Plans for
Concrete Farm Buildings

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THE United States census report for 1920 shows that more than $11,000,000,000 are invested in farm buildings in this country. This was more than three times the value of all farm machinery at that time and was equal to 14.7 per cent of the value of all farm property. The same report discloses that the value of farm buildings had practically doubled in the ten year period from 1910 to 1920. This increase is significant because it emphasizes the recognized value of well planned substantial farm buildings.

A very definite relation exists between good building equipment and farm profits. Many present structures are inadequate and are responsible for preventable losses amounting to millions of dollars annually. The United States Department of Agriculture estimates that rats eat or destroy over $200,000,000 worth of farm products every year. Such losses can be easily eliminated by observing simple precautions of ratproofing the various farm buildings, particularly those in which grain is stored. The lack of proper storage facilities for apples and potatoes on many farms is responsible for enormous losses, also preventable. Proper shelter of farm machinery and equipment greatly prolongs their usefulness and increases their efficiency. Farm animals produce more salable products when housed in comfortable quarters. In numerous other ways properly constructed farm buildings are an investment that help the farmer to conduct his business more efficiently and economically.

Well-built, well-planned farm structures are essential in profitable farm operation.

It Pays to Use Concrete

MAXIMUM economy is realized when farm buildings are constructed of concrete; then the *first cost* is practically the *only cost* because of their permanence and freedom from maintenance expense. Usually this makes them the cheapest in the end. Often first cost will be lowest because the owner can do much of the work with his own help during spare time. Sand and pebbles used in the concrete mixture can often be obtained locally for the mere cost of hauling.

The storm-proof and fire-resistive qualities of concrete make it especially suitable for farm buildings. So great is the strength of buildings constructed of this material that even the most severe tornadoes seldom damage them. Concrete has no superior as a fireproofing material. Since farm buildings usually have little or no fire protection in the way of water hydrants and fire-fighting apparatus, it is very important that they be constructed of materials that will not burn.

The resale value of a farm is undoubtedly enhanced when it is equipped with modern concrete buildings. The prospective buyer can afford to pay more for such a farm because upkeep expenses on the buildings will be negligible.

Concrete has many other advantages for farm building construction. For dairy barn floors, milkhouses and other structures where cleanliness is absolutely essential, concrete has no equal and is now used almost to the exclusion of all other materials. Floors and walls of concrete afford the greatest measure of sanitation since they are non-absorbent and do not provide lodgment for filth and disease. Concrete has a decided advantage for the construction of buildings to store feeds and grains because of its ability to exclude rats and vermin.

Concrete farm buildings are storm and fire resistive, attractive in appearance and last indefinitely

How to Make Concrete

THE elementary principles of making concrete are quickly and easily understood. Even a beginner can do creditable work if he is careful to observe a number of precautions, and, in a surprisingly short time, he can acquire the necessary experience to successfully undertake more difficult construction.

Tools commonly used in making concrete.

Concrete is a mixture of portland cement, aggregate, and water. By aggregate is meant the sand and pebbles or crushed stone. The proportion of cement to aggregate varies with different kinds of work. For example, tanks, troughs, and other structures that must be watertight are made of a richer mixture than foundation footings which serve only to sustain loads. Suggested mixtures for different kinds of work are given in the table below

Proportions for concrete mixtures are usually expressed as 1:2:3, 1:2:4, etc. The first figure denotes the number of parts of cement, the second figure the number of parts of sand, and the third, the pebbles or crushed rock. For example, a 1:2:3 mix contains one part cement for each two parts of sand and three parts of pebbles or broken stone. It is important that the materials be measured accurately. A pail, box, wheelbarrow or any other convenient measure may be used. One sack of cement is regarded as one cubic foot. In mixing one sack batches, it is convenient to measure sand and pebbles with a box made to hold exactly two cubic feet, three cubic feet, or any other desired capacity according to the proportions to be used.

Mix Thoroughly

Concrete may be mixed by hand or by machine. Machine mixing is preferable as it is easier to obtain uniform results. Whichever method is used, the mixing should be continued until every pebble is thoroughly coated with the cement and sand mortar. Use as little water as possible to produce concrete of a plastic (workable) consistency. Avoid sloppy mixtures; too much water reduces the strength of concrete.

TABLE OF RECOMMENDED MIXTURES AND MAXIMUM AGG REGATE SIZES

		Largest Size Pebbles or Crushed Rock
1 : 2 : 3	MIXTURE FOR:	
	Concrete walks, porch floors, steps	1½ in.
	Feeding floors, basement floors, floors in farm buildings, mangers	1½ in.
	Basement walls exposed to moisture, roofs of underground storage cellars	1½ in.
	Troughs, tanks, cisterns, hog wallows, well linings, well covers, milk cooling tanks	1 in.
	Fence posts, clothesline posts, grapevine posts, gate posts, corner posts, mail box posts	¾ in.
1 : 2 : 4	MIXTURE FOR:	
	Engine bases, bases for machinery	2 in.
	Scale pits, dipping vats, hot beds	1½ in.
	Reinforced concrete floors and columns	1 in.
1 : 2½ : 4	MIXTURE FOR:	
	Silo walls, grain bin walls	1½ in.
	Walls of barns, hog houses, poultry houses and other farm buildings	1½ in.
	Foundation walls and footings	2 in.

Placing Concrete

Concrete should be placed in the forms immediately after being mixed. In foundation and wall construction the concrete should be deposited in layers not more than six inches deep and should be thoroughly tamped and spaded. These operations compact the concrete, release air pockets in the mixture and work large particles away from the face of the forms so that the concrete surface will be smooth and uniform when the forms are removed.

Floors are laid either as one-course or as two-course construction. One-course construction means that the full thickness of the floor is placed at one time, using one standard concrete mixture throughout. In two-course construction the floor is laid in two courses, using a certain mixture for the base and another (usually mortar) for the top or wearing surface. One-course construction is generally more satisfactory.

Finishing

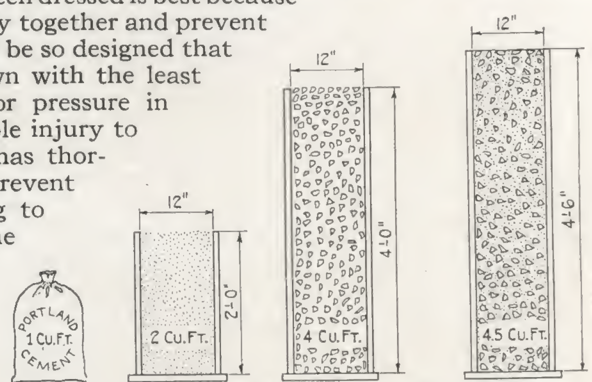
Walks and floors should be finished with a wood float. It will then be smooth, even and yet sufficiently gritty to provide safe footing. A steel trowel should be used only when it is necessary to produce a very smooth surface as in a feed manger or water trough. Use the trowel very sparingly as excess troweling tends to draw the cement to the top, possibly resulting in slippery surfaces or the formation of hair checks.

Curing

Concrete requires moisture to harden properly. Therefore, it should be protected from sun and wind in order to prevent the moisture in the concrete from evaporating. Floors and walks can be protected by covering with hay, straw, sand, earth, or other materials as soon as possible without marring the surface. These coverings should be left in place and kept moist for a week or ten days.

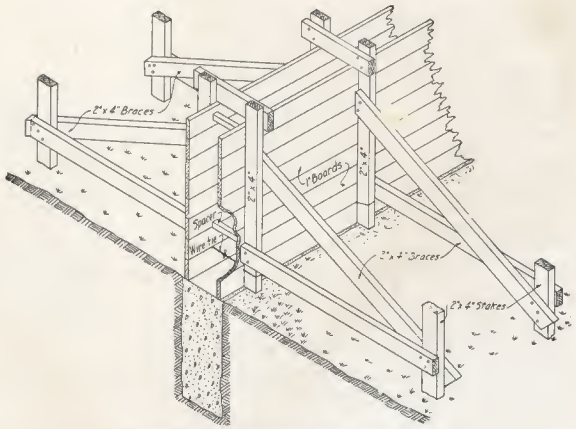
Forms

Forms are generally made of lumber and where smooth surfaces are desired, dressed and matched lumber should be used. Even for plain work, lumber that has been dressed is best because the boards will fit closely together and prevent leakage. Forms should be so designed that they can be taken down with the least amount of vibration or pressure in order to prevent possible injury to the concrete before it has thoroughly hardened. To prevent concrete from adhering to forms on removal, the faces against which concrete is placed should be given a thin coat of crude oil, machine oil or soft soap. Forms should be rigid, with sufficient bracing



One cu. ft. of cement, 2 cu. ft. of sand, and 4 cu. ft. of pebbles do not make 7 cu. ft. of concrete, but 4 1/2 cu. ft.

to withstand the pressure of new concrete without bulging. Do not remove forms until the concrete has hardened. In warm weather forms can usually be taken down in two days. In cold weather it may be necessary to wait a week or more.



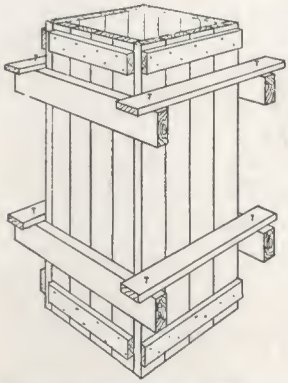
Forms for foundation wall above grade.

Select Good Materials

Sand and pebbles or crushed rock for concrete mixtures should be clean. Grass, dirt, sticks, and other foreign matter are objectionable because they prevent proper bond between the cement and particles of aggregate. Both sand and pebbles should be well graded, that is, the particles should not be all small or all coarse, but should range from fine up to the maximum size allowable. By sand is meant material fine enough to pass through a screen having four meshes to the inch. Aggregate coarser than this is known as pebbles or broken stone. The maximum size of pebbles allowable varies with the character of the work. (See table on page 5.)

Reinforced Concrete

Reinforcement is the term used to describe the steel rods or mesh sometimes placed in the concrete to increase its tensile strength. Concrete is a material that, like stone, is strong in compression, that is, very strong in bearing loads that are placed directly upon it, but its strength is not nearly so great in tension, so steel rods or wires are often placed in the concrete to increase its power to resist strains that tend to bend or pull it apart. It is very important that steel reinforcement be placed in the correct position, that is, in that part of the concrete mass where it will be most effective in resisting the tensile stresses. In a concrete lintel or beam the reinforcement is placed near the lower side as that is the side which tends to pull apart when the beam is loaded. In grain bins, water supply tanks, silos and similar structures where the contents exert an outward pressure, the reinforcement is placed near the center of the wall. The construction of reinforced concrete floors above ground, beams, columns and the more elaborate structures, should be undertaken only by an experienced builder. They should be designed by an engineer.


A simple form for the construction of concrete piers.

Concrete Masonry Construction

PRACTICALLY every community is within hauling or trucking distance of a concrete products plant or material yard where concrete block or concrete building tile are carried in stock. These units are extensively used in farm building construction. Concrete block are made in various sizes. The 8 by 8 by 16-inch block is perhaps the most common. It makes a wall eight inches thick, laid in courses eight inches high. Block are also made regularly for building walls 10 and 12 inches thick.

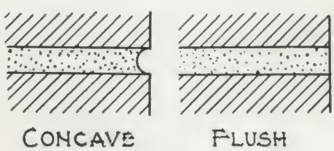
Concrete masonry units lay easily and quickly and take only a small amount of mortar.

Concrete building tile are usually smaller in size and have thinner walls than block, the standard size being 5 by 8 by 12 inches. They are suitable for constructing walls 8 or 12 inches thick, according to the way the unit is laid in the wall. The height of 5 inches is equivalent to 2 courses of brick.

Most products manufacturers and dealers carry half-length block and tile in stock, making it unnecessary to cut units on the job if a little care is observed in designing the building. It is a simple matter to lay out the building so that its width and length as well as the distance between doors and windows is equal to a given number of full and half length block. For example, a wall exactly 24 feet long will take 18 full block, 16 inches long, in each course; a wall 26 feet long will require 19 full length and one half-length block. Time is saved if the mason is not required to cut block and a more workmanlike job is secured.

Preparation of Mortar

Portland cement mortar should be used in laying concrete masonry units. A mixture of one part cement, one part well slaked or commercially hydrated lime and six parts clean, screened sand is generally satisfactory. Mix sand, water and cement together thoroughly and keep the batches small enough that they can be used within 30 minutes after the water is added.



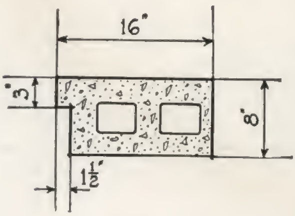
CONCAVE FLUSH

Mortar Joints

The concave type of mortar joint is usually preferred for farm buildings. It is made by drawing a pointing tool along the joint after the mortar begins to stiffen. This operation compacts the mortar and produces a tight, water-excluding joint. Both vertical and horizontal joints are usually made to average about three-eighths-inch thick. Block and tile are generally made so that their length and height are correspondingly shorter than their designated dimension, to allow for the mortar joints. That is, a block commonly referred to as an 8 by 8 by 16-inch unit actually measures $7\frac{5}{8}$ or $7\frac{3}{4}$ inches high and $15\frac{5}{8}$ or $15\frac{3}{4}$ inches long. When the wall is to receive a portland cement stucco finish or is to be plastered, the mortar is struck off flush with the wall surface.

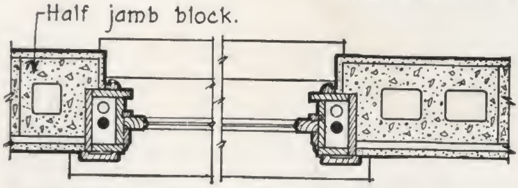
Corners

Most manufacturers of concrete block and tile make special units for use in corners. It should never be necessary when making regular 90 degree corners to cut block or fill in with brick bats and in the interest of neat and workmanlike construction, such makeshift means should be avoided. Mortar joints should break at midpoint as nearly as possible.



Door and Window Specials

Most products plants furnish special block for use where required against door frames and window boxes. Precast sills and lintels are also carried in stock regularly.



Special door and window jamb block which save time in laying the wall and insure a more workmanlike job.

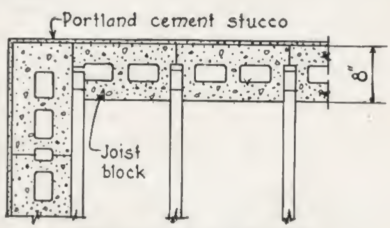
Setting Joists

Several methods for setting floor joists in masonry walls are in common use. Some manufacturers produce "joist" block which have notches cut out for the joists as shown in the drawing. Another scheme is to use veneer block on the outside wall, filling in between joists with similar block shortened to the distance between adjacent joists. The basement wall is sometimes made thicker than the wall of the superstructure, then on the ledge or shoulder formed by change in wall thickness the first floor joists are set.

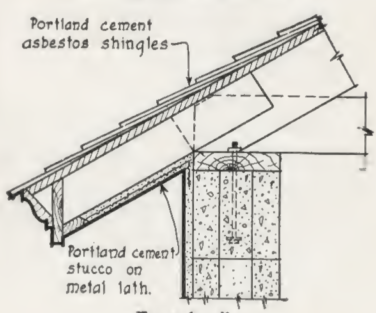
Attachment of Sills and Plates

The usual method of attaching wood sills and plates to concrete masonry walls is to bolt them down at intervals, six feet apart or less, to the top course. Bolts should be long enough to extend through the plate and at least one course of masonry. Firmer anchorage is secured by slipping a large washer on the bolt and filling around the latter with concrete.

Our booklet "A Manual of Concrete Masonry Construction" gives complete information on the different types of concrete block and tile and describes the best practices for use in building construction. A copy of this manual will be furnished without charge. Shipment can be made more promptly if your request is addressed to our nearest district office.



Common type of joist block.



Eave details.

Farm Building Plan Service

Nothing quite sets off a farm entrance so well as a pair of well-designed concrete posts.

THE plans presented in this booklet are intended to provide ideas and suggestions for designing and constructing needed farm buildings and improvements. Practically all of the plans, selected from thousands of designs, have been accepted as standard by farm building specialists. Most of the plans show the details necessary for constructing the different buildings. If blueprints are desired, however, they can be obtained free on request for all buildings except the residences. For these a charge of $5 per set is made to partly cover architectural fees and cost of making blueprints. Specifications are included with each set of house plans. Plans of the smaller buildings are accompanied by an estimate of materials required to complete the concrete work. Estimates are not given for several of the larger structures since their dimensions will usually be varied to meet individual requirements. However, the data presented on pages 46 and 47 will be found helpful in estimating material requirements in such cases.

Concrete

"Fertile prairie soil makes thick, sticky mud. It is hard to keep the pigs and steers gaining and the cows clean and comfortable when the mud is knee deep. In fact, there is only one way to do it, and that is to pave the barnyard and floor the buildings with concrete. Many farmers who have done this testify that the original cost is paid back in two or three years, while the concrete, if properly put down, will be as good as ever at the end of 20 years.

"There is no farm improvement that pays better than concrete. Concrete floors keep the rats out of the buildings. Concrete walks keep the mud out of the kitchen. Concrete yards keep the stock out of the mud. They save feed and manure, and the increased comfort of the stock means more rapid gains and a greater milk flow.

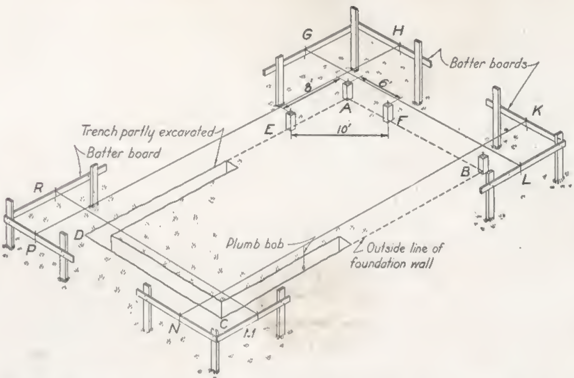
"Oil-stock salesmen talk 25 per cent dividends. Concrete will pay larger dividends than that. The concrete dividends are actually paid. The oil-stock dividends are not."

—*The Prairie Farmer*

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.

First, one side or end of the new building is laid out and stakes are driven in at the corners represented by stakes A and B in the figure. To locate the corner points more precisely, nails are partly driven in the tops of each stake. On the line from A to B a stake F is driven which should be exactly 6 feet from stake A. Stake E is then driven so that its center is exactly 8 feet from stake A and 10 feet from stake F. The corner represented by angle E-A-F is a right angle and the line A-E extended forms the second boundary line of the building. Other corners are located in a similar manner. After this is done strings are stretched over the corner stakes A-B-C-D and tied to batter boards at G-H-K, etc. as shown.



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

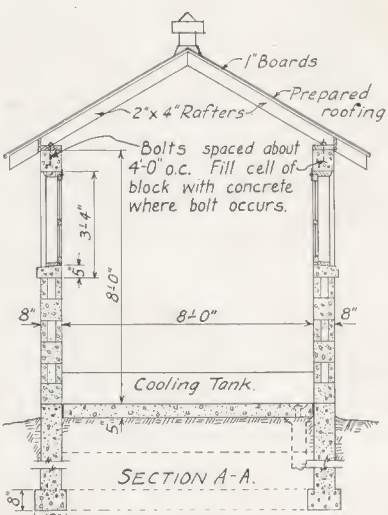
Nails are partly driven in the batter boards at these points so that in case the strings are removed or broken they can be easily replaced. Then the corner stakes A-B-C-D and stakes E and F can be removed so that the trench can be excavated. Having found the building lines, it is easy to locate foundation footings for piers, posts, columns, or other intermediate supports.


Building the foundation.

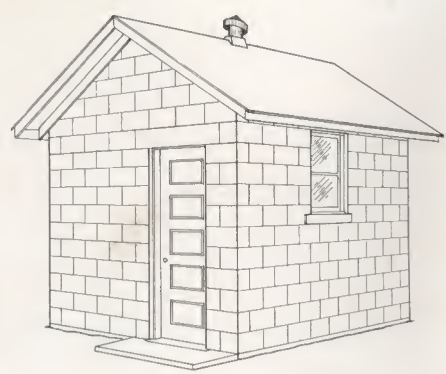
Milkhouses

A SMALL milkhouse separated from the dairy barn is essential in the production of milk of high quality. Because concrete is so easy to keep in a clean and sanitary condition it is widely used in the construction of milkhouses and cooling tanks.

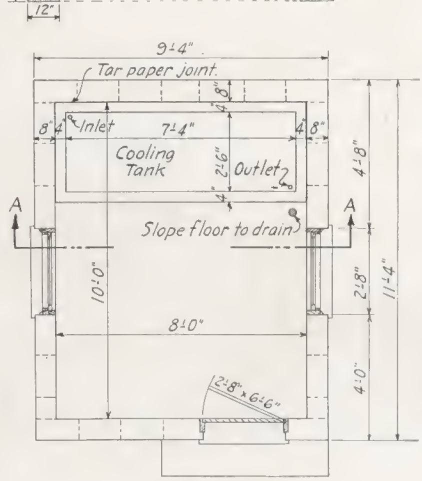
Two types of concrete milkhouses are illustrated—one rectangular and the other circular. A round milkhouse like the one shown can be built by using commercial forms commonly employed in building circular tanks or silos, or it can be built by using the type of concrete block used for block silos.



SECTION A-A.



PERSPECTIVE VIEW.



PLAN

Rectangular Milkhouse

CONCRETE MIXTURES

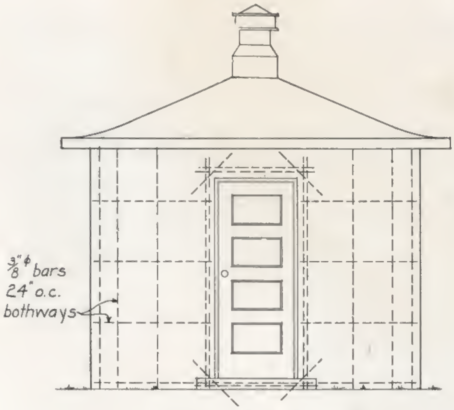
Foundation and footing	1 : 2½ : 4
Floor	1 : 2 : 4
Cooling Tank	1 : 2 : 3
Mortar	1 : 3

MATERIALS REQUIRED

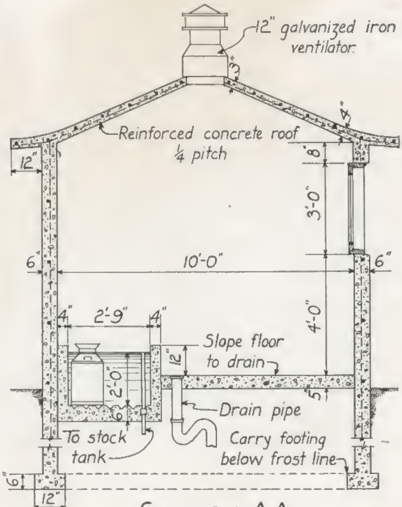
(Estimate based on foundation wall extending 3 feet below grade)

Cement	44 sacks
Sand	4 cubic yards
Pebbles or broken stone	5½ cubic yards
Concrete block, 8 by 8 by 16	353
Reinforcing steel	137 feet ⅜-inch rods

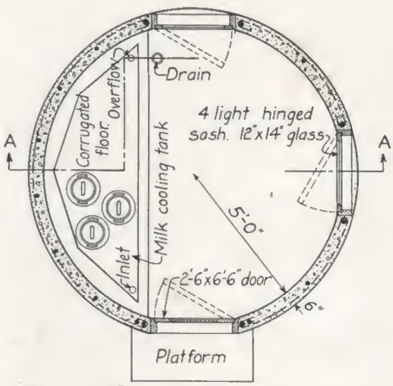
Circular Milkhouse



FRONT ELEVATION



SECTION A-A



FLOOR PLAN

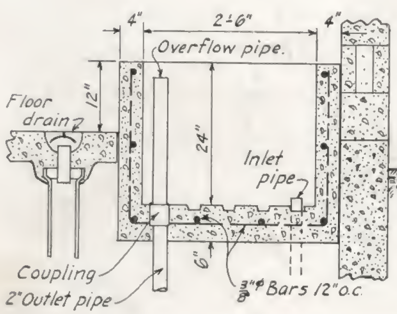
CONCRETE MIXTURES

Walls and foundation	1	2½	4
Roof, floor and tank	1	2	3

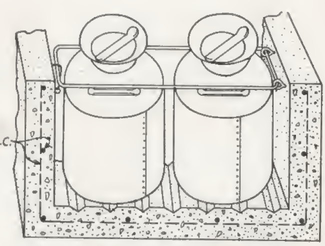
MATERIALS REQUIRED

(Estimate based on foundation wall extending feet below grade)

Cement	61 sacks
Sand	5½ cubic yards
Pebbles or broken stone	8 cubic yards
Reinforcing steel	805 feet ⅜-inch round rods



CROSS SECTION THRU TANK.



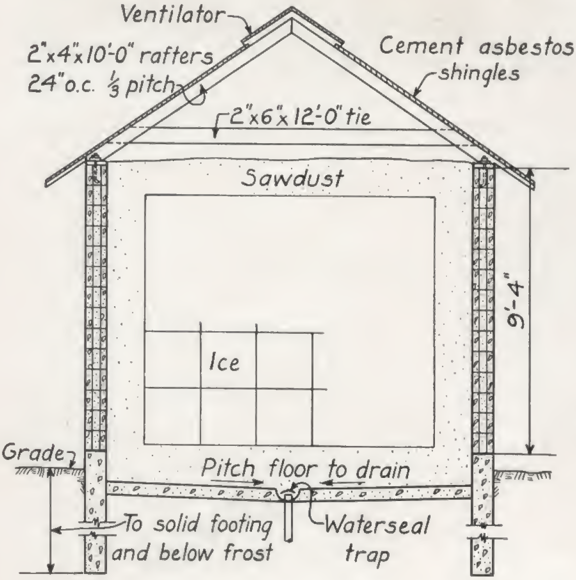
Device for holding cans in tank. Place eyebolts in wall about 21 in. from bottom of tank according to style of can used.

Icehouse

ICE is used to cool milk on many dairy farms. On every farm a supply of ice will add much to everyone's comfort during the warm days of summer and will simplify the housewife's difficulties in keeping food sweet and wholesome.

Monolithic concrete and concrete block are particularly suitable for ice house construction. Icehouses are always damp and concrete is not susceptible to rot or other forms of depreciation. Concrete is also fireproof. The air spaces in the wall, resulting from the use of concrete block or hollow wall monolithic construction, provide insulation against summer heat so loss from melting is small.

Because of its fireproof and rotproof qualities, concrete is well adapted to icehouse construction.



Cross-section of concrete block icehouse.

How to Figure Size Needed

In northern states one and one-half tons of ice are required to cool the milk from each cow during the summer. In southern states two tons per cow should be allowed. It is also well to store several tons for use in the home refrigerator. An allowance of 25 per cent is usually figured for shrinkage due to melting. The table of capacities shows sizes needed to store various amounts of ice in tons.

CAPACITY OF ICEHOUSES

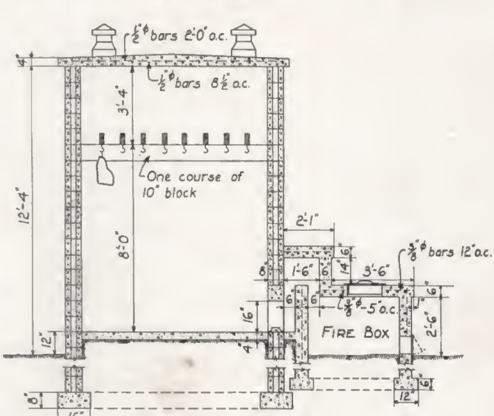
Height in Feet	Width in Feet	Length in Feet	Capacity in Tons
10	12	12	18
10	12	16	25
10	14	16	30
12	12	18	35
12	14	18	43
12	16	18	50
12	16	22	62
12	18	22	71
14	16	24	82
14	18	24	94
14	20	24	105

Smokehouse

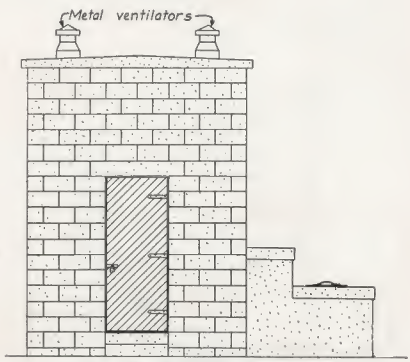
THE old practice of home curing meat by smoking is as popular today as ever. It is easy to build a smokehouse when concrete is the construction material.

Danger of fire in a smokehouse is always very great as the smudge is likely to burst into a blaze. It is, therefore, important that the building be constructed of a fireproof material; then the contents as well as the building will be safeguarded.

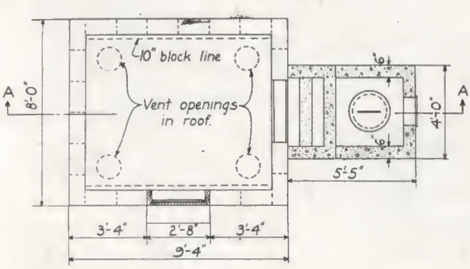
Smokehouse fire dangers are eliminated by concrete construction.



SECTION A-A



SIDE ELEVATION



PLAN

CONCRETE MIXTURES

Foundation walls and footings. 1 : 2½ : 4
Walls above grade, floor, roof and fire pot. 1 : 2 : 3

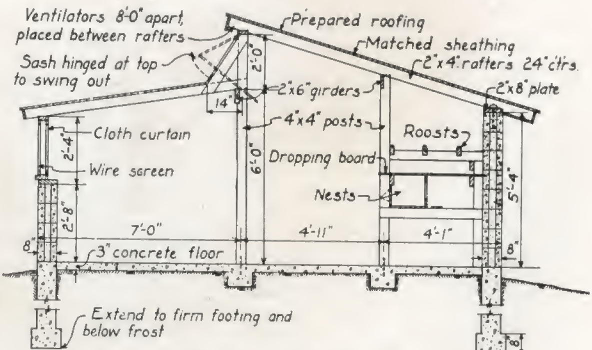
MATERIALS REQUIRED

(Estimate based on foundation wall extending 3 feet below grade)

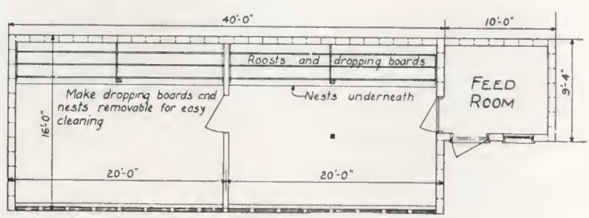
Cement .... 85 sacks
Sand .... 6¾ cubic yards
Pebbles or broken stone. 12½ cubic yards

Poultry Houses

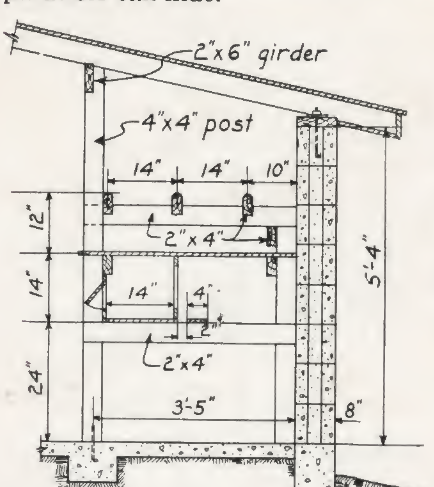
DRY, comfortable, well ventilated quarters which can be easily cleaned and disinfected are essential to a profitable poultry business. These conditions are readily obtained in concrete poultry houses. Such houses afford protection against rats, weasels and other rodents. Lice and mites are easily controlled as there are no crevices in concrete walls and floor in which these parasites can hide.



CROSS SECTION



PLAN



DETAIL OF ROOSTS, NESTS AND DROPPING BOARDS

Two common types of poultry houses are presented. Each is designed so that any capacity desired can be obtained by increasing the length, the width being standard. In determining capacity of poultry house three to four square feet of floor space is allowed per hen, according to breed. Sufficient roosts should be provided so that each grown fowl will have from seven to nine inches of roost space.

Half Monitor Roof Poultry House

CONCRETE MIXTURES

Walls and foundations	1 : 2½ : 4
Floor	1 : 2 : 3

MATERIALS REQUIRED

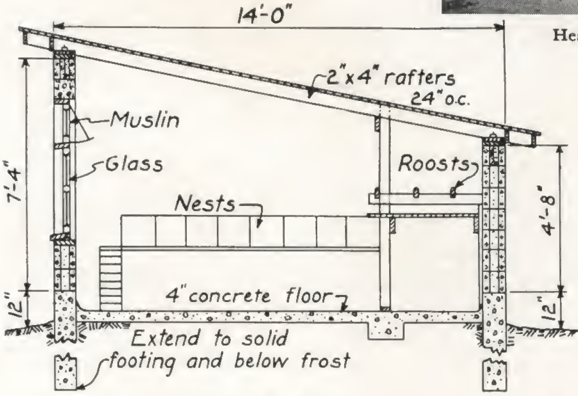
(Size 16 by 50 feet — two sections and feed room. Estimate based on foundation wall extending 3 feet below grade.)

Cement	213 sacks
Sand	19 cubic yards
Pebbles or crushed stone	30 cubic yards

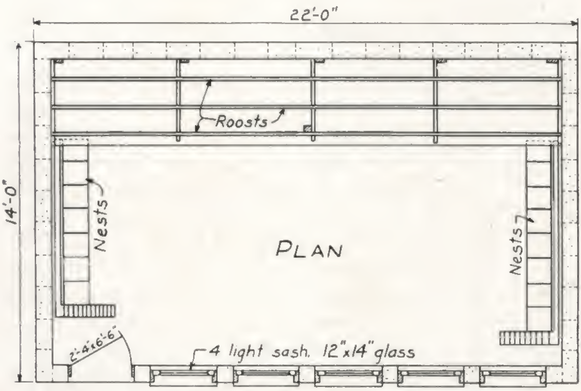
Shed Roof Poultry House

THE shed roof poultry house shown on this page will accommodate 90 grown fowls, allowing 8 inches of roosting space per bird.

Healthful quarters for the hens mean more eggs.



SECTION



Roosts, dropping boards and nests are placed in such location that they are readily accessible yet admit of the most economical use of space.

This type of poultry house, like the half monitor type, gives the best results when faced to the south or to the east, southern exposure being preferred by most poultry men. An abundance of light is provided by large areas of window glass. Frames covered with muslin are set in the wall directly over the windows to permit entrance of fresh air for the fowls. These may be replaced by windows in winter to conserve heat.

CONCRETE MIXTURES

Footings and foundation walls	1 : 2½ : 4
Floor	1 : 2 : 3
Mortar for laying block	1 : 3

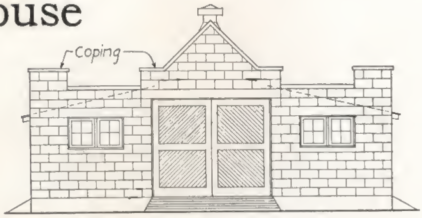
MATERIALS REQUIRED

(Outside dimensions, 14 by 22 ft. Estimate based on foundation wall extending 3 feet below grade.)

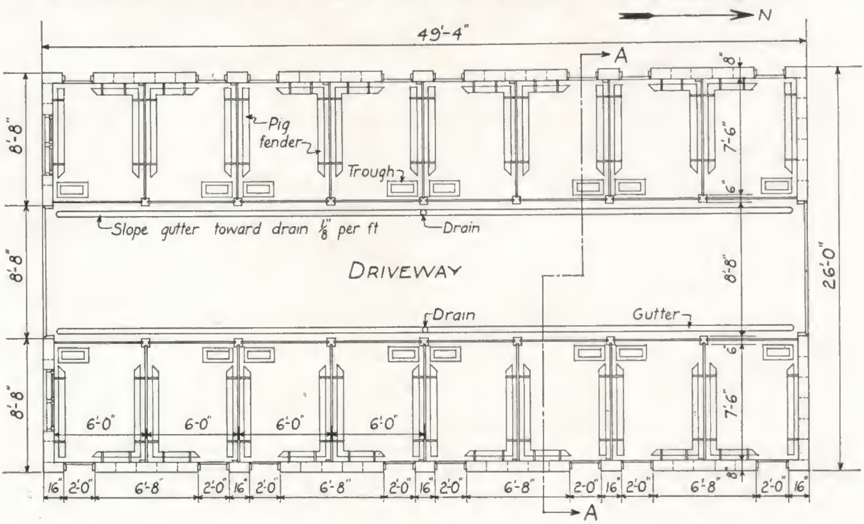
Cement	69 sacks
Sand	5½ cubic yards
Pebbles or broken stone	8½ cubic yards
Concrete block (8 by 8 by 16 inch)	400
Half block	40

Skylight Hog House

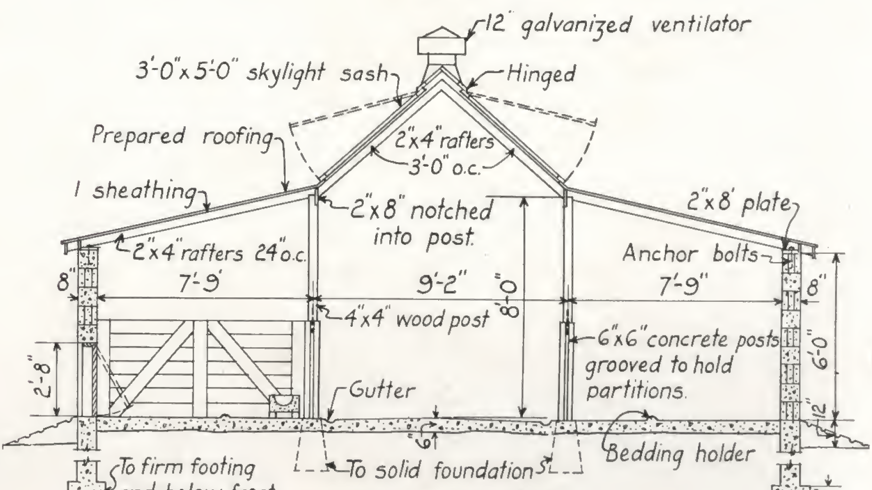
THE skylight hog house is so-called because of the rows of skylight sash on the roof which admit sunlight. A hog house of this type is generally built in a north and south direction; then the morning sun entering the row of windows on the east slope of the roof shines in the west row of pens. In the afternoon the sun shining through the windows on the west slope strikes the east row of pens.



END ELEVATION

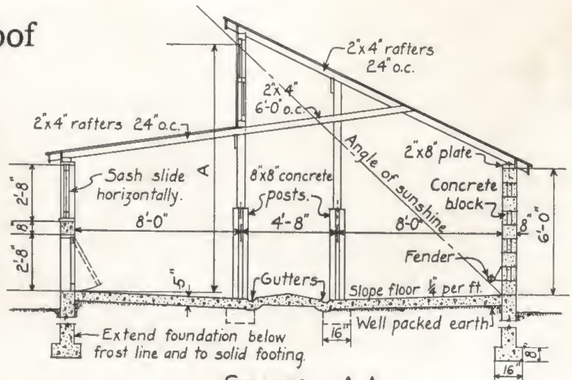


FLOOR PLAN



SECTION A-A

Half Monitor Roof Hog House



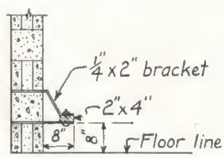
SECTION A-A

THE half monitor roof type of hog house is designed to face the south. The windows in the monitor are placed at such a height that the direct sunlight falls on the floor in the north row of pens during the farrowing season. The table given below will help the builder determine the correct placing of windows in different latitudes and for different farrowing dates. This table assumes a distance of 12 feet from a point directly below the window to the north wall of the building. The south row of pens is usually lighted by windows in the south wall, although these are sometimes located in the roof just over the pens.

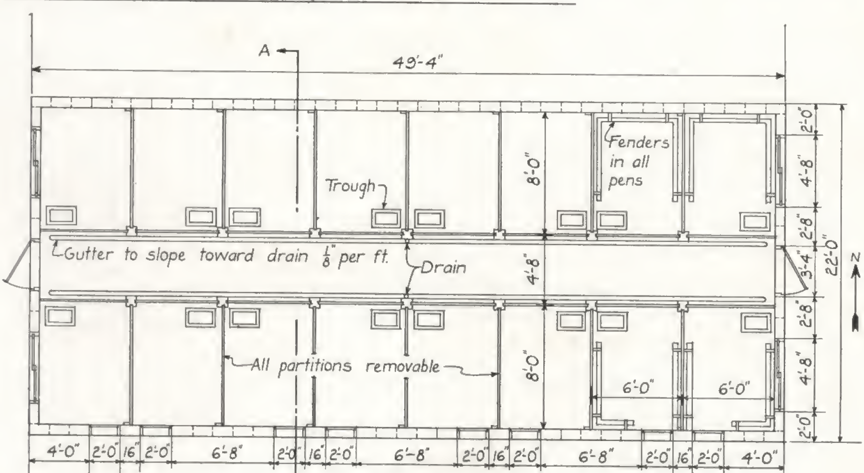
CONCRETE MIXTURES

Foundations and footings .... 1 : 2½ : 4
Floor, posts .... 1 : 2 : 4

Latitude Degrees N.	HEIGHT TO TOP OF WINDOW					
	Farrowing February 1		Farrowing March 1		Farrowing April 1	
	Ft.	In.	Ft.	In.	Ft.	In.
30	11	1	15	6	25	0
32	10	4	14	5	22	11
34	9	8	13	5	21	1
36	9	0	12	7	19	6
38	8	4	11	8	18	1
40	7	9	10	11	16	9
42	..	..	10	2	15	7
44	..	..	9	6	14	6
46	..	..	8	10	13	6
48	..	..	8	2	12	7



DETAIL OF FENDER



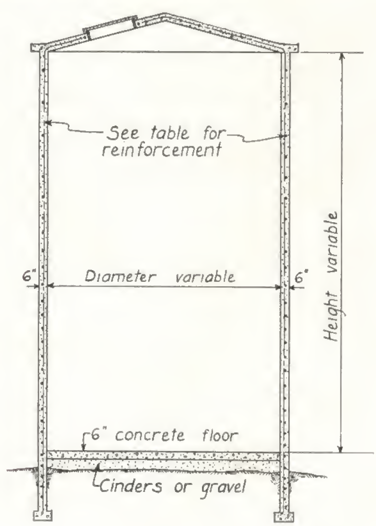
Floor Plan

Granaries

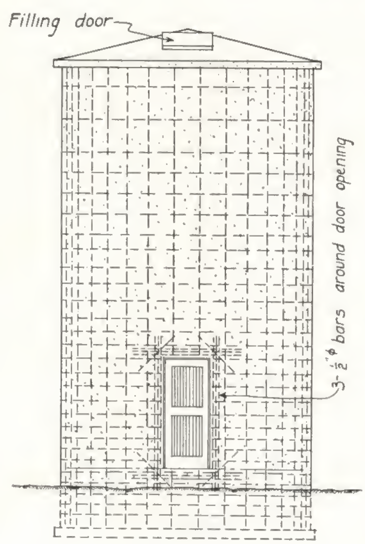
CONCRETE has decided advantages for the construction of storage structures for grains because of its fireproof and vermin-proof properties. The majority of modern elevators are now constructed of concrete. It is equally suitable for the construction of bins for the storage of grain on the farm. One of the prime essentials of a grain bin is that it have moisture-proof walls and floor. For the walls a 1:2½:4 mixture is recommended and for the floor a 1:2:3 mixture. Additional protection against soil moisture is obtained by placing the floor on a well compacted fill of coarse aggregate or cinders from six to eight inches deep. The correct thicknesses of walls and the proper amount of reinforcement for both circular and square bins are shown in the tables.

Circular Grain Bins

The table below indicates proper amount of reinforcement for circular bins of various depths and diameters. Suppose it is desired to determine correct reinforcement for a bin 12 feet in diameter and 15 feet deep. The table shows that ⅜-inch rods spaced 24 inches apart should be used in the upper 5 feet; ⅜-inch rods 18 inches apart in the middle 5 feet and ⅜-inch rods 15 inches apart in the lower 5 feet. For vertical reinforcement use ⅜-inch rods 18 inches apart in all bins irrespective of size. Walls are 6 inches thick.



SECTION



ELEVATION

REINFORCEMENT FOR CIRCULAR BINS

Depth in Feet From Top	Diameter in Feet					
	10′	12′	14′	16′	18′	20′
0– 5.........	⅜"@24"	⅜"@24"	⅜"@24"	⅜"@24"	⅜"@24"	⅜"@18"
5–10.........	⅜"@24"	⅜"@18"	⅜"@15"	⅜"@12"	⅜"@12"	⅜"@12"
10–15.........	⅜"@18"	⅜"@15"	⅜"@12"	⅜"@10"	⅜"@ 8"	⅜"@ 6"
15–20.........	⅜"@15"	⅜"@12"	⅜"@10"	⅜"@ 8"	⅜"@ 6"	⅜"@ 6"
20–25.........	⅜"@15"	⅜"@12"	⅜"@ 8"	⅜"@ 6"	⅜"@ 6"	⅜"@ 5"

CONCRETE MATERIALS REQUIRED FOR CIRCULAR BINS OF VARIOUS DIAMETERS

(These figures include footings and floor, but not roof. Walls 6 inches thick. Foundation and footing, and walls 1:2½:4 mixture; floor 1:2:3 mixture)

Inside Diameter Feet	For Bin 10 Feet Deep			For Each Additional 5 Feet in Depth		
	Cement Sacks	Sand Cu. Yd.	Pebbles Cu. Yd.	Cement Sacks	Sand Cu. Yd.	Pebbles Cu. Yd.
10	67	6.5	10.0	16.0	1.5	2.4
12	83	7.7	12.3	19.2	1.8	2.9
14	97	9.0	14.4	22.5	2.1	3.4
16	111	10.3	16.5	25.7	2.4	3.8
18	125	11.6	18.6	29.0	2.7	4.3
20	139	12.7	20.3	32.3	3.0	4.8

CAPACITY OF CIRCULAR BINS IN BUSHELS

Height in Feet	Diameter in Feet					
	10	12	14	16	18	20
10	631	910	1238	1616	2042	2525
15	946	1364	1855	2420	3060	3785
20	1212	1820	2475	3230	4090	5050
25	1578	2275	3095	4040	5100	6310

Square Grain Bins

Upper figures give thickness of wall in inches. Lower figures give size and spacing of rods. For example, a grain bin 10 feet square and 10 feet deep should have walls 5½ inches thick and be reinforced with ½-inch rods 8 inches apart in the upper 5 feet and ½-inch rods 6 inches apart in the lower 5 feet. Center of horizontal steel to be 1¼ inches from outside face of wall. Vertical reinforcement to be ½-inch rods placed 18 inches apart.

REINFORCEMENT AND WALL THICKNESSES OF SQUARE BINS

Depth in Feet From Top	Dimensions in Feet			
	8x8	10x10	12x12	14x14
0– 5	4″ ½″@10″	4″ ½″@8″	4½″ ⅝″@10″	6″ ⅝″@9″
5–10	4″ ½″@ 8″	5½″ ½″@6″	6½″ ⅝″@ 8″	8″ ⅝″@6″
10–15	4½″ ½″@ 6″	5½″ ½″@6″	7″ ⅝″@ 6″	9″ ⅝″@5″
15–20	4½″ ½″@ 6″	6″ ½″@6″	7″ ⅝″@ 6″	9½″ ⅝″@5″

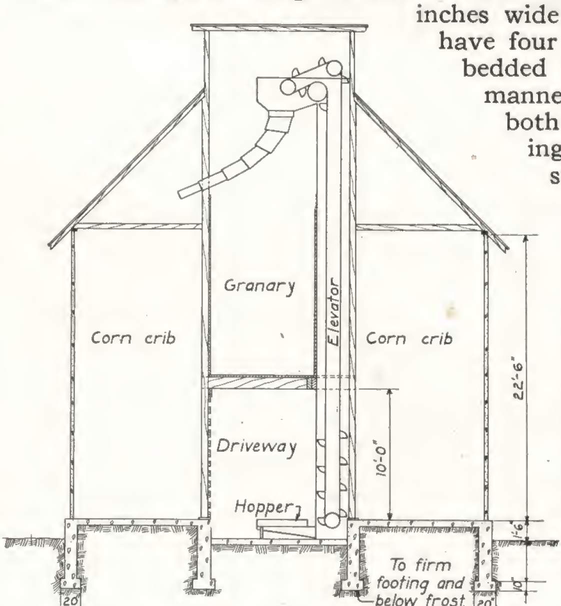
CAPACITY OF SQUARE BINS IN BUSHELS

Height in Feet	Dimensions in Feet			
	8x8	10x10	12x12	14x14
5	400	625	900	1225
10	800	1250	1800	2450
15	1200	1875	2700	3675
20	1600	2500	3600	4900

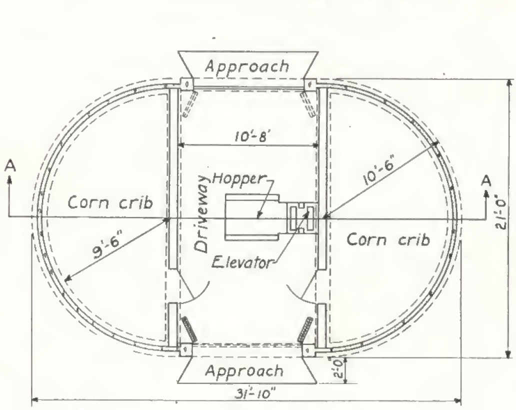
Farm Elevator

ON many farms the corn crib and granary are combined in one structure known as a farm elevator. The circular form is especially suited to masonry grain storage structures as this shape is easy to reinforce. There is also an economy of materials as a circular structure will enclose a greater volume for a given amount of wall space than any other form. One of the most recent developments in farm buildings is the concrete stave farm elevator. Ventilation is provided in the corn cribs through openings in the staves. These openings are each four inches wide and nine inches long and have four one-quarter-inch rods imbedded in the concrete in such a manner that they pass through both openings, forming a grating for excluding rodents. The staves average around two and one-half inches thick, thirty inches long and ten inches wide. The cribs of this installation are usually semicircular in plan. Storage bins for grain are provided over the driveway. Steel hoops serve as reinforcement. The ends of the hoops are rigidly secured to heavily reinforced concrete door jambs up to the top of the driveway doors. Above this point the rods are carried continuously around the structure. As the lateral pressure of the small grain is greater than that for ear corn, the additional reinforcement for grain bins is provided in the steel channels and "I" beams.

Several types of concrete staves and block suitable for corn crib construction have been developed. Such elevators are usually built by concrete products manufacturers specializing in the business. The names of such companies will be furnished on request.

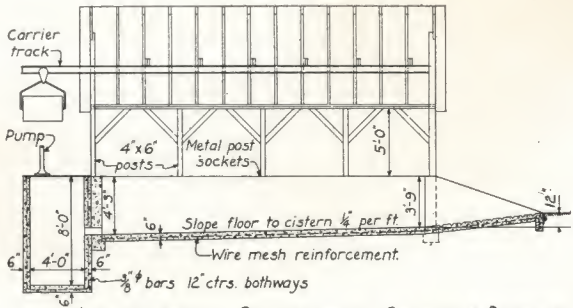


LONGITUDINAL SECTION A-A



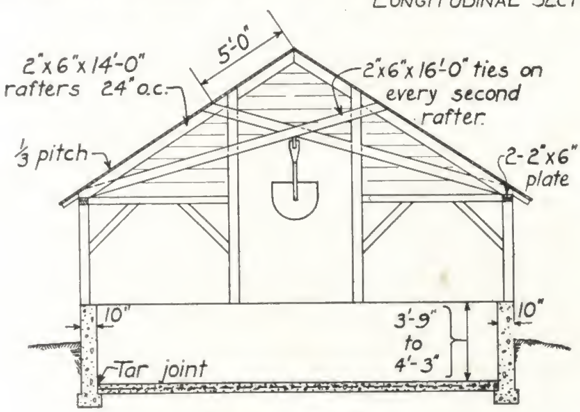
PLAN

Manure Pit



LONGITUDINAL SECTION THRU CISTERN & DRIVEWAY

ON most farms it is impractical to haul manure to the field daily. A manure pit is then essential to prevent loss of the valuable fertilizing elements. Concrete is the preferred material for manure pit construction because the watertight walls and floors do not permit any of the liquids to escape and the decomposition of the solids can be controlled so there is no loss of plant food.



CROSS SECTION

A location convenient for filling and emptying the pit is essential. In a pit of large size a driveway will save time and labor in loading. For long pits it is a good plan to build an approach at each end so that the spreader can be driven entirely through.

CONCRETE MIXTURES

Walls and footings	1 : 2½ : 4
Cistern and pit floor	1 : 2 : 3

MATERIALS REQUIRED

(Inside dimensions 20 by 24 feet)

Cement	165 sacks
Sand	14 cubic yards
Pebbles or broken stone	21½ cubic yards
Rods (⅜-inch)	320 lineal feet
Wire mesh reinforcement	560 square feet

DIMENSIONS OF PITS FOR DAIRY HERDS OF DIFFERENT SIZES

No. of Cows	Length	Width	Average Depth
10	16 feet	16 feet	4 feet
20	24 "	20 "	4 "
30	30 "	24 "	4 "
40	40 "	24 "	4 "

Beauty is combined with permanence in a well-built concrete garage.

Maximum fire protection is afforded by the garage built of concrete.

Concrete masonry units make speedy erection possible.

Gara

CONCRETE has outstanding adv account of its firesafeness, attr The plans shown are for a one-car ga Either block with a special facing latter provides an excellent backing For a single-car garage an inside wid satisfactory and for a two-car gar length of less than twenty feet i twenty-two feet is better. These d space around the car and provide ro and shelves for car accessories at one

One-Car

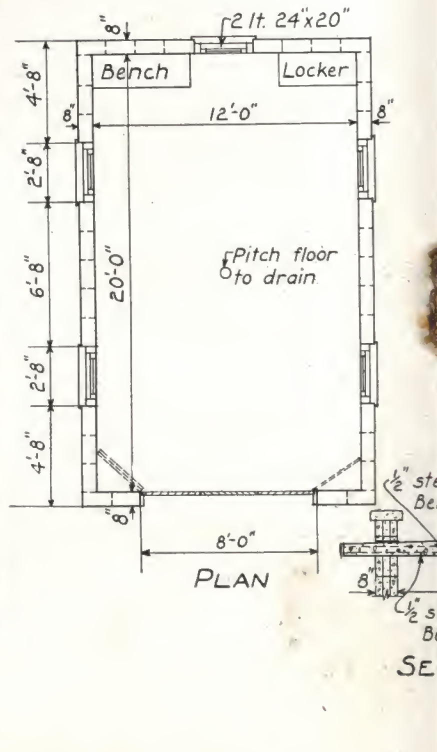
CONCRETE

Foundations and footings.......................
Floor..
Sills and lintels..............................
Mortar...

MATERIALS

(Inside Dimensions 12 by 2
on foundation wall extendi

Cement...
Sand...
Pebbles or broken stone........................
Concrete block (8 by 8 by 16 inch).............
Half block (8 by 8 by 16 inch).................
Corner block (8 by 8 by 16 inch)...............



...ages

...dvantages for garage construction on ...tractiveness and low cost of upkeep. ...garage constructed of concrete block. ... or plain block may be used. The ...for a portland cement stucco finish. ...of twelve feet has been found very ...ge twenty or twenty-two feet. A ...seldom advisable—for larger cars ...dimensions allow plenty of working ...room for a small work bench, closet ...e end.

Upkeep expenses are low, as concrete will not rot and requires no painting.

...r Garage

... MIXTURES

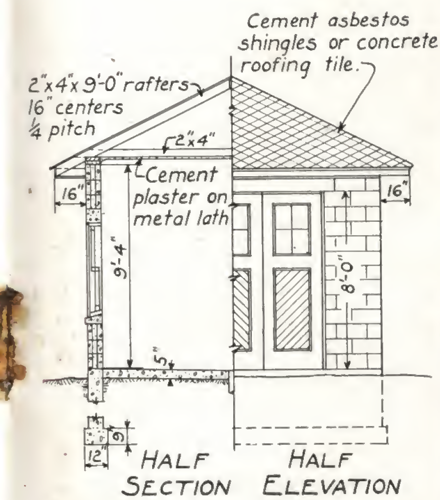
...	1 : 2½ : 4
...	1 : 2 : 3
...	1 : 2 : 3
...	1 : 3

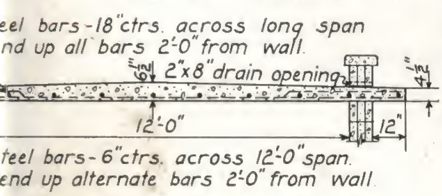
...S REQUIRED

... 20 feet. Estimate based ...ding 3 feet below grade.)

...	86 sacks
...	8¼ cubic yards
...	11¼ cubic yards
...	460
...	42
...	56

Concrete garages withstand severe wind storms.





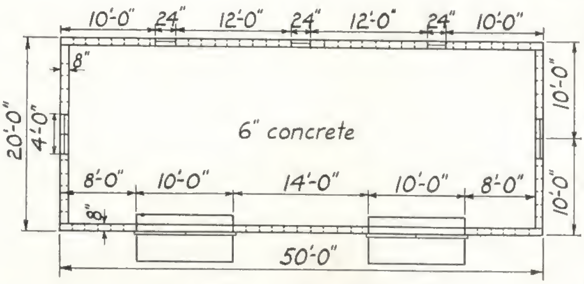
...CTION OF CONCRETE ROOF

Completing the walls of a firesafe, permanent. two-car garage.

Implement Shed

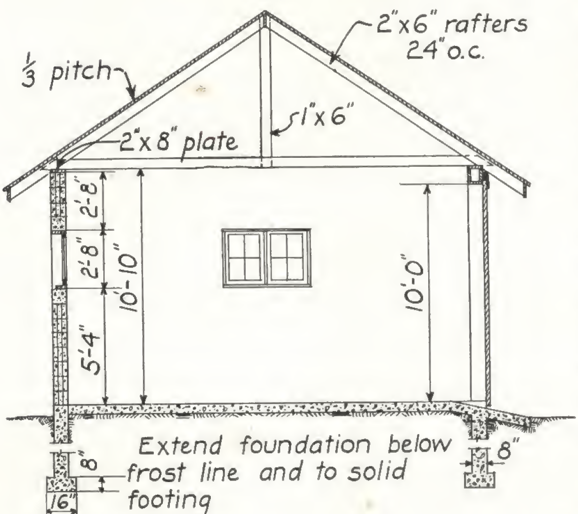
MOST farm machines are actually used only a comparatively short time each year and if they are not protected from the weather are attacked by rust and rot and soon become useless. On the average farm the amount of money spent for farm implements justifies the erection of a building which will afford them adequate protection. Such a building will pay good returns on the investment.

Adequate shelter greatly prolongs the usefulness of farm machinery.



FLOOR PLAN

A suggested plan for a farm implement shed is given here. This building is 20 feet wide and 50 feet long. The lengths, however, may be varied to suit housing capacity required. The roof is supported by a simple truss, in order that no posts or columns will interfere with the free handling of implements. Two large doors conveniently placed make it easy to move machinery in or out. The space under the roof may be utilized for storage of light implements and supplies by laying a board floor over the 2 by 8-inch cross beams.



CROSS SECTION

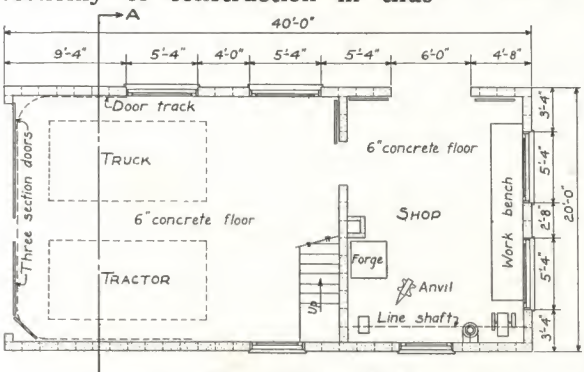
CONCRETE MIXTURES

Footings and foundation	1 : 2½ : 4
Floor	1 : 2 : 4
Sills and lintels	1 : 2 : 3

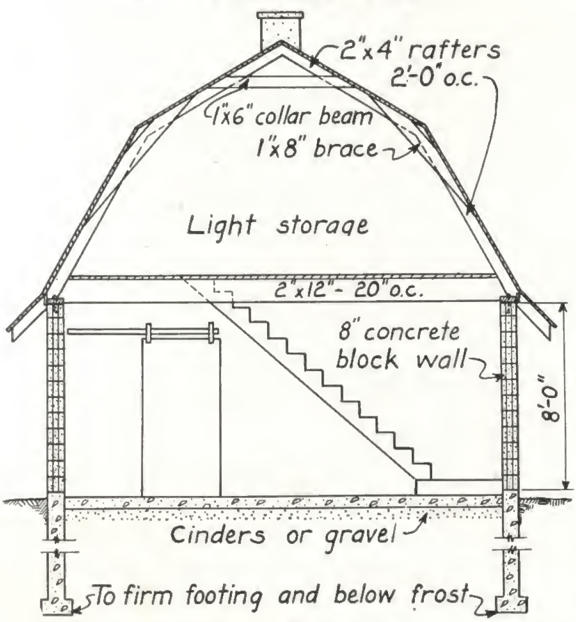
Tractor Shed and Farm Shop

The farm truck and tractor deserve to be housed in a fire and storm safe structure like this.

LIKE the automobile the truck and tractor deserve careful housing. It is convenient to include the farm shop in the same building. Then necessary repair work and overhauling can be done in winter or in bad weather. There is also an economy of construction in thus combining the tractor shed and shop because they have one wall in common.



FIRST FLOOR PLAN



CROSS SECTION

The plan shown provides storage space for a farm truck in addition to the tractor with plenty of working room around and between them. There is also space for the storage of supplies necessary for their operation.

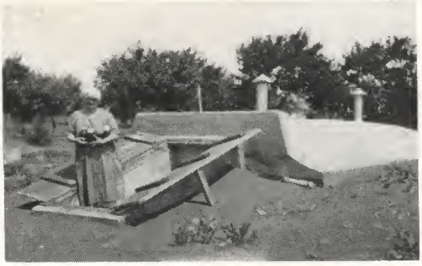
Concrete floors are specified for both rooms. Such a floor is durable, easily cleaned and permits heavy machinery to be moved on it readily. The floor is made 6 inches thick of 1:2:4 concrete.

The building has been designed for concrete block construction using units 16 inches long, 8 inches high, and 8 inches thick. Monolithic construction, with single or double wall can be used.

CONCRETE MIXTURES

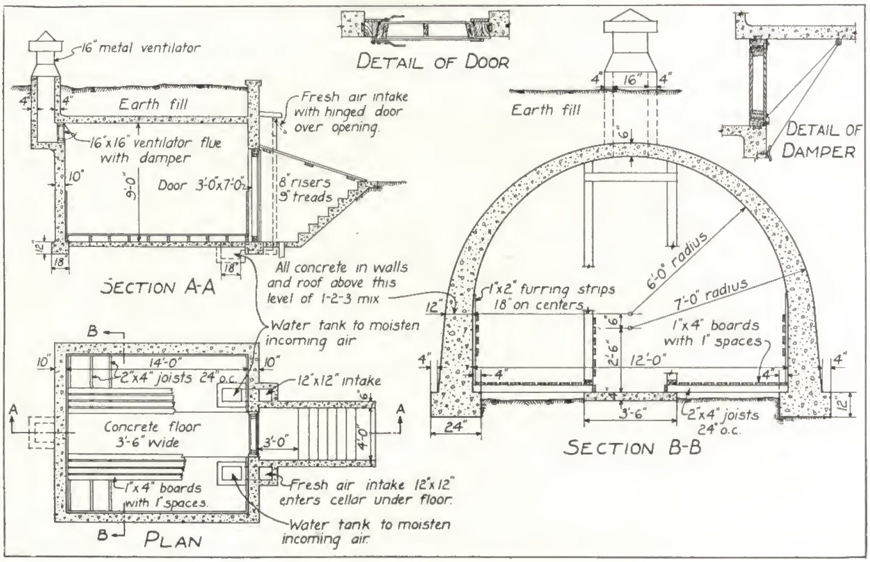
Footings and foundation	1 : 2½ : 4
Floor	1 : 2 : 4

Storage Cellar



Fruits and vegetables can be kept in good condition in a concrete storage cellar.

WITH a well designed storage cellar the grower can store his fruit and vegetables until market conditions are favorable. He is not compelled to sell his crop at harvest time when low prices usually prevail. Storage cellars are generally partly covered with earth to get the benefit of the insulation



Arched Roof Storage Cellar

CONCRETE MIXTURES

Footings	1 : 2½ : 4
Wall	1 : 2 : 4
Arched roof	1 : 2 : 3

MATERIALS REQUIRED

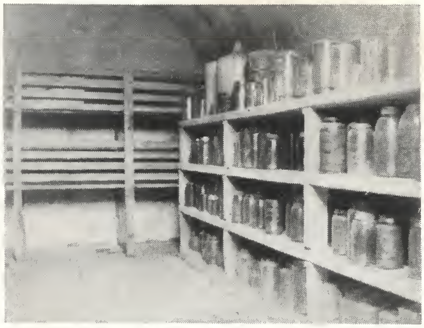
(Inside dimensions 12 by 14 feet.)

Cement	172 sacks
Sand	14 cubic yards
Pebbles	21¾ cubic yards

For each additional foot in length, the following material will be required:

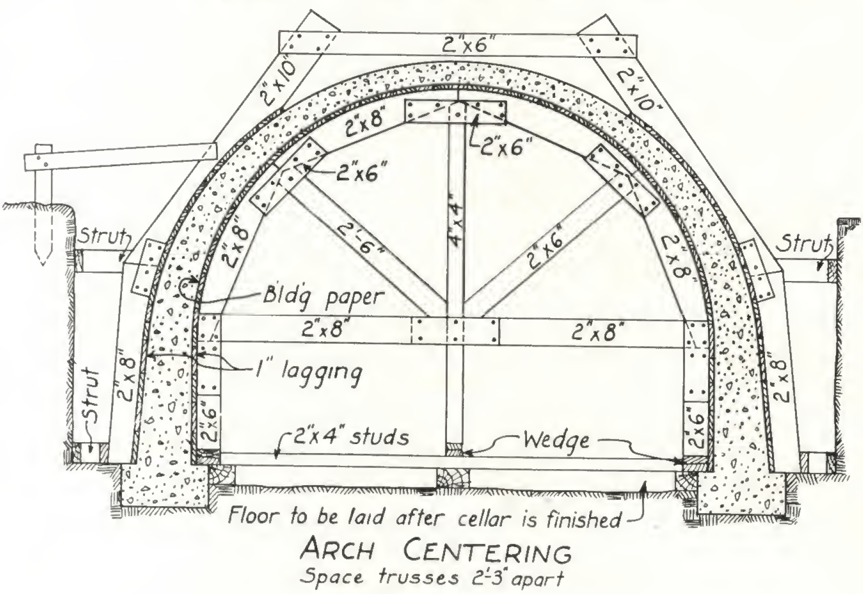
Cement	6½ sacks
Sand	½ cubic yard
Pebbles or broken stone	1 cubic yard

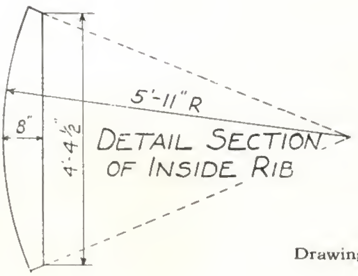
it affords both in summer and in winter. Only masonry materials should be considered for storage cellar construction since the damp earth covering would cause the rapid decay of less permanent materials. Concrete is most widely used because it is watertight, possesses great strength and is permanent.

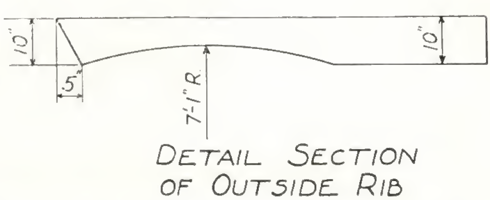


Concrete is the ideal material for storage cellar construction.

Forms for Arched Roof Cellar







Drawings show usual method of constructing forms for arched root cellar plan on page 28.

Storage Cellar of Large Capacity

THE storage cellar shown has a capacity of approximately 5,000 bushels. This capacity can be increased by using the driveway for storage in emergencies. The cellar is designed in ten-foot units and can be lengthened or shortened to give any capacity desired.

Temperature of Storage

Apples, potatoes, beets, carrots, and other fruit, roots, and vegetables will keep best at a temperature between 32 and 40 degrees F. The normal temperature of the earth is around 50 degrees F. In order to reduce and maintain the proper temperature in a storage cellar, cold air must be brought in from the outside. During the early fall months, there are nights when the temperature drops near or below the freezing point. Advantage must be taken of these nights to cool the storage cellar. To accomplish this it is essential that the cellar be equipped with proper intakes and outtakes to secure a rapid change and circulation of air.

Concrete combines rotproofness, water tightness, and great strength and is therefore universally used for storage cellar construction.

In the accompanying design, the fresh or cold air intakes are located on each side of the entrance doors. The cold air is delivered into the cellar close to the floor. The warm air that rises to the ceiling is drawn off through the two roof ventilators. In this way circulation of air is complete and in the course of one night the air is changed many times. On warm days and nights all ventilators and intakes are closed to keep the cold air in the cellar. They are not opened again until the next cold spell.

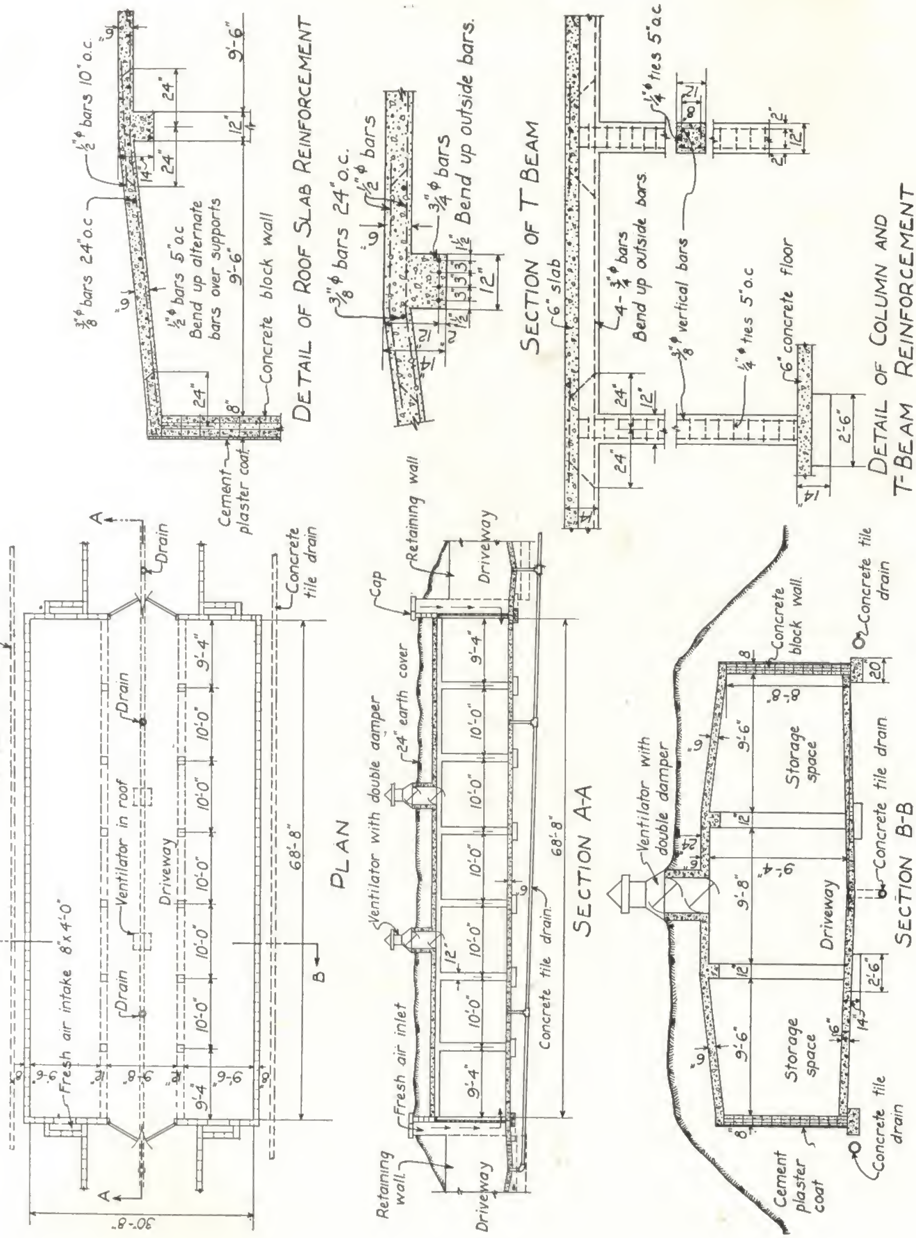
CONCRETE MIXTURES

Footing	1 : 2½ : 4
Floor and roof	1 : 2 : 4
Walls (concrete block or hollow wall monolithic construction)	1 : 2 : 4

MATERIALS REQUIRED

(Inside dimensions 30 feet 6 inches by 69 feet.)

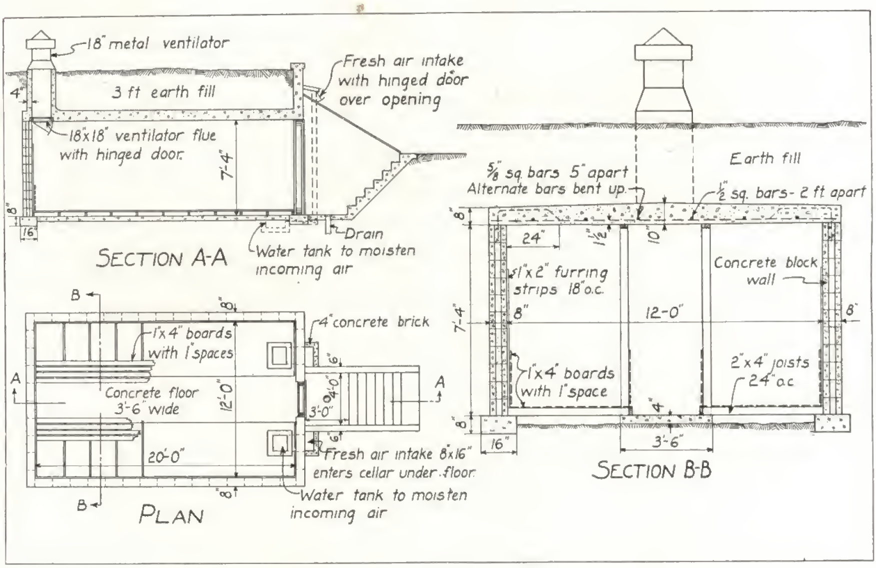
Cement	635 sacks
Sand	51 cubic yards
Pebbles or broken stone	92 cubic yards
Concrete block (8 by 8 by 16 inch)	2,058
Reinforcement rods (⅜ inch)	480 lineal feet
Reinforcement rods (¼ inch)	864 lineal feet
Reinforcement rods (½ inch)	3,400 lineal feet
Reinforcement rods (¾ inch)	720 lineal feet



Design for large storage cellar described on page 30.

Flat Roof Cellar

REINFORCING steel must be used in the roof of the flat roof cellar shown below. Bars 5/8-inch square are spaced 5 inches apart, center to center, and placed 1½ inches from the bottom of the slab. Alternate bars are bent up at a point 2 feet from the inside cellar wall. The ends of all bars are bent at right angles to form a hook about 3 inches long. This insures good anchorage in the concrete. One-half-inch square bars, placed 2 feet apart, are run lengthwise of the roof slab.



CONCRETE MIXTURES

Footings	1 : 2½ : 4
Walls and roof	1 : 2 : 4

MATERIALS REQUIRED

(Inside dimensions 12 by 20 feet)

Cement	191 sacks
Sand	16¾ cubic yards
Pebbles or broken stone	28¼ cubic yards
Steel bars (½ inch)	120 feet
Steel bars (5/8 inch)	720 feet

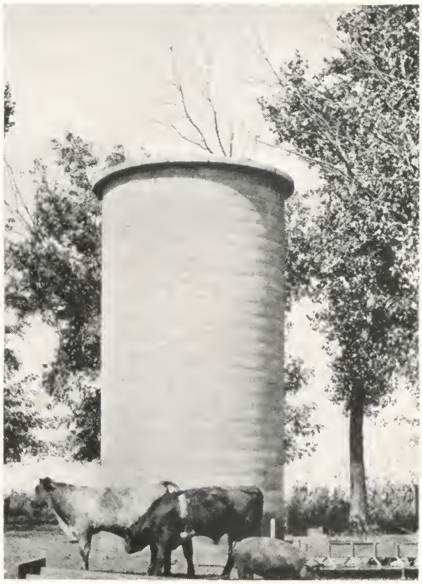
For each additional foot of length, the following material will be required:

Cement	6 sacks
Sand	½ cubic yard
Pebbles or broken stone	(nearly) 1 cubic yard
Steel bars (½ inch)	6 feet
Steel bars (5/8 inch)	36 feet

Water Supply Tank

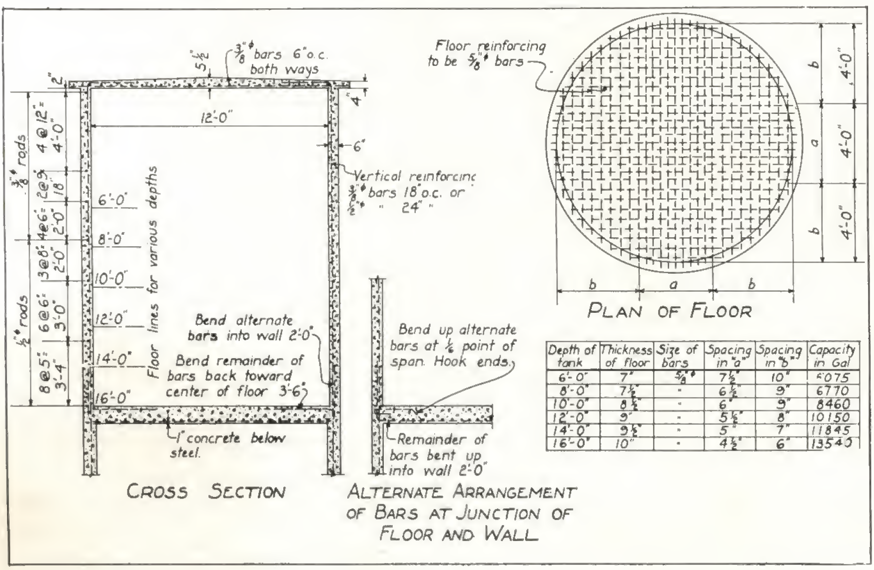
IN cutting down labor, increasing profits, and improving living conditions on the farm, a gravity water system is worth many times its cost.

The water supply tank shown in the drawing on this page is 12 feet in diameter and can be built on the top of a monolithic concrete silo if desired. Because the silo is generally the tallest structure on the place, a water tank located on top of it will develop pressure sufficient to force water to every building. Much needed fire protection is thus obtained.



A concrete tank provides storage for an adequate supply of clean, fresh water.

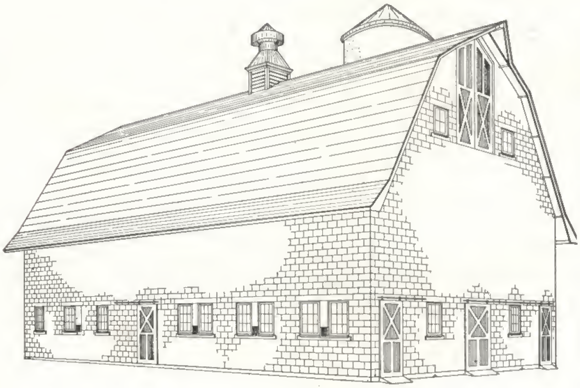
The drawing indicates the proper amount of reinforcement for tanks of different depths to 16 feet and the table gives the proper thickness of floor slab and correct amount of reinforcement for tanks of different depths. A 1:2:3 concrete mixture should be used throughout.



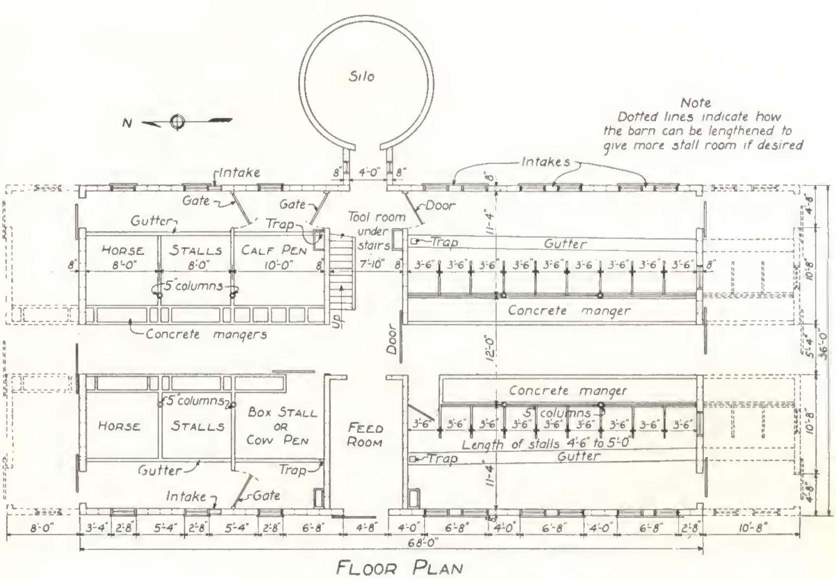
Depth of tank	Thickness of floor	Size of bars	Spacing in "a"	Spacing in "b"	Capacity in Gal
6'-0"	7"	5/8"	7½"	10"	5075
8'-0"	7½"	"	6½"	9"	6770
10'-0"	8½"	"	6"	9"	8460
12'-0"	9"	"	5½"	8"	10150
14'-0"	9½"	"	5"	7"	11845
16'-0"	10"	"	4½"	6"	13540

General Purpose Barn

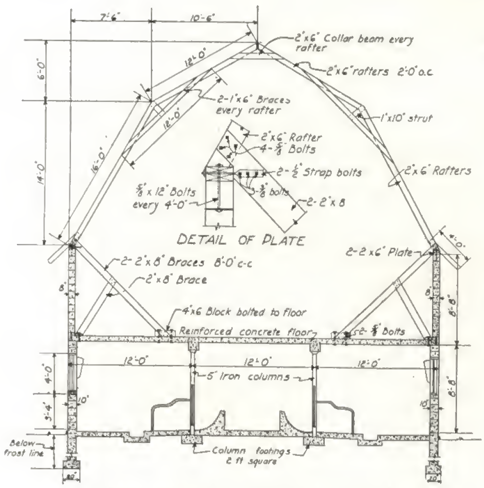
A FEATURE of the general purpose barn plan shown below is that it can be altered to give any capacity desired. The dotted lines indicate how either end of the barn can be extended to provide additional stalls for horses or cows; likewise the barn can be shortened if less capacity is required. It can be converted into a structure for housing dairy cattle only, or it can be made to cover the requirements of a horse barn with only minor structural changes. The silo and the feed bins are located near the center to permit future extension of the barn on either end. This location saves steps at feeding time. The type of roof framing shown on the opposite page gives the maximum amount of clear loft space and yet is economical and rigid.



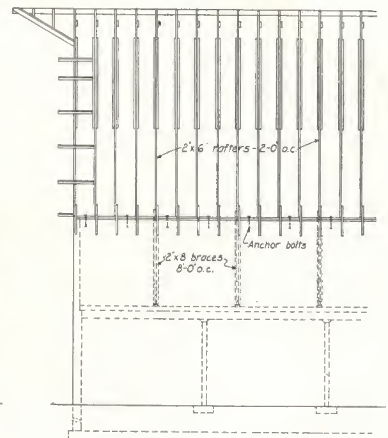
If possible the barn should be located so that its long dimension will extend north and south, thus presenting the greatest area of window opening on the east and west sides.



Floor Plan



CROSS SECTION THRU COW STALLS



SIDE FRAMING

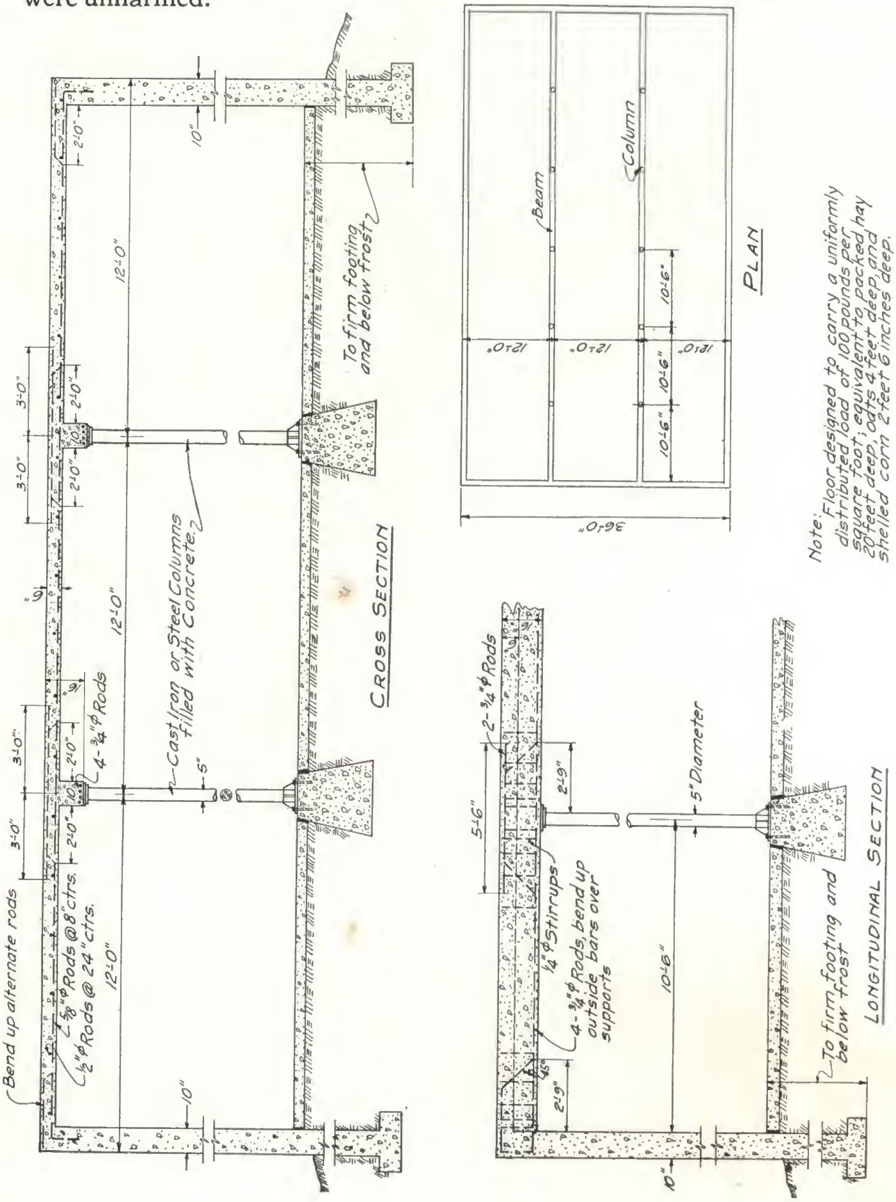
CONCRETE MIXTURES

Footings and foundation	1 : 2½ : 4
Floor, manger, alleyways, etc	1 : 2 : 4
Loft floor (reinforced concrete)	1 : 2 : 4
Side walls (concrete masonry units).	

A well-built and well-arranged barn lowers the cost of feeding and otherwise caring for the stock.

Reinforced Concrete Loft Floor

FOR complete fire protection, the loft floor should be of reinforced concrete construction. The merits of this type of construction have been proved by fires where the entire contents of lofts have been destroyed by fire, while the animals below were led to safety and stock quarters were unharmed.



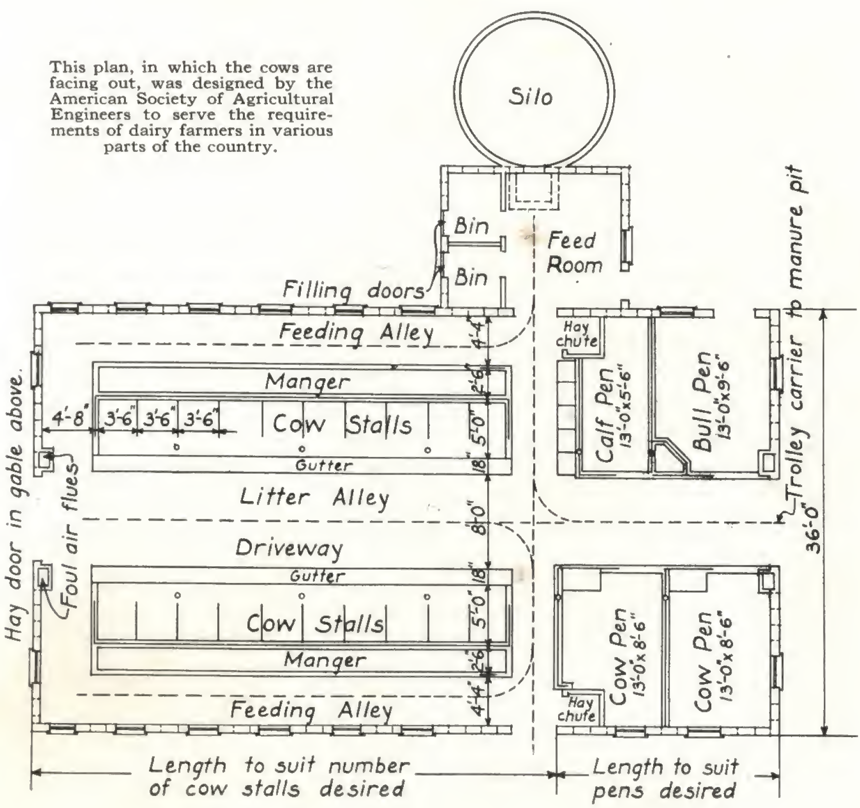
Dairy Barns

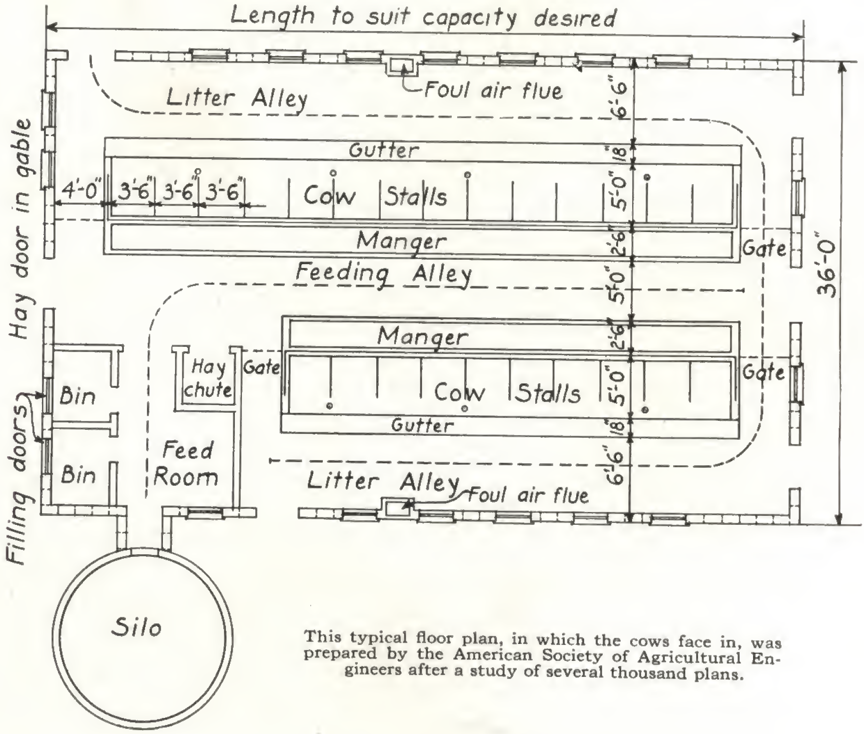
THE dairy barn plans shown below and on the following page were designed by the Farm Structures Committee of the American Society of Agricultural Engineers after a study embracing several thousand suggested arrangements. In one of the plans the cows are placed facing in, while in the other they face out. The cows are faced in or out largely according to personal preference. Both plans will be found satisfactory for a one-story, a one and one-half story or a two-story barn. In the case of a two-story barn, the barn framing shown on page 35 may be used. Roof framing for a one-story barn is shown on page 41.

Construction of Floors and Mangers

After the barn walls have been built, all boards, rubbish, and other material within the enclosure should be removed and the floor area graded to the required level, allowing for the thickness of the concrete floor. The soil where the concrete is to be laid should be compacted thoroughly.

This plan, in which the cows are facing out, was designed by the American Society of Agricultural Engineers to serve the requirements of dairy farmers in various parts of the country.

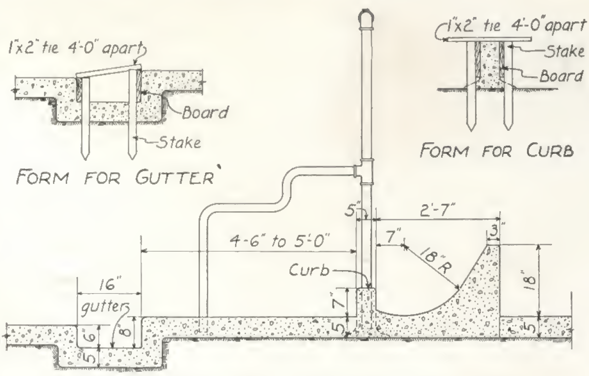




This typical floor plan, in which the cows face in, was prepared by the American Society of Agricultural Engineers after a study of several thousand plans.

An abundance of sunlight, uniform temperature, a plentiful supply of fresh air, and the highest possible degree of cleanliness, make this one-story, concrete barn ideal for housing dairy cattle.

The concrete may be placed directly on the earth if the building is located on high ground or where drainage from beneath the floor is good. Otherwise, a 6 or 8-inch fill of cinders or gravel is advisable.



SECTION THRU STANDARD COW STALL

Barn floors are usually made to average 6 inches thick, the full thickness being placed in one operation, using the same mixture of concrete throughout. This is known as one-course construction. The manger curb is usually placed first. It should be at least 5 inches thick and about 7 inches high above the floor on the stall side. Feed and litter alleys are usually placed after the curb; then the stall platform and manger are placed.

The utmost degree of sanitation is made possible when the dairy barn floors and mangers are made of concrete.

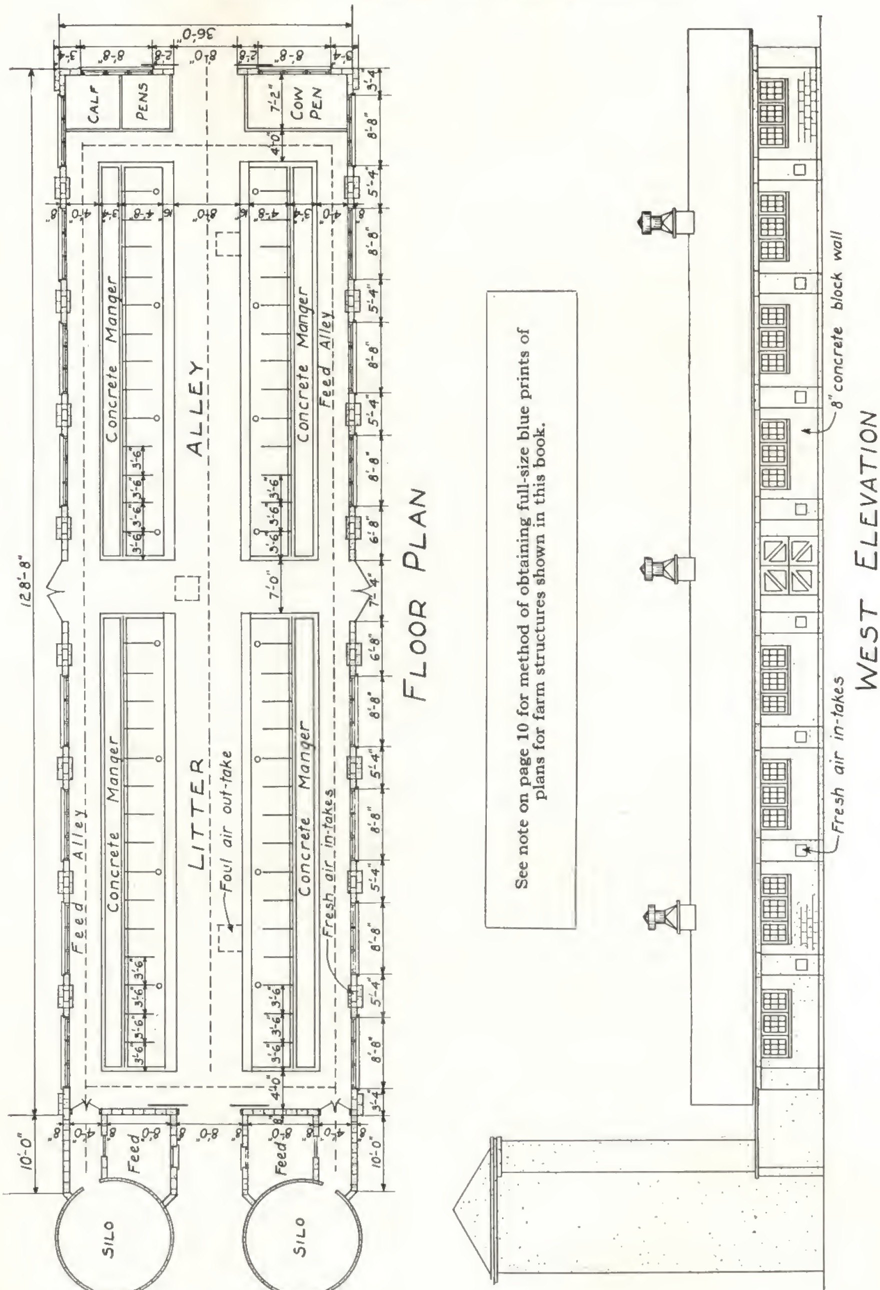
Dairy barn floors, mangers and alleys should be made of 1:2:4 concrete. Stall floors and alley floors should be finished with a wood float. Mangers should be finished smooth with a steel trowel.

The length of stall platform, that is, the distance from manger curb to gutter, will depend upon the breed of cattle kept. The width of stall should also be varied according to the size of cattle. The table below indicates the proper length and width of stalls for several breeds.

DIMENSIONS FOR COW STALLS

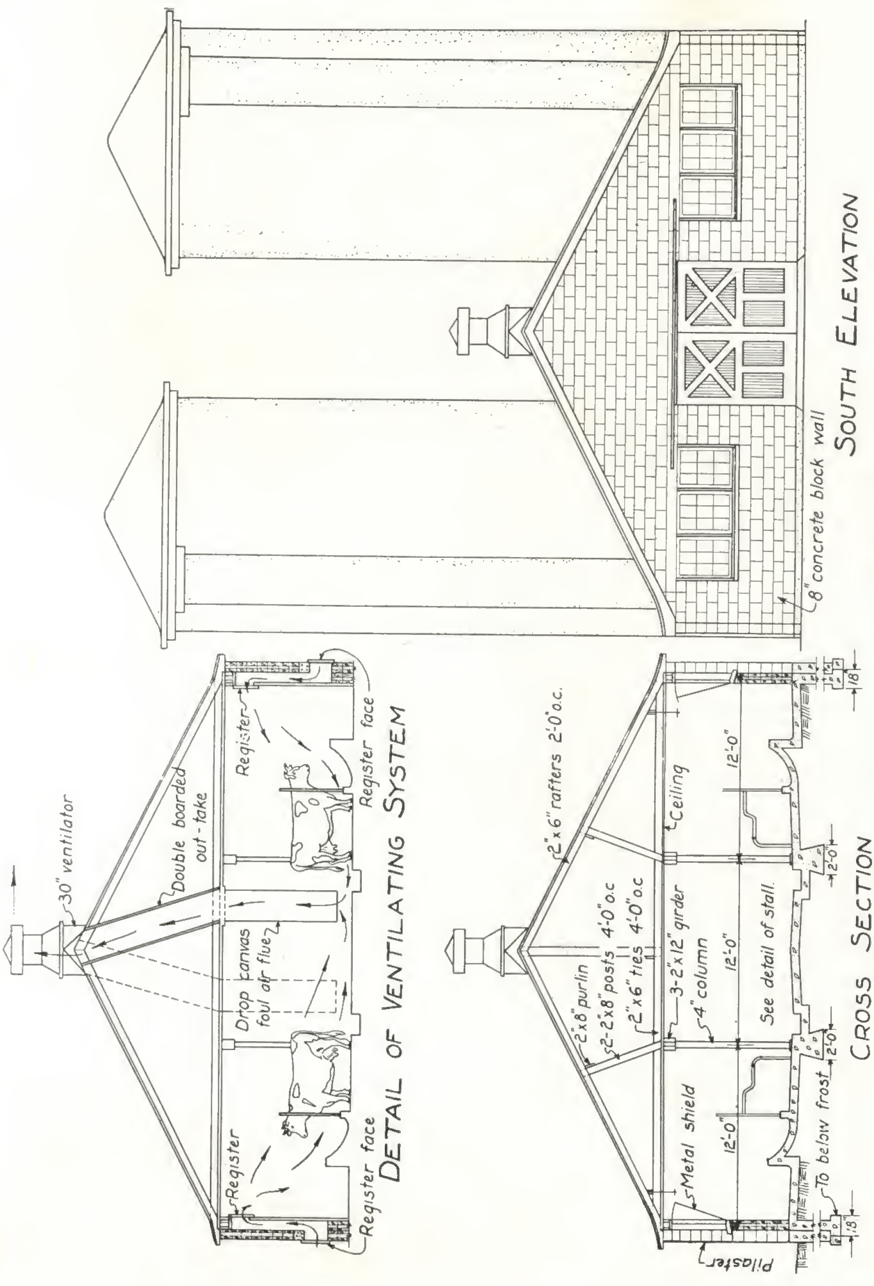
Breed	Width	Length		
		Small	Medium	Large
Holstein	3′–6″ to 4′–0″	4′–10″	5′– 2″	5′–8″
Shorthorn	3′–6″ to 4′–0″	4′– 8″	5′– 0″	5′–6″
Ayrshire	3′–6″ to 3′–8″	4′– 6″	5′– 0″	5′–6″
Guernsey	3′–4″ to 3′–6″	4′– 6″	4′–10″	5′–4″
Jersey	3′–4″ to 3′–6″	4′– 4″	4′– 8″	5′–0″
Heifer (of any breed)	2′–9″ to 3′–2″	3′– 8″	3′–10″	4′–2″

One-Story Dairy Barn



Plan and side elevation for one-story dairy barn. End elevation and cross-sections are shown on page 41.

One-Story Dairy Barn



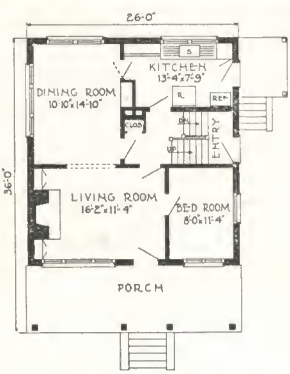
Cross-sections and elevation for one-story dairy barn. Floor plan is shown on page 40.

Farm Residences

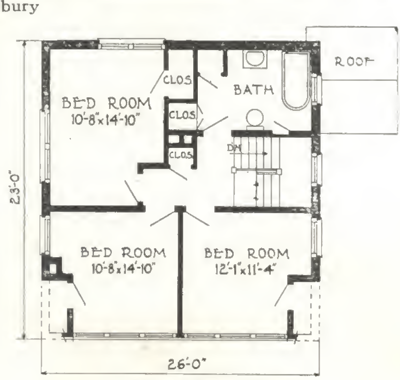
THE durable qualities of a concrete masonry house appeal to thrifty farm owners. With such a house, maintenance and repair expenses are practically eliminated. The staunch character of concrete masonry construction makes these houses unusually storm-safe. This is a very important consideration in many sections. The fire-resistive properties of concrete further safeguard the house as well as its occupants.

The three houses illustrated appear in our book, "Plans for Concrete Houses" which contains designs for 37 other attractive homes. Blue prints of any of these houses may be obtained as explained on page 10. The plans include bungalows, cottages and two-story residences in a variety of architectural styles. The price of this book is 50 cents. For prompt attention send your order to our nearest district office. See list on the back cover.

The Middlebury

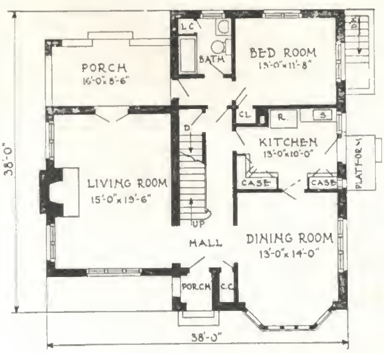


First Floor Plan

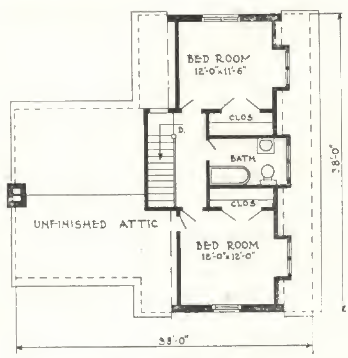


Second Floor Plan

The Pelham



First Floor Plan



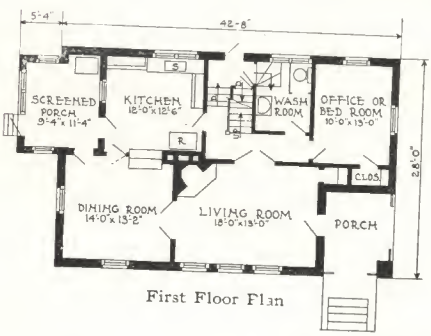
Second Floor Plan

Portland Cement Stucco

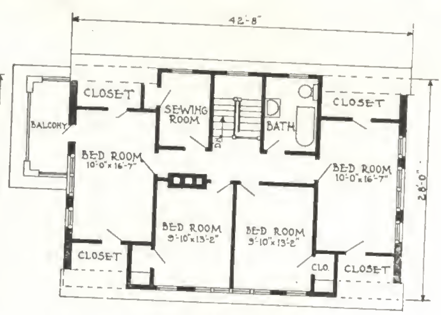
Portland cement stucco makes a very attractive as well as a very durable finish for residences. A great variety of interesting surfaces of different textures and colors are now possible with portland cement stucco. Applied on a wall of concrete block or concrete building tile as a backing, cement stucco clings tenaciously. Cracking or spalling is entirely eliminated; the stucco is on to stay. Our booklet "Portland Cement Stucco" shows a number of color panels of different finishes and describes how they are produced. A copy of this booklet will be mailed on request. Address our nearest district office.

Portland cement stucco applied to concrete masonry wall—construction that both permanent and attractive.

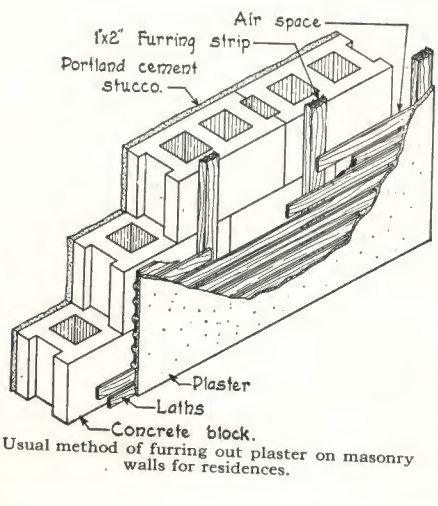
The Wakefield



First Floor Plan



Second Floor Plan



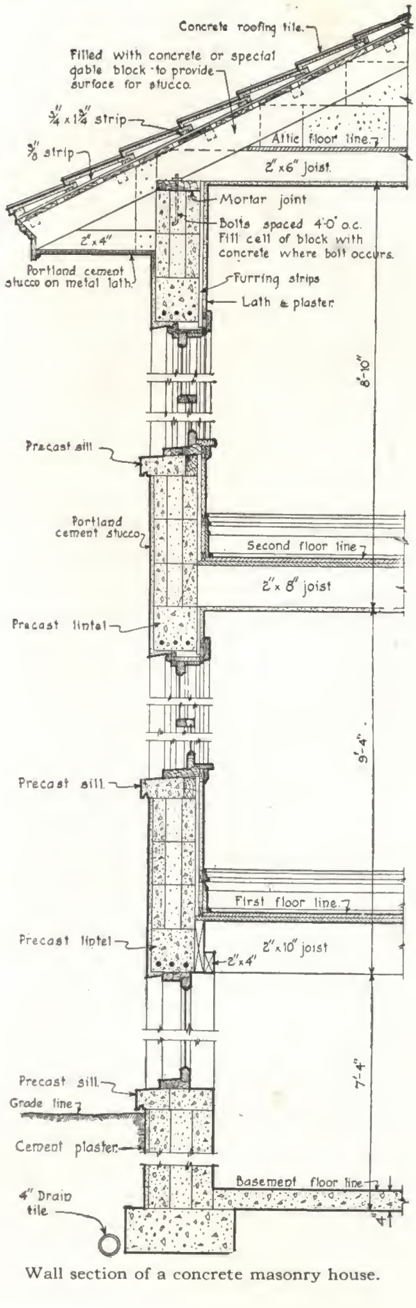
Usual method of furring out plaster on masonry walls for residences.

Furring and Lathing

In masonry houses it is common practice to fur out the plaster so as to provide an air space between the plaster and the wall.

The air space thus formed usually affords sufficient insulation so that plaster is about the same temperature as the air within the rooms, preventing condensation and assuring a dry wall. The insulating air space makes the house easy to keep at even temperatures. In summer this means cooler rooms, and in winter a saving in fuel bills. Fuel saved soon repays for the cost of furring out the plaster.

House Construction Details



Wall section of a concrete masonry house.

Wall Footings

Properly built footings prevent settlement and cracking of plaster and walls and prolong the life of the building. Footings should always rest on firm soil and extend to below possible frost penetration. Under average conditions a footing 18 inches wide will be satisfactory for residences up to two stories in height. Such a footing is usually made eight or nine inches thick, using a 1:2½:4 mixture.

Dry Basement Walls

Basement walls should be built to exclude moisture. Both monolithic concrete and concrete masonry are extensively used for basement walls. A 1:2½:4 mixture is recommended for monolithic walls. When walls are constructed of concrete block or tile they should be carefully bedded in cement mortar. Where there is a possibility of much ground water being present, it is a good scheme to plaster the exterior wall below grade with a 1:2 cement mortar.

Fire-Resistive Roof Coverings

A large percentage of dwelling house fires is caused by inflammable roof coverings. Roof fires ordinarily originating from the outside can be entirely eliminated by the use of cement asbestos shingles or concrete roofing tile. Besides affording fire protection, these roofing materials will withstand the action of weather almost indefinitely.

How to Figure Quantities

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. (Sand)	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 TABLES 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.

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

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

$\frac{924 \times 89.4}{100} = 825$ cu. ft. coarse aggregate.

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

$\frac{132 \times 22.4 \times 1\frac{1}{2}}{100} = 44.4$ sacks cement.

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

$\frac{132 \times 89.4 \times 1\frac{1}{2}}{100} = 177.0$ 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 plaster coat, 4 ft., equals 544 square feet.

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

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

Additional Farm Building Helps

Concrete Around the Home tells in everyday language how to use concrete for constructing drives, walks, steps, porches, and other permanent improvements which every home needs. Complete instructions make it easy to estimate the materials and to mix, place, and finish the concrete for these improvements.

Concrete in Home Sanitation gives complete information and practical suggestions for proper sanitation of the home. *Your* home can be made safe against typhoid fever, dysentery, and similar filth diseases by constructing concrete septic tanks, privy vaults, well-platforms and well-curbs. Riddance of rats, mice, and vermin can be accomplished easily by building of concrete.

Concrete Silos—Monolithic and Block, completely describes and illustrates the best procedure to follow when building a concrete silo, either monolithic or block. Various tables enable anyone to determine exactly the size of silo needed to feed any number of animals. Every farmer should have a copy of this booklet.

Address the District Office nearest you for your free copy of these booklets.

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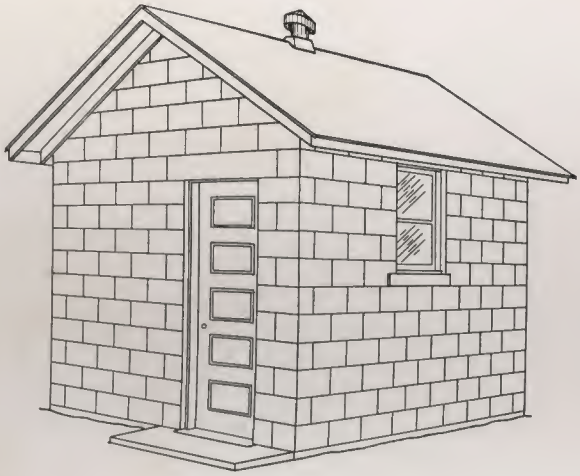
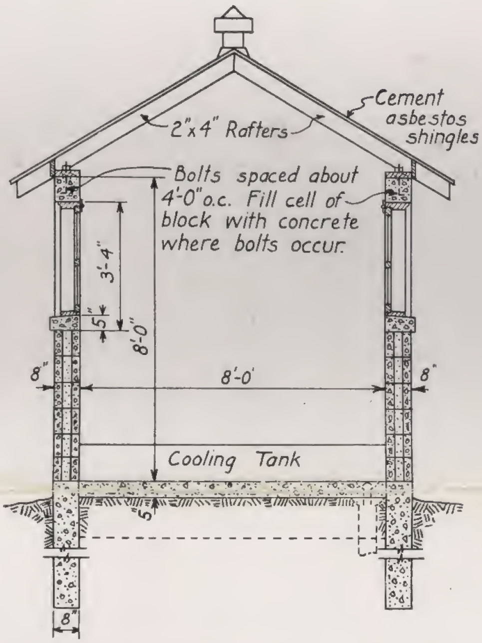
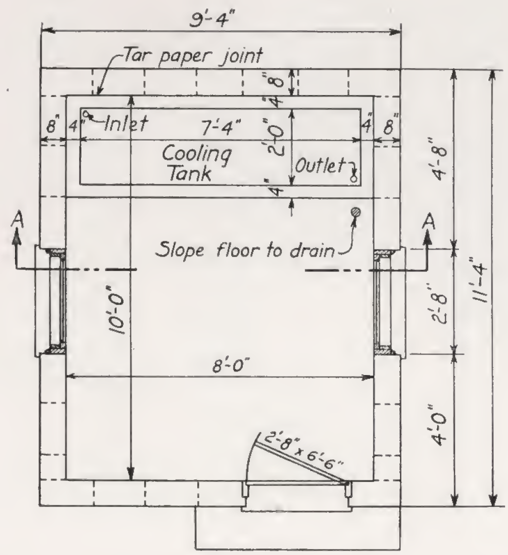
SUGGESTED PLANS
for
MILK COOLING HOUSES





Milk Cooling House
for
Herd of 15 Cows

Cross Section and Floor Plan of Milk Cooling House of 15-Cow Capacity



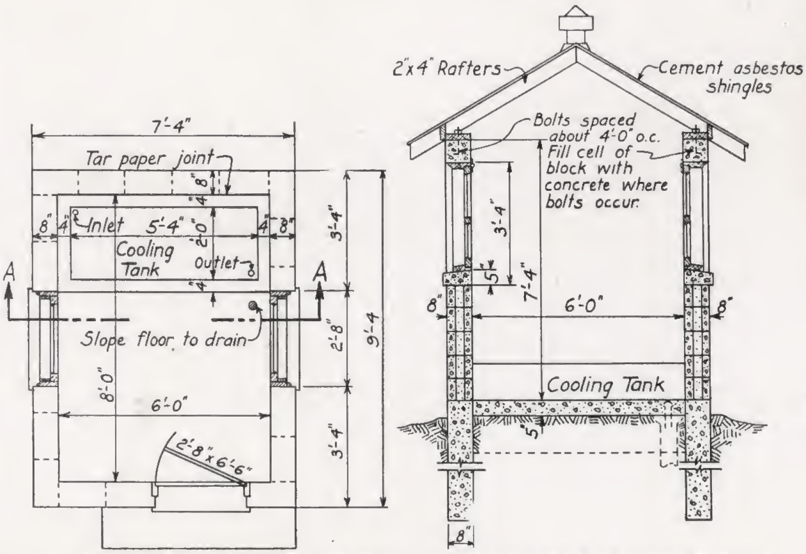
Materials Required:

- Cement—38 sacks
- Sand—3½ cubic yards
- Pebbles or broken stone—4¼ cubic yards
- Concrete block, 8" x 8" x 16"—310
- Half block, 8" x 8" x 8"—30
- Reinforcing steel—159 feet ⅜-inch diameter round rods

Concrete Mixtures:

- Foundation—1:2½:4
- Floor, Tank, Sills, Lintels, Platform—1:2:3
- Mortar—1:3

Milk Cooling House for 10 Cows



Floor Plan and Cross-Section of Milk Cooling House of 10-Cow Capacity.

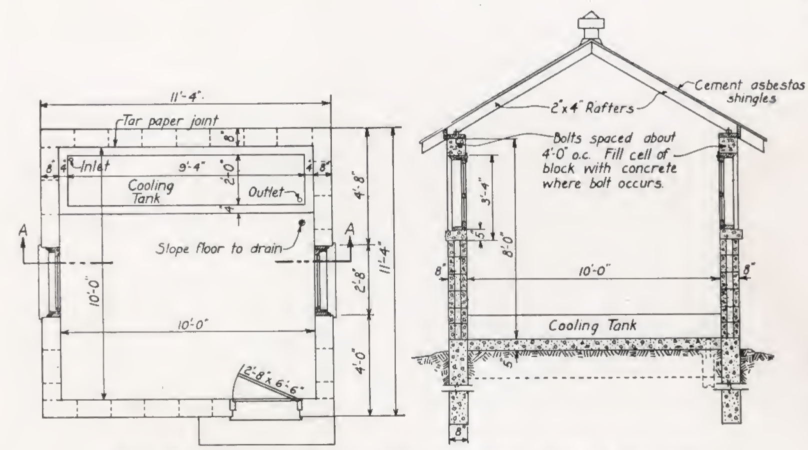
Materials Required:

- Cement—27 sacks
- Sand—$2\frac{1}{2}$ cubic yards
- Pebbles or broken stone—$3\frac{1}{4}$ cubic yards
- Concrete block, 8″ x 8″ x 16″—220
- Half block, 8″ x 8″ x 8″—28
- Reinforcing steel—129 feet $\frac{3}{8}$-inch diameter round rods

Concrete Mixtures:

- Foundation—1:$2\frac{1}{2}$:4
- Floor, Tank, Sills, Lintels, Platform—1:2:3
- Mortar—1:3

Milk Cooling House—20-Cow Capacity



This Milk House is Suited for the Farm Having 20 Cows.

Materials Required:

- Cement—44 sacks
- Sand—4 cubic yards
- Pebbles or broken stone—5 cubic yards
- Concrete block, 8″ x 8″ x 16″ 362
- Half block, 8″ x 8″ x 8″—30
- Reinforcing steel—189 feet $\frac{3}{8}$-inch diameter round rods

Concrete Mixtures:

- Foundation—1:$2\frac{1}{2}$:4
- Floor, Tank, Sills, Lintels, Platform—1:2:3
- Mortar—1:3

Construction Details

Building a concrete milkhouse is a job which may be done in odd times. Herein are suggested plans and methods for carrying out this work.

FOUNDATION

After carefully marking out the foundation, excavate the trench so that the sides are even and vertical. If the earth walls of the trench are firm, forms will not be necessary for that part of the foundation wall below grade. If the soil is not firm, additional excavation will be necessary to permit using forms to construct the foundation walls.

For the wall above grade forms may be made with 1 by 6-inch boards, well braced. Concrete mixed in the proportion of 1 part cement, 2½ parts sand and 4 parts pebbles or broken stone, is satisfactory for the foundation. The foundation should be carried below usual frost line to prevent upheaval by freezing.

BUILDING THE WALL

The mortar used in the block walls should be mixed in the proportion of one sack of portland cement to 3 cubic feet of clean, well-graded sand. A small amount of hydrated or slaked lime (not to exceed 10 pounds per sack of cement) may be added to the mortar to make it more plastic.

Door and window frames are set and built in place as the block are laid. The frames may be anchored to the wall by driving spikes partly into back of frames to extend into the block walls at the mortar joints.

The usual method of attaching plates is to bolt them down at intervals of four or five feet to the top course of block. Bolts should be long enough to extend through one course of block and the plate. Cores of the block where bolts occur are filled with concrete to insure firm anchorage.

MILK COOLING TANK

When milk is cooled by well or spring water, a minimum net width of 24 inches is recommended for the tank, but in case iced water is used this width may be reduced to 19 inches. Capacity for four, six and eight cans respectively is provided in the three sizes shown. The tank is made just deep enough so that water will come well up on the necks of the cans. To lighten the labor of lifting cans in and out of the tank, part of its depth is below the floor level. A device for holding the cans down when partially filled is shown on this page. This device keeps partly filled cans from over-turning and spilling their contents.

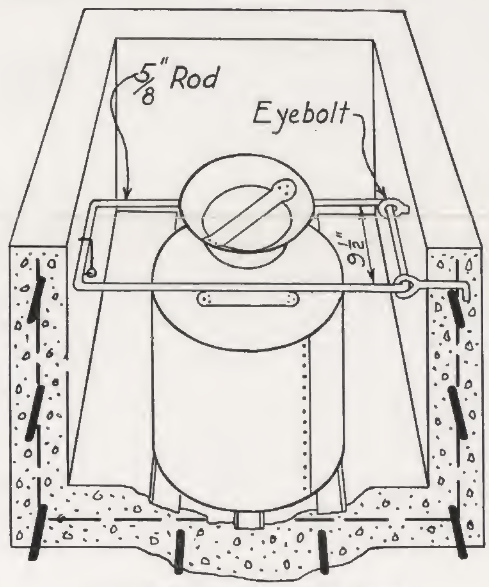
If ice is not available, milk can usually be cooled to 55 degrees Fahrenheit or lower by circulating spring or well water through the tank. A uniform flow of water is secured by placing the inlet at one end of the tank at floor level and the outlet or overflow pipe at the opposite end. The grooves in the tank floor permit water to circulate under the cans freely, resulting in more rapid cooling of the milk. These grooves are made by pressing wood strips in the concrete at the time floor is finished. Before the concrete has hardened the strips are removed.

Tank floor and walls are concreted in one operation. the floor of the tank being made six inches thick and the walls four inches. Reinforcement consists of ⅜-inch rods spaced 12 inches apart, as indicated in the drawings. The reinforcement of the floor and walls is made continuous by bending the rods "U" shaped. Rods are also extended around the tank walls, with ends lapped at least 12 inches. At all intersections reinforcing rods are firmly wired together to hold them in correct position. A 1:2:3 mixture for the tank is considered most satisfactory. Screened gravel or crushed stone up to one inch in size may be used.

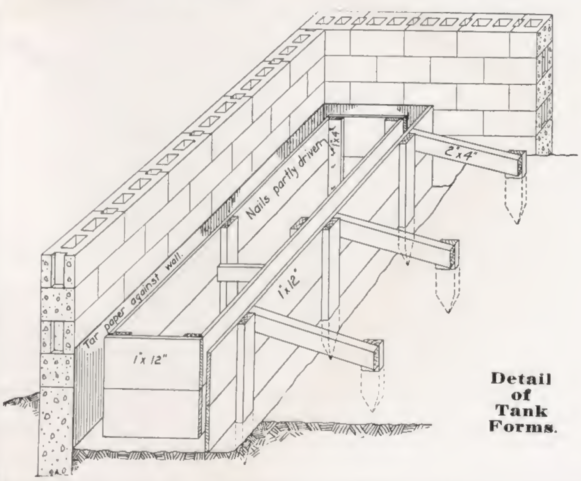
Simple forms for making the tank walls and floor are shown in an accompanying sketch.

PLACING THE FLOOR

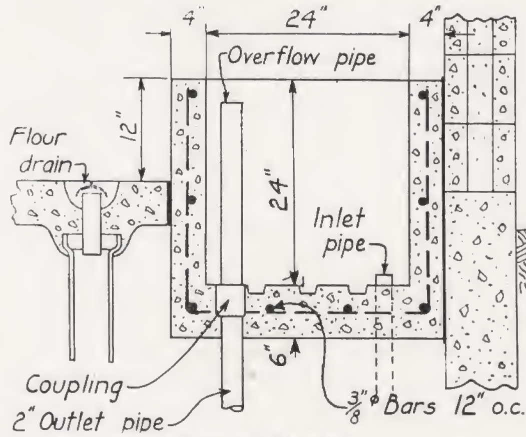
Where the ground on which milkhouse is to be located is sloping, the area should be levelled off and tamped so that the entire floor rests on firm soil. A 5-inch floor made of 1:2:3 concrete is generally used, with stone or gravel not larger than 1½ inches. One-course construction is recommended which means that the full thickness (5 inches) of concrete is placed in one operation, and thoroughly tamped. A dense, even surface is produced by smoothing with a wood float. A little 1:2 mortar may be used in finishing, if needed.



Device for Holding Milk Cans.



Detail of Tank Forms.



Cross-Section of Tank.

How to Make Good Concrete

The materials used in making concrete are portland cement, sand, pebbles or crushed rock and water. The rules for making concrete are easily understood and for uniformly successful work they must be carefully followed.

Tools commonly used in making concrete

PROPER PROPORTIONING

Concrete mixtures are usually expressed as a 1:2:3 mixture, a $1{:}2\frac{1}{2}{:}4$ mixture, etc. The first figure denotes the number of parts of portland cement, the second figure, the number of parts of sand and the third figure, the amount of pebbles or broken stone. For example, a 1:2:3 mixture means that for each sack of cement there should be used 2 cubic feet of sand and 3 cubic feet of pebbles or crushed rock.

ACCURATE MEASURING—THOROUGH MIXING

It is important that the materials be measured accurately. A pail or box or wheelbarrow may be used for the purpose, whichever is most convenient. Mixing may be done either by hand or by machine but it must be continued until every particle of sand and stone is completely covered with a coating of cement mortar and the mass is uniform throughout. Use only enough water to produce a plastic, quaky mixture that is readily workable. Avoid using a sloppy mixture.

PLACING CONCRETE IN FORMS

The newly mixed concrete should be placed in the forms within 30 minutes after it is mixed. As it is being placed in the forms, it should be tamped or spaded. This operation makes the concrete dense and improves the surface.

PROTECT AND CURE CAREFULLY

Do not permit the newly placed concrete to dry out for a week or ten days. Protect it from sun and drying winds; otherwise the water necessary for the proper hardening will evaporate, resulting in a loss of strength. Floors, walks and similar surfaces can be protected by covering with moist earth, hay or straw, as soon as the concrete has hardened sufficiently so that the surface will not be injured. This covering should remain on for a week or ten days and be kept moist by occasional sprinkling.

SUITABLE MATERIALS

To make good concrete, it is necessary to use proper materials. Both the sand and pebbles should be clean and free from dirt or organic matter. Such substances prevent proper bond between the cement and particles of sand and pebbles or crushed rock. By sand is meant that material ranging in size from fine up to that which would just pass through a screen with $\frac{1}{4}$-inch openings. Coarse sand makes better concrete than fine sand. The material that will not pass through the $\frac{1}{4}$-inch screen is referred to as coarse aggregate. The particles of coarse aggregate may range from $\frac{1}{4}$ inch to $1\frac{1}{2}$ inches or more in size according to the nature of the work. Crushed rock or screened gravel may be used for this purpose. Bank run gravel (just as it comes from the pit) should not be used without separation. It must be screened to separate sand and pebbles, which are then recombined in proper proportion for the work at hand. Water used in mixing should be clean; if it is fit for drinking, it is suitable for use in concrete.

PORTLAND CEMENT ASSOCIATION

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NEW YORK

A National Organization to Improve and Extend the Uses of Concrete

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