THE EXPENSE-PROOF FARM

The
Expense-Proof Farm

PUBLISHED BY THE

LEHIGH PORTLAND CEMENT CO.

ALLENTOWN, PA.

CHICAGO, ILL. SPOKANE, WN.

Table of Contents

Foreword

FIVE reprintings of our original farm construction book have convinced us that there is a very real demand for a book describing the simple forms of concrete construction which a farmer or home-owner can handle himself.

Although new uses for concrete are constantly turning up, and will continue to do so, the general rules of construction laid down herein should enable any careful workman to handle what simple construction work he wishes, and to develop any new uses the nature of this material makes possible.

The sources from which we obtained much of the information contained in this book are so numerous and so varied that we simply take this opportunity for a general acknowledgment of our indebtedness to all our many friends.

The
EXPENSE-PROOF FARM

General Instructions for the Handling and Placing of Concrete

THE THEORY of a perfect concrete mix is—as many cubic yards of pebbles or crushed stone as there will be in the finished work, with as many cubic yards of sand as will fill all the voids or open spaces in the pebbles or crushed stone, and sufficient cement to fill all the voids in the sand, with a slight excess. The purpose of the sand, therefore, is simply to serve as a filler, and of the cement simply to serve as a binder.

Many people, offhand, would consider that a 1:2:4 mix would approximate a mix of one part cement and six parts gravel. But they forget that the ordinary bank-run gravel already has its voids filled with small aggregate, so that a mix of one part cement to six parts gravel approximates a 1:3:6 mix if the gravel be well proportioned. However, it is impossible by ordinary inspection to tell in exactly what proportions the aggregates are mixed, so that the only safe way is to grade out the aggregates or gravel by means of screens to the proper size before using. Otherwise your gravel is as apt to be four parts sand to five of stone, as it is three of sand to six of stone.

If the gravel be so graded, there is no objection to its use in place of crushed stone. In fact, recent experiments show that concrete made of well-graded pebbles and coarse sand with rounded edges attains greater density, and consequently greater strength, than stone and sand of the same quality but with broken, sharp edges. This disproves the early impression that it was necessary for the sand to be sharp and the stone to be more or less broken.

Since the purpose of the cement is that of a binder, it follows that the sand and stone must bear their share of the stress to be borne by the entire mass. This makes it essential that they be of good quality, and not of a weak, crumbly nature. The nature of the work, of course, determines just what class of aggregate may be satisfactory.

For instance, cinder aggregate, which is not sufficiently strong for many classes of concrete work, gives very good results in fireplaces.

Local conditions also largely determine just what class of aggregate to use. As a general rule, there should be absolutely no foreign matter in either the sand or the stone. The reasons for this are: first, that the foreign

matter takes up space which should be filled by the sand or stone, and so makes weak spots in the concrete, and, second, that it coats over the sand or stone and so prevents a perfect bond between it and the cement.

Sand.—There are two simple methods of testing sand. The simplest is to rub a small quantity between your hands. Loam or clay will show its presence by soiling the hands. A second method is to fill a fruit-jar to the depth of four inches with sand, then fill with water to within an inch of the top, shake well, and allow to stand for a couple of hours. The sand will sink to the bottom, while any mud or clay will settle on top of the sand. There should not be more than one-quarter of an inch of such sediment. If a half-inch or more is found, the sand should be washed, provided it is impossible to obtain cleaner sand.

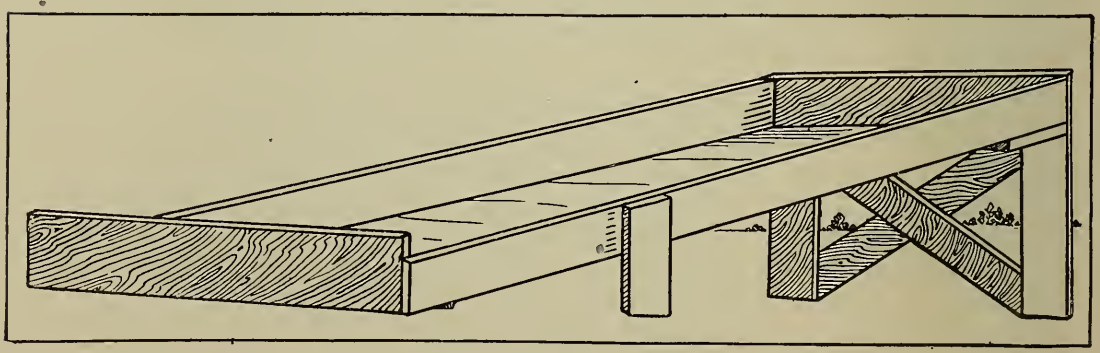
For washing the sand, place it on an inclined board platform of from 10 to 15 feet in length, raised a foot to a foot and a half at one end. At the lower end nail a six-inch board to hold the sand, which is spread over the platform three to four inches deep. Side boards will also be required on the platform to keep the sand from washing over the edges. A stream of water running from the upper end through the sand and over the base-board will cleanse it.

The sand should not be too fine. If it is more convenient to use fine than coarse sand, obtain an equal amount of the coarse to mix with the fine. When it is impossible to obtain a coarse sand, the amount of cement used must be doubled.

Stone or Gravel.—Any aggregate which cannot pass through a quarter-inch screen is called coarse aggregate, stone, or pebbles. Any passing through such a screen is called fine aggregate or sand. It is just as essential that the coarse aggregate be clean as that the sand be clean. For cleansing it, where necessary, the same method may be used as outlined for sand. In crushed stone a small amount of dust is permissible, but a proportionately smaller amount of sand should be used.

Best results are obtained with a mixture graded from small to large, as the mass is then more compact and so gives a denser concrete. Less sand is also required with such a mix.

It must be remembered that the cement does not give strength to the aggregates it unites, but simply binds them together. You, therefore, cannot expect the same strength from a cinder concrete that you will have from one made of granite. Granite, hard limestone, trap-rock, and hard



1. Sand-washing board constructed of inch lumber. The slope in this board should be in the ratio of one to ten.

gravel give the best results. Soft sandstones and limestones, slate, and shale should be avoided.

The proportions of cement, sand, and stone vary according to the class of work and according to the quality of the sand and stone. The following table gives a variety of proportions showing the amount of each material required per cubic yard of rammed concrete:

AMOUNT OF CEMENT, SAND AND STONE, OR GRAVEL REQUIRED PER CUBIC YARD OF RAMMED CONCRETE

CEMENT IN BARRELS (4 SACKS TO THE BARREL), SAND AND STONE IN CUBIC YARDS

MIXES	STONE 1 INCH AND UNDER, DUST SCREENED OUT			STONE 2½ INCHES AND UNDER, DUST SCREENED OUT			STONE 2½ INCHES MOST SMALL STONE SCREENED OUT			THREE-QUARTER INCH GRAVEL, SAND SCREENED OUT		
	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
1:1½:3	1.85	0.42	0.84	1.90	0.43	0.87	1.96	0.45	0.89	1.71	0.39	0.78
1:2:4	1.46	0.44	0.89	1.48	0.45	0.90	1.53	0.47	0.93	1.34	0.41	0.81
1:2½:4 ..	1.35	0.52	0.82	1.38	0.53	0.84	1.42	0.54	0.87	1.24	0.47	0.75
1:2½:4½	1.27	0.48	0.87	1.29	0.49	0.88	1.33	0.51	0.91	1.16	0.44	0.80
1:2:5	1.27	0.39	0.97	1.29	0.39	0.98	1.33	0.39	1.03	1.17	0.36	0.89
1:2½:5 ..	1.19	0.46	0.91	1.21	0.46	0.92	1.26	0.48	0.96	1.10	0.42	0.83
1:3:5	1.11	0.51	0.85	1.14	0.52	0.87	1.17	0.54	0.89	1.03	0.47	0.78
1:3½:5½	1.00	0.53	0.84	1.02	0.54	0.85	1.06	0.56	0.89	0.92	0.48	0.78
1:3:6	1.01	0.46	0.92	1.02	0.47	0.93	1.06	0.48	0.97	0.92	0.42	0.84
1:3½:6 ..	0.95	0.50	0.87	0.97	0.51	0.89	1.00	0.53	0.92	0.88	0.46	0.80
1:3:7	0.91	0.42	0.97	0.92	0.42	0.98	0.94	0.42	1.05	0.84	0.38	0.89
1:3½:7 ..	0.87	0.47	0.93	0.89	0.47	0.95	0.91	0.49	0.98	0.80	0.43	0.85
1:4:7	0.83	0.51	0.89	0.84	0.51	0.90	0.87	0.53	0.93	0.77	0.47	0.81
1:4:7½ ..	0.80	0.49	0.91	0.81	0.50	0.93	0.84	0.51	0.96	0.73	0.44	0.83
1:4:8	0.77	0.47	0.93	0.78	0.48	0.95	0.81	0.49	0.98	0.71	0.43	0.86

Water.—While such cases are uncommon, there have been some where the use of improper water has resulted in the failure of the concrete. The water must be clean and free from acids and alkalis. It may be kept in a barrel by the mixing board and placed on the concrete with a bucket. In cold weather it must be kept warm and free from icicles.

As the amount of water required varies with the nature of the sand used, it is impossible to lay down any set rules as to quantity. The cement worker soon learns what amount is best for the aggregate he has in hand.

Cement.—One item which the average cement user neglects, often to his own loss, is the proper protection of the cement prior to its use.

If it is to stand in a building for any length of time, it should be piled on boards raised above the floor on wooden blocks or two by fours. It should never be piled directly on the ground nor against the outside walls of buildings.

When exposed to moisture, the cement sets, and, after once having obtained an actual set, becomes useless for mixing. It should, therefore, be covered if left outdoors overnight.

What is sometimes mistaken for an actual set is what is known as a warehouse set, which is really not a set at all, but merely the compacting of the cement caused by pressure in the storehouse. Lumps caused in this way may be easily broken up with a blow from the back of a shovel. Such

cement is perfectly satisfactory to use, although the time taken in setting may sometimes be longer.

The Tools.—The tools required in mixing concrete are few in number and easy to obtain if hand mixing is intended. But if any extensive concrete work be planned, it will be found economical and far more convenient to purchase some small mixing machine. The concrete, also, will be more uniform and better.

For hand mixing there will be required: one shovel for each man on the job, two wheelbarrows with sheet-iron bodies, one spade, one rake, one water-barrel, one tamper, several water-buckets, a sand screen, and a mixing board. The sand screen should be between five and six feet in length and between two and a half and three feet in width.

The mixing board should be about 10 feet square, made of one-inch surfaced lumber free from knots, and tongued and grooved. The boards should be cleated on the under side every 18 inches, and be drawn close together so that no cement grout will run through while mixing. The board should be so placed that there will be plenty of room and that it also will be convenient to the piles of sand and stone.

From the mixing board to the spot where the concrete is to be placed should be wheelbarrow runs made of boards at least 20 inches wide. Care to see that these are well laid will prove an actual economy in the work.

Mixing.—The proportions used in mixing depend on the nature of the work contemplated, as well as the nature of the sand and stone used. Whenever the concrete worker is in doubt as to just what mix will best suit his purpose, this company, on receipt of samples of his aggregate, will be glad to advise him.

The use of a measuring box for the sand and stone is imperative. What is probably an average mix of concrete is a 1:2:4 mix, using stone of about an inch size. The amounts required for one cubic yard of rammed concrete with this mix are 1.46 barrels of cement, 0.44 cubic yard of sand, and 0.89 cubic yard of stone.

For a two-sack batch of this mix the measuring box should measure 16 inches deep, 18 inches wide, and 2 feet long, inside measurement. This filled once with sand and twice with stone will give with the two bags of cement the proper proportions.

The measuring box is simply an ordinary box without a bottom, but with handles at each end for convenience.

Sufficient sand for one batch is first measured out and spread over the mixing board to a depth of three or four inches. The cement is next spread as evenly as possible over the sand. The cement and sand are then shoveled until the mixture shows a uniform color, usually after the fourth turning.

Next spread the mixture out as the sand was first spread, and measure the stone onto it. Add not quite the full quantity of water necessary to make the required medium consistence, shoveling the mass and adding the balance of the water where dry spots show. After three turnings the mixture will usually show uniform, but where it does not, continue shoveling until the desired result is obtained. After the final turning it may be shoveled into a pile ready for placing.

With a mixing machine much of the labor of hand mixing is eliminated, and the speed of the work greatly increased.

A word as to the various mixes to use for different purposes would not be amiss.

The mixture of 1:1½:3 gives a very dense, strong, and waterproof concrete. It is, therefore, suitable for cisterns and tanks, roadways, stairways that receive incessant traffic, lintels, and all other work subjected to unusual stress, wear, or moisture exposure.

A 1:2:4 mix, while not quite so strong as the 1:1½:3, still gives a concrete of quite high strength and waterproofness. It is used in columns, beams, fence-posts, and much-used sidewalks.

The 1:2½:4 mix is used for feeding floors, the body of mortar-surfaced blocks, ordinary walls of six-inch thickness or less, culverts, and work needing concrete of ordinary strength.

A mix of 1:2½:5 is suitable for foundations, retaining walls, and other walls thicker than six inches.

Any mix in which the cement proportion is lower than those given is suitable for work only where mass and not strength is required.

The proper proportions of cement, sand, and stone or pebbles for these various mixes is given on page 11.

Placing.—Immediately after mixing the concrete should be placed in the forms. It may be either wheeled to position in wheelbarrows and dumped, or deposited in buckets. It should never, however, be dumped from a great height, as this causes the large and small aggregate to become separated and spoils the concrete. The ideal method of placing concrete is to pour it on in layers, each to be placed before the preceding one has thoroughly set.

After placing, it should be tamped lightly until water shows on the surface and no stones are left uncovered by the mortar. The concrete should also be spaded with a narrow flat spade next to the forms, to work back the heavy aggregate, eliminate the air-pockets, and insure a smooth, even surface. The drier the mix, the more spading is required. Where the narrowness of the space between the forms prevents the use of a spade, a wooden "spader" may be made, to be used as in the sketch on page 14.

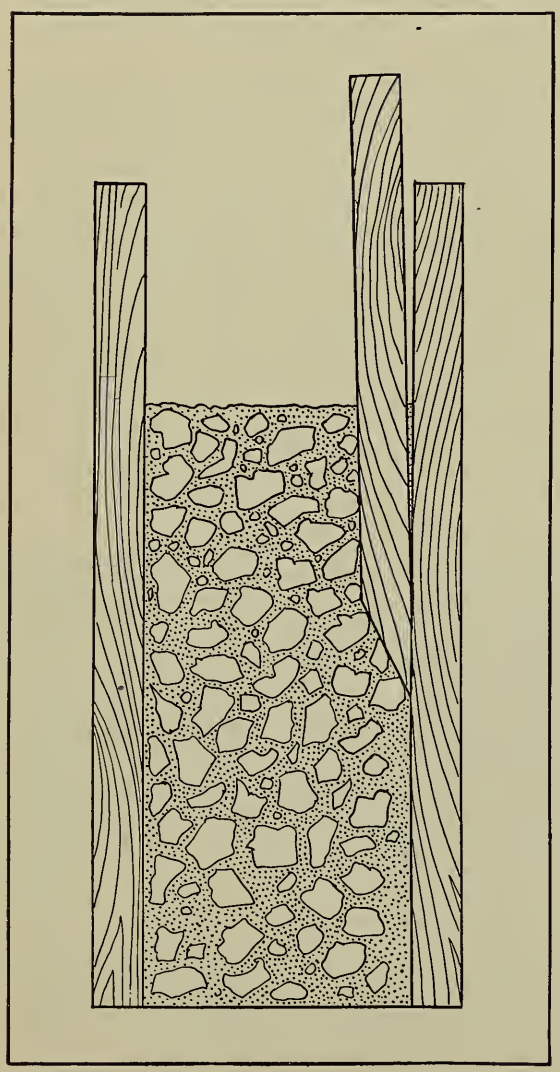
2. Process of shoveling sand and stone in hand mixing. The ideal method is with each man shoveling half way but spreading the full distance of the board.

Whenever such a spader is used, the flat side should always be placed next the forms.

Keep the concrete thoroughly wet and covered after placing for a period of from six to ten days. This is particularly necessary during the hot summer months and on particularly windy days. The canvas, burlap, or straw with which the concrete is covered should also be kept wet.

In winter weather it is necessary to protect the concrete from freezing, as well as from too rapid drying. This is taken up more at length under the heading of Winter Work.

Forms.—Because of the fact that concrete is plastic and will take the shape of whatever it is placed against or in, it is essential that the forms used be absolutely rigid. Any material which will give the shape desired, maintain its position, and can be easily removed after the concrete has set, is suitable for forms. The forms must be strong enough to hold the weight of the concrete without bulging out of shape. They must, therefore, be well braced. Lumber which is free from knots and is smooth is best, although knot-holes and cracks can be remedied by tacking a board over the outside and filling with clay.



3. "Spading," showing how spader works back larger aggregate.

Where a smooth finish is desired, metal forms are usually preferred, being more easily kept clean and being more durable than those of other materials. Wood is probably more generally used, however, as being more easily obtained and less expensive in its first cost. For ornamental work wax molds and molds of wet sand are used. As this book simply covers general construction work, these classes of forms will not be discussed.

Where wooden forms are used, it is best for convenience in handling to make them in sections. As often they will never be used again, however, the lumber should be cut or nailed to as small an extent as is practicable.

If the forms are to be used more than once, it is worth while to make them well, otherwise almost any boards can be utilized which have smooth surfaces and even edges.

Cleaning the Forms.—After use, particles of concrete will stick to the forms. To prevent this

give the surface next the concrete a coating of either soft soap, linseed oil, or black or cylinder oil. Kerosene should not be used.

Before erecting the forms cover them with this coating and then protect from dust or dirt until erected. Upon removal, clean off all concrete adhering to the forms. This may be done with a short-handled hoe and a wire brush. Do not scrape the wood in cleaning, as this will render its surface uneven. Whenever spots free from the soft soap or oil appear on the form, put on another application of the oil or soap.

All chips, blocks of wood, or other matter that fall inside in the forms should be carefully removed, as the presence of foreign matter of any nature is apt to weaken the concrete.

Outside foundation forms where the earth is firm are ofttimes superfluous.

Reinforcing.—Where any great strength is necessary, it will be found most economical to use reinforcing. This may take a variety of forms, all, however, serving the same purpose, namely, to take upon the reinforcing some of the stress otherwise borne by the concrete alone.

For bearing great weight a concrete column under direct pressure can stand a tremendous load. On the other hand, a side pressure only half as great might cause the same column to snap, for concrete, though strong, is not adapted to bear excess tension. Steel, on the other hand, is elastic, and when intelligently used with concrete, imparts sufficient of this elasticity to make concrete the ideal building material for strength.

Reinforcing may be obtained in two general types, the ordinary steel bar and the wire mesh. It will be found most convenient, where a large amount of reinforcing is used, to use the steel bar. Where less reinforcing is required, wire mesh gives it in a very easily handled shape.

Bars.—Although round bars of the required size can be obtained from almost any blacksmith or hardware shop, these bars may not have the qualities most desired for concrete reinforcement. It will be found most satisfactory to purchase the bars from a company making a specialty of this class of work.

Wire.—Wire can be obtained either straight or in mesh form. For such work as fence-posts it is, of course, necessary to purchase it straight and tie it together in the sizes desired. For work where mesh form can be used, it will be found most convenient to handle it in this form.

Expanded metal lath comes from the manufacturer cut to size and shape desired. It is peculiarly adapted to plastering and stucco work. Being procurable in any size or shape desired, makes it extremely simple to handle. It may be attached to wooden studding or steel strips, the latter being preferable as the more permanent type of construction.

Concrete Work in Cold Weather.—In general, concrete work in cold weather will be more expensive than the same work done in mild weather, because of the extra care needed to protect the work both while it is being carried on and while the concrete is curing.

So much spare time is given the farmer during cold weather, however, that the difference in cost may be more than counterbalanced.

Two things are necessary to the setting of the concrete—moisture and heat. Under ordinary circumstances concrete will provide its own heat, so that the worker need care only to make sure there is sufficient moisture present. But in cold weather it frequently happens that the low tempera-

4. Heating of materials in cold weather. The aggregates are so placed as to be easily shoveled next to the heater.

ture so chills the concrete that its setting is retarded, even when the temperature is not sufficiently low to freeze the water and prevent its incorporation with the cement into concrete.

The general opinion is that concrete will not be damaged by freezing if it has had forty-eight hours to harden before freezing, although the freezing, of course, does the concrete no good. Alternate freezing and thawing at short intervals is very injurious, as the hardening process should be continuous.

Two methods are employed to prevent the freezing of concrete, one being to lower the temperature at which the water with which the concrete is mixed will freeze, the second being to heat the materials which go to make the concrete and then to protect the work until concrete has reached its full strength.

The least expensive way to obtain the first result is by the use of ordinary salt. The addition of the salt retards the setting, so that the concrete takes longer to gain its full strength, yet unless an excessive amount of salt is used, the final strength is not impaired. This method is successful only for temperatures but little below freezing.

The usual rule is to add approximately one per cent. of salt by weight to the water for each degree below 32° Fahrenheit. More than 10 per cent. of salt cannot be considered safe.

If sufficient precautions be taken in heating the materials and in protecting the concrete after it has been placed in position, there is no necessity for using salt. In fact, it is as well to keep away as much as possible from using it, as there is always a possibility that, through carelessness, an excessive amount be used. *Care should be taken never to use it in reinforced work because of the action of the salt on the reinforcing.*

Everything considered, it is far better to heat the materials than to use salt.

It is unnecessary, in heating the materials, to use any complicated appliances, although a small heating furnace is undoubtedly an advantage. An

old iron pipe or boiler a foot or more in diameter and six to ten feet long will make a very serviceable heater. One can also be built of a few concrete blocks and an iron plate or sheet of corrugated steel, although this is not as handy for heating in large quantities. Whatever style you use, be sure that you have one for the sand and one for the gravel, so that they may be heated simultaneously. Too great heat is apt to make the stone soft or crack it. A temperature in the neighborhood of 150° F. is a safe one.

The water is best heated by a coil of pipe which may be warmed by the same fire that heats the sand and gravel. There should be a barrel to hold the hot water, which may be kept hot by cutting down, as soon as the barrel is full, the stream running through the coil until it exhausts as steam and so heats the water. If no running water can be obtained, the water may be heated in a large kettle.

The variety of concrete work that can be done in winter-time, of course, is smaller than in summer, as it is not advisable to attempt work that will be exposed too much to the weather. Work that can be done indoors, however, or can be easily protected, can proceed as well in winter as in summer. Fence-posts, blocks, slabs, window-sills, indoor floors, and tile are some of the indoor concrete work that can be readily handled, while foundations and low walls are open work that can still be easily protected.

All such work should be carefully covered with straw, burlap or some other material. If manure is used to protect the work, the concrete should be first carefully covered with building paper, for the acid in the manure will affect uncured or green concrete, discoloring it and sometimes causing it to weaken and crumble. Manure is the warmest material to use, but should always have some other material between it and the concrete. Heavy mass work often protects itself, the mass retaining the warmth of the heated water, so that if the forms are tight, it may be necessary to protect only the exposed surfaces of the work.

A thickness of 10 inches of manure laid over building paper or canvas, if kept dry, will protect work from freezing with a temperature as low as 10° Fahrenheit.

For outside forms, building paper furred an inch or two from the forms gives good protection provided the cold is not excessive. Actual tests show a difference in temperature as high as 15 degrees between outside air and air in spaces of this furring.

There have been occasional failures of concrete work, where the inspector has been deceived, thinking concrete which has merely frozen has gained its set, and has consequently removed the forms too soon. Frozen concrete will often ring when struck with a hammer, and even when broken closely resembles properly hardened concrete. If there is any possibility that concrete has frozen before setting, leave forms in position even after the temperature has risen above the freezing point.

Concrete about the House

Because of its strength, durability, fireproofness, and adaptability to all shapes and designs, concrete is probably the best material that can be chosen for house construction. This should not be attempted, however, except by one accustomed to handle such work. Yet there are numerous methods of using concrete about the house which add greatly to the comfort and value of the home, and also aid in keeping down expenses. Under this last head they deserve mention as items in the development of an expense-proof farm.

Foundations.—Ofttimes the first step in the development of efficiency on the farm is the construction of a waterproof foundation, either below the main building of the farm or under one of its barns or outhouses. The effect of such an improvement in one building usually is the rapid similar improvement of the balance of the buildings on the farm.

Just exactly what is the best size for this foundation depends, of course, on the size and weight of its superstructure. The foundation is usually 12 inches in thickness, resting on a footing twice as wide as the thickness of the

5. Concrete block foundation, laid in cement mortar. The hollow blocks give a non-continuous air space.

wall, and about 12 inches through. This footing should extend below the frost line, and be on solid, well drained ground.

The foundation above the footing may be either block or monolithic, according to local conditions. The blocks should be laid with cement mortar in the usual way, and then washed and coated on the inside with a couple of coats of neat cement and water of the consistence of thick cream, to further waterproof them.

With a poured concrete foundation the mix can be made sufficiently dense to eliminate the necessity of such after-work. Cuts showing the two types of construction are given herewith. Though the farmer can profitably handle much of his own small work in the foundation line, he will find it economical to have any extensive work handled by a competent contractor, both because of the economy of this way of handling and also because he will have better results from the work done.

6. Hollow wall monolithic concrete foundation. This construction gives continuous air space.

Foundation Gutter.—Foundation gutters catch the water from the rain-beaten side of the building, and prevent seepage into the cellar, basement, or ground floor, as the case may be. Around outbuildings which have no walks they also afford convenient walks in sloppy, muddy weather.

A pitch of one-eighth inch to the foot will be sufficient to carry the water away. Eighteen inches is sufficient width for the gutter, which should also have a three-inch depth to the groove running down its center.

To insure a good bond between the gutter and the foundation proper, carefully clean the dirt off the stone or concrete of the foundation wall, washing well and thoroughly soaking before the concrete is placed in position. The gutter should have below it a six-inch foundation of gravel, crushed stone, or similar material thoroughly tamped.

Be sure that the gutter has a slight slope to carry the water away.

Floors.—Concrete floors, properly constructed, have many decided advantages over floors of some other type of material. These advantages are mainly the advantages of permanence over that which is merely temporary.

Particularly in such structures as the milk-house, dairy, etc., where cleanliness is imperative, is their value shown. They afford a permanent protection against fire, vermin, and dirt, and also eliminate the necessity of repair work constantly required with floors of wood and dirt.

The various useful forms this class of construction may take can be enumerated briefly: as an entrance floor outside a stable or garage, as an alleyway connecting such buildings as inclement weather would make unpleasant to travel between, as washing floors on which to clean machines

and carriages, as feeding floors, corn-crib floors, dairy-barn floors, and so on. The method of construction is very similar for all.

Very seldom on the farm are floors raised above the ground. When conditions make such a floor necessary, reinforcement must be used either in the shape of steel rods or expanded metal lath.

Generally speaking, the same method of procedure, with slight variations, holds true. Even a sidewalk, for instance, is constructed on practically the same plan as a feeding floor or basement.

First make as compact and well drained a foundation as possible. Next place the wooden forms, taking care to see they are perfectly level, unless a slight drainage is desired, when the surface may be sloped accordingly.

In sidewalk work it is best to have the slope to one side. To permit of expansion and contraction the concrete should be laid in squares or blocks, these being separated by sheets of building or tar paper. The usual method of laying floors or sidewalks directly upon the ground follows:

First, prepare the foundation. Dig the bed for the work. If the soil is wet or spongy, and if there is any danger of water gathering beneath, lay an outlet drain to carry the water off, and so do away with any chance of ice forming under the concrete and cracking it. In sandy soil this precaution is usually unnecessary. Avoid all chance of upheaval by tree roots by cutting out all roots that run under the pavement at a depth of less than 18 inches.

The depth of excavation for a floor depends on the purpose to which it is to be put. The depth of excavation for a concrete sidewalk depends on the soil. If walks are bounded on each side by turf, 15 to 18 inches should be dug out. Ram the ground thoroughly to avoid all settlement cracks and insure a solid base for the foundation. Next fill to within four inches of the top with good clinker, gravel, or stone, and again ram well. This is to prevent frost getting under the pavement.

Second, place your stakes and outside strips. A long piece of twine stretched taut will help you to get a straight line for the strips.

Third, fill within one inch of form tops with concrete mixed one part cement, two parts sand, and five parts broken stone. Ram well, and before the concrete is set, add the top surface, composed of one part cement to one or two parts good sand or coarsely ground marble-dust, limestone, or trap-rock screened from $\frac{1}{8}$ to $\frac{1}{16}$ inch in size.

Last, obtain an even surface by working the top dressing backward and forward with the edge of a level board, which should rest on the strips on each side of the walk. When it is worked sufficiently to fill all the pores, trowel the surface even, but remember that too much troweling is objectionable.

Blocks should be laid in four- or five-foot squares; lay every other block, returning to lay intervening ones when the first ones are sufficiently set to allow strips to be removed. Waterproof paper should be laid between joints to prevent the sections adhering to each other. Dusting, after the concrete is in the forms, sometimes done when the mix contains too much water, should always be avoided. Protect the surface against the hot rays of the sun and against currents of air.

Walks laid according to the above rule will require seven to eight pounds of cement to the square foot. Curbs and gutters should be made in one so that they may bind together, and should be made in lengths of four or five feet each; the facing or curbing should be finished with a coating of one

part cement to one part sand, carefully worked and troweled as soon as the boards can be removed; the edges should be leveled off. One barrel of cement should lay a little less than 50 square feet of good sidewalk.

Porches.—The concrete porch may be either of the small doorstep variety, simply to keep the entryway to the house clean, or may be built sufficiently large to provide a cool and shady place to work or rest during the hot months. If made large enough, it can also provide dancing room or sufficient space for other evening entertainment.

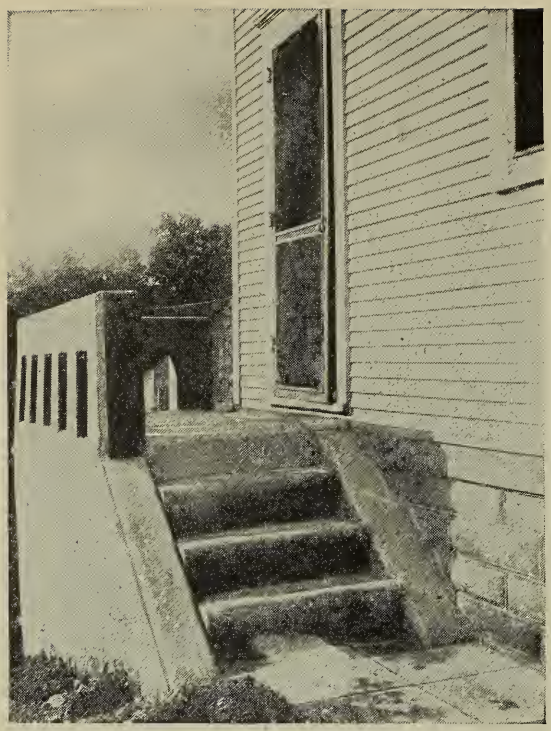
The first requirement of the concrete porch is a solid foundation, the size of this foundation depending, of course, on the size of the porch.

It is best to have the ventilation below the porch so arranged that the space can be completely closed in or left open to the air, as conditions make advisable.

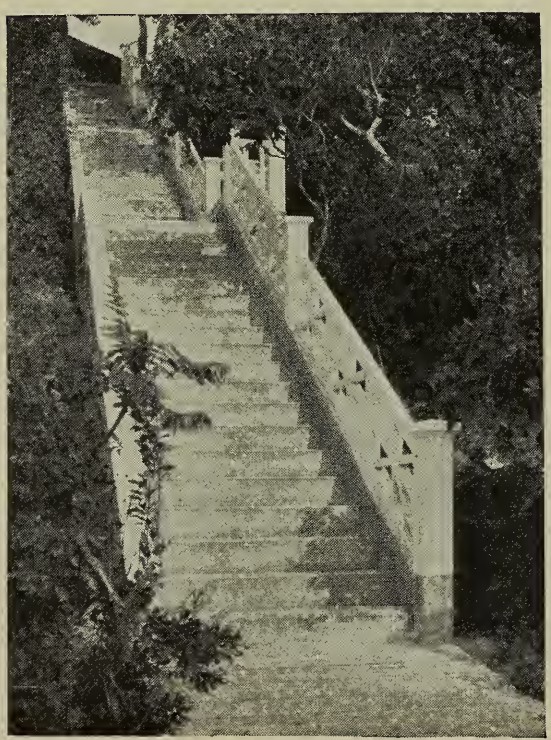
The weight of the floor of the porch should be borne on concrete pillars spaced not farther apart than 10 feet. These pillars need not be larger than one foot in diameter, and should rest on two-foot footings.

The reinforcement for these pillars should be half-inch steel rods, one inch from the surface, connected at distances of eight inches with steel wire. Above these pillars can rest the spans for the floor. Between the pillars may extend lattice work, thin slabs of concrete on metal lath, or any other type of finish the owner pleases. If the foundation for the porch be of concrete blocks, there is no necessity for pillars unless the span from the outer edge of the porch to the wall of the house is more than 10 feet. If this space should exceed 10 feet, it is best to have a line of pillars running midway of the span spaced 10 feet.

7. Besides being utilitarian, the concrete porch is capable of very pleasing appearance. Design of house and contour of ground decide whether angles or curves be used.



8 and 9. The upper and lower views illustrate the possible range of concrete stairway construction from utter simplicity to complicated design.



Upon the spans across the pillars rests the floor, which is reinforced with $\frac{3}{8}$-inch steel bars spaced on six-inch centers $\frac{3}{4}$ inch from the bottom surface. The floor can be molded in slabs which are afterward placed in position, or can be poured already in position.

The style of porch floor just outlined is the more complicated type of construction. If the porch be a very low one, the porch floor may be laid directly on a foundation of gravel, crushed stone, or some similar substance without the use of any pillars or other supports.

A concrete porch is easily kept clean, does not wear out, and never needs replacing.

Steps.—As concrete is far more easily handled and less expensive than stone and yet has its durability, and as concrete is far stronger and more durable than wood and yet costs but little more, it has proved itself the logical material for stairways and steps, the places in a house or other building which receive the most constant and exacting wear.

There are three main types of reinforced concrete stairways: the all-beam, the girder-and-slab, and all-slab types. Of course, concrete slabs can be molded and laid similar to stone slabs, but there is nothing gained by this method of construction, while the strength of monolithic work is lost. By having the stairway thoroughly reinforced and monolithic in character, any strain is divided and so more easily borne.

The all-beam type is the strongest and best, but also the most expensive, as the entire stairway must be poured at once, necessitating complete forms instead of mere sectional forms.

This style of construction consists of two girders with cross-beams

that form the steps. Assuming a stairway six feet wide with a 14-foot flight or girder length, reinforcing should be with one-inch rods in girder and ¾-inch rods in the beam, the beam rods being looped around the girder rods. The rods in the girders are also looped with loops made from three strands of No. 4 common annealed wire, the loops being two feet apart.

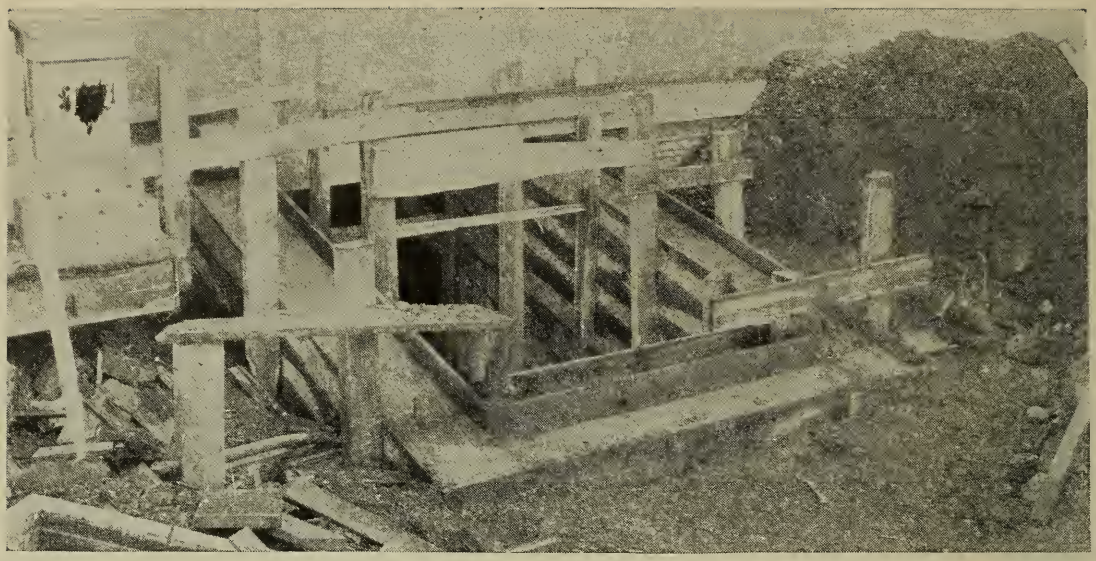
The girder-and-slab type of stairway, next to the all-beam type, is the strongest and is most commonly used. The steps in this type add load to the stairway, but no strength, all the strength lying in the reinforced girder and slab at the base.

The all-slab type is the easiest to build, as the reinforcing is placed altogether in the slab (rods running both ways), and as the steps may be added after the slab is built, this is the commonest method of construction.

In both the girder-and-slab and all-slab types the strain, instead of being equally divided throughout the structure, centers at the narrowest point in the topmost step. To strengthen this point bent rods should be used to project into the slab several feet and tie into the cross-beam or pass on into the concrete floor.

Any carpenter can build the forms required for any of these styles of construction, the outer tread of the step overlapping being beveled, rounded, or slanting back as taste dictates, though the square step is best when it is to be covered with wood or slate. The slant step is best for steep flights. Never use weaker concrete than one part cement, two parts sharp sand, and three parts fine gravel or crushed stone. For the all-slab stairway space lengthwise and crosswise on 12-inch centers; for girder-and-

10. The outdoor step of concrete offers, in the making, a very pleasing method of entrance to the home.



11. Home-made forms, a little care in mixing materials, and the cellar has permanent protection in its entrance. This is a small investment that may mean large returns in health and comfort.

slab space on 16-inch centers lengthwise and 8-inch centers crosswise. All cross-rods should be wired together at their intersection.

Cellar Hatchways.—Wooden cellarways receive such constant wear and rough usage that they seldom are in good condition, either being so broken as to let the weather in and cause a damp cellar, or having one or more steps broken, causing inconvenience in carrying anything to or from the cellar.

Because of their position below the surface of the ground wooden cellar steps are constantly damp and soon rot, requiring the expense and trouble of constant renewal. The possible personal danger to any one carrying a heavy load up or down rotted wooden cellar steps can hardly be overestimated.

Concrete cellar steps and hatchways are safe and permanent. The steps can be adapted to any size or style personal taste dictates or the space available makes necessary. The door of the cellar usually limits the depth of the steps, while the depth of the cellar decides the height of the risers.

The methods of building hatchways for either new or old cellars are very similar. With an allowance for a three-foot landing at the bottom of the stairs excavate the opening to the width of steps desired plus one foot. This extra width is for a six-inch thickness of concrete wall on each side. The steps themselves have a rise of six and a tread of nine inches. Beneath the steps proper is a four-inch thickness of concrete. Therefore provide for this thickness in sloping the ground upward from the landing to the top of the stairs. Extend the trenches for the side and end walls one foot below the concrete of the steps. As forms choose two one- by twelve-inch boards and notch them as though they were to be used as "horses" to support wooden steps of the same dimensions as those of concrete. Place the notched edges down with the ends fixed at the top and bottom of the stairs. To mold the rise of the concrete steps use one- by six-inch boards 3 feet 10 inches long, which are secured to the forms by means of nails and wooden cleats.

With the forms firmly fixed in position, fill the mold for the bottom step, and the space back of it, with concrete proportioned one bag of Portland cement to two cubic feet of sand to four cubic feet of crushed rock. If gravel is used, mix the concrete one part cement to two parts sand and four parts pebbles. Bring the concrete in each step to the top of the riser, and finish the surface with merely a wooden float. Continue the work upward until all the steps are finished. At the top of the stairs tie the apron foundation to the side walls by means of old iron rods embedded in the concrete and extending around the corners. This will prevent possible heaving and cracking by frost.

The side forms of the six-inch walls are then erected and are thoroughly cross-braced against each other. For these forms use one-inch siding on two- by four-inch studding, spaced two feet apart. The walls can be carried to any height desired, so as to give the cellar doors sufficient slope for shedding rain-water. Above the ground line, outside forms must be provided. Fill the walls with concrete mushy wet. Before the concrete sets, bolts are placed (heads down and washered) in the top of the side walls for holding the wooden sills to which the cellar doors are hinged. After two or four days the forms can be removed. Connect up the drain in the landing and lay the landing floor.

The eight cellar steps of the hatchway shown in the illustration have a tread of nine inches, a rise of six inches, and a length of four feet. The clear height of the doorway in the cellar wall is six feet six inches. The landing at the top of the steps is three by four feet and has a four-inch concrete floor. This same thickness of concrete lies under the steps proper. The side walls were built as described above. For this improvement there were required the following quantities of materials:

Crushed rock	2½ cubic yards
Sand	1¼ cubic yards
Portland cement	12 bags

12. A later view of the cellarway shown under construction on the opposite page. The bolts which hold the hinges of the door were placed in the fresh concrete.

13. A very quaint and permanently fireproof method of handling the fireplace.

For improving old cellar hatchways it is frequently necessary to fill with earth and gravel so as to provide the earthen slope for the concrete steps. Such filling must be thoroughly tamped into place and should be water-soaked and allowed to settle before the steps are built.

Concrete steps, unlike other kinds, become stronger with age. They are perfectly safe under the heaviest of loads. Moreover, besides being water-tight, they keep out rats, mice, and other obnoxious vermin.

Fireplaces.—Comparatively recent has been the use of concrete for fireplaces, but with the returning demand of homeowners for fireplaces has come the use of this material.

Unless the fireplace is to be one which must withstand excessive heat, its lining with fire-brick is a rather unnecessary precaution. If desired, it may be constructed of cinder concrete, as this resists the action of fire much better.

The outer surface and mantel of the fireplace may be inlaid with stones or tile in patterns, or may be finished in plastic form, as the owner wishes.

There is such variety in size and style that it is impossible to lay down any general directions.

Chimneys.—The old-fashioned fireplace chimney of brick at one end of the house is picturesque, but bricks, except when laid in cement mortar, are apt to work loose and fall out, proving a fire menace to the home.

The chimney is a necessity and also a danger to the house. Its construction should be of some material fireproof in itself, and not apt, through the action of fire or passage of time, to lose its fireproof qualities and expose the house in which it is to the danger of flames.

Either concrete block or monolithic construction may be used. If blocks

are used, the flat-surfaced ones will give a more pleasing appearance than those with a beveled edge or imitation stone effect. If monolithic construction be used, cinder concrete is sufficiently strong and is a better heat resistant than concrete made of such aggregates as are affected by heat.

The reinforcing for the chimney should be triangle mesh or expanded metal lath, supplemented by steel rods in each corner of the chimney.

For specially shaped chimneys special forms will be required. For ordinary chimneys quite simple forms will do.

Chimney Caps.—Where a brick chimney is already installed and giving good service, it would be a mistake to tear it out and install a concrete one. Longer life will be given the brick chimney, however, if it be topped with a concrete cap. This may be molded on the ground in any shape desired and later placed in position.

A simple style of cap, but pleasing in appearance, is one extending two inches beyond the chimney on each side, six inches in depth, beveling from halfway up the side to an oblong four inches smaller than the outside measurements of the chimney.

Forms should be well greased before being filled with concrete. The concrete should be left in the forms and kept thoroughly moistened for three days. After this it can be placed on the chimney. Small mesh wire placed near the outer surface of the bevel and side adds to the strength of the cap.

Gutters.—Foundation gutters running around the circumference of the house or other structure have already been mentioned on page 19.

It is worth while to have also small gutters running away from the house, connecting with the gutter-pipes from the eaves, to carry away any excess which the cistern cannot handle. If there is a walk running around the house, these gutters can be incorporated as a part of the walk.

The gutters should be from 8 to 12 inches in width, with about a two-inch hollow in the center. Their discharge should be sufficiently far from the house to carry the water well away from the foundation.

Cisterns.—The best water obtainable for washing purposes, and many physicians say for drinking purposes as well, is rain water. Those who make no provision for saving what rain they have are paying small heed to comfort or economy. The cistern is the logical thing for any one having any extent of roof surface.

The cistern may be above ground or below, the latter being the more common type, although, if arrangements can be made to raise the water sufficiently high above ground, it will supply its own pressure to carry it to the various parts of the house. This can be accomplished by the installation of a small engine, but resolves practically into the construction of a ground-level cistern with a raised tank to which the cistern water is elevated.

Underground Cistern.—The circular type of cistern is the most economical from the point of quantity of materials used for a given capacity. It is also the strongest type and the one least apt to develop cracks. If constructed of concrete, it presents a smooth, even surface which can be easily cleaned.

As a concrete cistern properly constructed will last forever, too much care cannot be taken in building it. Where such a course is possible, it is well worth while to obtain the services of some silo contractor to build the cistern

14. An above-ground cistern that supplies all the requirements of a large home. By following the same general lines as the house, the cistern improves the property's appearance.

with his forms. Where this is impossible, the cistern can be constructed by the owner using the following method:

First, decide on the capacity you wish your cistern to be, making plenty of allowance for a possible increase of water supply. Then figure out what diameter and depth will be required, and make your excavation. The circle for the excavation can be marked with a simple sweep, and can be made just large enough, if the ground be firm, for the excavation to make the outer form of the wall. The excavation should be well below the frost line. If the soil be so loose that it cannot be used for the outer form, light boards held in position by stakes may be used.

The ground on which the cistern rests must be well drained and thoroughly compacted, to prevent uneven settling after the construction of the cistern and consequent strain on its walls. Above this should be a six-inch layer of gravel or crushed stone thoroughly tamped. Upon this layer of stone is laid the concrete foundation, reinforced with steel rods at right angles to each other. These rods are bent at the ends to project up into the wall of the cistern, so tying the sides and bottom together. The floor rods should project at least 6 inches into the side walls. It is best to have wall rods also projecting into the floor.

The entire foundation must be concreted in one operation, and as soon as possible boards laid on the fresh concrete, the wall forms placed in position, and the walls themselves poured.

The forms may be of either sheet iron or wood, but should be well greased before using, to facilitate ease in raising and progress of the work. Where it is impossible to procure the use of good forms and it is difficult to make your own forms, it will be more convenient to use silo blocks. An easily

constructed circular form can be made of narrow flooring fastened on the inside to wagon-tires or curved wooden templets.

The cover to the cistern is laid in practically the same way as the floor, except that wooden forms are required to hold it and that an opening for a manhole must be kept.

Square cisterns are more easily built than round ones, and their forms are more easy to make, this, to some people, making up for the difference in the amounts of materials required. It often occurs also that a cistern must be made to fill a certain space which is more easily filled by a rectangle rather than by a circle.

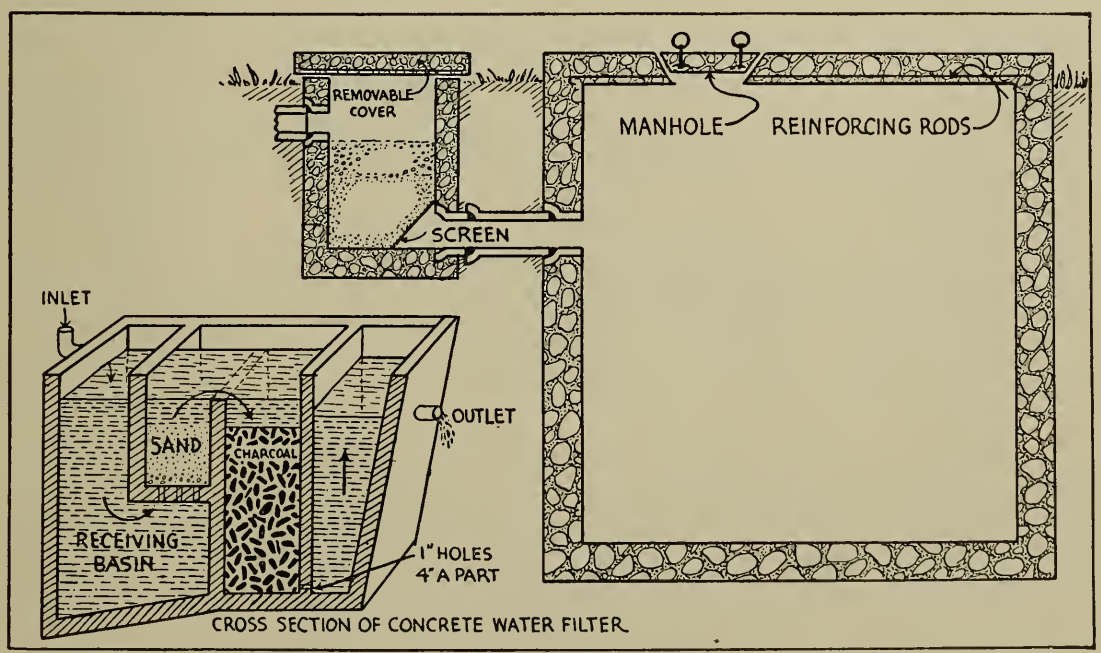
The same style of rods may be used for the side walls as for the floor and foundation.

The only difference in the method of procedure then being that the horizontal reinforcing of the walls as well as the reinforcing in the floor be bent to tie into the adjacent wall.

The manhole should be laid with beveled sides, as also should be made the cover, so that the two will fit snugly when finished.

If the water of the cistern is to be used for drinking or cooking, it should be filtered before entering the cistern, usually through a charcoal filter. This filter can be constructed at the same time as the cistern, the dimensions being four by three feet and four feet deep. While building the cistern wall, lay a tile through it at such a height as will connect with a similar opening in the filter wall at its base. Cover this opening out of the filter with a removable screen of ¼-inch mesh, fill in two feet of coarse charcoal, covering this with one foot of sand and gravel. These materials should be changed as often as they become unclean.

The pipes from the eaves and gutters should then lead to this filter, which in turn leads into the cistern.

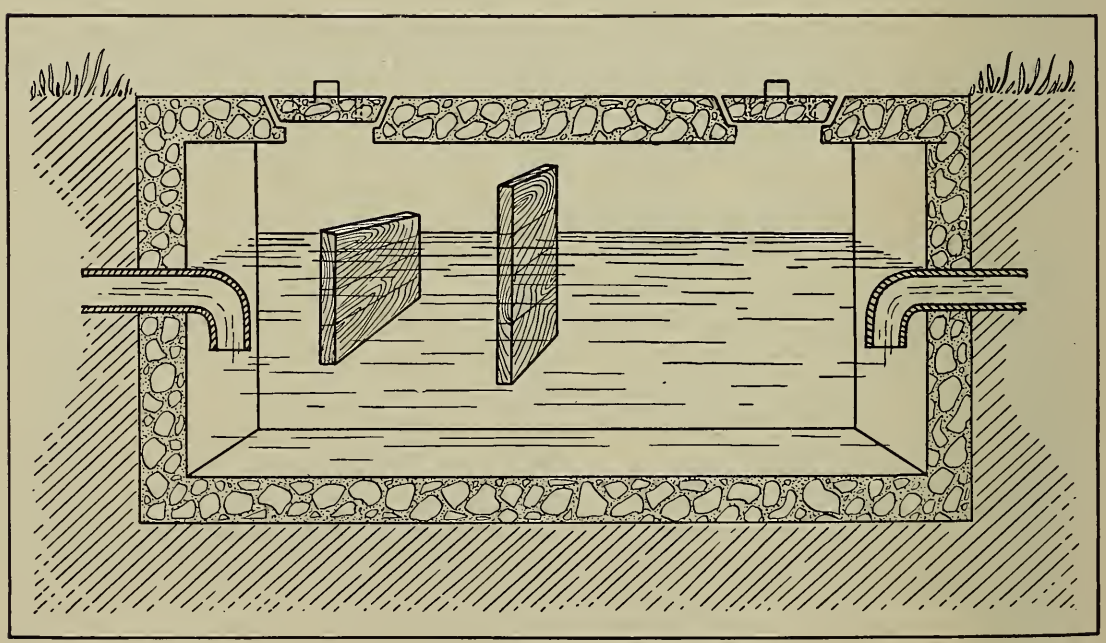


15. View of typical underground concrete cistern. Two types of filter are shown. The cistern should be sufficiently large to take care of a heavy rain.

16. Septic tank which takes care of sewage from a large country home. Although practically odorless this is best situated away from the house.

Above-ground Cisterns.—For small-sized cisterns many people seem to like them above ground. This makes necessary outside forms for the cistern. An excavation at least a foot deep should be made, and filled in as for underground cisterns. If the cistern be high enough, it will furnish pressure sufficient to force the water flow on the first floor of the house.

Septic Tanks.—Away from the larger cities, which take care of the whole community's sewage, the farmer has quite a problem on his hands in the



17. Cross section of a septic tank showing baffle boards and arrangement of inlet and outlet pipes.

18. Concrete well platforms keep the water pure and the health of the family in good shape. If properly built they improve the appearance of the place.

satisfactory handling of his sewage. Ordinary draining off into the ground is unsanitary and unsatisfactory. The septic tank is the logical solution of the problem.

The theory of the septic tank is to allow the sewage to pass through it so slowly as to give the bacteria which form in the tank a chance to purify the water. The elbow arrangement of inflowing and outgoing pipes, with baffle-boards, walls extending across the tank, prevents a too strong current of water.

The method of construction is the same as that for the rectangular underground cistern, an average size for a tank being five feet wide, five feet deep, and ten feet long. The baffle-boards will be two and four feet from the inlet pipe. Bolts may be placed in the concrete walls at these distances for convenience in attaching the boards later.

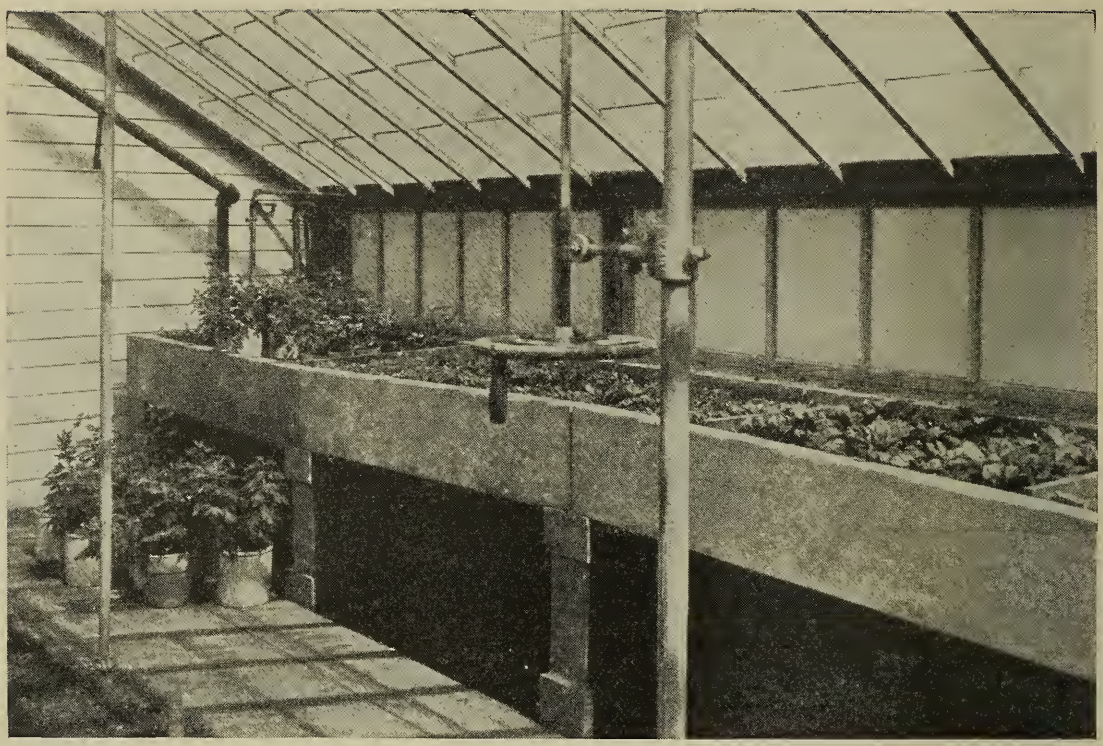
The illustrations show the general design of such tanks.

Well Platforms.—The ordinary well with wooden platform, sometimes with practically no platform at all, can never be free from danger of contamination. Often the brick walls of old wells have so rotted and crumbled that even below the surface of the ground there is great danger of the water becoming impure. One solution to both these troubles is a concrete lining and platform.

The reinforcing required for this well platform and the well walls depends on the size of the well.

Remove the brick of the wall down to dense clay—usually this is not more than six feet. If the earth wall holds its place, it may be used as the outside form for the lining, simply needing an inside form. But if the earth shows signs of crumbling, before taking out the brick, dig back the ground to the necessary depth and use an outside form. The inner form will be circular or rectangular, as the original shape of the well.

The same type of form may be used on the interior of the well as for the interior of the underground circular cistern. If the outer wall of the excavation be firm it can be used as a form.



19. The concrete benches of this greenhouse help keep the earth moist, and never wear out. Openings in their bottoms permit the warmth from the pipes to enter.

Greenhouses.—The small greenhouse can be utilized for profit as well as pleasure. Beautiful flowers, ferns, and foliage plants can be grown through the winter at the same time with lettuce, radishes, and other vegetables. Your regular truck garden can also be given a much earlier start by preparing the tomato plants, cabbages, and other similar plants in the greenhouse.

By building this greenhouse as a lean-to, expense is kept down to a reasonable figure, and further protection is afforded it from waste of heat. The lean-to should be on the south side of the building. The foundation can be best made from concrete blocks on a concrete base. This wall should be three feet high and extend below frost line. A sill is fastened on top of the blocks by bolts placed at intervals, the heads being held with strips of metal put in between the first and second tiers of blocks.

The posts are fitted on top at the proper distance for the glass panes, each post being rabbeted on one edge for the glass to set in and to hold the putty. A plate with the top edge dressed is nailed on top of the post. Rafters rabbeted the same as the post are cut with the proper slope to the side of the house. The ridge has a cap fitted watertight to the building, to keep the rain or snow from running down the wall on the inside. Ventilation sashes are hinged at the top on the roof part, also at the top of the wall part. The illustration shows how benches are placed. These can be built of wood or concrete as desired.

Heat can be supplied to the greenhouse through pipes from a steam or hot-water boiler. While it is better to have a separate heating plant, the one used for the house can furnish the heat for such a greenhouse.

Mushroom Cellar.—To many people the greenhouse, though desirable, is rather impracticable because of the expense of extra construction work and heating arrangements. The mushroom cellar may appeal to such because of its inexpensiveness in original outlay and also because of the very real enjoyment derived from such a cellar.

Because of the fact that mushrooms spring up in the dark, there is no need of good lighting facilities. Any dark corner of the cellar, provided it can be kept at an even temperature, will be satisfactory. The shelves can be arranged one above the other at distances of about 20 to 24 inches.

These shelves can be made in the shape of racks on which can rest the trays for the mushroom culture.

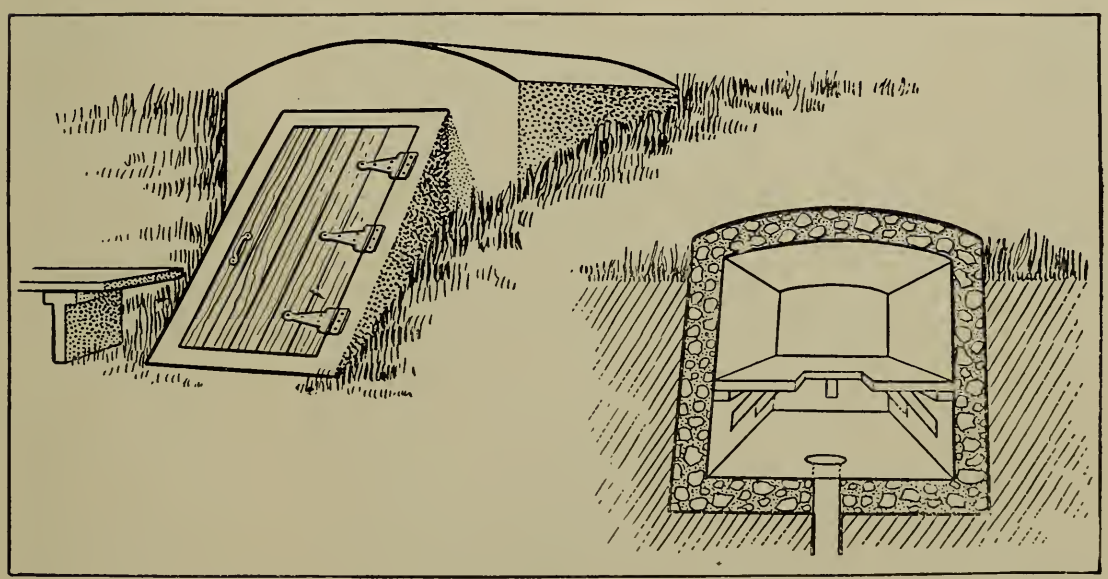
Four inches square concrete posts with concrete cross-bars provide racks which last forever. Although the trays themselves have in some cases been made of concrete, this makes them too heavy and unwieldy to handle, wood, though more perishable, being preferable for this particular work.

Another type of construction is with permanent shelves. As there is no necessity for moving these, the entire structure can be of concrete. Many consider this the preferable type, as the earth can be as easily changed with the shelves stationary as movable. Concrete construction keeps the whole arrangement clean and sweet, so there is no need occasionally to expose it to the sun, as is done with wood.

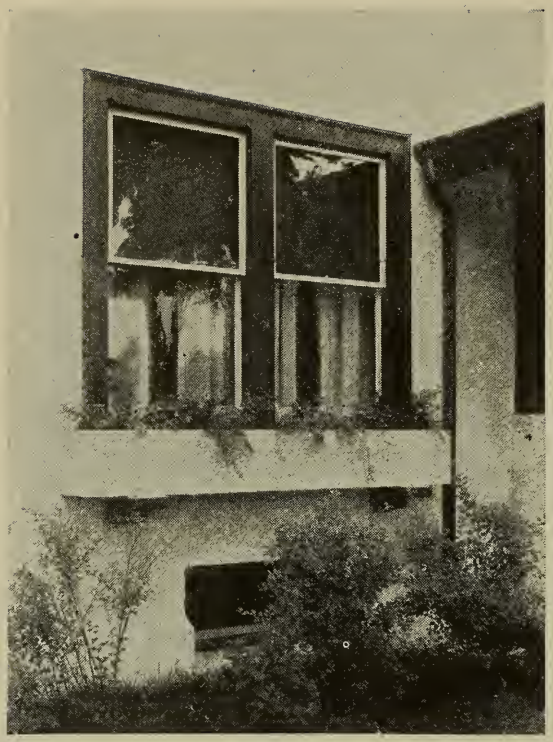
Bee Cellar.—The owner of an apiary in cold climates is confronted with quite a problem in the winter protection of his bees. The bees must be kept dry and kept also at an even, moderate temperature. The concrete underground cellar is the logical answer.

This cellar may or may not, as the owner wishes, be in connection with the house. For convenience in handling the hives shelves may be provided on the walls.

As the very days in the winter which are sunny enough to place the hives outdoors for a short time are apt to be slushy and unpleasant underfoot, it



20. A small bench outside this bee cellar provides a place for the hives on sunshiny days. The door so nearly reaches the roof that ventilation may be provided through it.



21. This concrete window-box was built in as the sill for the double window.

will be found a good plan to construct a low bench just outside the doorway of the cellar on which the hives may be set for an hour or two on sunshiny days.

The walls of the cellar should be about five inches thick, and should project a foot or more above ground, five or six feet being underground. The sketch shows details of construction of one such cellar.

Window-Boxes.—During the warm months concrete window-boxes filled with plants, either flowers or vines, add greatly to the appearance of the home. The weight of the concrete box prevents any danger of dislodgment from the window-sill, with possible danger to those below. Being made of a material which neither weather nor time affects, such a box is permanent.

Many quaint designs can be incorporated into the structure of such a box, but because of the way concrete harmonizes with vegetation, such decoration is really unnecessary.

A simple form made of boards the desired length and depth will enable the home-owner to construct at his leisure as many such boxes as he wishes. A 1:2:4 mix in most cases will be found to give the best results. For a light-colored box, paint over the exterior as soon as the box is taken from the form with a creamy wash of cement to which about 10 per cent. of hydrated lime has been added.

Stucco.—The adaptability of stucco to almost any style of construction, and the beauty of a well-finished bit of work, make it in many cases a favorite form of finish even when concrete is the base on which it is placed. Old brick and frame houses can be remodeled by its use into attractive modern homes, while entirely new buildings can be finished rapidly when this style of construction is used.

Wherever possible an experienced plasterer should be employed to do the work. It may be applied to wood or metal lath, brick, stone, or any other building material, though great care should be taken to prepare the surface properly so that the stucco will adhere and not crack or scale off.

The proper proportions for stucco are one part of cement to not more than two and a half nor less than two parts of sand. If lime putty is added, it should not be in excess of 1:3 the volume of cement.

Before stucco is applied to stone, brick, or concrete, the wall should be thoroughly cleaned with plenty of water, so that it is well soaked. Roughen the surface, if concrete, by picking with a stone-ax. If the wall be of brick, be sure to see that all mortar joints are picked out as much as possible. Apply a 1½-inch coat and finish with a wooden float if a smooth

surface is desired, or a float covered with some heavy rough cloth, as burlap, if a rough surface is wished. Keep the stucco wet as long as possible, protecting it from the sun for several days. The longer it is kept wet, the stronger it will be.

To stucco a frame structure, cover with two thicknesses of roofing paper, place furring strips about 12 inches apart, and fasten the metal lathing to this. Next apply the scratch coat one-half to one inch thick. The last coat may be smoothed with a wooden float, roughed with a burlap-covered float, or thrown on with a large stiff brush or a trowel to produce a spatter-dash finish. A pebble-dash finish can be obtained by throwing on with trowel a mixture of one part cement and three parts coarse sand.

As said before, the best stucco work can be done only by a competent man. This is particularly true of spatter- and pebble-dash work.

Terrazzo Floors.—Occasionally for tiling a porch or bathroom the owner wishes to lay a terrazzo floor. For such work we strongly recommend obtaining the services of a competent contractor, as there is too great an expense involved to risk the work in inexperienced hands.

The floor may be laid either with white or with colored stone, and later finished by hand rubbing or by electric grinders. The aggregate used is marble chips, as a general rule, although granite chips have also been used.

The method of construction is to lay the floor in the method outlined previously, then spread a layer of the granite or marble and roll this in. The rolling gives the floor a smooth surface, which is still further finished by the rubbing or grinding.

22. Sweeping lines can relieve any effect of stiffness that may be feared in the concrete house. This Omaha home shows simple but pleasing design.

About the Yard and Garden

AROUND the yard and garden of the farmhouse and suburban home are many places in which the use of concrete would increase the comfort, beauty, and value of the place. The man who is constantly improving his property quickly realizes the advantage of having these improvements permanent.

Driveways.—Farm buildings should be connected with each other and with the main roadway by means of concrete driveways. These driveways preserve the health of your stock, make hauling of fodder and other materials easy, keep the farmhouse and buildings free from the mud usually tracked in during wet weather, and save the garden and lawn from being cut to pieces with wagon-wheels, as they often are when the ordinary roadways become too muddy.

Such driveways are easy to lay, and can be done a little at a time during the slack hours of farm work.

Excavate the driveway 12 inches deep to the width desired, usually about eight feet, although this should be made wider at the corners to allow for

23. A concrete driveway helps keep lawn and garage neat in appearance. A slight slope should be provided to take care of drainage.

24. Through large estates and parkways the concrete driveway is becoming a favorite because of its self-maintenance.

turning vehicles. Fill to a depth of six inches with gravel, tamp thoroughly, and over this place your concrete mixture to a depth of six inches on the side and seven on the center.

The concrete should be of a 1:2:4 mix, wet enough to pack well. The surface is left rough to give good foothold for the horses and cattle.

Alleyways.—Alleyways between farm buildings may be constructed in exactly the same way, except that in place of being crowned they should be dished an inch in the middle to carry the rain drainage away from the buildings rather than toward them.

Sidewalks.—The method of constructing concrete sidewalks has already been outlined on page 20. There is, therefore, no necessity for going over this work again. A few items are worth explaining, however:

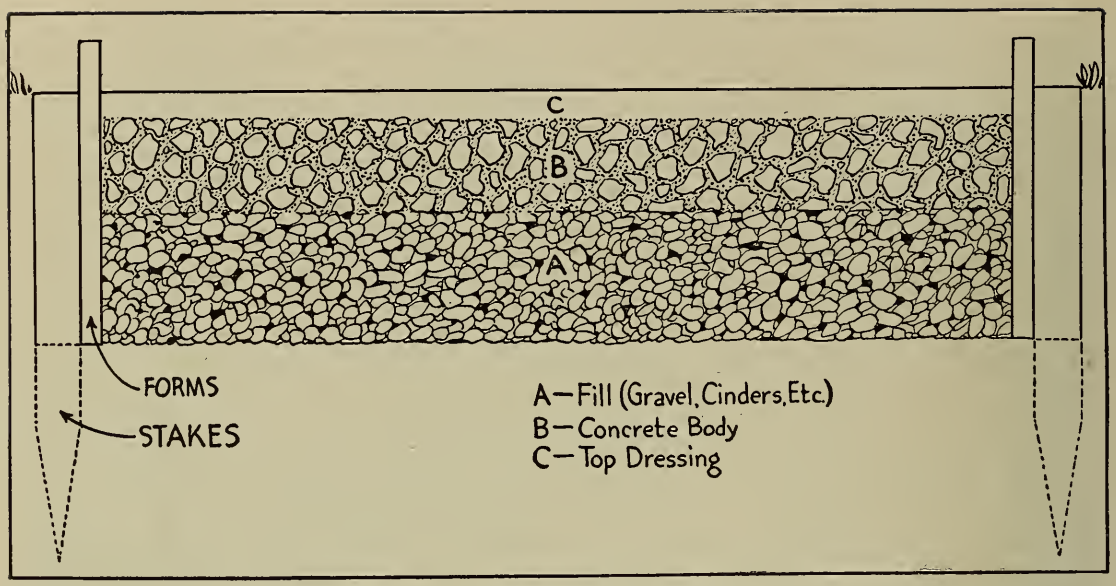
First—have the aggregates well graded. The stone should pass through a ¾-inch mesh, but be retained on a ¼-inch mesh, sieve.

Second—the ground and subbase should be thoroughly rammed and packed. To insure good drainage, crushed stone, furnace clinker, or broken brickbats of about two-inch size should be placed in first layer of subbase. All the roots should be cut out to a distance of 18 inches below the surface of the ground.

Third—the construction joints should not be farther apart than six feet either way, and should be cut clear through to the subbase by working a trowel or cleaver along their length after the concrete is placed.

Fourth—the concrete should be mixed only in sufficient quantities for a half-hour's work at a time, and should be used as soon as ready.

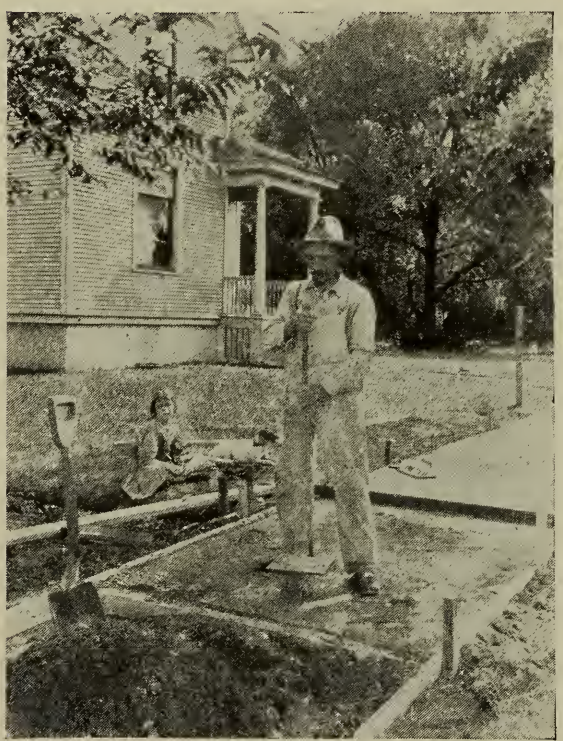
Fifth—avoid troweling too much, as this floats the cement to the surface and, though it gives a temporarily good-looking walk, gives a surface which



25. Cross-sectional view of concrete sidewalk under construction. Below the fill all roots should be cut to 18 inches below ground.

will not hold up well under traffic. Smooth the surface with a wooden float, and later, when concrete is nearly hard, brush with a piece of oakum or stiff brush to remove the marks of the float and give an even wearing surface.

Sixth—cover as soon as sufficiently hard with burlap, straw, or some other material, keeping well soaked for at least four days.

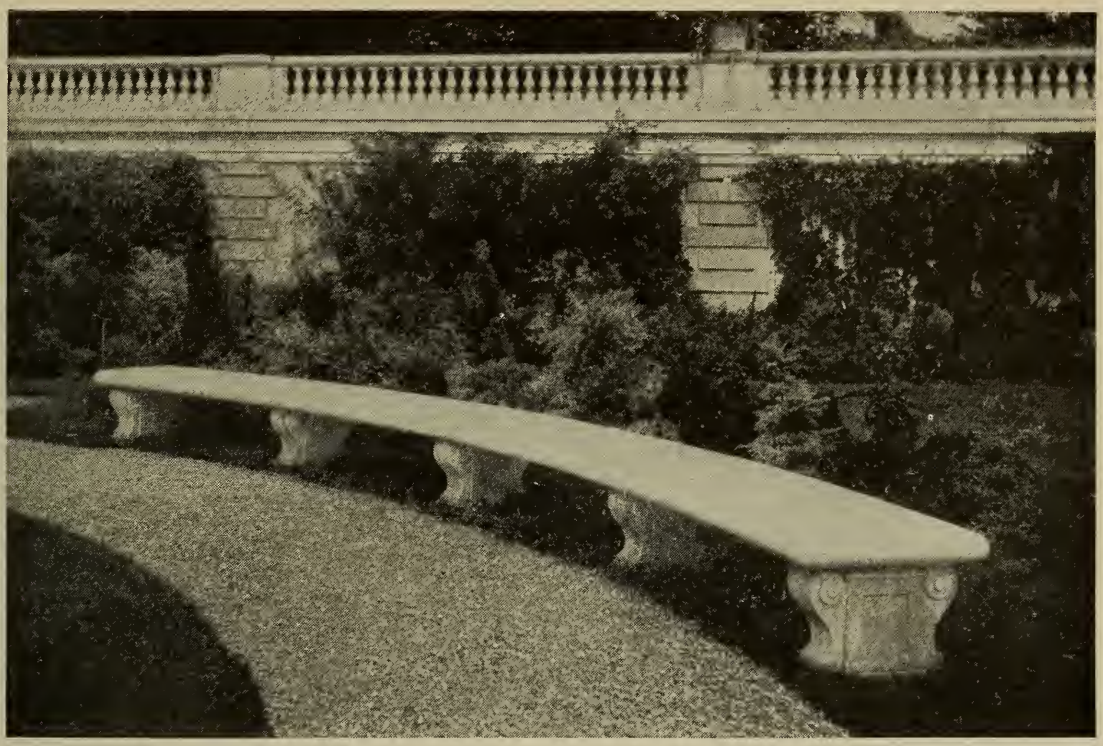


26. Method of tamping concrete in sidewalk work.

Benches.—In shady corners of the garden, or on knolls which present a good view of the surrounding country, nothing is more suitable or apt to give more comfort than a neat bench. For permanent satisfaction this should be of concrete.

The exact size and shape will, of course, depend on individual taste. The accompanying photographs show types simple of construction and pleasing in appearance. The addition of a small shelf directly beneath the seat gives a convenient place for keeping reed or rush pads for cushions, if these are to be used on the bench.

Should the owner wish to put a little extra trouble into the manufacture of the benches, they can be made with granite or marble chips, and the surface washed off after completion with acid, so



27 and **28.** Two very simple types of concrete benches, simply slabs placed upon uprights which in turn rest upon concrete bases.

29. Concrete posts and rails curing for use in fence similar to that at foot of page. The time of curing in this case averaged two months.

exposing the aggregates. Simple flutings can be made in the end-pieces by tacking half-inch rounded strips in series on the inside of the forms.

Replacing about 10 per cent. of the cement with an equal quantity of hydrated lime will give a whiter and better weather-resisting concrete. The end-pieces and main slab of the bench should be reinforced with steel rods.

Unless there is likelihood of the bench being moved from time to time, the end-pieces or legs should rest below ground on footings from 18 to 24 inches in width.

Fence-Posts.—Probably the most extensive use for concrete on the farm is in fences and fence-posts. Yet nowhere is there more apt to be improper

30. This type of fence, though more costly than one of posts and wire, has the advantage of being absolutely permanent.

or unintelligent handling than in making posts, and nowhere is it more important that proper precautions be taken to insure satisfactory results.

The construction of posts without reinforcing is a waste of money and time, for sooner or later the posts will fail. The construction of posts with insufficient or improper reinforcing is almost equally as bad. The proper amount of reinforcing, properly placed, produces economical and permanent posts.

The size of the post depends on the nature of the soil, whether loose or solid, and on the purpose to which the ground inclosed is to be put. In general, the concrete post can safely be made slightly smaller than the wooden post which has been used for the same purpose.

31. A home-made mold which will give the owner durable posts.

A good wooden post can hardly be purchased for less than from 20 to 40 cents as an average cost. Due to rotting at the base, failure of some other post in the same fence, or partial destruction of the fence by fire or other cause, the post will probably have to be reset every five years and replaced at the end of fifteen years. Allowing 10 cents for the resetting of the post twice and retightening of the wire, the post will cost from 30 to 50 cents for fifteen years, and then need to be replaced.

Allowing a good margin for materials and time, the average cost of a concrete post will approximate 30 cents. There will be no danger from rotting, from fire, or from failure of some other post, for they will all be equally strong. And at the end of fifteen years the concrete post will be actually stronger than when first placed in the ground. At the end of twenty years it will have cost no more than when first placed in the ground, while the replacing of wooden posts would have probably run their average cost above 50 or 75 cents apiece.

Wooden posts lose a half to a third of their original strength in the first three years, while concrete posts grow constantly stronger. Every one is familiar with the sight of old wooden fences where posts are put every few feet, new posts being added whenever a weak place appears, so that there may be as many as five posts where one good concrete post would have been sufficient.

Concrete posts are attractive because of their uniformity of size, shape, and color, and their durability. They give the fencing material greater length of life, and add value to any property because of the improvement in appearance.

The failure of a concrete post is usually due to cracking of the concrete

32. The commonest type of durable fence—concrete posts with metal fencing. Fencing may be attached with wiring.

on the side opposite the one on which the force is applied. This failure may be due either to insufficient reinforcing on the side receiving the stress, or to crushing from too small a depth of concrete.

As the post is more apt to be strained by animals, either forward or backward, than bent to either side by the stress of the wire, if there is any difference in the breadth and depth of the post the wider measurement should be placed at right angles to the line of the fence.

The simplest to construct, commonest, and apparently most satisfactory post, however, is the oblong cross-sectioned one with a slight taper toward the top.

An exceptionally good commercial form is what is called the heel-shaped post, flat on one side, with a rounded opposite side. This permits of the easy removal of the post from the form, and also makes it a simple matter to attach wire to the post.

To the man contemplating extensive use of concrete posts it will be most economical to purchase some good fence-post mold. In choosing a post mold according to its cross-sectional shape the oblong cross-section is to be preferred, with the square, round, and triangular shapes following in the order named. The mold giving the greatest number of posts per cubic yard should not necessarily be selected, as it is very apt to be one unsuitable to the farmer's purposes. The argument that a lighter post is more easily handled is not one deserving serious consideration, for a concrete post is apt to be handled only once before placing in the ground, and once in the ground additional weight is a decided advantage. An additional half-inch of width or depth to the post will not add more than a cent or two to its cost and may add years of life.

Two general types of mold are on the market, those standing upright and those lying flat. The former is more economical in space, but sometimes necessitates an extra platform for lifting the concrete to be poured into it. The second type is made convenient for placing the reinforcing. Before using, molds should always be thoroughly cleaned and lightly coated with crude oil or soap. Kerosene should never be used.

33. A heavy ornamental post which can also be used as a gate-post.

In filling the flat or horizontal molds, $\frac{5}{8}$ inch of concrete is poured in the mold, and the first pair of reinforcing rods laid, each rod $\frac{5}{8}$ inch from the corner of the post, stirruped at distances of from 8 to 12 inches with wire looped around them, the ends of the rods being hooked. After sufficient concrete has been added, two more rods are similarly located $\frac{5}{8}$ inch from the upper side of the mold, the balance of the concrete filled in, and the face finished with a trowel or wooden float.

The mix used should never be weaker than a 1:2:4 mix, and should be sufficiently wet, although not sloppy. For at least two days after being made the post should be protected from sun and wind to keep it from drying too rapidly. If possible, a four-day period would be better. On the fifth day it may be slid gently onto a level surface, covered with burlap or straw, and sprinkled daily with water. At the end of two weeks it may be stacked outdoors to finish curing.

Throughout its course of manufacture it should never be jarred, as this might develop slight cracks which would never show until after the post had been in use some time. The longer the time allowed for the curing of posts, the better they will be. They should never be used until at least two months old.

The United States Government has published a Farm Bulletin No. 403 on fence-post construction, entitled "Concrete Fence Posts." This bulletin can be obtained free on application to the Agricultural Department or to your local Congressman.

Gate-Posts.—Gate-posts may be made in the same general way as fence-posts. As they, with corner posts, generally bear a heavier strain than ordinary line posts, they should be of more solid construction, be more strongly reinforced, and rest on some sort of a foundation or base.

Gate-posts may be either monolithic or block, the block posts being laid, of course, simply as an ordinary brick post is laid. The monolithic post, however, gives an opportunity for greater variety of design and greater strength of post. It may be constructed of very severe and simple style,

34. A combination concrete and brick post, showing a rather unusual treatment. This method of handling is suitable for large country estates.

or be more or less decorative in design. It may be constructed in horizontal molds, as the ordinary fence-post, or molded directly in position. Provided the post is not so heavy as to be difficult to handle properly, better results will usually be obtained by molding it horizontally and then raising to position. The accompanying views show possible treatments of gate-posts. Size and design are governed by the nature of the estate on which they are to be used.

Hitching-Posts.—Though the auto is fast displacing the horse, even in rural districts, it is still well worth while for the owner of any fine shade trees to protect these when they stand near a roadway by providing posts for any possible horse-drawn vehicles.

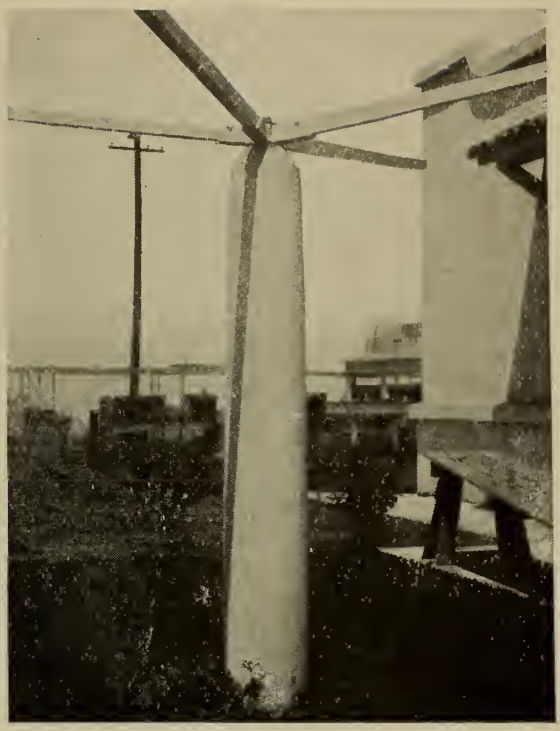
Such a post should be made about twice the size of an ordinary fence-

35. Horse-block and hitching-post of concrete, with small retaining wall in background. Only home-made forms are required in this construction.

post, having bolts sunk in on each side of the top, to which can be fastened the hitching ring. The sides may be beveled and top rounded, or any other style of ornamentation the owner wishes used.

Clothes-Poles.—Differing but slightly in method of construction from ordinary fence-posts, the concrete pole furnishes the housewife a clothes-pole which will be neat in appearance and permanent.

This may be either of two types—the solitary pole or the series pole. The former is one from which a spider-web arrangement projects on which garments are hung. The second type consists of a series of two or more poles with lines strung between.



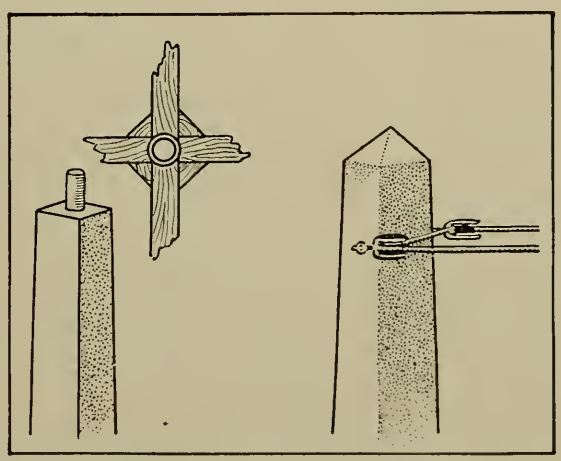
36. Solitary clothes-poles of concrete—the arms are so arranged as to be removable.

In the solitary type of pole the pole rests on a foundation about three feet under ground, from which the shaft proper extends about six feet above ground, to be surmounted in turn by a spike of about one-third the diameter of the shaft. Around this spike revolves the series of wooden arms with the cross wires on which the clothes are hung. An iron band at the base of the spike, kept well greased, furnishes the best wearing surface for the revolving spokes.

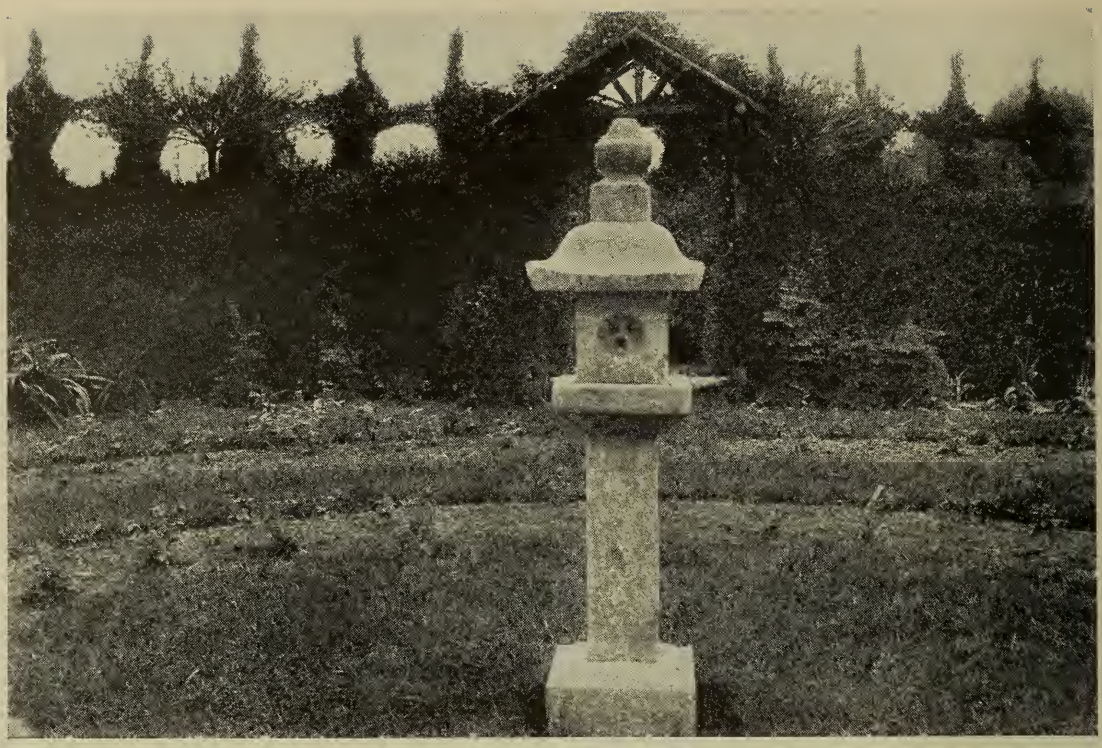
A strip of concrete two feet wide, extending out as far as the arms of the pole, furnishes a dry footing in muddy weather, from which the clothes can be hung as the arms revolve.

In the series type of pole the foundation base can be dispensed with, as there is not nearly the same strain on the pole. The size of pole can also be smaller.

The most satisfactory method of attaching the clothes-wire or cord to this type of pole is by the double pulley arrangement, by which the clothes can be fastened to the line at one point and the line slid along through the pulleys so that the clothes-hanger remains stationary, while the line, as the clothes are hung, moves along. This eliminates all the heavy lifting of a basketful of wet clothes, so tiresome after the other work connected with washing.



37. Comparison of the solitary and series type of pole.



38. Garden light of concrete in the Japanese style. The method of lighting depends on the facilities of the estate.

A small strip of concrete, six feet long and a couple of feet wide, at the end from which the clothes are hung, will be found a great comfort.

For the person who does not wish to go to the trouble of putting up a pulley system for the clothes-line, a simple eye-bolt embedded in the concrete, between six and six and one-half feet above ground, is the best means of attaching the line.

The illustrations show the method of construction of these two types of clothes-pole. The reinforcing consists of ⅜-inch rods placed one and a half inches from each of the corners. With this difference, the method of construction is similar to that of fence-posts.

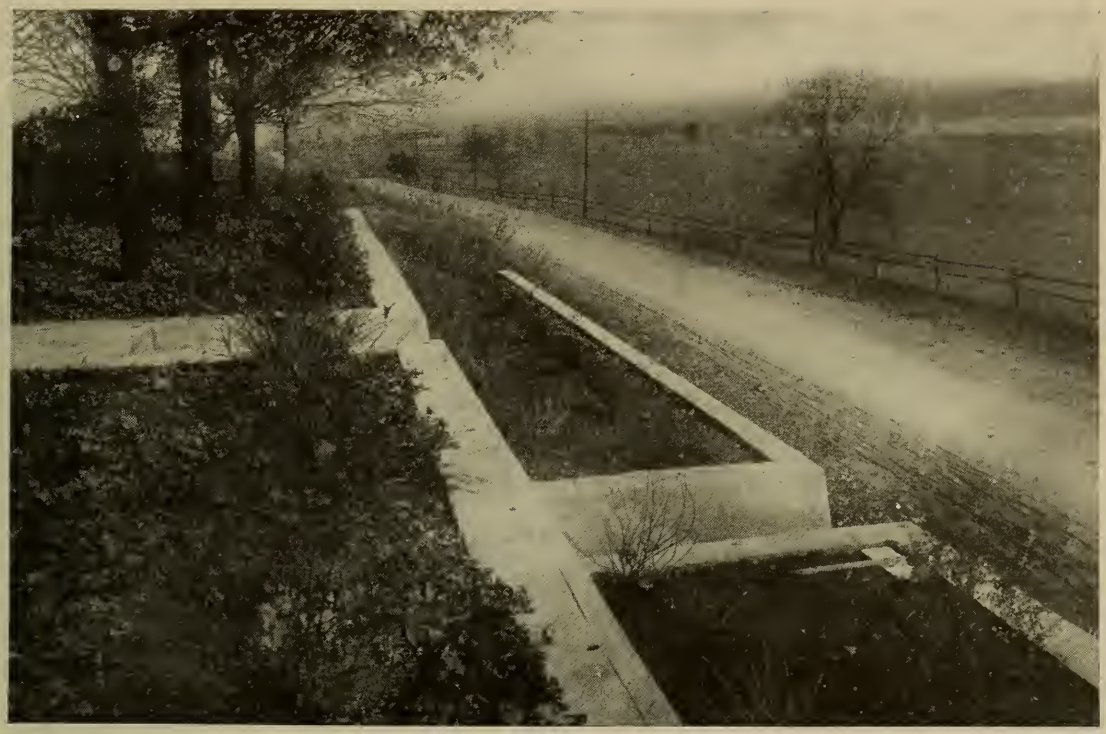
Lamp-Posts.—Occasionally the owner of a home wishes to erect outdoor lamp-posts around his place. These may be either very simple in design or more or less ornamental, as the Japanese post shown in the illustration. If they are to be lighted by electricity or gas, they must be made hollow to provide for the electric wiring or gas-pipes.

Such posts are best not attempted by the amateur workman in concrete, as they require special forms and skill in handling. When any extensive system of lighting is planned by their use, they can be obtained from one of the manufacturers of such forms.

Horse-Blocks or Curb-Steps.—Though the low broad step of the auto is far easier to mount than the narrower higher step of the horse-drawn carriage, it is still a great convenience to have a horse-block or curb-step in front of the average home.

This can easily be made in position.

First measure the exact size you wish the step to be, and stake firmly your side forms. If you wish the corners beveled off, tack triangular strips



39. Concrete terrace or retaining wall. Showing a pleasing method of breaking up a very steep slope.

up the corners. If panels are desired in the sides, oblong strips of wood beveled 45 degrees can be tacked to the interior of the forms.

The forms can then be filled with a concrete mix not weaker than a 1:2:4, this mix to be placed in the forms quite wet and spaded back from the edge to remove all voids in the concrete.

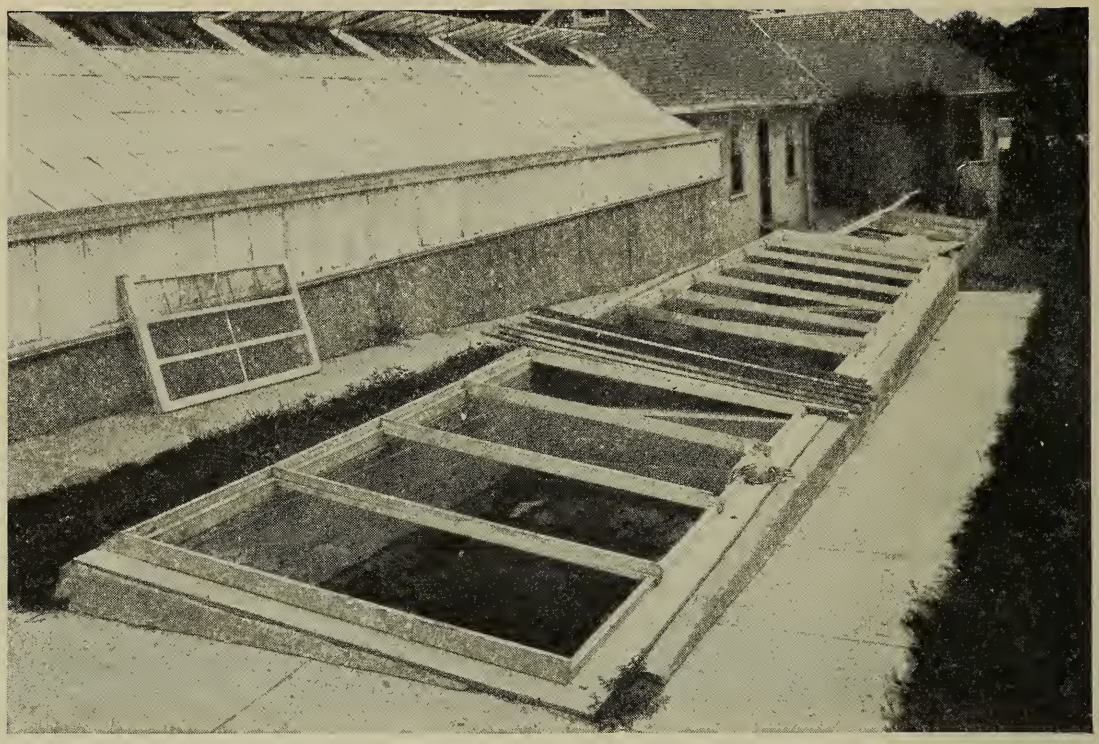
The top surface should be lightly floated and brushed as it hardens.

Retaining Wall.—This may be merely a low wall of a foot or so to retain a terrace, consequently bearing little weight, or may be a wall keeping back a heavy bank of soil with possibly a stream of water pounding it on the other side. Retaining walls are also often used on the shores of large bodies of water, extending out from land to prevent the too great changing of the shore line. The size and strength required of retaining walls, therefore, vary greatly.

Of the heavy type of retaining wall, probably the commonest is that used in railroad construction. The base of the wall in this type is from $\frac{2}{5}$ to $\frac{1}{2}$ as wide as the wall is high, narrowing by a progression of steps to the top. For this so-called gravity wall no reinforcing is necessary. This company is always glad to receive inquiries on any walls, stating the conditions that must be met, and will give information to all desiring advice.

For many of the smaller retaining walls, such as at the edge of sidewalks and terraces, no such special data are required, an ordinary eight-inch wall being sufficient. This can be, if so desired, buttressed at distances of six to eight feet into the higher ground.

The reinforcing should be horizontal, of quarter-inch rods, spaced usually eight inches apart, and located one inch from the outer face of the wall. If no buttresses are used, the reinforcing should be vertical one inch from the



40. Hotbed or cold-frame of concrete, with sash removed to show construction. The concrete walk gives easy access in all weather.

inner surface of the wall. All buttresses should be well tied into the wall with angle-bars.

The forms used and methods of construction are identical with those already described under the heading Foundations.

Hotbed and Cold-Frames.—Many farmers, and city dwellers as well, while they do not wish to go to the expense of a greenhouse, still wish to obtain some of the benefit and luxury of having vegetables and delicacies out of season. The solution of this is the cold-frame or hotbed.

Concrete is the best material for its construction, as concrete is not affected by weather, moisture, or time, but will last indefinitely without repairs.

The bed should be on the sunny, wind-protected side of a building. Usually a four-sash bed is large enough, except for commercial purposes. A standard hotbed size is 3 by 6 feet. Lay out the bed 6 feet 8 inches by 12 feet 10 inches, the walls being 6 inches thick. Dig the foundation walls 2½ feet deep, and raise the forms above this 6 inches on the south (front) side and 14 inches on the north (back) side. Before filling the forms with concrete, test the dimensions of the bed by means of the sash. See that the sash laps the inside forms two inches on all sides.

Reinforce the corners with old iron rods bent at right angles. While placing the concrete, set ½-inch bolts about two feet apart to hold the wooden top-framing of the bed to the concrete; or make grooves in the top of the concrete for countersinking the sash to the level of the walls, with an allowance of ¼ inch for clearance.

The forms should be left in place for five days. The extra 2⅞ inches in length of the bed is allowance for the three cross-bars between the sashes.

These sash supports are of dressed one-inch stuff, shaped like an inverted "T". The length of the "T" is equal to the thickness of the sash, the cross-bar being three inches wide.

The bed is finished for a cold-frame when covered with glass. For a hotbed, dig out to a depth of two feet, tramp in a mixture of fresh horse manure and leaves to a depth of 18 inches, and fill rest with four to eight inches of rich soil. Bank excavated earth around the outside of the bed.

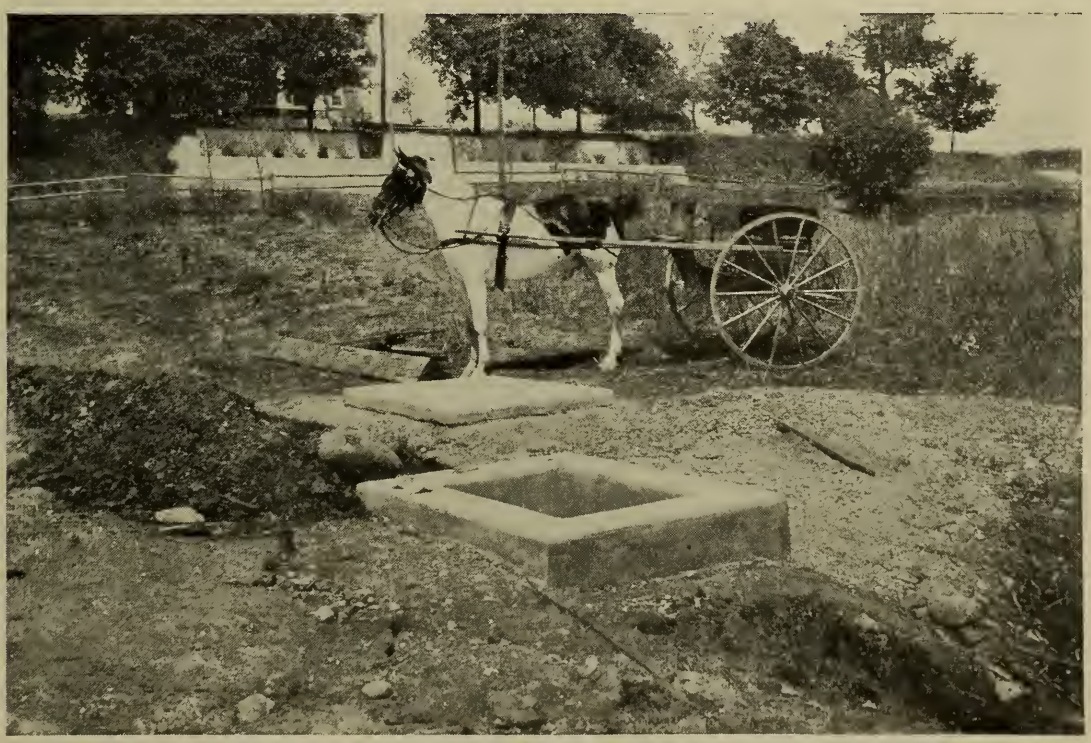
Put sash in place, hang a thermometer inside, and let bed heat up for a couple of days. After temperature has dropped to 85° or 90° F., planting may be safely begun. During midday the bed should be ventilated, as it would otherwise become too hot. Plants should be watered only in the morning. It is best to cover the bed through the night in winter-time.

Well-Curbs.—Old springs and wells will preserve the purity of their water better if protected by concrete curbs. The method of relining old wells has already been outlined on page 31. To place a concrete curb around a spring proceed as follows:

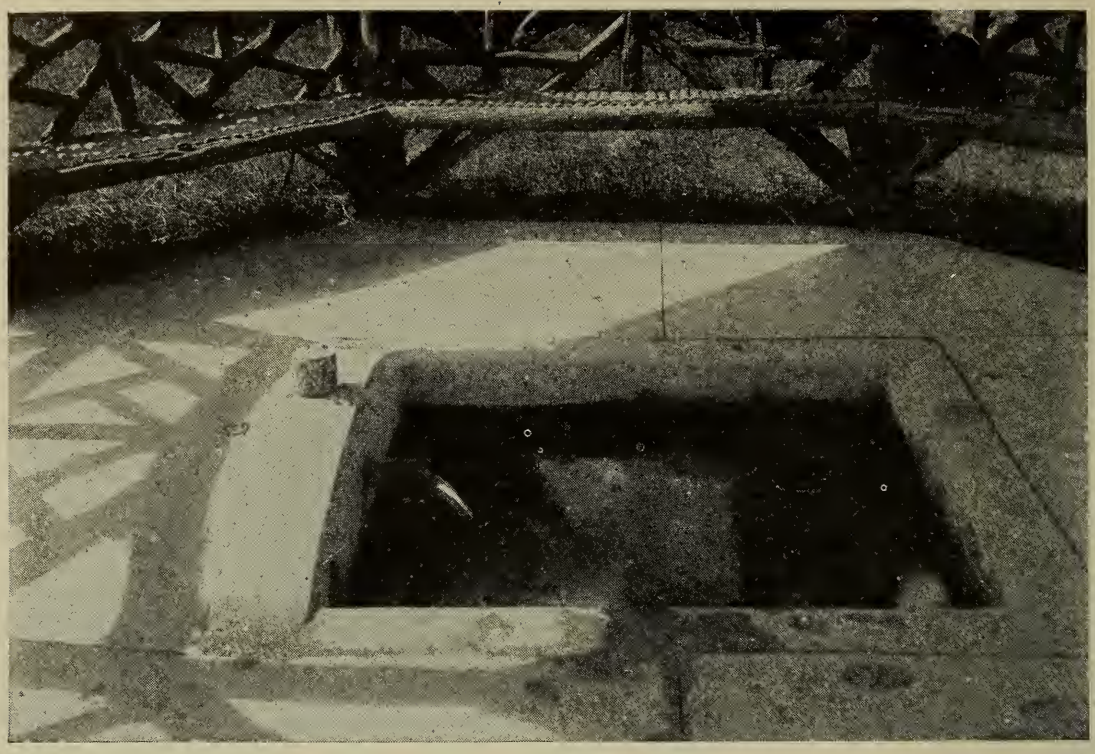
First, open up the channel and drain out all the water possible. Clean out the spring to increase its flow. Wall up the well of the spring with concrete blocks laid without mortar to a point above the inflow streams of the spring. Lay the balance of the blocks in a 1:2 cement-sand mortar.

The curb of the well or spring may be finished with these same blocks or be monolithic. Whichever style is adopted, a floor should extend around the spring, turning down at the edges two feet under ground to prevent the frost from getting below the concrete and breaking it up.

Ice-Houses.—Many farmers are situated near a lake or river, from which they can easily lay in their summer's supply of ice. By packing this in



41. An exceptionally simple type of well-curb that is pleasing in appearance and durable. Such a curb is suitable for any surroundings.



42. Type of well-curb common in a spring-house or arbor. The location of this well in a spring-house eliminates the necessity of a surrounding curb.

sawdust in a small ice-house they can not only secure for themselves a plentiful supply, but can even make a profitable business from it.

The house should be located where it can be well drained by underground tile, and where it will be shaded in midday by the trees or larger buildings.

The size depends on the number of pounds used daily and the number of days ice will be used. The average family consumes at least 100 pounds a day for six months—a total of nine tons. It is better, however, to provide for a larger consumption. A ton of ice occupies a trifle less than 40 cubic feet. No packing is required between the cakes of ice, but around the walls, on the floor, and above the ice should be a 12-inch layer of sawdust. If sawdust cannot be obtained, an 18-inch layer of prairie or marsh hay can be used if it is thoroughly packed and weighted down. With an allowance for packing and eight-inch concrete walls, a house 12 by 16 feet, outside, and eight feet to the eaves, will hold enough ice for the average family. Its full capacity is over 17 tons, but melting, due to ice being poorly frozen or packed, frequently amounts to from one-third to one-half capacity. It is best, therefore, to build the house to hold twice the calculated need.

The method of construction need not be complicated. It may be monolithic, of block, or of expanded metal lath construction. To the average farmer used to handling concrete the monolithic is the best to construct.

Excavate the foundation trench three feet deep and 12 inches wide, of such dimensions that the foundation extends three inches on each side of the six-inch wall. As soon as the foundation is sufficiently hard, erect the wall forms and fill with concrete.

The reinforcing, whether of rods or of triangle mesh, should extend from the foundation to the roof. The outer wall forms should project in an elbow at the top to form the concrete eaves. Spaces for the doors and windows are provided by door- and window-frames. Above and below each opening, two inches from the opening, should be embedded two ½-inch bars projecting eight inches beyond each side of the opening. At each corner of an opening, at right angles to a line bisecting the corner, should also be laid 12-inch lengths of ½-inch rods.

43. An ice-house of simple but attractive lines. The wide roof in part makes up for lack of shade.

The door-tread and window-sill may either be molded in position or made in a separate mold and placed in position after the forms are removed.

The floor should slope toward the door to a small depression from which leads a drain, with a goose-neck to prevent the entrance of hot air.

The simplest roof is of expanded metal lath, concreted above and below.

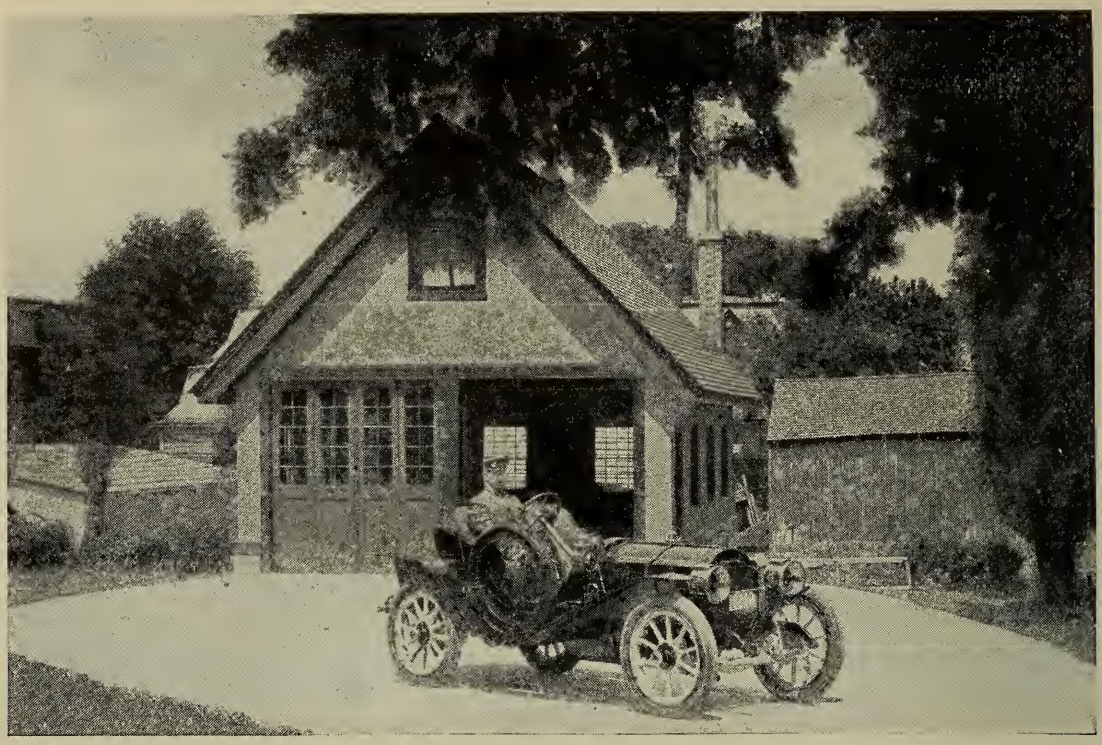
The forms must not be removed for at least a week, the roof particularly being kept thoroughly wet while curing.

Garage.—The day when the farmer left his valuable planting, cultivating, and harvesting machinery outdoors from one year's end to the other has passed. Today, in the care of his machinery the farmer is a careful mechanic. Particularly true is this of his auto.

Auto insurance is necessarily high—as the risk is great—and unsatisfactory, for you would by far prefer the car to the insurance money or the car would never have been purchased. Strange as it seems, the great majority of autos that are destroyed by fire are destroyed not while running, but while idle in the garage; this is due to oil-soaked wooden floors and the improper storage of combustible materials.

An ounce of prevention is worth a pound of cure. When you realize that an absolutely fireproof garage can be built for a fraction of the cost of the automobile and for but little more than the cost of a wooden garage, the absurdity of failure to protect your machine properly is at once seen. The advantages of a concrete garage can be summed up briefly. It is far more durable than wood, and the floors will not become oil soaked and rot the tires of the car. If a fire should start in some tank of combustible material, it will not spread through the rest of the structure—the building is absolutely moisture and weather-proof, is easy to keep clean, and is absolute insurance against loss by fire.

The garage may be of concrete block construction, reinforced monolithic



44. This turntable serves the double use of simplifying entrance to garage and washing of machine. It also affords a handy place to work on the machine in fine weather.

construction, stucco on metal or wooden frame, or a combination of any of these styles of construction. The general directions for work under the classifications given in this booklet are sufficient for the person who is accustomed to do his own work. Best results are secured when a competent contractor supervises the construction.

Outdoor Storage or Root Cellar.—In cold climates outdoor cellars give the best and cheapest storage for fruits, vegetables, and butter, while in summer milk, eggs, and berries can be kept in them. No vegetable odors can be carried from an outside cellar into the house, while the contents of the cellar will be kept at a lower and more even temperature than if the cellar were under the house.

A good average size for the cellar is 10 by 14 feet, with a self-supporting arched roof five feet above the floor at the sides and seven feet eight inches in the center. All side walls are eight inches thick, the floor being four inches thick.

Make the excavation, allowing eight inches for the walls on each side and four inches for the floor. The usual depth is about five feet, so that only the arch shows above ground. At one end cut out the earth to a width of four feet four inches, and slope up for a flight of seven concrete steps, each step with a rise of eight inches and tread of ten inches, with an 18-inch landing at the bottom of the stair.

Place the forms for the walls, filling with concrete in eight-inch layers, laying all four walls at the same time. If the ground is dry and well drained, the only reinforcement necessary is a $\frac{3}{8}$-inch steel bar one inch from the outside and six inches from the top running around all four walls. If the ground is apt to be very wet, however, and the walls

will receive severe strains from sudden rainfalls, be sure they are well reinforced.

When the walls are a week old, the roof can be added. To make the arches for the roof forms, take a string 5 feet 11 inches in length, with a pencil at one end and a nail at the other. On a flat piece of ground or floor draw with this a half-circle. Lay a board 10 feet long across this, so that the board's ends just touch the circle. The part of the circle above the board represents the arch. Cut and nail together two sets of boards of this shape and size, connecting with cross boards and reinforcing them as shown in the sketch.

For reinforcing the roof, space $\frac{3}{8}$-inch rods 6 inches apart crosswise and 12 inches apart the long way of the cellar. Provide for ventilation, as shown in the sketch. Above all, do not leave the work partly finished, as this means a weak place in the concrete.

From four to six inches of crushed stone outside the walls with a drain at the bottom will carry away any excess of water that might otherwise affect the wall.

Land Rollers.—These may be of various sizes, from the small hand lawn roller to the large, horse-drawn clod breaker used in clayey fields. Originally such rollers were made from the trunks of trees, supplemented with boxes of stone perched above the trunk for weight. Today all the weight can be concentrated in the load itself by means of concrete construction.

The size of the roller depends on the weight desired. More pressure will be given by a narrow than by a wide roller of the same weight. An average weight of 150 pounds per cubic foot can be taken for estimating the size

45. An outdoor storage or root cellar is a comfort, luxury and economy—it is also inexpensive to build.

of roller desired. Concrete rollers of average size usually range from 12 to 24 inches in diameter, and from two to three feet in width.

The simplest method of construction is to mold your roller within a tile having the same interior diameter you wish the roller to have, and the length, minus the "bell," equal to the width of the proposed roller.

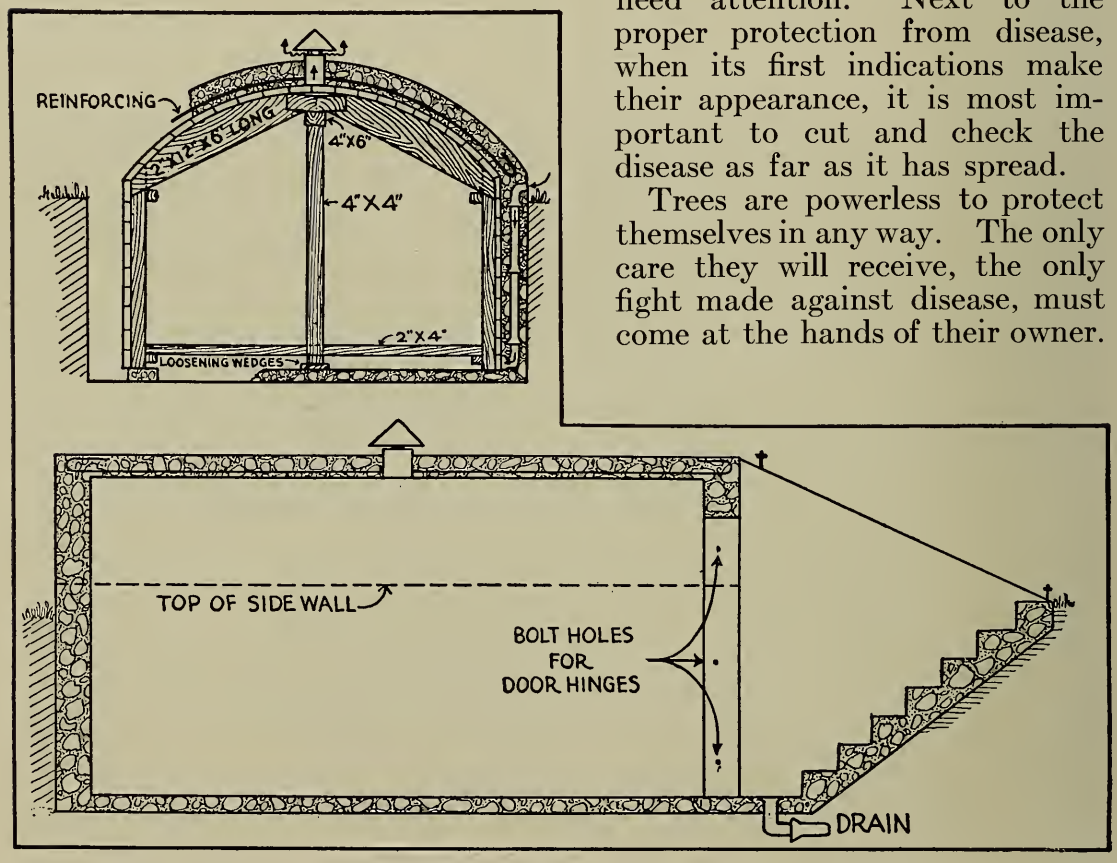
Set the tile, small end down, upright on a wooden platform. Through a hole directly in the center of the circle made by the tile insert a one-inch round iron bar, bracing it in exactly the same position at the upper end of the tile by a wooden bar across the top and cleated to the platform with cross pieces. Fill up to the "bell" of the tile with a wet mix of 1:2:4 concrete, and allow to stand for ten days, when such a handle as is used on lawn-mowers may then be attached, the forks provided with holes in which the iron bar, the axle of the roller, turns.

If the tile is to be left on the roller after the concrete is hardened, be sure to see that the "bell" of the tile is chipped off or sawed off.

A roller 18 inches in diameter and two feet long weighs in the neighborhood of 600 pounds. Heavier or lighter ones may be made by changing the diameter or width of the roller, or by constructing it with air-spaces through its length.

Tree Surgery.—The storms of the last few years, the numerous European insect scourges which have destroyed many of the oldest and most beautiful shade trees of this country, have stimulated an interest in tree preservation long due. Trees, like teeth, need attention. Next to the proper protection from disease, when its first indications make their appearance, it is most important to cut and check the disease as far as it has spread.

Trees are powerless to protect themselves in any way. The only care they will receive, the only fight made against disease, must come at the hands of their owner.



46. Illustrating method of construction of concrete root cellar. Reinforcing in roof runs both lengthwise and laterally, as shown.

Where they are easily accessible, horses gnaw their bark off, lawn-mowers often mutilate their base, linemen from telephone companies wantonly and deliberately hack their tops off, and careless pruning and neglect of breakages often cause their final destruction.

Ofttimes there is no external indication of disease. From some neglected wound the fungus has obtained a foothold, and, unseen, eats out the heart of the tree, unnoticed until some storm blows it down.

Wood-rotting fungi cannot enter a tree except through wounds. Consequently if these are kept cleansed and protected as fast as they appear, the life of your tree will be practically indefinite. Where rot has already obtained a foothold, the following is the best method of procedure:

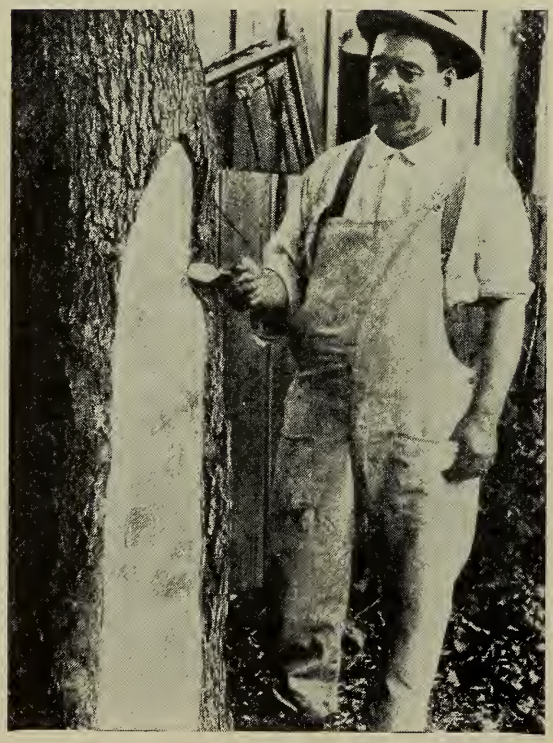
First, remove all decayed wood—not merely the punk wood, but also the harder wood back of it into which the germs have extended. Particular care must be taken that the corners and crotches are not neglected. Gouges and chisels, with an expansion augur for the pockets, are the necessary tools. In the hands of an expert, a gasoline torch may be used. An amateur would be apt to burn the cambium.

The excavation, like that in a tooth, should be made with the sides slanting back, so the filling will not fall out, and should be cleansed with a disinfectant such as corrosive sublimate, blue vitriol, creosote, or carbolineum. When this is thoroughly dry, the cavity is coated with heavy coal-tar or asphalt and is then ready for the filling.

The majority of cavities are so placed that the concrete for the filling must be mixed rather dry and rammed into place. Where possible, however, it is best to have it fairly wet. Where fillings are of any size, they

47. These rollers cost practically nothing to make, and can be made in any number of sizes and weights.

48 and 49. Showing preparation and filling with concrete of a bad cavity. This may double the life of the tree.



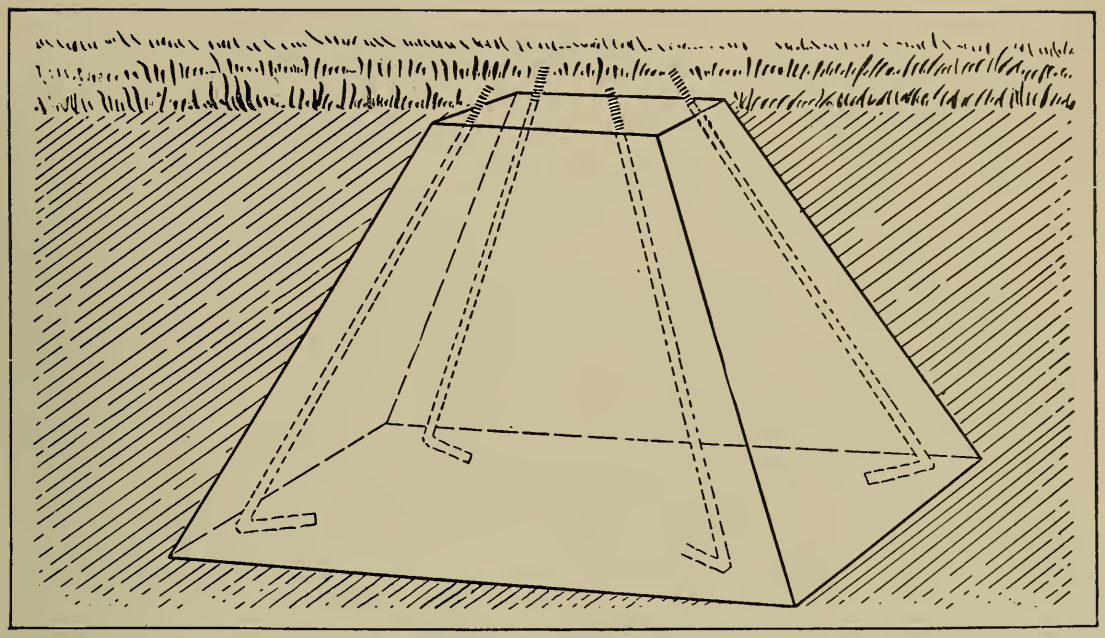
should be put in in sections of 12 to 18 inches with tarred felt between the sections. These sections serve the double purpose of taking up any expansion and contraction due to change in temperature, and also take care of any strain due to the swaying of the tree. Where reinforcing is used, it should never extend from one section of the filling to the next, and usually consists of wire mesh or metal lath.

The filling must never be brought out beyond the cambium, as this makes it more difficult for the new bark to form over it. When the concrete is dry, it in turn is painted with the heavy coal-tar or asphalt and the callus or bark allowed to grow over it.

Windmill Foundation.—Probably no farm structure has such a severe or continuous strain on it as has the windmill. It is purposely raised to a sufficient height for the wind to reach it, so it is essential for it to have a firm foundation.

The most durable, least expensive, and most easily constructed foundation consists of four pyramid bases, one for each of the steel legs. These should extend well below the frost line, and be so leveled as to have a secure grip in the ground. In soft ground they necessarily must have a wider base than in hard ground.

They should be reinforced at each of their four corners by a twisted steel bar. This bar should be set in from the outside an inch or so, and should be bent in an angle at the bottom, the bent part running parallel with the bottom of the base, toward the center of the base. The bars should extend sufficiently at the top for the legs of the windmill to be bolted to them.



50. A concrete windmill base gives a firm grip on the earth. The embedded bars give the windmill an equally firm grip on the base.

A very strong and well-mixed concrete should be used, care being taken to see that it is thoroughly wet before pouring. These foundations should never be built when frost-time is near at hand.

Swimming Pools.—On the country estate, at the summer club, and, in fact, almost every place where live those who enjoy outdoor life, the swimming pool is very desirable. Congestion of population is robbing the boy of to-day of the old mud-hole. No exercise is more beneficial than swimming. The logical thing is, therefore, a concrete swimming pool.

The size of the pool may vary; at least one end, however, must be kept sufficiently shallow for those who are unable to swim—say from three to five feet deep. The longer the pool, the deeper can be the diving end. A maximum depth of nine feet should be ample for the largest tank.

The excavation can be done most rapidly by means of teams and scrapers, the finishing work of excavating being done by hand. After the excavation has been made as nearly as possible the exact size desired, the bottom of the pool may be wet and tamped thoroughly. If the soil be too loose, a fill of gravel or crushed stone may be put in. The roughing in for the supply and waste may now be set in position, and a wet mix of concrete poured to a depth three inches less than the final thickness of the pool floor.

The average pool is constructed nine feet deep at the deepest end, with the floor of the tank gradually sloping to three feet at the shallow end. The floor should be made six inches thick, reinforced with a heavy woven-wire mesh.

The walls of the pool should be made 12 inches thick throughout. Where the wall and floor join, a fillet of 45 degrees should be made to prevent a sharp joint at this point. The nine-foot end wall should be reinforced with ½-inch square twisted bars, spaced four inches on centers. The three-foot high end wall should be reinforced with the same size bars spaced 24 inches on centers. The side walls should be reinforced with ½-inch bars spaced

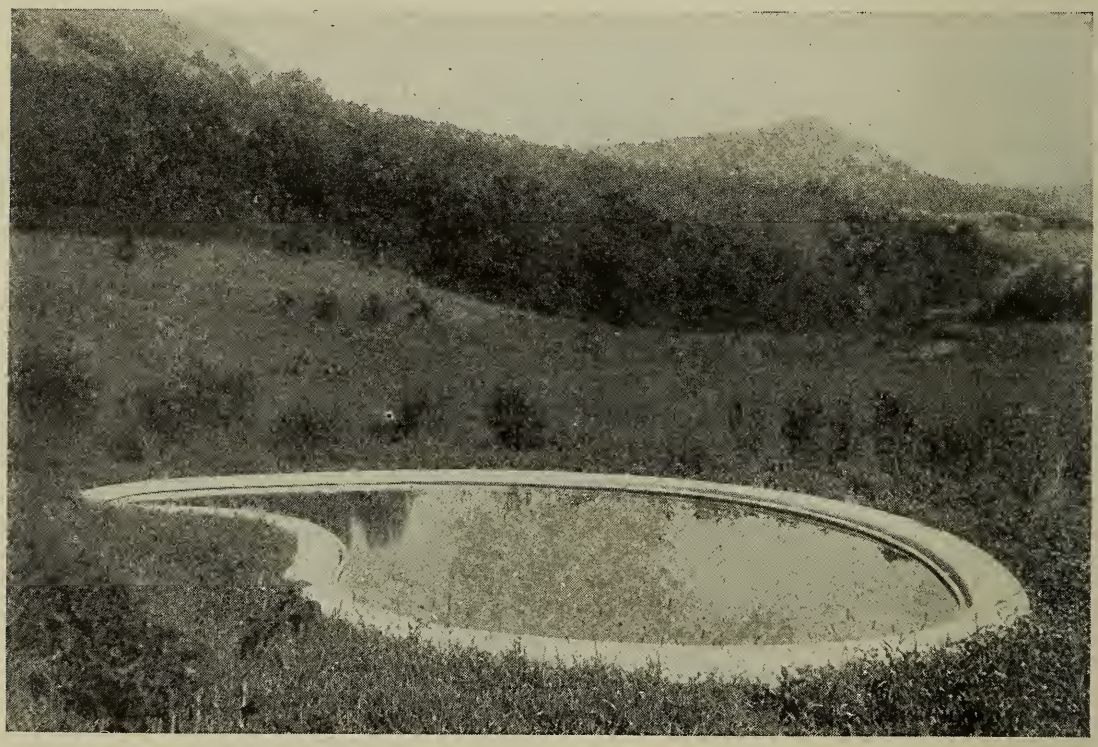
four inches on centers at the deep end, this spacing gradually increasing to 24 inches at the shallow end. All the ½-inch bars should be placed vertically two inches from the inner face of the wall. The bars should extend two feet into the floor of the tank.

To take care of temperature, there should be placed horizontally ½-inch square twisted bars spaced 24 inches on centers.

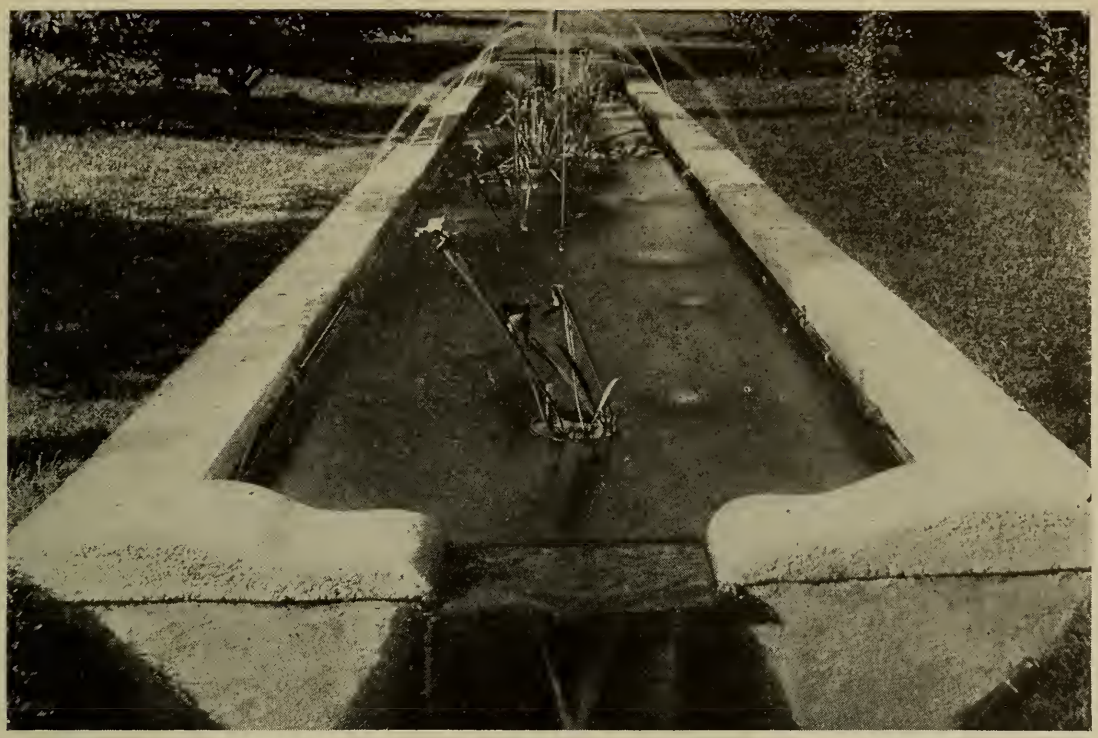
The side wall forms are then placed in position, and the balance of the floor and sides poured in one operation. The mix used should be a 1 : 2 : 3 mix of cement, sand, and fairly small gravel or crushed stone, in which 10 per cent. of the cement is replaced by an equal amount of hydrated lime, the whole to be mixed thoroughly and placed in the forms in a very wet condition.

The usual design for walls is to have them project three feet above ground and one foot above the water-line. Buttresses every eight or ten feet twice the thickness of the wall at the top add to the appearance of the pool. Steps, if any, should not be wider than two feet, and should have riser and tread of ten inches each. If steps are used at each end, they should be on the same side of the pool.

When the wall forms have been filled to within six inches of the top, insert at distances of about five feet the ⅝-inch eye-bolts, which hold the one-inch rope which encircles the tank to aid in climbing out. In the end wall at the deep end sink, 30 inches apart, two heavy iron bolts to which can be bolted the iron saddle which fits over the spring-board. Forms should not be removed for ten days. After the forms have been removed, wash over the entire inside with a creamy wash of neat cement; in the mean time cover



51. The swimming pool may be of any size or shape the owner wishes. For permanence it should be made of concrete.



52. The construction of the lily pond is practically identical with that of the swimming pool. Constantly running water requires some arrangement for outlet. A drop of a few inches looks well.

floor with wet straw and top with burlap, keeping the same thoroughly wet for a period of five days.

Water may be turned into the tank immediately after the forms have been removed, but the spring-board should not be placed in position for a month.

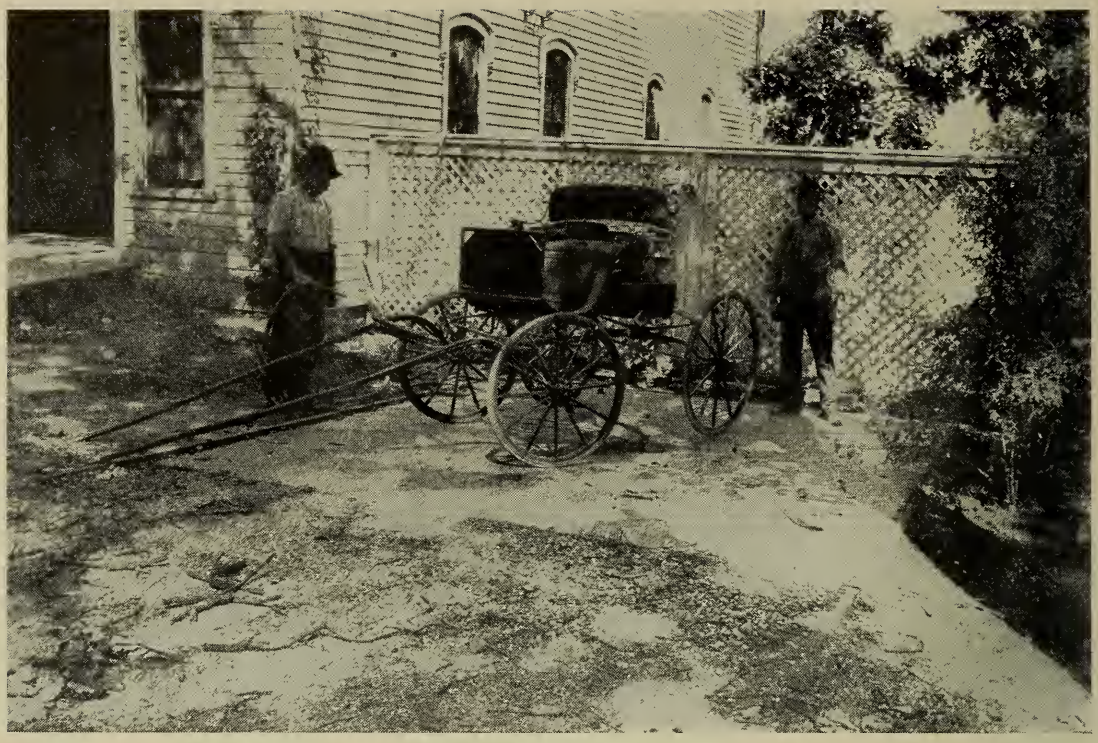
Lily Ponds.—In construction, lily ponds differ but little from swimming pools save that there need be no variation in depth for the opposite ends. The depth depends on the size of the pool, as well as on the nature of the plants to be grown in it. If fish and aquatic fowl are to be in the pool, a larger one than for plants alone will be required.

For the more common water plants, two feet of water with one foot of soil below this and six inches of tank wall above give excellent results. If there be a fountain in the pond, there should be an overflow provided, either by a small stream or by an overflow pipe. The soil should be either of a sandy or a gravelly nature.

Washing Floors.—A washing floor for the carriage or automobile is practically a necessity. It should be sufficiently large to hold the entire vehicle, including the shafts, if it be a carriage, and should be conveniently located just without the door of the barn or garage and handy to some source of water supply.

Washing outdoors keeps all the dirt outside the garage or barns, but washing on the uncovered ground would be both an eyesore and an inconvenience. The logical alternative is the concrete washing floor.

The method of construction is similar to that outlined under the heading Floors, except that the floor should slope toward its own center on a grade



53. Washing floors for carriages and machines are an actual economy, saving the owner time, money and temper.

of ⅛ inch to the foot. In the center is sunk a catch basin, protected by an iron grating with openings in it of not less than ¼ inch, and drained by a pipe not less than six inches. Grooves may be formed in the soft concrete with either a sidewalk edger or home-made wooden strips. These strips should be well greased to permit their easy removal from the concrete.

Laundry.—Wherever practical, the present-day housewife has a separate room for clothes washing, this room usually being located in the basement. When the washing to be done is very extensive, as on a large farm, with a number of workers, it is worth while to have a separate building constructed for the purpose. Usually, however, a separate room in the basement of the house is ample.

The floor of the laundry should be concrete, so that splashing water will not injure it, while the stationary tubs should also be of concrete. If the room is in the basement of the building, be sure that sufficient light, either window-light or artificial, is given. Next, see that the arrangement of the tubs is convenient for the washing of the clothes. And finally, make sure that the whole laundry is easily lighted, ventilated, and kept clean.

Garbage and Refuse Burner.—The simplest way to dispose of garbage and combustible trash is by fire. A concrete trash burner permanently takes care of this, and, if a little trouble is taken in its construction, need not be an eyesore on the landscape.

The main items to remember in its construction are: First, an ample capacity, as it is better to have it too large than too small; second, plenty of draft, so the fire will draw well, as the matter to be destroyed may sometimes be hard to burn; third, an easy way to remove the ashes when the pit

is filled, and to remove the grating on which the trash rests, in case this becomes clogged. The interior can be so arranged that one large door gives easy access to both the ash-pit and the grating on which the fire rests. This door should have a draft opening in its base to deliver plenty of air to the fire.

54. In the country or at the summer home a garbage burner is indispensable. Again—concrete.

The flue for escaping smoke and gas may, but need not, have a chimney attached. The walls of the burner should be tolerably heavy, and reinforced with metal lath or triangle mesh wire. A cinder concrete will give excellent results for this purpose if all its ash is screened out.

Concrete Around the Stock

THE disappearance of the mixed dairy herd of twenty years ago, the Western longhorn and the Southern razorback, shows the difference between yesterday's ideals of stock raising and those of to-day. This difference is fundamental, being the difference between the farmer who, for temporary profit, exhausts his farm without investment toward its future productiveness, and the farmer who temporarily lays out time, labor, and money if he can see ahead future profit.

This attitude is shown in the class of structures erected on a farm. The wise man is he who selects material which insures the health of his stock, the permanence of his work, and the improvement of his farm. To-day there is probably no issue of a farm paper published, no meeting of farmers or in farmers' interests, which does not bring out the necessity of healthy and permanent construction. And it is safe to say there are very few such papers published or such meetings held in which concrete construction does not receive its share of consideration.

The Dairy Barn.—The concrete dairy barn is durable, fireproof, vermin-proof, and sanitary. The first investment in it is the only investment, as properly made concrete is repair proof.

If a large number of cattle are to be housed, the stalls may be extended along two sides of the barn, facing the windows in the barn wall, and also the ventilators in the wall which give them their fresh air. The foul air is

55. A small concrete dairy barn, protecting stock from weather, vermin and fire. This type is rapidly replacing the old frame structure.

56. Interior view of large stock barn, showing method of facing stock toward windows. The carrier suspended from the ceiling simplifies bedding and cleaning.

exhausted in the center of the barn by outlet ventilators. If the distance between the two gutters on the opposite sides of the barn be left sufficiently wide, a small cart for carrying bedding, etc., can be run to and fro for convenience in caring for the stock. Many farmers prefer that this carrier be suspended from an overhead tramway rather than run on the floor. This method tends to keep floor and barn cleaner.

A still more recent arrangement of the cattle is with their heads facing each other. The advocates of this arrangement argue that the placing of cows with their tails toward each other will occasionally allow manure to splash even across an eight-foot passageway, so fouling the udders of the cattle on the opposite side, and sometimes even fouling a pail of milk.

Such a possibility should, of course, be guarded against in every way. Probably, therefore, for milking cows it is best to have the stock head to head. Young or dry stock may be placed tail to tail, as, with the exception of the one point mentioned, this is the preferable arrangement.

As a concrete barn is absolutely permanent, and as heavy concrete work, such as overhead floors and girders, requires sufficient reinforcing, the expense for specifications laid down by a competent engineer or contractor is money well invested. For any farmer who does not feel justified in such an expense we will be glad to lay out plans for his barn upon being informed as to the number of cattle to be housed, storage room desired, etc.

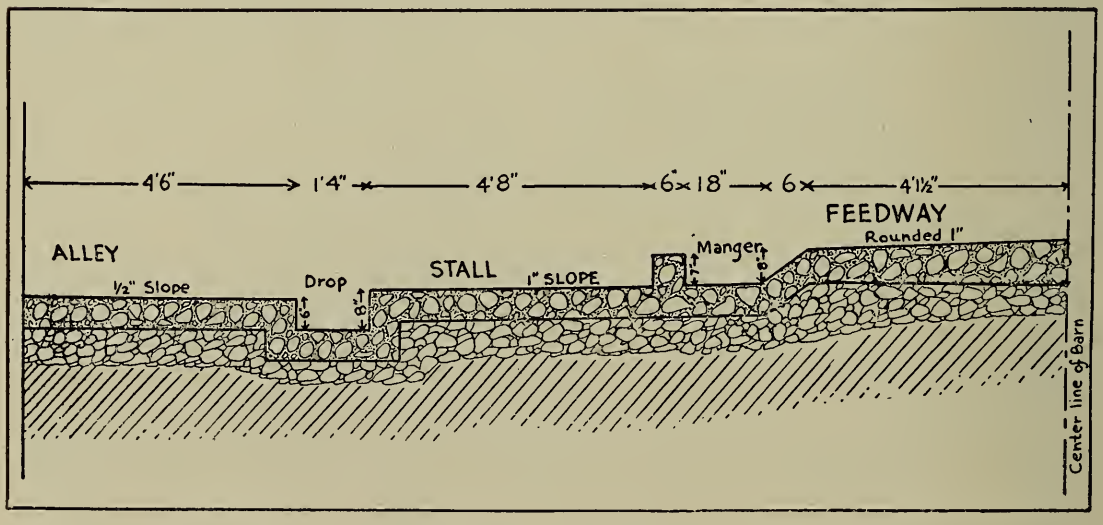
The general directions for constructing the foundations of the barn will be found on page 18. The balance of the directions follow.

Barn Floors.—Floor construction in general has been discussed on page 19. A barn floor varies somewhat, however, from an ordinary floor in that

57. Interior view of barn, showing arrangement of cattle facing each other. Note wide space between heads of facing animals.

it is laid at varying levels, most of these levels having a slight slope one way or the other to render cleaning more easy.

The arrangement of these slopes and levels depends on whether the animals face the interior of the barn or face the windows, and also on the position of the manure pit outside. The levels range in the order named: feedway, manger, stall, alley, and gutter. The slope of the feedways runs



58. Diagram of stock-barn floor construction. As shown previously, either alley or feedway may be center of barn.

from the silo, that of the manger from the feedway to the stall, that of the stall from the manger to the gutter, that of the alley to the exit door, and that of the gutter to the manure pit. The diagram on page 64 gives a typical arrangement of the various levels.

The method of construction follows:

Make the excavation for the barn floor as nearly as possible of the same levels as the finished floor will be, allowing for tamping and a two-inch gravel fill. Before making the gravel fill stake out your various levels, making them true by means of a taut line and carpenter's spirit-level. The slope of the feedway, alley, and gutter should be ⅛ inch to the foot. The stall, which is usually about five feet in depth, should have a slope of from one-half to one inch.

After the forms for the various levels have been staked off, work may be commenced, first laying the feedway at the edge of the barn, then laying the alleyway in the center and working back toward the feedway.

The Feedway.—The level of the feedway should be eight inches above the level of the manger and upper end of the stall. If the excavation work has not taken care of this difference in level, fill in the feedway forms with sufficient gravel to take care of it. A five-foot feedway is ample when the feedway is around the edge of the barn. Some farmers prefer it down the center, when it should be eight feet wide at the least.

The passageway between the rows of cows head to head should always be sufficiently wide to prevent one cow from breathing in the face of another. At least eight feet is required for absolute protection. The feeding trough should also be low, so that there will be a good circulation of air around each animal's head.

Five inches of concrete, laid as described previously, is sufficient.

The Manger.—The feedway should drop with first a gradual and then a sudden drop into the manger, eight inches below it. Give the manger what depth is desired, according to the class of feed, and set the forms for the manger wall between the manger and the stall.

If metal stanchions are to be used, now is the time to place the bottom socket; if wooden stanchions, the attaching bolts. The metal stanchions are by far the more sanitary and satisfactory.

The Stall.—The usual length of the stall from the stanchion to the gutter is four feet eight inches, the width being three feet six inches. Mortises should be left in the floor for the installation of the stall divisions, unless they are ready. If ready, they may be placed in position as the floor is laid.

It will be found convenient in working on the stalls to use side forms, shifting these as the work progresses. By doing this it is easier to maintain the slope to the gutter. The amount of gravel fill necessary should be placed in the forms and the concrete poured. The surface should be finished with a wooden float and brushed with a wire brush.

It is best in laying the stall floor to have it vary from four feet six inches at one end to four feet ten inches at the other, so supplying the proper length for animals of varying sizes.

The Alleyway.—This should not be less than eight feet in width, and may, if so desired, be made even wider. The surface of the alleyway should also be roughened to prevent the cattle from slipping in going to and from their stalls. In addition to its slope toward the door opening into the barnyard,

it should have a slight slope on each side toward the gutter to aid in cleaning the barn.

The Gutters.—A ten-inch gutter is usually considered sufficient. This should have an eight-inch drop from the stall and a six-inch drop from the alleyway, as the latter is on a two-inch lower level than the stalls.

The surface of the gutter should be troweled smooth instead of brushed rough, as the idea in cleansing the stalls is to have all refuse carried away as quickly as may be. To render the gutter as nearly perfectly waterproof as possible, replace 10 per cent. of the cement in the mix with an equal amount of hydrated lime.

For dairy barns of any size the saving of the liquid as well as the solid manure is well worth while. Gutter-traps leading to an outside manure-pit make this possible, and also hasten in carrying out from the barn unnecessary impurities.

As the daily washing out of the barn which is frequent in large establishments greatly dilutes this liquid manure, some dairies have installed a double system of plumbing with reversing tops to the gutter-traps. In this way, during the washing out of the barn, all water can be carried away to the sewage disposal plant.

For the health of the cattle it is best not to wash out the barn oftener than once a day, as otherwise the dampness may injure the stock. When the washing is not done more than once a day, one drainage system is all that is needed, as the amount of water so used will not injure the liquid manure as a fertilizer.

Lighting.—Ample lighting space should be allowed in the walls of the barn. But all windows should have means of darkening them at hand, to keep the snow glare from the animals' eyes in the winter, and provide a cool, dark retreat from flies in summer.

Ventilation.—The theory of ventilation as worked out by Professor F. H. King, of the University of Wisconsin, is by the exhaust system, in which the fresh air enters at the top of the barn, while the vitiated air, which is heavier, is exhausted at the bottom. This provides a circulation of air which insures proper ventilation.

The so-called "sweating" and dampness of many barns are not caused by the materials of which these barns are constructed, but by the fact that in cold weather the amount of air necessary properly to carry off the exhalations from the animals chills the barn. To prevent this chilling the farmer closes his ventilators, so preventing the carrying off of these exhalations and causing their condensation as moisture on the walls of the barn.

It is, therefore, best, when possible, to provide artificial heat in extremely cold climates, so that ample ventilation may be had, together with sufficient warmth for health.

The best method of ventilation is by means of a duct running from the floor up above the roof, the higher above the roof the better. There should be one of these ducts for every 25 head of cattle, the interior of the duct being figured at four square feet for every 20 cows, assuming the duct to be at least 30 feet high.

This duct must be air-tight and provided with two registers, one about six inches above the floor to be used in cold weather, the second about six inches below the ceiling to be used in warm weather..

59. Concrete manure pit, showing sump well in far corner. Construction plan for such a pit is shown on next page.

Fresh air may be provided for either by inlet ducts, or simply by the ordinary windows.

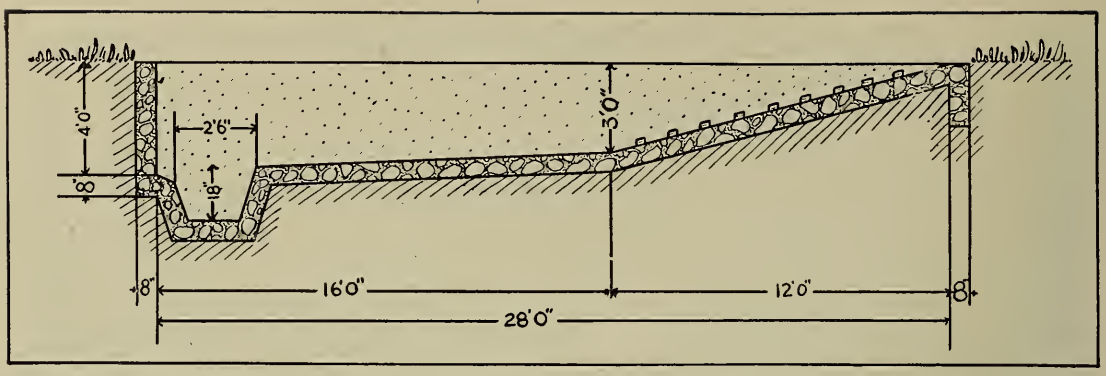
Manure Pits.—The value of manure as a fertilizer is too well known to need mention, as well as the fact that the greater part of the manure's value is wasted from being piled in the open or stored in sheds. When piled in the open, manure deteriorates in fertilizing properties and is washed away by the rain; when stored in sheds, "firing" through lack of moisture destroys it.

The logical remedy for both these features is the concrete manure pit. Government experts have estimated that one load of manure stored in a concrete pit is worth from one and a half to two loads of manure cared for in the ordinary way. Add to this the fact that the amount that makes a load when stored in a pit would be considerably less than a load stored in the ordinary way. The waterproof nature of a concrete pit preserves the liquid manure that formerly ran to waste. By having a sump hole at one end of the pit, this liquid can be pumped out when needed for the garden or truck patch.

For barns of any extent it is best to have separate pits for the liquid and the solid manure.

The majority of farmers find that the shallow pit, though it holds less than the deep one, is more convenient and practical. This is especially true when the manure is hauled to the fields frequently.

The sectional drawing shown on the next page, together with the instruction given in the fore part of the book, are sufficient for the construction of the pit. Remember, however, to place cleats on the



60. Diagram of manure-pit construction, sump well at left hand of illustration. The cleats on the slope are to provide foothold for horses when necessary.

sloping side of the pit to give teams a foothold. A roof may be added to the pit if desired.

Feeding Floors.—Feeding floors may be placed directly adjoining the barn, or by themselves in some field. The advantage of following the former method is that gutters may be laid to the manure pit to save all manure washings. Also in bad weather the cattle may be put out or in the barn at a moment's notice.

The floor should rest on a 12-inch foundation of crushed stone or gravel, its full four- to six-inch thickness projecting above ground. It should have a slight slope toward its gutters, so that water will not collect on it. Around it an apron 12 inches wide and 18 inches deep should be constructed to pre-

61. A concrete feeding floor that saves both food and stock. This floor can be thoroughly and quickly cleaned.

62. Small concrete feeding floor. It also affords an easy entrance to barn in bad weather. This is a good investment for both comfort and economy.

vent hog wallows from undermining the floor, frost getting below, or rats making their nests beneath it.

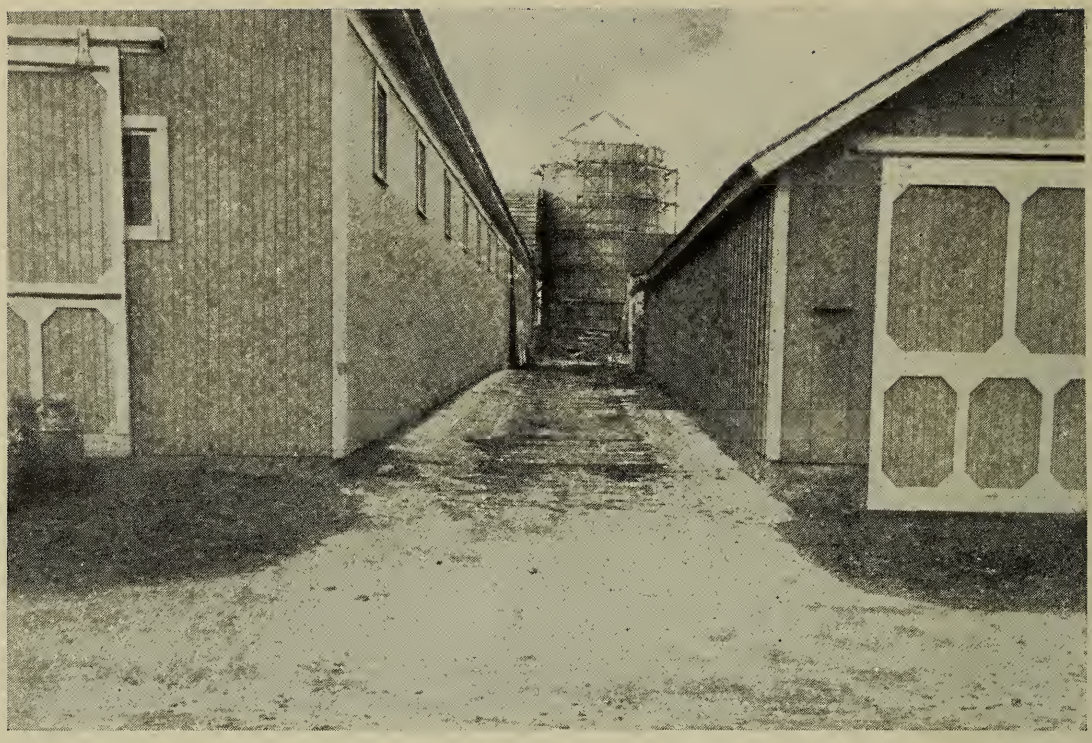
A floor 24 by 36 feet has been figured as sufficiently large to accommodate 50 hogs. The floor should be laid in segments after the method outlined on page 20. A rough finish with wooden float or brush will be found to be the best.

Dipping Vats or Tanks.—With the steadily decreasing size of our cattle ranges, and consequently increasing crowding of them, the insect enemies of stock have increased at an appalling rate. Young stock are especially subject to these pests, and should be guarded particularly through the growing period so that their strength will not be sapped. No domestic animal has the natural means of freeing itself from these parasites, but must depend on its owner for proper protection.

The best way to combat insects and skin diseases has been found to be by submerging the animal in a fluid which will destroy the insect without injuring the animal. Dipping has passed the stage of experimentation and is now one of the most important factors in the welfare of any herd or flock.

A concrete dipping tank can be easily and inexpensively built, and will far outlast one of any other material. It should be built on a high, well-drained piece of land where the earth is firm. If possible, a drain-pipe should be laid from the bottom of the tank to the surface of the ground, some distance away.

Directions.—Dig a pit of the desired size, covering the bottom with a two-inch layer of well-tamped cinders or gravel. Make the forms about 16 inches narrower than the pit, and fill with a thoroughly wet mixture, tamping well as the forms are filled. If possible, fill all four sides at the same time so there will be no cracks or weak joints at the corners. The floor of the pit should be laid as soon after the walls as possible. Two weeks should be allowed for the cement to set, or a still longer time if the ground is at all damp.



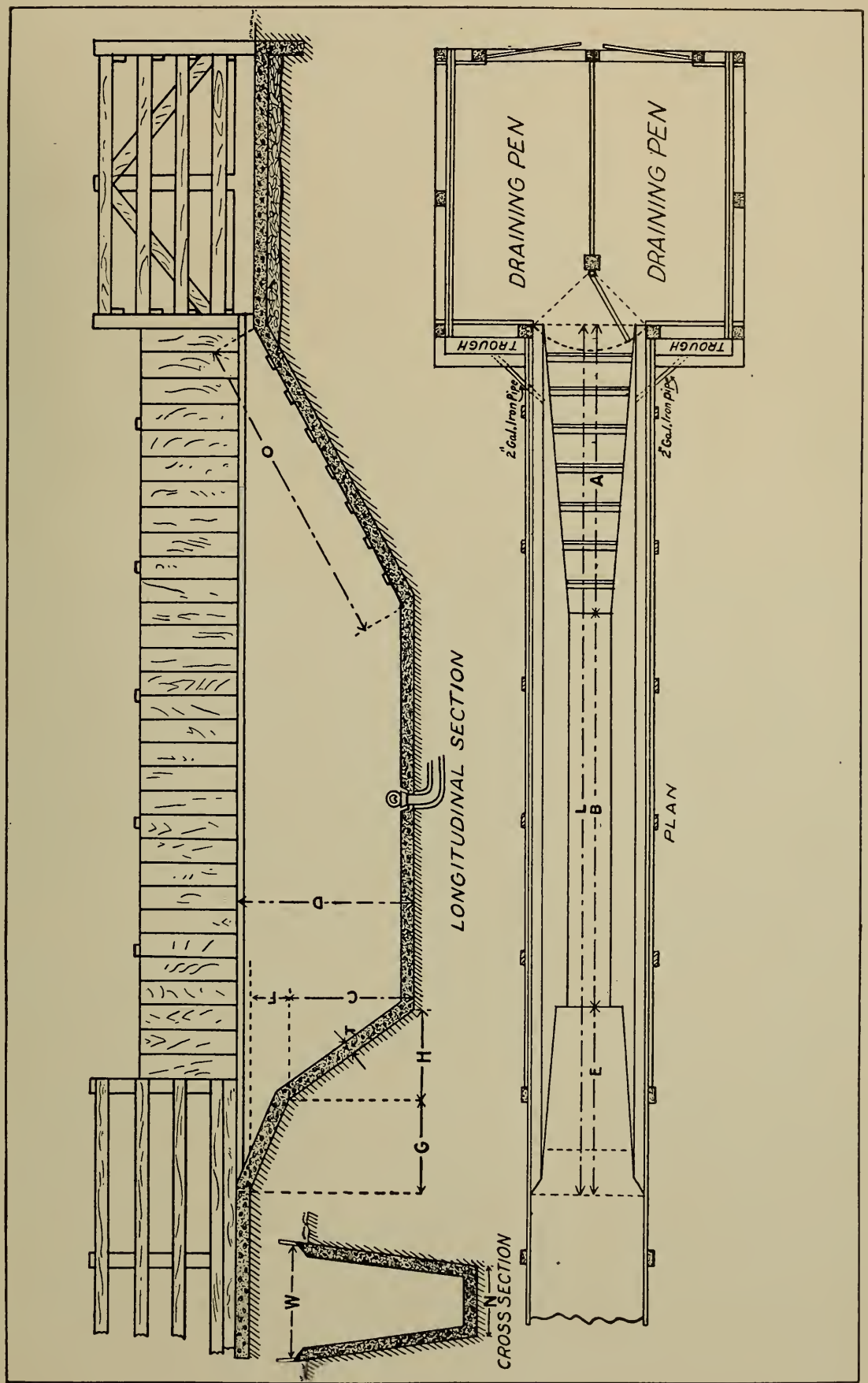
63. Concrete alleyway and feeding floor. A slight slope toward the center keeps the water away from the foundations.

On the entering side should be a slide, with sufficient slant to shoot the animal into the pit, but gradual enough to keep the animal from dropping the entire depth of the pit. The tank should be narrow enough to prevent the animal from turning around, long enough to keep it in the tank at least two minutes, and deep enough to force it to swim and submerge the entire body. The slope at the end where the animal leaves the tank should have a gentle incline and be provided with cleats to give the animal a good footing. It is well to cover the tank when finished with a coat of half cement and half sand, to make it completely watertight.

One dipping of an infected animal will kill the insects, but not their eggs. With the average parasite a second dipping should be made in a week or ten days, to kill the insects that have hatched since the first dipping. Remember that dipping is a cure, not a preventive. If animals are allowed to go to a place that is infected, or to mix with other animals that are infected, the trouble may occur again. It is best to dip every ten days animals that show any indication of trouble, in this way completely exterminating all parasites.

The sketch and table given herewith are reproduced from Bulletin No. 481 of the United States Department of Agriculture.

Care of Concrete Dipping Vats.—Concrete dipping vats need no care other than covering them up or so inclosing them that persons and animals cannot accidentally fall into them. Concrete is not injured by moisture. It will not rot or rust out. It requires no repairs. A concrete dipping vat, built of good materials and properly constructed, will always be ready for use and lasts forever.



64. Details of construction of a dipping vat.

Dimensions of Ground Pits for Dipping Vats.—The dimensions of ground pits for dipping vats are shown in the following table, the letters at the heads of each column corresponding to those shown in figure on preceding page:

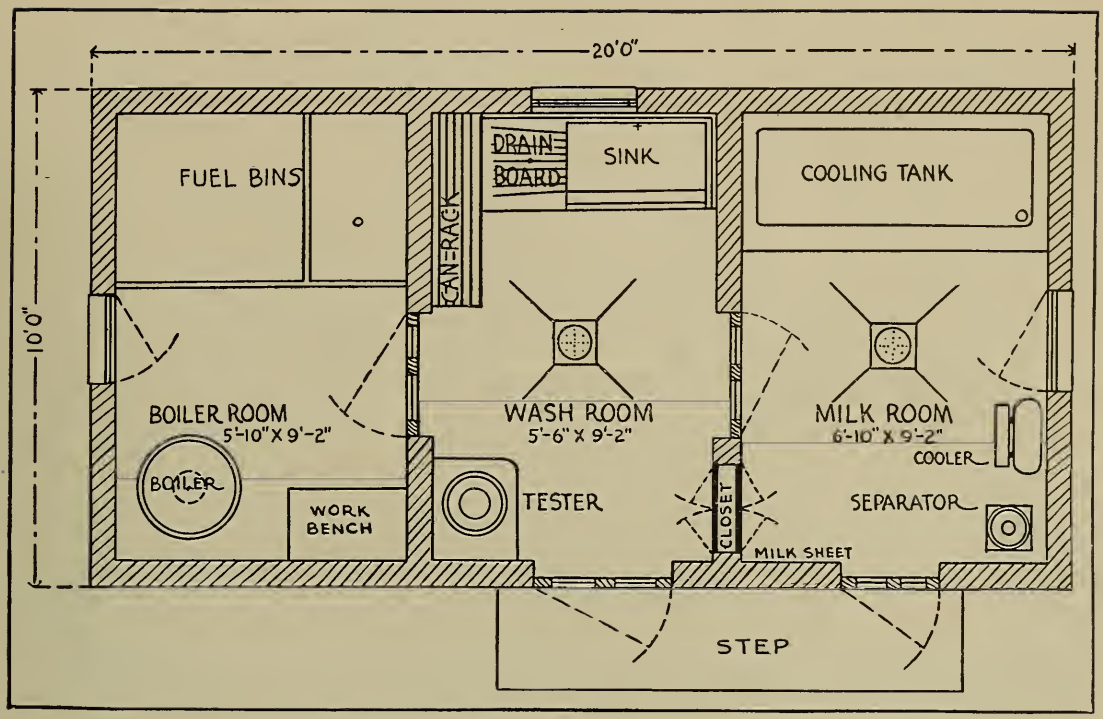
Kind	W		N		D		L		E		B		A		G	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Horses	5	10	3	4	8	8	55	0	7	6	31	0	16	6	3	9
Cattle	5	4	3	4	7	8	51	0	6	8	31	0	13	4	3	4
Sheep	3	4	2	4	5	8	46	0	5	0	31	0	10	0	2	6
Hogs	3	4	2	4	5	8	36	0	5	0	31	0	10	0	2	6

	F		H		C		O		T		Cement	Sand	Rock
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Barrels	Cu. yds.	Cu. yds.
Horses	2	2	3	9	3	9	18	7	0	8	43	13	26
Cattle	1	11	3	4	3	4	15	4	0	8	37	11	22
Sheep	1	5	2	6	2	6	11	6	0	8	24	7	14
Hogs	1	5	2	6	2	6	11	6	0	8	19	5½	11

Draining Pens.—At the leaving end of the vat lay out the two dripping pens with their division fence on a line with the center line of the vat, so that the gate at the dipping vat, hung to this fence, may close either pen, when it is full, and allow the animals from the vat to pass into the empty pen. Use concrete posts for the fences, as they will require no replacing. Excavate for the drainage foundation, set the posts, and build a six-inch concrete floor according to the directions given under "Feeding Floors." Slope the floors one-fourth inch to each foot in length or width, so that the dip running off the animals will be saved and drained back to the vat. Corrugate or groove the floor to the depth of one-half inch every eight inches in one direction. During the construction of the floor, mold around the outside a concrete curb, six inches above the floor and four inches wide. Where the dip from the floor empties into the vat, place a removable wire screen or strainer to keep the droppings and wool tags out of the vat.

Figure on preceding page shows a plan for draining the dip from the draining pens back to the vat, which is much more convenient than strainers and permits the floors of the drain pens to be made with a very slight fall, so keeping the animals from crowding to the rear of the drain pens after being dipped.

A shallow trough, 8 to 10 inches deep and 8 inches wide, is made from the side of the incline from the vat along the edge of the drain pen, or on both sides of the incline in the case of a double pen. At any convenient point, insert a 2-inch iron pipe into the trough, 2 inches below the top of the trough, and run this pipe to the vat. The dip drained from the animals will run to the trough, the solid matter washed into the trough will settle to the bottom, and the liquid will drain through the pipe back into the vat. As solid matter accumulates it can be shoveled out of the trough. By making a hole in the far end of the trough and inserting a plug, rain water can be drained away from the vat when it is not in use. This also affords an easy method of cleansing it.



65. Diagram of model dairy house from design in Government Bulletin. This house will take care of a fair-sized herd.

Milk or Dairy House.—Milk strained in the barn, or even allowed to stand there any length of time, absorbs stable odors and is apt to be contaminated by germs. The best practice is to remove to the dairy house the milk from each cow as soon as it is milked. Here the straining and cooling, which should be done promptly, can be attended to at once.

Although the milk-house should be sufficiently far from the barn to be free from all chance of contamination, it should be near enough to be reached quickly. A narrow concrete walk will make the pathway much easier in wet weather. It should be on a well-drained spot, and have its own drainage also carried well away from the building. If there is any slope between the dairy house and the barn, it should be toward the latter. The interior should be so laid out that the utensils need not be washed in the same room in which the milk is cooled, strained, or stored. Thorough cleanliness is essential. Consequently there must be no unnecessary ledges or rough surfaces on the interior of the building on which dust is apt to collect.

Windows are essential to let in the sunlight. They must be well screened in summer, however. There must also be a plentiful supply of cold running water for cooling the milk, as well as a good supply of hot water for cleaning all the utensils.

If the milk-house be of concrete, there will be no crevices between walls and floor to collect dirt. The whole interior can be scrubbed out as often as is desired. The floor plan shown here gives a model arrangement suggested by the United States Department of Agriculture.

The method of construction may be similar to that already described on pages 12 to 15 and 51.

66 and 67. Two types of concrete dairy houses. The interiors are smooth and free from every possible ledge or crevice in which dust or germs might lodge.

68. Milk-cooling tank in modern dairy establishment—construction of same shown on next page. A bracket overhead would simplify handling of cans.

Milk-Cooling Tanks.—Often a farmer's herd of cattle is not large enough to warrant the erection of a special building to care for the milk. Yet the milk should be thoroughly cooled before bottling and delivery. The solution of this difficulty is a concrete cooling tank beside his bottling table.

Patent tops can now be obtained which permit the milk-can to be completely submerged and yet give the animal odors of the milk a free chance to escape through a small air-space into the water. Tanks, therefore, should be built sufficiently deep to allow complete submersion of the can. The tank should be large enough to allow the cooling of more than one can at a time.

The wall of the tank need not be very thick, as the tank will be indoors and not subject to freezing. It should be well reinforced with wire mesh in all four walls and the bottom, and should have a steel rod in each corner. The inlet pipe and outlet should be placed in position before the concrete is poured. The concrete itself should be of a 1:2:4 mixture, thoroughly mixed and well wet. The inner form can be removed as soon as the concrete is thoroughly set. The tank should be covered, as soon as the forms are removed, with cloth or straw kept thoroughly wet for a period of at least a week, when it may be filled with water.

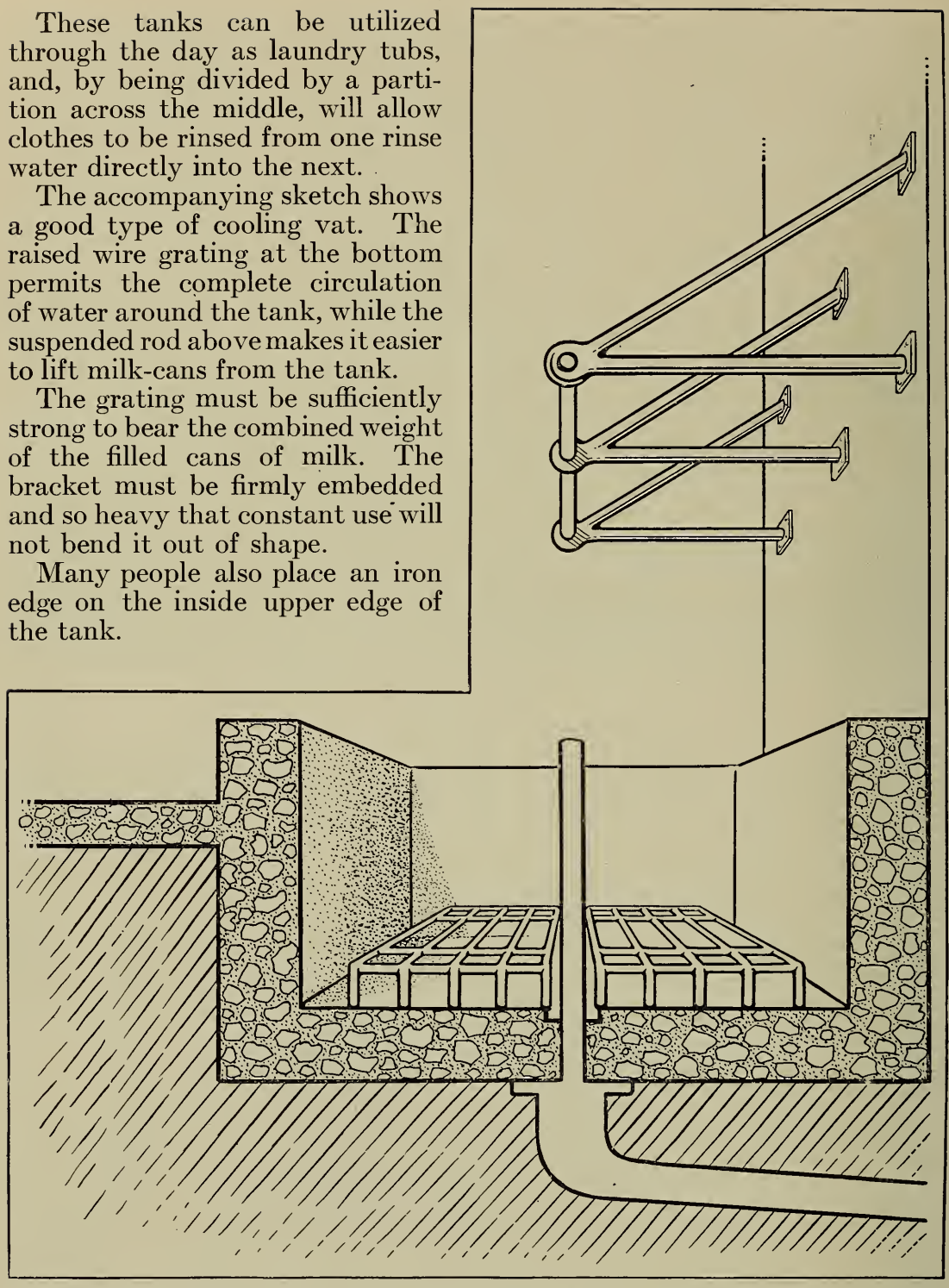
The advantages of having this tank built of concrete rather than metal, enamelware, or wood are that it will not rust like metal, chip off when knocked, as enamel, nor rot like wood. A concrete tank would never need polishing, reënameling, or painting, but in ten years would look as well as when first built and would be actually stronger.

These tanks can be utilized through the day as laundry tubs, and, by being divided by a partition across the middle, will allow clothes to be rinsed from one rinse water directly into the next.

The accompanying sketch shows a good type of cooling vat. The raised wire grating at the bottom permits the complete circulation of water around the tank, while the suspended rod above makes it easier to lift milk-cans from the tank.

The grating must be sufficiently strong to bear the combined weight of the filled cans of milk. The bracket must be firmly embedded and so heavy that constant use will not bend it out of shape.

Many people also place an iron edge on the inside upper edge of the tank.



69. The grill in this tank permits complete circulation of water. The bracket above makes it easier to lift out cans.

70. The interior walls of this trough slope inward toward the base, to relieve the pressure of ice in winter.

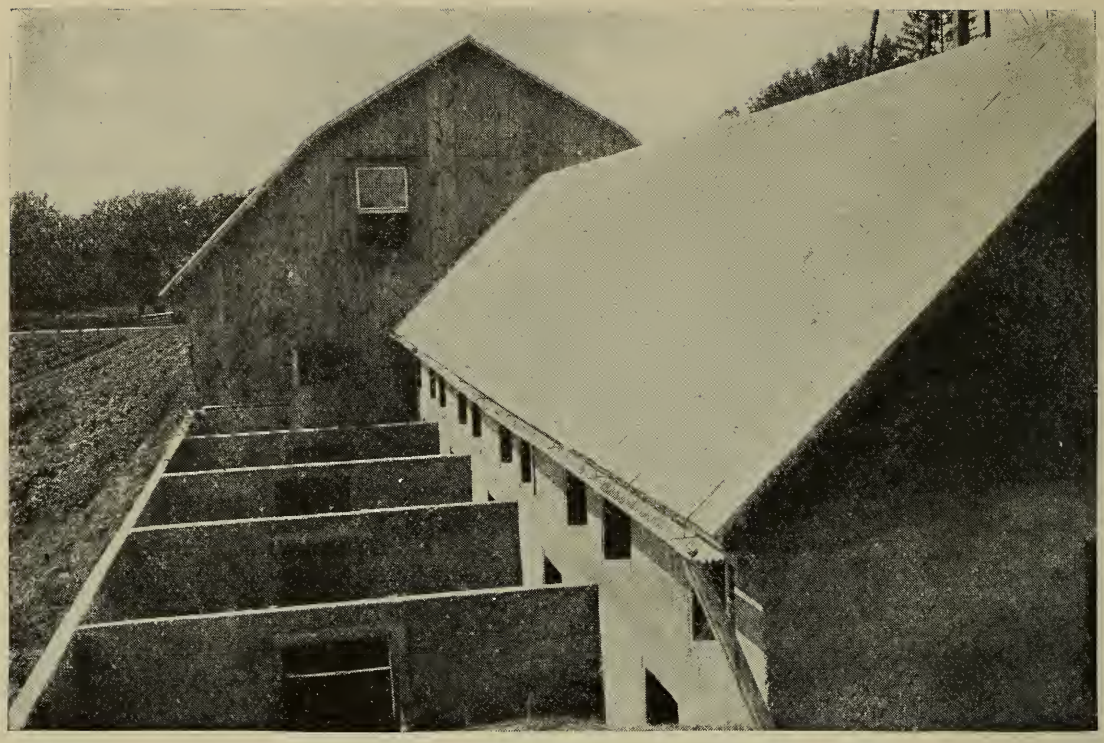
Watering Troughs.—The size and shape of watering troughs depend on the animals for which they are intended. Horses and cows naturally require different sized troughs from sheep and hogs.

The concrete watering trough will not rot, rust, or leak. It will last indefinitely and never need repairs. It is easily cleaned, and has a tendency to keep the water pure and sweet. Watering troughs are usually either circular or oblong in shape. The circular ones are used principally in open fields, to allow approach on all sides. The best ones have a concrete flooring around them, so that the animals will not tramp the ground into mudholes. The oblong troughs are more convenient around barns and stables, as they take up less space for their capacity.

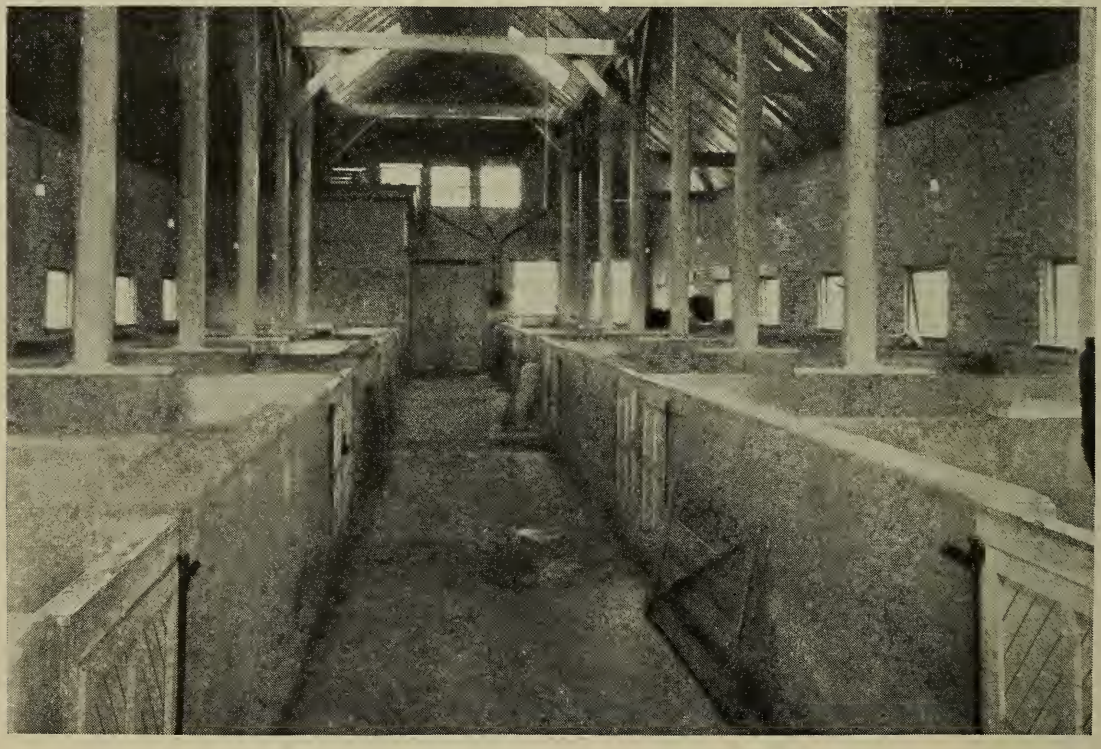
No matter what kind of trough you build, be sure, first of all, that the foundation is level, solid, and well drained. The inside walls should be sloping, with the greatest width at the top, so that in case the water freezes in the winter the pressure will not be too great against the sides. Hot-water pipes can be laid through the tank to keep the water from freezing. The foundation should extend below the frost-line, though the floor of the tank need not.

For a circular tank the simplest forms can be made of strips of sheet iron held in place by circular-sawed wooden braces. For an oblong tank, the forms can be made in the shape of two boxes without top or bottom, one fitting inside the other. The inner forms of both the circular and the oblong tank should be smaller at the bottom than at the top.

The tank should be reinforced next the inner surface, and should never be made of a weaker mix than 1:1½:3. After twenty-four hours of setting the inner surface should be washed with a mixture of cement and water,



71 and **72.** To-day the ideal hog's home is one of cleanliness and good health. Concrete, as used in the hog house illustrated, makes this possible.



about the consistence of thick cream. When this has dried, fill the tank with water, but do not remove the outer form for a week or more. The pipes for inflow and drainage should be placed before the concrete is poured. Never build a watering trough when freezing weather is near.

Hog Houses.—The hog, from simply being a convenient method of getting rid of refuse, has come to be one of the most profitable as well as most carefully handled branches of modern farming. But so great has been the chance of loss from cholera and other sicknesses that many farmers are not making as much in this way as they might. Protection from cold and wet and a good bed are essential. Expert hog raisers who have hog houses combining these two necessities can have their sows farrowing about March 1st, but without good houses this is impossible. Sunshine and ventilation are needed for healthy hogs.

Concrete is best adapted for making a warm, dry, well-ventilated, free-from-drafts hog house. Lay out the house the size desired. Excavate below the frost-line, and place the forms for the walls. If the ground is firm, no outside form is necessary below ground. Make the wall from four to six inches, according to the climate. It is best to have the floor of the pen also of concrete. A 1:2:4 mixture is best for the hog house and pen floor.

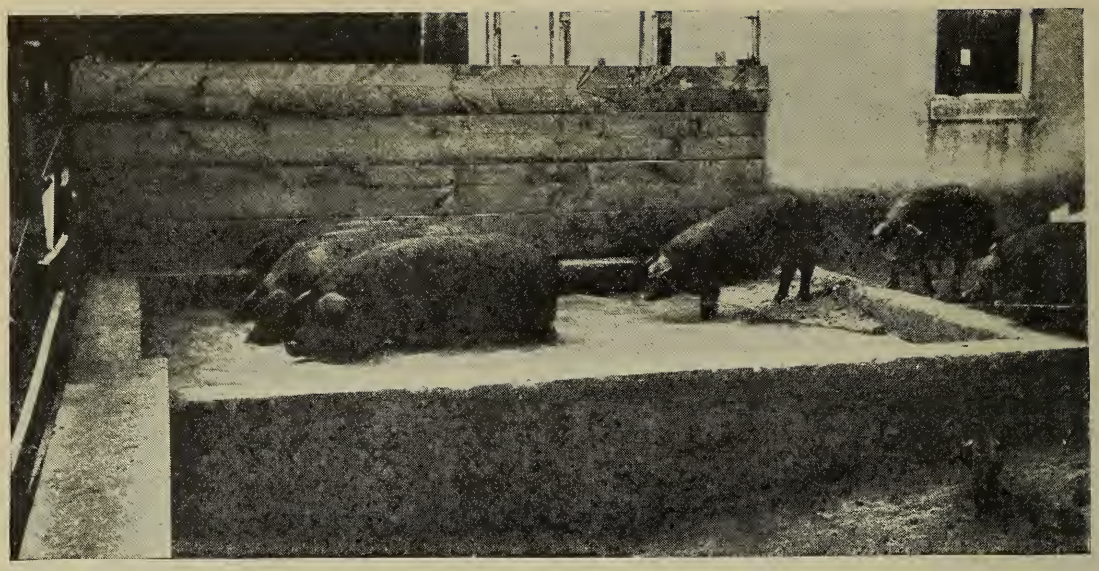
The method of construction is given in the front part of this book.

Hog Wallows.—A hog wallow is an absolute necessity because—(1) It keeps the hogs clean and free from cholera; (2) because it prevents other diseases, such as mange, scurfy skin, etc.; (3) because it is good economy to provide for health and against disease.

The wallow should be located near a water-supply, but a level spot should be chosen, rather than one where surface water will drain in and fill with mud. It is not necessary to build the wallow in the hog yards. When they are near an orchard, it is a good plan to place them in a corner where the pigs are kept in the spring and summer. The important thing is to place it where it will always be available to the pigs in midsummer, when it is most needed.

Directions.—To build a wallow 6 by 8 feet on the bottom, 10 feet long at top, make a frame of 2- by 4-inch pieces of the following outside dimensions: Length, 10 feet 8 inches; width, 7 feet. This allows 4 inches for each side wall, 4 inches for one end wall, and 2 feet for a sloping end. This incline enables pigs to get in and out of the wallow easily, and is also a convenience in cleaning out.

Place this frame upon the exact position the wallow is to occupy and level it. Use a carpenter's level to do this; don't guess at it. Drive stakes at each corner outside, and nail frame to hold it in place. Dig a pit inside the frame, making it at least 18 inches deep. If the soil is loose, it will be better to make the depth 20 inches, so that a thick bed or foundation may be used. After the pit has been completed and all loose dirt thrown out, cover the bottom with a layer of cinders or gravel. If the pit was made 18 inches deep, make the bed four inches in depth, but, as already stated, it will be better to have this six inches if the soil is not firm, which means that the pit should be 20 inches deep. Pack this bed well as it is laid, and thus avoid trouble later on from settling and cracking of the cement. You are ready now for the first cement work. In a shallow mortar box mix Portland cement with clean sand and wet down to proper consistence. Cut three



73. The hog wallow can be kept clean and healthy if made of concrete. Drainage facilities should be provided for cleansing pit.

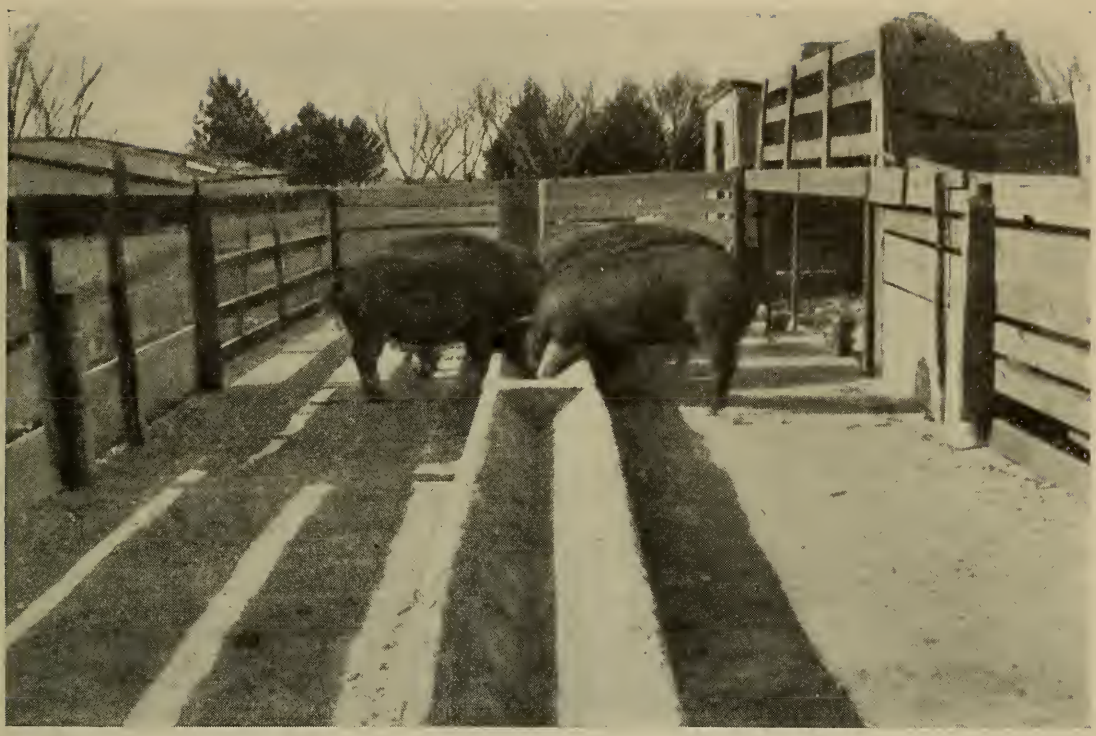
strips of inch board four inches wide and six feet eight inches long. Place one of these on edge, crosswise, in the middle of the wallow, and one at each end. These strips serve to indicate thickness floor is to be built up, and also make a convenient base for leveling. Lay the sloping end and one-half of the floor first by placing a four-inch layer of cement directly upon the bed, working it on with a trowel and leveling as above directed. Use a straight-edge board to make a series of grooves in the sloping end, so that hogs may have a foothold when going in and coming out of the wallow. The cross strip at this end should be taken out at the last moment and its place filled with cement. The other end may now be laid and leveled in the same way, the two remaining cross-strips removed, and the floor completed.

While laying the floor, it is well to bury in it a strip of woven-wire fence or a half-dozen strands of barbed wire which will serve to bind the entire mass together.

In building the walls, cut two ten-inch planks nine feet eight inches long, and slope the ends, also two cross-pieces five feet eight inches of the same material. You will also need two or three lighter cross-pieces for the top. Fasten these together. Now place this frame upon the cement floor, with the outside edges exactly four inches from inside edges of the temporary frame. Lay two or three strands of wire in these four-inch spaces, and fill them with cement, tamping it on to insure a compact wall. Make the top smooth, and round the inside edge so that it will not injure animals that come in contact with it.

Cover the entire wallow with loose boards or canvas to protect it until the cement is thoroughly "set." After this it only remains to remove the timbers and wash the walls and bottom with pure cement as a safeguard against leaks. The wallow is then ready for use as soon as this last coat is hard.

Feeding Troughs.—Concrete feeding troughs for hogs are a great aid in keeping the food from being spilled over the ground or trampled by the hogs and so wasted. When built in connection with a concrete floor, they can



74. This concrete feeding trough is permanent and cannot be upset. It can be easily built with home-made forms.

be made part of the floor, so doing away with all chance of being overturned. The trough should have a slope of two or more inches, and be spaced off with removable partitions, so that these can be lifted and the whole trough sluiced out with water to clean it. The forms for the trough can be made of ordinary boards of any desired size. It is simpler, of course, to construct the trough by itself than to build it as part of the feeding floor.

Wire netting makes very good reinforcing as an additional precaution against freezing.

If the trough is not built as part of the floor, a simple rest can be made with two slabs of concrete with a V-shaped hole in each. One of these at each end is usually sufficient to support the trough. To protect the trough from being cracked by any blow on its edge, steel rods should be run one inch from the edge along each side.

Concrete Comfort for Poultry

Of all stock on the average farm or country place, there is probably none which shows the effect of poor attention so rapidly as does poultry. On the other hand, with the possible exception of hogs, there is no stock which, when properly cared for, gives such a high percentage of profit. And yet the rules which govern the success or failure of this end of your farm investment are so simple that there is really no excuse for not having a large profit from your poultry.

Summed up briefly, the essentials are: clean and dry housing for your birds, warm in winter and cool in summer, plenty of exercise, and enough, not too much, of the right sort of feed. Uncleanness means the sapping of your flock's vitality and is the sure forerunner of disease. Properly constructed concrete houses will protect poultry from changing weather conditions and from insect parasites, and also enable the owner to easily cleanse and keep clean the house. Concrete drinking fountains keep the drinking-water pure and cool for the birds. Concrete hen's nests are free from vermin and easily cleaned. Concrete feeding troughs keep whatever sloppy food is fed your birds from being spilled on the ground and wasted. Concrete ponds give your water fowls a chance to obtain such exercise as is natural for them, and so enables them to reach their fullest development.

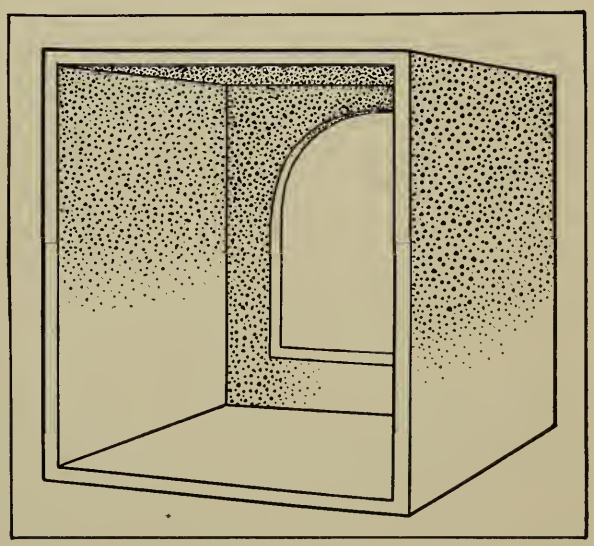
Poultry Houses.—One objection that has been advanced against concrete poultry houses is that, if improperly built, they are sometimes damp, due to the absorption of water by porous concrete. Care should be taken that the concrete be so mixed as to be dense, and not porous. One method of securing this result is to replace about 10 per cent. of the cement with an equal quantity of hydrated lime. This gives a denser and more waterproof concrete.

The house should be located on well-drained, porous soil. If surface drainage is not secured naturally, it is best to insure it by grading. A gentle slope to the south or southeast is best. The house also should face in this direction, to secure the greatest amount of sunlight. The windows should be large, for this same purpose, and also to provide as much fresh air as possible. Except in extreme cold weather they should always be open, though covered through rainy and stormy weather with a light cloth shutter. Occasionally this cloth shutter is in an entirely separate opening from the windows themselves, as shown in the block-house illustrated herewith. The windows should be hinged at the top so as to swing back into the building and hook to the roof when open. One class of poultry house with a low slanting roof has the windows on the south side of the roof when open. The only objection to this type is that in winter snow may cover the windows and darken the house. It is also difficult to keep this type of window weathertight.

75. An ideal poultry house is warm and dry in winter, and easily opened to sun and air in summer.

The best and most modern type of poultry house is that built on the unit plan, that is, with separate buildings or sections for each flock of 25 to 100 birds. The width of the house seldom exceeds 12 feet, the length of each unit or section being about 16 feet. In localities where the flock is housed during much of the winter, half of each of these units should be fitted for an exercise or scratching pen, larger ventilation space being provided than for the roosting quarters, and a box being filled to a depth of an inch or more with hay or straw in which the dry feed, such as wheat or corn, is scattered. A second box should be provided in this scratching pen filled with sifted ash or dry dirt, in which the poultry can dust themselves. The dirt or ash should be replaced about once a month with clean material.

The construction of the house may be monolithic, block, or stucco. One of the last two is usually used as simplest to handle. If stucco is used, it should be on expanded metal lath, and, in cold climates, be of hollow wall construction, as this type keeps warmest and is



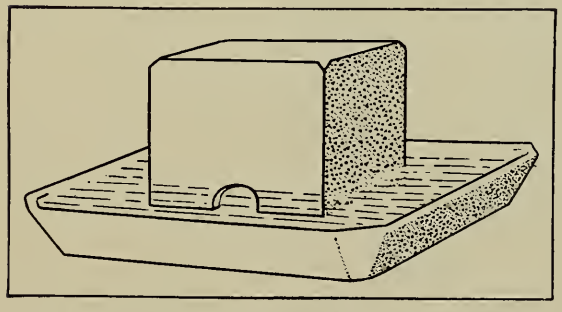
76. The back of this nest is a hinged door that permits easy removal of eggs. Entrance faces toward wall of poultry house.

77. A muslin curtain above the windows gives constant access to fresh air. The windows themselves hinge in against the roof.

most moisture-proof. The foundation should be a thoroughly drained one of coarse gravel. Prepared roofing is preferable to wooden shingles, as the roof need not then be so steep. Cement shingles are still better for resisting the weather and are far more permanent. The owner must decide for himself, however, whether the additional cost is justified.

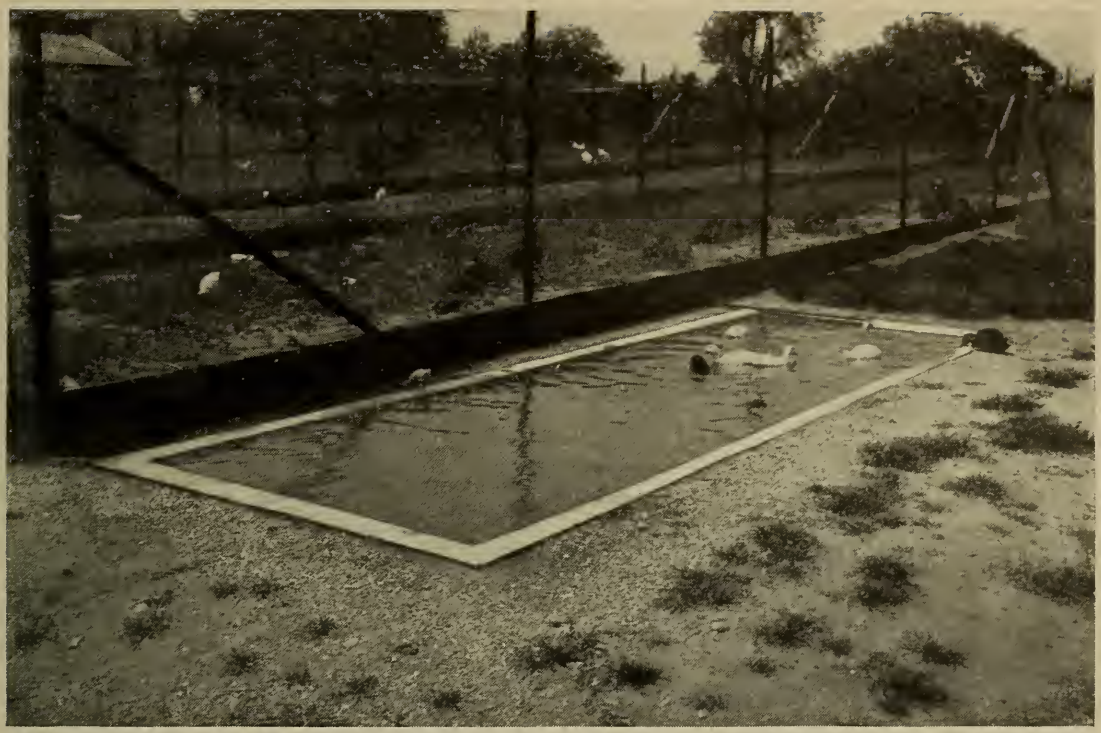
Although the dropping board and roost supports should be of concrete, the roosts themselves should be of wood, as this is easiest on the chicken's feet. The roosts should not be too large, the size varying slightly with the size of the breed, and should have beveled edges. They should be removed and stood in the sun at least every third day, being sprayed with some disinfectant once a month. A small runway up to the roosts is advisable, particularly for the heavier breeds, such as the Brahmas and Cochins.

Poultry Nests.—As poultry generally prefer dark nests, these may be located below the dropping board, but should be so arranged that they are easily accessible for egg gathering, a convenient method being to have them with the opening for the poultry facing the wall, but the back hinged so that they may be quickly emptied from the front of the board. By making these nests of concrete, no cracks or crevices are left in which vermin can be harbored. The size of the nests varies from 12 by 12 by 15 inches to 14 by 14 by 18 inches, according to the size of the breed.



78. This fountain consists of two boxes, one inverted above the other.

Drinking Fountains.—Simple and durable drinking fountains may be made of concrete of the style shown in the illustration. The form should be well made, as it will last practically forever. Such fountains keep the water pure and cool, and are not so apt to be broken through the winter

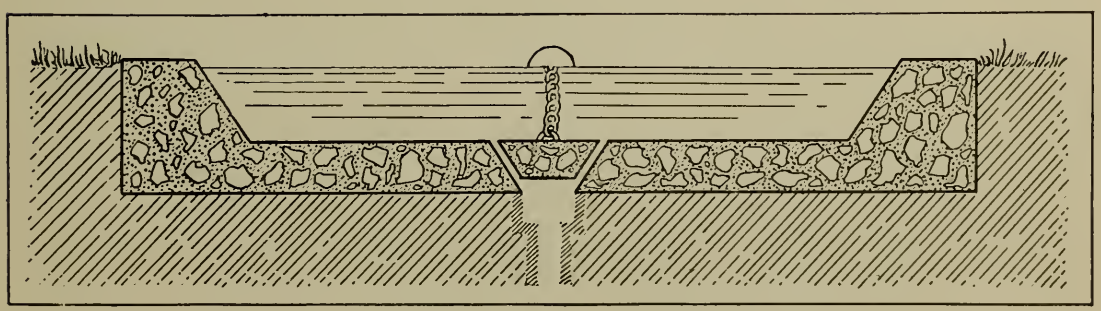


79. Helping nature out. The concrete pond keeps water fowl healthy, and can be easily constructed.

as ordinary porcelain ones, although those in the yard should be emptied once freezing weather starts.

For such food as cannot be fed in the scratching pen, small feeding troughs will prove a saving of food and also a means of keeping the house and yard clean. These are also simple of construction and permanent if made of concrete.

Aquatic fowl, such as ducks and geese, thrive best if they have some opportunity of swimming, as this is their natural method of exercise and keeping themselves clean. Some method of emptying the pond, either by drainage or siphoning, must be provided to change the water whenever it becomes foul. A small float attached by a chain to the plug closing the drain pipe is the simplest method.



80. Construction plan of pond shown above. After completion a shallow fill of sand or gravel may be put in tank if desired.

Other Construction Work on or Around the Farm

THE FARMER must adapt himself, as one in no other occupation does, to meet special and unusual conditions. In the city the rules which govern construction work are more or less stable. On the farm all such rules are subject to change, and even entire discard, both on account of the variety of structures to be erected, and the special conditions that govern their erection.

The drainage of a farm is one of the problems to be solved by the farmer. Even after his sewage disposal has been attended to, the excess water which a heavy rain may cause must be taken care of in some way. Otherwise the mud-holes which form in his roadways and mire his wagons, and the jolting ditches between his fields and these roadways, will continue to take their tax of wasted effort, lost time, and repair expense.

Culverts.—A system of culverts connecting with some central drainage system is the best method of correcting this evil. Such culverts are simple of construction, permanent, and quite economical.

Ordinary planks may be utilized for the forms. The quantity of water to be taken care of determines the size of the culvert. For a culvert of 18-inch width or less no reinforcing is required ordinarily. When the opening is larger than this, however, it becomes essential to have reinforcing, both in arched form, over the opening and running lengthwise of the culvert.

For very small culverts inside forms can be dispensed with by using terra-cotta pipe as the form and leaving it in position after the job is completed.

Larger culverts demand more care in their construction.

The mixture should be a 1:2:4 one for the reinforced part of the structure, a 1:2½:5 one for the walls, and a 1:3:6 mixture for the footings.

Unless several culverts are to be built, the amount of work would hardly justify the expense of a mixer, although this will make the work of construction much easier and quicker, as well as make the concrete of more uniform strength.

Immediately after mixing, the concrete should be placed in position, in layers of not over six inches in thickness, and tamped until water flushes to the surface. Concrete should never be deposited in running water, as the fine particles of cement would be washed away before they had a chance to crystallize. When deposited in still water, a chute should be used.

Forms should be of selected lumber, of even thickness, free from flaws of any kind. They should be built true to dimensions and thoroughly braced to prevent displacement under the weight of concrete. They should be thoroughly wet inside before the concrete is placed in them. Forms for the abutment and walls should not be removed for from one to three days, while

81. Method of placing reinforcing in small culvert or bridge, showing lateral and longitudinal reinforcing. Spacing and size depend on size of structure.

forms supporting the reinforced superstructure should be kept in place for ten days, and in cold and wet weather for twice this time.

The edges of the forms should be well worked with a narrow flat spade as the concrete is placed, so insuring a strong, smooth surface. If any cavities

82. Commercial forms for building culverts. These forms are collapsible, rendering them easy to remove.

83. The combination of an iron railing with this concrete structure possibly saved money—but some day the railing must be replaced.

appear on the removal of the forms, they should be filled at once with a mix of the same proportions as the portion to be patched.

There are a number of good metal forms now on the market. These have the advantage over the wooden ones of being easier to place, simpler to handle, and more certain to give good results.

The reinforcing should be of steel that can be easily bent into the proper shapes while cold. It should be free from rust, grease, paint, or dirt, to insure a perfect bond between the bars and the concrete. For an ordinary size bridge or culvert a strength of at least 16,000 pounds per square inch should be required, with a safety factor of 4.

Box culverts endure the greatest strain on the top slab unless the height of the sides exceeds the length of the slab. It is safe to say, therefore, that reinforcing sufficient for this slab is sufficient for the bottom and each of the sides. Special conditions sometimes make it desirable to add a projecting apron to the base, as when deep freezing occurs or when the bed of the stream is likely to erode.

Railings are not usual on culverts, except when very large. Even the smallest bridge, however, is incomplete without one. Often the simplest railings are the more effective, though very complicated designs can be worked out with concrete. The simplest designs are the easiest to construct and offer the least chance for disfigurement. They may be solid or paneled walls.

Small Bridges.—Occasionally, to cross some ravine or gully, it is desirable to construct a small bridge, although impossible to obtain the services of a contractor. When this is the situation, the owner may, if he so desires, attempt the work himself, although he should on no account do this unless he has had previous experience in the handling of concrete. Under no circumstances should he attempt the construction of a bridge with a span of any considerable size.

The safe loads given under the heading Culverts hold true for small span bridges. These spans may be either of the arch type or of the beam and

84. An ideal small bridge—pleasing in design, permanent in construction. Such a structure should be built only under competent supervision.

girder type. Without special molds the latter is the simpler of construction, though the former is more pleasing in appearance.

We would strongly urge any one planning a bridge to get in touch with some reputable concern whose business is the erection of bridges. Even if the bridge is so small that it is not worth while obtaining their services, the suggestions they are able to give may prove invaluable.

Small Dams.—Frequently some small stream running through the farm may be profitably dammed either to supply motive power for such stationary machines as are used on the farm, or to store up water for the stock or the irrigation of the farm. By this means a large natural reservoir can be formed which may mean the difference between profit and loss in a dry season.

The size of the dam depends, of course, on the head of water to be held back and on the nature of the bed of the stream. If the latter be of a rocky nature, into which the dam may be keyed, all the better. If the bed be of a clay or sand bottom, by all means put the construction of the dam in the hands of a competent engineer. This company will gladly furnish names of such on request.

The size and spacing of the reinforcing rods depend on the size of the dam.

A weaker proportion than a 1:2:4 mix of cement, sand, and gravel should never be used for this class of work. A 1:1½:3 mix is better, in which 10 per cent. of the cement is replaced by a like quantity of hydrated lime.

Bulkheads.—To prevent drain tile and the smaller culverts from being covered at their openings by broken-down earth embankments, bulkheads are practically essential. These consist simply of small concrete retaining walls protecting the openings to the drain or culvert. Their cost is negligible, while the improvement in appearance of property as well as the time saved in keeping the drain in repair are well worth the expense.

Small Piers.—The owner of a farm at the edge of a stream or beside a small lake often wishes to construct a small pier for his boats. The winter's storms are apt to loosen any wooden piles driven in the stream, while the

85. A concrete ram house is simple to build and affords permanent protection to the ram.

constant action of water and weather decays the wood and ultimately destroys the pier.

The fact that concrete is unaffected by water or weather makes it the logical choice as the material for the pier. Where the pier extends into deep water, concrete piles can be driven. Steel shells for such piles are obtainable from a number of firms whose names will be supplied on request. Where the pier is in shallow water, the owner can sink the foundation for it himself by the use of home-made caisson forms. A simple box of wood can serve as his caisson and later as the form in which to deposit the concrete.

Concrete should never be dumped in the water, as the water separates the cement from the coarser aggregates. It should either be lowered to position in buckets and poured, or be placed in position by means of chutes. The forms should be watertight, and should not be removed until ample time has been allowed for the setting of the concrete, as otherwise the action of the water will wash the particles of cement away. Particular precautions must be taken to prevent this in running water.

Concrete steps may be built at the side of the pier for the convenience of those landing from small boats.

If boats of any size are to make landings at the pier, it would be well to have wooden straps to take up the jar of their striking the pier, as otherwise the boat might be crushed because of the non-elasticity of the concrete.

Hydraulic Ram House.—The hydraulic ram house should have a concrete foundation to make it simpler to keep the machinery clean and in good order. While the foundation is being put in the owner may as well go a step further and build the whole house of this material.

The foundation on which the ram rests must be separated entirely from the foundation of the wall of the house itself. The method of construction may be either block, metal lath, or monolithic, and may be handled as outlined previously.

Smoke-House.—Practically every farm which raises hogs in any quantity will find it profitable to have a smoke-house. The illustration shows a seven-foot square one made of concrete blocks. Near the roof are placed the iron rods from wall to wall on which the hams hang while being smoked.

Some farmers have also constructed their smoke-houses circular in form, using the silo molds for this purpose after the silo has been constructed, and while the forms are ready, on the ground. Most silos, however, have a much larger diameter than is required for a smoke-house, except one of unusual capacity.

Drain Tile.—In considering the drain tile problem to-day there are really only two types of tile—the clay tile and the cement tile. The materials of the two are entirely different, however.

As clay tile ages, it weakens. When exposed to moisture it is apt to swell and finally rots away.

Concrete tile increases in strength with age. The presence of moisture is not only not injurious to concrete but is an actual advantage.

The requirements of concrete drain tile can be determined by the requirements and nature of concrete. Concrete is a material whose strength and durability are determined by the extent to which all its voids are filled and the aggregate cemented together. Too many people think that the value of drain tile is measured by the extent to which the voids are left unfilled and the concrete left as nearly sponge-like as possible. This is at the expense of the cementing bond, upon which the durability of the concrete depends. Consequently such loose-mixed, weak tile last but a short time and must be replaced.

86. Such a smoke-house may be built of blocks, metal lath, or monolithic construction. If concrete, it's permanent.

There is no tile stronger, more durable, or more satisfactory than properly made concrete tile. On the other hand, improperly made concrete tile is simply a waste of money.

Concrete tile should never be made of a weaker mix than one part of cement to three parts of sand. The sand should not be fine, but graded from fine to coarse particles just passing a ¼-inch screen. After the cement and sand have been mixed, sufficient water should be added so that the mix will pack hard in the molds, and leave a webbed effect on the surface of the molds after these have been removed.

The tile should be wet three times a day for a period of six days, and may then be piled in the yard for three weeks, for the first week of which they should also be sprinkled three times a day.

Professor Musselman, of Michigan Agricultural College, figures the cost of four-inch tile with a $\frac{9}{16}$-inch wall as running from $14.38 per thousand to $16.09 per thousand, the difference in cost being the difference between engine and wind power.

Concrete Roads

EVERY farmer is vitally interested in the roads adjacent to his property and connecting the nearby villages and towns. Good roads mean actual dollars and cents in the farmer's pockets.

They mean the easy and rapid marketing of his produce, the safe and uninterrupted schooling of his children, the greater length of life and the greater efficiency of his horses, wagons, and farm machinery, greater possibilities for social communication—and, because of all these, greater value to his property.

As a result of improved roads in Spottsylvania County, Va., the products shipped from that county increased in two years 45 per cent. Dairy and poultry shipments increased 137 per cent. Farm values as shown by actual sale prices increased from 33 per cent. to 233 per cent., depending on location.

As a result of similar improvement near Federalsburg, Md., the same increase in products marketed and in land values resulted.

The same story is true of Harris County, Tex., Essex County, N. J., Wayne County, Mich., Mecklenburg County, N. C., Sullivan County, Tenn., and numerous other counties through the country.

One advantage of the concrete road can be given no monetary value—the increased social life it gives to any community. The road which is always open for traffic does away, largely, with dependence on weather conditions. This one feature helps to simplify both the labor problem and the problem of making the home attractive to its children—and by making the community more attractive affects in one more way the value of both property and produce.

The taxpayer should urge for his community the type of road which has proved most satisfactory from a standpoint of service as well as economy. The concrete road is the road which fulfils all the requirements of the perfect highway.

The surface yardage of concrete roads laid in 1915 exceeded by 34 per cent. the amount laid in 1914. And the noticeable fact is that the greatest amount of concrete roads was built where concrete, as well as other materials, had been previously tried. In other words, the best friends of the concrete road are those who have used it most and longest.

The reasons for this are too numerous to more than mention in this article. The main ones are: Freedom from mud or dust in all seasons—open to all kinds of traffic at all times of the year—minimum maintenance expense, with greatest portion of road taxes going toward building new instead of repairing old roads—permanence of investment, the road will never need rebuilding.

To anyone actually interested, we will gladly send our booklets on concrete roads, their advantages and how to construct them.

87 and 88. Two country roads from Milwaukee County, Wis. As a result of these concrete roads, this County has arranged a schedule for a term of years to provide, ultimately, for concrete roads throughout the entire County.

Index