Foundation Walls *and* Basements *of* Concrete

Concrete for Permanence

Published by
Portland Cement Association

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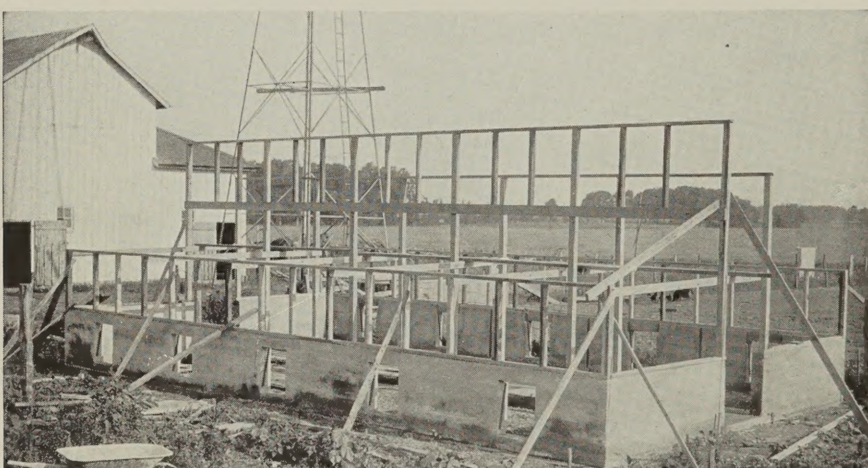
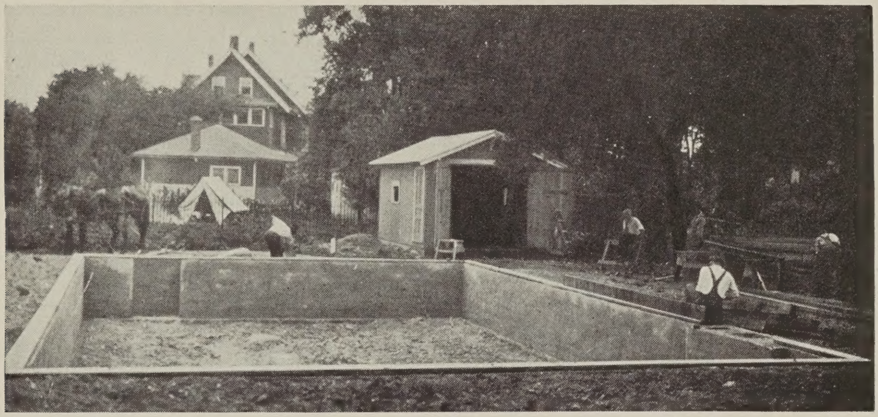
Every building should rest on a strong, durable foundation. Because it insures uniform distribution of the weight of the building on the soil, such a foundation prevents settlement and cracking of walls, reduces maintenance and repair costs, and prolongs the life of the building. Concrete meets all requirements so well that it is now being used for basement and foundation construction almost to the exclusion of other materials. Concrete is always used to support skyscrapers, yet it is so moderate in cost that it is economical to use it for foundations of even the smallest farm buildings. Sand and pebbles make up the bulk of a concrete mixture and can usually be obtained locally at moderate cost, sometimes for only the labor of digging. Forms are easily made by anyone having average carpenter skill and mixing and



A sanitary, permanent wall is formed by carrying the foundation of this hog house three feet above grade.

placing is done by common labor under intelligent supervision. Concrete foundations are uninjured by freezing, thawing or other weather changes. They are also ratproof, fireproof, economical and permanent.

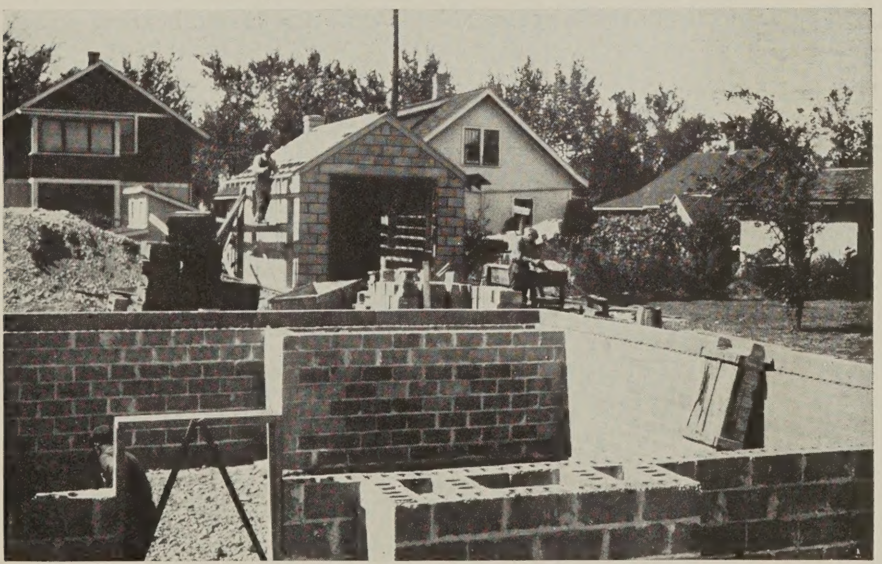
Many cities in rat infested districts have passed ordinances requiring that buildings be made ratproof with concrete floors and foundation walls, because no rat can gnaw through concrete. By keeping rats out of a storage building, a concrete foundation or basement wall will in a short time prevent waste or destruction of food or other products equal to its cost.



A typical monolithic or solid concrete foundation in place after the forms have been removed. Sills are attached to the walls by means of bolts set in the concrete.

Types of Foundation Walls

Concrete foundation and basement walls are of two types, those made of concrete cast in place and those built of precast units, such as concrete block. Both types have proved satisfactory. Concrete block walls are usually less expensive than solid concrete walls, but where loads are very heavy or where there is a severe side thrust of soil as in deep cellars or hillside locations solid concrete walls are usually preferable. Where unusual strength is required steel reinforcement and concrete pilasters or buttresses are easily added.



A typical concrete block foundation in the course of construction. This kind of foundation may be built quickly and at a minimum of expense, assuring a strong, durable structure.

Designing the Foundation Wall and Footing

Concrete foundation walls and footings must have sufficient strength to support the weight of the building safely and without settlement. When the foundation serves as a basement wall it must have strength to withstand the lateral pressure of the soil and also must be watertight.

For all types of buildings it is essential to extend the foundation below possible frost penetration even though firm bearing soil is found at a shallower depth. Then the foundation will not be upheaved by freezing. The depth to which frost penetrates varies and may be as much as 6 feet in sections where winters are severe.

The base of the foundation is usually given a "spread" or "footing" to distribute the weight of the building over a larger area than covered by the area of the base of the walls. In determining the width of footings the character of the soil, as well as the weight of the structure and its contents, must be taken into account as the load bearing capacities of different soils vary.

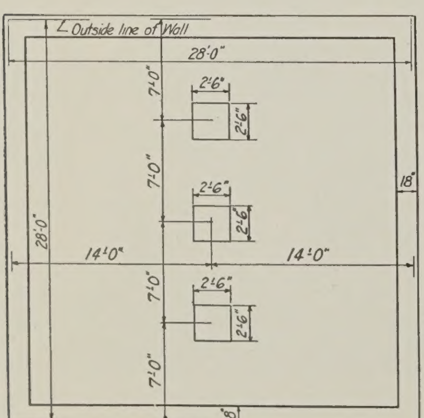
The following table indicates the safe loads for various soils:

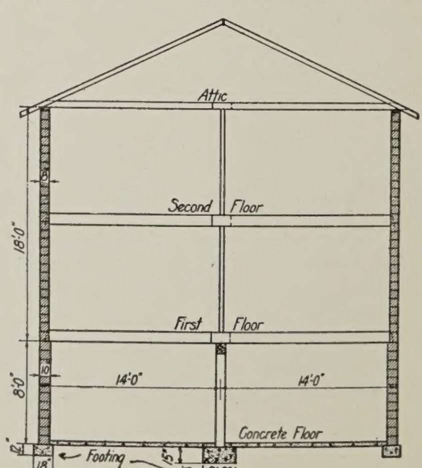
Soft clay	1 ton per square foot
Wet sand	2 tons per square foot
Firm clay	2 tons per square foot
Fine and dry sand	3 tons per square foot
Hard dry clay	4 tons per square foot
Coarse sand	4 tons per square foot
Gravel	6 tons per square foot

To calculate the proper width of footing, it is necessary to estimate the load to be carried (the weight of the building and contents) and to ascertain or make reasonable assumption of the bearing power of the soil where the building is to be located.

Typical Example

The following example shows the method of calculating the width of footing for the two-story concrete block residence, the cross section





and foundation plan on page 4, the building located on soft clay soil that has a safe bearing capacity of 1 ton per square foot.

Combined "live" and "dead" loads are assumed to be as follows:

First floor	50 pounds per square foot
Second floor	50 pounds per square foot
Attic floor	20 pounds per square foot
Roof (including wind pressure)	40 pounds per square foot

Weight of 8-inch concrete block wall, 70 pounds per square foot.

Weight of 10-inch concrete block wall, 80 pounds per square foot.

No deductions are made for door and window openings.

Note that the "live" load is the load caused by contents and moving objects. The "dead" load is the weight of the materials of the building itself. Each must be computed or estimated carefully in every case.

Load on Wall Footing per Lineal Foot

10-inch basement wall, 8 ft. high, 8 times 80 lb.	= 640 pounds
8-inch superstructure walls, 18 ft. high, 18 times 70 lb.	= 1,260 pounds
1st and 2d floor loads, supported on walls, ½ span, 2 times 7 times 50 lb.	= 700 pounds
Attic floor walls, ½ span, 7 times 20 lb.	= 140 pounds
Roof load, Area times load divided by perimeter	= 280 pounds
Total load on footing per lineal foot	3,020 pounds

Since 1 square foot of soft clay soil will bear 1 ton (2,000 pounds) it will require approximately 1½ square feet to carry 3,020 pounds. Therefore, a footing 18 inches wide is needed. A footing of this width should be from 9 to 12 inches deep. A good rule to follow in the design of footings for small buildings is to make the depth of the footing a little more than one-half its width.

Load on Each Post Footing

First and second floors, 2 times	7 times 14 times 50 lb.	= 9,800 pounds
Attic floor	7 times 14 times 20 lb.	= 1,960 pounds
Partitions		= 1,000 pounds
Total load on each footing		12,760 pounds

Dividing 12,760 pounds by 2,000 pounds, the load 1 square foot will bear, gives 6.38 as the number of square feet needed to carry the load. A footing 2 feet 6 inches square has approximately the required area. Though this may seem a larger footing than is commonly used in small houses, it is needed to carry the load. Central footings with too small bearing areas are often the cause of floor settlement in residences.

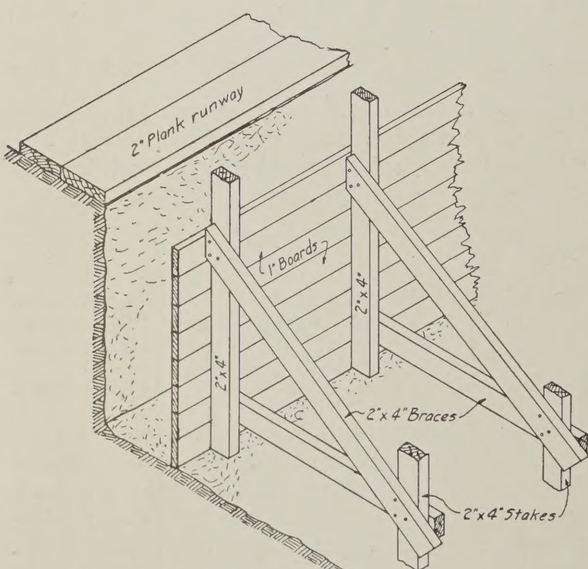
In a similar manner, the proper width of footings can be determined for any size of building.

Suggested Dimensions for Foundation Walls and Footings of Small Buildings

Under the basement walls of a barn, a concrete footing 2 feet wide and 12 inches deep will usually be sufficient. Interior posts supporting mow floors must also have carefully designed footings to carry the maximum load. Small residences generally require footings 18 inches wide and 12 inches deep. Footings 12 inches wide and 8 inches thick will serve for farm buildings such as hog-houses, poultry houses, milkhouses and buildings of that size.

A foundation wall 8 to 12 inches thick is generally ample for structures not more than two stories high. Small structures such as poultry houses, milk houses and garages require foundation walls from 6 to 8 inches thick. Basement walls for small and moderate sized residences are generally made from 8 to 12 inches thick.

The thickness of walls is often regulated by state or local building code. Eight inches is usually specified as a minimum thickness for exterior or load bearing walls. In dwellings, private garages and other small buildings the actual loading is frequently less than 1/25 of the crushing strength of the wall but a minimum thickness of eight inches has been commonly adhered to regardless of load for reasons of stability and convenience in construction. The thickness of bearing walls in heavily loaded buildings is properly governed by the load to be carried.



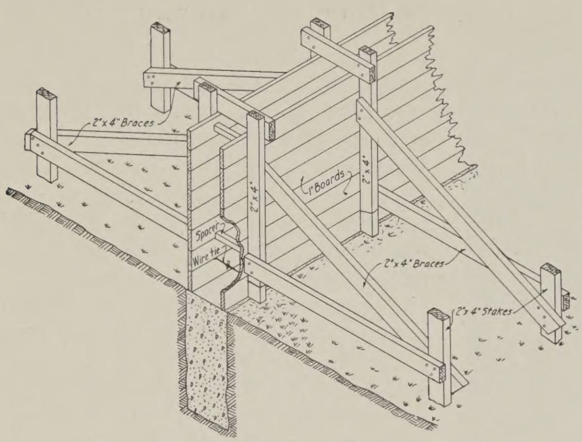
Forms for foundation walls where the embankment serves as the outer form. Illustrations on page 7 show the case where wood forms are used both inside and outside.

Concrete Footings

The usual practice is to lay monolithic concrete footings for all types of foundation walls. They are easy to build and insure uniform distribution of the weight of the building on the soil. They provide an even surface on which to start laying the wall proper whether block or monolithic.

Earth Forms

In building foundations for small structures without basements, the earth walls of the foundation trench may be

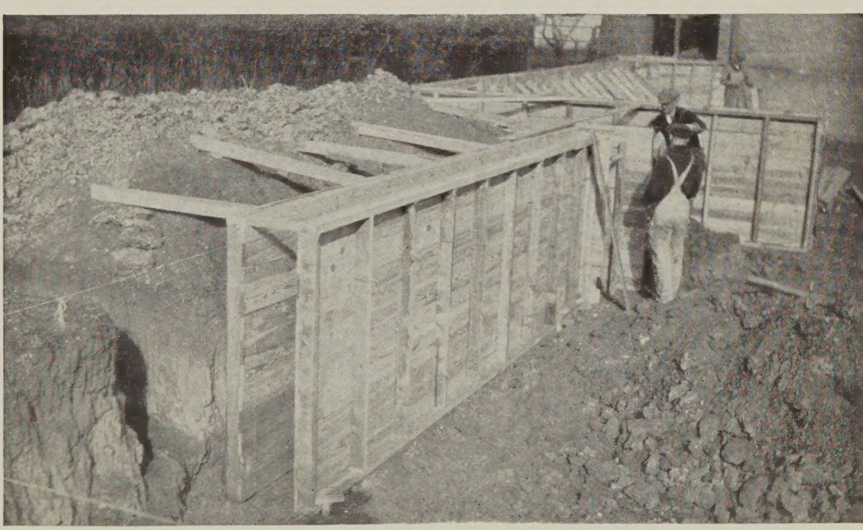


Forms for foundation wall above grade.

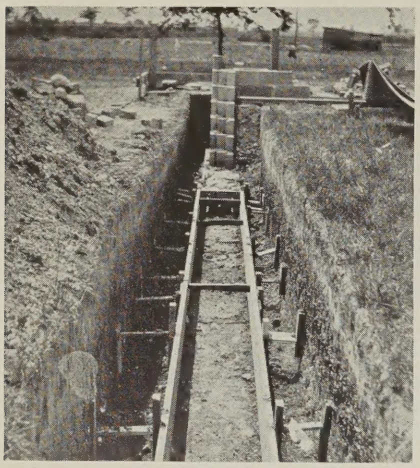
so firm as to make it unnecessary to use specially built forms for that part of the wall below grade. The trench should be excavated carefully so that the sides will be even and vertical, and care should be taken not to knock earth into the trench when depositing or spading concrete. Planks placed alongside the trench will help to protect the edges and provide a convenient runway for wheelbarrows. In soft ground and for walls above ground levels, forms are required.

Wood Forms

Forms or molds are the receptacles in which concrete is placed so that it will have the desired shape or outlines when hardened. Forms are usually built of wood. Where a very regular and even surface finish is required, planed lumber should be used. Well seasoned, air dried lumber is best, as green lumber will shrink if not kept wet, thus opening cracks in the forms through which water



Forms, when built in sections, are easily erected and removed and may be used many times. Sections should not be too long or too heavy for two men to lift. The forms shown in this picture would be more convenient if made in sections half as long.



Forms for a concrete footing in place. Note that the concrete block wall has been begun at the far corner.

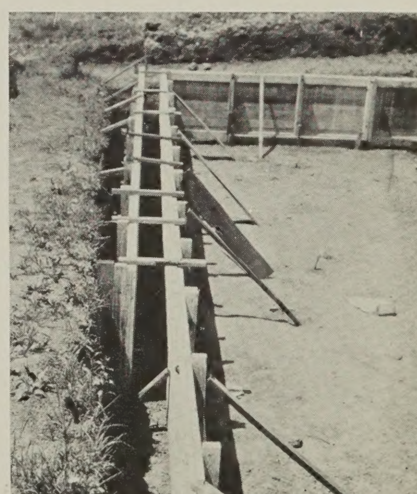
carrying cement will leak when the concrete is placed. It is best to use lumber that has been dressed at least on one side and on the edges, because the boards will fit closely together and the planed surface next to the concrete will reduce the labor of removing and cleaning forms. Tongued and grooved lumber is often used for form sheathing, and is recommended for tight forms. Form lumber should be uniform in thickness, as any inequalities of thickness cause unevenness on the concrete surface.

Beveling one edge of each form board reduces the tendency toward bulging which might result from swelling of the boards due to absorption of moisture from the concrete. Any expansion that occurs is taken up by the compression of the fibers in the beveled corner.

Posts and studs for supporting forms must be sufficiently stiff and strong to hold forms in true line. Forms should always be rigid and well braced in order to withstand the pressure of wet concrete and produce a straight, even wall without bulges or depressions. For keeping inside form surfaces the proper distance apart, inner and outer sections should be clamped or wired together, against wood "spacers" or "spreaders" of a length equal to the desired wall thickness. The spreaders are removed as the forms are filled with concrete.

Forms should be so built that if it is desired to use them again or to use the lumber for other work, they can be "knocked down" with least injury to the lumber. Screws or special double headed nails are often used instead of common wire nails for making forms.

To prevent concrete from sticking to the forms and to aid in their removal, crude oil, soft soap or whitewash should be painted on the forms before plac-



Forms in place for a monolithic concrete foundation wall on completed footing.

ing concrete, this being repeated each time the forms are used.

Retaining Walls

Foundations for deep cellars and basements for buildings on sidehill locations must often withstand a heavy side pressure from the soil. These foundations are then designed as retaining walls. They require careful design, and if the builder is not familiar with the principles of retaining wall design, he should consult a competent structural engineer. Basement walls of large barns are often designed as retaining walls. For most residences and farm buildings the ordinary basement walls have sufficient strength to withstand soil pressure.

Concrete Mixtures

If the foundation is located in soil that is not well drained and is to form part of the enclosure of the basement or cellar, a 1:2:3 mixture (1 part cement, 2 parts sand and 3 parts pebbles or broken stone) is recommended for such work to insure watertight construction. For most foundation work a 1:2½:4 and in some cases a 1:2½:5 mixture will be found satisfactory. Sand should be clean and well graded in size up to one-fourth inch. Pebbles or crushed stone should also be clean, hard and well graded, ranging in size from one-fourth inch up to 1½ inches or more, depending on the thickness of the foundation wall.

Use only enough water to produce, after thorough mixing, a plastic workable mixture. Too much water produces a sloppy mixture, resulting in a concrete of inferior strength and too little water results in a porous concrete also deficient in strength. From 6 to 7 gallons of water per sack of cement will usually produce about the right consistency for a 1:2½:4 concrete.

Concrete should be placed in the forms in layers of from 6 to not more than 10 inches deep and in a continuous operation if possible to avoid construction seams. Concrete of the consistency described above will require only light tamping but should be well spaded next to form faces to obtain smooth, even surfaces. It is well to complete a foundation or wall in one day's operation if possible so as to avoid construction seams. If it is necessary to stop work before a wall can be finished the concrete should be leveled in the forms and the surface roughened by scratching it or by placing large pebbles in it projecting about half way out of the concrete. This will help to secure a good bond between old and new layers of concrete when work is resumed. Before depositing an additional layer of concrete the roughened surface of old concrete should be scrubbed to remove any dirt or scum and, just before placing new concrete, it should be painted with cement and water mixed to the consistency of thick cream.

Frozen Concrete

Concrete may be placed safely even in cold weather if water, sand and stone are heated and the finished work is protected from frost. Heat hastens and cold delays the hardening of concrete. Under conditions favorable for hardening, concrete soon acquires sufficient strength to be safe against damage by frost. The warmer it is kept the sooner will it reach this degree of hardness. Concrete which has frozen before it has thoroughly hardened is often mistaken for properly hardened concrete, but when it thaws it will soften.

Our booklet, "Concrete Around the Home," gives full directions for proportioning, mixing and placing concrete. "Winter Construction with Concrete Masonry" and "Concreting in Cold Weather" give directions for cold weather work. Copies of these booklets will be furnished free on request.

Reinforcement in Foundation Walls

If the wall is to carry extremely heavy loads or is to be subjected to excessive side pressure, vibration or unusual strains, steel reinforcement must be used. Reinforcement is also used in walls above ground to counteract expansion and contraction caused by temperature changes. Reinforcing rods are also required over door and window openings. The size and number of rods will be governed by the width of the openings and weight of the super-structure. The design of reinforcement involves the application of engineering principles and is best done by an experienced engineer.

Concrete Block Basement Walls

Concrete block are now in common use for the construction of basement walls. They may be laid up quickly and economically because the units are relatively large, and uniform in size and shape. No forms are required. The air spaces in the block help to provide a dry, well insulated wall as well as to effect a saving in concrete and to make the units lighter and easier to handle.

Concrete block used in basement construction should have great compressive strength or carrying capacity. The block should develop an average ultimate compressive strength of 700 pounds per square inch over the gross area of the block when 28 days old. Booklets are issued by the Portland Cement Association containing specifications for concrete block, adopted by the American Concrete Institute, and other useful information on the use and manufacture of concrete building units. Copies of these booklets will be sent on request.

For the foundation wall below grade, smooth faced unsurfaced block are used. Unsurfaced block are also used above grade and when the wall is to be stuccoed. Block having smooth faces or special facings of selected aggregate are recommended if stucco is not to be applied.

Laying Concrete Block

Care is needed when laying concrete block to secure a strong, watertight wall. Mortar for laying block is usually mixed in the proportion of one part portland cement, one part lime and six parts sand, (measured by bulk). Use only well slaked or commercially hydrated lime. The sand should be clean and well graded. By "well graded" is meant that the particles should not be all fine nor all coarse, but should be made up of fine, intermediate and coarse particles. Sand should pass through a screen having meshes ¼ inch square. Mix

A line of concrete drain tile placed on the outside of the footing assures a dry basement.

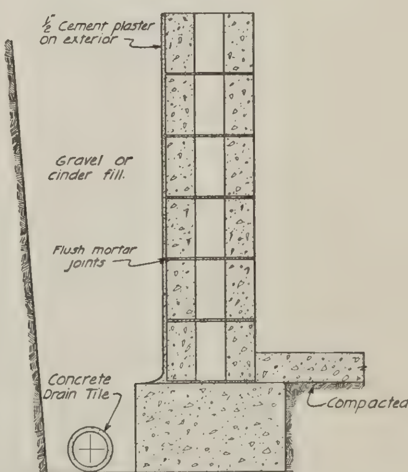
only enough mortar at one time for 30 minutes' work. Retempered mortar should not be used, as its strength will be reduced.

Before the block are laid they should be moistened with water so that they will not absorb too much water from the mortar, thus reducing its strength.

In first class masonry work joints are usually made from one-fourth to three-eighths inch thick. All joints should be well filled with mortar and carefully pointed. Joints on the outside wall below grade should be struck flush with the wall surface.

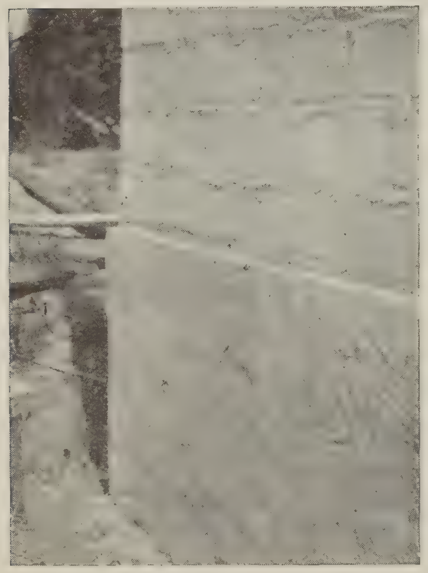
Constructing a Watertight Basement

The time to make a basement wall watertight is when it is built. It costs less to build a watertight wall than to repair a leaky one later. If properly made, a concrete wall is watertight. The aggregates must be carefully graded and properly proportioned with the correct amount of cement and water and then mixed and placed as described on the preceding pages. However, it is not always easy to get first class workmanship and when the foundation is located in heavy water-logged soils, water may find its way through construction seams. To allow for the possibility of defective workmanship, it is well to use the additional precautions shown in the illustration on page 12 and described below. Similar methods are used for repairing leaky basements and for insuring watertightness in basements built of concrete block or concrete structural tile.



Cross section of a basement wall and footing showing location of the concrete drain tile.

In each case a line of concrete drain tile is placed entirely around the outside of the footing and is connected to a suitable outlet. The excavation above the tile is filled to within a foot of the grade line with gravel, cinders or some other material of a porous nature to provide a fill that will allow water to seep through quickly. When the foundation is erected so near another building that it is impossible to run a line of tile around the outside, the tile may be placed on the inside of the footing and slightly below it. When there is considerable water in the soil it is often advisable to place lines of tile both inside and outside of footings.



Concrete block basement walls are sometimes plastered on the exterior surface with a 1:2 cement mortar one-half inch thick to increase their watertightness in wet soils.

As a further precaution in securing a dry basement, two or more coats of cement plaster mixed in the proportion of 1 sack of portland cement to 2 cubic feet of clean, well graded sand may be applied, as shown in illustration on this page, to the exterior surface as soon as wall forms are removed or in the case of a concrete block wall just as soon as the mortar joints have hardened. The wall surface should first be thoroughly dampened. A similar coating may be placed on the inside surface if desired.

Another common method of wall treatment is to coat the exterior surface with hot tar, pitch or some other suitable asphaltic preparation, using a broom or fiber brush. The wall must be clean and dry when this coating is applied, otherwise it will not adhere. The cement plaster treatment is generally the most satisfactory method.

Basement Floors

A concrete basement floor should be at least 4 inches thick. It may be of two-course construction, using a base of 1:2½:4 concrete and a three-fourths inch top coat of 1:2 cement sand mortar or it may be of one-course construction, using a 1:2:3 concrete throughout. In the latter case mortar is brought to the surface by careful tamping and a dense, even surface is produced by smoothing with a wood float, and finishing with a steel trowel, thus producing a surface that can be easily kept clean. A little 1:2 mortar may be used in finishing if needed. In general the one-course construction method is satisfactory.

If the soil is water-logged, special care should be taken to make a tight joint between the floor and the wall. Strips of beveled siding well oiled or soaped are placed where the walls and floors meet.

These are taken out just as soon as concrete has hardened sufficiently to stand by itself. This can usually be done within a few hours after concrete is placed. The joint is poured full of hot tar later, the tar being calked or rammed home.

Where the situation of the basement is such that the ground water level is likely to rise above the floor level, further precautions should be taken to prevent leakage, since the construction becomes similar to the building of a tank, except that external and not internal pressure must be provided against. It may be necessary to make the walls thicker and to place reinforcement in the walls and floor. Such

Concrete foundation and floor for a corn crib and granary. Bolts have been embedded in concrete for the attachment of sills.

cases require special design for walls and floor and this should be made by an experienced structural engineer.

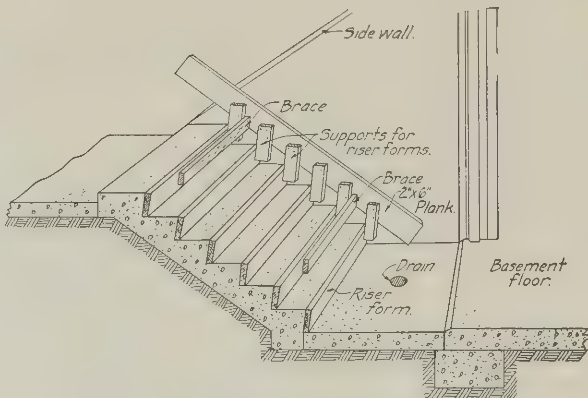
Attaching Sills and Plates to Concrete Walls

Sills and plates of frame structure should be bolted down to concrete walls. The anchor bolts should be imbedded in the concrete as shown in the illustration at the top of page 16 the anchor bolt being supported by a block laid across the form while concrete is being placed.

Setting Door and Window Frames

Frames for doors and windows may be set before the walls are built or they may be inserted after walls are completed. In the first case the frames are carefully set in proper place in the forms before concrete is placed. Spikes are partly driven into backs of frames so that when concrete is placed they will be securely tied to the wall.

When frames are set after wall is built rough "bucks" must be set in forms to provide the required openings. Nailing blocks are lightly tacked to the backs of the bucks. When concrete has hardened the bucks are removed, leaving the nailing blocks firmly imbedded in the concrete with one surface exposed. The frames are then set and nailed to the blocks. The first method is the simpler and insures the tighter joint, and is generally used in all except the highest class of construction.



Concrete basement steps are not hard to build by the use of the easily made forms shown in this sketch. The concrete in the steps should be nowhere less than six inches thick.

In constructing concrete block walls, the frames are usually set and built in place when the blocks are laid. The frames may be anchored to the wall by driving spikes partly into back of frames at mortar joints.

Cellar Steps

Concrete steps do not wear out, get loose or become unsafe. The space under ordinary stairs where trash and vermin accumulate is eliminated when concrete steps are built.

Forms for cellar steps are shown on this page. The side walls


Concrete block foundation piers help to ratproof cottages and bungalows

Concrete footings and concrete posts provide strong, durable supports for this cattle shed. They will not decay.

are placed first, using the same type of forms as used in the construction of foundation walls. Earth is then filled in and thoroughly tamped so as to provide a firm base on which to place the concrete steps. A 1:2:4 mixture of concrete is placed, the treads being "floated" with a wood float.

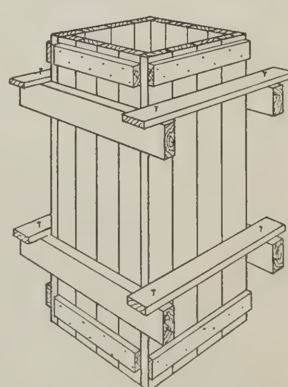
Concrete Piers

Light wooden sheds, barns and frame houses without cellars should be supported on concrete piers and posts. Concrete piers are rotproof, fireproof, easy to build and will not require replacing. A simple form for a rectangular pier is shown on this page. Footing for pier should have sufficient bearing area so that it will carry the load without settlement. Proper method for determining the size of footing is described on page 4. A 1:2:4 concrete mixture is recommended for pier or post construction.

Piers are often built of precast concrete block. Many maufacturers of concrete products make pier block of various sizes to support porches, small houses and other light frame structures. If the base of the pier does not have sufficient area to transmit the load to the soil without settlement a monolithic concrete footing should be placed under the pier. For the block, a mortar mixed in the proportion of one part portland cement to one part hydrated or well slaked lime to six parts sand (measured by volume) is recommended. Block should be carefully imbedded in the mortar.

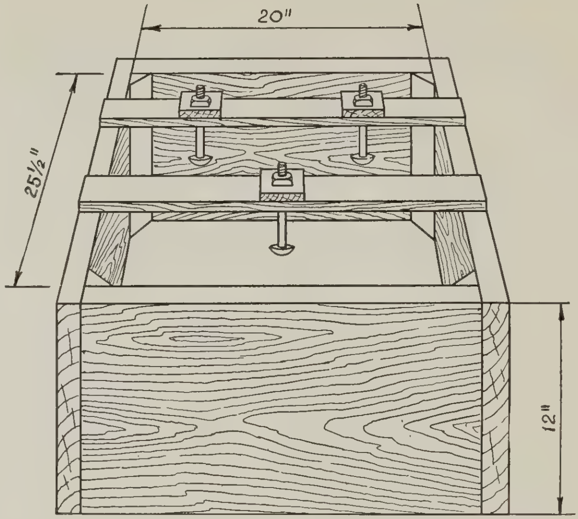
Machine Foundations

Concrete is ideal for making foundations for gas engines, cream separators and other stationary machinery. The depth to which foundations should extend will depend on the weight of the machine and the load bearing power of the soil. A method of constructing forms for machine foundations is shown in an accompanying illustration. Such a foundation should al-



A simple form that makes the construction of concrete piers for foundations, easy and economical.

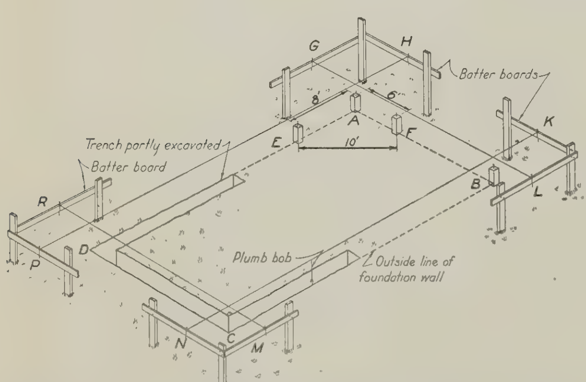
ways be placed first and the floor laid around it afterwards. Anchor bolts for attachment of the machinery are embedded in concrete, using a template as shown. For ease in adjustment a pipe sleeve larger than the bolt can be slipped over it, and filled with cement grout after the machine is lined up and before it is finally bolted down. This template is taken off after the concrete has hardened sufficiently to grip the bolts and the surface is then leveled off.



This drawing shows how to make the form for a machine foundation. Strips across the top hold the bolts in place while the concrete is being placed.

Laying Out the Foundation

The easiest, quickest and most accurate way to determine the boundary lines of a new building is by means of surveying instruments. When such instruments are not available, one of the simplest methods for laying out corners, known as the right triangle method, can be used. A triangle with sides 6, 8 and 10 feet long is a right triangle and the 90 degree angle, or right angle, is opposite the longest side.



This method of laying out foundations assures true walls that are right to receive the remainder of the house.

First, a base line is established, marking out one end or side of the new building. See line A-B on this page. Stakes are set at A and B on this line, locating two corners. In the top of Stake A a nail is partly driven in near the center. This nail accurately locates the corner. On the line A-B another stake is driven at F, 6 feet from Stake A. A nail is driven in the top of this stake exactly 6 feet from the nail in Stake A. Stake E should be driven so that its center will be exactly 8 feet from Stake A and exactly 10 feet from Stake F. The corner represented by the angle E-A-F is a right angle; the line A-E extended to D will form the second boundary line of the building and D will represent the third corner. Other corners are located in a similar manner. After this has been done, strings are stretched over the corner Stakes A-B-C-D and carried to outside supports called "batter boards" as indicated by G-H-K-L-M-N-P-R. The top of the horizontal batters should be set at first floor level or some other convenient "datum.". The building lines may be projected from the strings to the ground by means of a plumb bob suspended as shown in the drawing. When the outside Stakes G-H-K-L, etc., have been set and the strings indicating the layout of the building transferred to them, the corner Stakes A-B-C-D and Stakes E and F are removed so that the trench may be excavated. Nails should be driven in the batters where the strings are fastened so that in case the strings are broken or removed, they can be accurately replaced. How a corner may be tested for squareness is clearly illustrated below. Having found the building lines, it is easy to locate piers, posts, columns or other intermediate supports.

In the absence of surveying instruments a corner may be tested for squareness by the simple method shown in this illustration. Definite instructions for laying out a foundation are given above.

Quantities of Cement, Fine Aggregate and Coarse Aggregate Required for One Cubic Yard of Compact Mortar or Concrete

MIXTURES			QUANTITIES OF MATERIALS				
Cement	F. A.	C. A. Gravel or Stone	Cement in Sacks	Fine Aggregate		Coarse Aggregate	
				Cu. Ft.	Cu. Yd.	Cu. Ft.	Cu. Yd.
1	1.5	..	15.5	23.2	0.86	..	..
1	2.0	..	12.8	25.6	0.95	..	..
1	2.5	..	11.0	27.5	1.02	..	..
1	3.0	..	9.6	28.8	1.07	..	..
1	1.5	3	7.6	11.4	0.42	22.8	0.85
1	2.0	3	7.0	14.0	0.52	21.0	0.78
1	2.0	4	6.0	12.0	0.44	24.0	0.89
1	2.5	4	5.6	14.0	0.52	22.4	0.83
1	2.5	5	5.0	12.5	0.46	25.0	0.92
1	3.0	5	4.6	13.8	0.51	23.0	0.85

1 sack cement = 1 cu. ft.; 4 sacks = 1 bbl.

Based on tables in "Concrete, Plain and Reinforced," by Taylor and Thompson.

Materials Required for 100 Sq. Ft. of Surface for Varying Thicknesses of Concrete or Mortar

C. = Cement in Sacks.
F.A. = Fine Aggregate (Sand) in Cu. Ft.
C.A. = Coarse Aggregate (Pebbles or Broken Stone) in Cu. Ft.
Quantities may vary 10 per cent either way depending upon character of aggregate used.
No allowance made in table for waste.

Proportion	1 : 1½			1 : 2			1 : 2½			1 : 3		
Thickness in Inches	C.	F.A.	C.A.	C.	F.A.	C.A.	C.	F.A.	C.A.	C.	F.A.	C.A.
⅜	1.8	2.7		1.5	3.0		1.3	3.2		1.1	3.4	
½	2.4	3.6		2.0	4.0		1.7	4.3		1.5	4.4	
¾	3.6	5.4		3.0	6.0		2.5	6.3		2.2	6.8	
1	4.8	7.2		4.0	7.9		3.4	8.4		3.0	8.9	
1¼	6.0	9.0		4.9	9.9		4.2	10.5		3.7	11.1	
1½	7.2	10.8		5.9	11.9		5.1	12.7		4.4	13.3	
1¾	8.4	12.6		6.9	13.9		5.9	14.7		5.2	15.7	
2	9.6	14.4		7.9	15.8		6.8	16.9		5.9	17.7	
	1 : 2 : 3			1 : 2 : 4			1 : 2½ : 4			1 : 2½ : 5		
3	6.5	13.0	19.3	5.6	11.2	22.4	5.2	12.9	20.6	4.6	11.5	23.0
4	8.6	17.2	25.8	7.5	14.9	29.8	6.9	17.1	27.5	6.2	15.4	30.7
5	10.8	21.6	32.2	9.4	18.7	37.4	8.6	21.5	34.3	7.7	19.2	38.3
6	12.9	25.8	38.6	11.2	22.4	44.7	10.3	25.8	41.2	9.2	23.0	45.9
8	17.2	34.4	51.6	15.0	29.8	59.7	13.7	34.3	54.9	12.3	30.7	61.3
10	21.5	43.2	64.4	18.7	37.4	74.8	17.2	43.0	68.6	15.3	38.3	76.6
12	25.8	51.6	77.2	22.4	44.7	89.4	20.6	51.6	82.4	18.4	45.9	91.8

How to Use Materials Table for Calculating Quantities

Problem 1:

What quantities of materials are required for a monolithic concrete foundation wall 34 feet square, outside measurements, 12 inches thick, 7 feet high, with a footing 12 inches thick and 18 inches wide, using a 1:2:4 mixture in both the wall and footing?

Solution:

The wall contains 924 square feet of surface, 12 inches thick, deducting for duplication at corners.

Referring to table under 1:2:4 mixture for 12 inch walls, 22.4 sacks of cement are required for each 100 square feet of surface. Dividing 924 by 100 gives the number of times 100 square feet are contained in the total wall surface and multiplying by 22.4 gives the total number of sacks of cement required. Similar calculations are made for the fine aggregate and the coarse aggregate in both the wall and the footing, noting that the width of the footing, 18 inches, is 1½ times the 12 inches thick.

$$\frac{924 \text{ x } 22.4}{100} = 207 \text{ sacks cement.}$$

$$\frac{924 \text{ x } 44.7}{100} = 413 \text{ cu. ft. fine aggregate.}$$

$$\frac{924 \text{ x } 89.4}{100} = 826 \text{ cu. ft. coarse aggregate.}$$

The footing contains 132 square feet of surface, 18 inches thick (1½ x 12 inches) deducting for duplication at corners.

$$\frac{132 \text{ x } 22.4 \text{ x } 1\tfrac{1}{2}}{100} = 44.4 \text{ sacks cement.}$$

$$\frac{132 \text{ x } 44.7 \text{ x } 1\tfrac{1}{2}}{100} = 88.5 \text{ cu. ft. fine aggregate.}$$

$$\frac{132 \text{ x } 89.4 \text{ x } 1\tfrac{1}{2}}{100} = 177.0 \text{ cu. ft. coarse aggregate.}$$

Total materials required for footing and wall: 251.4 sacks cement, 501.5 cu. ft. fine aggregate, 1003 cu. ft. coarse aggregate.

Problem 2:

What quantities of material are required for a 1:2 cement plaster coat, one inch thick on the lower four feet of the above foundation?

Solution:

Perimeter of foundation: 4 x 34 feet = 136 feet. This multiplied by height of plaster coat, 4 ft., equals 544 square feet.

$$\frac{544 \text{ x } 4.0}{100} = 21.8 \text{ sacks of cement.}$$

$$\frac{544 \text{ x } 7.9}{100} = 42.5 \text{ cu. ft. sand.}$$

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