100.00
Interest on investment	336.00
Drivers' salaries $12.00 per week	1,872.00
Total	$7,468.00
KISSEL-KAR FOUR-TON TRUCK	
Cost of 4-ton truck	$3,800.00
Gasoline, 2,400 gallons a year at 10 cts.	240.00
Oil, 156 gallons a year at 23 cts.	35.88
Driver's salary at $18.00 a week	936.00
Amortization, 10 per cent, on $3,800.00	380.00
Interest on investment	380.00
General overhaul, once a year	150.00
Total—truck	$5,921.88
Balance in favor of commercial vehicles	$1,546.12

Possibly numerous cement dealers will find equally great reductions in transportation costs by the use of motor trucks. Certainly those dealers who are compelled to make long hauls will find the motor truck of great advantage. However, a careful consideration of the individual hauling problems is always necessary and the reliability of service in the motor-driven vehicle is essential.

Cement and the Lumber Dealer

Evidences of the growing unity of interest between retail lumber merchants and dealers in Portland cement are multiplying. A case in point is a letter issued by the E. C. Robinson Lumber Co., St. Louis, to its yard managers. The letter calls the managers' attention to a recent issue of a lumber trade paper, with special reference to an article entitled, "When Your Cement Cakes." Another article on "Silos" is referred to, with the added information that farmers in Illinois are "building silos of cement blocks, claiming they are better and cheaper in the long run than any other kind." The letter urges the managers to read the lumber paper with care, evidently with especial emphasis on the articles that have to do with the merchandising and uses of Portland cement.

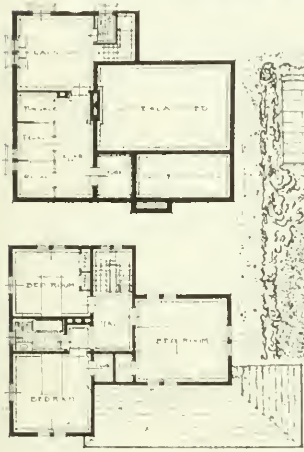
FIG. 2—TRUCK LOADED WITH BAGS OF GRAIN

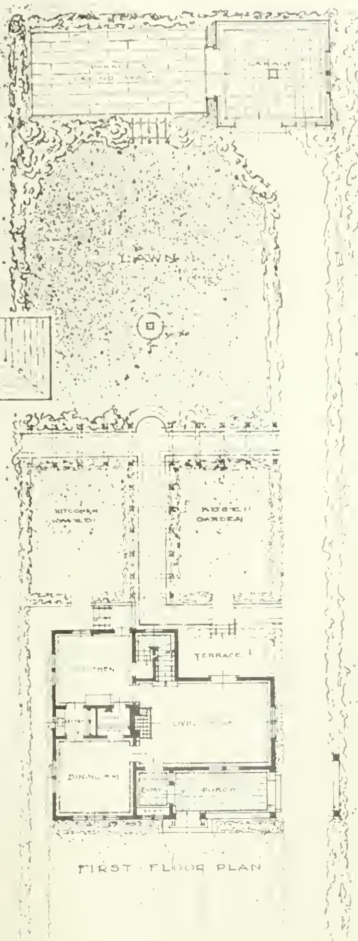
It is gratifying to learn that large lumber dealers realize the important part played by Portland cement in the dealers' calculations. It is still more gratifying to note that the lumber papers themselves find it necessary to devote at least a portion of their space to the problems of Portland cement storage, sale and uses, as they appear to the man who is handling lumber at retail.

In the November issue, in the article "Attractive Use Of Concrete In Chicago Parks," an erroneous statement is made as to who supplied the waterproofing material used by the South Park Commissioners. This waterproofing was supplied by the Good Products Co., 1705 Austin Ave., Chicago.

Suggestion for Poured Concrete House

This page offers a suggestion for home builders—a poured concrete house, illustrated in perspective with floor plans and proposed ground arrangement. The design is by E. Parmiter, New York City, and was awarded first prize in a competition conducted by the Blaw Steel Construction Co., the designs being judged by Prof. A. D. F. Hamlin, Columbia University.





Perspective View, Floor Plans and Proposed Arrangement of Grounds for a Poured Concrete House to Cost $3,000

The exterior walls and foundations are to be of concrete, the exterior plastered with cement stucco. Other construction details are wooden floors, stud partitions, shingle roof, stained, house heated by hot air and wired for electric lights. Prof. Hamlin comments:

"The best of all the plans from the point of view of simplicity, spaciousness and general convenience. Adequate entrance lobby; living room admirable, 13′ 6″ x 21′ 6″; dining room fair, 12′ x 12′; kitchen excellent, 12′ x 12′; pantry; three bed rooms, 13′ 6″ x 14′ 6″, 12′ x 12′, 10′ 6″ x 12′, each with closet; bath room 8′ x 5½″; all have good head room; all rooms well lighted; good porch. Plan of second story superposes well on first, one chimney stack. Exterior simple and attractive, good lines and masses, simple roof. Plan of grounds shows admirable taste. Entire design shows artistic skill and taste. Cubic contents, exclusive of porch, 15,773 ft. from cellar floor to middle of height of gable roof; porches, 2,480 cu. ft."

It is proposed to build this house under ordinary circumstances for $3,000.

This, from the *Record* of the Association of American Portland Cement Manufacturers, is a message to the block men:

The maker of concrete block has had some pretty hard knocks in recent years, but if he will stick to a first-class product from the structural standpoint and at the same time produce a simple and pleasing surface, he will win out in the end. It will no doubt interest and encourage every block maker to know that in England this product is gaining in favor. The leading British publication devoted to cement and concrete says with reference to opportunity there that "as a matter of fact, the field for the concrete block is even greater than for reinforced concrete. Its economical advantages are equal, if not greater; and we would, therefore, again call attention to its use for cottages, and suggest that the subject should receive careful attention from those who have economic problems of housing before them."

David White has been appointed chief geologist of the United States Geological Survey, succeeding Waldemar Lindgren, who has become Rogers Professor of Geology and head of the Geological Department of the Massachusetts Institute of Technology.

Mr. White has been connected with the Survey since 1886. His specialty has been the study of the fossil floras of the older geologic formations. He has naturally a wide technical knowledge of coal. Mr. White is a member of several scientific societies, President of the Paleontological Society, and Vice-President Geological Society of America.

U. S. Government Experimental Pavements

The specifications which follow, cover work which is being done under the direction of the United States Office of Public Roads. The specifications for the concrete sections of these experimental roads, together with the specifications covering the materials to be used in the concrete, were published in the September issue. The following, covering bituminous concrete under the Topeka and District of Columbia specifications, vitrified brick pavement, and the concrete base used under all the pavements, are published now, together with drawings showing typical cross-sections, because of their value in making comparisons of the construction work which enters into the various types of pavement. Just a glance at these drawings must impress anyone with the very great economy which will result from the adoption of concrete paving as compared with the other types, if the concrete proves to be as satisfactory as work elsewhere has led us to believe it will. One interesting feature of the experimental sections of concrete pavement is the use of brass plugs, by means of which, together with a special apparatus, the Office of Public Roads expects to determine with great exactness, the temperature changes in the pavement.—Editors.

General Statement

The work to be done under these specifications contemplates the carrying out of a number of experiments in road construction on the Kensington Road in the County of Montgomery, State of Maryland, beginning at the south side of Bradley Lane and extending north to the south track of the Chevy Chase Lake loop of the street car lines of the Capital Traction Co., a distance of 6195′.

The proposed experiments, their tentative location and numbers referring to specifications for the same are as follows:

Experiment No. 1, Bituminous Concrete—Topeka specification.
Station O—15 to Station 6+25.
Specification "A."

Experiment No. 2, Bituminous Concrete—District of Columbia specification.
Station 6+25 to Station 12+50.
Specification "B."

Experiment No. 3, Cement-Concrete—Surface coated with bituminous materials.
Station 12+50 to Station 25+00.
Specification "C."*

Experiment No. 4, Oil—Cement—Concrete—
Station 25+00 to Station 38+50.
Specification "D."*

Experiment No. 5, Cement-Concrete—
Station 38+50 to Station 52+00.
Specification "E."*

Experiment No. 6, Vitrified Brick—
Station 52+00 to Station 61+80.
Specification "F."

Specification "G"—Concrete Base

Upon the sub-grade prepared as herein specified shall be laid a concrete base 6″ thick. The sub-grade shall be wet, but not muddy, when the concrete is placed upon it.

Concrete—The concrete shall be composed of the following materials by volume: 1 part cement, 3 parts sand and 7 parts gravel. Broken stone, run of the crusher, may be substituted for part or all of the gravel at the option of the contractor.

Cement—The cement used shall conform to Specification "I."

Sand—The sand used shall conform to Specification "K."

Broken Stone—Broken stone, if used, shall be broken small enough to pass through a ring 2″ in diameter and in all other respects conform to Specifications "L" or "M."

Gravel—The gravel used shall not contain pebbles that will not pass through a ring 2″ in diameter and in other respects shall conform to Specification "L."

Water—The water used shall be fresh and clean.

Platforms—All sand, gravel and broken stone for concrete when brought upon the line of the work shall be placed upon platforms and kept there until used.

Mixing—The concrete shall be mixed in a machine mixer of the batch type so constructed that the accurate proportioning of the materials and thorough mixing of them may be readily done. The thorough mixing and incorporation of all materials will be insisted upon. The whole operation of mixing and laying each batch shall be performed as expeditiously as is practicable. The mortar for the shoulders may be mixed by hand.

Spreading and Tamping—Each batch of concrete after being mixed shall be spread in place in horizontal layers so as to give the requisite thickness after being tamped and shall then be thoroughly compacted. Concrete which shows loose and porous, due to improper mixing, proportioning, placing, or lack of tamping, shall be removed and properly replaced.

Concrete shall not be used after it has begun to show evidence of setting and no concrete which has once set shall be used as material for mixing a new batch.

Shoulder—There shall be built a shoulder on the base as shown on the plans. It shall be composed of cement

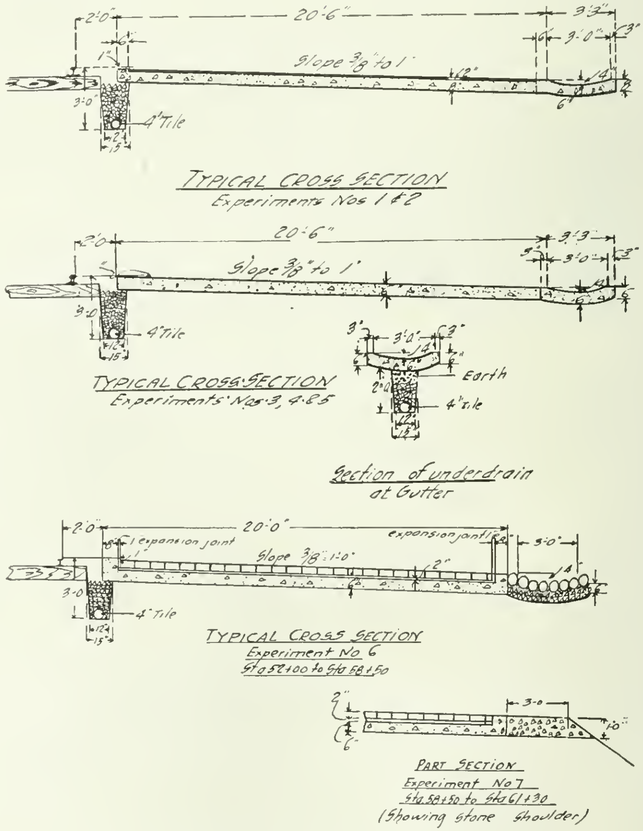


Fig. 1—Typical Cross-Section of Bituminous Concrete Pavements
Fig. 2—Typical Cross-Section of Portland Cement Concrete Pavements
Fig. 3—Typical Cross-Section of Brick Pavements

*Published in the September issue together with Specifications, "I," Cement; "K," Sand; "L," Gravel; "M," Crushed Limestone and "N," Crushed Trap Rock.

mortar of the proportions of 1 part cement and 1½ parts sand when 2" in height, and of cement concrete of the proportions of 1 part cement, 1½ parts sand, and 3 parts of gravel or stone, when more than 2" in height. The mortar or concrete shall be placed on the base before the concrete of the base has taken an initial set and care taken that the shoulder will be firmly bound to the concrete base. The top of the shoulder shall be troweled to a smooth finish.

Protection of Work—To prevent the concrete from drying out too rapidly while setting, it shall be thoroughly wetted by sprinkling at least twice a day for a period of 5 days. During this time no travel shall be permitted upon it.

Specification "F"—Vitrified Brick Pavement

Upon the concrete base prepared and laid to conform to Specification "G" shall be laid a vitrified brick pavement from Station 52+00 to Station 61+80.

Brick—The brick will be furnished by the U. S. Department of Agriculture, f. o. b. cars at Chevy Chase, Md. The contractor shall unload and neatly pile them at a convenient place along the work. In hauling from the car no throwing or dumping will be allowed and during the progress of laying they shall be brought to the bricklayers on pallets or in clamps and not wheeled in barrows.

Sand Cushion—Upon the foundation prepared as specified shall be spread to a uniform depth of 2" when compressed, a cushion of clean sand free from loam or foreign matter. The sand must all pass a screen having 4 meshes to the linear inch. The sand shall be spread with the aid of a template so as to conform exactly with the true surface of the road. After the sand is screened, a hand roller weighing 400 or 500 lbs. shall be used to compress the cushion; the depressions formed shall be filled and the surface trued up and again screened with the template and the operation repeated as often as necessary to obtain a thoroughly compressed bed. If necessary to secure good compression the sand shall be slightly damped.

Brick Laying—The brick shall be laid at right angles to the curb. The courses of brick shall be kept straight. If a variation in alignment of 2" exists, as many courses as may be necessary shall be taken up and relaid until the defect in alignment is removed.

No parts of brick will be allowed in the pavement expect at the beginning or ending of courses or at other closures. They shall be laid with the best edge exposed and as close as possible. All soft brick and those badly spalled or ill-shaped shall be removed and replaced with perfect ones. The kiln-marked brick may be turned over and if the reverse edge is smooth and no other fault be found, they may remain in the pavement.

After the brick are in the pavement and the surface is swept clean of spalls, they shall be well rolled with a tandem roller weighing not less than 3 tons nor more than 5 tons in the following manner: The brick next to the shoulder will be tamped with a hand wood tamper, to the proper grade. The rolling shall then commence near the shoulder at a very slow pace and shall continue back and forth until the center of the pavement is reached, then pass to the opposite shoulder and repeat in the same manner to the center of the road. After the first passage of the roller the pace may be quickened and the rolling continued until the brick is firmly embedded in the sand cushion. The roller shall then be started at the end of the section and the pavement rolled transversely at an angle of 45° with the shoulder, repeating the rolling in a like manner in an opposite direction. Before this transverse rolling takes place all broken or injured brick must be taken up and replaced with perfect ones.

Filler—The filler shall be composed of 1 part each of sand and Portland cement conforming to Specifications "I" and "K," and sufficient water to form a thin grout.

One sack of cement with an equal volume of sand shall be mixed dry until the mass assumes an even shade, in a box 4' 8" long, 2' 6" wide and 1' 2" deep, resting on legs of different lengths so that the mixture will readily flow to the lowest corner of the box, the bottom of which should be 6" above the pavement. The side and edge of the brick shall be wet before the filler is applied. The grout of the consistency of thin cream must be kept in constant motion from the time water is applied until swept into the joints of the pavement. It shall be removed from the box with a scoop shovel and immediately swept into the joints, all the while being stirred in the box as the same is being emptied. At least two boxes shall be provided.

The work of filling shall be carried forward in line until an advance of 15 or 20 yards has been made, when the same force and appliances shall be turned back and cover the same space in a like manner, except, that the grout shall be composed of 2 parts Portland cement and 1 part sand. Enough shall be used so that the joints remain full to the surface.

After this has had time to settle and before the initial set has taken place the surface shall be finished with a squeegee having a rubber edge which shall be worked over the brick at an angle with them. When completed and after the initial set has taken place, a ½-in. coat of sand shall be spread over the surface and kept damp for 7 days.

The street shall not be open to vehicular travel of any character until one full week has elapsed from the final completion of the pavement.

Expansion Joint—An expansion joint 1" wide shall be constructed along the shoulder on both sides of the pavement. The expansion cushion shall be bituminous material, which will be furnished by the U. S. Department of Agriculture, f. o. b. cars at Chevy Chase, Md.

Stone Shoulder—Broken stone from the present macadam road shall be placed so as to form a shoulder along the pavement from Station 58-50 to Station 61-80, as shown on the cross-section.

Specification "A"—Bituminous Concrete Wearing Surface, Topeka Specification

Surface—Upon the concrete base laid as specified in Specification "G," after being thoroughly cleaned, a bituminous concrete surface prepared as hereinafter described shall be laid.

Mineral Aggregate—The mineral aggregate shall consist of trap rock and limestone conforming to Specifications "M" and "N" except as to the size. All of it shall pass a ½-in. screen and 90% of it shall pass ¼-in. screen. It shall contain from 5% to 11% of 200-mesh particles. The trap rock shall be used from Station 0—15 to Station 3+00 and the limestone from Station 3+00 to Station 6+25.

Filler—If the screenings do not contain sufficient 200-mesh particles, they shall be supplied by the addition of a suitable amount of ground limestone. It shall be so fine that at least 66% shall pass a 200-mesh screen, and all of it shall pass a 50-mesh screen.

Bituminous Cement—The bituminous cement shall be subject to the approval of the engineer and shall conform to Specification "H," published below.

Combining Materials—The materials complying with the above specifications shall be heated separately in a suitable plant to a temperature of from 300° to 350° F. and shall be combined and thoroughly mixed while hot by machinery, such mixing being continued until the mass is a homogeneous and uniform bituminous concrete, and each particle of the mineral aggregate is thoroughly coated with bituminous cement. The filler (if required) shall be mixed, while cold, with hot aggregate. The bituminous cement will then be mixed with the other materials at the required temperature, and in the proper proportion, in a suitable apparatus, so as to effect a thoroughly homogeneous mixture.

Proportions—The proportions of asphaltic cement and mineral aggregate shall be such that the mixture shall contain the necessary elements to procure a pavement surface showing no excess or deficiency of bitumen, and the percentage of bitumen soluble in carbon disulphide shall not vary beyond the limits of from 7% to 11% by weight of the total mixture. It shall have the composition set forth as follows: To wit—

Bitumen from 7% to 11%.
Mineral aggregate passing 200-mesh screen from 5% to 11%.
Mineral aggregate passing 40-mesh screen from 18% to 30%.
Mineral aggregate passing 10-mesh screen from 25% to 55%.
Mineral aggregate passing 4-mesh screen from 8% to 22%.
Mineral aggregate passing 2-mesh screen less than 10%, sieves to be used in the order named.

Laying the Wearing Surface—The above mixture shall be delivered on the road in trucks, properly protected from radiation by tarpaulins, at a temperature at not less than 250° F., and it shall be evenly spread with hot rakes, using the back and not the tines for this purpose, so that it will make a layer 2" thick after compression. This compression will be attained by first smoothing the surface with a hand roller or other light roller, after which hydraulic cement or stone dust shall be swept over it, when the rolling shall be continued with a tandem roller, weighing not less than 175 lbs. per inch run, until the surface is properly compacted.

Specification "B"—Bituminous Concrete Pavement, District of Columbia Specification

Foundation—Upon the concrete base laid as specified in Specification "G" there shall be laid a surface of bituminous concrete which shall have a thickness of 2" after compression.

Bituminous Concrete — The paving mixture shall be composed of crushed rock, by volume, 2 parts, and sand 1 part, mixed in a mechanical mixer with such proportion of hot bituminous cement as may be directed by the engineer in charge. In no case, however, shall the percentage of bitumen soluble in cold carbon disulphide in the finished mixture be less than 7% or more than 9%.

Crushed Stone—The stone shall conform to Specifications "M" and "N" except as to the size. It shall be that part of the run of crusher which passes 1¼in. screen, and shall contain not more than 5% of material passing a 100-mesh sieve. The locations for using each aggregate shall be as follows:

From Station 6+26 to Station 9+35 Limestone.

From Station 9+35 to Station 12+50 Trap Rock.

Sand—The sand shall be clean, hard grained and moderately sharp. On sifting it shall have at least 25% of material that will be retained on a 20-mesh per inch screen and at least 5% of material that will pass an 80-mesh per inch screen.

Bituminous Cement—The bituminous cement shall be subject to the approval of the engineer and shall meet the requirements of Specification "H," published below.

Mixing and Laying—The aggregate and paving cement shall be heated separately to a temperature of about 300° and shall be combined and thoroughly mixed while hot by machinery. Such mixing shall be continued until the composition is a uniform bituminous concrete. The amount of paving cement and the mixing shall be sufficient to thoroughly coat each particle of the aggregate and the entire mixture shall be subject to the approval of the engineer.

The mixture shall be hauled while hot to the site of the work and shall be covered with tarpaulin until deposited on the street. Its temperature at the time of dumping shall be not less than 220° F. The hot mixture shall be evenly spread with hot tools to such a thickness as will form a layer 2" in thickness after compression. The compression shall be accomplished by means of a roller weighing not less than 175 lbs. per inch run until no further compression can be secured. The finished surface shall be free from lumps and depressions and shall be true to grade and cross-section.

Surface Finish—After the rolling of the wearing surface has been completed, there shall be spread over it a thin coating of the hot bituminous cement, which shall be uniformly squeegeed over the wearing surface so as to fill all voids. There shall then be spread over and rolled into this flush coat a thin layer of rock screenings, which shall be practically free from dust and of such size as all to pass a ½-in. screen.

Specification "H"—Bituminous Cement

(*1*) The bituminous cement shall consist of refined Bermudez asphalt and a heavy petroleum flux combined in a homogeneous mixture which shall contain not less than 70% of the refined asphalt.

(*2*) The bituminous cement shall have a specific gravity of not less than 1.040 at a temperature of 25° C.

(*3*) It shall be soluble in carbon disulphide at air temperature to not less than 95%, and shall contain not over 2.5% inorganic matter insoluble.

(*4*) It shall contain not less than 20% nor more than 30% of the bitumen, insoluble in 86° B. paraffin naphtha.

(*5*) It shall yield not less than 9% nor more than 13% of residual coke.

(*6*) When tested for 5 seconds at 25° C. with a standard No. 2 needle weighted with 100 grams, it shall show a penetration of not more than 7.0 millimeters nor less than 5.0 millimeters. The more exact penetration between the limits named shall be fixed by the engineer.

(*7*) When 20 grams of the material are heated for 5 hours in a cylindrical tin dish 2½" in diameter by 1" in height, at a constant temperature of 163° C., the loss in weight shall not exceed 5%. The residue thus obtained shall not have hardened over 50% as shown by the penetration test.

Specification "O"—Gutters

Concrete Gutter—A concrete gutter shall be laid along the west side of the experimental pavements approximately from Bradley Lane to the Columbia Country Club, as shown on the plans.

The contractor is to remove the present cobblestone gutter and make such cutting and filling as may be necessary to bring the foundation, when completed, to the desired depth and cross-section. The contractor shall thoroughly compact the bed by rolling or ramming.

On the bed thus prepared will be laid the gutter composed of the following materials: Concrete, mixed in the proportions of 1 part cement, 2 parts sand and 4 parts gravel or stone, and mortar mixed in the proportions of 1 part cement and 2 parts sand. If the mixing be done by hand, it shall be done on a water-tight platform with tight raised edges. The sand and cement must be thoroughly mixed dry and then sufficient water added, by fine sprinkling, to form a stiff, plastic paste. This paste shall then be spread out and the proper quantity of stone or gravel, which shall have been thoroughly wetted just previous to its use, shall be added and the whole mass turned over until each pebble or piece of stone is thoroughly coated with mortar. The concrete, immediately after mixing, shall be spread upon the foundation in such a manner that the mortar will remain evenly incorporated with the gravel or stone, and shall then be thoroughly compacted by ramming.

The exposed or top surface of the gutter shall be of mortar mixed in the proportions of 1 part Portland cement and 2 parts sand. The mortar shall be spread while fresh upon the concrete, before the latter shall have reached initial set, in such quantity that after thorough manipulation it shall be ¼" in thickness. It shall be leveled off and troweled to a smooth finish and to a true line, grade and cross-section. The same precautions, to prevent the too rapid drying out of the concrete, shall be taken as are specified under Specification "E," hereto attached. The cement, sand, gravel and stone shall conform to Specifications "I," "K," "L," and "M."

At driveways or crossings the gutter shall be divided into small squares as are the driveways across the sidewalks in K Street, N. W., near Connecticut Ave.

Cobblestone Gutter — A cobblestone gutter shall be laid along the west side of the experimental pavements approximately from the Columbia Country Club, Station 45+50, north to Station 58+50.

The stone shall be rounded bank or river stone not less than 6" nor more than 10" in its longest dimension; no flat, shaky or rotten stone shall be used. The stone may be selected from those in the present cobblestone gutter which is to be removed to make way for the concrete gutter above specified. The larger selected stone shall be laid in the gutter row and on the edges to a true line and grade. All stone shall be laid with the largest diameter lengthwise of the road.

The trench shall be excavated to a depth of 14". Upon the bottom of the trench, broken stone shall be spread and rammed to a depth of 6". The stone may be taken from the present macadam roadway and sufficient "fines" shall be added to insure a firm foundation and to prevent the sand, hereinafter specified, to be used as a bedding course, from settling into the voids of the stone. A layer of bedding sand shall be spread upon the stone foundation of sufficient thickness to bring the gutter stones, which are embedded in it, to the proper grade and cross-section after they are thoroughly rammed.

Each stone is to be rammed to an unyielding foundation. The surface shall then be covered with coarse sand, which shall be well broomed into all joints. The stones shall then be rerammed and the surface left smooth and even. Sand shall then be spread upon the surface, in sufficient quantity to fill all interstices.

The edge of the gutter shall be ¼" lower than the adjoining pavement; in no case shall any stone project above it.

All material excavated, of whatever nature, shall be considered the property of the U. S. Department of Agriculture and shall be disposed of as the engineer in charge may direct.

Materials Furnished

The U. S. Department of Agriculture will furnish f. o. b. cars at Chevy Chase, Md., the bituminous materials necessary for the surface in Experiment No. 3 and the oil required in the oil-cement-concrete in Experiment No. 4. The contractor shall use due care in opening and handling the barrels or cartons in which the bituminous materials are shipped, so as not to unnecessarily damage them and shall load in a car at Chevy Chase, Md., those designated by the engineer.

Reference Plugs

There shall be placed in the concrete pavements where designated by the engineer, approximately 100 brass plugs ¾" in diameter and 6" in length. These plugs will be furnished by the U. S. Department of Agriculture and will be placed in position by employes of the U. S. Department of Agrictulture just before the surface of the pavement is floated and the contractor shall not disturb them and shall finish the pavement evenly and smoothly around them.

A Reinforced Concrete Water Tank

BY A. E. DIXON

The accompanying Figs. 1, 2 and 3, show respectively a reinforced concrete water tank on the top of a building, the inner form with the horizontal and the vertical reinforcing in place and the outer form, nearly completed, and the completed form for the tank. This tank is 11' in diameter inside and 15' high. The top is closed by a concrete slab with a small vent opening and the tank stands entirely exposed to the weather. It was built about five years ago without any waterproofing and showed no signs of seepage or leakage after three years of use. The floor slab upon which the tank stands was used as its bottom.

The first step in constructing the tank was taken in pouring the reinforced slab that supported it. This slab was designed for the water and tank load and the circle of the tank was laid out on the slab form and stub ends were connected to the slab reinforcing, so that they would project vertically into the walls of the tank and supply an anchorage to which the vertical rods in tank could be wired. This slab was then poured with a very rich concrete, consisting of 1 part of cement and 2½ parts of sand and very fine gravel mixed to the consistency of very thick soup. As soon as the slab had had an opportunity to become thoroughly set, the inner form was started. The horizontal rings to which the vertical form lagging was nailed were made ready on the ground with three vertical 2-in. x 6-in. spacing pieces for setting them. These rings were piled on the slab and the 2-in. x 6-in. pieces were then nailed to the bottom ring and braced at the top. The top ring was then raised and secured to the verticals and was used to hoist the other rings to their proper location, working from the top down. When this skeleton was completed, the cylindrical lagging was nailed to the rings and the completed form was then located in its final position.

The vertical reinforcing bars were then put in position and wired to the anchor stubs with soft iron ties. Tie-wires at the top were used to hold them in position while the horizontal reinforcing was placed. This consisted of small rods about 30 ft. long, their spacing being closer at the bottom and increasing toward the top of the tank. These were wired to the vertical rods and lapped about 15 in., where they were spliced with tie-wires. In this particular tank these rods were in the form of rings, but less splicing would have been required had they been arranged to form a spiral, the pitch of which increased as it approached the top of the tank. The spiral would also have avoided considerable cutting to length, as the rods forming it could have been used in mill lengths and the only cut required would have been on the last rod used.

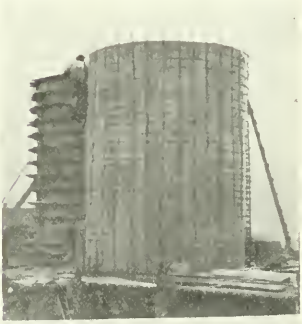
FIG 1 REINFORCED CONCRETE WATER TANK

The outside form was constructed in a manner similar to the inner form. In Fig. 2, a man is shown standing upon one of the rings to which the lagging was secured. This form was built as a complete circle and was split by sawing at diametrically opposite points so that it could be moved into position to form the outside of the tank. Fig. 3 shows it after it had been made ready for the concrete with two of the working platform supports. The top of the inside form was also a form for the cover and served as a working space for the laborers. The concrete mixture used for the walls of the tank was the same as that used for the slab upon which it stood. This mixture was poured into the form from buckets which were handled by men stationed on the small outer platforms. The concrete was brought to them by 3 wheelers, who ran the concrete carts between the elevator and the tank and filled the buckets as fast as they could be emptied. The pouring was a continuous process until the form was filled. Four men on the inner working platform were provided with tamping rods, with spade ends about 4 in. wide by 6 in. long. They kept working the mixture to the forms and reinforcing. The smooth surface obtained in this way is shown in Fig. 1, which shows, in the illustration, the marks of every piece of lagging, while the concrete itself showed the grain of the wood against which it had set.

The pipe connection was made by boring a hole large enough to pass a short piece of 8-in. wrought iron pipe through both forms. This pipe was of sufficient length to project about 1 in. inside and outside of the tank, and served as a stuffing box through which the 6-in. supply pipe passed so that a rigid connection at this point was avoided and an outside packed joint was secured.

After the concrete had been poured, it was kept wet down every few hours day and night for nearly two weeks; the forms, however, were removed in five days. The bottom of the tank inside was kept covered with a few inches of water and when it was three weeks old the tank was filled to the top and kept full for several days. After this water was let out, both the inside and the outside of the tank were washed with a coating of neat cement and water.

The top of the tank was formed of a flat slab of concrete, supported by the walls of the tank. A square opening, 2' on a side, was left so that the inside could be got at by passing a ladder down into the tank. A permanent ladder could have been formed by setting "U" shaped rungs, properly spaced, in the inner form and wiring them to the vertical bars.



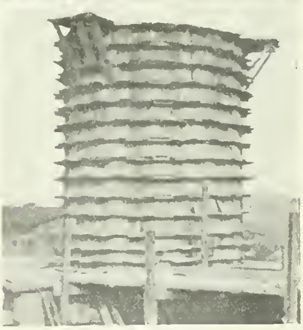


FIG 2 (ABOVE) SHOWS THE INNER FORM WITH THE STEEL IN PLACE; THE OUTER FORM IS SHOWN IN THE BACKGROUND

FIG. 3 (BELOW) SHOWS THE OUTER FORM IN PLACE

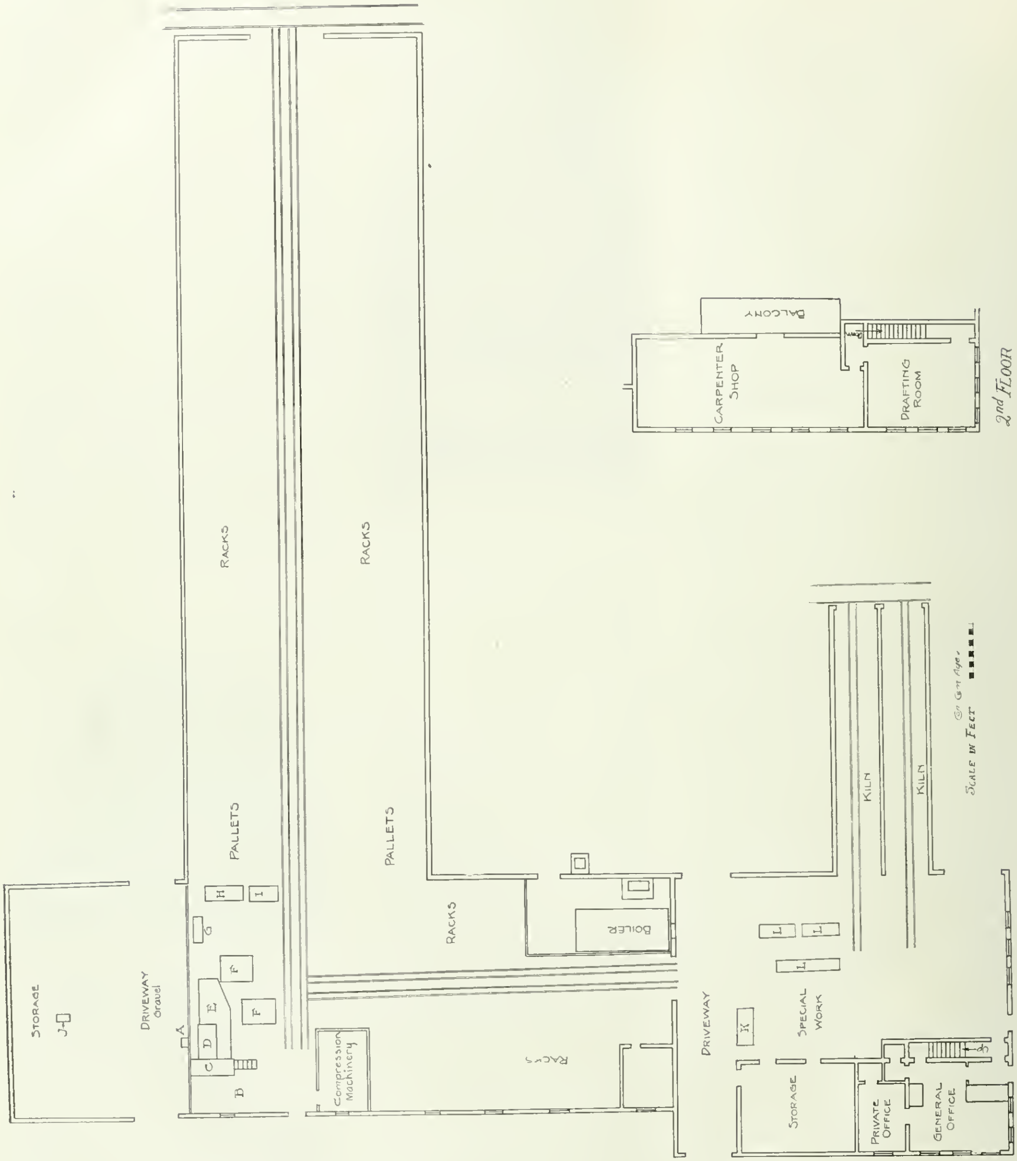


FIG. 1—FLOOR PLANS OF J. FRANK NORRIS CONCRETE PRODUCTS PLANT, ROCHESTER, N. Y.

A—Gravel Screen. B—Storage Space for Cement Piled in Sacks. C—Platform used in Feeding Cement to Mixer. D—Mixer. E—Platform to which Concrete Falls from Mixer. F—Hydraulic Block Machines. G—Batch Mixer. H—Double Hand-Power Block Machine. I—Single Block Machine. J—Home-made Barrel Mixer. K—Batch Mixer. L—Metal Molds for Sills, Lintels, etc.

A Successful Concrete Products Plant in Rochester

Layout, Equipment and Methods in Factory of J. Frank Norris—Air and Water Curing

The concrete products plant of J. Frank Norris, Rochester, N. Y., has been successfully operated for several years. It has recently been considerably enlarged and new equipment added to it. Most of the concrete products plants described in this magazine use the steam curing system; Mr. Norris is not yet a convert to steam curing. He has two acres of ground for his plant and he says that with large storage space and plenty of shed room where block can be sprinkled and kept under cover in warm air in winter, he has been able to get most satisfactory results without steam curing. An idea of the amount of floor space which Mr. Norris uses is given in the floor plan sketches (Fig. 1) which accompany this article.

The principle thing to be said about Mr. Norris' plant is that it has turned out a product excellent in quality and appearance which has won over architects to such an extent that it is specified for important work where appearance, coupled with strength, is the first consideration. Block are being turned out, granite-faced, which have life and sparkle, due not only to a careful choice of the material used in the facing mixture, but to the methods employed in the plant in treating this surface as the block come from the machine. Every faced block, as it comes from the machine, is subjected on its face side to a fine spray of water from a special nozzle, by a man who does nothing else but handle this spray apparatus. This is done after the block leaves the machine and before it is loaded on the car on which it is conveyed to the racks and the operation requires 5 to 10 seconds per block. While similar methods are used elsewhere, this plant has been unusually successful in turning out products now known by the special name of "Norristone," which have unusual quality in texture.

Equipment

The Norris plant has the following principal items of equipment:

Two Jaeger-Keny hydraulic block presses.

One Jaeger-Keny continuous mixer.

Two double Hercules block machines.

One single Hercules block machine.

Two Blystone batch mixers.

Special Arthur--Kappel Co., block cars.

Three sill and lintel machines which were specially designed and made for the Norris plant, besides special molds and smaller equipment.

Beginning at the raw material end of the plant the back part of the one-story building, as will be seen in the plan, is

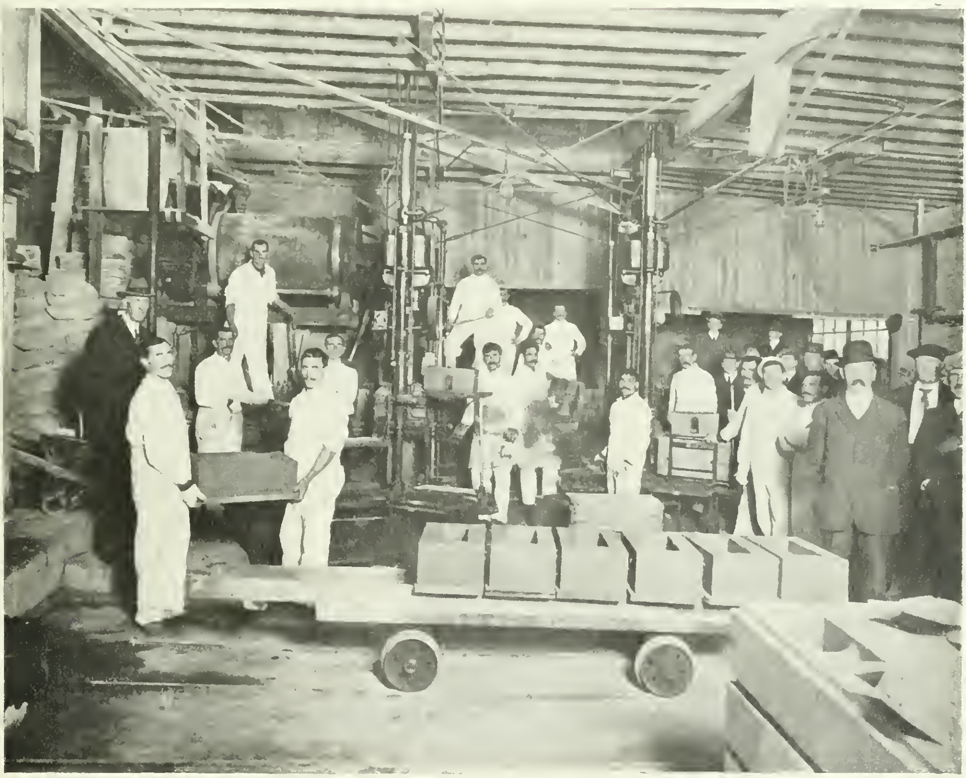


Fig. 2—Interior View of Norris Plant Showing Hydraulic Block Machines in Operation

Fig. 3—Exterior View of Norris Plant With New Portion in Foreground

reserved for storage. Here the special facing materials are piled in bags. Here also is located a home-made mixer for making the facing material. This is a cider barrel mounted on an axis through the center and turned by hand with a crank, and with a hole in the side through which the special sand, granite, or other material is put, together with the cement and afterward closed. Through the sides of the barrel 20-penny spikes are driven to aid in the process of mixing.

There is a driveway through this back part of the building. On it, the gravel wagons come from the pit which is at a distance of about a quarter of a mile from the plant. The gravel is dumped just to one side of this drive way and as near as possible in front of the screen through which the gravel is to be shoveled. Gravel over 2″ in size is eliminated by this screen. That which falls through the screen goes to the chain bucket conveyor which lifts it to the hopper above the mixer. This back room just in front of the driveway is partially partitioned off.

Facilities for gravel storage are unhandy and sometimes necessitate shutting down in bad weather. Mr. Norris proposes to build in the near future—before winter closes in, if possible—large storage bins above this back room of the building, and to these he will elevate the gravel as it comes to the plant in wagons, in order that there may be plenty of stock on hand to carry the plant well over any period of weather in which hauling could not be done.

In the corner of the room in which the block are made, the cement is piled in sacks, as indicated on the drawing. This is carried up the steps and dumped into the hopper by hand. The concrete leaving the mixer falls onto a platform which is so constructed as to be conveniently located for the removal of the mixed concrete to the weighing devices placed at the edge of the platform from which it goes direct into the molds on the presses. This arrangement is quite clearly shown in Fig. 2. The concrete is approximately of a 1:5 mixture, considerably wetter than is ordinarily used in block manufacture, though not by any means so wet as to be called quaky.

Two kinds of crushed granite are generally used for the facing mixture, light gray granite* and dark gray granite,† mixed 1:2 with cement. Other block are faced with a specially screened sand in a 1:2 mixture. The facing mixture is brought in a wheelbarrow from the barrel mixer which is only temporarily in use, to a box which stands beside the press. As the bed of the press revolves bringing around one of the three plates, the facing mixture is put in and leveled off with a trowel, and it then goes under the press where the parts of the mold forming the side walls and core are set on, and the concrete put in by the weighers. As the block come off the press they are carried on the pallets to the car on which they are removed to the racks. Before being removed they are sprinkled, as already mentioned, a nozzle being used to get a fine, even spray. This nozzle is known as the "Auto-pop" sprayer‡. A batch mixer is used at the location indicated on the plans when the hand power block machines are in operation. Another batch mixer is located in the room where special work is done on sills and lintels and dimension pieces.

Power and Employes

While the plant is steam heated, electric power is used for the machines. There are two General Electric Co. 5 H. P. motors and one Richmond 5 H. P. motor used in the operation of the presses and the continuous batch mixer. There is one 3 H. P. Richmond electric motor used to drive the Blystone batch mixer which is operated for the hand power block machines. There is another 2½ H. P. General Electric motor used to drive the mixer in the room where special work is done. About 200 t. of leather belting are used in power transmission. Under ordinary circumstances, the men employed in the plant are as follows:

2 men sifting gravel to the conveyor.

1 man feeding cement to the mixer.

2 men operating the hydraulic block presses.

1 man (who stands on the platform under the mixer to distribute the concrete for the convenience of the weighers).

2 men weighing concrete and feeding it to the presses.

4 men carrying block from the presses.

4 men racking and inspecting.

1 man spraying block as they come from the presses.

1 general utility man.

1 foreman.

3 men in the special work department.

3 to 4 men in the yards.

Besides these there are one draftsman, one bookkeeper, one stenographer, and Mr. Norris himself, who is the sales end of the establishment.

The capacity of the two hydraulic presses is 1,800 block per day, regardless of size. The average run of the two presses is 1700 block per day. The principal sizes made are as follows: 8″x12″x24″, 8″x8″x24″ and 8″x16″x24″.

Mr. Norris is making a great many of the 8″ by 8″ by 24″ block for use in walls heavier than those of the ordinary residence. These 3 principal sizes are manufactured in 4 principal styles, plain face, bevel face, rock face and dental face. Further variation is given by the fact that any one of these sizes or any one of these styles is made with any one of the following facing mixtures: sand facing, gray granite, and dark granite.

Of the men working in the plant aside from the draftsman and the foreman,

*Monarch Mining Co.
†Comes from Warren, N. H.
‡E. C. Brown Co.

three receive 30c an hour, three 26c an hour, and the others receive 28c an hour. The plant operates ten hours a day. The 8"x12"x24" block are sold for 22c each, and the 8"x8"x24" are sold for 20c each.

Curing

As to curing, Mr. Norris says that with his facilities for storing a large number of block so that he is always ahead of the demand on stock sizes, styles and faces, he finds that racking and sprinkling are entirely satisfactory. He has no quarrel with steam curing except that he believes it unnecessary when storage facilities are ample, and that in his case it would mean additional expense without additional advantage. The entire plant is heated with steam and in winter it is possible to leave the block inside the sheds for a full week. However, he does intend to put more tracks in his storage sheds and to equip his plant with cars so that the needless labor of loading and unloading will be obviated. He proposes to buy enough cars so that he can leave his output on the cars until cured sufficiently for removal to the yards to be stacked.

The plan shows two kilns. These have recently been constructed and will be kept for steam treatment of special products. This has not been done so far. However, it is not the intention to use steam all the time, but merely to use it when there is a special run of some product not held in stock, which is wanted in a hurry. In these kilns for curing the ordinary run of product which is to be held in stock, as most of the sills and lintels are held, sprinkling will be used and the kilns will be equipped with "Auto-pop" sprinklers very much like the sprinklers used in spraying the block as they come from the machines. Water pipes will be run down both side walls of these two kilns at a height sufficient to get above any product put into the kilns on cars, and beginning 5' from the front of one wall, two sprayers will be mounted on one tap at intervals of 10'. On the opposite wall the first sprayer will be placed 10' from the front and every 10' throughout the length so that with both walls the pairs of sprayers will alternate so as to be 5' apart throughout the length of the room. Each pair of sprayers will be mounted on the pipe at such an angle as to fill every inch of the room with a fine mist when they are in operation.

Mr. Norris aims to please the architects and in this lies the chief reason for his success. Of course, he naturally urges the use of the product which he has on hand and which can be had in large variety, but he is quick to meet any specifications which an architect may write for special work. Up to the present time, special patterns have been made outside the Norris plant on special order of pattern makers. Now that the plant is equipped with a carpenter shop in connection with the drafting room, much of the work will be done in the plant.

The new portion of the Norris plant, plain as it is in general outline, is a good advertisement of his business.

Fig. 1—Front View of Reinforced Concrete Coal Shed Which Cost About $1,000

Concrete Coal Sheds Are Durable and Fireproof

The retail coal shed is, as a rule, subjected to extreme wear and tear. The constant friction between coal and walls makes the life of the timber shed very brief. The best modern material for this purpose is concrete. Aside from the matter of durability, the fireproof question is most important. Coal

Fig. 2—Coal Shed Under Construction

sheds are in close proximity to railroads, and it is a common occurrence to have them take fire when sparks

Fig. 3.—Forms Being Erected

from locomotives fall on splinters of wood.

The coal shed illustrated herewith is that of the Harris Grain & Coal Co., of Harris, Ill. It is 13' 4" wide and 81' 4" long. The height at the front is 12' and at the rear 10' 6". The shed is divided into 4 bins by concrete crosswalls. The capacity is 300 tons of anthracite coal or 267 tons of soft coal. Figs. 1 and 2 show the shed at front and at rear.

The walls are 8-in. reinforced concrete and the partitions 6-in. reinforced concrete. The roof is 3" thick. The shed is fitted with cannon-ball rolling doors, and the door frames are steel.

Fig. 4—Most of the Wall Completed

The materials used included 125 yds. of gravel, 150 bbls. of cement and 8,200 lbs. of steel.

The walls are reinforced vertically and horizontally with ½-in round bars, both on 12 in. centers. The roof is supported by 9 in. x 13 in. beams spaced 12 ft. Each beam is

Fig. 5—Rear View of Coal Shed

reinforced with ¾-in. rods. The 4-in. roof slab is reinforced in each direction with ½-in. rods on 6 in. centers.

The cost of the structure was $1,000.

It is more than possible that the annual banquet of the Pittsburgh contractors and builders will be held Dec. 19, next, instead of sooner, as usual, because of the fact that the cement show will be held in Pittsburgh Dec. 15-20. It is believed that the annual affair will prove interesting to the many who will be in the city at that time, and for this reason the later date will probably be selected. Various committees now have the event in hand and are laying plans for a "huge" time.

Concrete Highway Construction*

BY A. N. JOHNSON†

For a number of years past attempts have been made at various times to construct a road surface of concrete. The writer had occasion to inspect a number of pieces of such work done some years since, none of which, in his judgment, seemed to warrant any very extensive use of concrete as a road surface, unless more promising results could be obtained.

In the last five or six years, however, great improvement has been made in the methods of construction, so that there are today many miles of concrete roadways which give every promise of service that makes this form of construction one of the cheapest durable pavements that can be laid on country roads.

Extended experience with concrete highways is lacking on which to base as definite conclusions as can be applied in the investigation of many other forms of pavement construction, and there is therefore wanting that fund of information from which to standardize the methods of construction and to draw specifications. This being true, makes not untimely any information on this form of construction.

Concrete pavements present many characteristics totally unlike other forms of pavement in much more general use. A concrete pavement has a hard, rigid, monolithic surface, and is properly to be classed as a sheet pavement. Practically all other forms of rigid surface pavements are of the block type, while all other sheet pavements are somewhat resilient. The fact that concrete pavements are composed of large monolithic slabs of rather brittle material, having a coefficient of expansion due to temperature differing not greatly from that of steel, makes it necessary to consider certain features of construction not usually important in other forms of pavement.

When we compare concrete roads with all forms of macadam construction, we are struck with many entirely opposite characteristics, chief of which is the fact that in the macadam roads, the matrix or the binder gives no stability to the road, which on the contrary receives its strength and stability from the fact that the rock or the larger pieces of stone are firmly keyed together, the binder merely serving to hold them in place, but in itself possessing no strength.

The sheet of macadam is not rigid, and if settlement takes place, it adjusts itself to the new conditions, perhaps forming a depression, but at the same time with the surface often remaining practically intact, while any settlement of a concrete pavement produces a crack which does not subsequently heal itself under traffic.

The fact that the concrete roads are rigid results in the surface layer, if we conceive the pavement made up of a number of layers, being subjected to far greater impact stress than is received by a pavement of a more resilient type. The strength of concrete to resist stresses of every character de- on the strength of the matrix or mortar holding the aggregate together, assuming that we have an aggregate of sound particles. The concrete being made of various sized particles held together by the matrix, it becomes necessary that none of these particles be loosened under the action of traffic. The condition to be maintained so that they will not loosen is that the matrix shall not become broken, thereby releasing the particles of the aggregate.

In nearly all previous experience with concrete, it has been subjected to general pressure stresses only. These usually distribute themselves throughout the mass of the concrete, so that the aggregate and the matrix supporting the particles of aggregate have only well distributed loads But the loads or blows to which a concrete pavement is subjected are totally different in their action from gradual pressure stresses, even though the latter may be well near the crushing limit of the concrete.

In the case of the blows received by the pavement, there is applied to a very small area of the pavement a sharp heavy stress, resulting in that particular portion of the surface being subjected to an extremely heavy load, suddenly applied. If such a blow falls upon the matrix, it is necessary, if the blow is to be resisted, that this wall of matrix be sufficiently strong to withstand the impact.

If a lean concrete is used in which the matrix or mortar has insufficient cement, it will not stand such stress. On the other hand, while the matrix may be made rich in cement, if the mortar is somewhat lacking so that the spaces between the aggregate are small and the walls of the matrix are thin, possibly not quite sufficient to fill all the voids in the aggregate, leaving some places unsupplied with mortar, we shall find again that the pavement will break down under heavy impact blows, such as are delivered by horse-drawn traffic.

Mixture

Failures of concrete roads, due to disintegration or raveling under traffic, probably may be attributed as much to a lack of mortar in the concrete as to a lack of cement in the mortar. The conclusion from observation is that with a given aggregate there will be little difference between roads built in the proportion of 1:2½:5, 1:2:4, or 1:1½:3, for in each instance, assuming that the aggregate runs precisely the same, there is but 50% mortar, and where a 1:2:4 mixture might have given unsatisfactory results, this condition would not be greatly bettered by using merely a richer mortar. What should be done is to increase the per cent of mortar. For example, instead of a 1:2:4 mixture, use 1:2:3½; the point being that in order to secure the requisite strength the walls of the matrix between the particles of aggregate must be of sufficient thickness to hold firmly on all sides of each piece of aggregate. To make sure of this requires an excess of mortar over the voids in the aggregate of 10% to 15%. In general it is recommended that the mortar should not be less than 60% of the aggregate.

The fact that the action of traffic subjects every portion of exposed surface of the pavement to severe treatment makes it necessary to have the requisite strength presented at all points. Therefore, concrete for concrete roads must be more thoroughly mixed and of higher grade than is necessary in any other form of concrete construction.

Each batch of concrete, as deposited in the road, should be watched, to insure that the mortar does not flow to the edge of the pile and leave a core of aggregate unsupplied with sufficient mortar. At least one workman should be assigned to shovel all such cores of aggregate to the bottom of the concrete layer so as to insure only concrete rich in mortar at the surface. If this is not done, depressions will develop in the surface under traffic which will loosen the clusters of pebbles, which do not have sufficient mortar to hold them firmly in place. The men finishing the surface should be warned not to let such places go by them without shoveling out the pebble clusters and replacing them with a richer mixture. A finisher can easily cover such a place by working a film of mortar on this surface without necessarily filling the voids below.

Aggregate

Attention should be given to the nature of the aggregate. None of it should be larger than 1" particles, and should grade as uniformly as possible to the sand grains. If crushed stone is at hand, the screenings should be retained in the stone unless they are of such a character as cannot be well used in the place of sand. Well graded gravel forms one of the best aggregates which can be used. Only hard material, absolutely sound and free from all soft particles, should be used.

In all cases, the amount of cement to be used must be carefully proportioned from the amount of sand. With a uniformly graded material, the amount of sand depends on the size of particles we arbitrarily determine shall be called sand, which is often taken to be all of the material passing a ¼-in. mesh. The amount of sand being ascertained, the amount of cement is thus determined for a given volume of the gravel. Most gravel carries a high percentage of sand as compared to the aggregate.

*Read at American Road Congress, Atlantic City, N. J. A brief reference to this paper, with quotations from it, was published in the November issue.

†State Engineer, Illinois Highway Commission.

There would thus be required in a cu. yd. of concrete under these conditions, more cement than would be the case were the sand not in excess. It will oftentimes be found economical to add screened gravel, so as to bring the sand and the aggregate more nearly to the desired proportion. It has already been pointed out that it is important to have a large proportion of mortar, not less than 60% of the volume of the aggregate. For example, with proportions of 1:3:5, 1:2½:4, or 1:3:3½, the mortar is about 60% of the aggregate in each case.

It has been pretty well established that the leaner mixtures, 1:3:6, and 1:3:5, are not satisfactory in concrete pavement work. The present practice of the Illinois Highway Commission is a mixture of 1:2:3½.

Action Under Temperature Changes

Owing to the constant movement of a concrete pavement, due to temperature changes, it is impossible to prevent cracks. On hot days the pavement tends to lengthen, and on cool days to shorten. It is evident that cracks will form when the pavement tends to shorten. As the pavement moves over the sub-soil, there is developed a frictional resistance which increases foot by foot as added length is given to the section under consideration. For example, suppose an attempt is made to hold one end of a section rigid, the force required will increase as the length increases of the slab which it is attempted to hold.

As a section of pavement of indefinite length tends to shorten under the action of low temperatures, a length of the pavement will be pulled over the sub-soil on which the frictional resistance to be overcome just equals the tensile strength of the concrete. When such a point is reached, the pavement cracks. Thus we can conceive that a section of pavement between two such cracks did not move at the center, but tended to draw towards the center from the ends where the cracks occurred, and that therefore, this length of pavement, whatever it may be, represents a section twice as long as the strength of the pavement or tensile strength of the concrete would permit to be dragged over the sub-soil or earth foundation.

Expansion Joints

If we are to forestall the formation of cracks in a haphazard way, it will be necessary then to provide joints close enough together so that there will be sufficient strength in the concrete to drag one-half its length between joints.

If expansion joints are placed from 40′ to 50′ apart and on the assumption that the coefficient of friction of the pavement with the sub-soil is 1, the tensile strength to be exerted as the pavement shortens under low temperature will be 20 to 25 lbs. per sq. in. While this is not too high an allowance for the tensile strength of concrete of the type recommended for concrete roads, it is evident that whether such a stress or a greater one is exerted, depends entirely on what is the coefficient of friction. However, there is every evidence to suppose that joints may be placed with entire safety even farther apart than 50′.

The advantage of making the cracks beforehand is that their edges may be properly protected from traffic. It will be realized at the outset that the expansion joints constitute the weak points in the pavement, and that there should be as few of them as possible.

It has been suggested that as concrete sets its shrinkage about equals the expansion due to 70° or 80° temperature change, so that it will be necessary to allow only for arbitrarily weak sections—for instance, a paper joint placed every 50′ or 100′. As the pavement sets, it will shrink and make a sufficient opening to allow for subsequent expansion. While there is no question that concrete shrinks in setting, laboratory observations having confirmed and measured the shrinkage, it should be borne in mind that when concrete is laid upon the road and is setting, it has a considerable frictional resistance to the sub-soil. The tensile strength of the concrete as it sets is extremely low, and instead of pulling any considerable amount of concrete over the surface as it shrinks, it is more likely that minute cracks are formed throughout the entire mass of the concrete, so that there would be no space provided for subsequent expansion. Whether this is the case, or actual cracks are formed due to setting, makes but little difference, for in either case they will not provide the expansion desired from the fact, that to be expansive, the joints must be free from incompressible material; i. e., material having no greater compressibility than the concrete itself. This cannot be the case with a road under traffic, as the crevices will soon become filled with dust and grit. Therefore, if the cracks do form and they are to remain expansive, it is necessary that they be filled with a plastic material.

If the joints become filled with a rigid material, the change in length due to ordinary variation in temperature will result in the development of compressive stresses of about 1,000 lbs. per sq. in. The deformation in the concrete for such stress would about equal the temperature deformation. But a thin slab of concrete of indefinite length and subjected to compressive stresses of 1,000 lbs. per sq. in., must necessarily buckle.

If a concrete pavement is laid without expansion joints, it might pass the first season without any serious consequences from buckling, as the cracks that are formed by the low temperature might not become so filled with incompressible material that they did not afford some relief as the pavement expanded under subsequent temperature rise. But as time goes on, the cracks will become more and more filled with grit and become more nearly incompressible, so that in no very long time they will cease to be expansive and afford no opportunity for movement of the pavement. The movement must then be taken up by deforming the concrete; and as already stated, the stresses induced by such deformation are beyond what it is to be expected that a thin slab can withstand without buckling.

Expansion joints should not be laid at right angles with the direction of the road, for there is quite likely to be formed at an expansion joint a slight unevenness in the surface. If this is the case, then both wheels of a vehicle strike it at the same time and the irregularities become noticeable, while, if the joint is placed at an angle with the direction of travel, the wheels on opposite sides of the vehicle will pass over the unevenness, if there is any, in succession and greatly reduce its effect.

It is recommended that expansion joints be placed at an angle of 60° with the center lines of the road, and that successive joints be not parallel, swinging first one joint 60° in one direction, and the succeeding joint 60° in the opposite direction, which will tend to reduce any cumulative vibrations.

In order to protect the edges of expansion joints, they may be faced with steel plates, which are manufactured for this purpose, and are cut to fit the crown of the road.

Longitudinal Cracks

One marked phenomenon observed in concrete roads is the formation of longitudinal cracks for which two reasons suggest themselves. It will be noticed usually in the construction of a concrete road that the moisture leaves the crown of the highest portion of the road first, and if the road is not immediately covered and protected, and if it should happen to be a very drying day, it could easily be conceived that this ridge near the center of the road would become deficient in moisture, and if small shrinkage cracks do not immediately appear, at least there would be formed an area of weakness along the crown of the road where, as a matter of fact, these longitudinal cracks are usually seen.

A second cause, and more probably the immediate one, is the seepage of moisture into the sub-grade from the edge of the concrete. On a number of sections of road where these longitudinal cracks were observed, it was noticed also that the shoulder was slightly raised above the edge of the concrete, so as to hold the water and tend to soften the foundation. Where this is the case and the sub-soil retentive, subsequent heaving by frost action would take place and tend to break the concrete slab towards the center. It is probable that a combination of these causes would account for many of the longitudinal cracks. That they are not due to the ordinary expansion and contraction from temperature changes, seems to be well established from the fact that there seldom are seen transverse cracks; yet the longitudinal cracks will occur in sections of pavement not more than 16' wide, while the distance between the expansion joints is much greater. If, therefore, cracks were due to contraction of the concrete from temperature changes, we would expect that more transverse cracks would appear and fewer longitudinal cracks, while the reverse is actually the case.

Prevention of Longitudinal Cracks

In the concrete pavements under construction by the Illinois Highway Commission, an attempt is made to provide against the settlement of the edge of the pavement, due to accumulated moisture, by placing a small sub-drain of broken stone continuously along the edge of the concrete, and extending from this longitudinal sub-drain, cross-drains through the shoulders at the end of each transverse expansion joint; the object being to take away any surplus moisture that may be held by the shoulder of the road if raised somewhat above the concrete, as is apt to be the case. Should the longitudinal cracks still appear in spite of these added precautions, there would seem to be but one remedy left which would be to supply a certain amount of steel reinforcement transversely of the road. It is believed that this will prove more effective and cheaper than an undue increase in the thickness of the pavement.

One- and Two-Course Construction

In general, two methods of laying concrete for pavement purposes have been followed. In one, the material is put on in two layers, the lower material acting as a base, and the upper material being made richer to act as a wearing surface, and in the other the concrete is made of the same consistency throughout and put on in one layer. It is believed there is considerable additional risk run in laying a concrete pavement in two layers. This method makes practically unavoidable the formation of a horizontal plane, at the junction of the two layers, considerably weaker than any other section through the concrete. The importance of avoiding any such plane of weakness will be seen when we consider the action of the pavement under exposure to the hot sun.

If a slab of any material whatever be heated on one surface more than on the opposite surface, the material at the surface of the higher temperature will have expanded more than the material near the surface of the lower temperature. Thus, if a slab of concrete be exposed to the hot sun, the upper surface tends to expand with a result that the slab will curve, being convex on the side of the higher temperature.

If there is a horizontal plane of weakness in the layer of concrete forming a pavement, there will be every reason to expect that under the action of a hot sun the top layer will pull away from the lower, owing to the inability of the weak section to carry the whole layer of the pavement with it. The first indication of this is a hollow sound as traffic goes over the pavement. It has probably been remarked by everybody that such places exist in concrete sidewalks, which usually have a very well developed plane of weakness comparatively near the top, and although they may sound solid for a time, as soon as exposed to the hot sun, the surface in spots will loosen and separate from the lower part. For this reason, the construction of concrete pavements in two layers should be avoided. As soon as the upper layer becomes loosened it is but a short time before it is cracked and pieces broken from the surface.

There is also every indication that moisture which tends to expand concrete has an effect similar to temperature changes, though not so marked. The fact that a pavement is exposed to varying conditions of heat and cold, dryness and moisture, which have opposite effects, must give rise to complicated and confusing phenomena. The somewhat limited and not very precise observations lead to the conclusion that a concrete pavement suffers greater changes due to temperature variations than to other climatic conditions. But much valuable information on these points will be afforded by the precise observations to be undertaken by the Office of Public Roads of the Department of Agriculture on an experimental section of concrete road which it is understood will soon be completed.*

Curing Concrete

Even if a good mixture has been used a bad pavement may result if proper care is not taken to supply an abundance of moisture while the concrete hardens. Shrinkage cracks occur if the concrete has not been covered and kept thoroughly moistened for a period of not less than two weeks. The usual methods to secure proper curing are: first, covering the concrete with canvas as soon as it has taken an initial set so that it will not be marred. The canvas is kept moist, and then in a few hours, or as soon as the road becomes sufficiently set, sand or earth is shoveled upon it and well watered. This requires that there be an ample water supply at hand, and is one feature of concrete construction that in some localities at certain times of the year may prove somewhat awkward.

The amount of water used in the mixer, as concrete highway work progresses, will be from 8,000 to 12,000 gals. a day aside from what is necessary to keep the road moist. Therefore, it is usually necessary to provide a concrete road outfit with sufficient pipe and pump capacity to furnish water along the road for one or two miles. Two-inch pipe will be found a convenient size, unless the distance becomes so great that the frictional head reduces the capacity of a transportable pump of reasonable size so that sufficient water is not furnished at the mixer. The pump should have not less than 50 gals. per minute capacity and should withstand a pressure of 150 to 200 lbs. per sq. in.

*See elsewhere in this issue, also September issue.—EDITORS.

Thickness

The thickness of a concrete road need not be greater than the same condition of sub-grade would demand for a macadam pavement. If the sub-grade is properly prepared and well drained there would seem to be little reason for a concrete road to be more than 6" or 7" thick. It should be borne in mind, however, that owing to the monolithic and brittle character of the concrete slab, it is very necessary, perhaps even more so than with macadam construction, to have a perfectly drained sub-grade. Also as a matter of economy in construction it is important that the sub-grade be prepared carefully and truly to cross-sections and grades, so that additional concrete, which is expensive, need not be employed in filling up depressions and uneven places on the sub-grade; but it is better that the sub-grade be a trifle too low than too high, in order to avoid thin places in the concrete from the latter cause.

The methods to be used in shaping the sub-grades, providing side planks for forms and templates for striking the surface of the concrete, are generally well known to road builders and will not receive extended discussion in this paper. The side forms should be set so rigidly that the workmen will not displace them in walking over them. While a slight defect in alignment is not a serious matter, the top edge of the side forms should be set as true to elevation as possible.

Crown

The surface of the concrete road will need no more crown than is absolutely necessary to keep it free from water that may fall upon it. Aside from draining the water, the road should not be made too flat, as it will not have so pleasing an appearance as one with a somewhat curved surface. If the center is raised about 3/8 in. to the foot above the sides and then a curve passed through this point and the sides, a very satisfactory crown is made and one that is by no means inconvenient for traffic. On very wide roads, roads of 30' or more, this could be reduced somewhat, possibly as low as 1/4 in. to the foot.

Finish

The surface of the road should not be finished smooth, but left slightly rough. This may be done by the workmen, using a wood float or it may be done after the work has been floated fairly smooth by slightly marking the surface with a broom. This latter method is perhaps better adapted to rock and sand concrete than gravel concrete, as the latter will leave many small pebbles in the surface and not finish with so smooth a mortar surface as sand and rock concrete.

Organization of Working Force

A good plan of organization for carrying on concrete road work is to divide the work into two parts, each under a competent foreman or superintendent. The first party is to do the grading, prepare the sub-grade carefully and haul the aggregate on the roadbed in such quantities that there will be enough to provide for the concrete. It is better, however, to have slightly less than too much aggregate in the roadway, as it is more economical to haul in an extra load or two to make up any deficiency than to dispose of a surplus.

It should be borne in mind for estimates for this part of the work that there will inevitably be a small amount of aggregate left on the roadbed, which is by no means a bad feature, so that there should be allowed a full cu. yd. of gravel or stone for each cu. yd. of concrete to be laid.

The second party comes upon the work with the concrete mixer and starts in at one end of the road to mix and place the concrete. With an automatic distributing type of machine, five or seven men will be about all that can be used advantageously in shoveling the material into the hopper. Two men will be required on the machine, one man to clean up as the machine advances, so that the concrete may be placed on a clean roadbed; two or three men taking up the forms as used and putting them ahead; three men to strike the work, using the template, and two men finishing with floats. Parties so made up, with a 12-ft. capacity mixer, will lay from 500 to 800 sq. yds. of 7-in. concrete in a day of 10 hours; 500 sq. yds. can be laid with a crew comparatively untrained or a trained crew should handle 700 or 800 sq. yds. The teams necessary for this part of the work would be only those required to haul the cement and an occasional load of gravel.

There are sections of the country where continued sultry summer weather prevails when it will be necessary to work the shovelers in two gangs, working from 15 to 20 minutes each. Either this must be done or the progress of the whole party reduced to about one-half what it is in cooler weather.

A third party might be organized to trim the shoulders and attend to final finishing of the side-roads and ditches

Relative Progress of Construction

In those sections of the country where the rainfall is plentiful and well distributed throughout the year, it will be found that the actual number of working days in which it is possible to lay bituminous macadam in some seasons will prove few indeed. There will be somewhat longer periods in which waterbound macadam can be placed, and a still longer period, under the same weather conditions, in which concrete construction may be carried on. This is explained by the fact that in concrete construction, after the roadbed is prepared (which will be done for the full length of the road or at least for a considerable distance), the subgrade is immediately covered with the gravel or stone to be used, and even though it may subsequently become wet, it helps rather than hurts the concrete. On the other hand, a wet sub-base in macadam construction, either waterbound or bituminous, will prevent the use of a roller and delay seriously the progress of the work.

For example, in the work under the Illinois Highway Commission in the last few years, the road rollers, out of their total number of working days, will not average much more than 60% working time, the delays being due chiefly to weather conditions. On some work it has run as low as 20% or 25%. On bituminous work the efficiency is less than on waterbound work to a noticeable extent, averaging but 40% to 50%. It is estimated that a concrete outfit under similar conditions would have an efficiency of from 75% to 85%.

Maintenance

Like all other forms of road construction, if the concrete road is to give proper service, it must have proper maintenance. Just what it will be necessary to do to maintain properly a concrete road cannot now be entirely foreseen, owing to the limited experience with this form of construction.

Most uneven places in concrete roads are started by the formation of a crack, the edges of which will become broken down under traffic. The fact that a crack forms shows that there has been movement of the concrete, and doubtless the *cause* of the cracks still exists. If the cracks should become filled with incompressible material, either by pouring in a thin grout or by being gradually filled with dust and grit from the road, there is every likelihood that the crack will extend under subsequent movement of the concrete slab.

It is believed that it is important to leave the concrete surface free to move as it is shown by the appearance of cracks that it is necessary for it to do. Therefore, as soon as cracks are formed, and a sharp lookout should be kept for them, they should be cleaned out as thoroughly as possible and filled immediately with some plastic material, such as an asphalt pitch. This will prevent water seeping through the cracks and also offers considerable protection to the edges, especially if the crevice is flushed with a slight excess of the pitch.

In the maintenance of concrete roads all expansion joints should be kept carefully under observation, and as soon as there is evidence that the plastic material has been worn away, as will happen during hot weather when it is squeezed out, it should be replaced and the cracks not allowed to become filled with hard material. The effect from this was well illustrated on one of the concrete roads out of Detroit. On either side of a certain joint for a number of expansion joints there was every appearance that nearly all of the filler was gone and the joints had become entirely filled with dust and no longer acted as expansion joints, the result being that the joint in question was called upon to take an undue amount of expansion. The asphalt felt with which this joint was filled had been squeezed out, on the day in question, much the same as paste would be squeezed out of a tube, and one section of the concrete surface had been forced an inch above the level of the adjoining block.

The most seasonable time to fill the expansion joints would be late in the fall before bad weather sets in, when the pavement is at a low temperature and the joints extended. They should then be cleaned thoroughly and filled full of the pitch. In the summer, doubtless most of this pitch will be squeezed out and lost, so that the joints should receive yearly attention late in the fall.

The shoulders must be kept flush with the edge of the concrete and, wherever possible, the shoulders had better be of macadam or gravel, at least for a narrow strip against the edge of the concrete. Special care should be taken to see that the drainage of the road is kept in perfect condition at all times.

If a depression is caused by wearing away of the material at some point in the road wherever the cement or mortar was deficient, it will be necessary to replace this portion of the work, which can be done only by cutting away with chisels, usually for the entire thickness of the pavement, and refilling with new concrete. The sides of the holes to be refilled should be as nearly vertical as possible, and carefully cleaned with an acid wash, rinsed, thin neat paste applied and immediately filled with new concrete, mixed of materials as nearly as possible like those in the old concrete. Under no condition should an attempt be made to mend the surface of a concrete road with anything but concrete. After a patch as described has been made, it is possible there will be formed a fine crack around the edge of the patch as the concrete sets. If this is noticed, it should be filled with pitch.

There is every reason to expect with well constructed concrete roads, from the experience already gained with them, that the maintenance, at the most, can be done at small expense, but this little must be done, for there is no such thing as a permanent road.

The reason that window panes are whitened in a building not yet completed is explained by a building contractor as reported in the *New York Times*.

We don't plaster them over with chalk to prevent the public from seeing the unfinished condition of the interior, but to keep the workmen from battering out the glass. Transparent glass looks just about as transparent as air to the man who is moving a wooden or an iron beam in a hurry, and he is likely to ram the end of it through an expensive window, but when the glass is coated with white it becomes visible, and the workmen hand their material in through the door.

Construction of Surfaces With Bituminous Materials *

BY ARTHUR H. BLANCHARD †

Various kinds of bituminous materials have been used in the United States in the construction of roads and pavements for over 50 years. The introduction of the use of bituminous surfaces and bituminous pavements in the construction of highways outside of built up districts of comparatively recent origin in this country, dates practically from 1906. Since that period the growth of the use of asphalts, asphaltic oils and tars has been exceedingly rapid. For example may be cited the increase of the yardage of bituminous surfaces and bituminous pavements constructed with bituminous materials, not including light oils, under the jurisdiction of eight highway departments of the East. In 1908 the total yardage was 416,700, while in 1911, 17,749,000 yards were constructed. The discussion of this subject will be presented in the form of a brief resumé of typical current practice and a review of some of the causes of failure of the different types of bituminous surfaces and bituminous pavements.

In order to avoid misunderstandings, the various methods of using bituminous materials referred to in this paper will be explained by the following definitions:

Bituminous surfaces are those consisting of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character.

Bituminous macadam pavements are those consisting of broken stone and bituminous materials incorporated together by penetration methods.

Bituminous gravel pavements are those consisting of gravel and bituminous materials incorporated together by penetration methods.

Bituminous concrete pavements are those having a wearing surface composed of stone, gravel, sand, etc., or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous surfaces are usually constructed on macadam or gravel roads, or on bituminous pavements or cement concrete pavements. A notable innovation is the use of bituminous surfaces on brick and wood block pavements. In the case of roads, the mode of procedure is to clean the surface thoroughly by sweeping with hand brooms or horse sweepers or a combination of these methods.

The bituminous material, which is generally heated, is applied to the surface with the aid of pouring cans, hose attached to gravity tanks, hand-drawn gravity distributors and pressure distributors. After a varying interval, some kind of mineral coating is generally applied to cover the bituminous material.

The causes of failure of bituminous materials are numerous. They may be considered from the standpoint of the condition and character of the original surface, the material used, and the method of construction or local conditions.

The failure of bituminous surfaces from the standpoint of the character of the original surface is many times due to the failure on the part of those in charge to place the surface in satisfactory condition before the application of the bituminous material. Many cases are noted where bituminous materials are applied over a surface in which are found many pot-holes and ruts, or which is dirty, due either to accumulation of dust and dirt or to the original method of construction. With certain kinds of materials a damp condition of the surface has resulted in failure.

From the standpoint of the physical and chemical properties of the material, many instances may be cited in which failure is due to materials not having the proper characteristics for the conditions under which they are employed. As an example might be cited the case of a thoroughfare in one of our large cities which is subject to motor 'bus traffic and a large amount of motor car and horse drawn vehicle traffic. This road is constructed with gravel upon which has been applied an asphaltic oil and gravel top dressing. The surface at the present time in many sections is full of ruts, caused by the traffic pushing the material from side to side. Again the large percentage of volatile constituents contained in certain asphaltic oils has rendered surfaces constructed with them unsatisfactory because of the long period required for these surfaces to "set up" so that the bituminous material will not track or the carpet thus formed will not creep and form waves and humps. In certain cases the use of light oils on tar or asphalt surfaces has softened the original bituminous surface to such an extent as to render the road or pavement unsatisfactory for use.

From the standpoint of construction, we find failures due both to the use of too small an amount of the bituminous material, and an excess of material. Improper application, resulting in uneven distribution, is accountable for many failures of bituminous surfaces, while in other cases a lack of sufficient covering of stone chips or material of a similar character has rendered the surfaces sticky or mushy, sometimes in the first season, but sometimes not until the second season.

There are numerous instances where bituminous surfaces have been adopted under conditions which call for the construction of bituminous concrete pavements or even some type of block pavements. A mat type of construction, which has been employed to a considerable extent, has proven inefficacious in cases where horse-drawn vehicle traffic has been more than a certain amount in combination with a motor car traffic which in amount was not sufficient to iron out satisfactorily the calk holes caused by the horse-drawn vehicle traffic. There are cases where esthetics should govern the selection of the type of surface, and generally in such cases the black or brown surface resulting from the use of bituminous material does not harmonize well with the environments.

Types of Bituminous Pavements

Bituminous macadam and bituminous gravel pavements are of many types, one of the primary differences in construction being the use of one or two applications of the bituminous material. The efficacy of many of the types depends upon the combination of sizes of broken stone or gravel and the combinations of bituminous materials used when two applications are employed. Variations in types also exist dependent upon the manner in which the different courses may be filled and the treatment of the filled course prior to the application of the bituminous material. The one-application method is very similar in its simplest form to the construction of a bituminous surface except that the bituminous material is applied on a much more open surface. In the case of the two-application method in certain instances an attempt is made to build up a two-course pavement, while in others the second application is in reality used as a seal coat.

Unfortunately there are many instances in which many improper bituminous materials have been employed. In some cases the materials were satisfactory in themselves but were used improperly. Many engineers having charge of bituminous work do not appreciate the cold fact that different types of bituminous materials have entirely different physical properties and require entirely different treatment in use, although they may have been purchased under one and the same specification covering chemical and physical properties. In some cases entirely unjustifiable combinations are employed. For instance, one case is in my mind where an asphalt of excellent characteristics was used for the first application, while for the second application an asphaltic oil having decidedly solvent and fluxing properties was employed. Overheating of the material has likewise proved the cause of many failures as thus the properties of the materials are sometimes changed and in many cases the materials are ruined.

Under the heading, "Construction," we find failures due to uneven distribution, resulting especially from the improper use of hand-pouring pots and hand-drawn distributors, and also in many cases when horse-drawn or power-driven distributors are employed. Many unsatisfactory bituminous macadam pavements result from the use of

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†M. Am. Soc. C. E., Professor of Highway Engineering, Columbia University, New York.

the wrong sizes of broken stone. One instance will be cited where a hard broken stone ranging from 2″ to 3½″ was used for the wearing surface. After rolling, 1½ gals. of bituminous material was applied and the road finished with a layer of chips. The rapid formation of fine cracks, due to the rocking movement of the individual stones under traffic finally resulting in raveling and disintegration, is of common occurrence. Segregation of sizes of stone preventing uniform penetration results in weak spots in some cases and "fat" spots in others. In certain cases after a rain the construction has been carried on before the broken stone immediately below the surface has dried out. Many of the causes attributed to the failures of bituminous surfaces may likewise apply to bituminous macadam and bituminous pavements.

Bituminous concrete pavements other than sheet asphalt and pavements laid by companies as proprietary articles have received more attention during the past season than at any time since the days of Abbot, Leverich, Scrimshaw, and Van Camp. Less fear of litigation proceedings and the introduction of economical mixing machines equipped with heating attachments have exerted a marked influence. But, furthermore, the rapidly growing recognition of the inherent advantages of bituminous pavements constructed by the mixing method has been largely instrumental in its adoption for traffic conditions for which it is believed to be economical and suitable.

Methods of Construction

This type of bituminous pavement is constructed usually by one of three methods. These methods, although overlapping to a certain extent, may be described as follows when broken stone is used as an integral part of the mineral aggregate:

Type A consists of so-called one-size run broken stone, mixed with bituminous material. It should not be considered that the designation, "one size crusher run stone," means an aggregate composed of broken stone of uniform size. This term as used here refers to the product obtained at a crushing plant which passes over one size of screen holes and through the next larger or passes through a screen of one size of holes and is retained upon a screen having smaller holes. It is evident to those familiar with the operation of crushers that the product thus obtained does not usually consist of stone of uniform size. For example, broken stone commercially designated as "¾″", used in the vicinity of New York City, is obtained in some cases by passing over ½ in. and through 1¼ in. openings. The size of the stone varies from 1″ to ⅛″. It is self-evident that this variation in size produces a more stable pavement than if the aggregate consisted of broken stone of uniform size. Type A has been constructed both by mixing and by using both unheated and heated stone. Many kinds of bituminous materials have been used, while in some cases one kind of bituminous material has been used in the mix and another kind for the seal coat, one of the most common combinations being the use of tar in the mix and asphalt for the seal coat.

Type B consists of one-size crusher-run broken stone and sand or other fine material matter, mixed together with bituminous material. The wearing surface of this mix is sometimes finished by rolling in fine stone chips, but generally a seal coat is used, together with fine mineral matter for top dressing. When constructed on a commercial scale, the mineral aggregate is always heated and mixed in a specially constructed machine. Usually the same grade and type of bituminous material is used for the mix and the seal coat.

Type C consists of a wearing course composed of a graded aggregate of broken stone and sand with or without other mineral matter, which aggregate is mixed after being heated with a bituminous cement in a specially designed machine. As with Type B this pavement is finished with and without seal coats of bituminous material. The Topeka and the Bitulithic pavements may be cited as examples of Type C.

Having reviewed the fundamentals of the various types, consideration will now be given to causes of failure of some bituminous concrete pavements. It should be noted that the percentage of failures of bituminous concrete pavements is much smaller than in the case of bituminous macadam and bituminous gravel pavements.

Poor and unsuitable materials have been accountable for certain failures. Attachment for a material of a certain type has led to a blind adoption of any material belonging to a given class. For instance, in one case coming under the writer's observation, crude coal-tar from one gas works had given good results on the average. Based on this fact, any crude tar was finally used, although those in authority had had an object lesson in a failure due to the haphazard purchase of crude coal-tar. Experiments in Rhode Island and in the Borough of Queens seem to have demonstrated that high-carbon tar of a certain consistency is not so satisfactory or advisable for a seal coat as some types of asphalt, when the percentage and volume of horse-drawn vehicle traffic is large. In some cases an apparent cause of failure has been an excess of flux or of the volatile constituents of asphalt cements. Pavements constructed with such materials are often wavy, due to the movement of the surface under heavy traffic. Many cases are reported where materials have been overheated at the construction site due to the belief that all may be and even should be heated to the same temperature before using, and that it is impossible to injure bituminous materials by heating to high temperatures.

Causes of Failure

In the course of construction these are various details which demand careful supervision. Either too large broken stone or stone of too uniform size may cause a failure. Especially is this the case with very hard and tough broken stone. The rocking of the stone causes the formation of fine cracks which eventually lead to disintegration. Naturally the amount and character of the traffic is intimately connected with the condition of the pavement, but cases have occurred in which failure, even under very light traffic, was due to using large uniform size broken stone for the mineral aggregate of the mix. Poor combinations of sizes of broken stone and sand have resulted in segregation in mixing, transportation or spreading, resulting in a pavement of varying density and stability. Overheating of the mineral aggregate has caused burning of the bituminous material in some instances or the formation of a thin film of bituminous material over the broken stone which is not of sufficient amount to bind the adjacent stones together. The use of a wet aggregate will usually result in a poor mix with consequent unsatisfactory results. In many instances the seal coat has not been applied uniformly. The result is either uneconomical, due to the necessity of a second application before 75% of the surface requires treatment, or the disintegration of the pavement wherever bare spots occur in the pavements where coarse aggregate was used, and where there is considerable horse-drawn vehicle traffic. Although of minor import to-day, some failures have been caused by using with unheated stone bituminous cements which will not adhere satisfactorily or which mix only with great difficulty under such conditions.

Many failures are due, both in the cases of bituminous macadam and bituminous concrete pavements, to poor foundations. Sufficient attention has not been paid to this important part of the pavement.

Many of the above causes of failure would be eliminated if engineers would devote more time to a consideration of the physical and chemical properties of the materials which they employ. Records should be at hand covering these data and details of the success or failure of every road noted. If a bituminous material laboratory is not connected with the department, it should not be either expensive or difficult to secure certified analyses made by reputable chemical engineers.

The writer wishes to emphasize the fact that a careful consideration of the causes of failure of bituminous surfaces and bituminous pavements constructed during the past five years will result in material benefit, inasmuch as a comprehensive knowledge of the various causes of failure is one of the most valuable assets of engineers having in charge the construction and maintenance of bituminous surfaces and bituminous pavements.

The Road Legislation and Syndic Associations in France*

BY M. DE PULLIGNY.†

France possesses a network of public highways as remarkable by reason of its vast extent as by the good condition of the roads as a whole. These highways are divided into seven classes, viz:

1—National roads;
2—Departmental roads;
3—Main traffic roads;
4—Roads of common interest;
5—Ordinary local roads;
6—Country roads, recognized and not recognized; and
7—Streets.

The first two classes constitute the main roads (grande voirie), and the five others, the lesser roads (petite voirie).

The national roads are the property of the State; they are controlled by the Minister of Public Works and work on them is performed by the engineers of bridges and highways. In January, 1911, the extent of the national roads was 23,760 miles (38,230 kilometers) which were, in that year, being maintained at the expenditure of $6,501,205 (33,685,000 francs).

Between the years 1868 and 1911, the total development of classified roads increased 53,805 miles ($86,573,587 kilometers), while the length of roads constructed and opened up for traffic is greater now by 136,136 miles (219,043 kilometers). Moreover in the same period of time 21,131 miles (34,000 kilometers) were removed from the classification of departmental roads. In the year 1910 the maintenance charges for all classes of local roads amounted to $37,537,018 (194,544,135 francs).

The fundamental law which governs the network of local roads was passed May 21, 1836. By its provisions the Municipal Councils are authorized to require for the maintenance of local roads, in case the ordinary funds of the commune are insufficient, 3 days of taxes in kind or not more than 5 per cent in addition to the principal of the four general taxes, or both.

System of Taxation.

Every inhabitant on the direct tax list is required to pay taxes as follows: 1st, for himself and for each man between the ages of 18 and 60 years, who is a member of his family or a servant and who resides in the commune; 2d, for each cart or carriage, and for each beast of burden, and draft and saddle animal in the service of the family. The tax may be paid in money according to rates fixed by the General Council or paid in labor according to rates fixed by the Municipal Council. The General Councils may divide the taxes, both cash and labor, between the main traffic roads and the roads of common interest. This is being done more and more frequently because of the increase in the mileage of these roads, and the consequence is that the greater part, sometimes the whole of the resources created by the law of 1836 are absorbed by the departments and nothing or not enough is left to the communes for the maintenance and improvement of the ordinary local roads. Nevertheless, while new legislation is needed on this point, excellent results have been produced for a long time in the development of the secondary road system of the country.

The provisions of the law of May 21, 1836, concerning the use of local roads by heavy enterprises, such as mines, forests, quarries, etc., and the subsequent payment of extra taxes in labor or money for damages caused by such heavy works have also been of great assistance in keeping the condition of the roads at a high standard.

But it must not be forgotten that the roads may be used normally and that, besides the extraordinary wear and tear produced by special enterprises, there is the ordinary wear caused by general traffic. The difference is to be noted only at the moment that the traffic is taking place. The simplest means of settling the difficulty is always to make a reduced advance payment whenever agreement can be reached between the government and the individual engaged in the business. In general a price is fixed per kilometer ton, but in the departments near Paris, these tolls vary from 4/5 to 6/5 of a cent per kilometer ton according to the nature of the commodities transported. Formerly the valuation was obligatory, but since the law of July 22, 1889, it is no longer required and must be demanded by one of the parties.

Until this year the fact that the State could assist the departments and communes on their local roads only, offered serious inconvenience owing to the development of the tourist traffic, especially automobiles, in the last few years. Roads which formerly were but rarely used in the transportation of agricultural produce, especially mountain roads, are now used in the touring season by great numbers of automobiles. These roads have thus acquired a general interest and consequently Parliament has passed an act by which assistance for maintaining tourist roads may be given from the federal treasury.

With this purpose in mind the National Bureau of Tourist Traffic has this year undertaken a census of all classes of vehicles on certain roads in order to establish the respective amounts of local and tourist traffic.

One other feature of French legislation is to be found in the Syndic Associations which are authorized by various laws, for the purpose, among other things, of maintaining, establishing and widening roads. It does not appear, however, that many of these organizations have turned their attention to roads. According to the statistics of 1901, the latest available, less than 300 out of 7,000 have taken up highway work. The organization is very similar to the drainage associations existing in the central and western states of the United States, except that these latter are confined to the one purpose. In France there are two kinds of organizations the free organizations which are formed only by the unanimous consent of the persons interested, and the authorized organizations formed by a decree of the prefect, either by change from free organizations or directly.

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†Engineer-in-Chief of Bridges and Highways of France.

Concrete Pavement in Davenport and Vicinity

BY A. M. COMPTON*

The first street paved with Portland cement concrete for the city of Davenport was completed in the fall of 1909 and comprised about 3,000 sq. yds. In 1910, about 16,000 sq. yds. were laid. This was widely distributed, consisting of small jobs, and was still considered a more or less dubious experiment. By the spring of 1911, the earliest paving had withstood two winters and two seasons of traffic, and its condition seemed to warrant the continued use of concrete. During the season of 1911, over 18,000 sq. yds. of concrete paving were laid in the city of Davenport, and the adjoining town of Bettendorf with a population of about 900, laid in the summer of 1911 a little over a mile of concrete paving in its main street, including nearly 29,000 sq. yds. The city of Davenport has either contracted or advertised for bids for nearly 40,000 sq. yds. of concrete street pavement to be constructed in the season of 1912.

With one exception all the concrete paving laid in the city has been on residence streets where there is no continuous heavy traffic, and has stood up under both weather and traffic conditions in a satisfactory manner. The city, a number of years ago, paved several rather steep hills with beveled vitrified brick with a Telford macadam strip 10′ wide in the center. These macadam strips washed badly and were in an impassable condition within a few years. We have recently replaced these center strips with a one-course concrete pavement from 4 to 6 inches thick and corrugated with a "hit or miss" tamper The grade of these hills varies from 9½% to 12%, and in one instance the

*City Engineer, Davenport, Ia.

paving receives very heavy traffic. *It has been noticed that teamsters generally prefer to drive on the concrete center strip rather than on the brick sides.*†

The only signs of failure so far have developed at the tranverse expansion joints which were left unprotected save for a sand filler. In fact none of our concrete pavements so far has shown any failure under traffic save at the expansion joints.

In 1909-10, the concrete pavement was laid under specifications briefly as follows: A 5-in. base of 1:3:5 concrete with a wearing surface of 1:1 sand mortar, corrugated transversely with tooled grooves about 8" apart. The mineral aggregate was river sand and 1½-in. crushed limestone. A transverse expansion joint filled with pitch was required every 50'. In 1909, the price on the only piece laid was $1.25 per sq. yd.; in 1910, the price varied from $1.27 to $1.37 per sq. yd. The same year a number of residence alleys were paved with one course 1:3:5 concrete 6" thick and rough finished, at an average price of $1.11 per sq. yd. During the fall and winter of 1910-11 the writer noticed that almost without exception these blocks of paving 50' long and 30' wide had developed irregular contraction cracks. While these cracks were negligible as to size they were without question a failure and detrimental to the life of the pavement.

With the idea of bettering the work without materially increasing the cost, our specifications were changed before the season of 1911 to read substantially as follows: A 5-in. base of 1:3:5 concrete, with a 2" wearing surface of one part cement to 2 parts sand, and with a 1-in. transverse expansion joint every 25', a 1-in. longitudinal expansion joint along either curb, and a ⅛-in. contraction joint midway between the transverse expansion joints, all joints to have tool rounded edges and to be filled flush with asphalt. This divided the work into blocks 12' 6" x 30' and so far has practically eliminated all contraction cracks. The concrete pavement under this specification was laid in 1911 for prices ranging from $1.25 to $1.30 per sq. yd.

During 1911 the city also laid several thousand yards of concrete pavement consisting of a single course 6" thick of 1:2½:4 concrete with the mortar flushed to the surface, floated and either broom finished or corrugated as the grade of the street required. This was laid at a contract cost of $.93 to $1.00 per sq. yd. During the same season it was required of our department to pave a street, the sub-soil of which was decidedly treacherous, consisting largely of saw mill refuse such as sawdust, chips, bark, etc., filled above the natural surface of the ground to a depth of from 6' to 12' and saturated with river water. Both railroad and street railway tracks which parallel and adjoin this street settle from 18" to 24" annually where they cross this fill. As this street is subject to heavy and high speed traffic, in the writer's opinion, a flexible type of pavement such as the previous forms of macadam would neither withstand the traffic without constant repair nor would it tend to be in the least self-supporting over what seemed almost certain excessive and unequal settlement.

†The italics are ours.—EDITORS.

A good brick or asphalt pavement with concrete base was discussed, but owing to the writer's experience with concrete base failures due to trench settlement, and the cost, these types were abandoned, and it was finally decided to use reinforced concrete pavement to consist of 7" of 1:3:5 concrete with one-half of one per cent steel mesh reinforcement placed near the lower surface of the concrete. It was thought that this type would withstand the settlement and still come within the requirements of a moderate first cost. Either a brick or an asphalt wearing surface can be placed upon it if, in the future, the surface should disintegrate or ravel badly under traffic. The contractor laid this pavement in the summer of 1911, using a sufficient amount of American Steel & Wire Co.'s wire fencing as reinforcement, for the price of $.93 per sq. yd. During and immediately after its construction several weeks of excessive and continued rainfall left the sub-grade in a jelly-like condition. The curbing settled badly but no signs of failure in the pavement have yet developed, not even contraction cracks, though it has already experienced a range of temperature of 113 degrees. As to the surface wearing qualities of 1:3:5 concrete, another year of the heavy traffic that this street receives should tell the tale.

Owing to the very general demand of property owners this season by petition, and otherwise, for concrete paving, the writer has again changed his specifications in the effeort to obtain the best and most substantial concrete pavement compatible with a moderate first cost. The present specifications are briefly as follows: A 5-in. base of 1:3:5 concrete upon which is laid a wearing surface not less than 1½" in thickness at any point and consisting of 1 part cement, 1 part of sand and 1 part ¼-in. to ½-in. granite chips; transverse expansion joints, consisting of creosoted long leaf yellow pine blocks 1" in thickness to be placed with the grain vertical, 20' apart and the same longitudinal joints along the curbs as before specified. The prices so far this season upon the pavement to be built under this specification have varied from $1.00 to $1.17 per sq. yd.

In Davenport we have approximately one and a half million sq. yds. of pavement, of which only 38,000 sq. yds. is concrete, so that it will be seen that this type of paving is in its infancy. It has demonstrated its advantages particularly in certain localities desiring or requiring street improvements in order to develop, and where abutting property is of such type and character that to lay either brick or asphalt would be a hardship to the property owners and a burden to the city.

The first cost of our concrete paving is only about 65% of the cost of brick paving and about 59% of the cost of asphalt. It is the writer's opinion, that this type of paving will give satisfactory service in such localities for at least ten years and at the end of that time be in such shape that either an asphalt or brick wearing surface may be laid directly upon the concrete paving as a base. We are designing our curb height and crown of street so as to permit of so doing in the future. In ten years the difference in first cost plus accrued interest will much more than pay for a first class asphalt wearing surface.

One objection to this type of pavement has been that it is slow in construction, but the Bettendorf work demonstrated that concrete paving consisting of a single course of 1:2½:4 concrete 6" thick, could be satisfactorily laid at the rate of 1,200 to 1,800 sq. yds. per day. This work in Bettendorf furnishes one of the best examples of the availability of concrete pavement where no other permanent type is possible. The city council required a paved street not less than 40' between curbs, while nearly all the adjoining property would show a valuation of not over $12.00 per front foot. Under the Iowa law this valuation would limit any assessment to a little under $3.00 per foot, which rendered absolutely impossible the use of either brick or asphalt. The plans and specifications called for 29,000 sq. yds. of concrete paving to be mixed 1:2½:4 with mortar flushed to the surface with a bar tamper, floated, and broomed; expansion and contraction joints to be placed dividing the work into blocks 12' 6" by 20', and all to be filled with an asphalt filler. There were also 18,000 cu. yds. of excavating, 11,000 lin. ft. of 18-in. concrete curb, and 12,000 lin. ft. of 12-in. concrete curb. The latter was placed around a 10-ft. center boulevard strip left for the use of a street railway. The successful bidder took the contract at the price of 85 cents per sq. yd., 30 cents per cu. yd. for excavating, 18 cents and 28 cents per ft. respectively for the curbing. The ground for this work was first broken in the middle of September and the pavement was completed and open for traffic in the middle of December.

During the past season, several thousand sq. yds. of concrete roadways and drives in private grounds have been constructed under the supervision of local engineers. Both the single course type and two-course type have been used with equally satisfactory results. One feature of this work has been the coloring of the concrete to prevent the objectionable sun glare from the dead white surface; this feature, I think, is particularly noticeable when the roadway is directly edged with grass and trees. From one-half to one pound of lamp black per barrel of cement was used, and the resulting slate color or light gray effect is most pleasing to the eye.

One of the objectionable features in the use of concrete street paving is the time that must elapse after completion before traffic may be permited. We never open a new concrete street until at least 10 days have passed after the time of placing the last concrete, while in some instances of unfavorable weather conditions, we have required 30 days.

It is not the writer's intention to present arguments for or against this type of pavement, as compared with the older standard types of pavement, but rather to demonstrate that under certain conditions, if properly handled, it is a very usable, economical type of pavement, and fully able to fulfill the demands which may be made upon it. The expansion joint is the weak point of this type; as soon as actual test has proven some scheme for protecting expansion joints successfully, then is concrete a paving success.

Particularly I desire to emphasize the fact that proper and experienced inspection is essential and that all cement used in construction of concrete paving should be properly tested by the city before its use in the street. I think we all appreciate what would be the result of the use of only one carload of defective cement in concrete paving, and hence it is the duty of all engineers in charge of such work to obtain adequate tests wherever possible.

Freezing Leaves Concrete Drain Tile Uninjured

In all discussion concerning the respective merits or defects of concrete and clay drain tile, there is one phase of the subject seldom mentioned, namely the advantages of concrete when it comes to the question of freezing and thawing. The tile illustrated is about 18 in. in diameter and was manufactured at Farmers City,

Concrete Tile Left Out in the Weather

Ill. It was photographed after long exposure to the weather, having passed through three winters without showing the least sign of disintegration. We doubt whether any manufacturer of clay tile would be willing to subject his product to this test.

There have been occasions where clay tile laid in a shallow trench has totally disintegrated under the influence of alternate freezing and thawing. As stated, the Farmers City tile has not been affected by exposure. This virtue of concrete is a decided advantage to the manufacturer of concrete tile. He need not worry about their destruction from influences that damage clay tile.

Concrete Slabs in Levee Construction

BY E. B. MURRAY*

In the present age of reclamation and conservation, it may be of interest to know how concrete can be adapted as revetment on levee construction. The particular district under discussion is in the Kaw Valley Drainage District, situated in Wyandotte County, Kansas City, Kans., and embraces approximately 7,500 acres. The size of the district is not so indicative of its importance as is the valuation of the protected lands, which contain all the business center of Armourdale, all the packing houses, Swift & Co., Armour, Cudahy, Fowler, Schwartzschild & Sulzberger, and innumerable other smaller ones. The "business bottoms" of Kansas City, Mo., are situated there, as are also the Stock Yards and the yards of the different railroads having terminals in Kansas City, such as Santa Fe, Kansas City Terminal, Missouri Pacific, Union Pacific, etc. A recent assessment of the enclosed lands of the district showed a valuation of $50,000,000. This has been under water several times, the worst of which was in the floods of 1903, when the water stood over 9 ft. deep in the business section of Armourdale, and was much deeper in other locations. The present levees were constructed to a grade 1′ higher than the highest point of water at that time which with the 10% for shrinkage, offers a complete protection for even an abnormal rise, as that one was.

Upon the recommendation of the engineers, a bid was asked, for concrete revetment as well as for rip-rap, and it was decided by the Board to use the concrete wherever it was practicable. The specifications called for a slab 4-in. thick, approximately 8′ 0″ wide, at whatever slope from the crown of the levee or harbor line was established by the Government. Some places it was found necessary to carry it down farther, and at all times provisions were made to allow for an extension in case it ever became necessary to extend it out to prevent scouring.

Construction—The revetment was put down as follows: a 2-in. layer of concrete was first laid, then a 2-in. by 4-in. triangle mesh, No. 9 wire, was laid on top, and a 2-in. layer of concrete placed on that. Every alternate slab was poured, and allowed to set before the forms were removed. The work had to be done as rapidly as possible behind the machine (the embankment was practically all done with drag line machines), for the contractor was held responsible for the embankment until it was completed, and the Board agreed to accept it in 500-ft. lengths. A fair day's run is about 100′.

The mix was a 1:2:4, and, as it was a small slab with the wire reinforcement running through the middle, the contractor was allowed to use Joplin chats, instead of crushed stone of a ¾″ size, which was called for in the specifications. The sand was obtained from the numerous sand plants situated on the Kaw river, and was of a rather fine grade, more suited for mortar than for concrete. The best grade of sand, in the writer's opinion, was some bank run which was obtained at the extreme southwest end of the district. This was very coarse and sharp, and when care was used in taking it from the bank, it was very clean.

This concrete protection has given excellent satisfaction, resisting the wash of the current and making a much better looking piece of work than the rip-rap. It is interesting here to note that the specifications for rip-rap call for "good hard lime, or sand stone, to be not less than 25 lbs. in weight, nor more than 200 lbs., and to be laid to a depth of 12″, slantingly, up the slope, the top to be covered with 2″ of spalls."

Vegetation on Concrete Revetment.—One curious thing about the concrete is that during the summer time weeds will grow on it, although it is practically impossible to see where they get a root hold. They do not detract from the

*Ch. Eng. Kaw Valley Drainage District, Wyandotte Co., Kans.

Fig. 1. Running a Revetment in Alternate 8-ft. Sections.
This shows the method of using the chute. A car going back for work material is shown at the right

Fig. 2. Mixing Plant and Industrial Railway for Handling Concrete
The main line of the K. C. S. Ry. is shown at the left

strength of the slab, by causing it to heave, or split, nor does the water which seeps in through the slab and freezes seem to have any tendency to harm the concrete.

Bottom Extensions.—At the bottom of the slabs there is a ⅜-in. galvanized cable loop, placed every 16" which serves as an anchor for an extension of the revetment in case of the river scouring under the protection. This extension is either a willow mattress or a flexible concrete mattress. This latter is composed of concrete blocks, 2' x 2' x 4" and are reinforced with cable. The cable also forms a loop on either side of the block. By the use of these loops and a long piece of cable, these blocks can be threaded, and laid at the foot of the slope, and at the end of the slab. The loop used in the extension block is simply a ⅜-in. galvanized wire cable, run through the block and twisted so as to form a loop at end. The cables running through the slabs, as well as the loops, are placed at the bottom, and the extension blocks are threaded on to these loops at the foot of the slabs, by a piece of ⅜-in. cable. The ends are then turned over and fastened by "U" clips. It is rather hard to thread more than 6 or 7 blocks at once, which makes the work very slow. This mattress fits the surface of the ground and adapts itself to it in case there is any scouring going on, and the ground is being undercut by the current. To date there have been laid 17,500 sq. yds. of this type of revetment and about 9,000 sq. yds. more are to be laid.

The important thing in laying these blocks is to see that they are extended far enough out from the slope, to afford protection to the bank in the event of the current starting to cut under. If they are not extended for a sufficient distance out, in the first instance, they will, after the current has cut from under them, hang vertically downward, thus throwing an extra strain on the slab and offering little or no protection to the bank. As the cutting continues, the lower portion of the slab is converted into a cantilever beam, with this load concentrated at the end; there can be but one result, that of the slab breaking off.

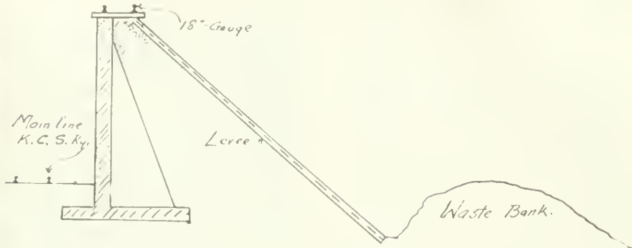


Fig. 3. Sectional Sketch Showing Arrangement of Tracks, Retaining Wall and Levee

Difficult Service Construction: As before mentioned, the work on both sides of the river was divided off into different length sections, ranging in size from a few hundred feet to over a mile. On this particular section the Kansas City Southern Ry. Co. built a heavy, high retaining wall of reinforced concrete. On the west side of this wall was their subway, while on the east side our levee came up against it to within 6" of the top. This wall extended from Central Avenue to Kansas Avenue, a distance of about a mile. Our harbor line ran within from 6" to 18' of this wall, and this made the revetment work for this section a very difficult job. Where the wall was low and the space between the revetment and the face of it was only 6", a derrick was rigged on a flat car, which also had the mixer and the engine mounted on it, and the slabs were poured from that.

The material was brought to the mixer by wheelbarrows, loaded out of adjoining cars, and the mixer emptied into a trip-bucket, which was raised when full by the boom of the derrick and swung around so as to empty into the chutes. One of the greatest difficulties of this outfit was the time lost in switching, for this was on the main line of the K. C. S.

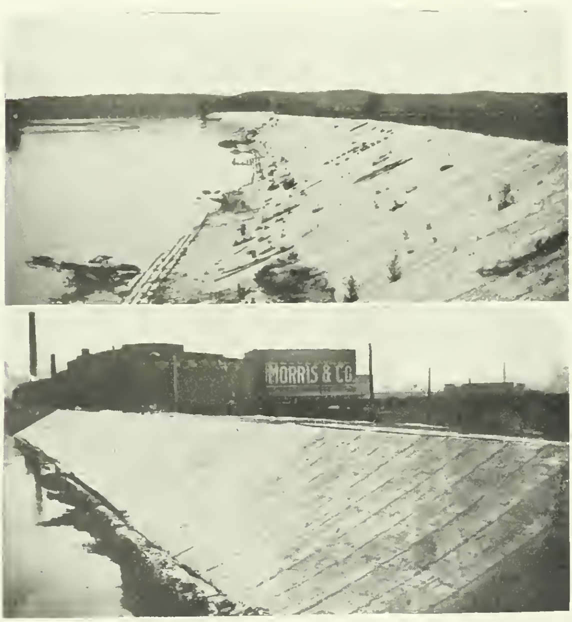


Fig. 4. Two Views of the Finished Levee
Note the growth of vegetation

Ry. track, and the entire outfit had to be moved every time a train passed. This meant considerable delay, with the entire gang and plant shut down, which ran the cost up rather high.

When the harbor line left the wall for such a distance as would allow room for the mixer, the plant was placed in the widest part and a narrow-gauge track laid both ways as far as possible. The mixer then emptied into side-dump cars and was hauled by a mule or pushed by two men to where the slab was to be poured.

On the lower end the wall and the harbor line ran parallel for a distance of about 2,000 ft., and the available room on top was only 2′. The contractor laid an 18-in. gauge track on this top and got some end-dump cars. He then built a platform for his mixer and plant at that point where the harbor line leaves the wall and where he could unload his material from cars, shoveling it over the wall. Two men pushed the cars from the mixer to where the slab was to be poured, and 3 cars were used. This made it possible for one to be at the mixer, one at the middle switch, and one at the slab.

Under ordinary conditions, where the contractor had the full width of the levee to work from (30′), the average run was about 750 sq. yds. or 135 lin. ft. per day; but under the conditions mentioned above the run was only about 465 sq. yds. or 84 lin. ft. per day. These figures are based on a length of slab of 50′. The Municipal Contracting Co. had all of the revetment work over the entire district, sub-letting it from Callahan Bros., who were the principal contractors.

A Home-Made Chicken House Readily Made of Concrete

One of the most satisfactory things about concrete is that it may be used for almost countless purposes about the home and on the farm. The poultry house shown herewith is an example. It is literally home-made and answers its purpose, as well as though planned and built at great expense. The very rough wall is not in the least a disadvantage. A far more pretentious structure might have the same crude surface and look well. It would be an easy matter to have vines and flowers growing along such a wall. This poultry house represents the advantages of concrete for buildings of this kind. It is verminproof and fireproof. It will never deteriorate or require any repairs. It is a perfectly practical, sanitary and economical building, representing a saving over other materials, both as to the first cost and as to maintenance. It was constructed without skilled labor and may be duplicated by any intelligent farmer or poultry breeder informed as to the most elementary principles of concrete construction. The house is now in use and is entirely satisfactory.

Two Methods of Treating Concrete and Reinforced Concrete

An article in a recent issue of "Le Ciment," the leading French paper devoted to Portland cement, is of interest in showing the cleverness with which French writers draw interesting comparisons from general topics. The article follows:

We have noted in our foreign exchanges two types of construction well calculated to show two opposite methods of treating the architectural side of construction in concrete and in reinforced concrete.

One is graceful from the point of view of the architect and the other is simple, but at the same time imposing, from the point of view of the engineer.

The first construction is an observation tower erected on the road from Dresden to a neighboring watering place, known as Weisser Hirsch, in order to give a view of a park belonging to the first named city. It replaced a wooden tower whose height of 6 m. became too low as a result of the growth of trees in the neighborhood. An engineer in the City of Dresden, Professor Erlwein, who had the matter in charge, designed the construction in reinforced concrete, to which he was able to give an artistic appearance of the highest order. The base is 8-sided, the shaft cylindrical and the capital had 12 sides, surmounted by a cupola. Two platforms are provided; the first at 4.50 m. from the ground, the second 16.30 m. The total height to the point of the lightning rod is 25 m. Concrete foundations rest upon rock which is found at a distance of more than a metre below ground. This concrete is composed of 1 part of cement to 6 of sand and 8 of broken stone, or only 5 of sand and 7 of broken stone.

The cylindrical portion, with its 14 half-circular columns of reinforced concrete set 1.50 m. center to center, narrowing at the top and crowned by circular arches, is the portion that presented the greatest difficulty in construction, since it was not possible to make use of wooden centering without using mixer on the platform or hoists for the mixer.

The second work, of which only a brief description is given, is a grain elevator at Montreal whose practical use does not demand architectural treatment. Although the engineer who designed the building did not have the architectural appearance of the building in mind, it is well known that reinforced concrete of itself produces a somewhat aesthetic effect, if only by the simplicity and dignity of its lines. With its towers rising from the 4-sided figure of the whole, the construction recalls that of the mansions with superimposed terraces which are observed in certain Italian cities.

This elevator was constructed entirely in reinforced concrete by the John S. Metcalf Co., Montreal. Several elevators of the same kind are in construction and will be completed in three years.

Changes Are Made in Mid-West Show Dates

Plats for the Mid-West Cement Show of the Nebraska Cement Users' Association, at Omaha, may be obtained by addressing the secretary, Frank Whipperman, Omaha, Neb. Dates for the show are: Feb. 4 to 8, inclusive, 1913, with Feb. 3 to install, and Feb. 10 to go out. This is a slight change from the dates first announced. The show will open on Tuesday instead of on Friday, and will close Saturday night instead of Tuesday. This change was made in order to accommodate the Hardware Dealers, whose show immediately follows the Cement Show. Prospects for a more successful show have never been brighter. The secretary has filed a large number of applications for space. He is also receiving quite a number of inquiries regarding the show, from men interested in concrete products, and from prospective home builders.

Roughly Built but Serviceable Chicken House

Fig. 1—View of Some Concrete Guard Rails Set up and Some Unused Sections Beside the Road

Guard Rail—A New Concrete Product

A reinforced concrete guard rail, devised by J. Y. McClintock, County Engineer of Monroe county, Rochester, N. Y., has been adopted as standard by the New York Commission of Highways, and is now used in preference to the old, continually rotting and breaking wooden rail. The rail is manufactured at a plant near Rochester, by the Concrete Guard-Rail Co. Detailed drawings of this work are shown in the accompanying sketches, Figs. 2 and 3.

This guard rail consists of posts which are usually 5" x 7" x 6' 6". These are set in the ground, usually to a depth of 3' 6", and are anchored into the embankment by anchor blocks 2' long and 7" x 4" in section. These blocks are held to the posts by means of ¾-in. galvanized steel rods 3' long. A rod passes through a hole in the anchor block and through another hole in the post just below grade and is held by nuts. The top of the post is rounded to a 5-in. radius so that when the rails are set in position slight variations in grade will not interfere with the setting of the work. The top rails are 9" wide, 7" thick, and middle sections are made 8' long and end sections are 8' 6" long, so that one end of the rail projects over the last post in the line, to give it a finished appearance and to insure solidity of its position. The under side of the rail is cored so that the walls on sides and top are 2" thick, and to give additional strength, there are three webs 2" in thickness. It is planned to set up the pieces so that the top of the rail is 3' 2" above grade. The only variation, to suit requirements of grade and alignment, are in the top rails which are made with many different mitered ends to get any curve desired.

Top rails weigh about 325 lbs. each, posts about 225 lbs. and the anchor blocks about 53 lbs. Taken together, the units weigh about one ton to every 26' of rail as set up. For this reason, it is manifest that the plant near Rochester cannot ship over a very large territory and the guard-rail company is now figuring on a plan to sell the patented molds to products manufacturers in other sections of the country, rather than try to push the sale of the manufactured rail themselves over a territory larger than freights will permit to be covered effectually.

The plant near Rochester is an outdoor establishment so far, having been in operation since early last summer. The demand is so great for the rail that plans are under way to enclose a large factory space so that the manufacture can continue throughout the winter. The plant at present consists merely of sheds for the storage of reinforcing steel, molds, and so on, and a large concrete paved area which is the casting floor.

In laying out the work, one man works ahead of the concrete gang, placing the galvanized iron trough-like forms (16-gauge galvanized iron), which weigh about 25 lbs. each, and this man also puts in the heads to form the ends of the top rail. Two men wheel concrete. As will be noticed in Fig. 5, molds are placed so that there are wide aisles at the ends. One concrete wheeler works in each aisle. Three men put in the concrete, which is a good gravel mixture made quaky, and varying somewhat in proportion with the nature of the gravel coming from the bank. These three men shovel in about 1" of the material and then place the reinforcing, which is the American Steel & Wire Co.'s triangular mesh No. 38, weighing 1.51 lbs. to the sq. ft. More concrete is put in to bring the bottom layer to 2" deep, then the pieces to form the cores are inserted and clamped in place. Cross-braces, which fit over the flanges of the molds are provided with clips, which hold the reinforcing mesh (which has been previously bent on a special machine) in its proper position, while the remainder of the concrete is put in. The concrete is carefully tamped in against the sides of the form to be sure to get smooth surfaces. The casting complete, the rails are left in the molds, usually two days, depending largely upon weather conditions, when they are turned over by means of a special tool which grips the flanges of the molds. Afterward, these molds are removed and carried to a new position for further work. Before the rails and posts are put in the stock piles, they are gone over carefully by a finisher whose business it is to touch up all slight imperfections. The rails are marked with proper letters and numbers to indicate for what angle they are intended. This system of lettering is shown in Fig. 3.

Since last summer, the plant has employed about 40 men and with such a

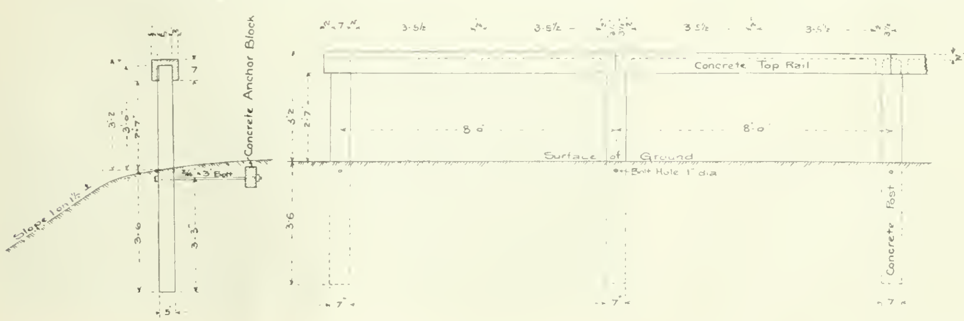


Fig. 2—Section and Elevation of Guard Rail

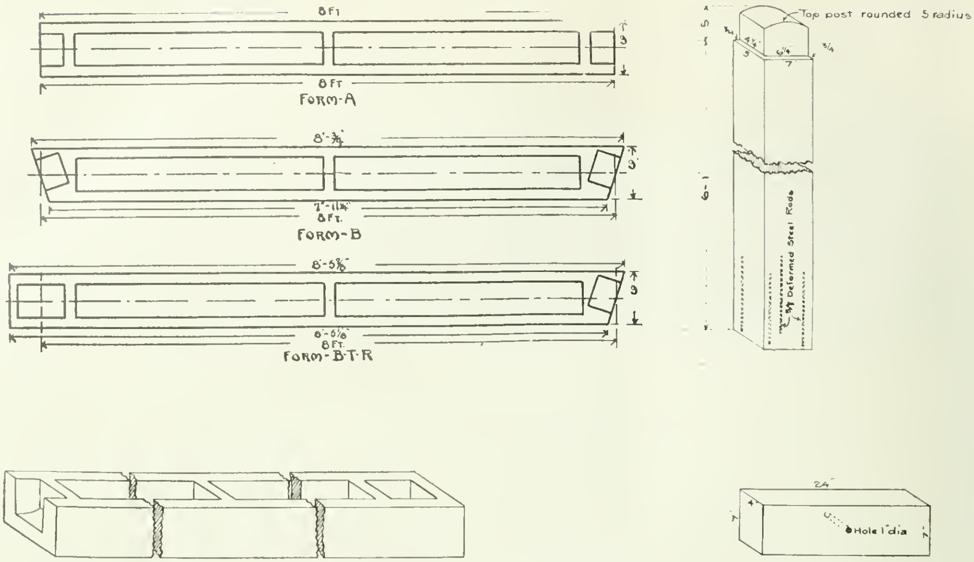


Fig. 3—Three of the Many Shapes in Which Top Rails are Made, Showing how the System Accommodates Itself to Angles; Detail of Posts; Below, at the Left, an Isometric View of the Top Rail Inverted to Show Cores and Webs; Detail of Anchor Block at the Right, Below

force, using hand-mixed concrete, wheeled in barrows to the men, it has been possible to make 1½ miles of guard rail per week, at 10 hours a day. Six men made 113 rails 8' long in 10 hours. Three men made 149 posts in 10 hours.

The ¾-in. hole in the posts and anchor blocks through which the galvanized steel rod is inserted, is made by using card-board tubes in the forms.

In New York state, it has been found that the rails can be manufactured at a profit and sold to contractors, who set them up and make a profit at a price to the public of $1.00 per foot of guard rail.

In the report of the New York State Commission of Highways of 1910, it was pointed out that some good substitute should be found for wooden guard rails. The report says:

The weakest part of the guard rail as built under the present standard is the posts which rot off below the ground line, causing the guard rail to become insecure and to lose its alignment, thus presenting a very bad appearance.

Assuming that a wooden guard rail will last eight years, the depreciation charge is approximately 3 cents per foot per year. Adding to this the necessary cost of painting and straightening of 3 cents per year, we would have an annual cost of 6 cents per foot per year for wooden guard rail. On January 1, 1910, there were 1,383,220' of guard rail in the State. The annual cost of maintenance of this guard rail at the above figure would be $82,993 per year. It must be borne in mind that this item is constantly increasing with every new road which is being built. Assuming that the ratio of number of feet of guard-rail built to the mileage constructed will be maintained with the balance of the highways constructed from funds under the $50,000,000 appropriation, and assuming the above figure of annual cost per foot, we would have an annual cost of the maintenance and guard rail on a total of 7,500 miles of $290,425. A number of thousand feet of guard rail have been removed within the year and the slopes filled out so that the points from which it was removed were not dangerous to the traveling public.

Assuming that the above figure of 6 cents per foot per year is correct for the annual cost of such guard rail, $1.25 per foot could be expended in eliminating this guard rail, and the cost to the State eventually would be less. If some form of concrete or pipe rail or even the guard rail with concrete posts could be substituted for the present standard form of guard rail, the annual cost of this item could be materially lessened.

It is pointed out by manufacturers of the concrete guard rail that the ordinary wooden rail, when new, will sustain a pressure not to exceed 2,000 pounds, while the hub guard will break under a pressure of a few hundred pounds, and it is claimed for the concrete guard rail that it will stand a pressure of 12,000 pounds. It is also pointed out by the manufacturers that while it is understood that no fence can be built and maintained in true line and grade indefinitely without readjustment, due to sliding or settling of the embankment, or action of frost, the concrete rail is designed to permit of reasonable settlement without injury, and is comparatively easy to readjust. With readjustment, it is believed the rail will be everlasting. It has no metal fastenings, and the top rail is held merely by being locked in place lengthways and sideways. The joints between the contiguous rails are not intended to be absolutely tight but to have suffi-

Fig. 4—Concrete Rail Guarding Approaches to a Concrete Bridge

Fig. 5—Molding Floor of the Concrete Guard Rail Plant, near Rochester
The flanged form of the mold is shown distinctly and also several types of end pieces which are inserted in the galvanized iron trough, to make the various end joints; the gravel bank which supplies the aggregate is shown in the background.

cient play to meet requirements in setting.

In addition to the ordinary type of posts, the posts are made in short lengths with the reinforcing bars projecting at the bottom, so that they may be set into the tops of retaining walls and bridge parapets. If such specially constructed posts are not immediately available on the line of work, it is said that two men with a hack-saw can cut off a post in twenty minutes, in case a short post is needed where rock is found close under the top soil.

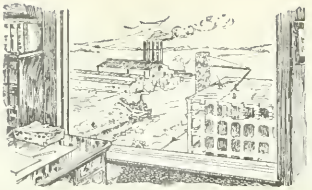
Bureau of Standards to Exhibit

A most elaborate and instructive exhibit will be made at the Pittsburgh Cement Show, Dec. 12-18, 1912, and at the Chicago Cement Show, Jan. 16-23, 1913, by the United States Bureau of Standards, Department of Commerce and Labor. Large space has been taken and a brief outline of the character of the exhibit and demonstrations is as follows: Various cement test pieces, apparatus used in testing cement, apparatus for standardizing sieves and specific gravity bottles, an exhibit of concrete electrolysis test specimens, a chemical exhibit showing the standard method of analyzing cement, a strain gauge with diagrams showing the value of an interferometer mounted on a concrete test beam showing the possibilities of precise measurements, various types of pyrometers for high temperature reading, clay and lime test specimens, with, perhaps, several other pieces of apparatus illustrating the scope of the Bureau's work. This exhibit will be accompanied by various diagrams and photographs and a collection of the publications of the Bureau.

Fig. 6—Concrete Guard Rails Being Erected

Charles Stevens, aged 30 years, a negro workman at the plant of the Edgar Thompson steel works in Braddock, Pa., had a unique experience with a concrete mixer at the plant Oct. 14. While working on the mixer, Stevens lost his balance and fell into the hopper. He was dug out by fellow workmen at the end of the machine where the mixed concrete comes out, a sorry looking sight. He was revived and sent to his home, little the worse for wear, and was at work again the next day.

On some recent work in New Orleans, corks have been used to plug the holes left by the form bolts in the concrete walls. The corks are made slightly larger, driven in a little way, and the hole pointed up with well compacted mortar.



COMMENT

Lower Taxes for Fireproof Buildings If the fire menace were a contagious disease, municipal, state and federal authorities would take drastic and effective measures to stamp it out. If we could build *health* to combat disease, as we can build fire-resisting buildings to lessen the fire loss, every encouragement would be given to such structures.

Given two buildings, side by side, one an old, poorly-designed fire-trap, the other a modern fire-resisting building, why should these buildings be taxed on the same basis? One building is a fire-breeder, and a fire feeder; the other, with walls of reinforced concrete, steel sash and wire glass, is almost a fire-fighter as it stands. It can not only not burn itself, but to all spread of fire it offers a check.

Fire insurance protects well-designed concrete buildings at a decided concession in rates. Why should not tax rates recognize this condition, and bear less heavily on buildings that are an asset to the city as a whole; and bear more heavily on the fire-traps? Why not make it an inducement for owners to tear down fire-traps and build fireproof buildings? Individual responsibility, brought home in an effective way, will alone reduce the fire hazards in our American cities.

* * *

Graded Aggregates for Concrete Work A dense, well-graded aggregate is an essential in concrete construction. Supply companies now sell sand and crushed stone at so much per yard, or so much per ton. Would it not be possible to have at the depot, the source of supply, crushing plant or gravel bank, equipped to produce a graded aggregate ready for a definite proportion of cement? Instead of hauling to the job the sand and the crushed stone separately, why couldn't they be scientifically combined at their origin, and brought on to the work ready for the cement?

Concrete in the field would then have 2 component parts only, instead of 3; and the aggregate would have one requirement only: it should be of the maximum density.

This suggestion has been made several times in the past few years. Supply companies might well take it under consideration. Better proportioned concrete would undoubtedly result from its use.

* * *

Competition—Which Way, Up or Down? The effect of competition may be disastrous or it may be highly beneficial. The result depends upon the choice to compete downward or upward. In other words, it is the old, old trade slogan, "not how cheap, but how good."

This is not a meaningless trade platitude—or at least it should not be, and we are reminded now and then quite forcefully how fine it would be in every industry if the fundamental truth of that maxim could be made to underlie all work. Put aside, if you will, the ethical consideration. It is a crass, commercial proposition. It means dollars and cents and lasting prosperity.

One of the reminders comes in the form of a letter from a concrete products manufacturer, of whose desire to do the right thing we have no question. He says: "My competitor works entirely by hand and cures by the air and water method. Block which he makes are neither square nor are they of a proper mixture. His price for an 8" x 8" x 20" block is 8c. That has been his lowest figure. The usual figure is 9c. You can readily see that the block business is nearly profitless in this vicinity. I make block 8" x 8" x 16", and in order to compete in price for a given wall area I would have to go below his figure of 8c per block. I decided to try making a better block and I found that by using a certain bank gravel I could use such a mixture as to get a good block to sell at a profit at 8½c. I found that I could economize in my methods by using steam curing and I now turn out a good block (for the kind) and readily outsell my competitor."

That phrase within parenthesis is deplorable—"for the kind." In it is told quite plainly that this man knows how to make much better block; that he would much prefer to make better block. Why not make up some products with concrete block which have quality, which have texture and general appearance to command attention and admiration? Get in a few jobs of this superior product. Teach the public the difference between good concrete block and bad concrete block. It doesn't take the public long to become discriminating in such matters, and anyway, the patronage of that portion of the public which is not discriminating is not worth having. The 8-cents-poor-block man could soon be forced to the wall, or better yet, be forced to mend his ways and enter into a decent competition for quality's sake. The manufacturer can add this quality for a few cents per block but the added value to the public is much more than the few cents. People are willing to pay for quality. The manufacture of products with quality is more satisfactory to the buyer and more profitable for the seller.

Concrete Highways and Race Development It has been a very general thing in our American farming life for the young man on the farm to own a horse and buggy. This equipment served its main purpose, when, spick and span, on Sunday afternoon, it carried its owner to see "his best girl"; or, on week nights, it may have brought "them" home from some neighborhood social affair.

With ordinary dirt roads, and a horse and buggy, the calling zone, the area in which a young man of the farm could conveniently call on a girl, and get home at any decent time without starting home almost before he had arrived, would probably have a radius of 10 miles. Unless he broke away from the farm, went to the city, and made his acquaintances there, his selection of a wife was restricted, and was not necessarily, but probably made from among those people living in the territory reached conveniently by a horse and buggy over dirt, and often muddy, roads.

In those yesterdays, when everybody rode bicycles, and the streets were considered dangerous because of rapidly moving cyclists, the young man of the farm had his wheel, and his zone of acquaintances was enlarged. Today, to an amazing extent, the automobile is on the farm, and 40, 50 and 60 miles are more probably the limits in which the young man can have his friends.

Today, and tomorrow, the concrete highway makes possible the best use of our wonderful automobile development. The farm is brought to the city, and the city to the farm. Isolated country hamlets are rapidly becoming a thing of the past. Interurban electric cars, automobiles, motorcycles and *concrete roads* are making the people one. A larger circle of acquaintances means better and more careful selection of husbands and wives, better mating, better homes and children—a better race. The entire development of better means of communication, in which concrete roads have played such an important part, is probably of far greater real good to the girls and women of the farm than to the boys and men. Heretofore, an aeroplane would have been the only means of travel to free them from the grim bondage resulting from impassable muddy roads. We are entering into a new era in race development, and low-cost permanent concrete roads will be an important factor.

* * *

Concrete Sign Boards for Highways and permanent "label" is an essential in A correct, intelligible highway construction. The painted sign board (wood, of course) has been in use from time immemorial. Concrete is the material for highway construction. Why couldn't the direction signs be formed of concrete boards, with the letters indicated by a suitable inlay, tile, metal, or a differently colored concrete? We venture to predict that before long, concrete sign boards and molds for making them, will be on the market.

Concrete Pavement Best Under Test

Under a testing machine devised to subject pavements to the same kind of wear and tear which they undergo on heavy traffic city streets, one-course gravel concrete, laid under the specifications of the County Road Commissioners of Wayne County, Michigan, has outlived four different makes of vitrified paving brick intended to stand just such wear. Furthermore, it has outlived granite block—not to mention creosote wood block and common cedar block.

An account of this test, made by the Department of Public Works of the City of Detroit, will be found elsewhere in this issue, together with photographs which tell the best part of the story.

The really remarkable thing is that the creosote wood block, next to concrete, stood the best, aside from the punctures made by the calks on the shoes which are a part of the testing equipment.

The machine with which this test has been made was devised (and on it a patent applied for) by John C. McCabe, Boiler Inspector for the City of Detroit. Mr. McCabe estimates that the test to which the sample sections of pavement have been subjected is equivalent to from 10 to 15 years' wear on heavily traveled city streets. The brick sections are worn down from one to more than three inches and one section of the brick pavement had to be replaced before the test could be continued because it was so mashed to pieces that it interfered with the progress of the testing mechanism. The granite block was worn down in most places considerably more than an inch. All these block pavements have given way irregularly—in patches—so that further wear aggravated the condition. On the other hand, the concrete shows scarcely one-quarter inch of abrasion, and this abrasion is even over the entire surface traveled by the testing wheels and shoes.

No matter how accurate is Mr. McCabe's estimate of the period of pavement service which the machine has reproduced by its ability to accelerate the wear, the lesson in comparisons shown by the existing sections of pavement after the test was completed, is an important one. It will surprise many of the best friends and advocates of concrete, who have been backward about advocating its use for pavements except for country highways and for light-traffic streets.

The result of such a test is sure to be followed by trials of concrete on heavy-traffic streets in many cities.

* * *

"The American Concrete Association"

At the Kansas City convention of the National Association of Cement Users last March, the matter of a change of name was referred to the executive committee. In the April issue of *Cement Age*, a correspondent suggested the name "American Concrete Association," as especially well suited to the work that this body of men is doing. As our correspondent said at that time, such a title would be definite, inclusive, comprehensive and brief. The National Association will do well to take this under consideration.

* * *

Transverse Reinforcement for Columns

Attention is called to a correspondent in this issue who suggests a rather ingenious way of placing horizontal reinforcement in columns. The value of reinforcement in planes at right angles to the axis of compressive stress has been the subject of much study. At the meeting of the National Association of Cement Users (Chicago, February, 1911) an interesting paper was presented on the reinforcement of horizontal or inclined compression members. A fabric or expanded mesh, the size of the cross-section, is inserted at right angles to the axis of compression. This would serve very well for bridge and beam work, but in concrete columns the field problem of accurately placing and holding in place such a reinforcement appears almost insurmountable; and, so far as we are aware, no attempts have been made to reinforce vertical columns horizontally. With this in mind, the suggested "wire cage" arrangement has more than usual value, and should be of interest to our readers.

* * *

Concrete in our Terse, Vernacular Tongue

Some time ago, in an editorial on the completion of the base ball grounds for the New York "Giants," we referred to the interesting fact that the "fans" who used to refer to a stupid player as having a head of "solid ivory," now refer to that part of his anatomy as "solid concrete." Concrete should be dense, and this quality of it is often applicable to certain people's heads.

Good concrete should also be hard, and in one of our recent comic operas, this quality is referred to by the "newly-rich" character, who, mixed up on the phrase, "an iron hand in the velvet glove," and trying to arrive at a similar meaning, very gravely referred to "the concrete head in the velvet cap."

We are glad to see that the crowd, even in the vernacular, considers concrete dense and hard. Good concrete is.

* * *

Again the Decorative Value of Concrete

Often have we urged possibilities for beauty which lie in concrete properly and tastefully used. In this issue we are able to give further evidences of such uses in the illustrations showing the park improvements designed by Arthur Ware for Hoboken, N. J. All such work as this does more than volumes of theorizing to bring about a more general use of concrete for rich or simple decorative effects, where freedom of design is a thing to be sought. We do not urge the material for this purpose because it is cheaper—though it is vastly more economical—but because, as we have said before, it yields so readily to the touch of the artist and makes possible so broad and general or so delicate and intricate an expression.

Testing a Concrete Bridge

On a bridge recently completed in England, a rather unique test was carried out. The bridge was loaded with water. Strange as this may at first seem, it was very easily and cheaply done.

The floor system of the bridge is carried by columns on 3 reinforced concrete arches. The clear span is 57', and the rise 8' 3". The parapets are solid concrete with sunken panels. In preparing for the test, a clay dam 3' thick at the base, and 1' thick at the top, was built at either end, and the water was conveyed through a 2½-in. hose. The load was applied in 8 hrs., and although it exceeded the required loading of 250 lbs. per sq. ft., the deflection at center was only 1/16". The water test load was rapidly and easily applied and removed, at a very low cost. It would be a very easy matter in situations where water service is not available to pump water from the stream which the bridge spans.

Concrete Construction a Good Investment

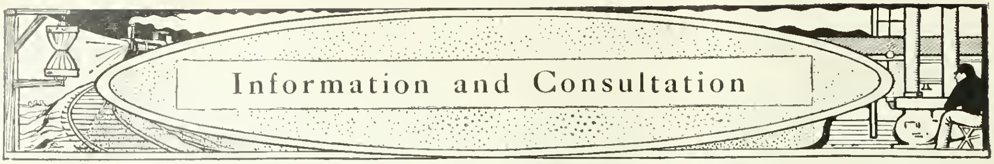
George W. Brown, Hancock county, O., writing to *Successful Farming*, makes the following statement:

Three years ago we built a pair of concrete gateway posts at the road side approach of our farmyard driveway which adds $100 in appearance and attractiveness to our farm home, and only cost us $1 each, the price of the cement used in their construction.

The stone and sand used were taken from the bed of the creek running through our farm. A wooden mold was made from light boards, shaped 18" square at the base, and 10" at the top. When we added a cap to the 4-ft. pyramidal form, after our own design, to match the iron bracketed fencing which encloses our lawn and garden, the entrance way was artistic and impressive. As we filled the forms up with concrete, we set into one post a pair of supporting gate hinges and a latch into the other in the proper place. An artistic iron gate and a stone fence finish the farm yard enclosure complete.

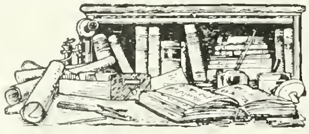
The value Mr. Brown puts upon his concrete posts is not unreasonable. They will suggest to every passerby that here is a good farm in good hands. People are always favorably impressed by improvements of this character. Properly designed and well-placed concrete construction is always a good investment.

Beginning Nov. 1, the Dominion of Canada restored the duty on cement. In the four months' freedom from duty, nearly 800,000 bbls. of cement were imported to Canada, chiefly from the United States. Shipments in this period were nearly double those of the preceding four months.



Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking of our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation



section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

215. Automatic Briquette Testing Record

"Is there any briquette testing machine on the market which will automatically record on cards, by means of diagrams or otherwise, the breaking load and strain curve?"

215. A Transverse Testing Machine: Discussion by Thorsten Y. Olsen.*

The tensile test for cement has been developed mainly because it is the least expensive test for the purpose. The small tensile test machine is comparatively inexpensive, thus enabling a large number of cement users to test their cement and see that it comes up to the established standard for this test.

An autographic machine for testing briquettes in tension can readily be made, but at great expense, and would be of but little value, because the amount of stretch or elongation in cement, especially in present briquette form, would be exceedingly small, measurable in ten-thousandths of an inch only. This fine measurement, which must be exceedingly accurate, makes the expense or cost of such a machine all the greater. The present form of briquette is such as to eliminate all stretch, as much as possible.

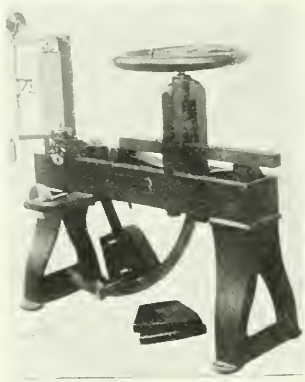
Autographic testing machines have been made for testing other material, such as iron and steel. On these machines cement and concrete also in both tension and compression have been tested, but owing to the expense of the machine and the time required to make such tests, they are not practical from a commercial standpoint for cement testing.

Considering the uses of cement, the compression and transverse tests are, in our opinion, the proper ones for cement or concrete. A number of the cement mills and large users are urging the compression test as a standard in preference to the tensile test.

The compression test of cement has the same disadvantage as the tensile when considering an autographic machine for the purpose, as the compression is so small, measured by a highly magnifying recording apparatus only. An autographic machine, with micrometer attachment, will automatically record the stress-strain diagram of such cement or concrete compression tests, just as well as the tensile test of the same material.

To make a successful autographic testing machine for cement or concrete, that will at the same time be a commercial machine, I would recommend the transverse test, in preference to all others. I would recommend a machine of the type shown in the accompanying illustration, which would be a commercial machine and would automatically trace the stress-strain diagram.

I would prefer a test specimen 1" square in section and 12" between supports (specimen 13" long), as with this size specimen considerable deflection could be obtained. The same machine could, however, be arranged for a test specimen 2" x 2" in section and 12" between centers, so that tests of both sizes could readily be made on the same machine.



A Machine for Transverse Testing

The results of an autographic transverse test should be more reliable also than any other, as the method of holding and shape of specimen are good, and the deflection such as to be quickly and accurately recorded by a simple and comparatively inexpensive machine.

In the machine illustrated the specimen is placed as shown, and as the operator gradually turns the hand wheel, the pressure is applied and weighed by pendulum balance and the stress-strain diagram recorded on the data sheet. The data sheet is of such size that it can readily be filed away for reference and the deflection at any point or load may readily be determined to a thousandth of an inch.

The pendulum weighing system is a very accurate automatic weighing system, and is arranged so that two magnitudes of curves may be obtained, depending upon strength or size of test bar.

This transverse tester was designed by Tinius Olsen with the thought that this test would be the ideal one for the purpose with a machine of low cost on which an autographic record of test could be made in as little time as it takes to make the present tensile test.

*Philadelphia.

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254. Steel Mixing Board

"We have been considering the value of steel mixing boards for hand mixing of concrete, and have wondered if there were any data available as to the best size, etc."

254. Discussion by C. M. Mullen*

In discussing this question the writer can only state that he has never used a steel mixing board, and does not consider that the market for this equipment would be very large.

With the high cost of labor, the difficulty of getting labor, and the efficiency of the out-put of this labor, I would say that practically all concrete from now on will be mixed in a mechanical mixer of some kind.

A mixer salesman was in our office recently, endeavoring to sell a small but complete hand-power mixer for $75.

A friend of the writer's used steel mixing boards several years ago. These boards were 5' wide by 12' long. Finding that he had little use for them, he disposed of them some time ago.

There are a few places where steel boards might be used to an advantage, but they are so rare that the writer would hardly term the steel mixing board a marketable article. One of the greatest objections to them is the necessary weight.

* * *

266. Hydrated Lime, and Its Use

"Will you please tell me exactly what hydrated lime is? How is it made and how used? I understand that it is used with Portland cement in concrete to make a whiter and more dense material.

*Cleveland.

What detailed information can you let me have on this?"

266. Discussion by Richard K. Meade*

Hydrated lime is nothing more or less than dry slaked lime. When a mason slakes lump lime, he places it in a mortar box and adds a quantity of water not only sufficient to slake the lime but to do more than this. The excess water remains in the mortar box and forms with the slaked lime a paste or putty. It is possible so to regulate the water, even where this is added in a mortar box, as to have a dry powder result, but as it is troublesome to do this and there is no special advantage in doing it, the excess water is always used.

Chemically speaking, hydrated lime is a compound of lime and water known as calcium hydrate. It always contains 76% lime and 24% water. It should not be confounded with air-slaked lime, which is also a dry powder and which consists of calcium carbonate for the most part. This latter compound is chemically the same thing as limestone and hence has no mortar properties.

Hydrated lime is made by machinery in a specially designed plant. The steps consist of first crushing the lump lime to pea size and under. The water and lime are then mixed in a special machine called a hydrator. This latter mixes the lime and water and hydrates or slakes the former. The water is so proportioned as to give a dry powder. After leaving the hydrator the slaked lime is bolted or sieved in order to get rid of any core which may have been in the lime or any unslaked particles of the latter. It is then ready for the market.

The advantages of hydrated lime are that it may be kept and stored without great depreciation of value and without fire risk as would be the case with lump lime. It is ready slaked and hence the mason is saved much trouble, time and space occupied by mortar boxes, etc. To the cement worker it offers the advantage that it is a dry powder like cement and may be mixed with the latter.

Hydrated lime is added to cement to make a lighter and more dense concrete. It is well known to cement workers that an addition of 15 to 20 lbs. of hydrated lime to each bag of cement (95 lbs.) will not affect to any serious degree the strength of the concrete made from this cement. The concrete will be considerably lighter in color. I do not think that absolutely waterproof concrete can be made by using hydrated lime, but it does make a more waterproof concrete than cement alone. For stucco and plaster work, hydrated lime should always be used, as the mortar therefrom is more plastic, and easily applied.

When hydrated lime and cement are used together it is the usual practice to make a small box holding the desired quantity of hydrated lime, and this lime is added to the mixer or batch directly after the cement. I think that the desired results can usually be obtained by adding about 15 lbs. of hydrate per bag of cement.

*Roland Park, Md.

266. Discussion by Rolf R. Newman.*

In reference to the use of hydrated lime, it may paradoxically be said to be both good practice and bad practice—depending upon how and where the mortar or concrete is to be used. Its presence adds to concrete that creamy, almost oily fluidity characteristic of the best mortar and concrete. A mortar wholly of Portland cement and sand (say in the proportion of 1 to 3) is somewhat lacking in this tendency to flow readily, and a mason will speak of it as "short" and will ask permission to put in some hydrated lime to make it "butter" and spread better, to make a fat mortar. For almost all purposes this request of the mason can be granted by adding say 8 lbs. of hydrated lime to every bag of cement as used. The use of hydrated lime always whitens the mortar or concrete and also tends to make the mixture more dense. Its use in concrete, however, is not to be recommended, especially if the concrete is to be exposed to saline or alkaline liquids, because an excess of lime in the concrete mixture will tend to form soluble crystals instead of permitting the normal formation of *insoluble* calcium hydro-silicate or hydro-gel, which, according to the colloidal theory, is now recognized as the basis of the hardening of all hydraulic cement.

Modern Portland cement is a carefully manufactured product, in which the proper amounts of lime and clay are delicately balanced. The delicacy of the balance and the fineness to which the cement is ground give it to a great extent its cementing power. The idea of careful balance is also carried out in properly proportioning the amounts of cement, sand and stone in any concrete. The addition of any more lime (in the shape of hydrated lime) may disturb this general balance. The same may also be true of the addition of clay. If, on the other hand, the sand and stone have brought into the general mixture any especial amount of either clay or lime, the addition of a corresponding amount of the opposite material may balance things and make the whole mixture *stronger* through what amounts to the addition of that much more cement. For this action to take place it is necessary that all materials considered as entering into it shall be very finely divided. At least 75% of all standard Portland cements will pass through a No. 200 sieve (having 40,000 openings to the sq. in.) Some cements pass as much as 90% through a No. 200 sieve. This extremely fine material is, as already referred to, partially the cause of the oily fluidity of mortars and concretes. There is historical authority for the statement that "hog's lard, curdled milk or blood" were specified as desirable additions to Roman stucco work. Alum, soft soap and certain animal and mineral oils have also been added partly to give flow and partly for waterproofing purposes. The combinations of all possible substance in the various patented compounds are legion. The authority or desirability for their use in concrete is usually *nil*. Those that chance to be really beneficial are those that happen to add (when required for a balance) a little lime or a little silica (in the form of clay, trass, or puzzolan). It is also true that the addition of both a little lime and a little clay may benefit a concrete mixture by combining with one or both of the opposite substances in the concrete mixture, or it may also be true that certain of the patented waterproofing compounds contain both lime and clay and either one needed is ready to act, while the amount of the other present and uncombined is not sufficient to unbalance the concrete.

*Riverside, Calif.

The recognition of collodial action and the addition of substances which will aid and not hinder it, would appear to be the great point to be kept in mind. An interesting fact in this connection is that gypsum (calcium sulphate) highly crystalline in effect, is purposely added to cement (in amounts of only 2% to 3%) to offset the collodial action and retard the set of the cement.

For the chemical reactions involved in the formation of hydrated lime reference may be had to page 2 of "Concrete, Its Composition and Use," by H. F. Porter, C. E. This same book in Appendix A also gives an excellent statement of the collodial action of cement as supported by the late German chemist and cement expert, Dr. W. Michaelis, Sr. It is sufficient to state here that all commercial lime not hydrated when received becomes so upon the addition of water; and while beneficial to cement mortars, its effect on concrete is, at best, uncertain and its use in concrete, as a rule, to be avoided. The question raised is an interesting one and deserves wide discussion.

* * *

268. Ornamental Rubble Posts

"What is the best way to build ornamental posts of rubble concrete—posts 2' square and 6' high? I want to use cobble-stones about 3" in diameter for facing."

268. Discussion by C. S. Fay*

My way to build ornamental rubble concrete posts is about as follows:

To make posts 6' high and 2' square I make the mold boxes 2' square in sections 1' 6" high. Make four of these sections and make about 9 yokes to prevent the forms from bulging with the weight of the concrete. As it is almost impossible to make the yokes fit exactly, use wedges to drive them tight. Rough lumber can be used for the forms. Put the first section of the post mold on the foundation previously constructed and begin to lay up the stone which is to form the surface of the post, piling them up against the inside of the board form. Back up this stone with mortar, 1 part cement and 2 parts sand, and use just enough of it to hold the stone in place. Then fill in the center space

*Brocton, N. Y.

with concrete of about 1 part cement to 5 parts gravel. I have found that it is possible to lay up 5" or 6" of stone around the sides, held by the mortar, then filling in with the concrete. Of course, much depends upon the kind of stone used and how well it is possible to pile them up. Keep up this work of laying up the stone backing with mortar and filling with

FIG. 1—RUBBLE CONCRETE WORK DONE BY MR. FAY

concrete until you have reached the top of the mold section. Then you put on another section and yoke firmly in place. If you are obliged to stop this work for an hour or more it is best to leave the surface of the post level and smooth. Be careful, of course, not to get mortar on the face side of the stone for the sake of neatness in the appearance of the finished job. Of course, if any of the stone face becomes spotted, you can clean off the mortar with acid, but the acid treated stone is apt to look quite different from the other stone.

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270. Concrete Paving in Europe

To what extent, if any, have concrete pavements been used in Europe?

270. DISCUSSION BY LOGAN WALLER PAGE.*

Concrete pavements for streets and highways have been in use in Europe at least since 1869. In this year a stretch of concrete roadway was laid in Grenoble, France. This concrete pavement proved so satisfactory that by 1890 it had practically superseded all other forms. It consisted essentially of a Telford base, on which was placed a layer of well-tamped gravel concrete provided with a 1½-in. to 2-in. wearing surface of 1:1 mortar.

About 1880 concrete pavements were laid in Paris. Here, however, they never became popular.

Concrete pavements were laid in Stettin, Germany, as early as 1893. A few years later they were also introduced in Berlin and other cities.

Modified concrete pavements, in which a small amount of coal tar or some other material intended to give resilience, was added, have been laid of late years in Oldenburg, Berlin and other places.

*Director, United States Office of Public Roads.

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271. Terazzo Floors

What is terazzo? How is it made and applied? What is a good substitute for a tile floor? Something a little more showy than plain concrete floor?

271. EDITORIAL DISCUSSION

A terazzo floor is made by embedding in the top layer of concrete, a hard aggregate consisting of differently colored granite or stone particles, so graded that the aggregate will cover a large percentage of surface area. When this concrete is hard, abrasive materials used either by hand on long handles or in polishing machines, are employed to grind down the surface, removing the film of cement and exposing the aggregate to the best advantage and at the same time giving the floor a smooth, hard surface. It is a very good substitute for a tile floor and many prefer it to a tile floor, and of course is more attractive for the purposes to which it is generally put than the ordinary plain concrete floor.

272. Dampproof Walls

Do you think a double-wall concrete block house is dampproof? Would it be all right to plaster right on the inside of the block?

272. EDITORIAL DISCUSSION

There is no doubt whatever about a double concrete wall being dampproof. Walls made of block which leave air chambers in the wall which are not all connecting and continuous may be dampproof or they may not, depending upon the quality of the block, the extent of the air space insulation and so on. Good concrete block make a dry wall, under all circumstances. If you have a double wall you are perfectly safe in plastering direct on the inside surface. Under other circumstances it is better to fur and lath.

* * *

273. Elevating Concrete on Residence Work

"Could a continuous mixer be equipped at the discharge end with a boot and a vertical flight of chain buckets so that in running residence walls the concrete could be elevated as rapidly as mixed? Can chain buckets be used to handle concrete?"

273. DISCUSSION BY F. A. KERSHAW.*

In the writer's opinion it is extremely doubtful that an arrangement such as proposed would be of any practical value, owing to the many difficulties in the construction that would have to be overcome. The inquiry seems to have hit on one of the most serious of these when it says, "Can chain buckets be used to handle concrete?" There is no doubt that when the material is comparatively dry, chain buckets would handle it successfully, but to handle wet or sloppy concrete, such an arrangement would in our opinion be very unsatisfactory. We think, too, that any elevating device should be driven separately from the concrete mixer, otherwise we would have always the prospect of the elevator stopping with all the buckets filled when anything happens to the mixer. This, we think, would be a very serious objection. We regret that we cannot give more encouragement in this matter, but the proposition does not seem to us to merit it.

*Kent, O.

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274. Handling and Testing Concrete Colors

"What ordinary methods can be used for testing concrete colors; and what makes a good green color?"

274. DISCUSSION BY C. J. OSBORN.*

In regard to the various minerals used for coloring concrete, there are many different methods of determining their value. No doubt the first consideration the contractor has is the shade developed, and the strength of the color, which, with the price, are the determining factors. These would possibly preclude any due consideration of anything else as applied to the color, but it is very often found to be the case that mineral colors which contain "lakes" or other coloring matter, will at first show up stronger in concrete, and thus appear to be more economical to use, but on account of the foreign coloring matter therein, they begin, in a comparatively short time, to fade. If the concrete faded uniformly it would not be so objectionable, but unfortunately, artifically colored mineral colors, almost invariably fade in blotches or patches, and so show the difference, and as a result many a good job is spoiled.

It will be found generally apart from analytic and ordinary physical tests for effective field testing, the colors should be mixed with strong lime, with pure cement, and also colored concrete block should be washed with acid. Colors that will not stand these severe tests should not be considered acceptable for first-class concrete work.

We believe that it is the opinion of concrete engineers, that color, in excess of 6% of the cement used, is injurious to the bond and strength of the concrete. We believe that it would be interesting to obtain from CONCRETE-CEMENT AGE readers, an opinion as to the amount of color that ought to be used, without affecting the quality of the concrete floor or structure.

There are no set rules so far laid down that are considered a reliable guide for a cement user, relative to the amount of color that should be used. Under average conditions we think that it is perfectly safe to use an average of 5%. Always color the floor to the depth of not less than ¼". Merely coloring the surface is not sufficient.

"Lakes"

[Editors' Note:—The term "lakes" seemed to require more explanation with particular reference to concrete colors. Mr. Osborn discusses this further in the following paragraph.]

The term "lakes" has particular

*C. J. Osborn Co., New York City.

reference to the addition to concrete and mortar colors, of aniline, coal tar, and similar colors. These have the effect of brightening and increasing the staining power of cement colors, but they are extremely dangerous to use, because they are fugitive, extremely soluble and fade rapidly. In alkali or acid, generally in alkali, "lakes" fail and the original color is left with a dirty appearance. No more beautiful color is produced than the mixture of the original mineral colors and a lake. At the same time, the colored concrete thus produced is most unsatisfactory when the color has begun to fade. This it will inevitably do. We recommend that under no conditions should anything be added to the natural mineral or metallic color. If Concrete-Cement Age readers have any different views on this subject, we should be glad to hear from them, so that we could prove to the entire satisfaction of the architect and contractor, that our advice is sound, and should be followed.

Green Color

[Editors' Note:—Since a question and partial answer under this same heading were published in the August, 1912, issue we have further information from J. W. Coulston & Co., New York City, as to suitable qualities of green color for cement work as follows:]

First, as to prices—green oxide of chrome, 30c a pound in bbls. of 500 to 600 lbs. A lime-proof green at 7½c in bbls. of 500 to 600 lbs. Prices about 1c per lb. higher in repacked quantities, minimum 100 lbs. These prices f. o. b. New York.

"We consider these two greens most suitable," says the letter, "as regards permanency, as some of our trade have experimented with various greens on the market and have reported to us much more satisfactory results with these two qualities. The green oxide of chrome is by nature permanent, but on account of price, not largely used. The lime-proof green is a very evenly balanced cement green—not too much on the blue nor on the yelolw. We think 5% or 6% of either quality would give pleasing results. We have developed some very satisfactory results by combination of a special strong yellow oxide, 2½ parts to 1 part of ultramarine blue (preferably a very strong grade) with a total percentage of color not exceeding 8% to 10%. This strong yellow oxide costs 3½c in original bbls., 600 to 700 lbs., New York.

* * *

275. Structural Steel Cores for Concrete Building

"In some of the more recent work structural steel shapes are used extensively for column cores.

In our modern city buildings where the floor space on the first floors is valuable, the steel column undoubtedly presents a very economical and efficient construction. We would like to know (a) What is the best steel shape to use for a column and (b) What is the best connection between the reinforced concrete girder and the steel column to take care of the excessive shear?

Detail View Showing Girder Connection with Structural Steel Column

275. Discussion by Albert Kahn*

In regard to structural steel shapes for reinforced concrete columns, the questions can be answered as follows:

(a) Steel shapes are used where it is necessary to obtain smallest possible column size; and therefore the section giving the greatest amount of structural steel is used. We invariably use either the Bethlehem-"H" column, or a built-up column of the same dimensions. This allows the concrete steel to become an integral part of the column.

(b) The best connection between column and reinforced concrete girder is, in our opinion, a structural steel seat on the column web, of sufficient size to carry the entire load in bearing. These seats being on the web do not appear in the finished surface of rooms, and their stiffness is considerably assisted by the concrete shell. Continuity bars run through the web of the columns.

[Editor's Note:—The accompanying illustration shows a structural steel column and the reinforced concrete girder with the steel in place ready to run. This is on work designed by Mr. Kahn.

The girder seat can be seen below the steel, and a small bracket at the side to help carry the floor slab is shown. The splice-plates are in position, ready for the next section of the column.

This is a flat-slab floor, with a wide masked T-girder. Note the girder rods going through the web of the column. The ends of the tile were covered with heavy cardboard before running.]

* * *

276. Articles on Concrete Boats and Barges

"May we have reference to articles recently published on concrete boats and barges?"

276. Discussion

The following references are from the library files of Sanford E. Thompson, Consulting Engineer, Newton Highlands, Mass.:

150-ton concrete freight boat used in Italy. *Cement & Engineering News.* Nov., '07, p. 259.

Barges and pontoons in Italy. *Engineering News.* Apr. 23, '08, p. 453.

Boats and barges. *Cement Age.* June, '08, p. 606.

Concrete boats on Missouri river. *Cement.* Oct., '08, p. 181.

Concrete boats to be built in U. S. *Concrete Engineering.* Dec., '08, p, 362.

Reinforced concrete boats in Italy. *Engineering-Contracting.* Feb. 10, 1909.

Reinforced concrete yacht built in 1898. *Concrete.* Feb., '09, p. 71.

Car floats to hold small freight cars, Italy. *Engineering Record.* Aug. 28, '09, p. 248.

Concrete barges for dredges, Panama Canal. *Concrete Engineering.* April '10, p. 83.

Scow for coal, 80' long. *Engineering Record.* Sept. 30, '11, p. 384.

Concrete scow, Welland Canal. *Cement Age.* Sept. '11, p. 109.

* * *

277. "Alca" Limes and Cements

"What are 'Alca' limes and cements; and how are they used?"

277. Discussion by E. L. Conwell*

"Alca" is an accelerating material consisting essentially of silica, iron oxide, alumina and lime. The proportions in which these are present are so regulated as to produce a materal 15% of which is able to confer hydraulic properties on 6 times its weight of hydrated lime. "Alca" is manufactured by furnacing together the proper raw materials at a temperature of about 3500° F. In this process the mass becomes molten, and is then tapped from the furnace and granulated in water, dried, mixed with a chemical ingredient to render it more active and ground. While in appearance it resembles cement, it differs in composition. It is furnished to the lime and cement trade ready for use.

"Alca" lime consists of 85 parts hydrated lime and 15 parts "Alca," and possesses the plasticity and sand-carry-

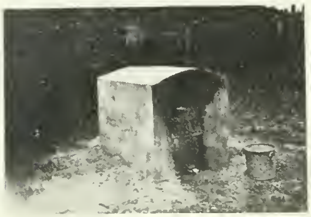
*Architect, Detroit.

*The Aluminate Patents Co., Philadelphia.

ing qualities of old-fashioned lime mortar, together with the rapidity of hardening and strength of gypsum plasters. Alca lime is manufactured by several firms. It is used for interior plastering, exterior stucco, brick laying, and as a mortar for all purposes where the strength of Portland Cement is not requisite.

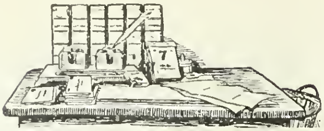
"Alca" cement consists of old-fashioned natural or Rosendale cement to which a small proportion of "Alca" had been added. Experiments show that the strength and rapidity of hardening of "Alca" cement are very much superior to the same qualities in the untreated natural cement, and in fact, approach these of Portland cement. Owing to the extremely low price which has prevailed for Portland cement for some time past, Alca cements have not been very widely used, but with the present gradual rise in the price of Portland cement we expect to see "Alca" cements make a place for themselves in the course of a few years.

An Inexpensive Garbage Furnace Built of Concrete



Garbage Burner of Concrete

The satisfactory disposal of garbage and other refuse that accumulates in every house is something of a problem. It is a nuisance to have to bury it and it is not a pleasant thing to have it on hand. The little concrete furnace shown herewith has solved the problem for a family living near Philadelphia. It is simple in construction, merely an old furnace grate and door surrounded with concrete and fitted with a piece of terra cotta pipe for a chimney or flue. It is most convenient and satisfactory. Ashes from it accumulate slowly and are easily removed. No skill is required to make the incinerator and second-hand material in the form of grate and door make the cheapest type of furnace. The same idea could be successfully carried out for an out-door grill. The furnace could be placed higher for convenience.. A little cement, sand and stone, or gravel, and cheap lumber for forms are the only requirements. The garbage furnace shown has not been affected by the heat and will not be injured by exposure to the weather. Farmers would find a furnace of this kind convenient where food is to be heated or cooked for live stock. A flat top with opening for a large kettle could be substituted for the arched roof shown in the illustration.



CORRESPONDENCE

Concrete Fence Posts

An idea similar to that prompting the erection of the fence on the property of O. C. Barber, Barberton, O., a description of which you published, occurred to me several years ago and out of that idea I built a fence around my home, employing wood panels instead of concrete, with poured posts instead of those made upon the ground and transplanted as on the Barber property.

Feeling that my methods might be of some interest to your readers who have a little time and inclination permanently to improve their homes, I am offering my plans.

From the sketch it will be seen that the form is made of two boards 1" x 6" x 6' 8". On the face of each of these boards is nailed a strip 1½" x 1½" x 5', so that it will form a groove for a panel on either side of the post to be formed. The two other sides of the form are made 1" x 8" x 6' 8". These four pieces are then clamped securely together and placed in the post hole so that the inside of the form from the ground up will make the grooves for the panels, giving the post at its top the shape of a capital "H" in heavy type, precisely as described in the Barber fence.

The post hole should be dug about 18" x 18" square and 2' deep. In the center of the hole drive a piece of gas pipe or water pipe about ½" in diameter until 7' is exposed from the bottom of the hole upwards. Then pour a mixture of cement, sand, rock or gravel in the hole 4" deep to form a base and anchor the post. Before this base gets too hard to unite with the concrete of the post proper, pour to form the post. The form should be placed around the rod and the pouring begun, but not until expanded metal has been cut into laths 5" x 6' 8" and wired together about 5" apart, and then fastened to the gas pipe so as to reinforce the flanges of the post.

I used a 1:2½ mixture of Portland cement and sand for the posts; let them stand about 24 hours; took off the forms and let them cure about two weeks before slipping the panels in place. I made the panels 12' long and studded them on either side with upright pieces in the middle and within 1½" of either end. I painted them as near the color of the concrete as I could and then slipped them into place. They should stand about 1" higher than the top of the post and be finished by cap boards running the whole length of the fence.

The incessant rotting of wood posts at the top of the ground ought to make the concrete post appeal to everybody. The reinforced posts I have described do not rot or sag, and are practically indestructible. Although the wood panels will ultimately fall into decay, almost any sort of carpenter or handy boy can renew them with little expense as compared to rebuilding the whole fence.

H. P. Taylor.

Hartford, Ky.

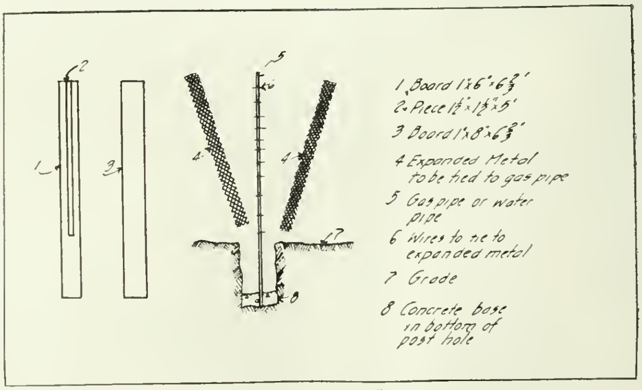
* * *

Transverse Reinforcement for Columns

Concrete column economies always open an interesting question. Two years ago, in a paper before the National Association of Cement Users, R. A. Cummings* presented an interesting paper on transverse reinforcement for compression members. In construction work described the rib of a concrete bridge was reinforced on the haunch with sheets of expanded metal placed at right angles to the thrust. Heads of concrete piles were reinforced with various fabrics in a horizontal position when the pile was being driven.

As was brought out in the discussion at that time, it was manifestly impractical to reinforce a column with sheets

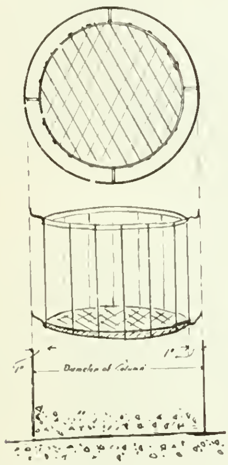
*Consulting Engineer, Pittsburgh.



Concrete Fence Post Details

of fabric placed horizontally. It is an interesting subject, however, and the accompanying sketches embody a suggestion that has occurred to the writer, and that may be of general interest.

The suggestion is to use a wire cage (a) the "floor" of which would be the reinforcing mesh. The vertical rods, with the spacers, would maintain the floor in a horizontal plane. Note that the top is open, and that the height of the cage determines accurately the spacing of the horizontal planes of reinforcement. The spacers, adjustable in the field, should insure a snug fit. The cages could be made with a taper so that they would nest for shipment. The illustration shows the cage adapted



Sketch Showing Suggested Arrangement of Wire Cages for Horizontal Reinforcement of Columns

to a round column. The idea would, of course, apply equally as well to a square column, and in a square column there would be no fabric wasted in cutting.

In pouring a column, no steel would be placed; the form would be clear. The required number of "cages" should be placed conveniently near. After running a few inches of concrete a cage could be placed. About a barrow load of concrete would fill the column to the top of the cage, when it would be ready for another cage, and so on, until the column is filled.

If desired, the hooped column effect could be secured by fabricating the cage with heavy bands. The placing of these would be accurate and, to a certain extent, inexpensive.

The only other way that I can see by which transverse reinforcement can be placed, is to leave one side of the column open, and place sheets of steel, and board up as the concrete is placed. This I do not consider good practice.

The suggestion may be of interest and I would be glad to follow any developments along this line.

Builder

Cleveland

Time Record in Building

[Editor's Note:—In building construction in the past few years, reinforced concrete has probably furnished some striking illustrations of its efficiency in rapid construction. There is in certain quarters, even at the present time, some opposition to concrete on the ground that it is slow in construction, that the concrete takes time to set, etc. Such opinion is without ground, and the following letters show some recent speed records in different parts of the country.]

Rapid Work in Portland

The Brayton Engineering Co. secured the contract for the Holtz store (Portland) Nov. 1, 1911. The plans were not completed and, in fact, the clients were out of the city, but we were awarded the contract in order that we might get the wrecking, excavating, etc., fin-

Fig. 1—Twenty-one Days' Work on the Holtz Store Building, Portland, Ore.

ished, and the steel ordered, so that the building might progress rapidly at the proper time.

Various delays occurred, one of them being non-delivery of the steel. All of these were unavoidable, but, as a consequence, the building did not reach the level of the 1st floor until Jan. 2, 1912. The photograph of that date shows the concrete in place on the 1st floor and the sidewalk, and some of the form material ready to be assembled for the first story.

The photograph of Jan. 18, 16 days later, shows interesting progress. The forms are in place for the 4th floor, the hoisting tower erected, the sidewalk covered for the protection of the public, and reinforcement ready for erection on the 4th floor.

Five days later (Jan. 23) shows the 5th floor in place. The photograph taken January 31, 8 days later, shows the 6th and the 7th floor completed and a good start on the form work for the 8th floor. The photograph taken Feb. 6 shows the 8th floor in place and the columns above well started. Feb. 14, 8 days later, shows the rough construction completed, the brackets for the cornice in place and part of the forms for the pent-house erected. Feb. 27, 13 days later, shows the form work stripped to the 5th floor and the brick work completed to the 4th floor. The photograph March 19, about three weeks later, shows good progress in the brick work, the exterior being entirely completed, the cornice partly finished and the pent-house stripped. April 2, just two weeks later, shows the completed building with the glass in the upper stories, fire escapes finished, the electric sign on top, and, in general, substantial progress.

By April 10, 8 days later, the interior finish, including plastering, mill work, and cement floors, was completed in 4 stories and turned over for the use of the tenant for the storage of goods and the installation of fixtures.

The building was turned over completed, accepted by the owner and tenants, and the first month's rent paid May 1, 1912. The picture dated June 1 is exactly as the building looked May 1, with the exception that the department store had been open for business for six days.

Our contract time of completion was June 1. The building was consequently finished 31 days ahead of time in spite of the fact that nearly 4 weeks' time was lost at the start, due to lack of materials impossible to obtain.

We feel that in the presence of a record like this it is impossible for one to criticize reinforced concrete construction from the standpoint of its being slow in erection, as the building was built above the 1st floor complete ready for occupancy in 4 months. Had the frame been of structural steel, 4 months' time, at least, under present market conditions, would have been consumed in obtaining the delivery of the raw material, exclusive of the time required for shop work, erection and

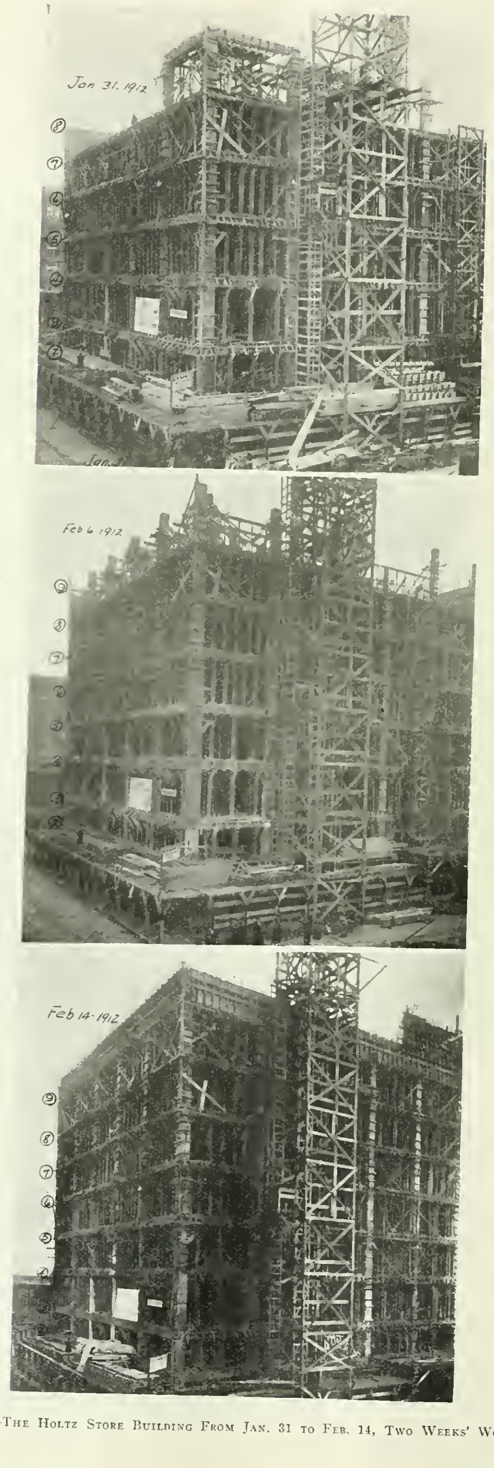


FIG. 2—THE HOLTZ STORE BUILDING FROM JAN. 31 TO FEB. 14, TWO WEEKS' WORK

the general construction of the building.

We take considerable pride in this construction, and in this feel that we are justified, as the owners and tenants

Fig. 4—The Building Was Finished As Shown by May 1

expressed their appreciation by giving us the largest bonus ever awarded in Portland for completion of a building ahead of contract time.

Louis F. Brayton.

The Brayton Engineering Co.,
Portland, Ore.

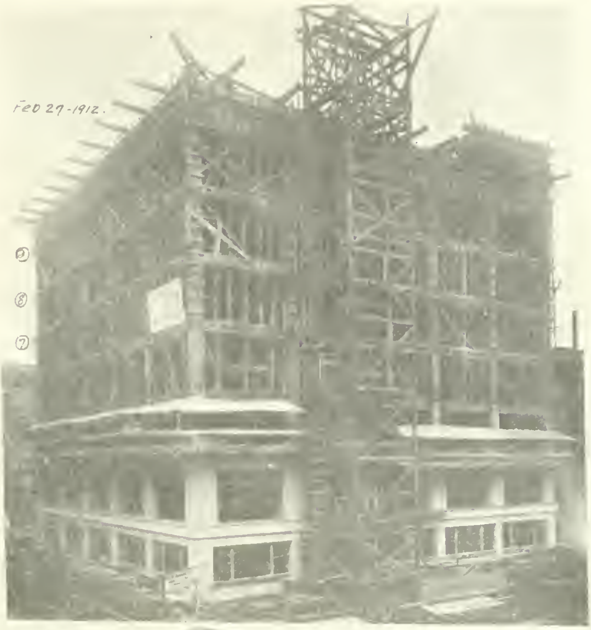
Concrete Makes for Rapid Work

I did not suppose that there was any argument as to reinforced concrete being the quickest type of construction available. We have never had any arguments about the speed, as it is quite obvious that the material required for this sort of work is more readily available than almost anything else used in building work. Cement, steel bars and lumber are always quickly available and under a good organization any building after the first floor is completed can go ahead at the rate of a story a week about as economically as at any other speed. This gait, of course, does not complete the building, as there is always work to do after the concrete part of the structure is in place, but the same work has to be done on a building of any other material and the rate of progress on a structure of any other material is very much slower.

I have always thought very pleasantly of the speed we made on the Harvard Stadium which was built some years ago, when we knew much less about handling reinforced concrete than we do today. We were able to occupy the field after the Harvard-Yale baseball game in June and had to turn the big structure over for seating of the Harvard-Yale football game in November. With what we know today we could probably handle a job like this very much faster and perhaps more economically.

M. C. Tuttle.

Abertháw Construction Co., Boston.



[illegible]

Congress and the Inventor

If everybody owning a piece of land were allowed by law just 17 years within which to use it or disuse it or deal with it as he chose, and at the expiration of that time were obliged to let the public use it without any restriction whatever, Utopia would be completely realized.

Suppose in that millennium that someone should arise and say that 17 years was too long a time for the public to wait, and suggest that unless the man had cleared his land wit his own hands he should be compelled within three years to improve it at his own expense or else let anyone else use it upon paying a sum which a court might guess was "just."

Wouldn't such a suggestion be denounced as unreasonable, even in Utopia?

If the words "property in invention" be substituted for "piece of land" in this supposition, the Utopia imagined would be exactly like the present state of the law regarding patents; and the suggestion which sounded so unreasonable, even in Utopia, would be precisely what Congressman Oldfield and the Patent Committee tried to do in Congress several months ago.

So unanimous, however, was the opposition all over the country from inventors, manufacturers, members of the Inventors' Guild,—including men like Thomas A. Edison,—engineering and electrical societies and commercial associations, that the Oldfield Bill was not pressed before Congress adjourned in August.

Congressman Oldfield announced, however, that his Bill will be passed by Congress this winter.

Do we want to kill inventive genius by cutting down its reward from 17 years of patent protection to a scant three?

Considering how enormously invention has enriched us in wealth, in comfort and in fullness and length of life, shall we gain by snatching five-sixths of the inducement to invention under the impression that we can thereby get the use of the invention a few years quicker?

The surgery by which the boy tried to get the golden eggs a few hours quicker was what killed the goose. Are we more sensible?

STERLING CHASE.

New York City.

Railroad Section Tool House

I attach hereto a sketch of a proposed railroad section tool house 10' x 14' with memoranda showing weight and cost. The cost has been made liberal and it can be built for less money than the same house built of wood, and it will be of great interest to your railroad readers, who could build them at their concrete products plants and ship them to destination on a flat car, as they have been designed the same width as a passenger coach so that they can be transported. The length can be varied. Wood skids have been provided underneath, so that loading and unloading will be simple. In the West, where track centers are wide, the houses might be built 12' 4" wide, and any length designed, at slight additional cost.

The amount of concrete in and weight of the house as planned is figured as follows:

Roof	10.5'x14.5'x0.33'=50.25 cu. ft.
Floor	10.5x14.5x0.33'=50.25 cu. ft.
Side walls	8'x14'x0.33x2 =74.00 cu. ft.
End walls	8'x10'x0.33'x2 =53.00 cu. ft.
Total	227.50 cu. ft. or 8.43 cu. yds.

Allowing 125 lbs. per cu. ft. the weight would be 14.25 tons.

The cost is liberally estimated as follows:

8.43 cu. yds. concrete at $10.00	$84.30
2 sash	5.00
1 pr. doors and hardware	8.00
700 lbs. reinforcing	28.00
1 smokestack	5.00
Cleats and racks	10.00
Pro-rata cost of forms	15.00
Loading onto cars	5.00
4 timbers 6"x8"x12'	9.60
Builders' profit, 10%	16.99
Total	$186.89

H. A. LLOYD.

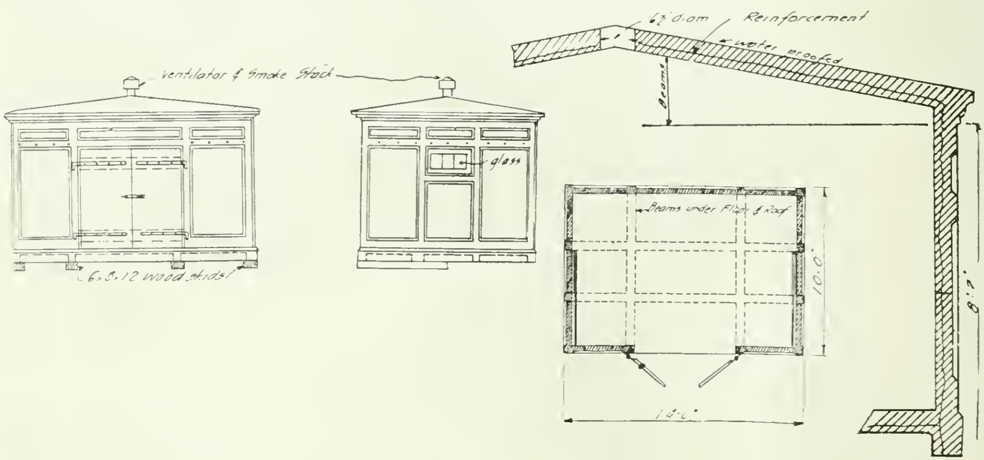
Newark, N. J.

Steam Curing

It is not absolutely necessary to have a steam curing plant in concrete products manufacture. Neither is there any saving in cost of manufacturing, but it is certainly very convenient and makes a material difference in the quality of the product. In the manufacture of block, for instance, we try to get in as much water as we can, but the facing of the block must necessarily be quite dry to prevent its sticking to the face plate. In the body of the block we use all the water it will stand without sagging when removed from the machine. If the facing could be made as wet as the remainder of the block, we should have very good block by allowing them to cure naturally, but the facing being so dry needs a supply of water to complete the chemical action of the cement. Therefore, it becomes necessary to devise a scheme to supply this water immediately after the block is made. If the water is used from a hose it will wash out the cement and thus destroy the face, and if the block is allowed to set the application does no good. But in the steam room a absorb as much as is necessary to com- gentle vapor is developed and the block plete the action, and a much better block is secured than by any other way I know of.

I have tried several schemes for steam curing. The first, an open-end pipe taking the steam direct from the boiler, but I found that the steam would rise to the top of the room, and condense and the drops of water fall on the upper block, while those below would secure little or no moisture or heat in the winter time.

Next time (before I had cars) I built a slat floor about 8" above the floor of the room and ran steam pipes under the slat floor with pet-cocks about 5' apart. The pipes were directly under each tier of block. This was much more satisfactory than the first attempt, as



DETAILS OF PROPOSED RAILWAY SECTION TOOL HOUSE the steam had to rise between the block and each row got its share while the steam was passing. The first row would set on the slat floor, then we made some jacks or horses, that would straddle the block, by nailing a plank 2" x 6" on top of uprights 2" x 6"; placing these about 10' apart, we laid planks across and laid another row of block on the planks, then repeating for the third tier, and so on for as many tiers as the room would hold, keeping the steam on all the time; and for those not using cars, I think this scheme can't be beaten. It is a very simple arrangement and the whole cost was about $400. I had a second-hand boiler and burned about two tons of coal per week. I made 250 block per day with two machines and cured them all in the basement of a house 26' x 40'. The basement floor was level with the ground in the yard, so it was necessary to put the boiler in a pit to receive the return water from the pipes. But business developed and it was necessary to build a larger plant which called for the use of cars and tracks.

The steam rooms were designed for an output of about 600 block per day and were made 10' wide, 60' long and 7' high to contain three tracks which accommodate 8 Chase cars each, and each car holds 24 block, making the kiln capacity 576 block, 8" x 8" x 24". The tracks are 2-ft. gauge and 1' apart. The rails are laid on ties 2" x 3", 5' apart, then cemented in. Between the tracks is a trench 10" deep at the receiving end and 5" deep at the delivering end. In this trench are the steam pipes. The feed pipe enters even with the floor and pitches to the delivery end. There are 1/4-in. pet-cocks every 5' in the length of the room. The steam is supplied direct from the boiler through a reducing valve and enters the steam room at 5 lbs. pressure, which is ample. The pet-cocks are turned toward the cars, the steam rising between the block, and a dense fog is created, which is evenly distributed through the room, every block getting a good supply of moisture. The block come out covered with moisture.

The walls of the steam room are of concrete block and the roof is boarded with matched lumber and covered with tar and gravel roofing. After using this for some time, I found that it was a little unsatisfactory, as the steam would condense on the roof and drip onto the block, thus cutting holes in the faces, so it was necessary to form an arch over each car to make the condensation run off to one side. This is done with galvanized sheet iron curved to form an arch. A board is nailed on the rafter in the center over each car and a strip 2" x 3" suspended from the ceiling by straps and the iron nailed into the side of the 2" x 3" and also to the wall. This carries the drippings to the side of the car and they fall on the floor rather than on the block.

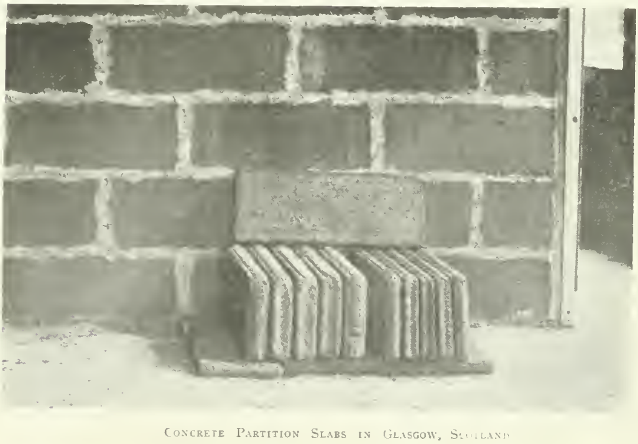
The tracks pitch to the delivery end 1" in 10', and with this arrangement one man can easily handle a car loaded with 24 block, or 2,300 lbs. The doors on the receiving end are made in sections, one door for each track, and are not hung. This allows us to take out a door at a time without losing so much steam as though the whole end of the room were open. On the delivery end, the doors are hung from the roof and a long pole with a weight at the top is fastened to each door. When open it is swung up in the air and forms an awning over the transfer track. The weight on the pole holds the door suspended. When the rooms are closed a canvas curtain is unrolled from the ceiling inside the wooden doors, making it practically air tight. It is essential to stop all draughts, for if draughts are present the steam goes to the top of the room and the lower block are not receiving their share. When putting in the trenches, I had in mind filling the trenches with water and running the steam pipe through the water, bringing the water to the vaporizing point. But the man who installed the steam system convinced me that it would cost too much for coal to heat the water, to be practical. Therefore I abandoned the idea. We have three steam rooms, each containing one day's work. We fill one today, tomorrow the next; next day we fill the third and empty the first; the third day fill the first and empty the second, and so on, leaving the block in the steam room about 48 hours, when they are hard enough to handle nicely without damage.

C. J. Rowley.

Builders' Concrete Stone Co.
Pawtucket, R. I.

Concrete Partition Slabs

Concrete can be easily molded into a light unit for partition work. The accompanying illustration shows work done by William Tonner & Sons, Glasgow, Scotland. The slabs are about 12" x30". Slabs very similar to this are being used in the Bush Terminal work, Brooklyn.



Concrete Partition Slabs in Glasgow, Scotland

A Concrete Watering Trough and Fence

The accompanying picture is not published because it represents anything beautiful or distinguished in the way of structural effort. It does, however, afford opportunity to make comparison between things of concrete and things of wood. This solid concrete watering trough and the concrete fence at its left will endure long after the buildings in the background have gone to decay. It was built on a farm near Joliet, Ill. The trough is sufficiently high for animals to drink comfortably, but can be arranged at any required

Trough and Fence Near Joliet

level by banking it up with earth. It is impervious and indestructible and far more economical than wood. The fence, which is built after the old board pattern, is especially desirable. It is suitable for either paddock or barnyard. It not only serves as a barrier, but in open country is an excellent protection from wind. Animals soon learn to seek its shelter on cold and windy days. Where the barnyard is near a house a fence of this character screens the enclosure.

It is in these homely but practical uses of concrete that the farmer and property owner find much of comfort and profit. They mean the elimination of bills for repairs and can be constructed at odd hours by ordinary labor, if intelligently supervised by the owner.

Fig. 1 Retaining Wall at the University of Pittsburgh

Concrete Retaining Walls in Pittsburgh

The illustrations show two concrete retaining walls recently completed in the city of Pittsburgh. Fig. 1 shows a curved concrete retaining wall built in connection with the construction of driveways on the campus of the University of Pittsburgh. The campus is a hillside site and the roadways are being built for the purpose of affording communication from one building to another. The type of construction here is plain concrete or gravity type. An interesting feature, desirable on account of the location, is a concrete parapet on the wall which, while simple in design, appears quite effective. The parapet is 15" thick underneath the coping, the coping itself being 2' wide. The quantity of concrete in this wall is about 450 cu. yds., and no special difficulties were encountered in construction.

Fig. 2 is a view of the recently completed retaining wall on Elliott St. This wall was built to replace an old stone masonry wall which had failed. The maximum height of this wall, which is built across a gully, is about 30 ft. from the top of the coping to the foundation. The quantity of concrete masonry placed in this wall is 425 cu. yds. The wall is completed with a 3-rail iron pipe fence.

In the past few years a large proportion of the retaining walls built in Pittsburgh have been of the reinforced concrete type. The walls above described, however, are samples of construction where, owing to the topographical features and other conditions, the construction of plain gravity walls was considered more economical.

Among the improvements now under way in Pittsburgh where concrete is being used in quantities may be noted the following:

In cutting the "Hump," all the streets are being constructed with concrete base; the raising and improvement of streets in the West End flood district; the elimination of the Second Ave. and Try St. grade crossing; widening and improvement of South 18th St., and other street improvements where all pavements are being laid with a 6-in. concrete base.

The city is also building 3 reinforced concrete bridges, two of which are on Atherton Ave.* over the Pennsylvania R. R. and the Pittsburgh Junction R. R., respectively, and one on the line of Hoeveler St. The total mass of concrete in these 3 bridges is about 16,600 cu. yds. Pittsburgh is also preparing plans for several other bridge constructions which involve the use of considerable quantities of concrete, among which may be noted the approaches to the North Side Point bridge, the Murray Ave. reinforced concrete bridge and the Haights Run reinforced concrete bridge. The aggregate estimated yardage of concrete is about 14,000 yds.

There is considerable activity in sewer construction in Pittsburgh. A contract was recently let for the construction of a concrete relief sewer in the 33rd St. drainage basin, about 3,000 ft. in length, the estimated cost of which is about $116,000. The city has also nearly completed a section of 48-in. concrete sanitary intercepting sewer in the West End flood district which will form part of a comprehensive intercepting system for what is known as the Saw Mill Drainage Basin, comprising about 20 sq. miles, a considerable portion of which is in the city limits.

Another example of extensive concrete work in the city is the construction of a large relief sewer in the Negley Run Drainage Basin. This sewer is about 9 ft. in diameter and its estimated cost is about $150,000.

An arch of concrete reinforced with embedded steel has all the permanence of stone; in fact, it is more permanent than the usual building stones, and has none of the limitations of steel, such as corrosion and crystallization; for concrete is but slightly affected by the elements, and the embedded steel is protected from rust and vibration. No painting or repairs are ordinarily required.

In the article describing concrete paving in Norwood, O., page 53 of the October issue, it should have been said that the mixer used on the work was the Chain Belt mixer made in Milwaukee, Wis.

Fig. 2 Gravity Type Retaining Wall in Pittsburgh

Building Failure Due to Workmanship

On the afternoon of Nov. 15 last, a section of a building at the corner of St. Antoine and Larned Sts., Detroit, failed. Three men were caught in the fall, and killed outright. Others received minor injuries. The building is a 2-story garage, 70' x 120'. A central row of columns 17' 2" apart, carry cross-girders. The floor construction consists of combination tile and concrete joists, 6" x 12" x 12" tile, a concrete joist 4" wide, and 2" of concrete over the tile. The slab span is approximately 16 ft.

The accompanying illustrations show the general arrangement of the building. Fig. 1 is a side elevation; the section involved in the failure comprised the first, second and third floors between columns 18 and 19, extending back into the building as shown in Figs. 2 and 3. The accident was probably due primarily to a failure of the second floor in front of the construction tower. Fig. 3 shows in outline the area of the second floor poured last (Oct. 15, 1912). This floor is immediately adjacent to the tower, and had to carry the day or so before the failure, the impact construction loads resulting from pouring the concrete of the third floor. The second floor was not sufficiently braced to carry these construction loads of the third floor. In stripping the centering of the second floor, all shores were removed, and the "re-posting" was apparently not so complete as it should have been.

The concrete on the second floor is apparently of fair quality, and the quality of concrete on the third floor does not enter into the question. The second floor, without sufficient shoring, was made to carry the construction load of the floor above. A concrete "buggy," carrying about 3 cu. ft. or only half of rated capacity, must weigh approximately 600 lbs.; and this construction load was probably most severe over the section which failed. The impact load is heavy where one of these buggies runs off a runway or drops an inch or more from a higher runway to a lower one. Two buggies were in use on the third floor.

In Fig. 3 a line starting at the center of the lintel between wall columns 1 and 2, and extending across the building to Panel "B," then across into Panel "C," and out to the elevator opening, defines the area of the second floor run Oct. 15, which was the last run on the second floor. This work was then 31 days old at failure. It will be noted by examining Fig. 3 that in the rear bay, the failure on the third floor was more extensive than on the second, yet in Panel "C" more of the second floor was destroyed by the fall of the third, and as shown in Fig. 5, a part of the third floor was carried on the centering of the girder between columns 10 to 17.

Fig. 4 shows a general side view of the building, the 4 rear panels of the side elevation of Fig. 1. This shows the hoisting tower, and the field-made wooden hopper as it was in position in running the third floor.

Fig. 5 is taken from a position on the third floor (roof) near the center of the girder between columns 11 and 20, as indicated in Fig. 3. This shows a girder on the third floor not shown in Fig. 3, running toward the front of the building from column 17. This was on the third floor to carry the elevator machinery. At the time these photographs were taken (Saturday afternoon, Nov. 16), 24 to 28 hours after the floor had been run, the concrete was still very soft, and could be easily scuffed up with the foot.

Fig. 6 is taken from a point near column 20, as indicated in Fig. 3, and shows in part the way the second floor acted in failing. As to the quality of work on the second floor, there was some talk of a heavy frost on the night of Oct. 15, the day the second floor section which failed was poured. The records of the Detroit office of the United States Weather Bureau show the following minimum temperatures:

October	12—45°	F.
"	13—43°	F.
"	14—41°	F.
"	15—44°	F.
"	16—39°	F.
"	17—43°	F.

At no time in October did the temperature go to 32°; the lowest recorded was 35° October 25.

The steel used throughout the work, shown in detail in Fig. 6, is high carbon open-hearth. An examination of the surface of failure where the second story wall beam joined column 18, shows that the reinforcing steel could not have extended very far into column. A detail view of the face of this column is shown in Fig. 7. The wall beam between columns 18 and 19, marked "L 2," calls for straight rods 16' 3". The span in the clear was supposed to be about 15' 9", allowing a 3-in. bearing into the column. However the back wall columns, it is stated, were 2½" out of plumb. This was to some extent evident to the observer the day after the failure. With the back column at all out of plumb, the bearing of the rods is diminished. Beam "L2" called for a truss rod 20' 0" long. A careful examination of column 18 shown in Fig. 7 fails to indicate that either trussed or straight rods were entered into the column to any great extent. The face of failure at column 19 at the second floor level, shows the gaping holes where the straight bars of beam "L 2" had been torn out, but there is little sign of the trussed or continuity bars. Beam "L 1" called for a trussed bar 24' 8" long. This, between columns 17' 2" on centers, and allowing for the truss, should have extended out into the top portion of Beam "L 2" an appreciable extent. The apparent absence of this continuity bar is still subject to explanation.

In Figs. 1 and 2 is shown the approximate position of the hoisting en-

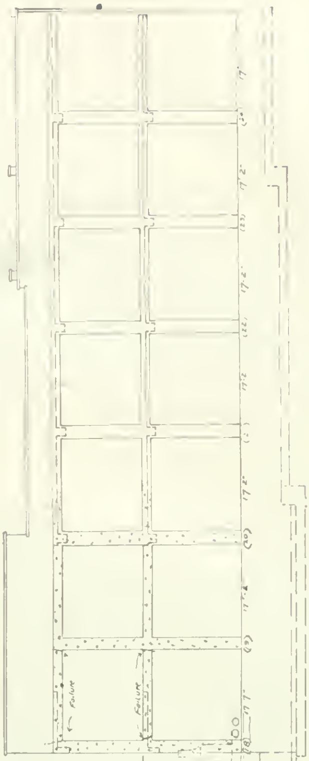


Fig. 2—Rear Elevation of the Building. The Failure Extended Back to Column 9, as Indicated

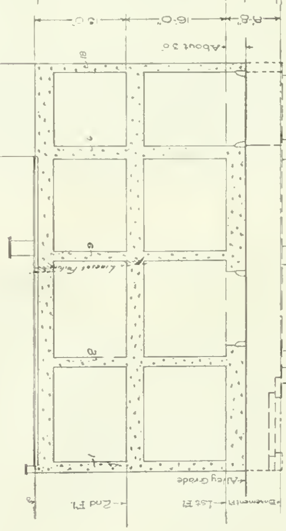


Fig. 1—West Elevation of the Building. The Failure Occurred Between Columns 18 and 19

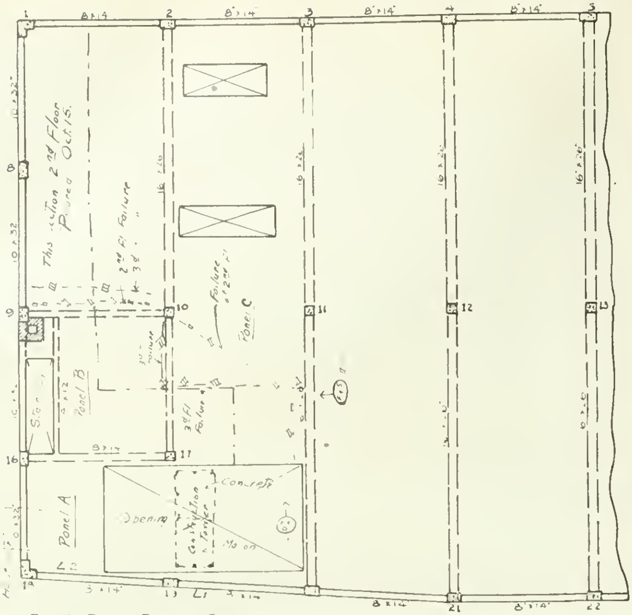


FIG. 3—DETAIL PLAN OF SECOND AND THIRD FLOORS SHOWING SECTIONS OF FLOOR THAT FAILED

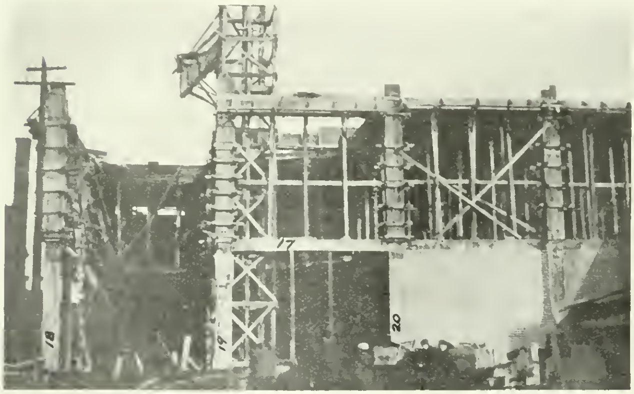


FIG. 4—SIDE VIEW OF THE REAR OF THE BUILDING, SHOWING THE SECTIONS OF THE FLOOR THAT FAILED, HOISTING TOWER, HOPPER, ETC.

FIG. 5—THE FAILURE AT THE THIRD FLOOR

FIG. 6—DETAIL OF THE SECOND FLOOR FAILURE SHOWING THE ACTION OF THE STEEL RODS

gine. The rear wall beam centering above the boiler was blackened with smoke. This blackened beam shows in Fig. 7. The position of the boiler and hoist offers two factors affecting the failure: one, the possible effect of vibration or strain caused by the operation of the hoist, and two, the very fact that the hoist was here may have interfered with the proper placing of shores. These are two points open to question.

The building was being erected by the owner under an arrangement with a local contractor, whereby the contractor furnished equipment, and estimated, requisitioned, and in some cases, ordered the material. The payroll was paid by the owner, upon requisition of the contractor. A local architect furnished general designs and specifications only, without supervision or details; and the structural concrete design, and the steel were furnished by a local steel company.

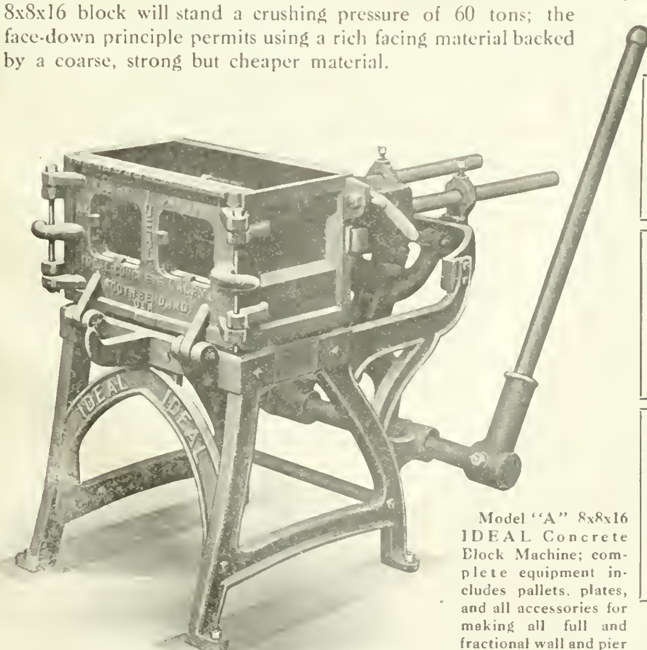
The failure is being investigated by the proper authorities, and until all the contributing circumstances are determined in detail, it is to no point to involve anyone in any way. It is plainly apparent in the conduct of this work, however, that no one experienced person was responsible for its proper execution. The work at the time of failure was in charge of a young man, who, it is stated, was running the hoisting engine prior to Nov. 2, when the superintendent, in charge of the work from its inception, left. The entire affair seems to be a series of circumstances in which, at any point, the accident would have been avoided by some one person being in responsible authority, with a workmanlike knowledge of handling concrete floor work. Erecting concrete is a trust and a responsi-

Grogg Made Concrete Blocks for His Own Use—Then Others Wanted Them

Auburn's largest factories are built of Grogg's Concrete Blocks

Over in Auburn, Ind., a cabinet maker—Isaac Grogg—wanted to build himself a workshop from concrete blocks. He bought an IDEAL Block Machine and went to work. Others in Auburn saw what Grogg was doing, liked the concrete block idea and wanted them for their own buildings. The demand started then has never ceased—now Grogg is the Auburn Novelty Company, concrete block makers.

You can do what Grogg has done. You can start with just enough IDEAL Machinery to profitably handle the business you have—as your business grows add the time-saving and production-increasing devices. The interchangeable feature assures a perfect fit of all additions. IDEAL Machinery makes 7 blocks more from a barrel of cement and a 25% faster output than any other machine; the 8x8x16 block will stand a crushing pressure of 60 tons; the face-down principle permits using a rich facing material backed by a coarse, strong but cheaper material.



Model "A" 8x8x16 IDEAL Concrete Block Machine; complete equipment includes pallets, plates, and all accessories for making all full and fractional wall and pier blocks in two designs.

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We publish a 160 page concrete-block-making encyclopedia which you need. To keep it out of the hands of catalog collectors we charge $1.00 for it but on your first order for $10.00 or over we will allow you $2.00, really paying you a dollar to read the book. Send for it now.

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Block machines, hand or power tamp.
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bility, requiring training and practical experience, and the work of supervision must, under any circumstances, not be entered into without a proper understanding of the work.

A floor, approximately 30 days old, was made to carry the construction and impact loads involved in pouring the

FIG. 7—COLUMN 18, AFTER THE FAILURE, THE BOILER STACK SHOWING AT THE RIGHT

floor above. All these details of steel placement, etc., in the second floor are not the main issue. *The floor should have been properly and sufficiently shored according to the best field practice.* This was not done, and the floor fell. The failure was one of workmanship.

N. A. C. A. Convention

(Continued from page 40)

S. Hudson, Chairman.

Report of the Committee on Fence Posts.

*"The Manufacture of Artificial Stone in Germany," Julius Carstanjen, Carstanjen & Co., Duisberg, Germany.

*"The Coloring and Texture of Concrete Products," Adolph Schilling, Philadelphia.

8:00 p. m.

*"The Use of Concrete by the Bureau of Yards and Docks," H. R. Stanford, chief, Bureau of Yards and Docks, Washington, D. C.

*"Recent Applications of Concrete and Reinforced Concrete in the City of Pittsburgh," Norman S. Sprague, superintendent, Bureau of Construction, Department of Public Works, Pittsburgh.

*"The Application of Concrete in the Abolition of Grade Crossings," James W. Phillips, assistant engineer, Department of Public Works, Philadelphia.

"Reinforced Concrete in Railroad Works," M. A. Long, architect, Baltimore & Ohio Ry., Baltimore.

*"Some Recent Applications of Concrete," Frederick Auryansen, bridge engineer, The Long Island Railroad Co., Jamaica, N. Y.

Saturday, December 14

9:30 a. m.

Visit to United States Government Testing Laboratories, Old Arsenal Grounds, Fortieth and Butler Streets, Pittsburgh.

*Illustrated with stereopticon.

Cement Section—Am. S. C. E.

The meeting of the Cement Section of the American Society of Mechanical Engineers will be held at 10 a. m. Thursday, Dec. 5, at the house of the society, 29 West 39th St., New York City.

An attractive program has been arranged and the following papers will be presented:

"Some Remarks on the Depreciation and Obsolescence in Portland Cement Plants," by G. S. Brown.

"Mechanical Appliances to Prevent Accidents," by Paul C. Van Zant.

"Motor Drive Data and discussion," by R. K. Meade.

"The Prevention of 'Missed Fires' in Blasting," by W. H. Mason.

"Deterioration and Spontaneous Combustion of Gas Coal," by Perry Barker.

Through the Chairman of the subcommittee, F. W. Kelley, of the Helderberg Cement Co., the members of the American Association of Portland Cement Manufacturers have been extended a cordial invitation to be present.

Trade Publications

Concrete Highway Bridges. Universal Portland Cement Co., Chicago. 6" x 9", paper bound, 40 pp. Illustrated. This booklet opens with a general discussion of the value of concrete in bridge construction. Typical bridge structures of many American cities and counties are illustrated and described.

Park Bridges of Reinforced Concrete. Daniel B. Luten, Indianapolis. 6" x 9", paper bound. Illustrated. Six of the most typical of concrete arch bridges designed by Mr. Luten are illustrated in this booklet.

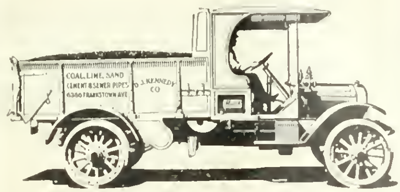
Buildings. Wilbur J. Watson & Company, Cleveland. 29 pp., 6" x 9", paper bound. Illustrated. This booklet shows interesting illustrations of some of the recent work designed by this company.

Oshkosh Portable Saw Rig. Oshkosh Mfg. Company, Oshkosh, Wis. 10½" x 7", paper bound, 16 pp. Illustrated. Concrete constructors are recognizing more and more that hand sawing is expensive. Well-built efficient portable saw rigs are used on every hand, and this catalog describes in detail the essential features of the Oshkosh equipment.

Metal Lath Silos. Northwestern Expanded Metal Co., Chicago. 48 pp., paper bound, 6" x 3½". Illustrated. This vest pocket circular is a reprint of a paper on concrete silo construction published by the Extension Department of the Kansas State Agricultural College, and covers the subject in an interesting and instructive manner.

Expansion Bolt Facts. The Van Expansion Bolt Mfg. Co., Fort Dearborn Bldg., Chicago. 6¾" x 3½", paper bound, 14 pp. Illustrated. The "Van" expansion bolt is described in detail. The holding power of this bolt was investigated in a mechanical engineering laboratory, and the results of the tests are presented.

United Steel Sash. Trussed Concrete Steel Co., Detroit. 10¾" x 8", paper bound, 102 pp. Illustrated. Maximum daylight is an essential in modern building construction, and steel sash are a primary consideration. This catalog describes in detail "United" steel sash, its installation and operation. Steel sash used as office partitions are an interesting feature.



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No other trucks have such records of steady, economical service as Mack, 12 years; Saurer, 18 years; Hewitt, 10 years.

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High School, Phoenixville, Pa. Henry Reinhold, Architect, Philadelphia
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The walls of this building are waterproofed and colored with

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the only artistic and thoroughly waterproof concrete colorings. The waterproofing penetrates into the pores and fills them, making the surface completely and permanently rain-proof. The coloring effects are soft and artistic and do not cover over or spoil the natural cement texture as coatings do. They form no coating and therefore cannot crack or peel off, but grow softer with age. They cost less than coatings, are easier to apply, more durable and much more waterproof.

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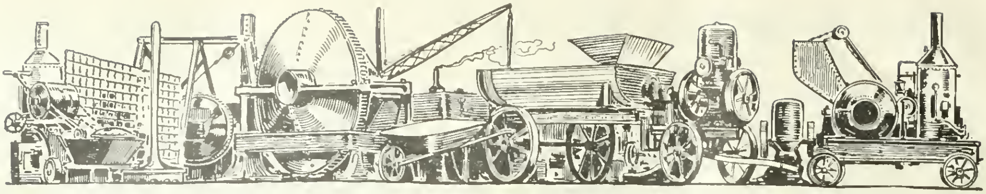
Conservo Wood Preservative — Sheathing and Deafening Quilt
Damp-proofing Protective Paint



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

Cold Weather Concrete

The accompanying illustration shows an ingenious use of a "hot" mixer for heating concrete aggregates in cold weather work. The equipment illustrated is the standard "Smith" mixer (T. L. Smith Co., Milwaukee), equipped with the "hot" pipe. This was designed primarily for heating bituminous materials when being mixed in the drum. A steam blast drives flame and heat from the fire-box through the pipe into the drum; and the materials being mixed are "sprayed" through the hot blast.

For heating concrete materials, the elbows are reversed, and the "hot" pipe goes out into the stone and sand, adjacent to the mixer. This equipment has the advantage of thawing out and heating materials without reducing in any way the capacity of the mixer. The plant is provided with a boiler of capacity sufficient to operate the mixer and at the same time generate plenty of heat for treating the materials.

In using this equipment the material could be dumped into bins built around the "hot" pipe, feeding out at the bottom, immediately adjacent to the pipe, and if possible within shoveling distance of the loading hopper. This arrangement should make for the economical and effective heating of concrete materials.

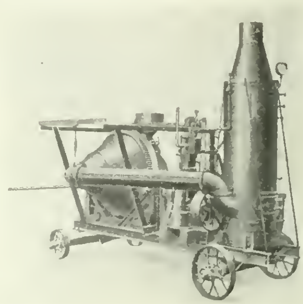


FIG. 1—GENERAL VIEW OF MIXER WITH "HOT" ATTACHMENT

P-169

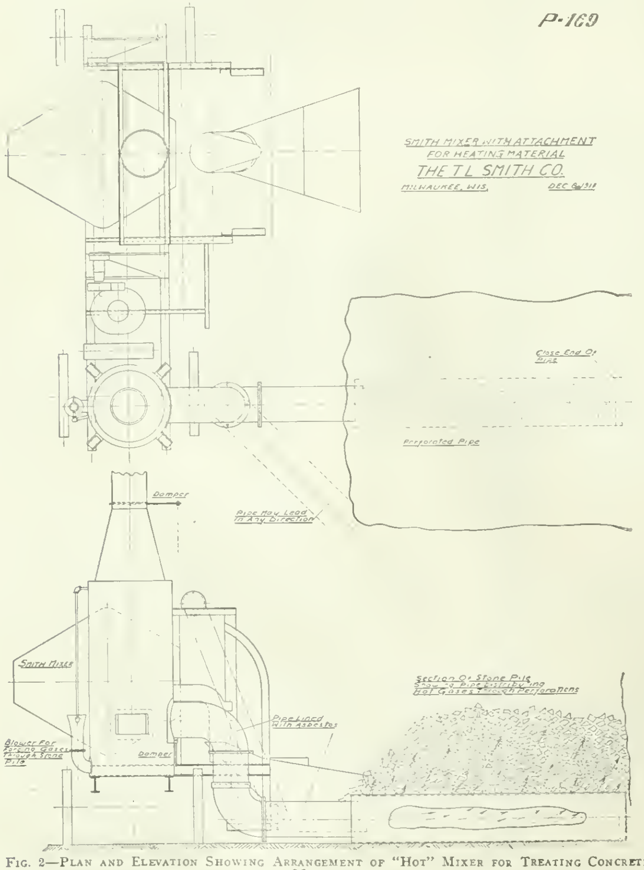


FIG. 2—PLAN AND ELEVATION SHOWING ARRANGEMENT OF "HOT" MIXER FOR TREATING CONCRETE MATERIALS

Barrett Specification Roofs

A Mile of Barrett Specification Roofs

The wonderful Bush Terminal in Brooklyn, illustrated below, includes 181 buildings, comprising tremendous warehouses, enormous pier sheds for docking ocean steamers, huge factory buildings, a large modern power house and an enormous freight structure.

These buildings stretch for a mile along New York harbor. Their total roof area is 3,100,000 square feet—more than seventy acres.

This entire area was covered with Barret Specification type of roofs, for the following reasons:

1. Low first cost.
2. No maintenance expense, such as painting, etc.
3. They are not injured by steam, gases and acid fumes.
4. They are fire retardent and take the base rate of insurance.
5. The net unit cost, that is, the cost per foot per year of service, is lower than that of any other type.

Although some of the buildings are fifteen years old, the roofing contractor states that the expense for maintenance of this entire roof area has been less than $10.00.

He estimates that if metal or ready roofings had been used, it would have been impossible to keep the buildings free from leaks and that the painting bill alone up to date would probably have amounted to at least $50,000.00.

We wrote to the Bush Terminal Company, asking what they thought about Barrett Specification Roofs. The Vice-President replied:

> "We use this kind of roofing because our experience has shown it to be the best and cheapest. Our analysis of first cost of application and cost of maintenance entitles us to speak with some measure of authority."

We shall be pleased to mail architects, engineers or owners of buildings copy of the Barrett Specifications with diagrams from which blue prints can be made. Address our nearest office.

Barrett Manufacturing Company

TRADE B MARK

New York, Chicago, Philadelphia, Boston, St Louis, Cleveland, Pittsburgh, Cincinnati, Kansas City, Minneapolis, Seattle, Carey, Ala. THE PATERSON MFG. CO., Ltd.:—Montreal, Toronto, Winnipeg, Van Couver, St. John, N. B. Halifax, N. S.

Special Note

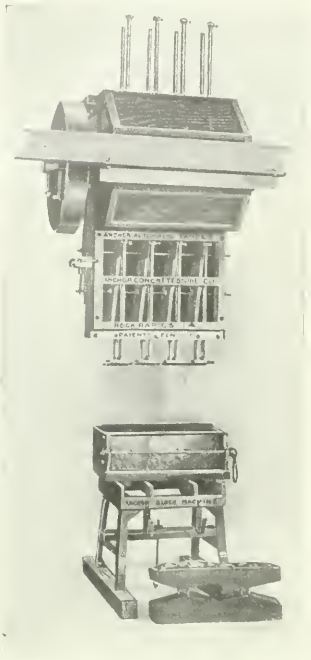
We advise incorporating into plans the full wording of The Barrett Specification, in order to avoid any misunderstanding.

If any abbreviated form is desired, however, the following is suggested:

ROOFING—Shall be a Barrett Specification Roof laid as directed in printed Specification, revised August 15, 1911, using the materials specified, and subject to the inspection requirements.

The Anchor Automatic Tamper

The accompanying illustrations show the general arrangement of the Anchor tamper. (Anchor Concrete Stone Co., Rock Rapids, Ia.) This equipment is constructed of solid steel and is placed directly above the block or brick ma-



THE ANCHOR AUTOMATIC DISENGAGED AND HELD CLEAR ABOVE BLOCK MACHINE

chine, taking up no floor space. About 1½ h. p. are required to operate the tampers.

From letters received from plants using this tamper, a better, cheaper and more uniform product can be made with a machine tamper than by hand tamping.

Demonstrating Concrete Pavements

A contrivance intended to draw attention to the Atlas Portland Cement Co. booth at the recent American Road Congress at Atlantic City is not unlike, in its main idea the Paving Determinator designed by J. C. McCabe—described in this issue.

It consisted of a miniature concrete roadway, 2′ wide and 16′ in diameter, built in 4 sections, each a different type of concrete roadway construction. Section No. 1 was a 1-course mixture of 1:1½:3, 6″ thick, with troweled surface; No. 2 a 2-course, the 4″ base of which was 1:3:5, and with a 2-in top course of 1:2, ¼-in. screened grit, with a broomed surface; No. 3 a 1-course 1:2:4 mixture, with a bituminous covering, and No. 4 a 1-course, the same as No. 2, but with a bituminous covering. Over this concrete roadway were run two wheels of a standard equipment commercial auto truck. Each of these wheels was driven by a motor, just as in actual service, and the weight on each wheel was 800 lbs. These wheels were run almost continuously for the week, and in the same track 79,500 times. This is equivalent to 23,850 vehicles traveling over one mile, on a 16-ft. road. This exhibit was not intended to demonstrate conclusively the wearing qualities of the concrete road. It was one of the most attractive features of the show, and was closely watched to detect any possible wear. Not the slightest wear was discernible.

Could such a track as put down by the Atlas company have included sections of macadam the superior value of concrete under automobile traffic would have been much more apparent.

Use of Molds Increases

The Simpson Cement Mold Co., Columbus, O., has again take on larger quarters and its new address is 179 West Maple St. The company will be at both the big cement shows—at Pittsburgh and Chicago. During the past season Simpson molds have been ordered and shipped in very large numbers, and the total number in use is now approaching 50,000. Not only has the domestic trade been excellent but foreign trade has assumed much larger proportions than ever before. The company's orders and correspondence indicate in a remarkable way the spread of interest in concrete, not only to far distant points on the usual lines of travel but also to some of the most out-of-the-way points in countries scarcely considered civilized. Recent inquiries announce the formation of some concrete block companies in the islands of Polynesia—among Malay countries of the South Seas which are almost unknown except to the readers of the fanciful tales of Jack London. A large shipment of Simpson molds was recently made to Quito, Ecuador, packed for transportation on muleback over 100 miles or more of mountain roads in the Andes.

For the coming season, some new column molds have been placed on the market. These molds are made in both rock-face and panel designs and range from 6″ to 16″ square, with "OG" caps and bases to fit all sizes.

The Atlas Portland Cement Co. has sent out a neat announcement directing attention to the fact that the 5,000,000 bbls. of "Atlas" cement already supplied for the construction of the Panama canal have been accepted by the U. S. government without the rejection of a single barrel; and further, the government has ordered The Atlas Portland Cement Co. to supply, in addition, all the cement necessary to complete the work in the entire canal zone.

The Monarch Mfg. Corpn. announces the removal of its plant from Onawa, Ia., to Boone, Ia., where it has recently completed a modern factory building. The new factory is built of reinforced concrete, and is modern in every detail. It will give the company ample room for its growing business.

"Monarch" supplies, such as packer heads, trowels, pallets, jackets and jacket fronts, may be used on any of the standard tile machines, and prompt shipment of any supplies can be made.

The Monarch tile machine has met with approval. The No. 3 machine makes tile in all sizes from 4″ to 18″ in diameter and 12″, 18″ and 24″ in lengths, and is used extensively.

Lupton Specialties—No. 6. David Lupton's Sons Co., Philadelphia. 11″ x 8½″, paper bound, 36 pp. Illustrated. This catalog describes in detail side-wall steel sash, counterbalanced and continuous sash. Window operating devices, louvers, and similar equipment is presented in detail.

Utility Wall Board. The Heppes Co., Chicago. 24 pp., paper bound, 9″ x 6″. Illustrated. This is a fibrous composition board, available in convenient length and width, and is used instead of lath and plaster for interior wall construction. The material and its uses are described in detail.

The Pulsometer. The Pulsometer Steam Pump Co., 17 Battery Place, New York City. This leaflet illustrates some of the recent work on which this pump has been used. A diagram is also included showing the comparative efficiency of this pump with a simple cylinder pump expressed in capacity gal. per min. and weight.

Facts. American Engineering Company, Philadelphia. 9¼″ x 6″, paper bound, 47 pp. Illustrated. This is the title of a catalog presenting the results of many tests made on the mechanical efficiency of the Taylor underfeed stoker.

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In preparing the index for this volume, we have endeavored to make the subject matter accessible under the best known heads. As practically every item deals with cement or concrete in some way there has been no attempt to index under "cement" or "concrete." There is no classification under "tests" or "testing" and in general none under "design" or "construction." Look directly for the subject.

"(E)" indicates that the item is found in the Editorial Department, "(Inf.)" Information Department, "(Com.)" Comment, (Con.) in Consultation, "(I-C)" in Information-Consultation, "(Cor.)", in Correspondence, "(Briq.)" in Briquettes. Illustrated articles are followed by (*). The months and the pages are indicated.

Concrete