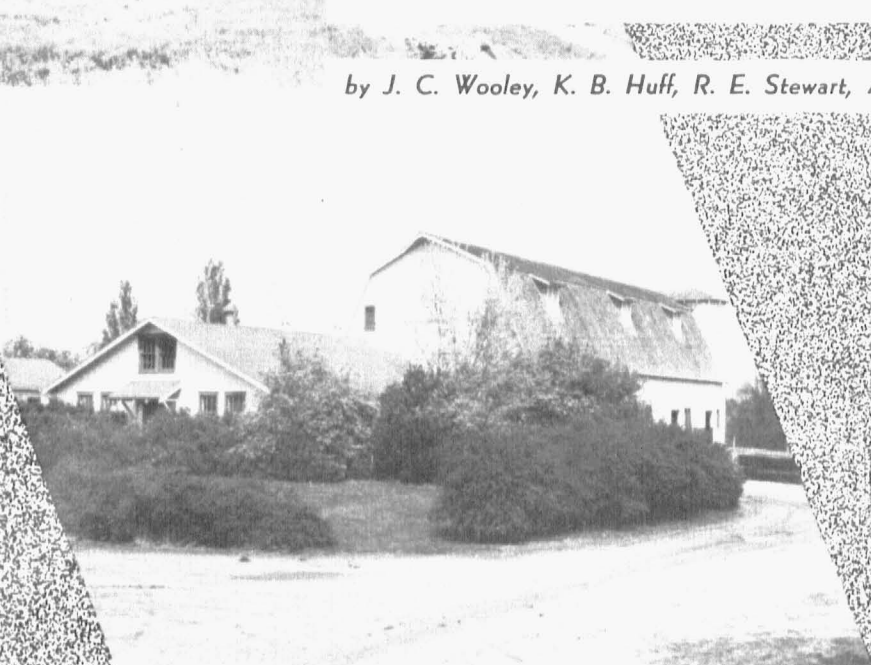




BUILDINGS FOR THE DAIRY ENTERPRISE

by J. C. Wooley, K. B. Huff, R. E. Stewart, A. C. Ragsdale



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WHAT YOU WILL FIND IN THIS BULLETIN

	Page
Milking and Milk Room Facilities.....	4
Floor Level Type	4
Elevated Platform Types	6
Sanitation Requirements	8
Combine Milkers	8
The Loose-Housing Barn	10
Grouping the Buildings to Meet Requirements	12

BUILDINGS FOR THE DAIRY ENTERPRISE

J. C. WOOLEY, K. B. HUFF, R. E. STEWART, AND A. C. RAGSDALE

An increasing number of dairymen in Missouri are using the loose-housing system of management. It offers numerous advantages which account for its widespread use. (1) Many farms are equipped with obsolete barns because of changes in equipment and management. Where housing for the dairy enterprise is needed they can be remodeled for use as loose-housing or young stock barns and their usefulness and value restored. It greatly reduces the first cost of providing buildings for the enterprise; (2) loose-housing gives more freedom to cows; (3) it makes possible warmer and more comfortable floors; (4) it reduces the area requiring frequent cleaning; (5) it provides for better storage of manure; (6) it permits some of the work to be done at off-peak times; (7) the size of the enterprise or a change to other animal enterprises can be made with less loss than is the case with the individual stall type of housing; (8) the loose-housing system provides sufficient exposure of the cows to the seasonal rhythm of temperature, sunshine, etc. so that nature prepares them for the change in seasons.

There are some objections to the loose-housing system. Cows consume some additional low cost, heat producing feed, and will require from 50 per cent to 100 per cent more bedding than would be necessary in individual stalls. Some dairymen who keep only pure bred animals do not wish to dehorn their cows, a practice that may be necessary when using this system.

The following buildings are essential for efficient operation of the loose-housing system of management:

1. A milking room or milking barn that will meet sanitation requirements for the production of high quality milk.
2. A room for taking care of milk and milk handling utensils.
3. A loose-housing or loafing barn with space for cows and storage space for the hay and bedding needed for one season.
4. A hard-surfaced, roofed area connecting the loafing or feeding barn and the milking room.
5. A silo located adjacent to a surfaced feeding area in the barn yard for outside feeding or connected to the barn for inside feeding.
6. Space for maternity and calf pens inside the loafing barn or in a separate building.
7. A place for storage and processing of concentrated feed.

CONSIDER THESE BUILDINGS AS A GROUP

Often the immediate problem is given consideration without taking into account efficiency in the operation of the enterprise as a whole. A combination milk-house and milking barn is frequently built to meet the demand for immediate sale of milk. If it is located without giving thought to the other buildings and the yards needed to operate the enterprise, a costly mistake can be made. By planning for the location of all the buildings in their proper relationship, the housing for the enterprise will develop into an efficient and satisfactory working unit.

MILKING AND MILK ROOM FACILITIES

The widespread popularity of this system of dairy cattle housing has been greatly influenced by the fact that highly efficient milking and milk handling facilities, meeting the most stringent sanitation requirements, can be provided at a very reasonable cost. These are usually combined into one building and in some cases built as a part of the loose-housing barn, or connected to this barn by a paved and roofed passageway. The combination milk house and milking barn, frequently called the "milking parlor", usually includes a milking room, milk and utensils handling room, vestibule or hall connecting these rooms, a feed storage room for concentrated feed and sometimes a toilet or shower room.

There are many ways in which the combination milking barn and milk house structure can be planned and erected. Some of these differences include: number and arrangement of milking stalls, floor level or elevated platform, adaptation to use of conventional milking machine or to the "combine" or "pipe line" milking system, and use of various materials of construction.

Floor Level Type. In a floor-level milking barn, the cows stand on the same level as the operator. A typical floor level milking barn is illustrated in Figure 1. This building has been very popular. During the past twenty years an estimated 3000 have been built in Missouri. Sizes range from two to 20 or 30 stalls. In the larger sizes there is little difference between the milking barn and the stanchion barn except that the cows are not housed in the milking barn. The six-stall size is most commonly used for the 18 to 30-cow herd. One man with two milking units can work efficiently in this size barn. Most operators of floor-level milking barns prefer to fill all stalls, complete milking, turn out the group and allow a new group to enter. This reduces the total amount of time required to handle the cows and provides

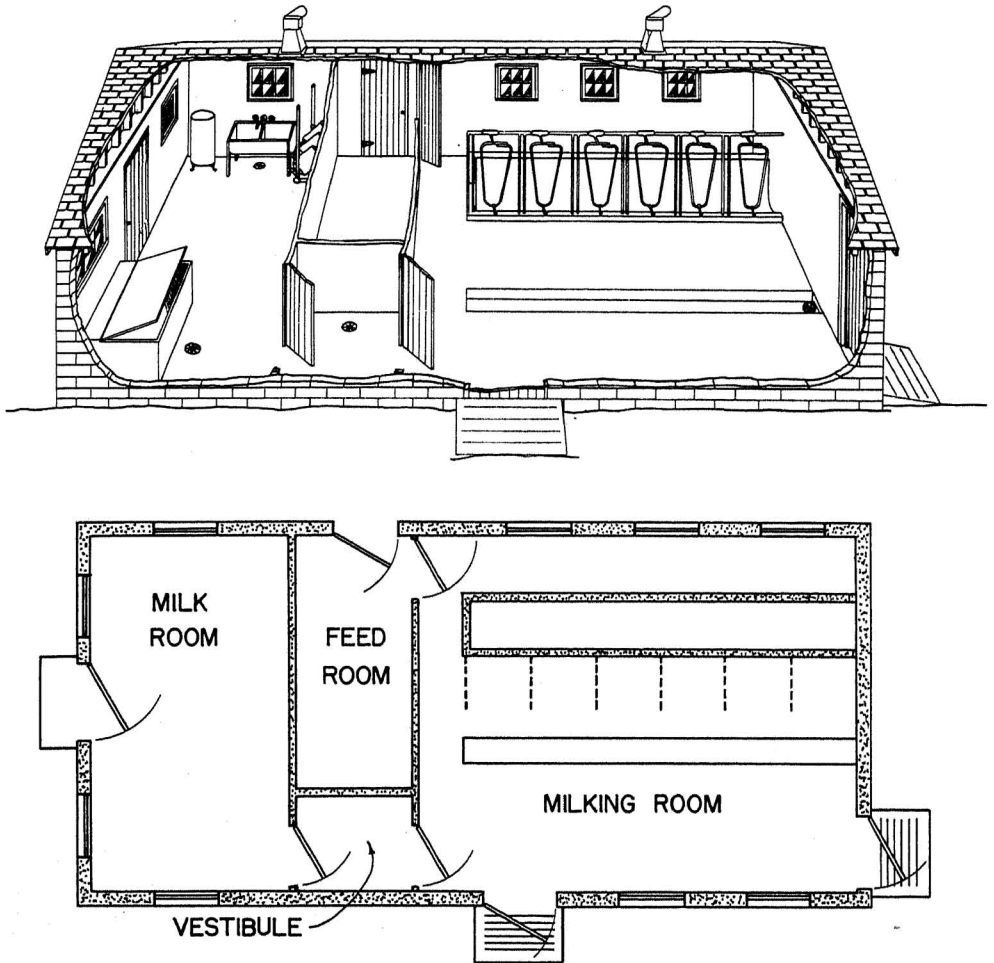


Fig. 1.—Floor level type, combination milk house and milking barn (Mo. Plan No. 8-723-C1).*

adequate time for the cows to consume their full ration of concentrated feed. Some operators prefer to release a cow as soon as she has been milked allowing another to enter at the same time.

Some of the advantages of the floor-level milking barn are: (1) handling of cows is simple and direct; and (2) cows are easily accessible for observation and cleaning by the operator.

* Plans showing the details of construction of the dairy buildings shown in this bulletin may be obtained from your County Agricultural Agent or from the Agricultural Engineering Department, University of Missouri.

Elevated-Platform Types. The elevated-platform type of milking barn is one in which the cows stand approximately 30 inches higher than the operator while being milked. The difference in elevation may be obtained by providing a pit for the operator or having the cows walk up a ramp to the elevated platform. This type milking barn has become very popular. Its most important advantages are: (1) the elimination of stooping while milking because the cow's udder is in a convenient position both for cleaning and milking; and (2) it can be compactly arranged so that a relatively simple low cost combine milking system can be used.

There are a number of different arrangements:

1. **Tandem.** In the tandem arrangement the cows stand head to tail in line on the platform. Three stalls are usually considered the optimum number for one man to operate, although two stalls are commonly used when the milk from individual cows is weighed. In most cases a milking machine is provided for each stall. Figure 2 shows a typical three-stall, tandem-milking barn.

2. **U-Shaped.** In this arrangement the stalls form the letter U around the operator's pit. There may be three stalls forming the U for one-man operation or there may be two stalls on each side with or without one across the end, for two-man operation. A three-stall U-shaped milking barn is shown in Figure 3.

3. **Chute or Straight-Through.** Here the stalls are arranged in tandem on each side of the pit. There are usually two stalls on each side of the pit for one-man operation and four stalls on each side for two-man operation. There is usually one milking unit, supported above the center of the operator's pit, for each opposite pair of stalls. Since no cow alley is provided, the cows must pass through the stalls themselves in order to get through the building. Each stall is equipped with a sliding panel which, when pulled open across the operator's pit, opens up the stalls. Feed boxes are fastened to these sliding doors.

4. **Other Types.** (1) Two-stall, V-shaped arrangement in which the stalls are placed at about 90 degrees to one another; and (2) the two-stall, tail to tail, in line arrangement. These, and other two-stall milking barns are primarily adapted to one-man operation of a small herd. The time required for the cows to eat their concentrates in this size milking barn may be more than necessary for milking. Feeding of part or all of the concentrated feed outside the milking barn will reduce the time a cow must be held in the milking stall, thus making the milking barn less attractive to flies.

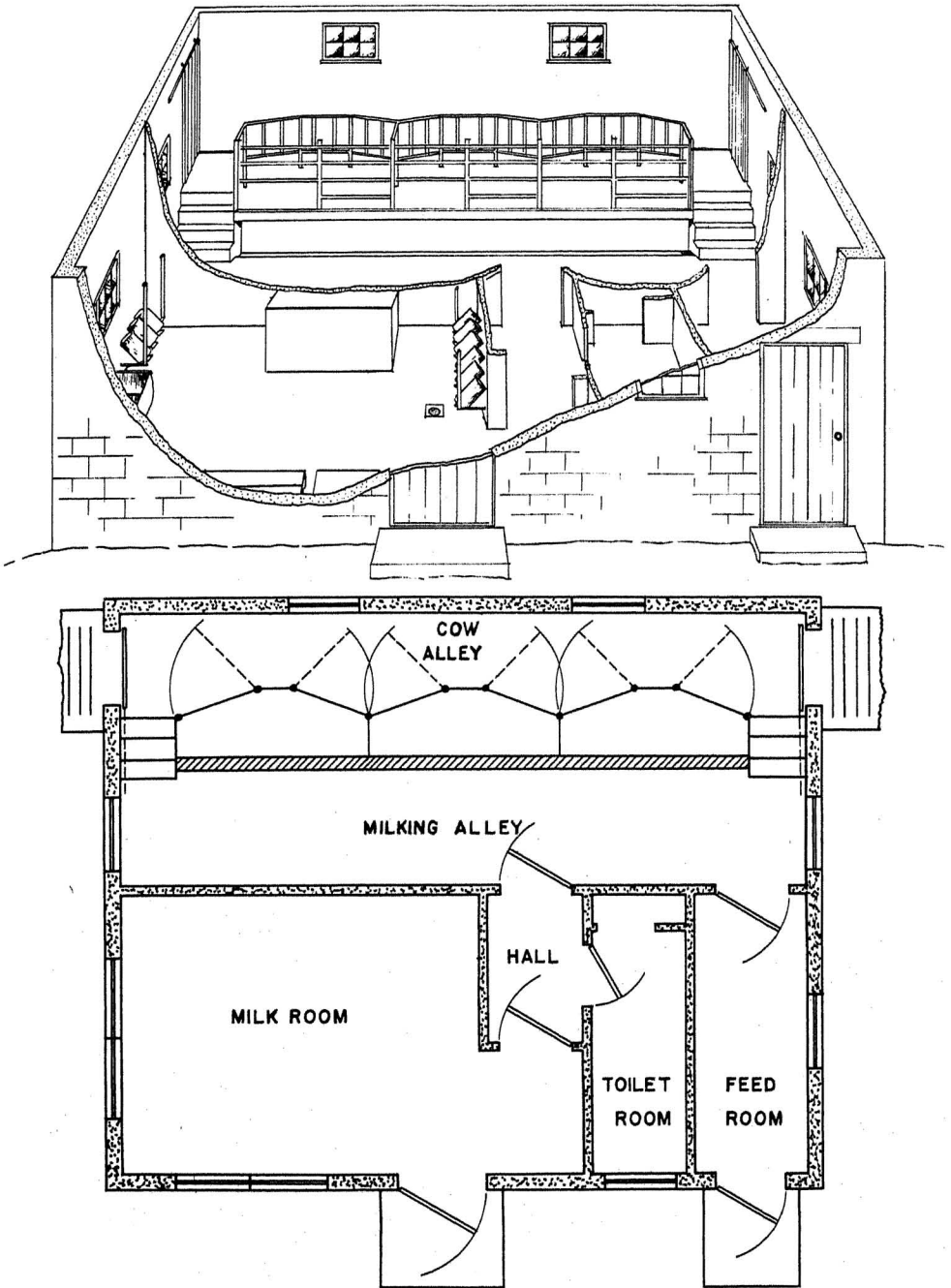


Fig. 2.—Tandem Arrangement, Elevated-Platform Milking Barn and Milk House Combination (Mo. Plan No. 17-23-C1).

In choosing which type and size of milking barn to build, the prospective producer should consider several factors:

1. Number of cows to be milked.
2. Number of men available to milk.
3. Building site.
4. Cost.
5. Personal preference and neighborhood practice.
6. Type milking equipment desired.
7. Milking speed desired.

Sanitation Requirements. Regardless of the type or size of milking barn and milk house definite fundamental construction requirements must be met in order to secure approval of local and state health authorities. These have been developed as a result of long experience, are designed to make it easier for the operator to produce a clean and satisfactory product, and are in the interest of public health. Detailed information regarding these requirements is included on each of the plans illustrated in Figures 1, 2 and 3. Further information on structural requirements can be found in Missouri Ext. Cir. 606.

When contemplating construction of a milking barn it is advisable to work very closely with local milk sanitary and health authorities. Doing this will help prevent errors in construction which might cause serious trouble and be costly to change.

Combine Milkers. The use of the combine milking system in farm dairies has increased greatly. In this system the milk is conveyed directly to the cans in the milk room through a pipe. The elimination of the time and labor of milk carrying is a very popular feature. It is highly desirable to keep the length of pipe required to a minimum. A compactly-arranged elevated platform milking barn lends itself to this system.

In considering the purchase of a combine system it should be kept in mind that the same amount of dismantling, washing, cleaning and assembly of equipment is required regardless of the number of cows milked. This feature makes the system less desirable for the man with a small herd.

The advantages of a combine system from a sanitation standpoint are considerable. The milk is strained automatically as it passes through the pipe. The milk is not exposed to the air at any time in its passage from cow to can. But the piping and associated equipment must be kept scrupulously clean to maintain a low bacteria count.

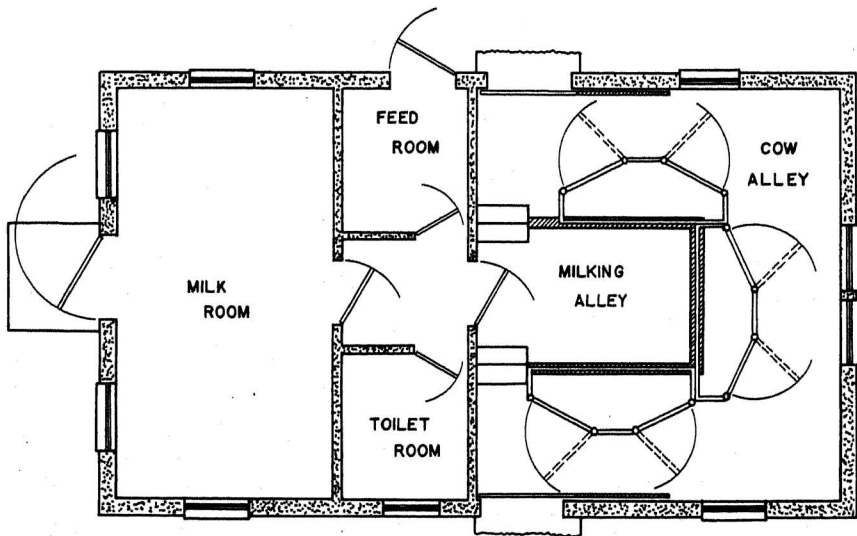
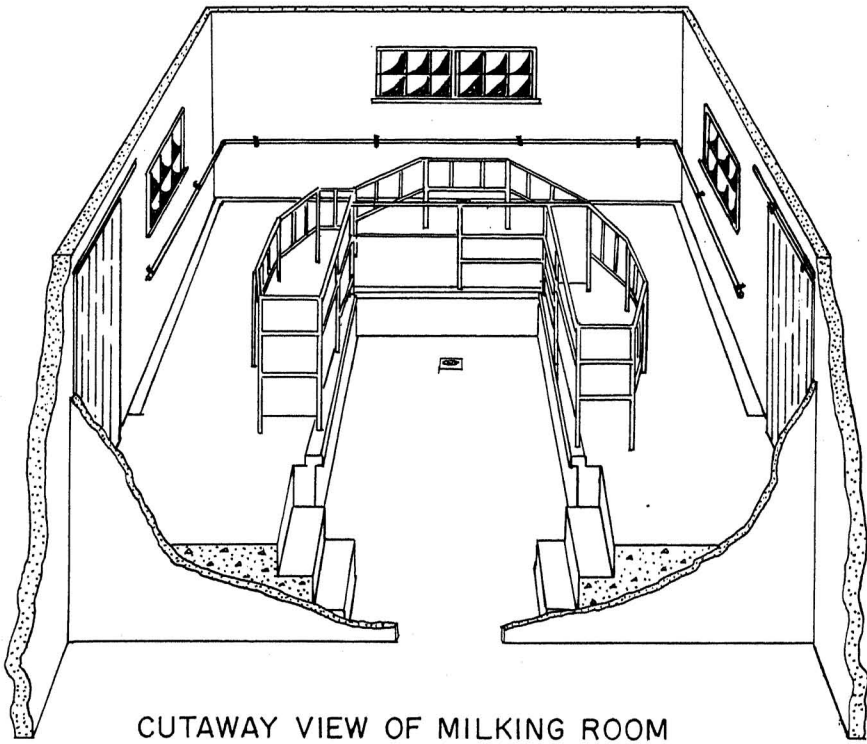


Fig. 3.—U-shaped Arrangement, Elevated-Platform Milking Barn and Milk House Combination (Mo. Plan No. 18-723-C1).

THE LOOSE-HOUSING BARN

Recommendations for this building have been considered from four points of view:

1. The comfort and well-being of the cow.
2. The production of clean wholesome milk.
3. Efficiency in the use of labor.
4. Economy of construction.

Floor Space: Experience has shown that when cows are crowded in the loafing area, the work of cleaning them is increased and if extra care is not exercised, the bacterial count rises rapidly. Under crowded conditions the possibility of injury is much greater. Some of the bad effects of crowding can be overcome for a limited time by extra care and a liberal use of bedding. In order to provide the conditions needed for satisfactory operation, from 60 to 80 square feet of floor space is needed per cow. Sixty square feet is the desirable minimum for small cows and 80 for the larger breeds.

From 15 to 20 square feet of this space may be taken for the hay feeding area and the remainder used as a bedded or resting area. Best practice provides space for the hay feeding area on one side of the bedded area. The hay feeding area should be paved, kept free of bedding and cleaned frequently. This paved area can often be connected with or used as a part of the holding area at milking time. The bedded area may have an earth floor, graded up 6 to 8 inches higher than the ground outside to keep it dry. The bedded area should be protected by use of bars or gates so that it will not be a traffic way. To be most effective it must be an undisturbed resting area. A long narrow area with opening at the end is less desirable than a wider one.

Manger Space: When hay is self-fed, manger space for from one-half to two-thirds of the cows has been found to be sufficient. For batch feeding of hay, manger space for each cow is needed. Two and one-half feet of hay manger space per cow is adequate.

Silage Feeding Space: For Missouri conditions, yard feeding of silage has been found to be satisfactory. It is preferred by many because it reduces the problem of maintaining satisfactory conditions in the barn. Two or three feet of manger space per cow has been found to be adequate for feeding silage.

Storage Space for Hay and Bedding: The amount of hay storage needed varies with the breed of cows kept, the use of silage in the ration and the extent to which the all-year pasture system is used.

Stewart found the average hay consumption on 36 Missouri farms to be 1.83 tons per cow per year.¹

¹ Mo. Agr. Exp. Station Res. Bulletin 468, Dec. 1950.

A North Central States Regional Publication gives the following annual requirements for hay and bedding per cow in the Missouri area:²

Hay fed without silage	2.18 to 1.75 Tons per cow per year
Hay fed with silage	1.40 to 1.00 Tons per cow per year
Bedding (loose housing)	1.25 to 1.00 Tons per cow per year

Ventilation: The south, open-front type of buildings having a straw loft section and the space above the loft equipped with louvers to permit circulation of air, provides the ventilation needed. Three sides of the space provided for cows should be tight to prevent drafts. This makes it necessary to close the space between manger openings and the ceiling.

Lighting: Windows should be used wherever needed to prevent dark corners in the resting and feeding areas. Supplementary lighting is essential for inspection and operation.

Paved Yards and Passageways: The passageway between the loafing area and the milking barn together with the holding area at the milking barn should be paved. Cows will come into the milking stalls in better condition and, if extra cleaning is essential, it can be carried out effectively in this area.

The requirements for the loose-housing barn have not been so well established as those for the milk-house and milking barn. The barn where cows are housed, and the connecting area between it and the milking room, have a definite effect upon the degree of sanitation that can be obtained; therefore, the quality of milk produced is affected. A part of the value of good design, construction, and operation in the milking room and milk handling room is lost if the cows come from a dirty barn or must wade through filth to reach the milking barn.

Efficiency in Feeding: Self feeding for hay and silage is the ultimate goal for efficiency in operation, but in many cases the size of the enterprise will not justify its complete adoption. Some farmers are using a system of feeding hay in which mangers are filled twice a week or once in two weeks, greatly reducing the time required for this chore.

All-weather watering places are recommended. They reduce the chore of watering to the few hours per year required for maintenance of pumping and distributing equipment.

Chutes equipped with metering valves to supply the desired amount of concentrates to feed boxes in the milking stalls save time.

Management of the Loose-Housing Barn: In the bedded area some of the manure may be moved over to the hay feeding area when the bedded area is cleaned or it may be scattered along walls and in less intensively used areas and covered over with straw to make a manure

² Wisconsin Agr. Exp. Station Bulletin 470, Sept. 1949.

pack. Ceiling heights and door openings should allow for use of tractor manure loaders.

Winter Protection: The areas adjacent to buildings on the south and east are protected from winter wind and allow for use of needed sunshine. These areas may be as valuable as those enclosed in the building and should be utilized for winter yards wherever possible. A tight fence on the west gives added protection and is recommended in exposed locations.

GROUPING THE BUILDINGS TO MEET REQUIREMENTS

The barn is an integral part of the facilities needed to operate the enterprise. It is shown in a suggested arrangement with other buildings needed. There are many factors such as varying topography, orientation, location of pasture, protection from winter storms, prevailing winds of summer, etc., which require consideration on each farmstead, but there are basic principles that apply to all situations. Protected areas on the south and east sides of buildings are the choice for winter yards; summer air drainage from barns and pens should not be toward the milk house; a paved area should connect the barn and milk-room. The milk house should be located on the service court. These and other basic recommendations remain as guides for each situation. Revised plans may of necessity require compromises but an appreciation of the basic aims and objectives is essential for getting the best plan for any situation.

Figure 4 is an aerial view of a dairy building group showing a desirable arrangement of buildings and yards.

A study of the group shows that good use has been made of the area protected by the buildings by using it for the winter yard for the cows and for the silage feeding area. A minimum of 60 square feet per cow of paved area is essential in most sections of the state in order to maintain both quantity and quality of production. The summer yard on the north, providing a minimum of 100 square feet per cow, equipped with shade and water, is very desirable. The barn may be closed during the summer by use of bars or gates, reducing the problem of maintaining sanitary conditions. Cows can be routed to the milking room from the summer yard and returned or retained in the winter yard if silage is fed in summer.

The milk room extends into the service court, a grassed area where the surroundings are satisfactory for a building of this type. This location also makes for convenience in loading out the milk for delivery.

The building for storage and processing concentrated feed is located adjacent to the milking room where concentrates are fed.

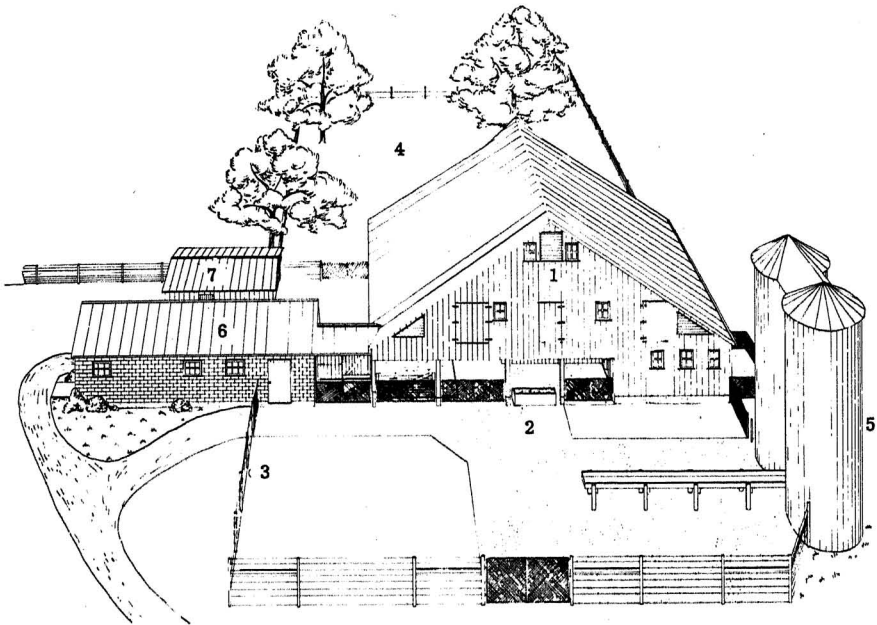


Fig. 4.—Dairy building group showing hay-to-ground type loose housing and young stock barn. 1—Loose housing and young stock barn; 2—Winter yard; 3—wind-proof fence on west side if needed; 4—summer yard with shade and water; 5—Silos for summer and winter feeding; 6—combination milk house and milking barn (any type desired)—floor level type shown; 7—feed storage and processing building. This is Mo. Plan No. 5-723-C3 for pole frame, 14-723-C3 for post frame on a concrete foundation.

Two small diameter silos are shown.

Calf and maternity pens are provided in the barn so that a sufficient number of heifer calves can be retained to maintain the herd.

The south open front and straw loft sections over the bedded and calf pen areas provide good protection and adequate ventilation.

The water tank accessible from the barn or yard simplifies the problem of watering.

An examination of the layout shown in Figure 4 by a farmer brought this statement: "That's a regular manufacturing plant."

Until the cows are familiar with the buildings it may be necessary to use the gates shown in Figure 5 to confine them in the barn before milking. Some brushing of the cows may be carried out here if needed. A feedcart can be pushed into the feed alley for convenience in feeding the cows.

Cows coming from the bedded area walk over the concrete floor in the hay feeding area, the alley and the holding area between buildings.

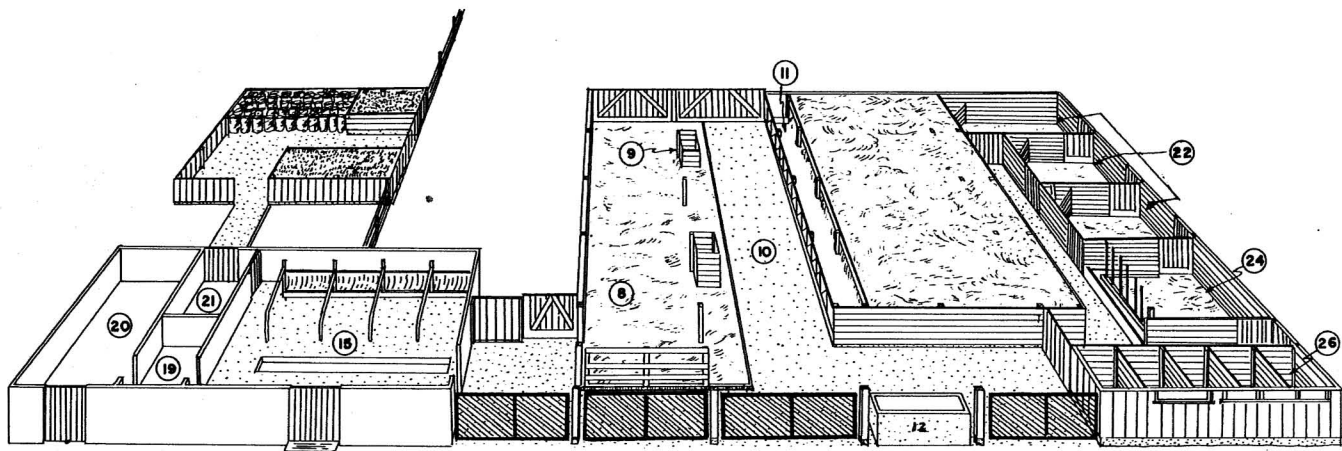


Fig. 5.—Working arrangements for buildings shown in Figure 4. 8—Bedded or resting area; 9—bedding chutes from loft storage above; 10—hay feeding area; 11—hay feeding manger filled from mow direct; 12—watering tank (small drinking place may be used); 15—floor-level milking stalls; 19—vestibule between milking and milk room; 20—milk room; 21—feed room; 22—maternity pens; 24—community calf pens; 26—baby calf pens.

This is helpful in reducing the amount of material carried into the milking room. Two cows are milked and turned into the winter yard. The machine is placed on the other two cows, two more cows are admitted, fed and their udders cleaned ready for milking. The procedure is repeated until all the cows have been milked. The milk is moved through the vestibule between the milking and the milk room, poured up and cooled ready for delivery.

The hay feeding area, a 7-foot paved strip, is cleaned frequently and kept free from bedding to discourage cows from lying down.

Some of the manure that collects in the bedded area is thrown over on the hay feeding area and removed; for the most part it is scattered over places along walls and around posts where manure does not usually collect and then covered with bedding to make a manure pack. Bedding chutes filled from above make bedding available near to where it is needed, and reduce the time required to maintain satisfactory conditions.

The hay manger can be used for batch feeding or it can be filled once every ten days or two weeks. By filling mangers and bedding chutes at the same time the number of trips to the mow can be greatly reduced.

One of the baby calf pens can be closed in and a two weeks' supply of concentrated feed stored in it. Maternity and calf pens are provided with yards on the east side of the barn. In the winter, the gate at the end of the hay feeding area can be moved to close off the area beside the water tank as a sun pen for calves.

Tractor manure loaders can be used for cleaning the hay feeding area and also the bedded area. Rolling doors on the north can be moved back along the barn and the north end of the hay feeding and bedded areas opened up for cleaning or to provide a cool shed in summer.

Baled hay may be placed in the mow by using a grapple fork. The tonnage needed can often be placed in the barn without giving it any attention other than piling some bales along the edge of the mow.

Baled straw for bedding will require piling in the mow to make sufficient room for a season's supply.

The barn shown in Figure 7 is the two-story type often seen throughout the state. The two-story barn is considered uneconomical by some who believe that it is cheaper to pile hay on the ground than to build a structure to support it. This viewpoint is not entirely correct because: (1) The two-story barn usually requires less roof area and foundation length for a given capacity; (2) Less labor is usually expended in feeding hay from the two-story barn. If power hoisting or elevating equipment is available, there appears to be little difference in labor required to fill either type barn with hay.

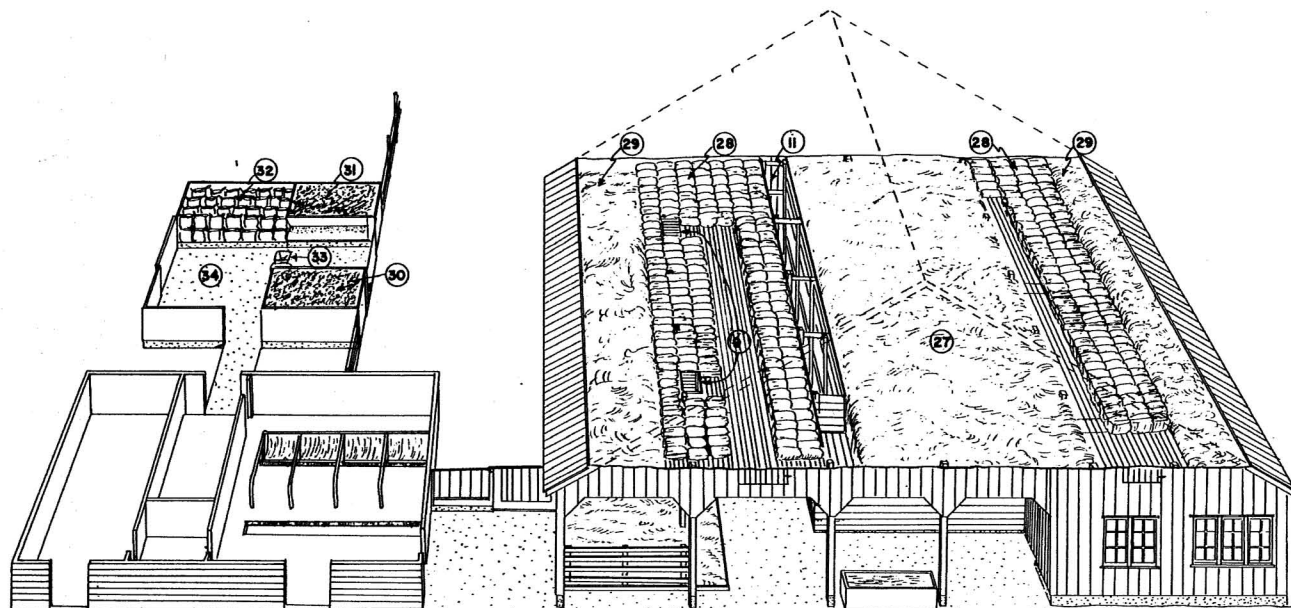


Fig. 6.—Feed storage and handling in buildings shown in Figure 4. 9—Bedding chutes; 11—hay feeding manger; 27—hay storage; 28—bedding storage; 29—straw loft; 30—corn; 31—oats; 32—supplements; 33—grinder; 34—mixing floor.

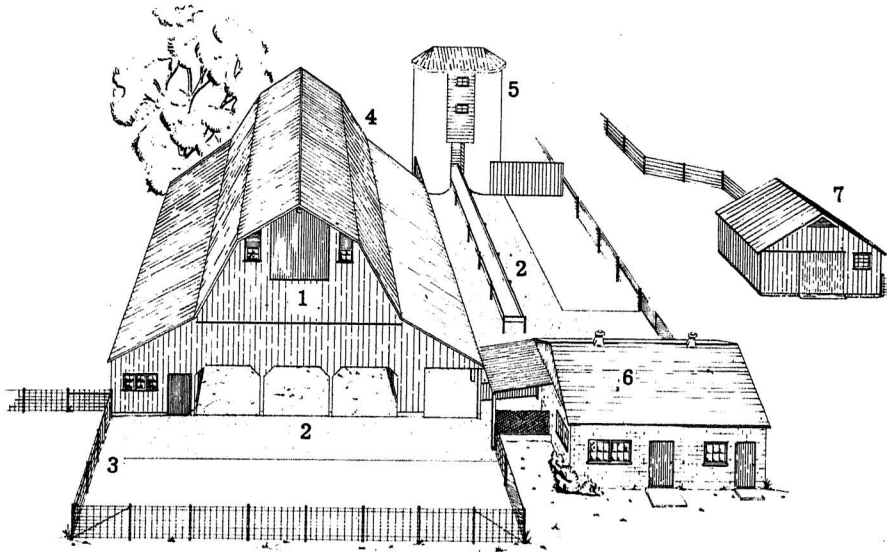


Fig. 7.—Overhead storage barn and other buildings used in housing the dairy enterprise (Mo. Plan No. 13A-723-C3). 1—Loose housing and young stock barn; 2—winter yard—60 sq. ft. of paving per cow; 3—protected fence on west, buildings on north; 4—summer yard, shade, connected to pasture; 5—silos for winter and summer feeding; 6—combination milk house and milking barn; 7—feed storage and processing building.

Many loafing or loose-housing barns are made by remodeling existing structures. This plan (Figure 7) will furnish some suggestions for making changes needed. The protected areas on the south and east are used for the winter yard with the combination milk room and milking barn building fitted in between them. The silos are located to increase the protection of the winter yard on the east side of the barn and for use with the summer yard at the time of filling. The feed storage and processing building is located on the lane to the field for convenience at harvest time, and to keep the dust produced by grinding away from the milk house and milking room. A location closer to the milking room would have the advantage of reducing the time required in handling the feed. The milk house extends into the service court for loading milk for delivery and to secure proper conditions around it.

The first floor of the two-story barn shown in Figures 7, 8 and 9, is made into a bedded or resting area. Gates are provided for fencing off temporary maternity pens from this area when needed. Either the hay feeding area or the pavement on the south may be used as a holding area. The gate across the hay feeding area may be moved to the end of the barn to reverse the routing of the cows from the bedded area.

Hay and silage feeding, watering and supplying bedding are made as nearly automatic as possible.

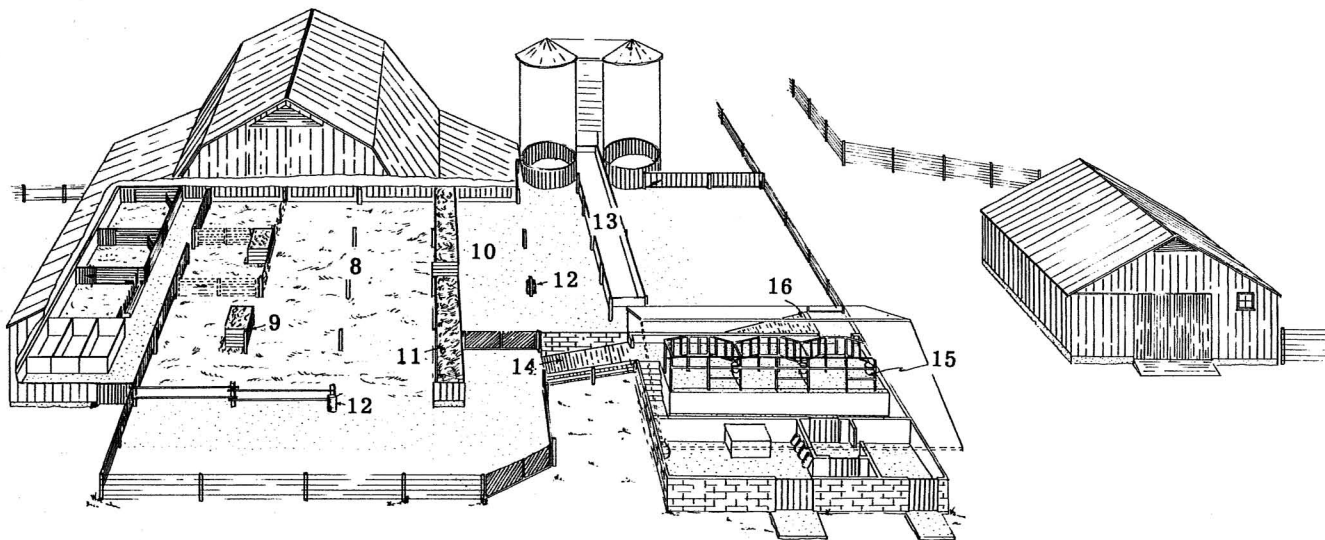


Fig. 8.—Functional features of buildings shown in Figure 7. 8—Bedded or resting area; 9—bedding chutes holding several days' supply, available where and when needed; 10—hay feeding area; 11—hay feeding manger, which can be filled for self-feeding or used for batch feeding; 12—all-weather watering place; 13—silage feeding bunk; 14—ramp to elevated floor of milking room; 15—tandem milking stalls; 16—ramp to yard level.

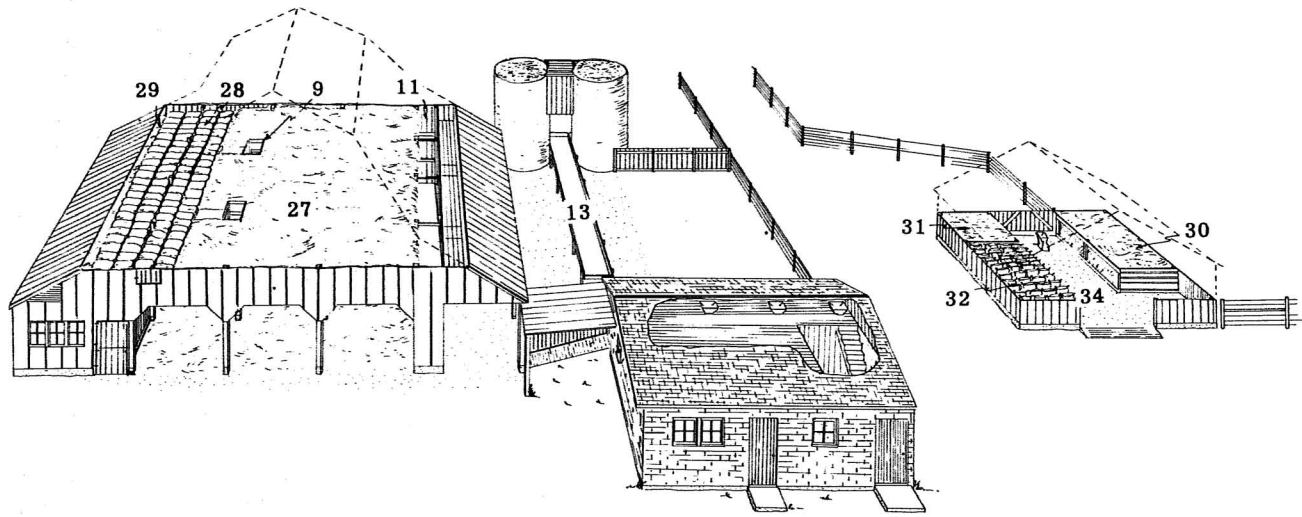


Fig. 9.—Feed storage and handling in buildings shown in Figure 7. 9—Bedding chute; 11—hay feeding manger; 13—silage feeding bunk; 27—hay storage; 28—bedding storage; 29—straw loft over calf maternity pens; 30—corn; 31—oats; 32—supplements; 34—mixing floor.

Maternity and calf pens are much the same as those described under Figure 5.

Cows can be brought from the summer yard on the north through the hay feeding area without using the barn if desired. The summer yard is accessible from pasture fields.

If hay is stored loose, about three-fourths of the mow space is needed. By using the hay in such a way as to maintain a slope to the manger, the movement of hay across the mow will be less difficult.

Bedding will probably be placed in the mow after it is partly filled with hay. If a grapple fork is available the bales may be dropped on the hay and moved over in place. If an elevator is used, the small door in the end of the barn is available.

A feed cart equipped with flange wheels to run on the sides of the bunk will speed up a silage feeding. The cart should be made large enough to hold one feed. It can be wheeled to the end of the bunk and the silage dumped on the return trip.

The small feed hoppers, one for each stall, shown in the attic of the milking barn are to be filled before each milking period. A metering valve to control the amount of feed for each cow reduces the time for feeding. Cows may be fed from the operator's pit if desired.

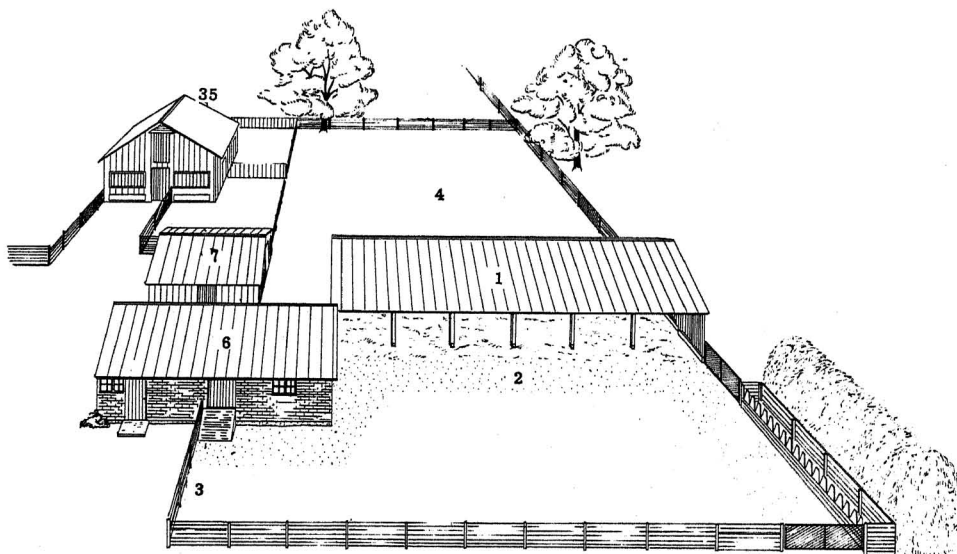


Fig. 10.—Buildings for a dairy enterprise where hay is fed in the winter yard (Mo. Plan No. 16-723-C2). 1—Loose housing shed for dairy cow; 2—winter yard; 3—protecting fence on west side; 4—summer yard connected to pasture; 6—combination milk-house and milking barn; 7—feed storage and processing building; 35—young stock barn.

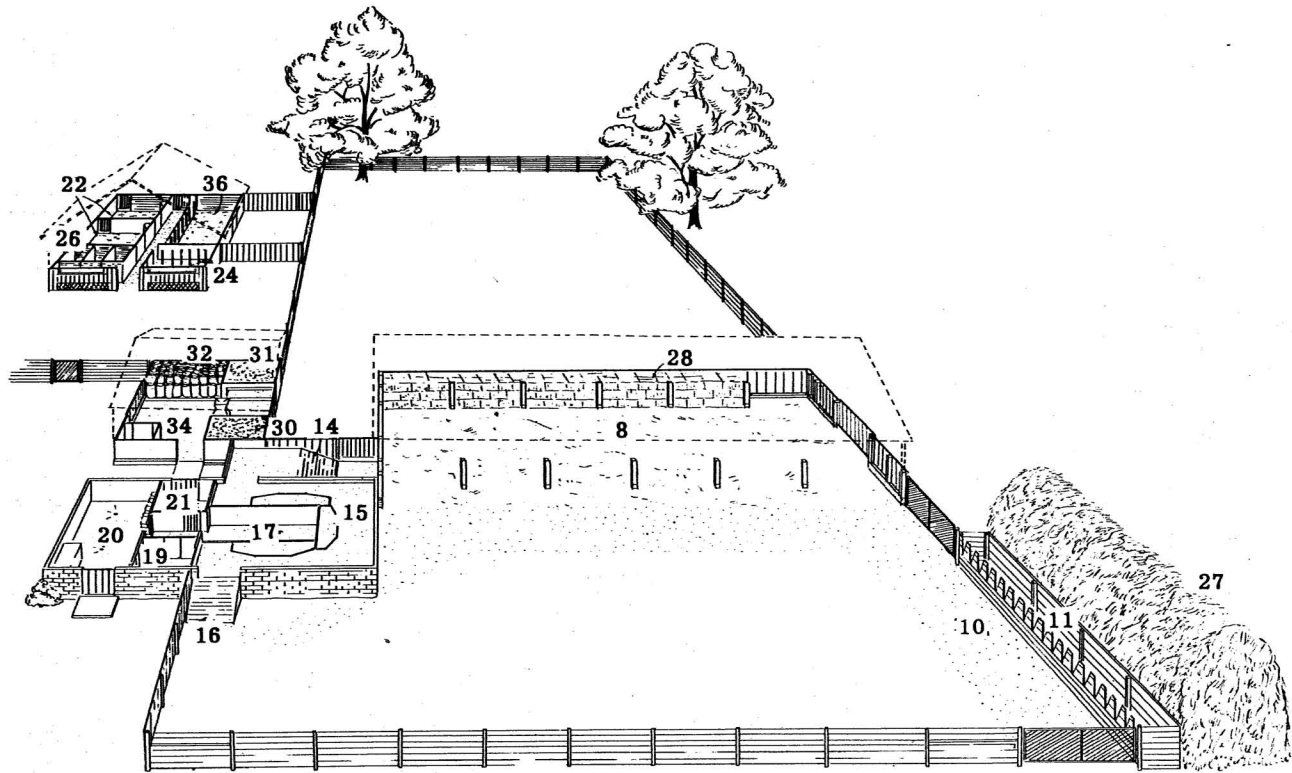


Fig. 11.—Functional features of buildings shown in Figure 10. 8—Bedded or resting area; 10—hay feeding area; 11—hay feeding manger; 14—ramp to elevated stalls; 15—elevated U-shaped stalls; 16—ramp to yard level; 17—operator's pit; 19—vestibule between milk and milking room; 20—milk room; 21—feed room; 22—maternity pens; 24—community calf pens; 26—baby calf pens; 27—outside hay storage; 28— bedding storage; 30—corn bin; 31—oats bin; 32—supplements; 34—mixing floor; 36—pen for yearlings.

The bedded or resting area shown in the arrangement in Figure 10 and 11, is provided by the open shed adjacent to the combination milk room and milking barn building.

Cows can be routed into the milking room from the summer yard if desired. The milk handling room extends into the service court to provide proper surroundings and to facilitate delivery of milk.

The feed storage and processing building is located beside the milking room for convenience in feeding.

The young stock barn is accessible from the service court, to pasture and to the yards for calves.

The bedded area 20 x 60 feet provides space for 20 cows leaving 4 feet along the north wall for bedding. Space for bedding for half the season is available if piled to the ceiling.

Hay is fed from the stack in the outside manger. Some type of all-weather surface must be provided in the yard as shown to maintain satisfactory conditions. This area should be cleaned frequently and kept free of bedding.

The U-shape three-stall milking room is shown although any type may be used.

Feed preparation, feeding and care of milk is similar to that in other buildings.

The young stock barn 30 x 30 feet provides space for two maternity pens, one pen for yearlings, and pens for young calves. The south exposure provides sunshine in calf pens and windows on the sides provide for light and sunshine in other pens. Dutch doors are used to provide ample ventilation for summer conditions.

Space is provided for baled hay and straw in the center section of the loft and a section five feet wide on each side of the loft provides for air movement into the ventilated attic.

This plan allows for distribution of building construction over a period of years as a herd is being built up. Starting with the combination milk room and milking barn building and the loafing shed, the other buildings can be added as time and funds permit, provided the first buildings are located with this in view.

The buildings of this group do not require as much skill in construction nor as great an investment as those in the other groups shown. There may be additional loss of hay and the operation of the enterprise will require more outside chore work, but if yards are paved the quality of milk produced should equal that of any other type of housing where similar care and management are given.