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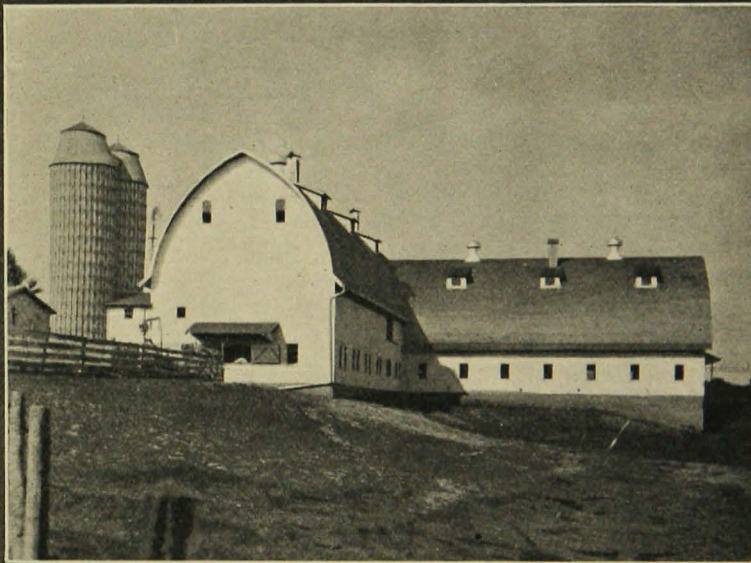
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BARNs

By

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Division of Agricultural Engineering
AGRICULTURAL EXPERIMENT STATION



A Modern Dairy Barn

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXTENSION DIVISION

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PLAN BEFORE YOU BUILD

1. Decide on location of new building.
2. Decide on space required in the building.
3. See county agent and dealers for plans and catalogs.
4. Make sketch showing arrangement desired.
5. Consult someone who has built a similar building.
6. Consult a good builder as to construction and local materials.
7. For further information write Division of Agricultural Engineering, University Farm, St. Paul, Minn.
8. Decide on plan to be used.
9. Obtain a list of material from builder who is to erect the building.
10. Submit list of material to dealers for prices.

PLAN BEFORE BUILDING

A well planned and well built barn saves labor, makes work more pleasant, decreases the loss of young animals, prevents waste of feed, increases milk production and the comfort of animals. A barn should be a good investment, that is, for the shelter provided, the animals should return to the owner a fair income on the cost of the building. This usually requires careful planning and management. Details of the method of caring for the animals should be thought out before construction work is started. Highly productive cows will pay for more expensive shelter than will scrub animals. The high cost of farm labor may warrant the installation of equipment that will save additional help and thus reduce expenses. Such equipment as drinking cups for a dairy barn should and often does increase the production and return a profit to the owner. It may be said of such improvements that even tho the farmer does not buy them, he sometimes pays for them by reduced production. Before building, one should make a careful study of barn plans and visit farmers who have good barns. Altho it is not always possible, because of lack of funds, to build as well as is desired, one is well repaid for the time spent in inspecting well built barns, in studying the best location for his own barn, and in so building it as to have as many of the conveniences and good points of arrangement as possible. Many features that give a great deal of satisfaction after the barn is completed do not cost much in dollars but must be planned for before the building is begun so that they may be installed with a minimum expenditure of time and money.

Location

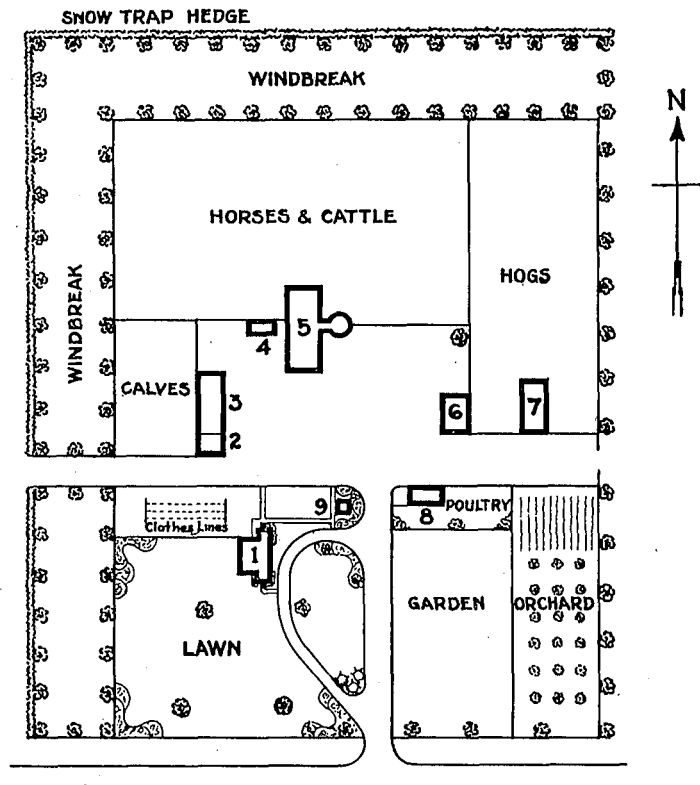
Farm buildings should be so grouped as to save steps in doing the work. Usually the barn should be about 150 feet from the rear of the house. Yards adjoining the barn should be well drained, as mud holes are a source of dirty milk, sore teats, and disease. It is desirable that the prevailing winds do not blow from the barn toward the house, carrying flies, odors, and noises. In Minnesota the prevailing winds are from a westerly direction, so the barn is usually located east of a north and south line passing through the house, or if west or southwest of the house, placed somewhat farther away. The Farmstead Plan 221, shown in Figure 1, has the barn located 150 feet to the north and slightly east of the house.

Kind of Barn Depends on Use

Barns are often classified, according to the animals sheltered, as general purpose, dairy, beef, horse, and sheep barns. Under

ordinary farm conditions the cattle and horses are sheltered in the same barn, which is usually called a general purpose barn. Such a barn is not best where a high class dairy herd is to be kept, because of the dust, flies, odors, and noises from the horse stable. In many cases the horse stable is built as an ell against one side of the dairy barn. Another arrangement is to separate the horse stable from the cow stable by a partition with doors which are kept closed as much as possible.

Barns are also classified according to shape, as rectangular, round, L-, U-, and T-shaped.



LEGEND.

- | | | |
|-------------------|-------------------------|-------------------|
| 1. HOUSE. | 4. ICE & MILK HOUSE. | 7. HOG HOUSE. |
| 2. SHOP & GARAGE. | 5. BARN. | 8. POULTRY HOUSE. |
| 3. MACHINE SHED. | 6. CORN CRIB & GRANARY. | 9. WELL HOUSE. |

FARMSTEAD PLAN 221

Fig. 1. A Good Farmstead, Plan 221

Various Factors Control Size

On planning the size of a barn attention should be given to the number of animals that can be sheltered and cared for comfortably as well as to space for their feed. The width will be from 30 to 36 feet. In Minnesota, because of the cold winters, 34 feet is usually regarded as the maximum width desirable. The length of a barn is limited by hay carrier equipment, slope of ground, etc. This results in the adoption of L-, or U-shaped barns instead of exceedingly long rectangular ones. The first story is from 8 to 8½ feet high. As a ton of hay in the mow occupies about 500 cubic feet, the mow space required can be figured when the number of animals, the feed, ration, and the length of the feeding season are known. The size of alleys, gutters, mangers, cow and horse stalls usually found desirable is shown in the details of stalls in Figure 15, Plan 188; Figure 16, Plan 121; and Figure 17, Plan 187.

Convenience Essential in Arrangement

In small barns the animals stand in a single row. The doors should be so placed that one opens into a yard connecting with the pasture while the other allows the horses to be brought out to be hitched to vehicles or implements at the implement shed without passing through the cow yard. The farm barn is usually rectangular with two rows of animals facing either in or out as shown in the plans in this bulletin. In the round barn the animals stand in a row around the centrally placed silo. According to the more modern arrangement, the first floor is entirely occupied by the stock and the space overhead used for the storage of feed.

Whether the animals should face out or in is largely a personal question. Each plan has advantages. They are:

When Facing Out

- Only one cleaning alley is required.
- Operation of milking machine is more simple.
- Sunshine falls on mangers.
- Only one door is required from the cattle yard.
- Herd shows to better advantage.

When Facing In

- Feeding is done from one alley.
- Ventilation system can be installed more easily.
- Better light is provided for milking cows or grooming horses.

Good Equipment Saves Labor

Drinking cups, litter and feed carriers, chutes, milking machines, etc., have much to do with the saving of time in caring for the animals. Stanchions that can all be operated by one lever save

time. Stanchions for calves save time, prevent waste of feed, and keep the calves from sucking each other. Gutters, that help in keeping the animals clean, make their care much easier and thus save time. If drinking cups can not be afforded, an inside tank with a float may be kept filled from a tank at the well, thus making it unnecessary to turn animals out on stormy days. Hay slings or a hay fork for filling the mow are desirable. The hay over the animals helps to keep the stable warm in winter, and is convenient for feeding.

Good Lighting Is Important

Barns are usually not sufficiently lighted. A square foot of window to every 20 or 25 square feet of floor is sufficient. Barns are best placed with the length north and south. This admits sunlight through east windows in the forenoon and west windows in the afternoon. In Minnesota it pays to use storm sash on the dairy barn. Table 1 gives the spacing of windows for proper lighting of barns 30 to 36 feet wide.

Table 1—Spacing of Windows for Proper Lighting of Barns
(Windows measured from center to center)

Size of glass Inches	4-Light		6-Light		8-Light		9-Light		12-Light	
	Feet	In.	Feet	In.	Feet	In.	Feet	In.	Feet	In.
8x10.....	2	4	3	5	4	8			5	8
9x12.....	2	7	3	11	5	2	5	11	7	10
9x14.....	3	0			6	0				
10x12.....	3	0	4	4	6	0			8	8
10x14.....	3	4			6	8			10	0
10x16.....	3	10			7	8				
12x14.....	4	0			8	0				
12x16.....	4	8			9	4				

Health of Stock Depends on Ventilation

Ventilation furnishes fresh air, regulates temperature, and removes odors and moisture. Just as the draft of a stove fluctuates, so the flow of air in a ventilating system will fluctuate because of changing winds and temperature. The barn should be so built as to maintain a temperature sufficiently high that fresh air may be admitted even in cold weather without discomfort to the stock. For dairy animals, 50 degrees Fahrenheit is about right.

The air in the barn is moved through the ventilating system by the difference in temperature, by wind pressure, and by wind suction. Table 2 gives the amount of air per minute required by each farm animal, also the cross-section area of an out-take flue 20 feet high necessary for each.

Table 2.—Air Requirements per Minute per Animal and Area of Out-take Flue 20 Feet High

Animal	Air required per minute	Area of out-take flue
	cubic feet	square inches
1 Cow	59	36
1 Hog	33	20
1 Horse	55	32
1 Sheep	25	15

Usually the out-take flues extend from about 18 inches above the floor to 2 feet above the ridge. They should be as nearly plumb as possible and should have an opening near the ceiling for regulating the temperature. In-take flues are smaller than out-take flues and on account of the construction of barn walls are spaced along the wall. The outside opening for admitting air should be about 4 feet below the ceiling height. The air passing upward in the wall is admitted near the ceiling. If cows face out, the air is admitted through registers that may be partially or entirely closed on the windward side of the barn in severe weather. If cows face in, the flues are extended along the ceiling between joists to the middle of the barn, where the air is deflected downward.

Appearance Also an Asset

The barn to a considerable extent reflects the success of the farmer's business. It is a good plan to give special attention to making the barn attractive. This usually is not so much a matter of extra expense as of care in planning. The shape of the building, including location of doors and windows; the overhang of the roof; and the painting are the three most important points in regard to appearance. The roof, which is a conspicuous part of the barn, should have careful study and be properly proportioned. With the many plans now available there should be few poorly designed roofs.

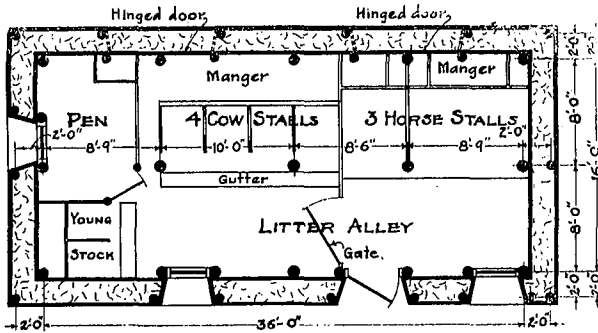
Types of Construction Vary

For barns built of lumber there are three styles of framing: the balloon, the timber, and the plank frame. For barns of moderate size, the balloon frame is most common. It consists of studing and rafters spaced 2 feet on centers and so braced that each pair of rafters supports its share of the roof. The timber frame, mortised and pinned together, was very common when large timbers were easily obtained, but as lumber becomes scarce in any locality this type is replaced by the plank frame, in which planks are bolted together forming trusses for the roof 12 or 14 feet apart.

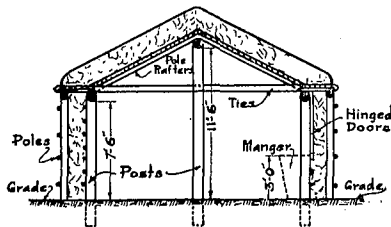
Windows should be either hinged at the bottom and open in at the top or be double hung, as in houses. Storm windows are desirable on dairy barns in Minnesota. Details of construction

are shown in the cross-sections of barns in Figure 18, Plan 116, and in Figure 19, Plan 180. In order to stand plumb and true a building must be well nailed and well braced. A slight saving in first cost may shorten the life of the building many years.

Figure 2, Plan 236, shows a straw stable that can be built with a small outlay of money. The frame is of poles set in the ground. Other poles are used for plates, rafters, etc. When well covered and banked with hay or straw it is a very comfortable shelter for stock, even in cold weather. Such a building should stand north and south with the door on the east side. During the winter the hay is taken in through this door. If desired, wooden doors may be arranged lengthwise along the west side just above the manger. These can be closed and banked in cold weather and opened in mild weather for light, ventilation, and convenience in feeding. Hay, for convenient summer feeding, may be stacked along the west side of the stable.



FLOOR PLAN



CROSS SECTION

STRAW STABLE PLAN 236

Fig. 2. A Good Stable for the Prairie Farm, Plan 236

Where softwood trees are plentiful, poles may be cut to equal length and used for a barn wall by standing them upright in place of studding and sheathing (see Fig. 3). These may later be boarded up outside and inside, making a permanent and comfortable building.

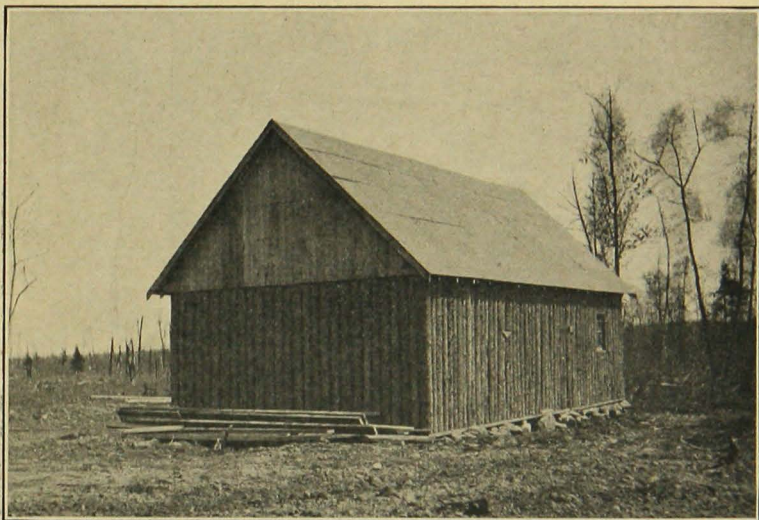
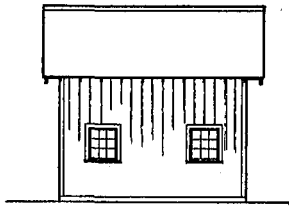


Fig. 3. A Pole-Walled Stable for the Wooded Region

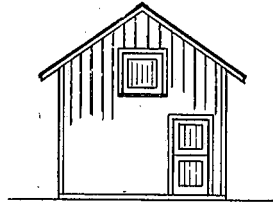
Plans Need Careful Study

In many localities a small barn is all that is needed. Figure 4, Plan 113, shows a barn for sheltering two horses and two cows. It is 16×18 feet with 12-foot posts. The roof is one-third pitch. This gives room for two or three loads of hay. Hay chutes are indicated above the mangers. The doors, commonly called "Dutch doors," are made so that the upper part may be left open for ventilation, while the lower part is closed to keep stock in the barn. Two large sash give sufficient light. The construction is very simple: 4×4 posts are used with 2×4 nailing girts, with boards and battens running up and down. If more room is needed, a barn of this plan built 32 feet long will shelter 3 horses and 5 cows very comfortably.

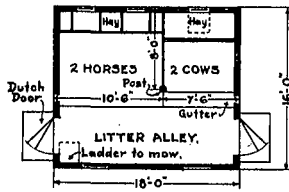
It is usually difficult to care for young animals in a small barn. Figure 5, Plan 115, shows a barn 16×36 feet, in which three horses, four cows, and two or three young animals may be sheltered. A box stall or maternity stall is also provided. The location of the door at the side makes it convenient to turn animals into the yard as well as to remove the manure.



SIDE ELEVATION



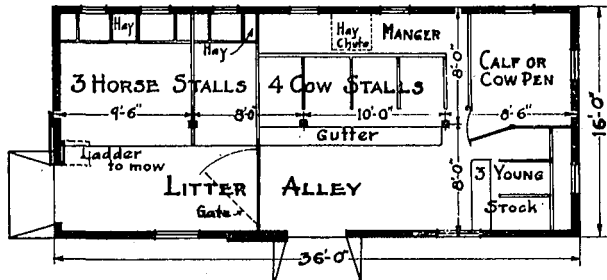
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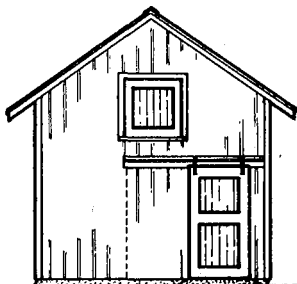
FIRST FLOOR PLAN

GENERAL PURPOSE BARN
PLAN 113

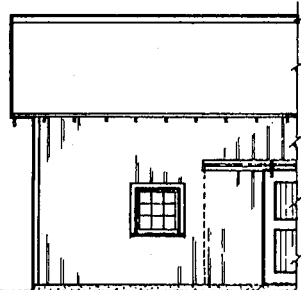
Fig. 4. Small Barn Built of Lumber, Plan 113



FIRST FLOOR PLAN



END ELEVATION

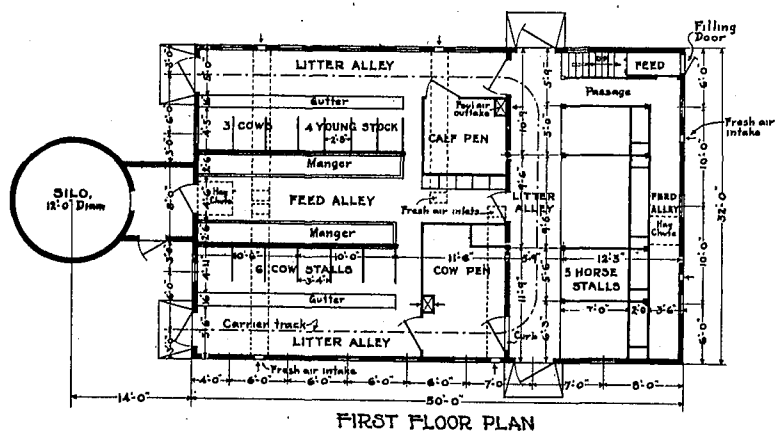


SIDE ELEVATION

GENERAL PURPOSE BARN
PLAN 115

Fig. 5. Barn for a Small Farm, Plan 115

If a considerable number of cows are to be sheltered, a single row requires a long, narrow building, which is not so economical to build or to use as one more nearly square. The common practice is to place the cows in two rows, facing either in or out. Figure 6, Plan 117, shows a barn 32×50 feet which shelters five horses, ten cows, four head of young stock, and also has a cow pen and a calf pen. It is often desirable to turn the horse stalls so that the feed alley is next the part of the barn occupied by the cows. In the plan shown, the litter carrier can be used in the horse stable to good advantage. The cows face in and are fed from one alley.



GENERAL PURPOSE BARN
PLAN 117

Fig. 6. Barn with Cows Facing In, Plan 117

It is desirable in some cases to drive through the barn lengthwise for the purpose of removing the manure. A barn 34×60 feet with this arrangement is shown in Figure 7, Plan 197. It shelters five horses, twelve cows, and three head of young stock, and has a calf pen, cow pen, and bull pen.

A General Purpose Barn

A general purpose barn 34×72 feet is shown in Figure 8, Plan 244. It shelters five horses and fifteen cows, and has a cow pen, a calf pen, and a bull pen. The stalls are 3 feet 6 inches wide for the cows, which face in. The horses face toward the wall. Thus the litter carrier can be conveniently brought to the litter alley. There is room in the ensilage room for ground feed, etc.

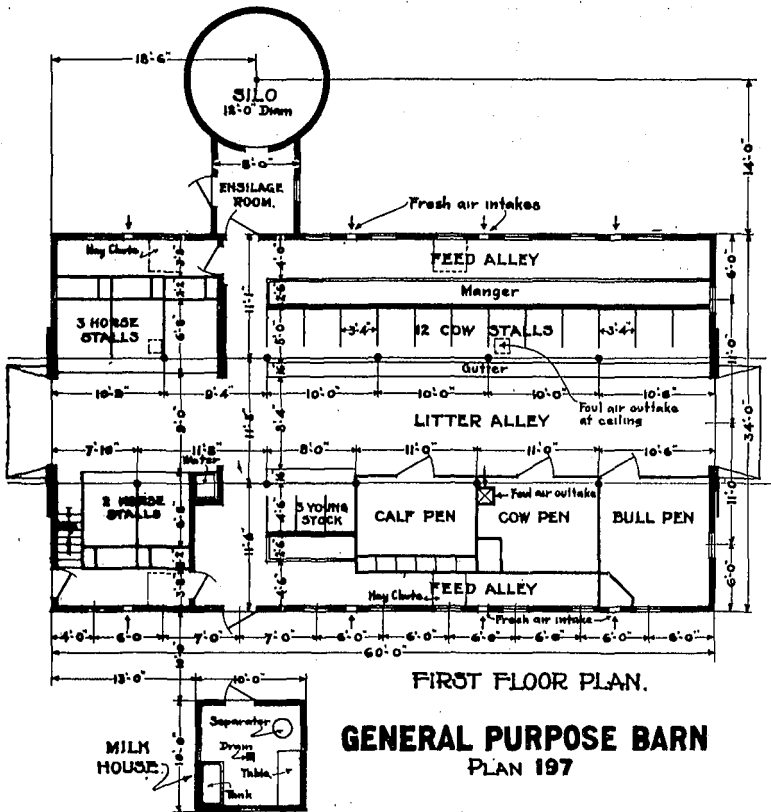


Fig. 7. General Purpose Barn, 34x60 Feet, Plan 197

A barn 36x76 feet is larger than is required on many farms and should be kept filled with stock and warmly built or it will be cold under Minnesota conditions. The one shown in Figure 9, Plan 174, shelters 5 horses and 14 cows and has a box stall, a cow pen, a calf pen, and a bull pen. The stock face out and the driveway is large enough to permit driving through with a spreader.

Hinged doors in addition to sliding doors are arranged to secure additional protection in severe weather. These doors may be removed in summer.

A barn for horses only is very similar to the horse stable part of a general purpose barn. Figure 10, Plan 185, shows the box stalls at one end and the single stalls at the other. Another arrangement is to use one side for box stalls and the other side for single stalls. No feed alley is shown in front of the stalls, the mangers being against the outside walls where hay chutes are located.

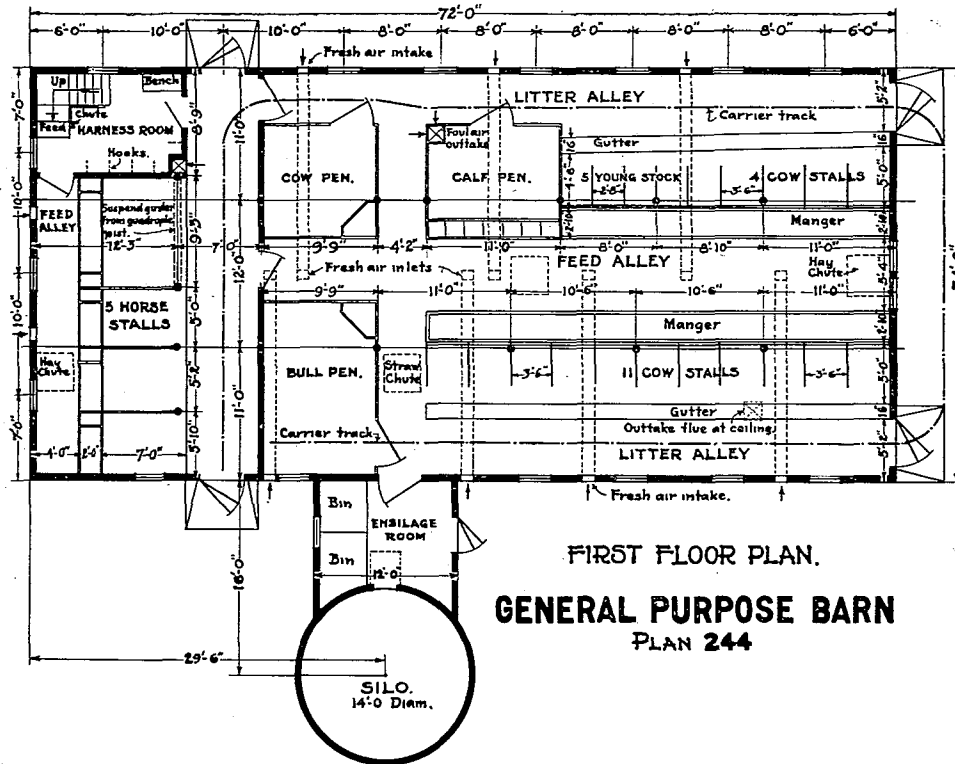


Fig. 8. General Purpose Barn, 34x72 Feet, Plan 244

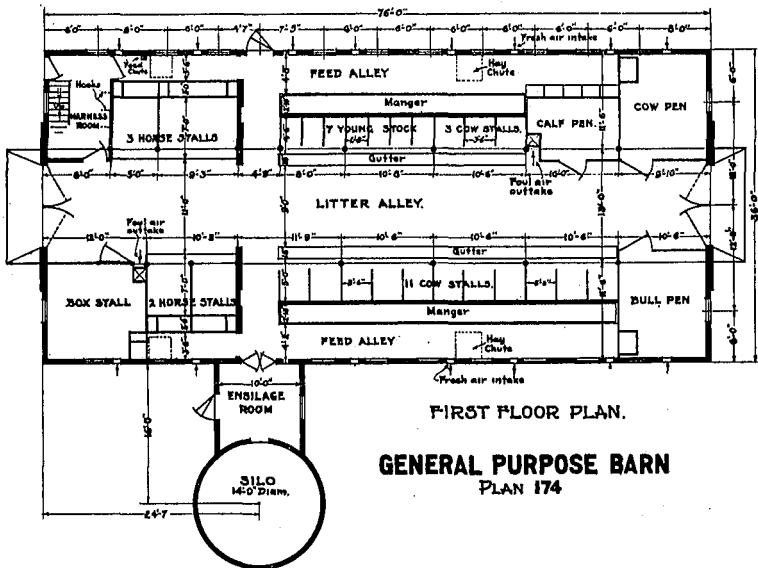


Fig. 9. General Purpose Barn 36x76 Feet, Plan 174

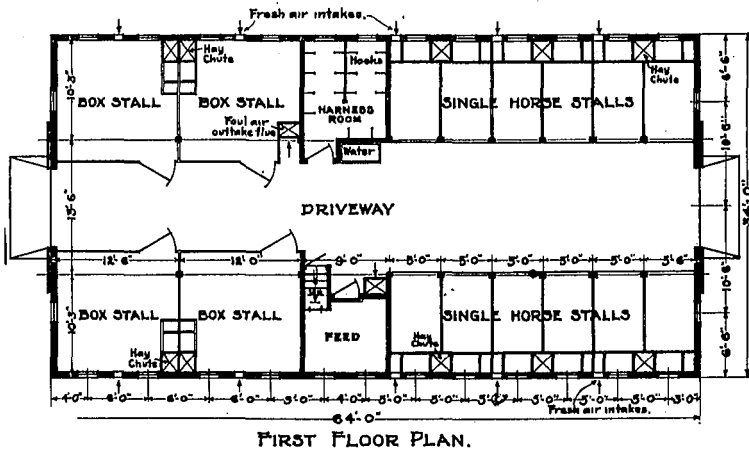


Fig. 10. Horse Barn, Plan 185

Barns for Beef Animals

A barn for sheltering beef animals is shown in Figure 11, Plan 176, and Figure 12, Plan 177. The two rows of animals face the feed alley and the young animals are in pens along the wall. The use of gates enables one man to care for the herd. The lean-tos may be built one at a time as the herd is developed and thus avoid a loss in remodeling. The floors of the pens are clay and the main floor is concrete. In some cases it may be desirable to make the cross-alley wide enough to drive through for hauling out the manure. Another beef barn arrangement is to extend the mow to the floor, with lean-tos on each side and mangers along the mow. Doors are placed at each end of the lean-tos so that a team may be driven through for removing manure.

Sheep Barn

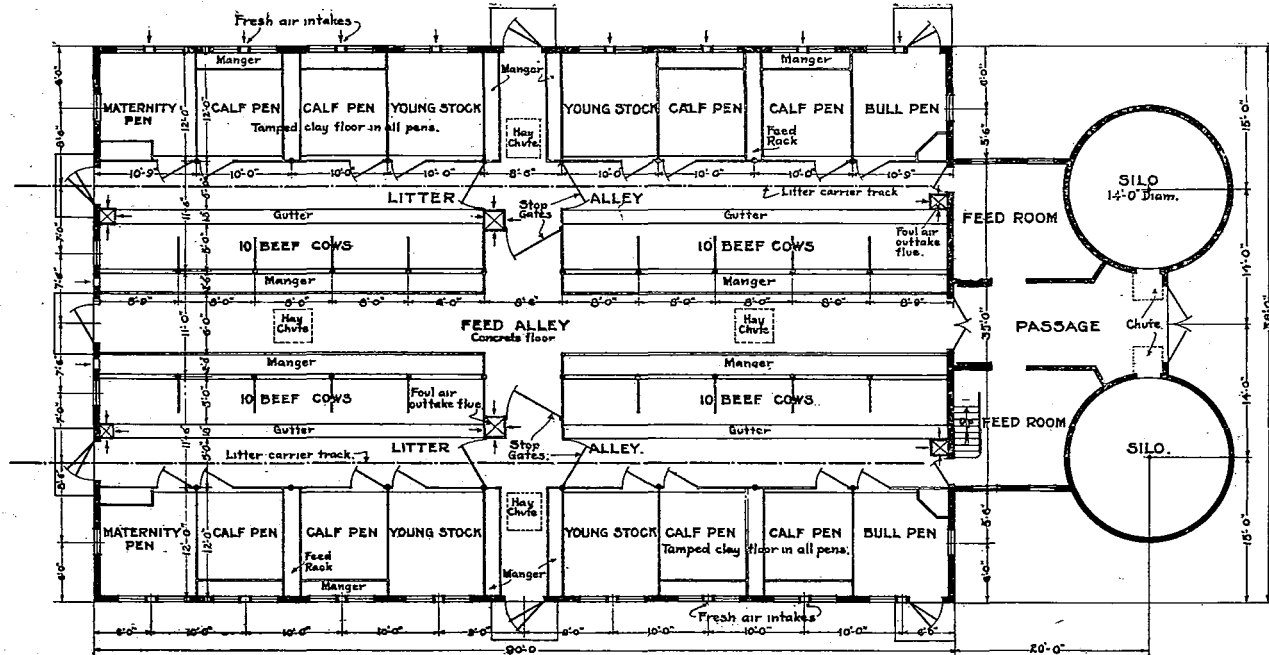
A sheep barn suitable for a farm flock is shown in Figure 13, Plan 192. It is a very simple building with shed roof and only one thickness of boards on the walls, with a concrete floor under the feed alley and manger only. The manger is sometimes placed against the wall. It is often built at one end of a building for sheltering beef animals, in which case the hay is stored overhead or in the beef part of the building.

Construction of Barns

Figure 14, Plan 130, gives an idea of the arrangement of bins, ladder well, and stairway of the second floor plan, which is often neglected in making up a barn plan. The second floor should be made good use of, as it is near the animals and feed stored can be fed with a small amount of labor and little waste. With a portable elevator available, it is often desirable to store the feed so that it may be drawn out of overhead bins by chutes as needed. If space permits, it is often more satisfactory to have a door at the foot of a permanent stairway.

The dairy cow stalls in Figure 15, Plan 188, show the measurements for a stall in a 36-foot barn with the cows facing out and also a stall in a 34-foot barn with the cows facing in. The range of measurements for width and length is also shown. If the barn is made narrower, the feed and litter alleys are the only parts made narrower.

A type of manger that is very satisfactory in some dairy sections is shown in Figure 16, Plan 121. The elevated feed alley makes it very easy to put back in the manger roughage that has been shoved out. The gutter shown is considered satisfactory by many dairymen.



FIRST FLOOR PLAN.

BEEF BARN
PLAN 176

Fig. 11. Beef Barn, Plan 176

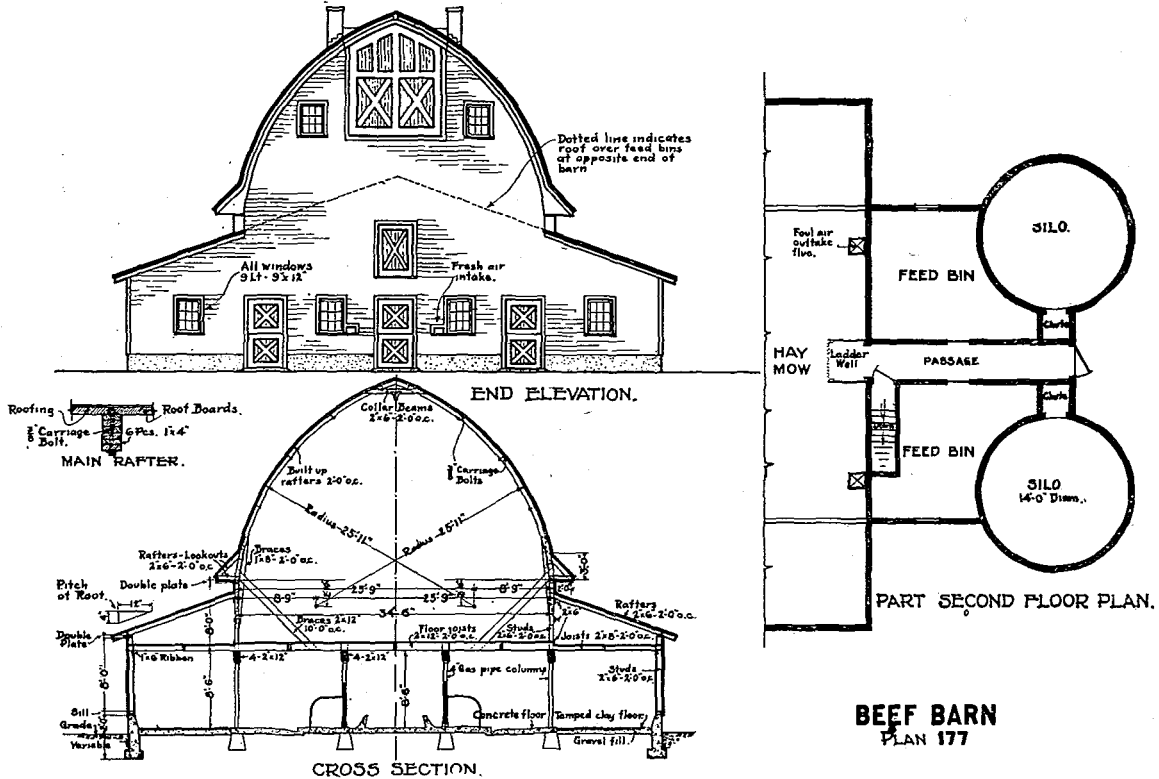
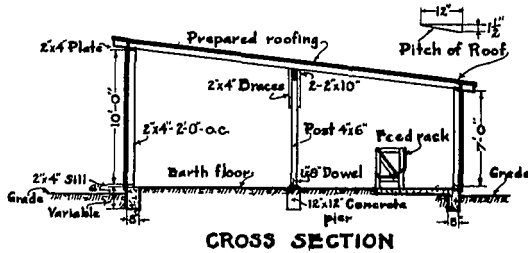
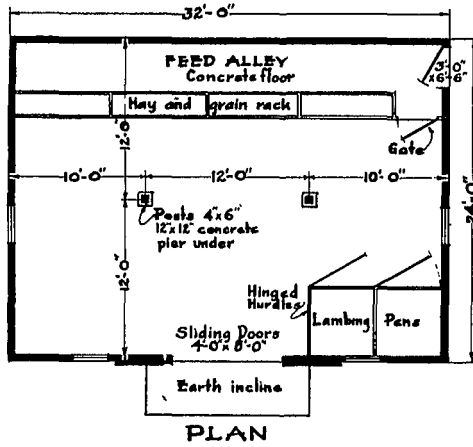


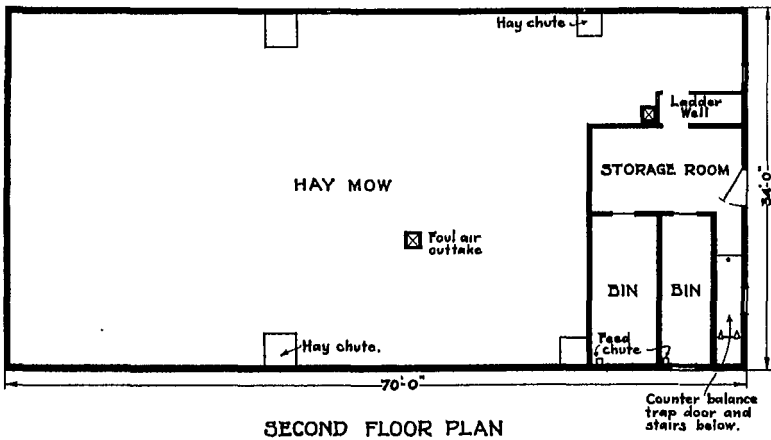
Fig. 12. End Elevation of Beef Barn, Plan 177

BEEF BARN
PLAN 177



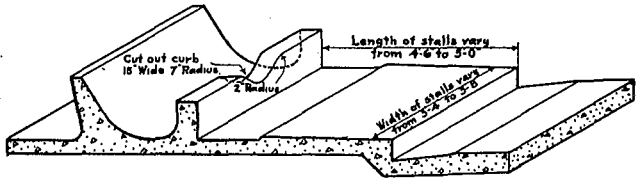
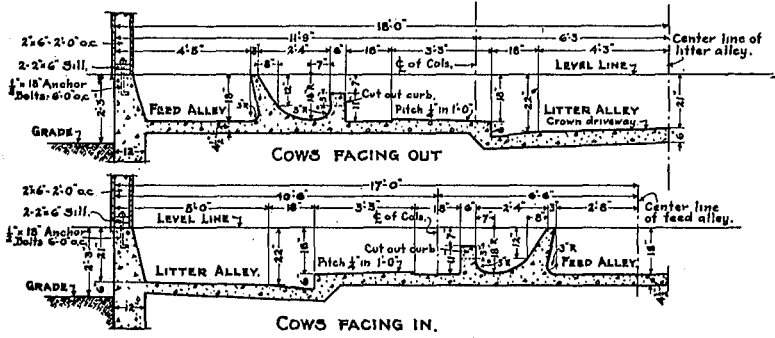
SHEEP SHED PLAN 192

Fig. 13. Sheep Shed for Farm Flock, Plan 192



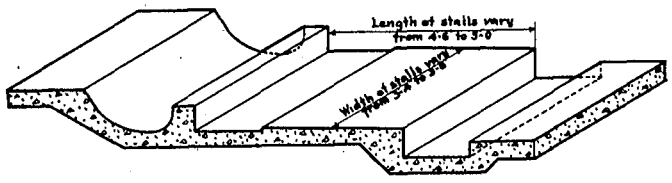
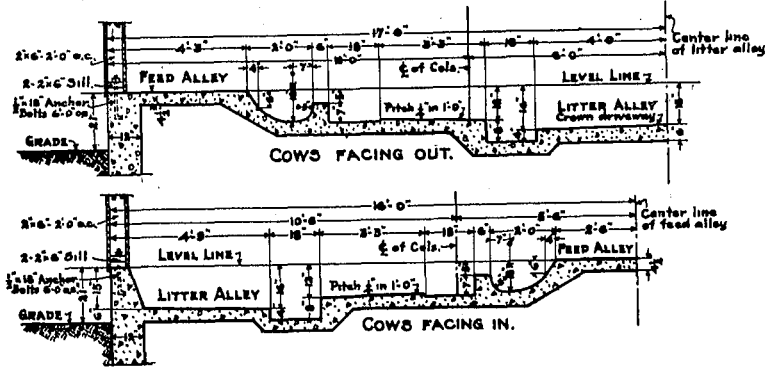
GENERAL PURPOSE BARN PLAN 130

Fig. 14. Second Floor Plan of Barn, Plan 130



DAIRY COW STALL
PLAN 188

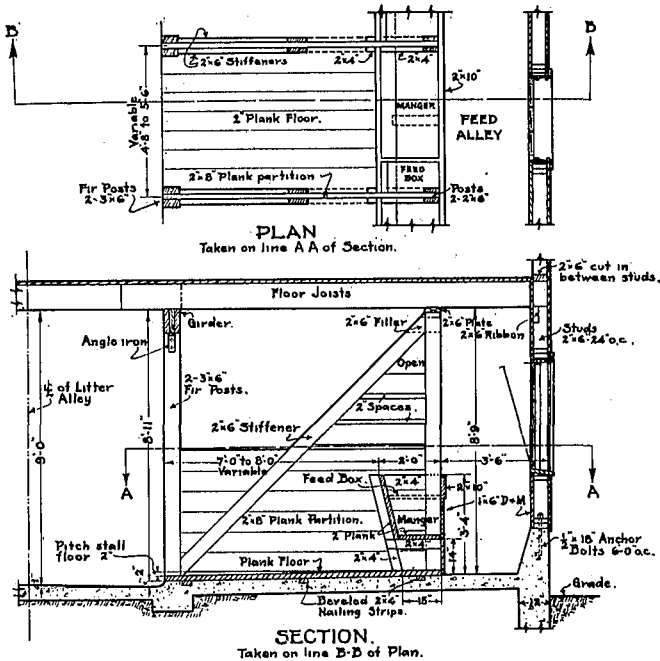
Fig. 15. Dairy Cow Stall and Floor Section, Plan 188



DAIRY COW STALL
PLAN 121

Fig. 16. Half-Section of Cow Barn Floor, Plan 121

A single horse stall is shown in Figure 17, Plan 187. The space under the manger is a convenient place to put bedding when the barn is cleaned in the morning. It is out of the way during the day and can be spread again at night. Planks over the concrete floor are desirable. One-half inch bolts or rods set in the concrete stall floor and projecting about an inch and a half into the floor plank near the end next to the manger are more durable than the nailing strips. Each plank can then be easily replaced when worn out.



SINGLE HORSE STALL PLAN 187

Fig. 17. Horse Stall, Plan 187

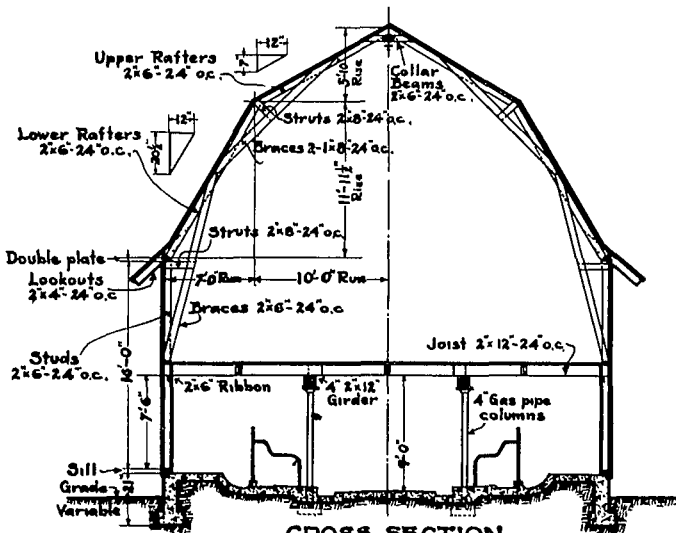
Figure 18, Plan 116, shows a gambrel roof for a 34-foot barn. The cows face out. The lower rafters are 14 feet long and the upper rafters 12 feet.

Gothic Roof Is Popular

The gothic roof is very popular in some localities because of its appearance and convenient mow space. The popularity of the gothic roof has led to a large number being built by inexperienced workmen and in many cases these have sagged and become unsightly. It is not a good investment to erect a barn of this type that will not stand up and give many years of service.



END ELEVATION.

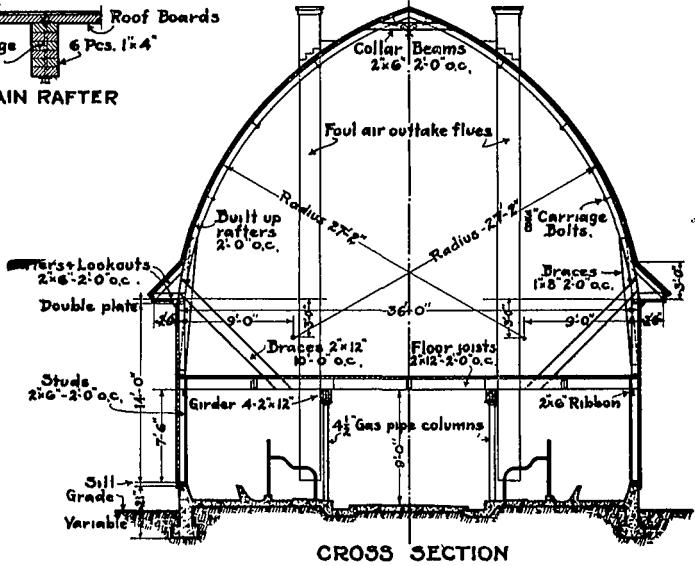
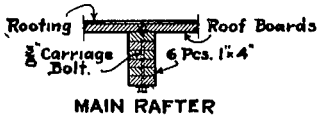
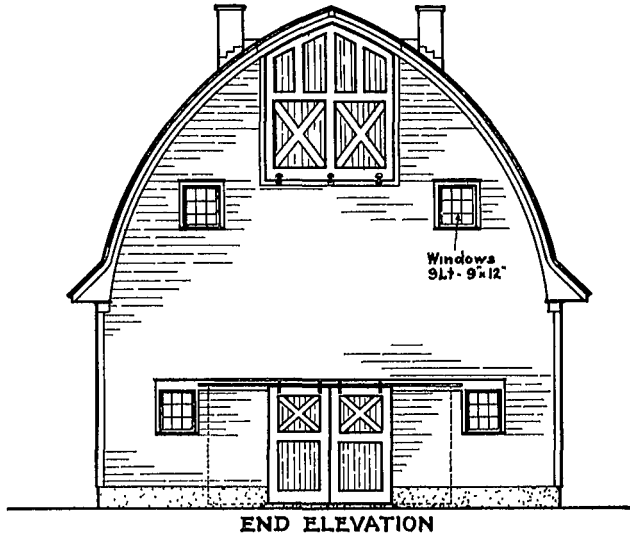


CROSS SECTION

**34 FOOT
GAMBREL ROOF BARN
PLAN 116**

Fig. 18. Thirty-four-foot Gambrel Roof Barn, Plan 116

A less pretentious barn well planned and well built will prove a better investment and give more satisfaction to the owner. Many inquiries to the Division of Agricultural Engineering show that too much importance is given to the roof and that other features—as arrangement and lighting—are neglected. A method of laying



**36 FOOT
GOTHIC ROOF BARN
PLAN 180**

Fig. 19. Thirty-six-foot Gothic Roof Barn, Plan 180

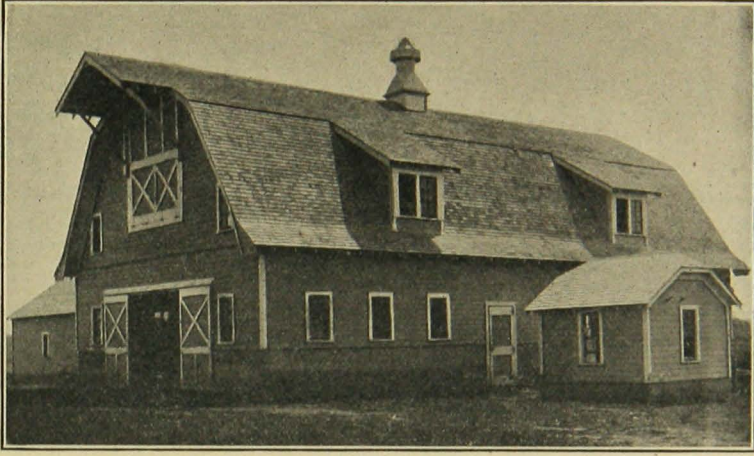


Fig. 20. A Well Planned Minnesota Barn, Plan 197

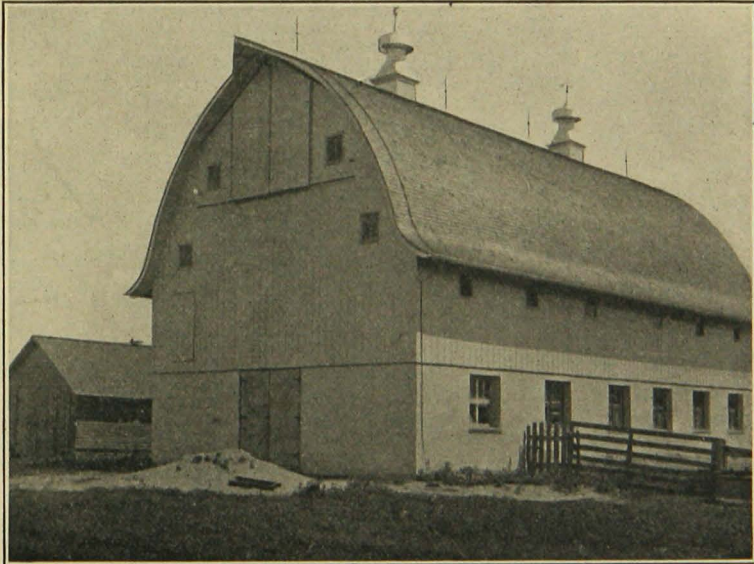


Fig. 21. A Well Designed and Well Built Gothic Roof Barn

out to obtain a well proportioned roof is shown in Figure 19, Plan 180. In the construction of the rafters, blocks are nailed about 2 feet apart on the floor of the mow on a curved line representing the inside of the rafter. The first three thicknesses of the rafter are bent around the blocks with the joint broken, so that in the completed rafter the joints will be broken about every $2\frac{1}{2}$ feet and securely nailed. Each additional piece is nailed as put in place until the 6-ply rafter is made up. It should then be bolted as shown, to make it retain its curve. The point from which the radius may be taken for making the arc is three-fourths the width of the barn toward the opposite side and one-twelfth the width of the barn below the plate line. The 2×12 -inch braces are placed every 10 feet and add stiffness to the whole structure. With 10-foot studding the braces may be omitted. The ventilators shown are often located one on each side of the ridge of the barn so that as one is slowed down by wind blowing over the ridge, the other is accelerated.

Figure 20 shows an attractive farm barn 34×60 feet with a milk house. A plan of this barn is shown in Figure 7, Plan 197. The silo is opposite the milk house. On this barn the concrete extends up about $3\frac{1}{2}$ feet. The windows open in at the top. The appearance is very satisfactory. It is painted gray with white trim. The paneling of the doors costs a little extra but gives finish to the barn.

The gothic roof barn, which is very popular, is well represented in Figure 21. The concrete wall is double and extends to the hay mow floor.

Many Plans Made Available

A large number of plans of farm buildings and equipment have been prepared by the Division of Agricultural Engineering in co-operation with the other divisions of the University Department of Agriculture. They include houses, barns, corn cribs, granaries, combined corn crib and granaries, garages, hog houses, ice houses, implement sheds, milk houses, poultry houses, potato warehouses, privies, shops, storage cellars, farmsteads, and such miscellaneous farm equipment as hay racks and self-feeders.

These plans are on file in the offices of the county agents throughout the state, where farmers may look them over and then send for those they desire. No farmer can afford to build or remodel without making use of this plan service. A list of plans may be obtained from the Division of Publications, University Farm, St. Paul, Minn.