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CIRCULAR NO. 128

BUILDING PLANS FOR THE DAIRY FARM

By

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BUILDING PLANS FOR THE DAIRY FARM

THE DAIRY BARN.

It is desirable that an adequate barn be provided for the dairy herd, so arranged and furnished with the necessary equipment that sanitary milk may be produced with the minimum of labor and expense.

This circular presents the most essential features of a good dairy barn. The details have to be determined for each individual farm. There are many good dairy barns in Kentucky, but there are also some very poor ones. Mistakes in design are likely to be made when the farmer has not considered carefully his particular requirements. Too often he decides on outside dimensions and erects the barn and then tries to divide the space so as to meet the requirements of his herd. He should first consider the number of cows, calves and bulls that are to be housed, and then calculate the proper dimensions for the stalls, bins, doors, ventilators, windows, etc., and build accordingly. He should also plan to take care of the future growth of his herd by being able later to increase the size of the barn without spoiling its appearance or impairing its convenience.

ESSENTIAL FEATURES OF A DAIRY BARN

The essential features of a good dairy barn may be enumerated briefly as follows:

1. *Warmth*: Dairy cows need protection and cannot produce large quantities of milk and butter unless properly housed.
2. *Sanitation*: Since dairy products are used for human food, and since milk is so easily contaminated, the sanitation of the dairy barn is a prime requisite.
3. *Ventilation*: To remain healthy and vigorous the cows must be provided with an abundance of fresh air.

4. *Light*: Plenty of sunlight should enter the barn.
5. *Drainage*: Damp barns are unsanitary and lead to rheumatic trouble among stock and make conditions favorable for disease.
6. *Convenience*: The arrangement of stalls, floor space, feed room, etc., should receive careful consideration in order to save labor.
7. *Extra Room*: Unless other provision is made the barn should provide for the stalling of young stock, bulls and pregnant cows, in addition to the regular milking herd.
8. *Storage*: Sufficient room for the storage of hay, feed and bedding should be provided.
9. *Permanence*: The barn should be constructed of substantial material. A concrete foundation and floor are best and most permanent.
10. *Cost*: The cost of the barn should be in keeping with the size and income producing capacity of the farm.

TYPES OF BARNS

In this circular, plans are shown of three types of dairy barns; the shed or "lean to," the one-story and the two-story barn. In addition, plans are given for combination cow and horse barns.

The type of barn to build depends upon local conditions and the personal preference of the farmer. The shed or "lean to" type of barn often is poorly lighted, poorly ventilated and very unsanitary. It is very difficult to produce clean milk in such a building. The "lean to" should be used only when the farmer cannot afford a better type of barn. It should be provided with a concrete floor, manger and gutters, standard stalls and four square feet of window glass per animal. Fig. I shows how to equip the shed.

The one-story barn is quite common. However, the two-story barn of the gambrel roof type is more economical when storage capacity and convenience of feeding are considered in relation to cost. There is no objection to storing feed above the cows if the floor is tight.

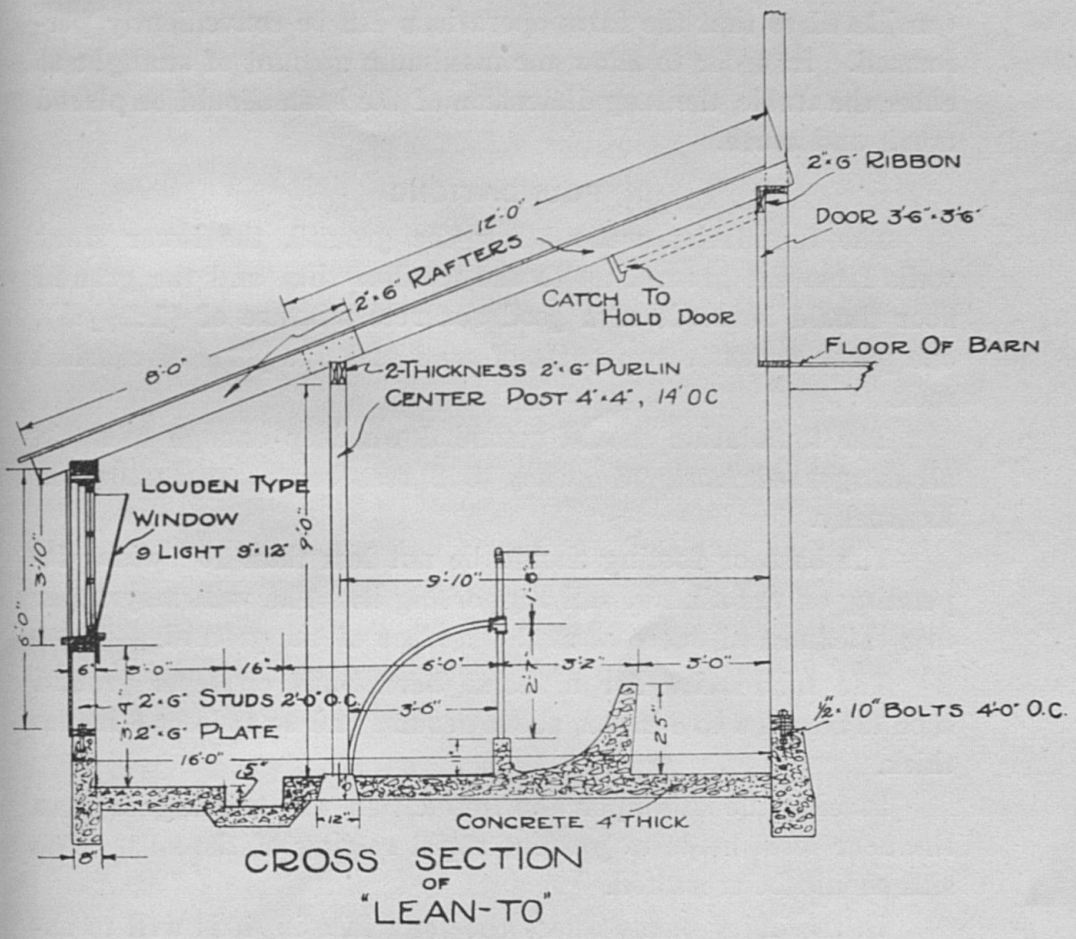


Fig. I. The "lean to," tho not a very desirable type of dairy barn, is being used for temporary quarters by farmers who cannot afford a better barn. The above drawing shows the most satisfactory arrangement for a "lean to." It should be located on the south side of the barn, and should be provided with four square feet of window opening per cow.

Regardless of what kind is chosen, it should be as convenient as possible because outside of the cost of feed labor is one of the largest items of cost in the production of milk.

SELECTING SITE

A great deal of care should be taken in selecting the site for the dairy barn. Land which will afford ample, well-drained yard space should be selected. A muddy yard is unsanitary. The relation of the barn to other farm buildings should be

considered so that the farm operations can be conveniently performed. In order to allow the maximum amount of sunlight to enter the stable, the long dimension of the barn should be placed north and south.

FOUNDATIONS

The foundation walls below the ground, the lower story walls from the ground up to the window sills, and the ground floor should be made of a good concrete mixture of (1:2½:5), one part cement to two parts of sand and five parts of crushed rock.

The foundation should extend down deep enough to avoid all danger of frost, 18 inches to 2 feet being satisfactory in Kentucky.

The base or footing should be not less than 16″ wide, depending on the kind of soil supporting it. The wall may taper to a thickness of one foot at the surface of the ground.

The foundation for a frame barn built on level ground should extend 6 to 8 inches above ground and be at least 8 inches thick.

Placing the sills upon the foundation which is higher than the floor level helps to prevent rapid rotting of the sills. The sills should be creosoted.

In the dairy barns where the cows face in, it is well to extend the foundation up as high as the window sills so that the manure which may splash against the wall may be easily washed off.

WALLS

It is essential to have a dry and warm wall, smooth on the inside. This may be provided by extending the concrete foundation, 3½ to 4 ft., up to the window sills. The wall from the foundation up may be constructed of 2″x6″ studding, sheathed on the outside with drop siding or boxing and on the inside with ceiling. In a mild climate a single wall is satisfactory if properly kept in a sanitary condition. Hollow walls made of concrete or clay block are proving satisfactory in barns that are properly ventilated and lighted.

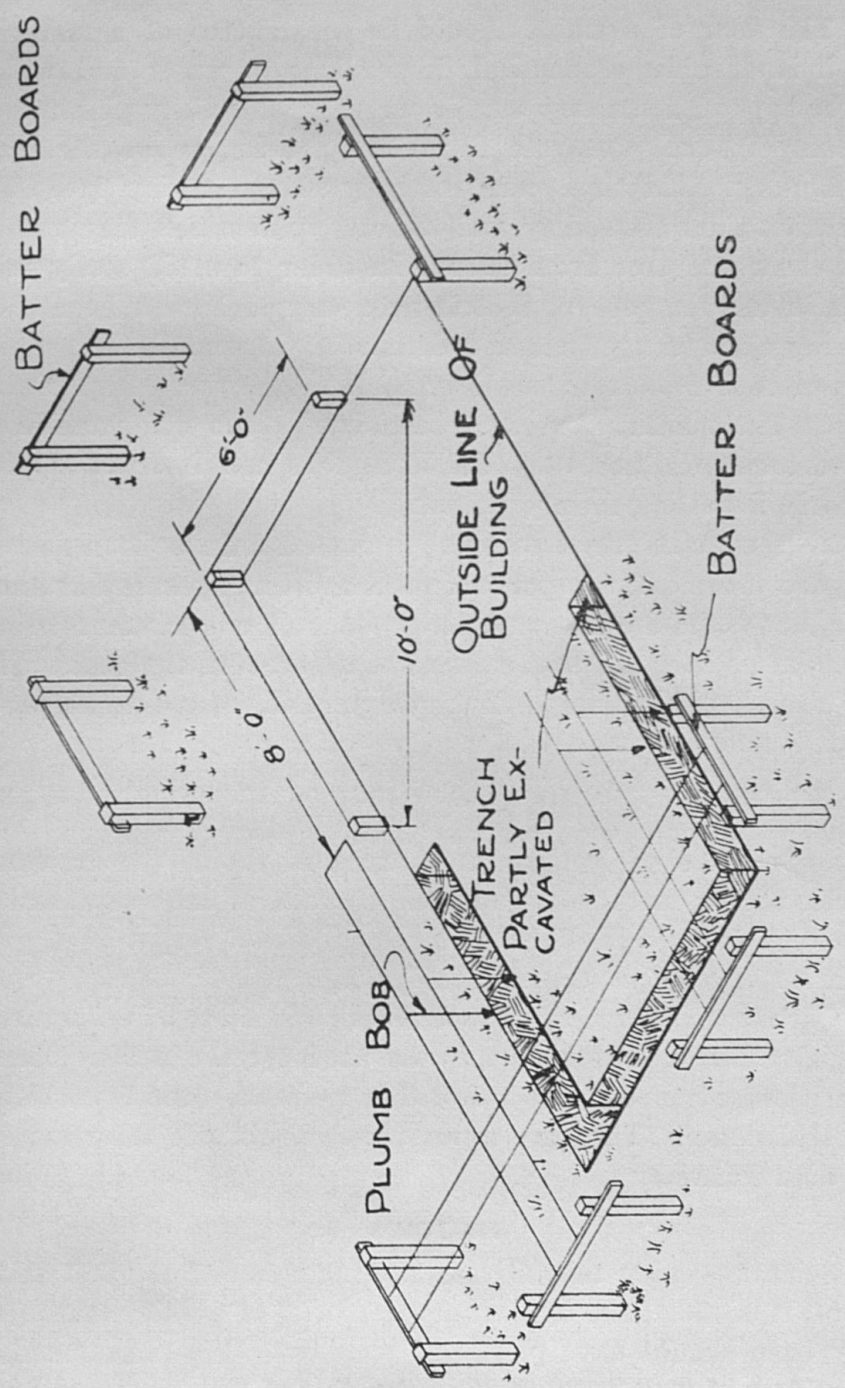


Fig. II. Method of squaring up corners and of using batter boards to establish building and excavation lines for foundation trench.

STABLE FLOORS

The floor of a stable should be constructed of a material which is durable, economical, impervious to water and which can be kept in a sanitary condition. The old, filthy plank floor harbors disease. Concrete floors are proving to be the most satisfactory. They are comparatively cheap, taking into consideration their durability and the ease with which they can be kept clean and free from odors. In order to avoid costly mistakes in the concrete work it is necessary to have a floor plan showing the arrangement and details of the installation of the modern steel stall equipment and all the drainage and water pipes. The manufacturers of barn equipment will furnish to the customer the necessary detailed plans and instructions for properly installing the equipment.

The best mixture of concrete to use for a dairy barn floor is one part of cement, two parts of sand and three parts of crushed stone, but floors are also commonly made of two mixtures; thus in the latter case the floor consists of a base and top coat. The base coat should be composed of one part of cement, three parts of sand, and five parts of clean gravel or crushed stone. The top coat should consist of a ¾″ layer of Portland cement mortar composed of one part of cement to two parts of sand. The cement surface of gutters and mangers should be troweled smooth with a metal float, but the surface of all walks, stalls, driveways and alleys should be finished with a carpet float, giving it a rough finish to prevent slipping.

Cork brick or creosoted wood blocks which are manufactured especially for this purpose may be used for the stalls. These materials are nonconductors and thus keep the floor from being cold and damp. They are quite durable, but are more expensive than concrete.

WINDOWS

Scientists claim that direct sunshine is one of the best germ killers; it is one of the important necessities of a dairy barn. A dairy barn should have plenty of windows. We recommend 1 square foot of glass to 20 to 25 square feet of floor space, or four square feet of glass per cow.

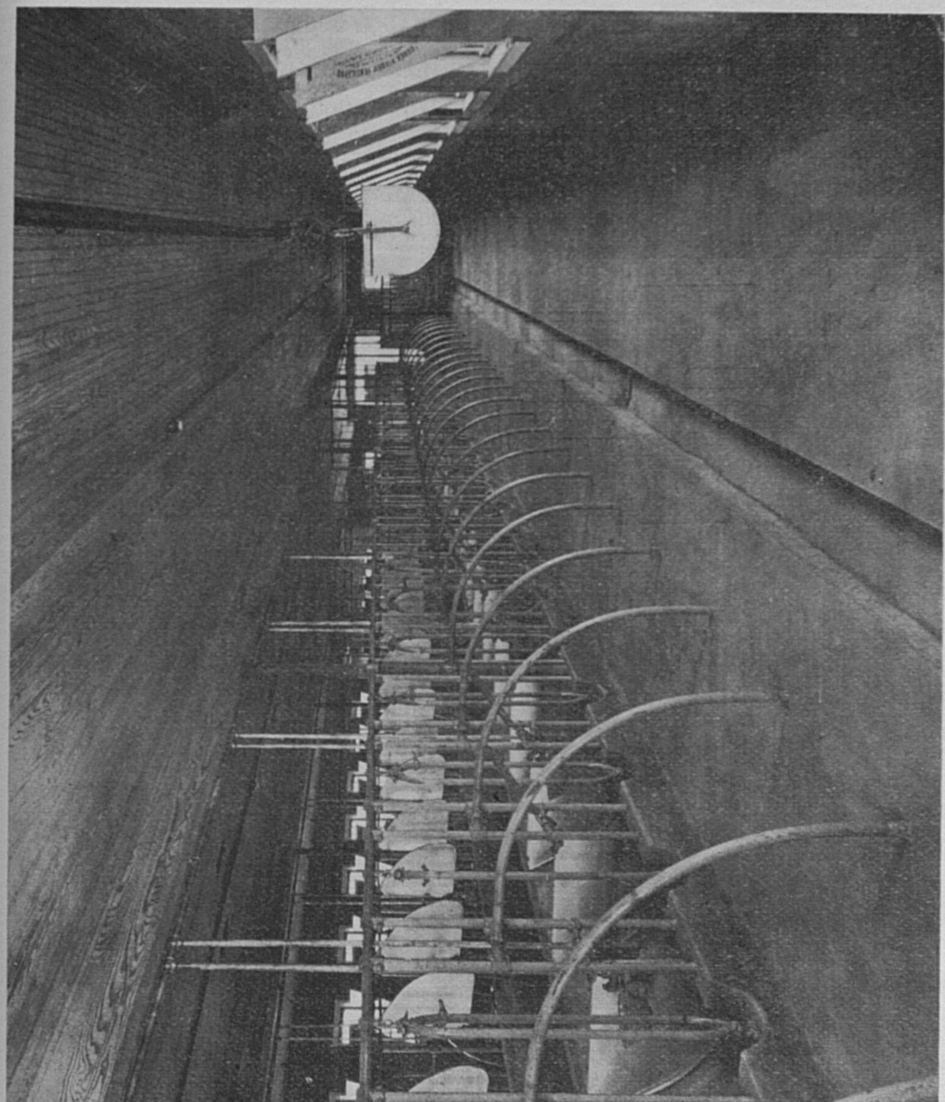


Fig. III. Interior view of a well lighted, ventilated, sanitary, and well equipped dairy barn built at the State Institution for Feeble-Minded at Frankfort, Ky.

Care should be taken in locating the windows, placing them so as to allow the maximum amount of direct sunlight to enter. The window sill should be from 3½ feet to 4 feet above the floor.

A six to nine-light, single-sash window, hinged at the bottom so that it can be swung in at the top, affords good ventilation.

Windows and doors should be screened to keep out flies.

ARRANGEMENT OF COWS IN THE STABLE

It usually is desirable to place the cows in two rows as this system requires less labor in feeding and in handling the manure. Opinions differ in regard to the advantages of facing cows in or out when two rows of stalls are used. Neither plan can be said to be superior to the other in all respects. The plan adopted will depend largely upon the individual preference of the dairyman.

SIZE OF STALLS FOR COWS

If the cow is to be comfortable it is essential that her stall be of the correct size. Three feet six inches usually is considered the standard width for cow stalls. For small cows a narrower width of 3 ft. 3 in. sometimes is used. The spacing of the barn bents or posts often causes the designer to vary the width of the stalls a trifle. A 14-ft. bent accommodates 4 stalls 3½ ft. wide; a 10 ft. bent, three stalls 3 ft. 4 in. wide, and a 12 ft. bent, 3 stalls 4 ft. wide.

LENGTH OF STALLS

Stalls should be 4′-3″ to 5 ft. long from gutter to manger, according to the size of the cow. Guernseys and Jerseys will keep clean and sleep comfortably in stalls 4′-3″ to 4½ ft. long, while Holsteins and the larger breeds of cows require 4′-8″ to 5′-3″. Some barns are designed with long stalls at one end of the row and short stalls at the other. There are on the market stanchions so adjustable as to line up the cows on the gutter. The floor should have a total slope of about one inch from the manger curb to the gutter.

TABLE 1.—SUGGESTIVE DIMENSIONS FOR COW STALLS.

Breed	Width	Length		
		Small	Medium	Large
Holstein	3′-6″ to 4′-0″	4′-10″	5′-2″	5′-8″
Shorthorn	3′-6″ to 4′-0″	4′-8″	5′-0″	5′-6″
Ayrshire	3′-6″ to 3′-8″	4′-6″	5′-0″	5′-6″
Guernsey	3′-4″ to 3′-6″	4′-6″	4′-10″	5′-4″
Jersey	3′-4″ to 3′-6″	4′-4″	4′-8″	5′-0″
Heifers	2′-9″ to 3′-2″	3′-8″	3′-10″	4′-2″

*Compiled by M. A. R. Kelley, Division of Agricultural Engineering Department, U. S. Department of Agriculture, Washington, D. C.
Length of stalls "S"—3′ 6″ for cows, 3′ 0″ for heifers and young stock.
NOTE.—See Fig. IV.

PARTITIONS

Some dairymen think that partitions between stalls are not necessary; however, the majority of them seem to desire a partition so as to provide each cow with separate space. It is easier to keep the cows and stalls clean where partitions are used.

Wooden stalls or partitions are being rapidly displaced by metal ones. Curved pieces of iron pipe 1¼ in. in diameter serve admirably for such partitions. This pipe can be purchased at a plumbing supply house. However, the different manufacturers of barn equipment are designing and putting on the market complete stall equipment at such a price that it will not pay one to buy the pipe and make his own equipment.

The modern stalls are made entirely of pipe or tubing with clamp connections. The size of pipe or tubing generally used has an outside diameter of 1⅝ to 1⅞ inches. Companies from which equipment is purchased will gladly furnish detailed information in regard to installing the same.

STANCHIONS AND TIES

One satisfactory method of securing cows in the stalls is to use a chain running between the posts of the stall to which a ring or strap around each cow's neck may be snapped. This device permits of a reasonable amount of freedom for the cow.

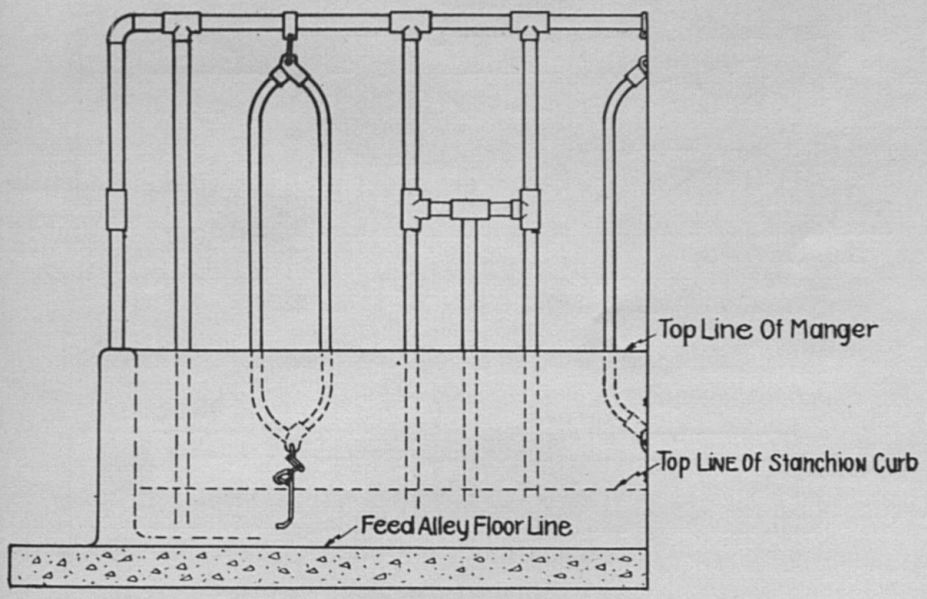
The stanchion, however, is the more generally used device and the later models of swinging stanchions leave little to be desired. The old style fixed stanchion consists of two upright bars one of which is hinged at the bottom and made to open wide enough at the top to permit the cow to insert her head between the bars. The hinged bar is swung towards the fixed bar and latched in a position which will prevent the cow from removing her head. This stanchion is uncomfortable.

MANGERS

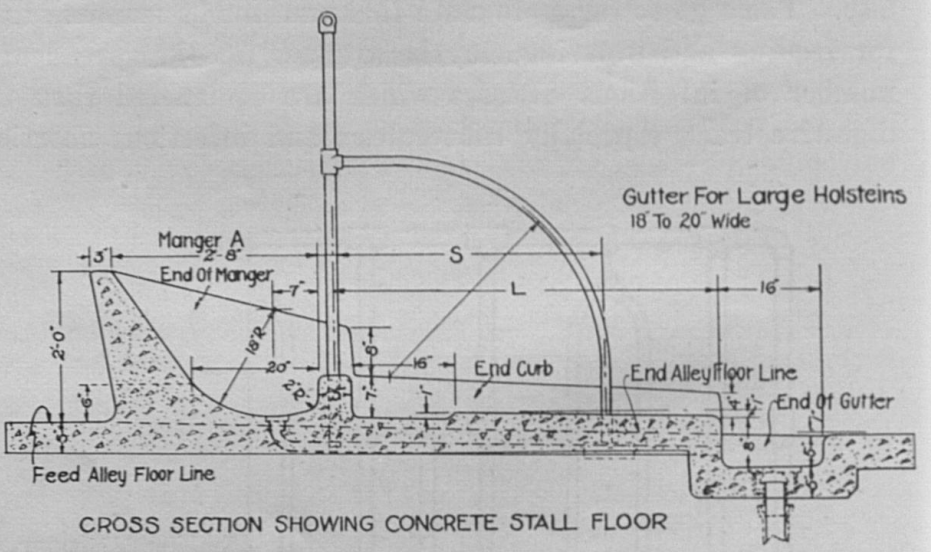
Formerly feed mangers were made of wood, but now concrete and steel are used to a great extent. Concrete mangers are sanitary and durable. The essentials of a good concrete manger, as recommended by the American Society of Agricultural Engineers, are as follows:

1. All corners should be rounded to facilitate cleaning.
2. Mangers should be free from cracks and crevices.
3. Continuous mangers are preferable; easier to clean and easier to construct.
4. Surface of manger should be smooth.
5. Mangers should have drains with sufficient slope to drain well. The manger should slope 1½ in. to 2 in. in 100 ft.
6. Concrete manger divisions are not desirable, as there are too many corners to keep clean.
7. It is preferable that manger division should be removable or hinged to aid in cleaning.
8. Width of manger should be not less than 24 in., and preferably 30 to 32 in.
9. Bottom of manger should be 1 to 2 inches higher than platform on which cow stands.
10. The rear curb of the manger should be 6 to 11 inches higher than bottom of manger.
11. Width of curb should be 5 to 6 inches.
12. Footing for wood posts should not form corners in mangers.
13. The front of manger should be 18″ high and never over 30″.
14. Curved manger bottom keeps the feed together and saves water when used as watering trough.

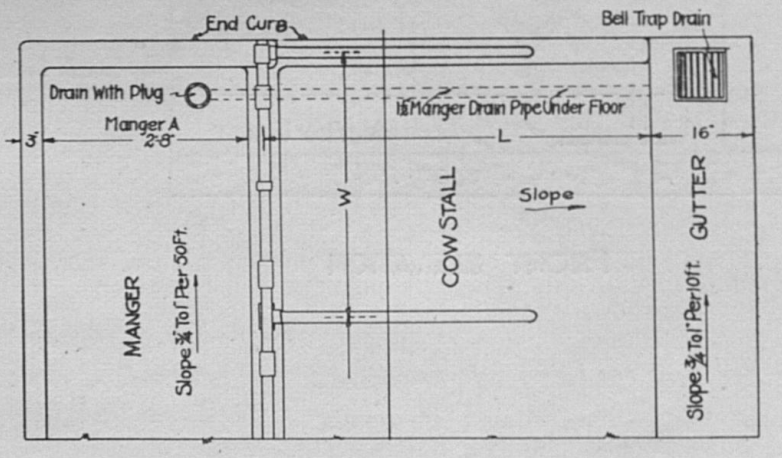
Live stock sanitation officers recommend the use of individual drinking bowls, and some recommend individual mangers also. These go so far as to state that continuous mangers used for feeding and watering may be avenues for the spread of a number of infectious diseases which are contracted thru the digestive tract, especially tuberculosis and infectious abortion.



FRONT ELEVATION



CROSS SECTION SHOWING CONCRETE STALL FLOOR



PLAN

Fig. IV. Detail of standard cow stall as recommended by the U. S. Department of Agriculture, Washington D. C., and the American Society of Agricultural Engineers. Steel equipment and concrete mangers and floors are essential for the production of sanitary milk. Construct the mangers and place equipment according to the directions furnished by manufacturers, getting the correct curve of manger by using templets furnished by them.

PICTURES SHOWING HOW TO INSTALL MODERN DAIRY BARN EQUIPMENT

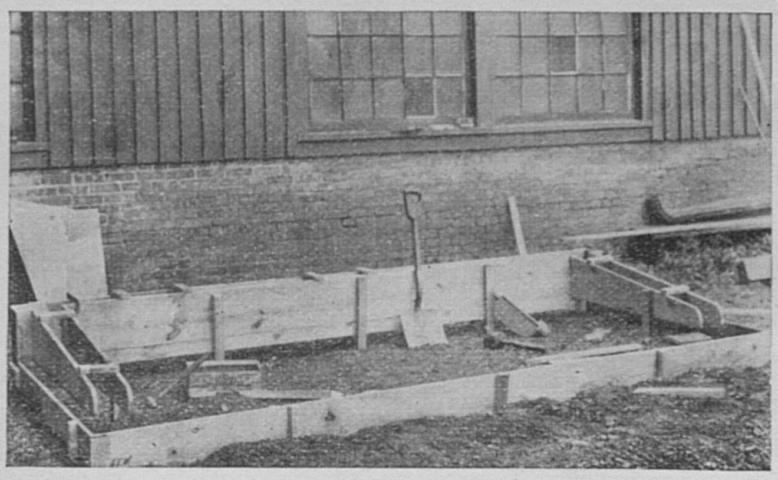


Fig. V. Forms for the concrete manger curb and stall platform.

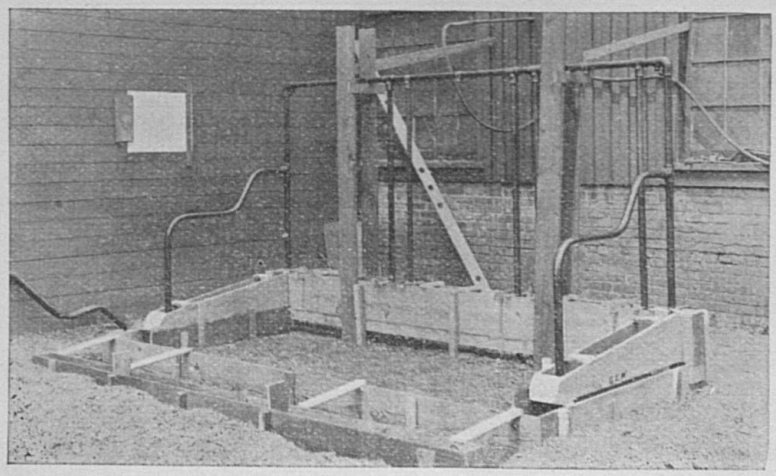


Fig. VI. The steel stanchion supports are shown carefully plumbed and braced in position.

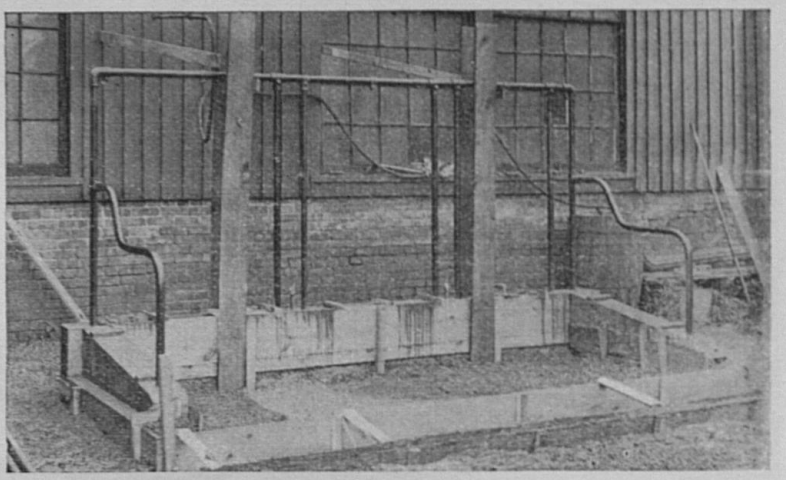


Fig. VII. The manger curb forms have been filled with concrete.

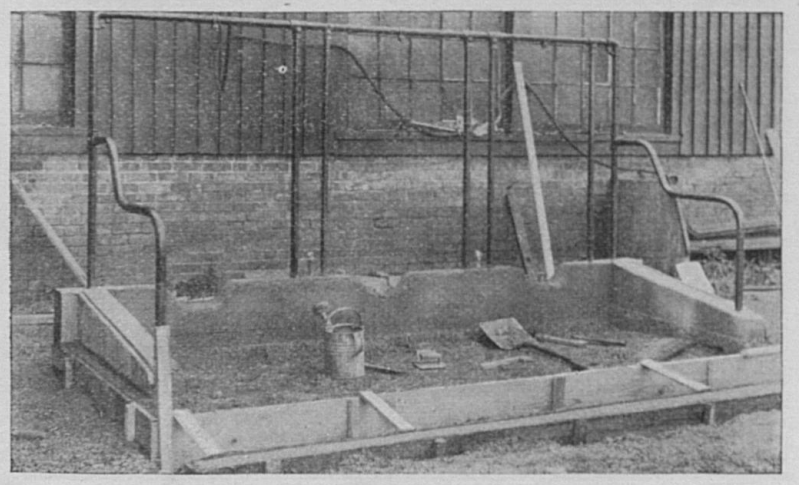


Fig. VIII. Concrete curbs after removing the form.

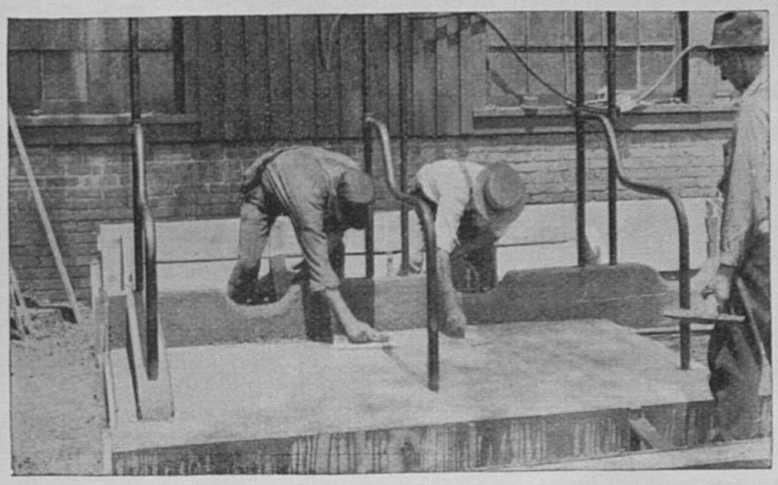


Fig. IX. The men are finishing the concrete stall platform with a wooden float thus giving it a rough surface.

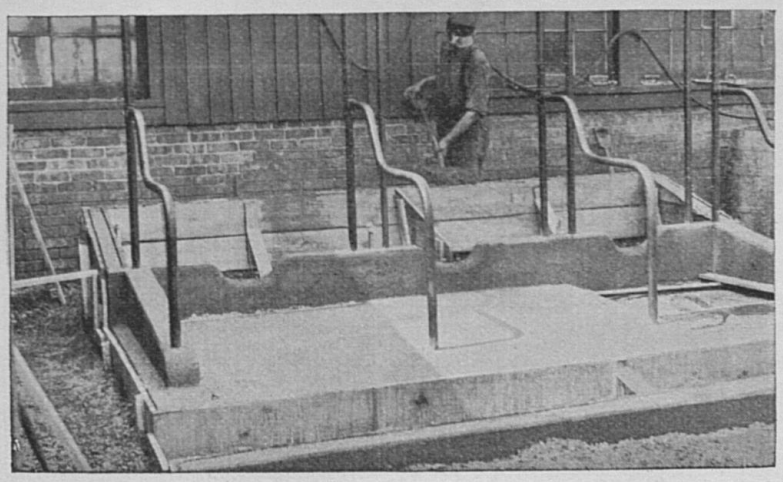


Fig. X. The manger forms have been constructed and are being filled with concrete.

Fig. XI. The manufacturers of barn equipment furnish all templates and information required for constructing the mangers, and instructions should be carefully followed. Picture shows the use of templates for accurately shaping the mangers. Manger surface should then be smoothed with a metal trowel.

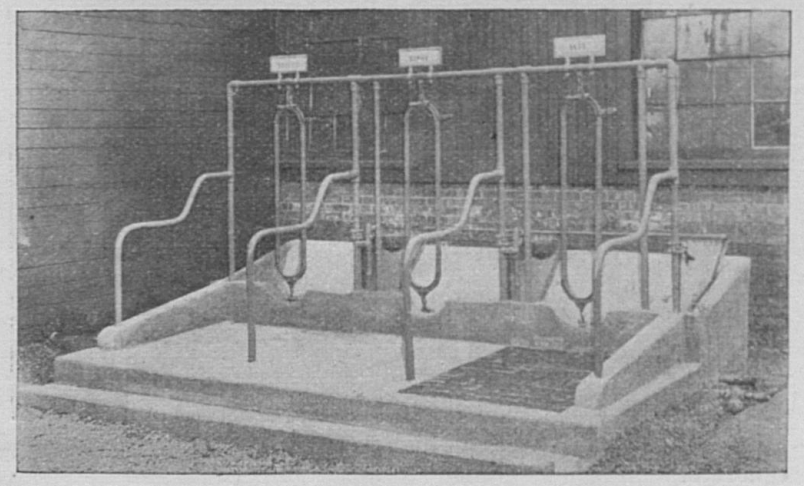


Fig. XII. A completed section of a modern dairy barn floor.

GUTTERS

The manure gutter usually is 14 to 18 inches wide in order that it may be easily cleaned with an ordinary scoop shovel. As it is preferable that the stall floor be higher than the alleyway, the bottom of the gutter will be 6 to 7″ below the stall floor and 3 to 4″ below the level of the alley. The gutter should have a slope of ¾″ to one inch per ten feet of length, for drainage. This slope will be sufficient to carry off the water when the stable is washed out, the water being drained off by means of a six-inch sewer pipe or tile. The truer the cement work the less the incline required. The entrance to the sewer should be covered with a perforated top. It is well to install a bell trap in the outlet.

Where the row of stalls is over 100 feet long it is best to have several points of drainage, a 50-foot stretch being about all that should be carried into one drain.

If the row of stalls is not too long it is best to have the outlet from gutter and manger at one end of barn. The principal disadvantage in locating the drain in the center is the clogging up of the cleaning opening, in which case it may be necessary to tear up the concrete floor across the barn in order to clean it out. For this reason, it is safer to have the outlet located at the end where it can be cleaned out easily without damaging the floor.

FEED ALLEYS

Feed alleys often are made too narrow. When the alley is used for no other purpose than to carry hay and grain to the stock, 3 feet is a common width; a narrower alley than this causes crowding. When space can be spared, make the feed alley 5 feet wide. If it is desired to install a feed carrier, the feed alley should be at least 4 feet wide. This is for feed alleys where cows face out. Where cows face in, 4 to 6 feet are common widths.

Some dairymen like the feed alley raised up on a level with the top of the front of the manger. It is much easier to clean out the manger for watering when a raised feed alley is used.

The dairyman can sweep the feed out on to the floor, water the cows and then sweep the grain back in to the trough without mixing the different cows' feed together.

Where the alley is below the manger top it is necessary to use a shovel. The cost of installing a raised feed alley is greater.

MANURE ALLEYS

When sanitary dairy equipment is used, cleaning alleys are usually made the proper width to accommodate such equipment; the style of equipment should be decided upon before the barn is designed. Most standard equipment requires a passageway 4 to 5 feet wide. When a wagon or manure spreader is to be driven thru the barn, the manure way should be 8 to 9 feet wide. When the alley is wide, less manure will spatter on the wall. However, when the manure alley is unduly wide its cost is excessive, and it also entails more labor in sweeping or cleaning the floor.

STORAGE SPACE

The dairy barn should be provided with storage space for hay, silage and grain feeds. For the hay loft we recommend a barn roof called the gambrel roof. It is a roof of two pitches. It is self-supporting, it gives a space free of posts. It is the most economical type of roof to build for barns not exceeding 40 ft. in width. It is built of light material which is easier to handle than the heavy beams used in gable roof barns.

Silos should be connected to the barn at the most convenient places. A silage chute fixed so as to empty into the silage truck saves labor.

VENTILATION

In planning a dairy barn the question of ventilation should not be overlooked. A cow does not do well and is apt to become diseased if housed in a damp, poorly lighted and poorly ventilated barn. Fresh air is as indispensable to a cow as is the hay or grain that she eats. Dairymen have learned that whenever it is necessary to keep the cows housed during the winter they do best if the barn is maintained at a minimum temperature of 45° F.

The plans in this circular provide means of ventilating thru windows and by the King system which has proved satisfactory. The King system consists of fresh air intake flues and foul air outlet flues for controlling the circulation of air, especially for the ventilation of the barn in the winter when it is desirable to keep some of the animal heat within the barn while the outside air is cold. It is not expected that these flues will give results when the windows, doors and hay chutes are open.

The system of windows for ventilation is to supply an abundance of fresh air without perceptible draughts on the animals in the barn and to exhaust all the heat and moisture thrown off by the animals. It is designed especially for summer conditions.

Many of the practical dairymen of Kentucky feel that they can not afford to incur the added expense of installing the King system of ventilation and believe that ventilating by means of windows is adequate under our weather conditions.

WATER TANKS

Plenty of water should be provided for the dairy herd. It does not pay to use high-priced feed to increase milk production and neglect to provide an abundance of pure water. A cow requires water in proportion to the milk she produces, the rate being about 2½ pounds of water per pound of milk.

There should be watering places at the barn as well as in the pasture. Some dairymen have found it profitable to install individual drinking bowls in the barn. Concrete water tanks properly constructed of a 1:2:3 concrete mixture reinforced with steel rods or square mesh woven wire fencing are most satisfactory. They will not rot, rust, warp or go to pieces if left empty and they can be kept clean. A concrete tank should be provided with a drain pipe and a frost-protected supply pipe. Fig. 13 shows how to construct the forms and to place the reinforcing.

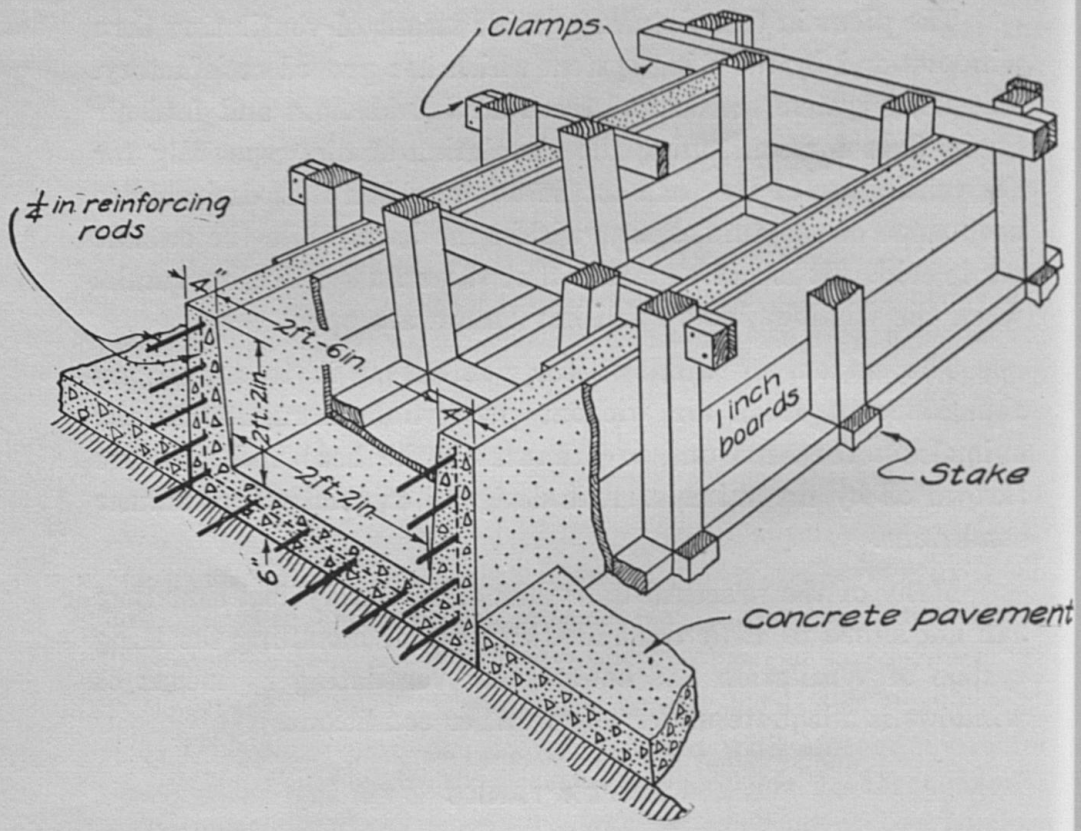


Fig. XIII. Forms and reinforcement of concrete water tank.

ESTIMATE OF MATERIAL REQUIRED FOR TANK SHOWN IN FIGURE 13

Outside dimensions:	3 ft. 2 ins. by 8 ft.
Walls:	2 ft. 8 ins. high
Floor:	6″ thick
Concrete mixture:	1:2:3
Volume of Concrete:	1¼ cubic yards.

Required:

9 sacks Portland cement

¾ cubic yard sand

1 cubic yard pebbles or broken stone

215 ft. ¼ inch round steel rods or its equivalent.

For each additional foot of length, add to the foregoing quantities:

1 sack Portland cement
2 cubic feet sand
3 cubic feet of pebbles or broken stone
22 ft ¼ inch round steel rods

MILK HOUSE

The milk house as shown by the plans, is 12 feet wide and 24 feet long. It is divided into two rooms, one for caring for the milk and utensils and one for the boiler and fuel. This house is well ventilated, amply lighted and with a reasonable amount of care can be kept in a sanitary condition. It is provided with nonabsorbing walls, concrete floor, concrete walls up to window sills, and the ceiled walls coated with good paint are all washable.

The house may be connected directly with the barn by a passageway or can be separate if conveniently located. Plans C-3-46-5 page 34 show a milk room located in the barn. This is permissible if the room is properly constructed so that it can be kept in a sanitary condition. It is, however, considered by most dairymen more desirable to have a separate milk house.

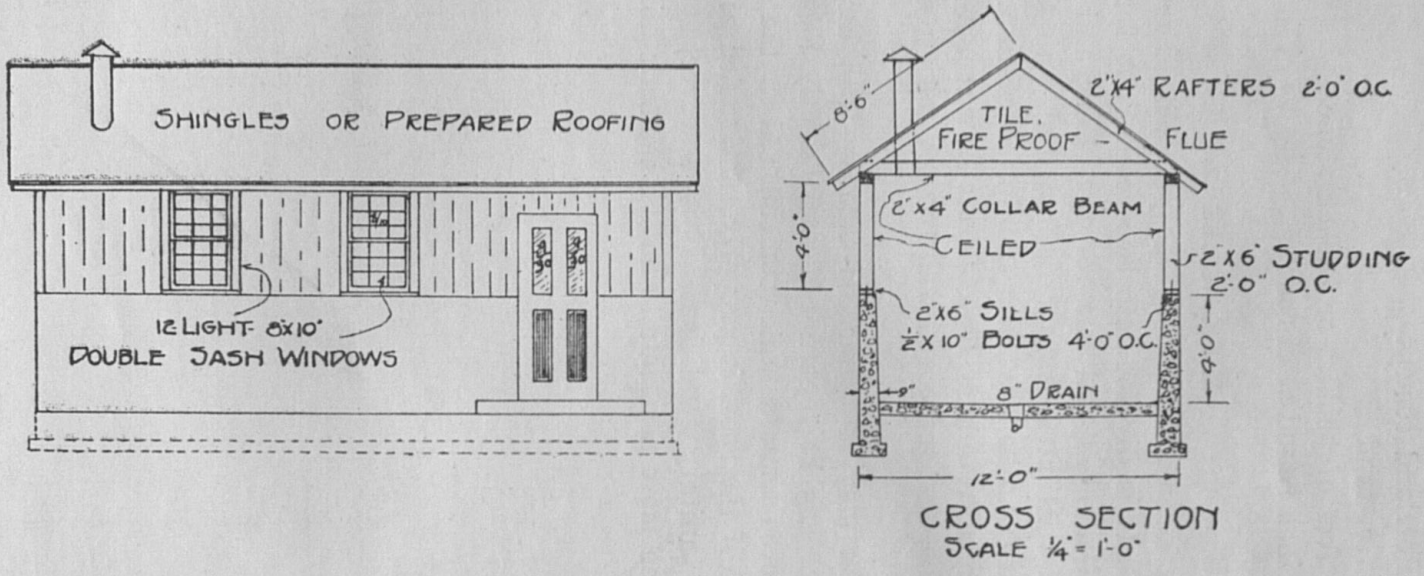


Fig. XIV. Elevation and cross section of milk house.

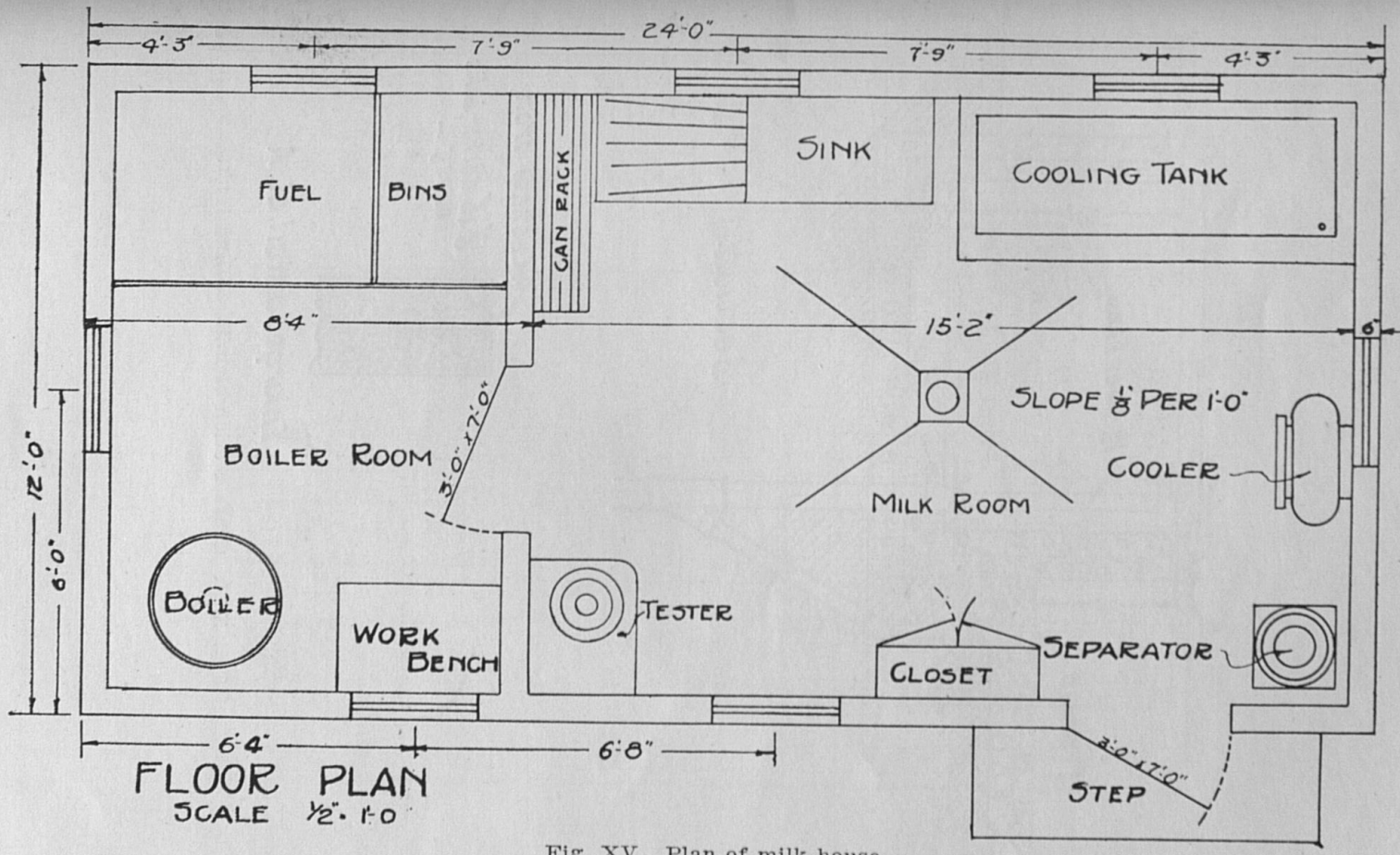


Fig. XV. Plan of milk house.

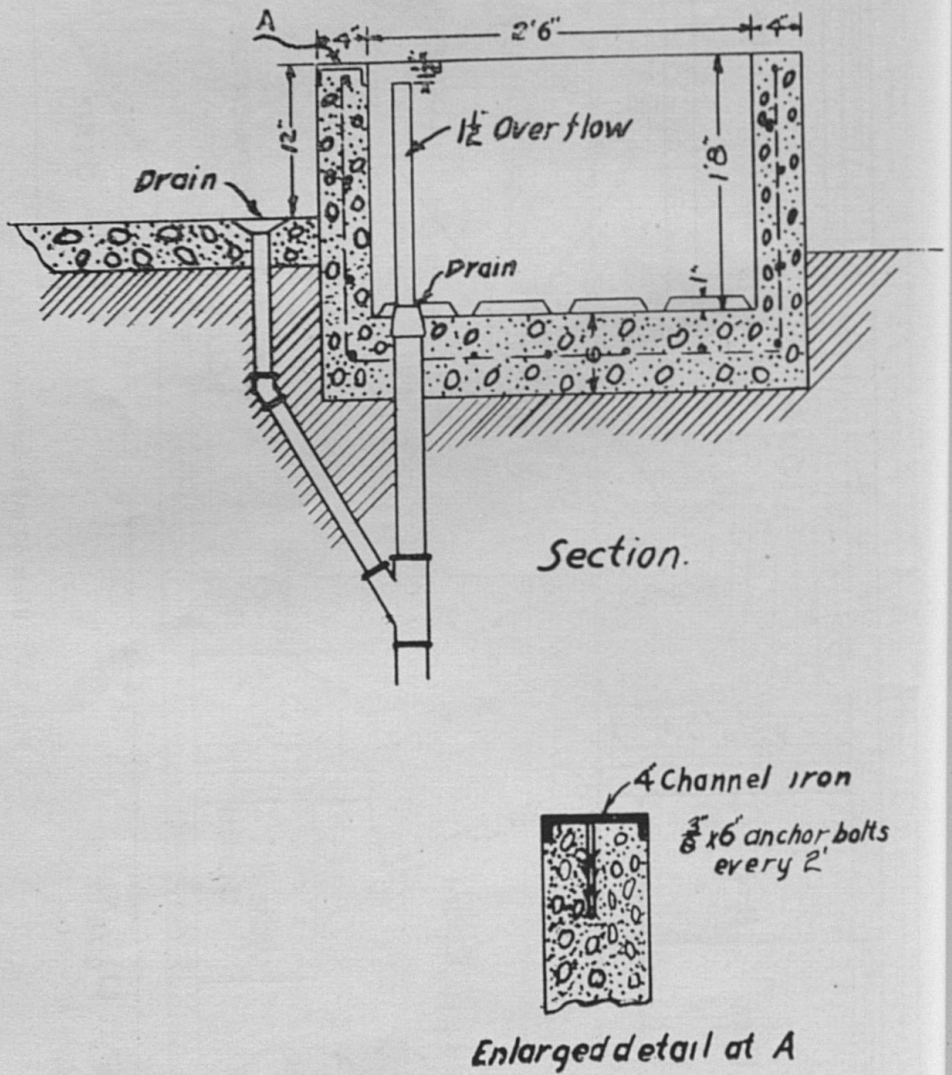
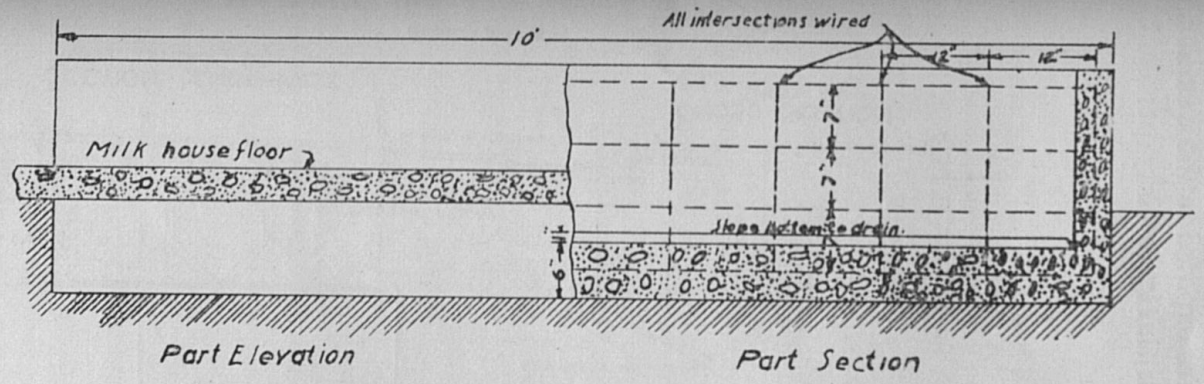


Fig. XVI. Cross section of milk cooling tank.



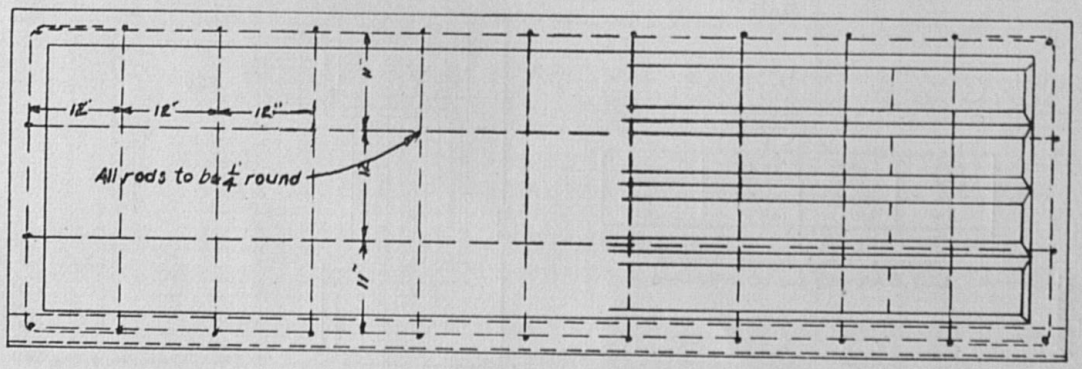


Fig. XVII. Section and plan of milk-cooling tank.

MANURE PIT

A good manure pit will conserve plant food. Tests show that the liquid contains approximately 60 per cent of the total fertilizing value of cow manure. Manure exposed to the weather from three to six months will lose from thirty to sixty per cent of its value.

DIMENSION OF PIT REQUIRED FOR VARIOUS SIZED DAIRY HERDS.

No. Of Cows	Length	Width	Avge. Depth
10	16 FT	16 FT	4 FT
20	24 FT	20 FT	4 FT
30	30 FT	24 FT	4 FT
40	40 FT	24 FT	4 FT

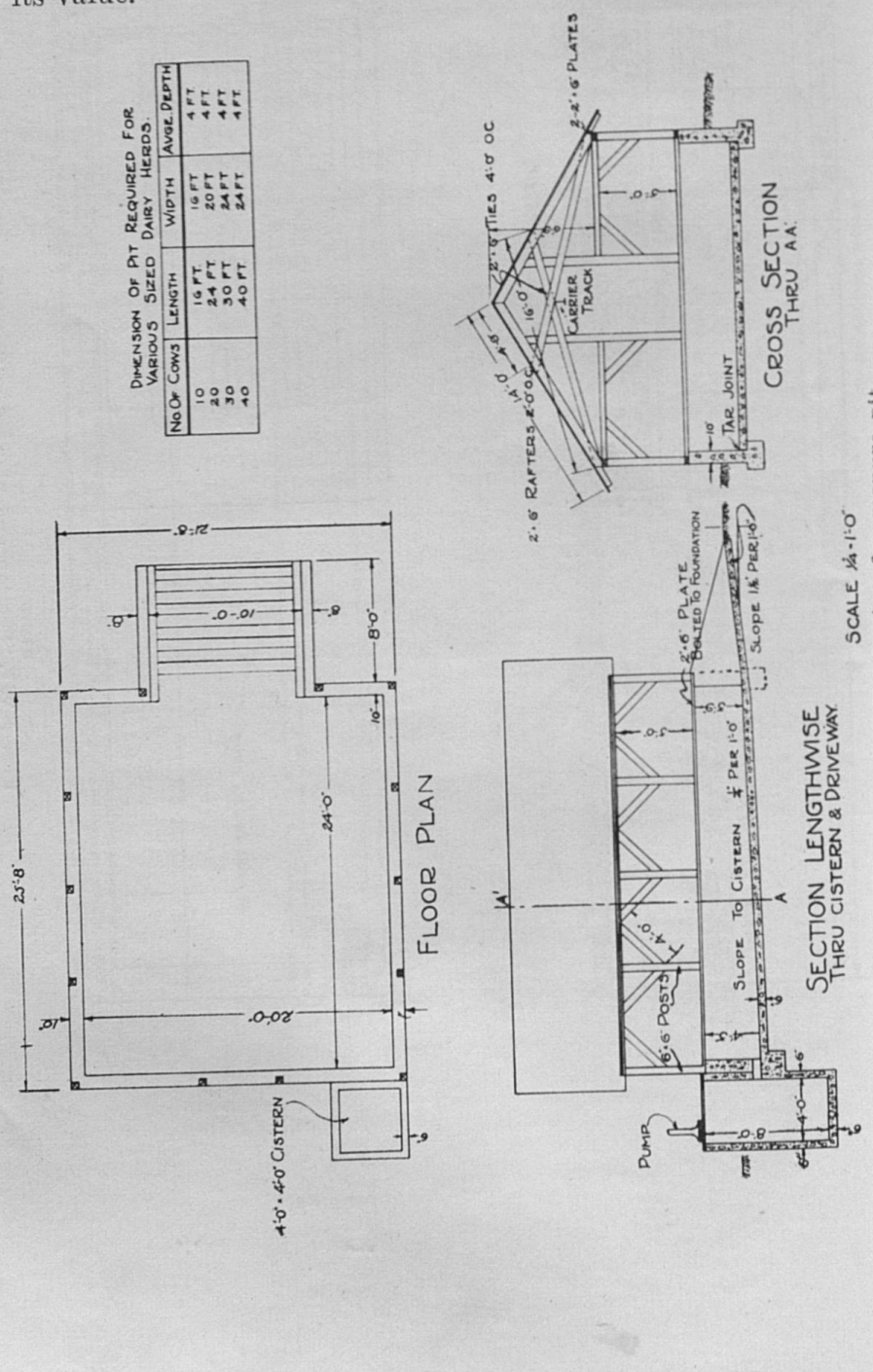


Fig. XVIII. Design for manure pit.

TABLE 2.—RELATIVE CAPACITIES OF SILOS AND ESTIMATED TONNAGE OF SILAGE BY VOLUME*

Depth of silage in feet when filling ceased	Diameter of silo in feet.								
	10	11	12	13	14	15	16	17	18
1	.63	.77	.95	1.07	1.24	1.42	1.62	1.83	2.06
2	1.33	1.60	1.91	2.24	2.60	2.98	3.40	3.88	4.31
3	2.07	2.52	2.90	3.51	4.15	4.67	5.32	6.01	6.74
4	2.88	3.49	4.16	4.88	5.66	6.50	7.39	8.35	9.37
5	3.75	4.54	5.40	6.33	7.35	8.44	9.65	10.85	12.18
6	4.68	5.65	6.71	7.89	9.15	10.52	11.96	13.52	15.16
7	5.64	6.84	8.12	9.54	11.07	12.70	14.45	16.32	18.32
8	6.68	8.63	9.60	11.27	13.06	15.00	17.08	19.30	21.64
9	7.75	9.38	11.16	13.09	15.17	17.43	19.84	22.42	25.14
10	8.84	10.76	12.78	15.44	17.40	19.96	22.72	25.69	28.78
11	10.08	12.16	14.48	16.98	19.70	22.62	25.72	29.08	32.60
12	11.30	13.64	16.25	19.05	22.10	25.36	28.89	32.64	36.57
13	12.53	15.18	18.07	21.20	24.60	28.24	32.22	36.32	40.67
14	13.90	16.89	20.00	23.46	27.20	31.22	35.54	40.18	44.97
15	15.24	18.45	21.96	25.76	29.90	34.53	39.08	44.10	49.40
16	16.75	20.19	24.00	28.16	32.68	37.50	42.67	48.40	54.09
17	18.12	21.95	26.11	31.30	35.50	40.68	46.39	52.45	58.75
18	19.60	23.77	28.28	33.30	38.45	44.19	50.27	56.75	63.61
19	21.16	25.62	30.49	35.75	41.50	47.68	54.05	61.25	68.64
20	22.78	27.55	32.75	38.45	44.60	51.23	58.28	65.83	73.80
21	24.40	29.52	35.14	41.23	47.80	54.90	62.48	70.54	79.13
22	25.96	31.54	37.54	44.05	51.10	58.80	66.70	75.32	84.48
23	27.14	33.61	40.00	46.95	54.40	62.50	71.80	80.30	90.00
24	29.50	35.67	42.45	49.85	57.80	66.30	75.48	85.27	95.53
25	31.30	37.85	45.20	52.83	61.20	70.38	80.00	90.36	101.25
26	33.08	40.00	47.66	55.45	64.80	74.40	84.64	95.54	107.22
27	34.92	42.21	50.28	59.00	68.40	78.62	89.30	100.85	113.29
28	36.78	44.50	53.00	62.13	72.10	82.80	94.10	106.25	119.25
29	38.67	46.80	55.75	65.31	75.80	87.10	98.90	111.75	125.40
30	40.60	49.16	58.50	68.60	79.50	91.30	103.80	117.30	131.60
31			61.27	71.90	83.37	95.75	108.89	122.90	137.90
32			64.12	75.20	87.20	100.20	113.80	128.60	144.35
33			67.00	78.50	91.10	104.60	118.90	134.40	150.80
34			69.82	82.10	95.10	109.20	124.20	140.25	157.35
35					99.10	113.80	129.30	146.10	163.90
36					103.20	118.50	134.70	152.15	170.70
37					107.20	123.10	139.90	158.15	177.40
38					111.30	127.80	145.30	164.20	184.20
39					115.50	132.60	150.80	170.30	191.20
40					119.60	137.40	156.20	176.40	198.10
41					123.80	142.20	161.70	182.70	205.10
42					128.20	147.20	167.40	189.00	212.05
43						152.00	172.90	195.30	219.20
44							178.60	201.80	226.30
45							184.20	208.20	233.60
46							190.00	214.70	240.85
47							195.80	221.30	248.20
48							201.80	227.90	255.65
49							207.70	234.50	263.20
50							213.60	241.20	270.75

*Nebraska Agricultural Experiment Station Circular No. 6.

Note—To calculate the weight of the silage remaining in the silo after it has been partially emptied first find from the above table the amount of silage in the silo when filling ceased. Then find the capacity of the silo for the space which has been emptied and subtract this from the first. The difference is the amount of silage remaining in the silo. For example, 10 feet of silage remains in a 14-foot silo which was filled to a depth of 40 feet. The above table indicates that there were 119.6 tons of silage put in the silo and that a space 14 by 30 feet would contain 79.5 tons. Hence the difference, 40.1, indicates the number tons remaining in the silo.

TABLE 3.—QUANTITIES OF MATERIALS REQUIRED FOR VARIOUS MIXTURES OF MORTAR AND CONCRETE

Mixture materials for one-bag batch.				Resulting volume in cubic feet.		Quantities of cement, sand and pebbles or stone required for one cubic yard of compacted mortar or concrete.				
	Cement in sacks	Sand, cu. ft.	Pebbles or stone, cu. ft.	Mortar	Concrete	Cement in sacks	Sand		Stone or pebbles.	
							Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
1:1½	1	1.5		1.75		15.5	23.2	.86		
1:2	1	2.0		2.1		12.8	25.6	.95		
1:2½	1	2.5		2.5		11.0	27.5	1.08		
1:3	1	3.0		2.8		9.6	28.8	1.07		
1:2:3	1	2.0	3.0		3.9	7.0	14.0	.52	21.0	.78
1:2:4	1	2.0	4.0		4.5	6.0	12.0	.44	24.0	.89
1:2½:4	1	2.5	4.0		4.8	5.6	14.0	.52	22.4	.83
1:2½:5	1	2.5	5.0		5.4	5.0	12.5	.46	25.0	.92
1:3:6	1	3.0	6.0		6.4	4.2	12.6	.47	25.2	.94

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

TABLE 4.—STORAGE SPACE REQUIRED PER COW PER YEAR BASED ON BARN FEEDING PERIOD OF 200 DAYS

Item	Pounds Required Daily	Tons Required Per Year	Cubic Feet of Space Required
Hay	10—15	1—1½	525—788
Straw	5—10	½—1	275—550
Sawdust	10—15	1—1½	150—225
Shavings	5—10	½—1	80—160
Grain	8—12	.6—1.2	75—100

Reference—(Table taken from Neb. Exp. Sta., Circular No. 6.)

TABLE 5.—APPROXIMATE SIZE OF SILOS REQUIRED*

No. of Cows in Herd	When fed 40 pounds per day for 180 days.			When fed 40 pounds per day for 240 days.		
	Tons of Silage Required	Diam. of Silo (Feet)	Height of Silo (Feet)	Tons of Silage Required	Diam. of Silo (Feet)	Height of Silo (Feet)
10	36	10	28	48	10	34
15	54	12	30	72	12	35
20	72	12	35	96	12	44
25	90	14	34	120	14	42
30	108	14	38	144	14	46
35	126	14	42	168	14	42
40	144	16	38	192	16	48
45	162	16	42	216	16	50
50	180	16	45	240	16	55

*Computed from Nebraska Agricultural Experiment Station Circular No. 1.

TABLE 6

Quantity of Nails Required for Different Kinds of Work	Covering Capacity of Shingles	
	Exposure to Weather inches	Number of Shingles required for 100 sq. ft.
1000 Shingles—5 lbs. 4d, or 3½ lbs. 3d.		
1000 Lath—7 lbs. 3d.		
100 sq. yds. Lath—10 lbs. 3d.		
1000 sq. ft. Weatherboarding—18 lbs. 6d.		
1000 sq. ft. Sheathing—20 lbs. 8d., or 25 lbs. 10d.	4	900
	4½	800
1000 sq. ft. Flooring—30 lbs. 8d., or 40 lbs. 10d.	5	720
	5½	655
1000 sq. ft. Studding—15 lbs. 10d., or 5 lbs. 20d.		
	One bundle of shingles contains the equivalent covering capacity of 250 shingles if four inches wide.	

RULES FOR ESTIMATING QUANTITIES OF SHEATHING, FLOORING, ETC.

For common sheathing laid horizontally on a wall or roof without openings, add one-tenth to the actual superficial area to allow for waste. On the walls of dwellings, figure the walls as though without openings and allow nothing for waste. If sheathing is laid diagonally, add one-sixth to the actual superficial area.

For tight sheathing laid horizontally, add one-fifth for 6 inch boards, one-seventh for 8 inch boards, and one-ninth for 10 inch boards. If laid diagonally add one-fourth for 6 inch boards, one-sixth for 8 inch boards, and one-eighth for 10 inch boards.

For 3 inch matched flooring add one-half to the actual superficial area to be covered.

For 4 inch flooring add one-third, and for 6 inch flooring add one-fifth. Ceiling is measured the same as flooring.

For drop siding, add one-fifth to the superficial area.

For lap siding laid 4 inches to the weather, add one-half to the actual superficial area; if 4½ inches to the weather, add one-third.

MISCELLANEOUS DATA

One bushel=2150.42 cu. in. = 1.2444 cu. ft.

One cu. ft. of water weighs 62.417 lbs. at 32 degrees F.=7.84 gallons.

One cu. ft. of ice water weighs 57.40 lbs.

One cu. ft. of soft coal weighs 50 lbs.

One cu. ft. of hard coal weighs 54 lbs.

One cu. ft. of Portland cement = about one sack = 94 lbs.

One barrel Portland cement = four sacks = 376 lbs. = 3.8 cu. ft.

One cu. ft. loose hay weighs about 4 lbs. Compressed hay about 25 lbs. cu. ft.

One ton of hay occupies about 512 cu. ft.

One ton straw occupies 600 to 800 cu. ft.

One bushel of wheat or shelled corn = 1¼ cu. ft.

One bushel of ear corn = 2½ cu. ft.

One cu. ft. of plain concrete weighs about 150 lbs.

One gallon contains 231 cu. in. = .134 cu. ft.

One cu. ft. sand weighs 90 to 106 lbs.

One cu. ft. brickwork, cement motar weighs 130 lbs. With lime mortar 120 lbs.

One cu. ft. of settled silage weighs about 40 lbs.

One cu. ft. of hollow tile masonry weighs from 40 to 50 lbs.

One cu. ft. cinder concrete weighs about 100 lbs.

The priming coat should be made of white lead and raw linseed oil, with a small amount of turpentine and japan driers. After applying the priming coat, all nail holes and cracks should be well filled with putty, and covered with one or more coats of paint containing a smaller percentage of oil rubbed thoroughly into the surface.

In painting iron surfaces, all rust, dirt, and grease should be removed, scraping the surface with a wire brush or sandpaper and brushing off all loose particles. All surfaces should be clean and dry before painting.

Painting should be done, if possible, during the warm, dry weather, as the paint flows better in warm weather than in cold, and the surface to be painted is less liable to contain moisture, which will cause trouble under a painted surface.

WHITEWASH

Whitewash is one of the cheapest kinds of paints, and may be used on either the interior or the exterior of a building. Whitewash makes a very good coating for the interior of poultry and hog houses, as it preserves the wood and makes the interior more sanitary, cheerful, and more easily illuminated.

Whitewash can be made by slaking about ten pounds of quicklime in two gallons of water, covering the pail with a piece of cloth or burlap, and allowing it to slake for one hour. Water is then added to bring the mixture to a proper consistency for applying.

Whitewash may be applied to the surface with a broad brush, spreading it lightly. A weatherproof whitewash for exterior or interior surfaces may be made as follows:

(1) Slake one bushel of quicklime in 12 gallons of hot water.

(2) Dissolve two pounds of common salt, and one pound of sulphate of zinc in two gallons of boiling water; pour (2) into (1) then add two gallons of skim-milk and mix thoroly.

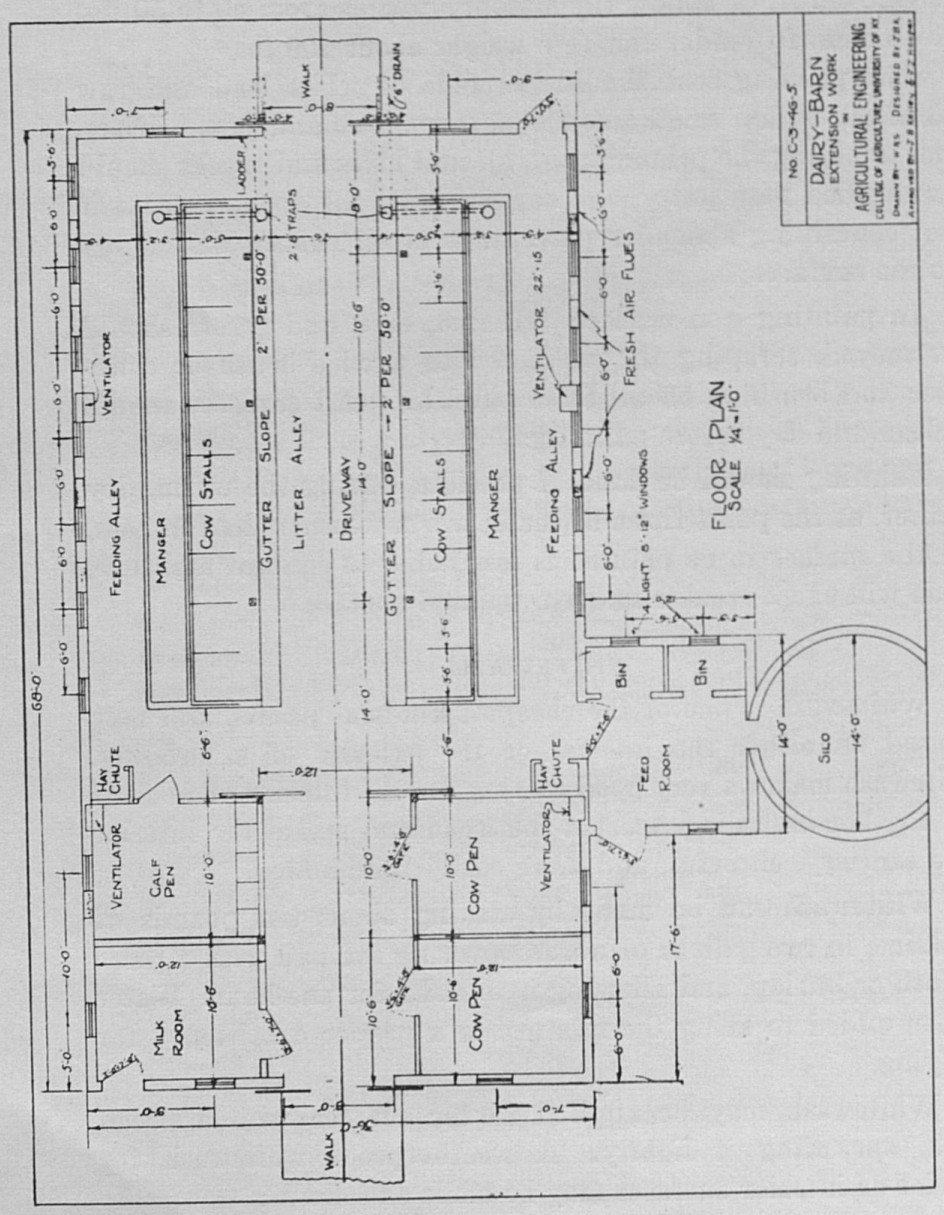
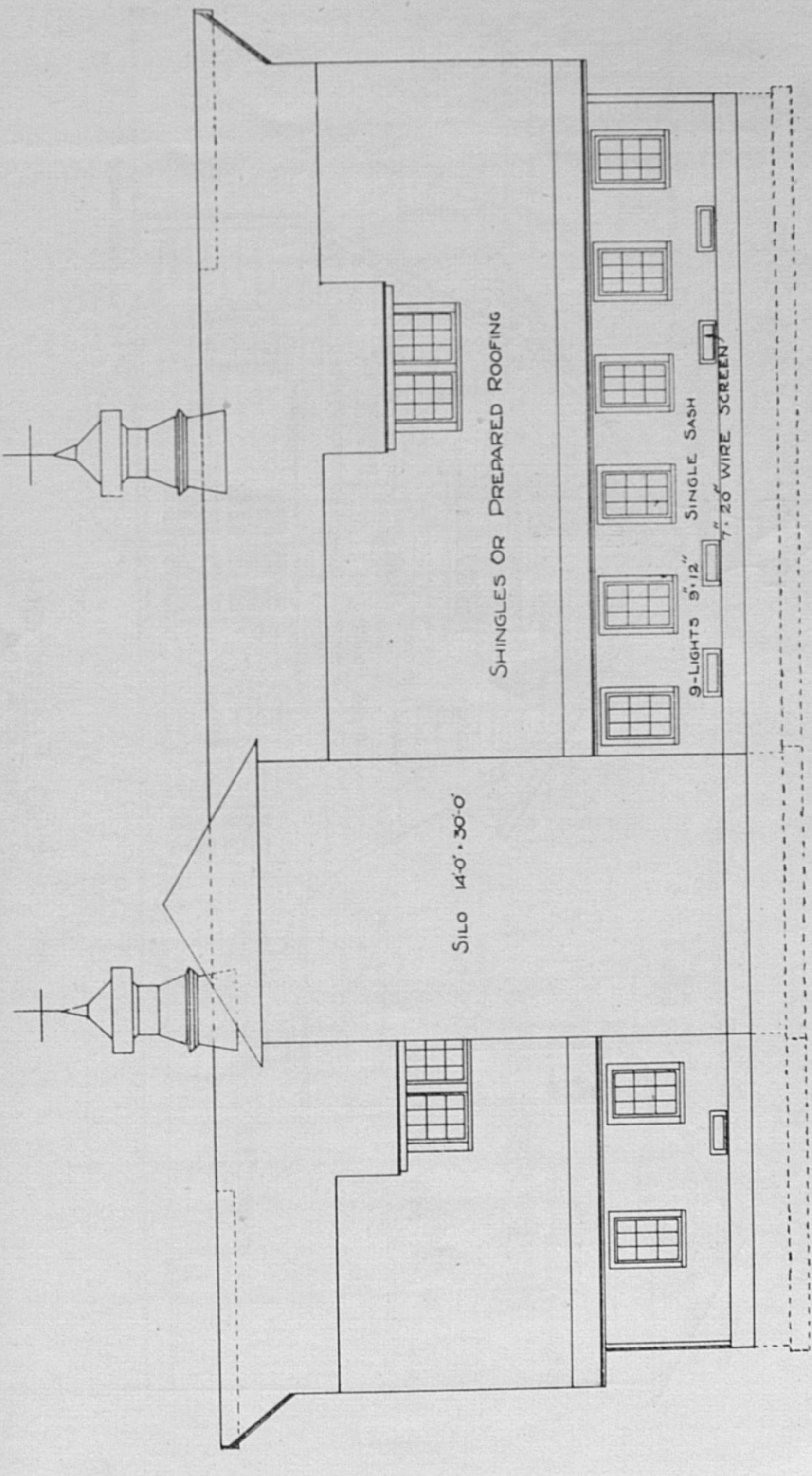
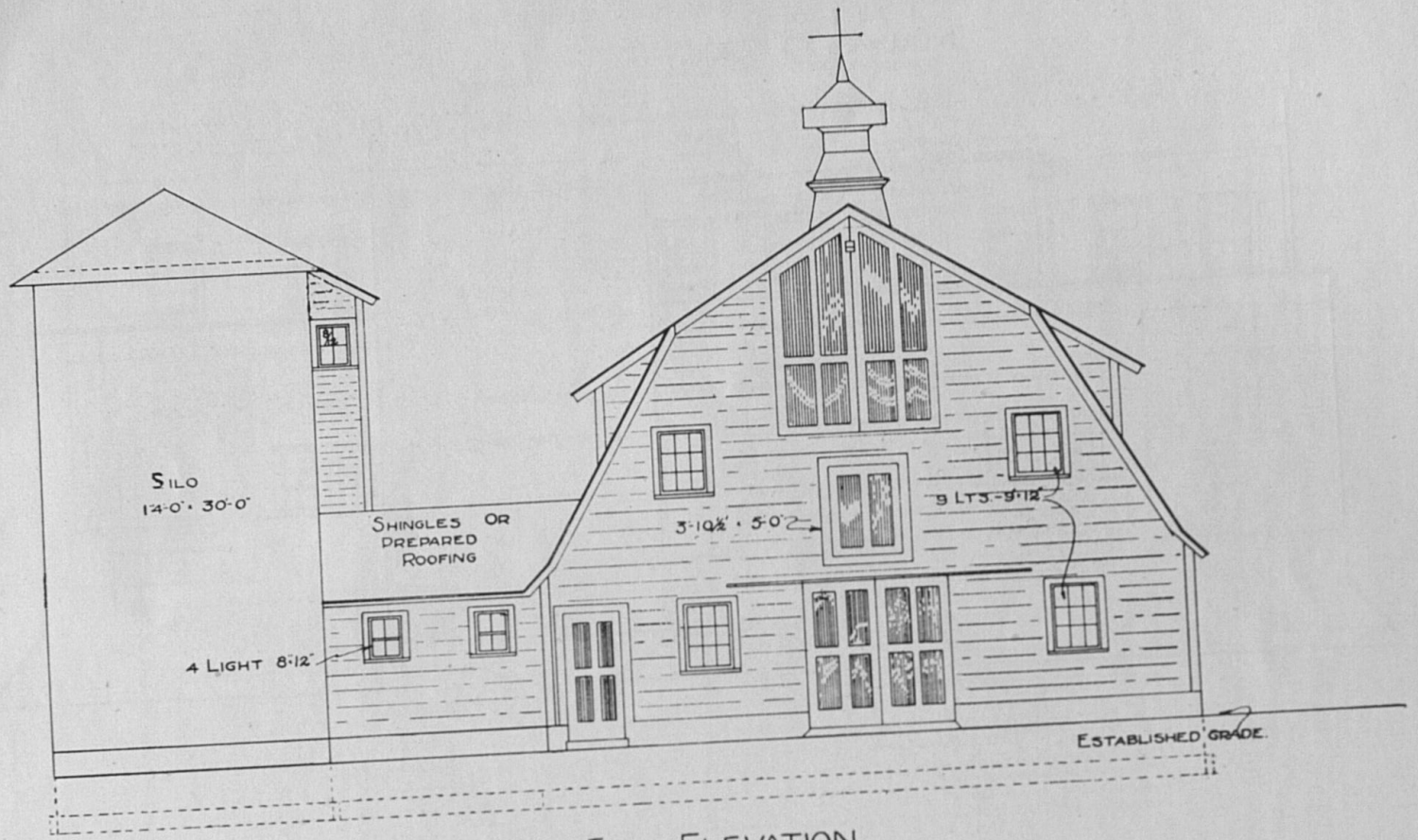


Fig. XIX. Plan C 3-46-5. Floor plan of a modernly equipped sanitary dairy barn, having concrete foundation and floors, frame structure with self supporting gambrel roof, loft space, ventilation system, 20-cow stalls facing out, calf pen, milk room, 2 cow pens, feed room and silo.



Side Elevation
Scale - ¼"·1'-0"

Fig. XXI. Plan C 3-46-5.

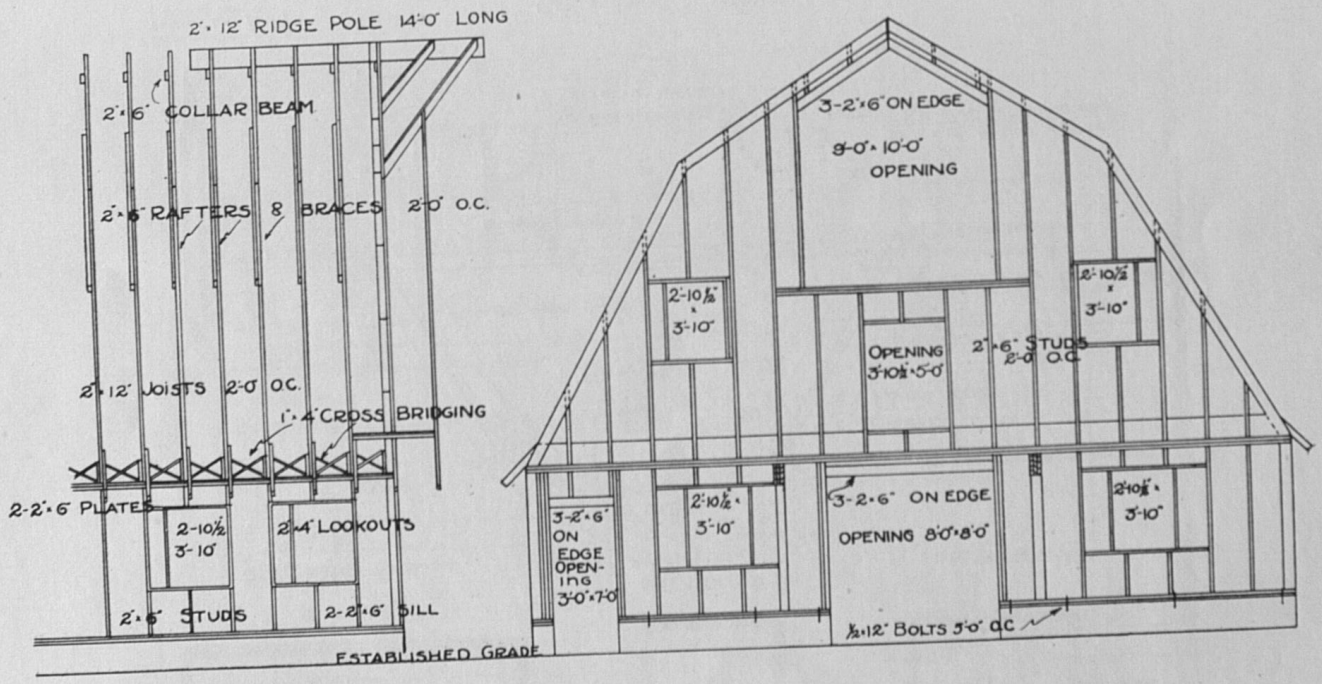


END ELEVATION
SCALE ¼ = 1-0

Fig. XX. Plan C 3-46-5.

END ELEVATION
SCALE ¼" = 1'-0"

Fig. XX. Plan C 3-46-5.



SIDE FRAMING
SCALE ¼"-1'-0"

END FRAMING
SCALE ¼"-1'-0"

Fig. XXII. Plan C 3-46-5.

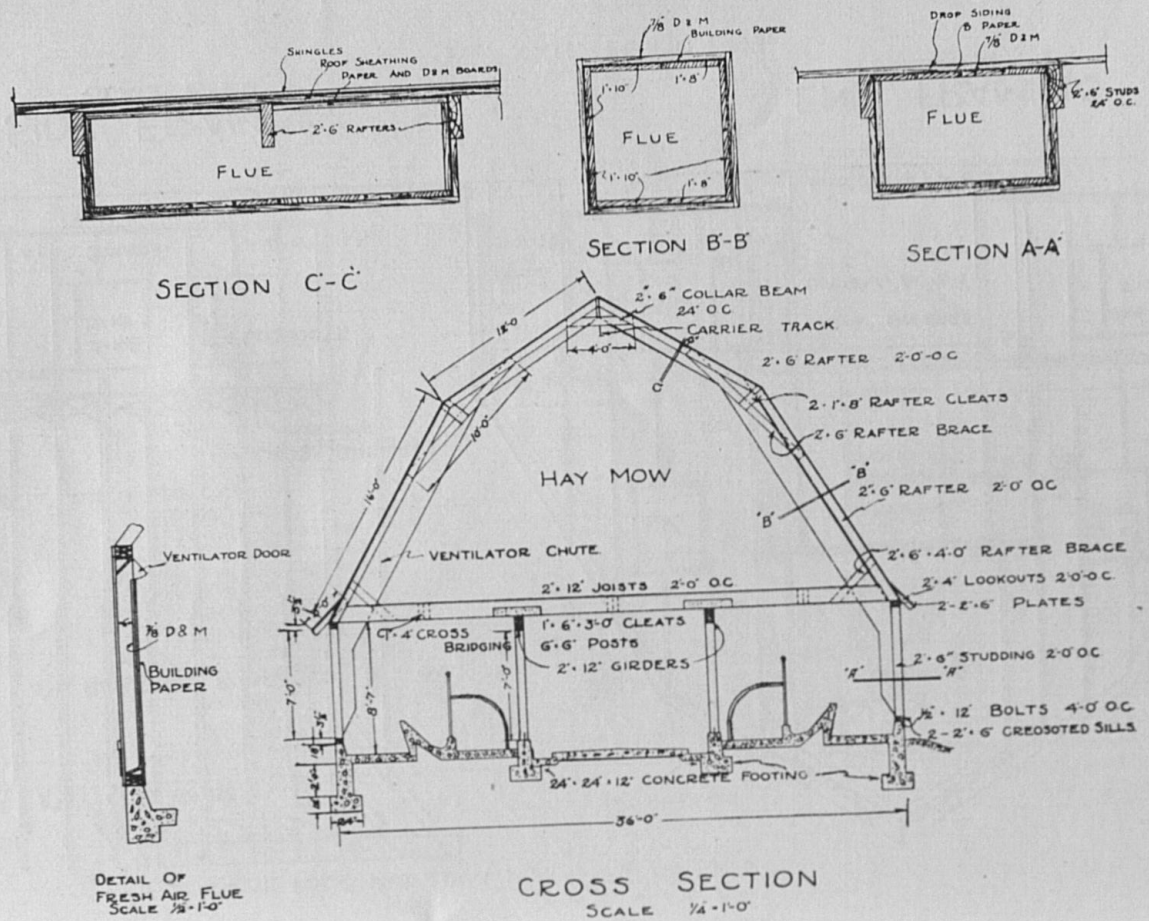
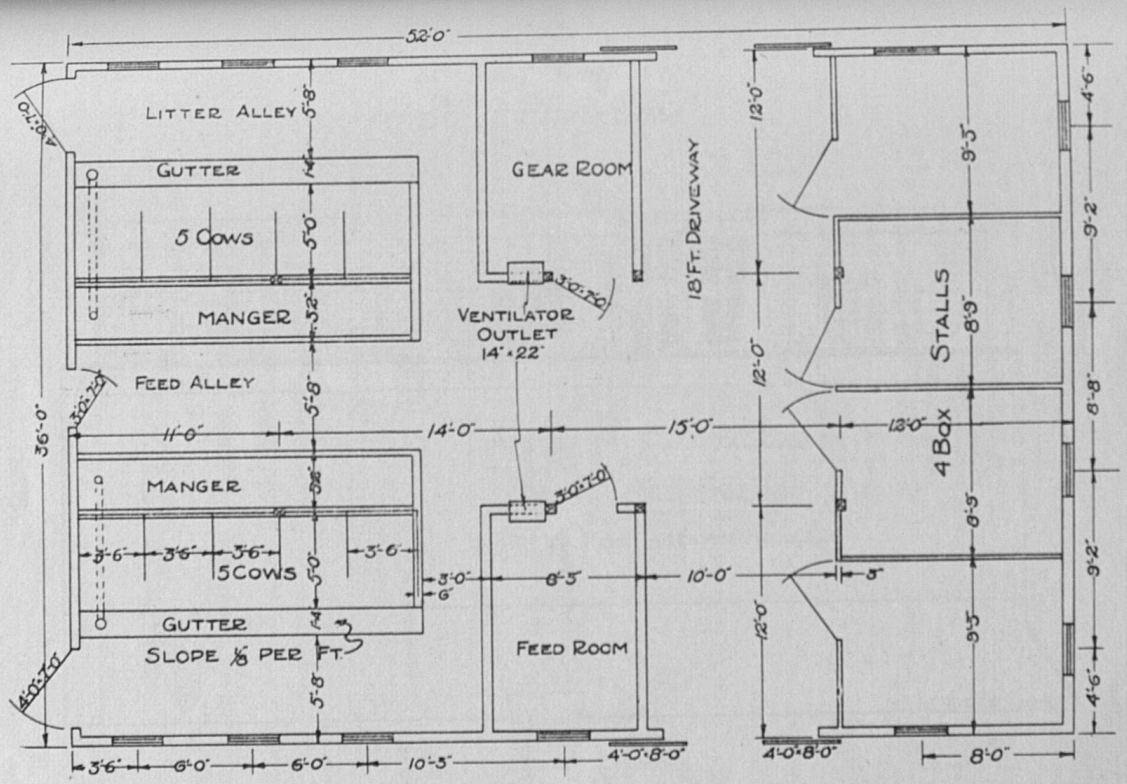


Fig. XXIII. Plan C 3-46-5.

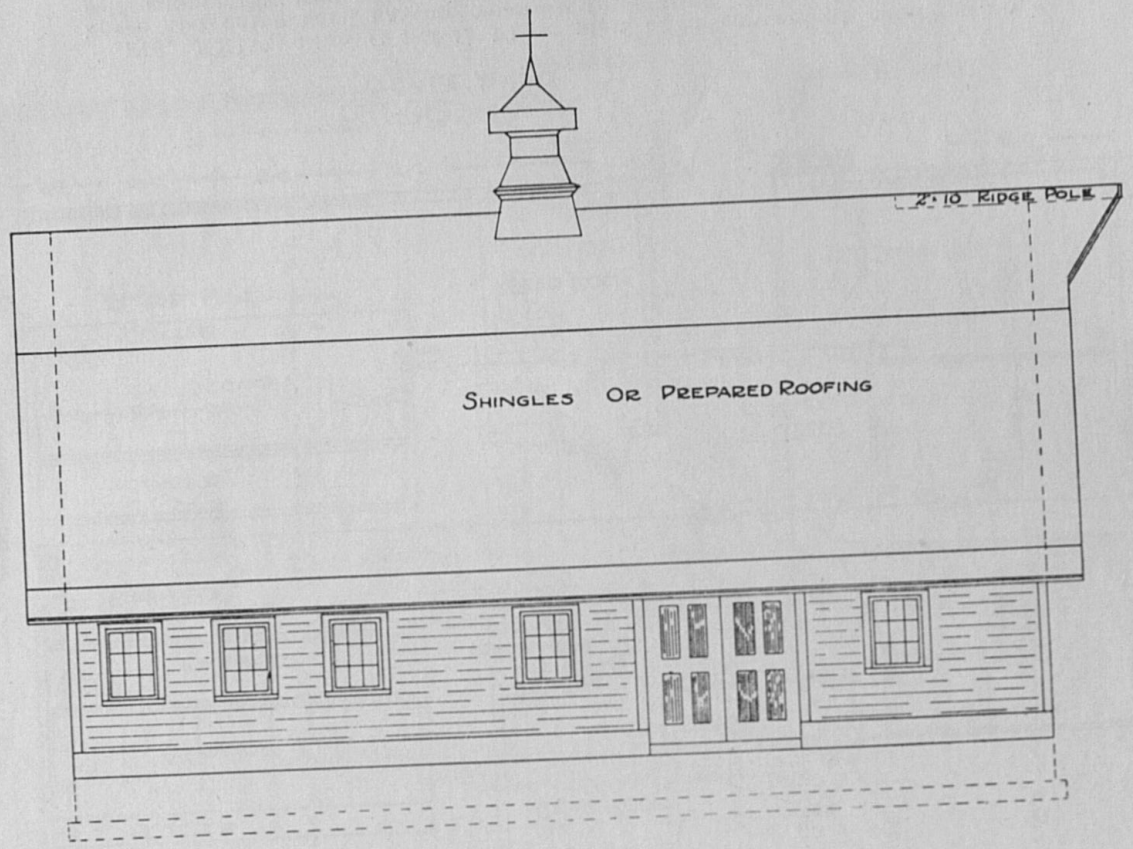
Scale ¼-1'-0"

Fig. XXIII. Plan C 3-46-5.



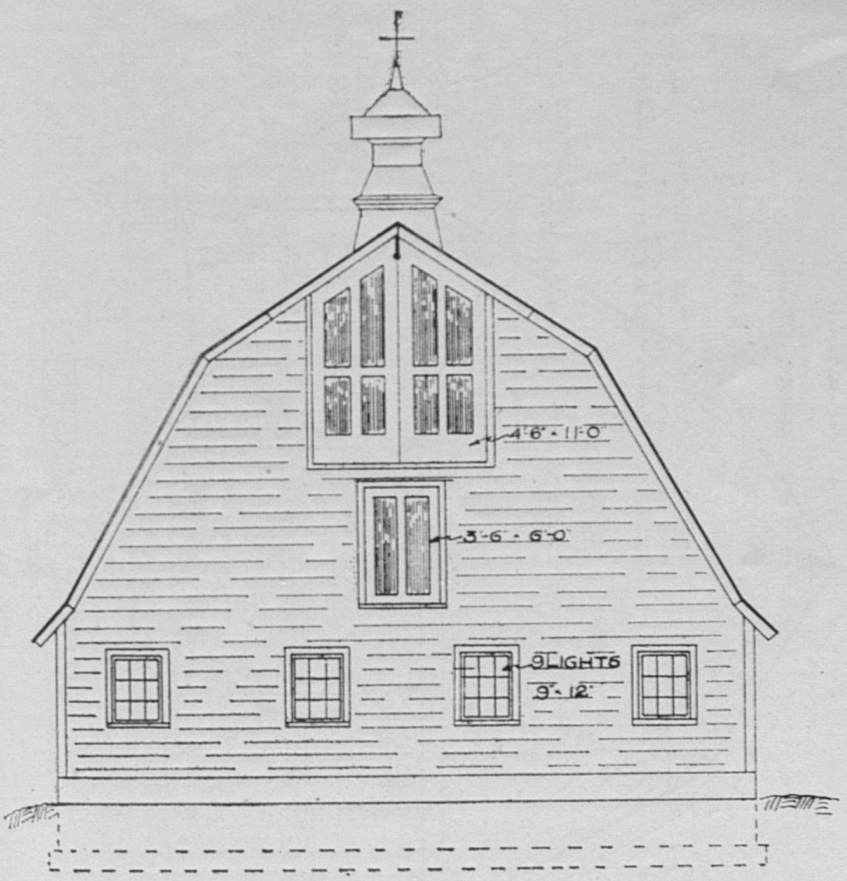
FLOOR PLAN
SCALE ¼-1'-0"

Fig. XXIV. Plan C 1-53-4. Floor plan of a convenient combination horse and dairy barn having concrete foundation, frame structure with self supporting roof, loft space, 10-cow stalls facing in, 4-box stalls, driveway, feed storage and gear room.



SIDE ELEVATION
SCALE ¼"=1'-0"

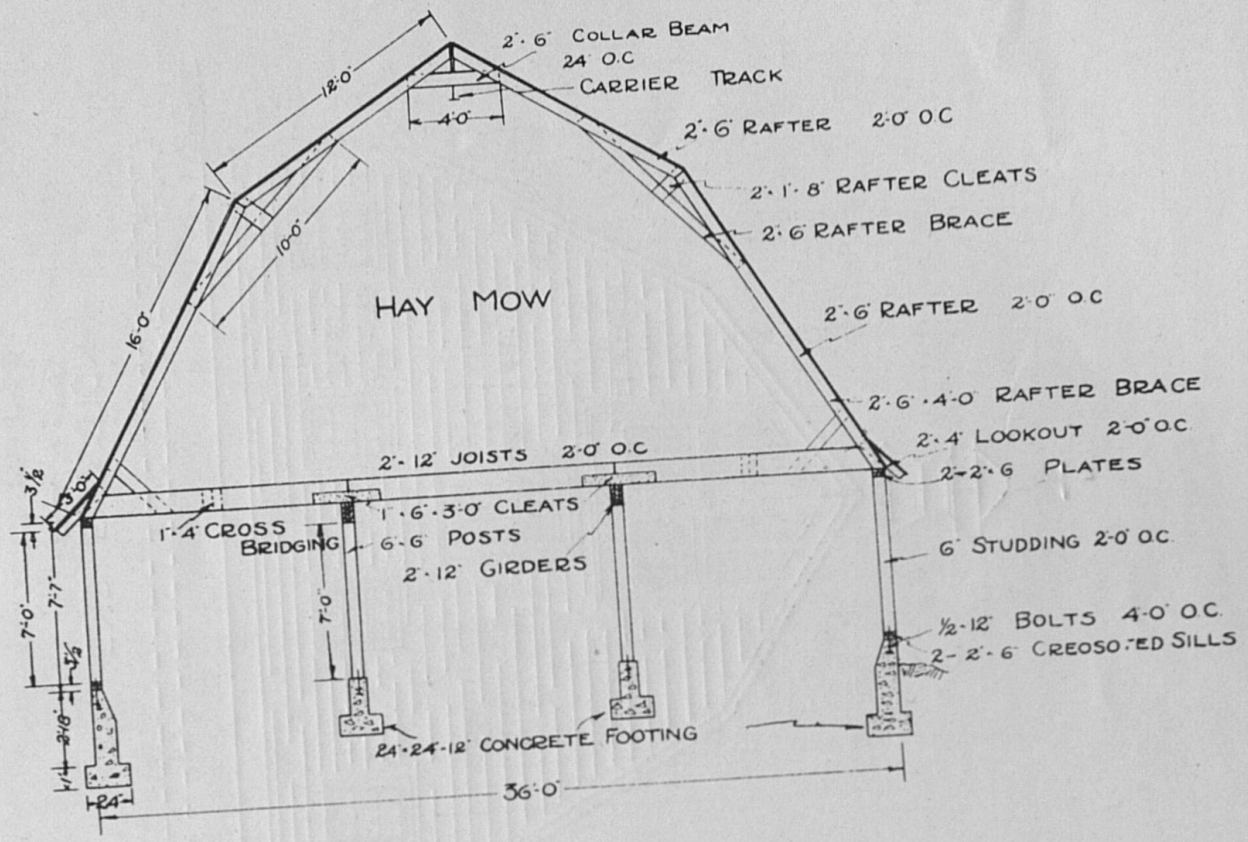
Fig. XXV. Plan C 1 53-4.



END ELEVATION
SCALE 1/4"=1'-0"

Fig. XXVI. Plan C 1-53-4.

Fig. XXV. Plan C 1 53-4.



CROSS SECTION

SCALE ¼"-1'-0"

Fig. XXVII. Plan C 1-53-4.

Fig. XXVII. Plan C 1-53-4.

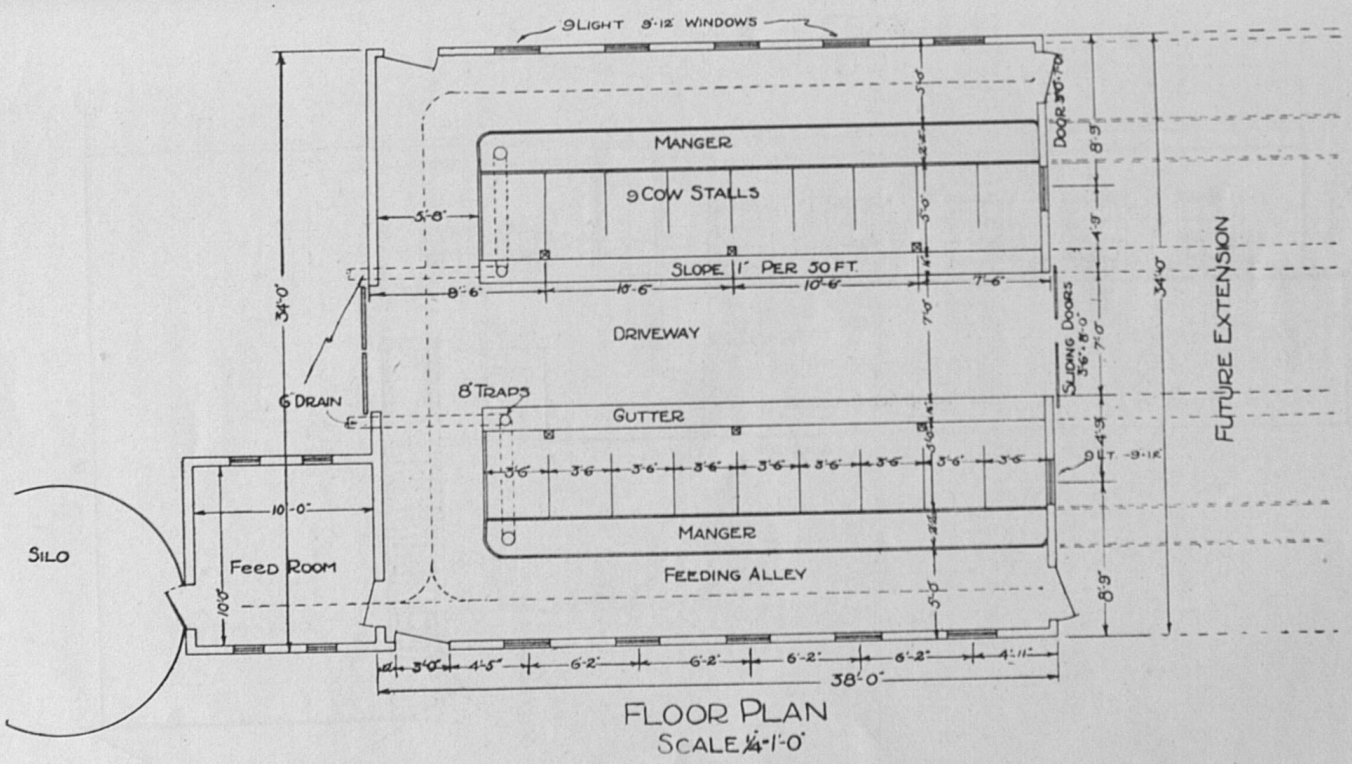


Fig. XXVIII. Plan C 3-51-3. Floor plan of a one-story 18-cow dairy barn having concrete foundation and floors, frame structure, modern cow stall equipment, feed room and silo, but no storage space for hay or straw.

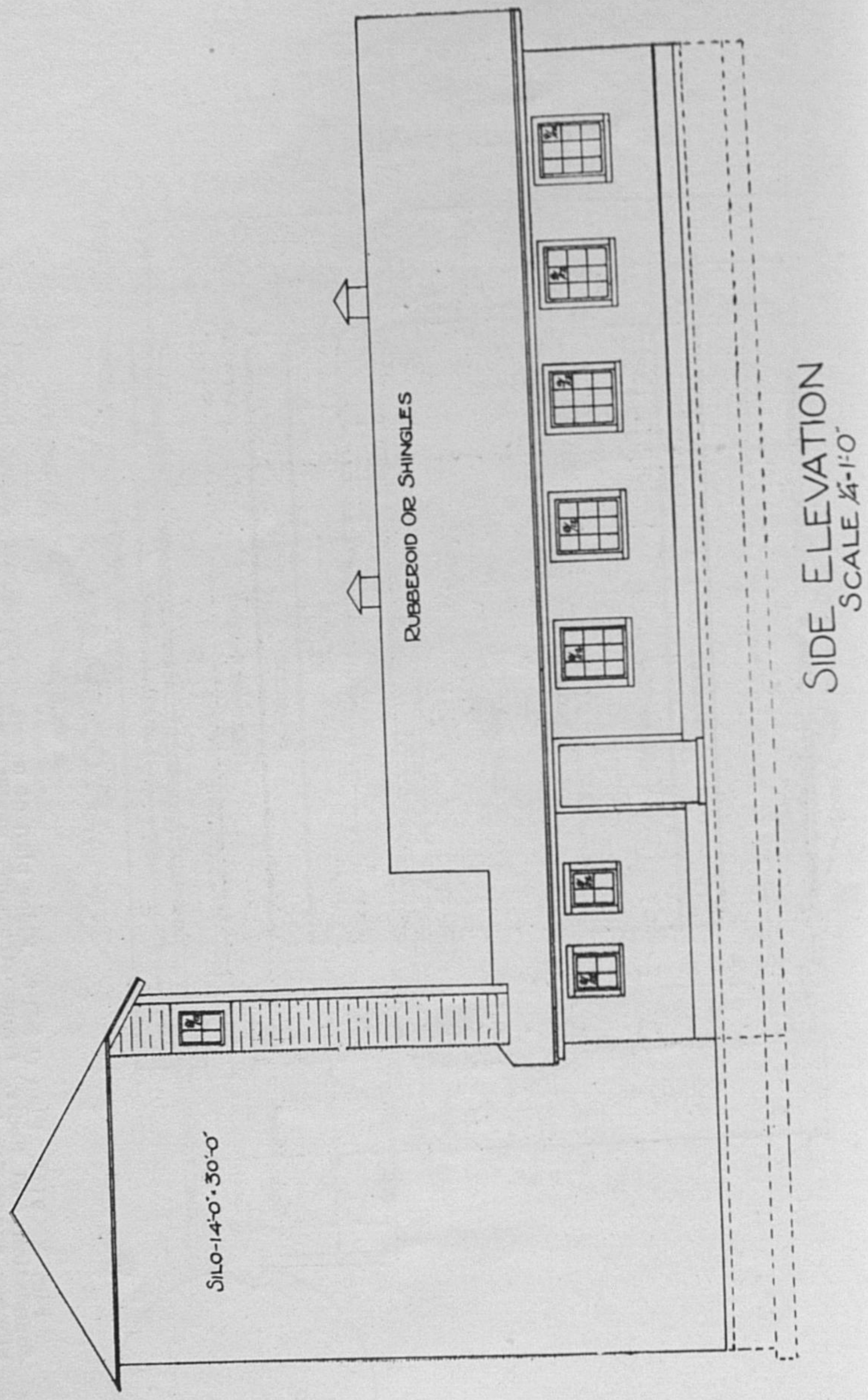


Fig. XXIX. Plan C 3-51-3.

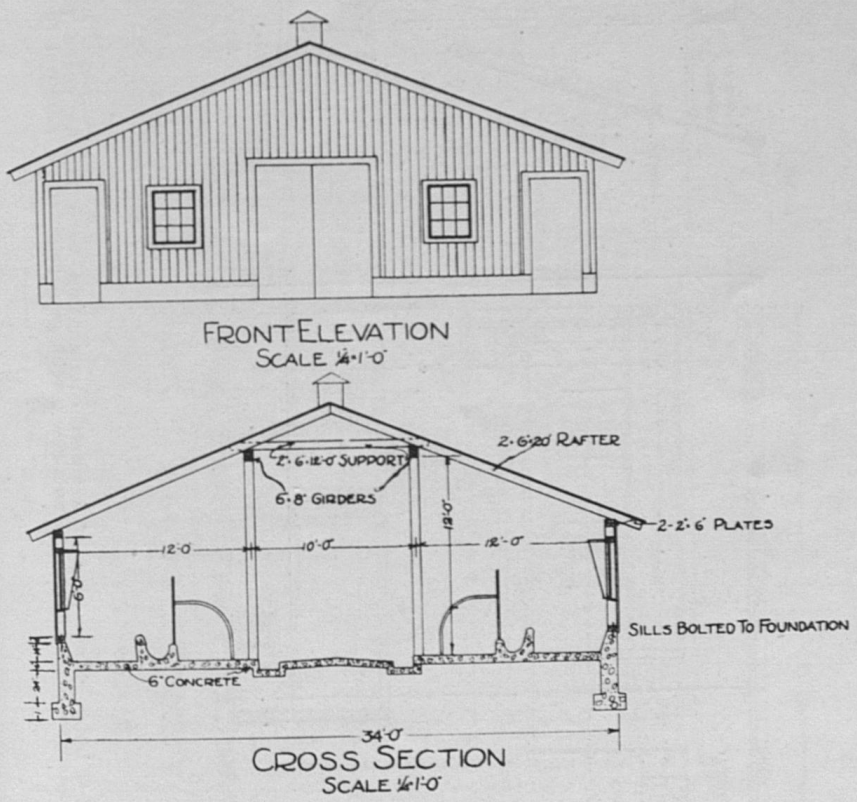


Fig. XXX. Plan C 3-51-3.

SIDE ELEVATION
SCALE 1/4"-1'-0"

Fig. XXIX. Plan C 3-51-3.

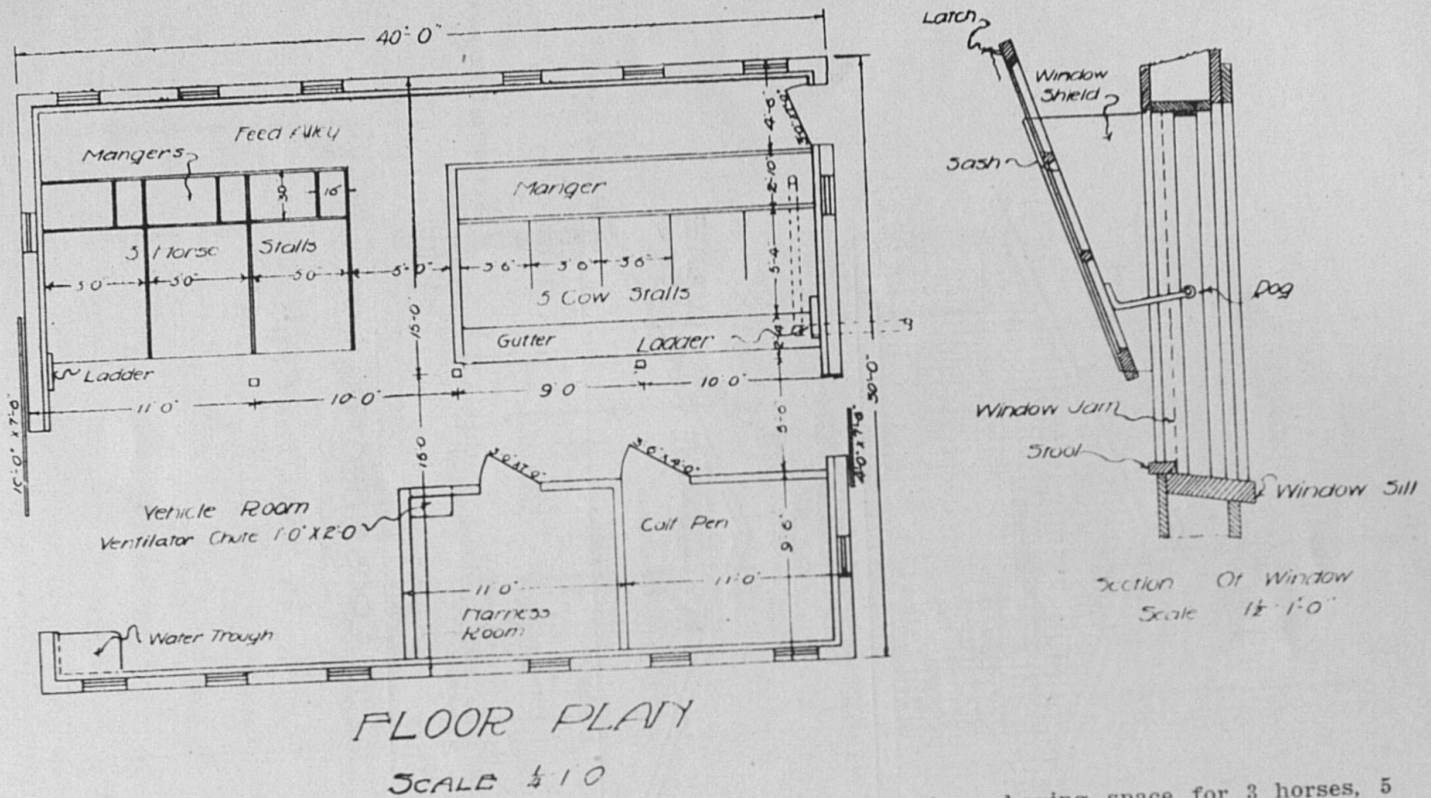


Fig. XXXI. Plan C 1-37-3. Floor plan of a small combination barn having space for 3 horses, 5 cows, one calf pen, harness room; extra storage space, concrete foundation, gambrel roof, and a large hay loft.

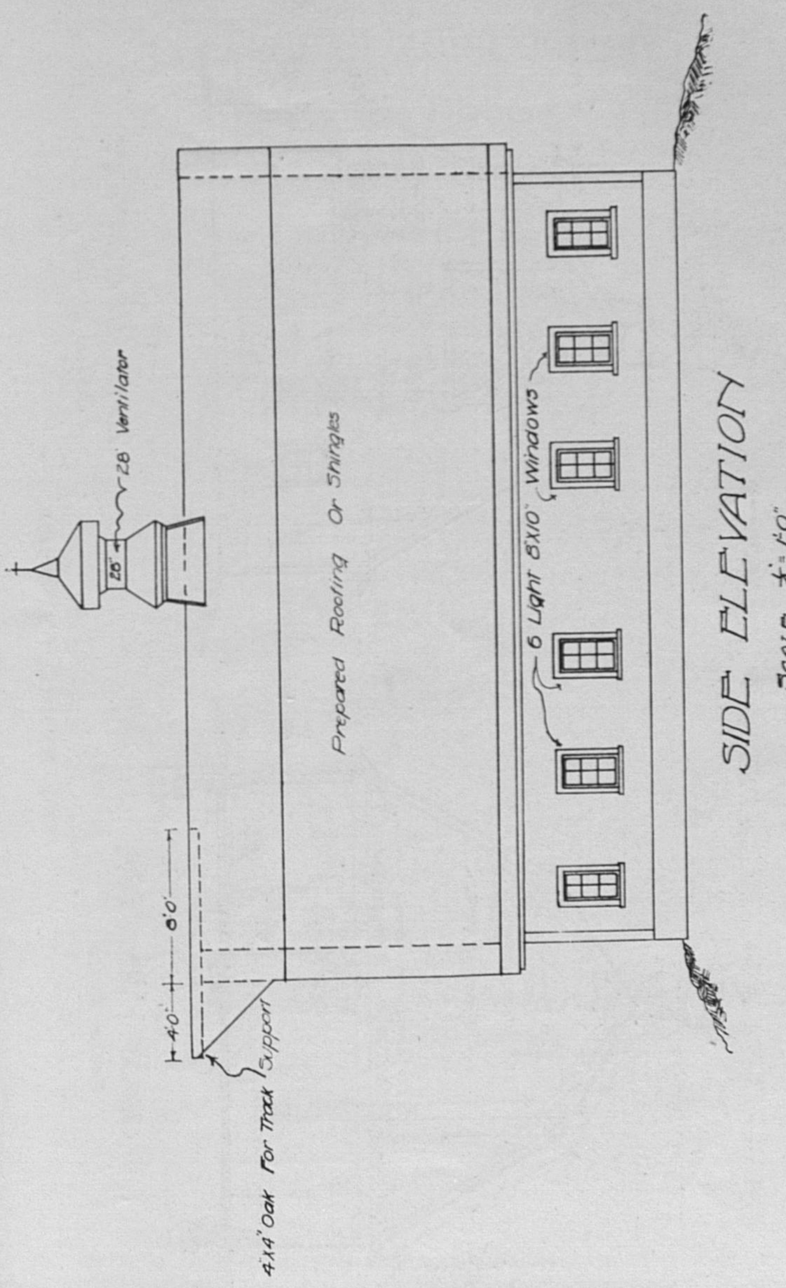
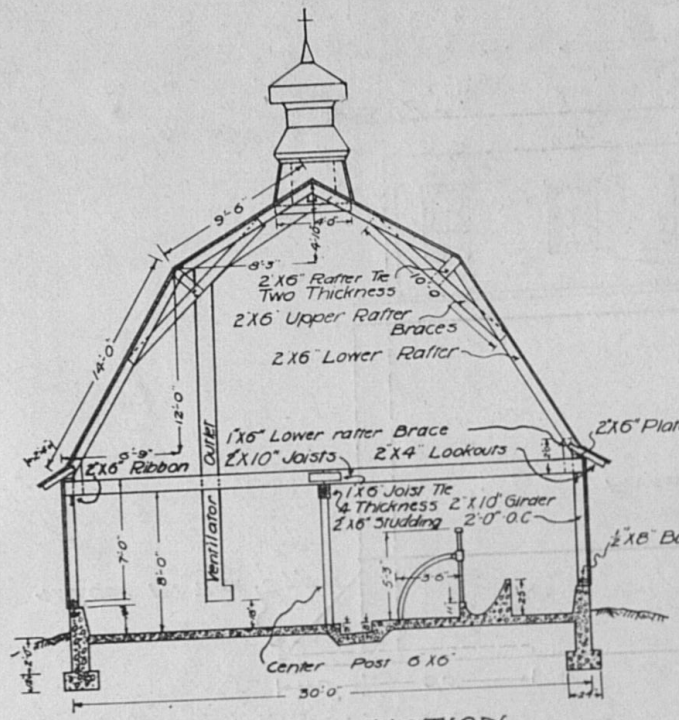
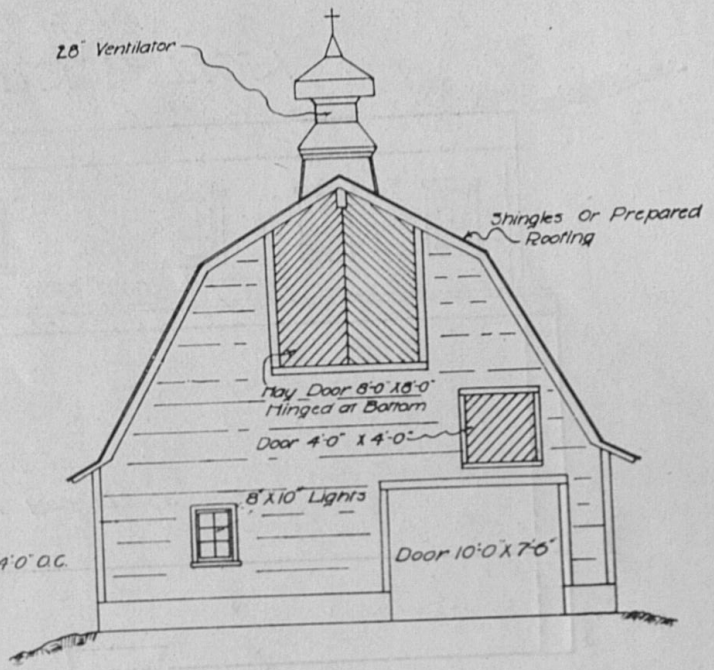


Fig. XXXII. Plan C 1-37-3.



CROSS SECTION

SCALE ¼" 1'-0"



END ELEVATION

SCALE ¼" 1'-0"

Fig. XXXIII. Plan C 1-37-3.