STATE AND FEDERAL ASSISTANCE

STATE AND FEDERAL AGENCIES STAND ready to assist Illinois farmers who desire to establish forest plantations on their lands.

The State Department of Conservation, thru its Division of Forestry, has established tree nurseries, where stock suitable for Illinois plantations is being grown for distribution to landowners.

The Extension Service of the University of Illinois, College of Agriculture, and the State Natural History Survey, jointly thru the Extension Forester, will advise farmers on their forest planting problems. They will also assist 4-H club members enrolled in forestry projects in starting plantations of their own.

Within C.C.C. camp areas the U. S. Soil Conservation Service is helping soil-conservation cooperators to establish forest plantations where they will control soil erosion.

For further particulars, write:

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URBANA
FOREST PLANTING IS THE SOLUTION to the problem of idle or eroded land on many Illinois farms. Acres of once good crop or timber land can be saved from further destruction by being planted to trees. Shelter belts will help to lessen wind erosion. Sandy wastes can be redeemed. And these wooded acres will provide a haven for wildlife, an economic as well as a pleasure asset to any farm or community.

To start a farm plantation is neither costly nor difficult. Maintenance is simple. And added to the other benefits are the ultimate returns to be realized in usable or marketable timber.

Where other generations have thoughtlessly destroyed, this generation has an opportunity to build.
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Urbana, Illinois

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October, 1937
Building and Remodeling Dairy Barns

By C. S. Rhode and W. A. Foster

With careful planning a dairy barn having all the necessary conveniences to produce clean milk and save time and labor can be built for no more, or for very little more, than a barn of the same size not so well arranged.

Planning the barn on paper is the first step in building or remodeling a dairy barn. Much time and effort can be saved each day if thought is taken to provide for the various dairying needs and if everything is located in the right place; and furthermore it is far simpler to make necessary adjustments in the arrangement of stanchions, feedways, feed bins, drainage gutters, or other parts of the barn, on paper, than it is to tear out a wall or a floor after construction is under way or after the barn is built.

To arrive at the best plan for a given set of conditions, it is necessary to study and carefully analyze various types of plans, considering especially the following points:

- Convenience of operation
- Economy of construction
- Comfort of the animals
- Sanitation and drainage
- Number and size of stalls
- Arrangement of feed alleys
- Location of windows
- Storage facilities for feed

Blueprints of dairy-barn plans showing details of construction may be obtained from the Department of Agricultural Engineering, University of Illinois, Urbana. Distribution is limited. If interested, write for particulars.

Choose site with good drainage

Good drainage is one of the first considerations in choosing a location for the new dairy barn. A slope that readily carries away the waste water means drier lots and cleaner cows. Suitable space for the cow lots, the presence of natural shelter, and easy access to pastures are other important considerations in choosing a location.

1C. S. Rhode, Professor of Dairy Husbandry Extension; and W. A. Foster, Associate Chief in Rural Architecture.
Altho, because of fire hazards, the farm buildings should not be crowded too close together, it is of course more convenient to have the barn reasonably close to the dwelling and to other farm buildings.

The barn should be so placed on the location that the best use is made of sunlight. If the long axis extends north and south, the maximum amount of sunlight and the most even distribution of it thruout the barn will result.

BUILD FOR WINTER WARMTH AND COMFORT

Barns that are carefully designed and well built of good materials, and that are given proper care, are usually warm and comfortable even in severe winter weather. Thin walls and loosely fitted doors and windows let air leak in and cause the barn to be drafty. If the walls are of wood construction, only the best seasoned siding should be used, and it should be primed as soon as nailed in place. Unseasoned or damp tongue-and-groove siding should not be used, for it shrinks and leaves cracks.

Low ceilings aid in keeping the barn warm, tho they should be high enough to provide sufficient air space and head room (see page 18 for dimensions). Barns built with mows above the stalls are usually warm in winter and cool in summer, for the roughage on the mow floor serves as insulation. The ventilating scheme, whether dependent on natural flues, a window system, or an electric exhaust fan, should be so arranged as to conserve heat when heat is wanted.

Caulking around the doors and window frames of masonry barns seals and closes cracks which otherwise are great heat robbers, and storm windows on the north and west usually add to the warmth and dryness of a barn. Insulating materials may be placed between the studding of frame barns to conserve the heat, tho because of the additional cost such insulation is not generally used. Such insulating materials should not be used unless they are reasonably priced, are effective for their purpose, fireproof, nonabsorbent, free from food for insects or rodents, and durable in quality.

Tho it is desirable that the barn be warm and comfortable for all the animals, special precautions should be taken in construction to assure warm, comfortable quarters for calves and cows at calving time.

SELECT TYPE OF BARN FOR INDIVIDUAL NEEDS

There is no one best type of dairy barn. Conditions on different farms vary too widely for that to be possible. The kind of market for dairy products and the market requirements, the kind and quality
of buildings already available, the size of the individual business, and the amount of funds that can be used determine the type of barn to be constructed. When funds are particularly limited but new housing quarters for the herd are necessary, a lean-to barn may be the best choice. Or perhaps an old general-purpose barn may be satisfactorily rearranged into a dairy barn. On the other hand, if more space for storing feed must be provided, the construction of a two-story barn may in the long run prove most economical and most satisfactory.

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Fig. 1.—A two-story rectangular barn provides storage space for feed as well as comfortable quarters for the dairy herd

Regardless of the type of barn that is selected to meet individual conditions, expenditures should be kept as low as possible without sacrificing good construction and good materials.

**One-Story Barn Makes Good Addition to Main Barn**

Any feed kept in a one-story barn must be stored in bins or in adjoining rooms, for there is no overhead storage space. And because there is no mowed hay for heat insulation, the one-story barn, unless insulated with other materials, is usually hotter in summer and cooler in winter than a two-story barn. Ventilation of one-story barns by means of natural flues also is difficult, because low-outlet flues are less efficient than taller flues.

One of the chief advantages of the one-story barn is its adaptability as an addition to another barn where the grain and roughage may be stored. Many old barns that are not well adapted for the dairy unit are adequate for feed storage, and can be made suitable for calving quarters, young stock, and horses. A one-story wing, added preferably to the south, provides satisfactory quarters for the dairy
cows. This addition may result in an L-shaped or a T-shaped plan, or it may be merely a lengthening of the old barn. Placing the grain bins and feed room in the old barn where the new barn joins it is a convenient and efficient arrangement.

**Two-Story Barn Provides Space for Stock and Feed**  
(Figs. 1 and 2)

The two-story rectangular barn generally used in Illinois, especially on large dairy farms, is the type most economical to build when space for storing feed as well as quarters for the dairy herd must be supplied.

The second story or mow is built with a large loft, free from structural members. Feed stored above is conveniently delivered to the floor below thru hay and grain chutes. A tight ceiling for the first story is essential to prevent dust from falling from the haymow above.

The stalls for the cows in a rectangular two-story barn are usually arranged in two rows, each row divided by cross alleys into groups of 10 to 16 stalls (Fig. 2). Frequently both the cows and the young stock are housed in a large barn; and while this arrangement has some practical advantages, many dairymen prefer to house the young stock in a separate building or in a wing of the main barn.

**General-Purpose Barn Best for Moderate-Sized Farm**  
(Fig. 3)

The general-purpose barn, as its name indicates, houses cows, horses, young stock, feed supplies, and often farm equipment. It is a type widely used on small dairy farms and other farms where dairy
products are produced but where dairying is not the sole or primary interest. For such farms, and if the barn need not be too large to house all the stock and feed, the general barn is the most economical and practical type.

It is of course cheaper to build one barn 36 by 80 feet than two barns each 36 by 40 feet,—two complete ends are saved and such equipment as hay carrier, hay fork, rope, and pulleys need not be duplicated.

Furthermore, one grain bin or feed room will supply all the animals in the general barn, thus reducing space requirements and simplifying feeding operations. But when an unusually large barn would be required to house all the stock and supplies under one roof, two or more barns each planned and built for its special purpose will probably be more satisfactory.

The general-purpose barn, whether new or old, should be so divided that there is a definite section for cows, another for horses, and still another for young stock. Efficient management and sanitation demand such an arrangement, for dairy products are easily contaminated by dust and barn odors. The horses and cows should be separated by grain bins, feed rooms, and tightly fitted doors. Never build a barn with cow stalls on one side and horse stalls opposite. Arrange
the section for the cows in the south end of the barn so as to secure the maximum benefit from sunlight. The horse section may well be placed in the north end.

**L-Shaped Barn Provides Sheltered Lot**

(Fig. 4)

The L-shaped barn has some distinct advantages over most other types. It forms a lot sheltered from the prevailing cold winds; it enables the dairymen to organize his work in feeding, milking, and cleaning to better advantage; and it includes a central storage space sufficiently large to hold the grain and roughage for the animals housed in both parts of the barn.

Another advantage is that a one-story unit can be used for housing the cows. This unit should extend to the south. The east-and-west unit should be used for the horses, the young stock, and the storage of roughage and grain.

![Diagram of L-shaped barn](image)

**Fig. 4.** The L-shaped barn forms a compact unit, with feed bins and feed rooms centrally located.
T-Shaped Barn Permits Feeding From Central Storage
(Fig. 5)

The T-shaped barn has many of the advantages of the L-plan. It provides sheltered lots and enables the attendant to feed the herd from central storage bins and mows.

Fig. 5.—This plan for a T-shaped barn, arranged for the cows to face in, can also be arranged for the cows to face out, as in Fig. 4

Arrangement should be made for reaching the grain bins and feed room with truck or team and wagon.

Bank Barn Adapted to Rolling Country

The bank barn gets its name from the fact that it is built into a hillside. The hillside serves as a natural approach or driveway to the second floor, and also shelters the stable, which is consequently warm in winter and cool in summer.

Bank barns were extensively used in the past when threshing
floors were commonly built into barns. They are still used in some sections, particularly where the land is rolling. A disadvantage of the type is the difficulty in arranging for adequate window space to light the stable.

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**Fig. 6.** A “lean-to” is simple in construction and inexpensive

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**Fig. 7.** In a “lean-to,” which usually has but one row of stanchions, both cleaning and feeding are easier if the cows face toward the old barn
"Lean-To" Barn Is Inexpensive
(Figs. 6 and 7)

A shed or "lean-to" located on the south or east side of the barn is inexpensive to build and provides comfortable quarters for dairy cows. The lean-to should be as near as possible to feed storage bins and hay mows, which of course are in the main barn.

A dairy barn of this type should be sufficiently wide for the feed and litter alleys, stalls, gutters, and mangers to be of the right dimensions.

"Loafing" Barn Permits Cows to Move Around

Some dairymen follow the practice of allowing their cows to run loose in a closed barn or open shed. At milking time the cows are placed in separate quarters where they are fed grain. Hay and other roughage are usually fed in the loafing barn.

Not less than 90 square feet of floor space should be available for each cow in this type of barn.

ARRANGEMENT OF STALLS AND ALLEYS

The arrangement of stalls, alleys, and gutters within any barn should be based upon efficiency, convenience, and established methods of handling the cows. In an old barn certain limitations of size or structural arrangements may practically determine the floor plan, but usually there is some room for choice.

Number of rows of stanchions. Two rows of stanchions are ordinarily an efficient and economical arrangement, tho some barns have only one, and others have three or more. In general, barn arrangements that have more than two rows of stanchions are not very practical or satisfactory, for effective lighting is difficult and construction is expensive.

One central feedway will accommodate two rows of cows facing in, and a central litter alley serves two rows facing out.

In a lean-to barn only one row of stanchions ordinarily is used. Some old general barns that are rearranged for dairy barns are restricted to one row of stanchions as they are not wide enough for two rows.

Facing arrangement. Should the stalls be arranged for the cows to face in or to face out? This is a question that is often raised. The choice is largely a matter of personal preference, for there are arguments for and against each plan. Plans for both types, in barns of different widths, are shown in Fig. 8 on the following page.
Fig. 8.—Service alleys and standing platforms can be more roomy in the wider barns, an especially important feature where large cows are to be accommodated.
The principal advantages of the facing-in arrangement are that the cows are easily fed from a central feed alley; that silos and feed rooms may be conveniently located at the end of the barn; and that the gutters and the back parts of the stalls have more exposure to light. The facing-in arrangement is probably the better one for narrow barns, for the feed alley with this arrangement does not need to be as wide as a central passageway does when the cows face out.

Most dairymen, however, prefer the facing-out arrangement. With this arrangement the barn may be more easily cleaned, for the manure may be loaded directly into a spreader drawn thru the central passageway, and no litter carrier is needed. Furthermore, milking is made more convenient, the cows have a better appearance in the barn, the barn walls are easier to keep clean, and the cows may be turned in and out of the barn more easily because of the wider central entrance.

FIGURING THE OUTSIDE DIMENSIONS

Thirty-Six Feet a Good Width

The most practical width for a two-row barn when construction, lighting, storage capacity, appearance, and comfort are taken into consideration, is 36 feet. The width is determined by the combined width of the gutters, mangers, and service alleys, and the length of the standing platform.

Barns that are narrow are usually crowded and easily become stuffy and unsanitary. Barns that are wider than necessary are difficult to light, and are likely to be unduly cold in winter.

When old barns that are less than 32 feet wide are rearranged for dairy cattle, no attempt should be made to use two rows of stanchions lengthwise of the barn.

The desirable width for a lean-to is 18 feet.

Length Determined by Four Factors

The length of the dairy barn is determined by the number of cows to be housed, the stall width, the number of cross alleys, and the thickness of the walls. Because the length of construction members ordinarily carried in stock are in even feet—12-, 14-, and 16-foot lengths—and rafters and studding are usually spaced 2 feet center to center, the length of the barn should be planned in even-numbered feet.

One cross alley is required at each end of the row or rows of stalls, and other cross alleys (the number depending on the length of the rows) are needed to separate the rows into batteries of 10 to 16 stalls each.
Supporting members or posts should be spaced, whenever possible, at 14-foot intervals. This is stock length of timbers; it is within the safety limits for the strength of girders, and is a dimension that is easily divided into cow stalls, or into horse stalls should the use of the barn be changed later.

In a dairy barn 92 feet long the following spacing of posts in relation to stalls and cross alleys is satisfactory (see also Fig. 2):

<table>
<thead>
<tr>
<th>Wall, alley, two stalls</th>
<th>Four stalls</th>
<th>Four stalls</th>
<th>Stall, cross alley, stall</th>
<th>Four stalls</th>
<th>Four stalls</th>
<th>Wall, alley, two stalls</th>
</tr>
</thead>
<tbody>
<tr>
<td>12'</td>
<td>14'</td>
<td>14'</td>
<td>12'</td>
<td>14'</td>
<td>14'</td>
<td>12'</td>
</tr>
</tbody>
</table>

This spacing of posts, 12 and 14 feet on center, permits the barn, or part of it, to be easily rearranged for horses if such a change is desired later. Three single horse stalls could be placed between the posts set 14 feet apart center to center, and a double horse stall and passage way could be arranged in the 12-foot spacings.

**DIMENSIONS FOR STALLS AND ALLEYS**

**Stall Should Fit the Cow**

The stall should be sufficiently wide for the comfort of the cow, and sufficiently long for her to stand in a normal position while feeding and ruminating, and for the wastes to fall into the gutter. When the platform is too long, the wastes litter the platform and soil the animal when she lies down. When it is too short, she must stand in the gutter in an uncomfortable position and the wastes are likely to fall back of the gutter.

Dimensions suggested for cow stalls are given in the following table. Wide stalls and long standing platforms should be built for large cows.

**STALL DIMENSIONS FOR DIFFERENT BREEDS OF DAIRY COWS**

<table>
<thead>
<tr>
<th>Breed</th>
<th>Width</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Narrow</td>
<td>Wide</td>
</tr>
<tr>
<td>Heifers, all breeds</td>
<td>2'10&quot;</td>
<td>3'2&quot;</td>
</tr>
<tr>
<td>Jersey</td>
<td>3'4&quot;</td>
<td>3'6&quot;</td>
</tr>
<tr>
<td>Guernsey</td>
<td>3'6&quot;</td>
<td>3'8&quot;</td>
</tr>
<tr>
<td>Ayrshire</td>
<td>3'6&quot;</td>
<td>3'8&quot;</td>
</tr>
<tr>
<td>Holstein</td>
<td>3'8&quot;</td>
<td>4'0&quot;</td>
</tr>
<tr>
<td>Brown Swiss</td>
<td>3'8&quot;</td>
<td>4'0&quot;</td>
</tr>
</tbody>
</table>
Gutters Should Be Deep and Wide

Gutters should be from 8 to 10 inches deep on the side next to the cow and from 3 to 5 inches on the litter-alley side. Sixteen inches, total, is a desirable width. The gutter floor should be level crosswise, and should slope lengthwise to a drain (Fig. 9) at a fall of at least 1 inch in 25 feet.

![Diagram of drainage system]

Fig. 9.—The drainage system for gutters, mangers, and feed alleys should always contain a sump that is easily cleaned and that will catch the sediment and prevent stoppage of the drain.

Sufficient height of the gutter wall on the standing-platform side reduces the tendency for the droppings to pile up and overflow onto the platform. A low gutter wall on the litter-alley side admits more sunlight, makes cleaning easier, and reduces the possibilities of injury to the cows if they slip into the gutter. Avoid shallow, narrow gutters.

Ample Mangers Reduce Feed Losses

Mangers should have good height and width; they should not be built low and narrow. The manger need not be so high, however, when the feed alley is built on a level with the top of the manger, for any feed rooted out may easily be returned to the manger. For the low manger with raised feed alley and the higher manger without the raised feed alley see Figs. 8 and 10. Both types are in general use.

The higher type of manger should be used when the feed alley is not raised. It should be low on the cow or curb side and wide enough
and high enough on the opposite side to minimize the waste that comes from pushing the feed out into the feed alley.

Dairymen who feed grain according to production often use metal dividers in the manger to keep the feed separate and prevent one animal from robbing another. These dividers are fastened to the stanchion supports and may be raised for cleaning the manger.

Provision should be made for draining the manger, so that it may be washed.

**Curb Should Be Small and Rounded**

The curb which separates the standing platform from the manger should be approximately 7 inches high and 5 inches wide and the top edges should be carefully rounded and smoothed. Uprights that support the stanchions are built into the curb (Fig. 10).

**Horse Stalls Should Be Standard Size**

In the general-purpose barn provisions are of course made for horse stalls. The standard size of a single horse stall is 4 feet 6 inches wide by 9 feet long from the feed-alley side of the manger to the gutter. The double stall is 8 to 9 feet wide.

**Width of Feed Alley Depends on Barn Design**

The widths of feed alleys vary according to the widths and interior arrangements of the barns. When the cows face out, the two feed alleys should be approximately 4 feet wide. When the cows face in, the center feed alley should be 6 to 8 feet wide. For proportionate widths see Fig. 8.
Wide Litter Alley Makes Cleaning Easy

When cows face out and the width of the barn permits, the litter alley should be wide enough for a wagon or manure spreader to be used in cleaning the barn. When the cows face in and the litter alleys are too narrow, the barn wall becomes badly soiled and milking and the handling of the milk are hampered. See Fig. 8 for proportionate alley widths.

Large Grain and Hay Chutes Prevent Clogging

Grain and ground feed are often carried in a chute to the first floor from a bin on the second floor. Such chutes should be steep enough for the grain to flow readily, and should be provided with a stop or gate so that the flow of grain may be controlled. A chute 8 by 8 inches in cross section is satisfactory for ground feed.

Because dust is stirred up when hay is dropped unconfined from a mow, hay chutes are sometimes used. A closet measuring 3 by 4 feet in cross-section, with a 2 3/4- by 6-foot door, serves well for the hay chute. Whether or not a chute is used, the mow opening should be closed to prevent interference with air movements in the ventilating system.

GOOD VENTILATION AND LIGHT ESSENTIAL

Controlled air movement is needed in the dairy barn more than in any other farm building. A system of ventilation that supplies plenty of fresh air without drafts, and conserves the heat inside the barn during low temperatures outside, is therefore highly desirable.

Fig. 11.—Ventilating windows that swing inward at the top are easily adjusted and inexpensive to install
Windows, Flues, or Fans Control Air Movement

The simplest way to ventilate, that is reasonably satisfactory, is by means of windows (Fig. 11). The kind generally used consists of a loose sash swung from the bottom which fits into the opening and is held in place at the top by a latch or lock. When loosened it swings inward away from the top and is held on the sides by triangular shields. This position allows the air to flow upward over the top of the sash. The sash may be lifted in the shield so that the air will flow both under and over the sash. This type of window is easily screened, simple to operate, and inexpensive to install. The success of ventilating with it depends upon the judgment of the attendant in knowing when and how many windows to open for the intake of fresh air and which ones to open on the opposite side for outlet.

Metal sashes of several types and kinds that have patented hinges or latches to simplify their use and hold the sash in almost any desired position are now on the market.

An automatic ventilating system that removes the foul air from a level near the floor and takes in fresh air near the ceiling, or that removes the foul air from the ceiling level and takes in the cold air near the floor, may be installed (Fig. 12). Both systems have merit, and either one must be designed for the individual barn, for the size of the barn, the exposure and construction, the facing arrangement, and the number of animals sheltered, all must be considered.

Where electricity is available an exhaust fan, controlled either automatically or by hand, may be used to draw out the foul air. These fans are available in several types, and may be purchased from the local or wholesale electric supply house.

Detailed discussion of ventilation may be found in U. S. Department of Agriculture Farmers Bulletin 1393, “Principles of Dairy Barn Ventilation.”

Ceiling Should Be High Enough for Light and Clearance

The ceiling of the stable should be sufficiently high for light to penetrate to the interior, for the attendants to pass under with an abundance of head room, and to provide the right amount of air space above the cows for the temperature to remain fairly uniform without being either stuffy or excessively cold.

In modern construction the joists are carried on a girder that projects below the ceiling its full depth, usually 12 inches. A height of 8 feet 6 inches from floor to ceiling leaves a clearance of 7 feet 6 inches to the bottom of the girders.
Fig. 12.—Automatic ventilating systems that remove foul air from near the floor and bring in fresh air near the ceiling are shown on the left sides of these barns; systems having the outlets near the ceiling are shown on the right sides.
Windows Should Provide Plenty of Sunlight

The window sashes in a dairy barn may be wood or steel, and they may be either hinged or movable sidewise, inward, or upward. The glass area should permit the barn to be well lighted by natural light. Four square feet of glass area per cow, or 5 square feet per 100 square feet of floor area, should be the minimum. Nine-by-12-inch panes set in a 6- or 9-light sash make a good window. The ventilating sash (Fig. 11) is a type that is easily screened or darkened in the summer.

Fig. 13.—Stanchions like these are comfortable, durable, and easily operated.
STALL EQUIPMENT

Swinging Ties Comfortable for Cows

The tie most commonly used for dairy cows is the stanchion of one kind or another. Adjustable swinging steel stanchions are preferable, tho ordinary swinging steel or wooden stanchions make satisfactory ties (Fig. 13).

A swinging stanchion permits a cow to move her head to either side, and is comfortable when she is lying down. Rigid stanchions are very uncomfortable, and for that reason are not recommended. Adjustable stanchions enable a dairyman to compel the cows to stand farther forward or backward on the stall platform.

The so-called “arch type” of tie (Fig. 13) is very comfortable and economical. A chain which extends from one upright to another in front of the cow is fastened around the cow’s neck or to a neck strap. The chain moves up and down on the uprights and provides unusual freedom. This type of stanchion is gaining rapidly in popularity.

Stall Partitions Prevent Injuries

Dairymen generally recommend the use of divisions or partitions between stalls, for such partitions prevent many injuries to the teats and udders and aid in keeping the stalls clean. Homemade wooden partitions (Fig. 13) or curved iron pipes may be used.

BOX STALLS, SHEDS, AND PENS

Box Stalls Essential in Herd Management

An ample number of box stalls for calving and for sick animals is practically indispensable in the management of a dairy herd. A few days before a cow is due to calve she should be placed in a box stall away from the herd, and should be kept there until she is normal following calving. Sick animals also need the room and freedom furnished by box stalls. Stalls used for these purposes should preferably not be located in the milking barn but in another barn or in the part of the general barn used for horses. If the floor of the box stall is built with a slope toward a drain, cleaning and disinfecting will be made easier.

Barns planned for high-producing purebred cows often have several box stalls in which cows that make high records are kept. The cows are more comfortable in the stalls than in ordinary stanchions.
Such stalls are usually located in a wing of the main milking barn. There is a tendency, however, to replace box stalls for this use with comfortable arch-type tie stalls, described on page 21.

**Calf Sheds and Barns**

Housing quarters for young stock need not be expensive, but they should be clean, warm, dry, light, and well ventilated. Young calves should have individual pens, or at least there should be only a few calves in one pen. After the calves are a few weeks old several of them may well be kept in one pen equipped with ties and a manger. As they develop they may be placed in larger pens or tied in stalls.

When conditions permit, it is desirable and usually more economical to house the young stock outside the barn used for the milking herd. Housing yearling heifers in open sheds tightly enclosed on three sides and open on the south is highly regarded by many dairymen. The sheds should be located so that watering and feeding will require a minimum of labor. Approximately 40 square feet of floor space should be supplied for a yearling heifer.

![Fig. 14.—Calf ties may well be homemade, for calves are usually tied only while being fed and for a short while afterward](image)

Desirable features in calf-barn construction are: The ceiling should be not more than 6 feet 6 inches to 7 feet high, for lower ceilings help maintain comfortable temperatures in cold weather. A 30-foot width is sufficient. The walls should be of wind-proof construction. Provisions for ventilating the barn without draft should be made. The floor of the calf pens should be built with a slope toward a drain at the rate of 1 inch to 4 feet, for the pens may thereby be kept dry, and they may easily be washed and disinfected.
Individual Calf Pens, 20 Square Feet

At least 20 square feet of floor space is required by a calf under 6 months of age. From the standpoint of health, calves should be kept in small individual pens.

Calf pens should be equipped with mangers and with stanchions so that the calves may be tied at feeding time and for a while afterward. When managing them in this way it is easier to give them the right amount of feed, and furthermore they are prevented from exercising their desire to nurse.

Wood stanchions of the type shown in Fig. 14 are satisfactory for calves. A tie 24 to 28 inches wide and 36 inches high will accommodate calves under 6 months of age.

KEEP BULL IN SEPARATE BUILDING

The dairy bull should be housed in a building separate from the dairy barn. Housing facilities should include a satisfactory shelter approximately 12 by 20 feet, an exercising yard 16 to 18 feet wide and 60 to 70 feet long, and a safety breeding stall.

Directions for building bull pens and for managing dairy bulls are given in Circular 460 of this Station, "Managing the Dairy Bull."

CONSTRUCTION OF FLOORS AND MANGERS

Because concrete is easily cleaned, durable, and relatively inexpensive, it is used very generally in constructing floors, gutters, and mangers in dairy barns.

Making the Concrete Mix

Only fresh cement and clean gravel and sand should be used in making concrete. A good mix for floors, gutters, and mangers is—

1 part cement
2 parts sand
4 parts gravel

Thoroughly mix together and then moisten with clean water at the rate of 5 1/2 to 6 1/2 gallons to a bag of cement.

The thoroughly mixed concrete should be placed immediately in the forms, spaded well next to the boards, and tamped into place.

The above mix, because it contains a high proportion of gravel, gives a fairly rough surface. Where a smooth surface is desired, a
finishing coat 1 to 1½ inches thick should be applied. Proportions for the finishing coat are—

1 part cement
3 parts sifted sand

Mix thoroughly and moisten at the rate of about 6 gallons of water to a bag of cement.

Steps in Construction

Time and effort may be saved, and perhaps costly mistakes avoided, by following step by step a definite plan in constructing the floor, manger, and gutter of the dairy barn (Fig. 15).

Check dimensions and stakes. In laying out the floor and setting the forms always check the dimensions and stakes. It is easier to reset a stake and change a form than to tear up and replace a floor.

Curb. The laying of the curb is a convenient point at which to start constructing the floor system. The procedure is as follows:

1. Smooth the earth floor until it looks level to the eye.
2. Lay off the barn floor so as to locate the curbs, mangers, alleys, platforms, and gutters.
3. Set grade stakes on both sides of the curbs. The tops of these stakes should be 12 inches from the earth floor and should be level with each other. The top of the finished curb should be level with the top of the grade stakes and 7 inches above the floor of the standing platform. The platform will be 5 inches thick.
4. Set the forms for the curb (Section 1, Fig. 15). Two 2-by-10-inch planks set level side to side and end to end make satisfactory forms.
5. Secure the form planks to the stakes by 8-penny nails. Drive the nails only part way thru the stakes so that the nails may be pulled and the forms taken down easily.
6. Tack to the inside of the plank on the manger side a 1-by-4-inch board slightly beveled for draft, to make a seal and prevent leakage (Section 3, Fig. 15).
7. Nail spreaders across the tops of the forms to hold the forms in alignment and to hold stanchion fittings in place.
8. If the stanchions to be used require sleeves for pipes, locate and set them carefully before the concrete is poured into the curb forms.
9. Pour the concrete into the curb forms, allowing the base to spread (Section 2, Fig. 15). Be sure the concrete is well mixed. Spade it into place so as to settle it well and obtain an even surface.
10. When the concrete is partly settled but before it has hardened, finish the top with a metal trowel and edging tool. Be sure the corners are well rounded.
Fig. 15.—Procedure in building curb, litter alley, and manger
Litter alley. While the curb is hardening, the litter alley may be poured.

1. Set the form for the litter side of the gutter 12 inches lower than the top of the curb (*Section 2, Fig. 15*).
2. Pour the concrete for the litter alley or driveway.
3. After the concrete has set but not hardened, float the surface with a wooden trowel or carpet float so that it will have a roughened surface and will not become slippery when wet.

Manger. When the curb has hardened, and while the litter alley or driveway is hardening, the manger may be constructed.

1. Remove the curb forms and set the forms for the front of the manger (*Section 3, Fig. 15*). This form must be made strong and must be firmly braced.
2. Set as guides for the shape of the inside surface of the manger some discarded sulky-rake teeth or other iron bars or rods bent to the desired form.
3. Mix the concrete as dry as possible so that when it is spread to the desired shape it will remain in that form until hardened.
4. After the concrete has set but before it has hardened, remove the guide rods.
5. Apply the finishing coat (1 part cement to 2 parts sand) with straight edge and trowel. After the concrete has set, smooth it with a metal trowel.

Stall floor. While the manger is hardening, the stall floor may be poured (*Section 4, Fig. 15*).

1. Set the form for the standing-platform side of the gutter.
2. Pour the concrete, and float with a wooden trowel as was done on the floor of the litter alley.

Some dairymen construct standing platforms that are slightly lower at the front than at the middle of the platform. Other dairymen prefer stall floors that are straight and slope uniformly from the front to the gutter.

Feed alley. After three days (or when the concrete is dry) remove the manger forms and pour the floor of the feed alley. Finish with a metal trowel for a smooth finish (*Section 5, Fig. 15*).

Gutter floor. As soon as the litter-alley floor and the standing platform are dry, remove the forms from the gutter side and pour and finish the gutter floor. For drainage allow a slope of 1 inch in each 25 feet (*Section 6, Fig. 15*).

Stanchions and partitions. The pipe for stanchions and partitions may be set now and pointed in place.
Fig. 15 (cont'd).—Procedure in building stall floor, feed alley and gutter
WHOLESONENESS OF DAIRY PRODUCTS, comfortable working conditions, and the health of the herd are at stake in the arrangement and care of the dairy barn. The difference between irritating drudgery and comfortable, profitable work is often no more than a matter of differences in the placing or the design of floors, gutters, stanchions, feed alleys, doors, and windows.

In building a new barn one has the opportunity to incorporate the essential features of approved design and modern equipment. If a new barn cannot be afforded, an old, inconvenient, unsanitary barn may often, by a few inexpensive and well-thought-out changes, be converted into a very satisfactory barn.

Plans and directions are included here that will be helpful either in the building of new barns or in the remodeling of old ones.