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Beef Cattle Housing in the North Central Region of the United States

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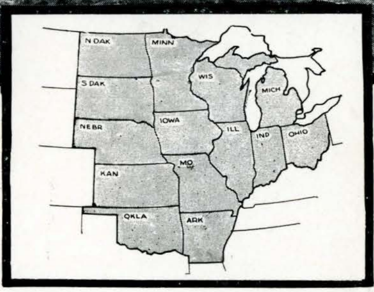

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AGRICULTURAL EXPERIMENT STATION • SOUTH DAKOTA STATE COLLEGE • BROOKINGS, S. D

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Foreword

In this bulletin there has been assembled an outline of functional requirements and accepted practices for beef cattle housing in the North Central Region of the United States. While some deviation from these recommended practices may be advisable under the conditions encountered on a specific farm, the general practices here outlined will serve as a very useful guide.

Efficiency in the use of labor for feeding and caring for the beef cattle enterprise should be studied carefully. Buildings are an expensive part of the farm enterprise. Once constructed, they are difficult to move and there is a definite limit to the changes that can be made in remodeling. As a consequence, it is most important that very careful consideration be given to the arrangement of buildings on the farmstead and to their design. Time spent in planning will pay tremendous dividends in the years that follow.

This bulletin attempts to highlight the principles which need to be adhered to in developing the buildings for the beef cattle enterprise—in order that labor may be used most efficiently, costs may be kept to a minimum, and as much of the hard manual labor eliminated as is possible.

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Acknowledgment

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*Deceased February 2, 1946
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Beef Cattle Housing

In the North Central Region of the United States

*By the Committee on Housing of Beef Cattle and Sheep**

Shelter for beef cattle is needed principally to protect the animals during severe cold and stormy weather and at winter calving time. In addition, structures should (1) provide a reasonably dry bed for the animals, (2) simplify feeding and management, (3) provide storage for feed and bedding, (4) protect young calves, and (5) conserve the fertility value of manure.

Besides pointing out the functions and requirements of housing in relation to climate and management, this bulletin considers various problems involved in planning buildings and equipment for beef cattle production. The practices discussed are widely accepted in the North-Central Region, where two-thirds of the beef cattle of the United States are located. Because of variations in climatic conditions, sizes and types of enterprises, and systems of management, however, the general recommendations given must be adapted to the specific needs in different areas and to the various systems of production. Recommendations and plans applying to a particular locality are available from the college of agriculture in each state.

Practices will be modified as better methods of production and new machines and equipment are found. A high degree of flexibility is therefore desirable in buildings, equipment, and management plans in order that the operator may conveniently make the adjustments necessary to carry on his business most effectively. Such developments, for example, as manure loaders, new methods for harvesting hay and small grain, and changes in cropping programs affect building dimensions and space requirements.

Planning the Livestock Program

In planning structures for beef cattle, consideration must be given to the whole farm plan, including organization, capacity, and production programs. The enterprise should fit in with the most effective crop rotations, soil conservation practices, and use of labor. It is possible to develop a program of beef cattle management to fit almost any feed supply. Practices vary from an all-pasture and hay program, as one extreme, to the use of eight acres of corn to one of hay for fattening calves to a high degree of finish, as the other extreme. The most practical plan, however, is to maintain a balanced program by keeping enough cattle to consume the roughage produced on the farm and feeding enough grain to put the animals in marketable condition.

Beef cattle are produced in large numbers throughout the region under conditions that vary from the open range in the southwestern part, to small farm pastures and feedlots throughout the region. Herds vary from large herds which are used to produce calves, to low grades and high producing purebreds, and production programs vary accordingly. Fattening cattle are grazed on pasture, fed in corn-belt feedlots, hand-finished, or even stall-fed on some farms in the northern and eastern areas. Most of the beef cattle in the region, however, consist of commercial and purebred herds and cattle and calves on roughage or pasture or in feedlots; and for these phases expensive shelter is not necessary.

Most buildings for cattle may be relatively simple in construction. A building may be convenient, well-planned, and attractively proportioned without increas-

*Manuscript prepared by Ralph L. Patty and Deane G. Carter, with the assistance of the members of the Committee.

ing its cost. If, in order to obtain advertising value or personal satisfaction, an owner wishes to build a more elaborate structure than is actually required for production, he should realize that the extra cost should be met during his tenure in order not to penalize the operations of future owners.

On the other hand, compared with feed and labor, structures and equipment account for only a small part of the cost of production—perhaps less than 10 percent. Therefore additional buildings investments add relatively little to production costs, and the net cost will be reduced if the investment results in a saving of feed, reduction of labor, or better conditions generally. Among the economical improvements are: (1) shelters adapted to climatic conditions, (2) methods that will save time and labor, and (3) such facilities as paved feeding floors, constant water supply, and equipment for feeding and manure removal. Existing buildings frequently hamper the size and type of the enterprise and may have to be remodeled to meet current needs. It is economical, in constructing new buildings, to make them relatively standard in size so that they can be adapted to various uses.

On general farms which have small numbers of cattle, the stock is usually housed in the general-purpose or dairy barn or in sheds or extensions to such barns. The types of structures illustrated in this bulletin are those most commonly used for beef cattle in the North-Central Region. Some of them are satisfactory for the entire region, but others are best adapted to specific conditions of climate, size of herd, or system of production. The variety of plans illustrated is probably adequate, however, to meet the various conditions.

Adaptation to Climate

The protection that must be supplied for beef cattle depends upon climatic conditions and the natural protection available. Open weather may permit the operator to bring feed from fields, stacks, or silos at some distance from the feedlots. In most of the southwestern areas and the Great Plains the herds may need only the protection of trees, hills, or valleys except at winter calving time. Then enough enclosed space is needed to shelter about 10 percent of the herd at one time.

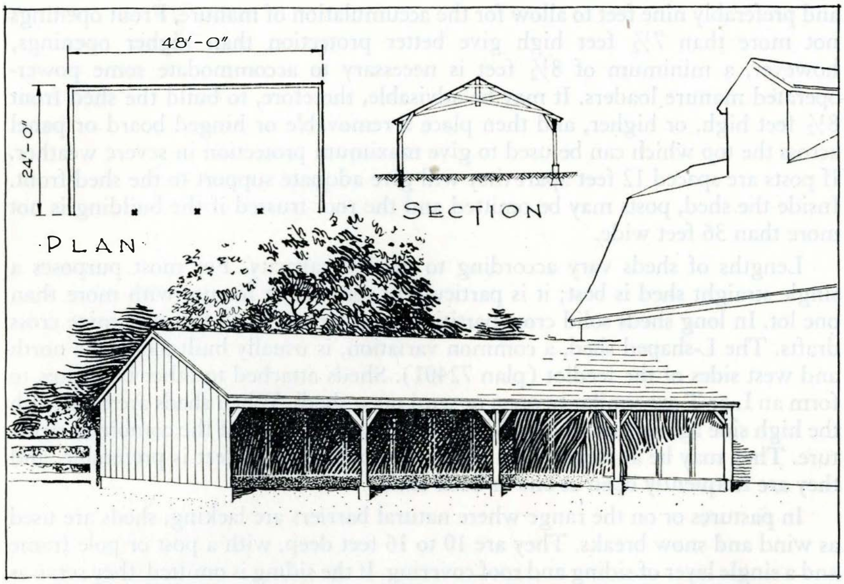
More protection is needed in the northern and eastern parts of the region. Frequent high winds, heavy snows, and long winters make it necessary to have buildings with three sides enclosed. To protect cows and calves at least part of the building should be completely closed. In areas which have heavy snowfalls and low temperatures for long periods, a compact arrangement of shelters and feed storage structures will provide needed protection.

Location and Arrangement

Shelters and yards should be so located that prevailing winds in summer will not carry odors and flies toward the dwelling. In the North-Central Region the wind in summer is usually from the south or southwest.

Buildings to house cattle should be farther from the dwelling than is necessary for storage buildings, dairy barns or poultry houses. From 150 to 200 feet is a frequently recommended minimum distance. Cattle barns or shelters should be located on elevated ground. Driveways and lanes should provide direct routes and permit allweather traffic. The driveways should be so planned that vehicles can go forward or turn without backing.

The yards and feedlots should be south or southeast of the shed or barn so that they will get sunshine in winter and the animals will be protected from north and west winds, ice-covered ground, and snowdrifts.



Plan 72404 Open-front shed. Is usually 24 feet deep, with length variation in units of 12 feet. Each 12-foot section will accommodate about six cows, eight yearlings, or ten calves. Construction may be either stud wall on concrete foundation or pole frame. This shed is used where all feeding is done outside.

If this or succeeding plans are used in areas such as North Dakota where there may be frequent heavy snow and high wind, more nearly complete enclosure may be needed for protection. This shed may be made semi-open by extending the wall 12 feet across the front next to each end.

Windbreaks to the north and west of the yards are an effective means of sheltering cattle and buildings from wind and snow. They will protect a strip eight or ten times their height. Strawstacks are also important as windbreaks. Natural woodland and hills or earth banks are used in some localities, but their use results in a loss in fertility value of the manure. Open-front sheds 10 to 16 feet front to back are somtimes used where there is no other protection. Another means of protection is a tight fence from 6 to 10 feet high on the north and west sides of the yards and sometimes also on the east.

There is sometimes an advantage in locating feeding units in fields or pastures away from the farmstead: It permits better rotation of pastures and distribution of manure over the fields, and it also saves hauling of some of the forage. On the other hand, where frequent attention must be given to the breeding herd or when cattle are to be finished on full feed, the barns and sheds should be part of the farmstead group.

Types of Buildings

Sheds: Sheds are the most widely used shelters for cattle throughout the region. They usually have the front open to the south or east and are enclosed at the back and on both ends. The semi-open shed is closed on the ends and sides and partially closed in front (See plans 72404 and 72405). In severe weather, doors may be used on some of the openings.

Permanent cattle sheds should usually be at least 24 feet deep, front to back, or deeper if racks or bunks are located inside. Headroom should be at least eight feet and preferably nine feet to allow for the accumulation of manure. Front openings not more than 7½ feet high give better protection than higher openings, however, a minimum of 8½ feet is necessary to accommodate some power-operated manure loaders. It may be advisable, therefore, to build the shed front 8½ feet high, or higher, and then place a removable or hinged board or panel across the top which can be used to give maximum protection in severe weather. If posts are spaced 12 feet apart they will give adquate support to the shed front. Inside the shed, posts may be omitted and the roof trussed if the building is not more than 36 feet wide.

Lengths of sheds vary according to needed capacity. For most purposes a single straight shed is best; it is particularly convenient for use with more than one lot. In long sheds solid cross partitions at intervals of 40 feet minimize cross drafts. The L-shaped shed, a common variation, is usually built along the north and west sides of the feedlot (plan 72401). Sheds attached to other buildings to form an L or T are similar to open or semi-open sheds. When sheds are built with the high side against another building, they become a part of the combined structure. They may be as narrow as 16 feet, although 18 to 20 feet is preferable, and they are frequently open at one or both ends.

In pastures or on the range where natural barriers are lacking, sheds are used as wind and snow breaks. They are 10 to 16 feet deep, with a post or pole frame and a single layer of siding and roof covering. If the siding is omitted, they serve as pasture shades (plan 72407). When feeding is done in open pastures or fields, it may be advisable to have sectional shelters. In such shelters panels of framework and covering materials make up the ends, roof, and rear walls. The panels are connected with bolts, and the whole structure is anchored to posts set firmly into the ground. In order to be handled readily and transported by truck, the panels should not exceed about 80 square feet in size.

Barns: Barns are more substantial structures than sheds and provide more complete protection for stock in the colder areas. Usually they are planned for hay and other feed storage in connection with animals. Stalls, pens, and storerooms may also be included. There are two types of barns in common use: (1) the pen, stall, or general utility barn ranging up to 40 feet wide (plans 72421, 72422, and 72423) and (2) the central storage type with attached sheds or livestock sections (Plans 72432 and 72433).

In plans for feeding barns up to 40 feet wide, a central alley extends the full length of the building or to within about 16 feet of one end. Racks and troughs are located on each side of the alley. If feeding is done inside, hay racks may be placed along the alley and feed bunks along the side walls; or the location of the hay and grain feeding equipment may be reversed. With feeder cattle hay is usually fed inside the barn and grain and silage outside.

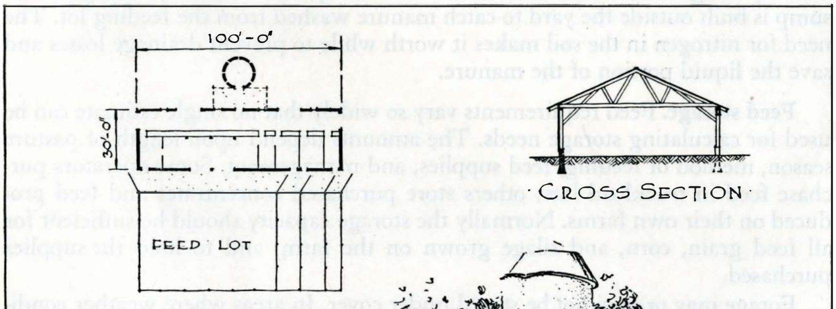
Variations in this plan may provide for a driveway and for stalls and pens for calves, cows, and bulls. The barn may have wings or extensions to form an L, T, or U shape. Floor plans of one- and two-story barns are similar, the only essential difference being the overhead loft in the two-story type.

The wide barn with storage in the center and attached pen sections or sheds is economical and provids for storage of chopped, baled, or long hay on the ground floor. Racks can be filled with a minmum of labor. The pens can be built along one, two, or three sides, depending on the capacity needed. The shed space can be altered for horses, sheep, or dairy cows without changing the general structure. A width of 60 feet allows for a 24-foot center and two 18-foot wings, which are satisfactory for most needs, although the width of both may be increased. Continuing the sheds across one end will give more shelter space in relation to storage, and the entire area for housing animals will be a single unit.

In this type of barn it is possible to connect the shed roof sections to the main roof to get a continuous roof line. Two possibilities are shown in the illustrations, one a gable roof covering the entire structure and the other a high roof over the center with a lower pitched roof on the sheds. The sheds can be ceiled to provide a strawloft or overhead storage space. In unceiled sheds the disadvtange of drafts may be overcome by making a tight partition above the hay racks to separate the sheds and the center sections.

Management Problems of Structure and Operation

In the beef cattle enterprise, efficient use of labor in managing and feeding animals and in removing manure is often fully as important as shelter, although yards, feedlots, feed storages, and facilities for operation all affect economy of production. In putting gains on cattle the labor cost is second only only to that for feed. The labor required for a cow and a calf to weaning age is approximately 25 hours, according to Illinois Agricultural Experiment Station data. Kansas Experiment Station records show that it takes 20 hours of labor annually per head for the cow herd. Feeder cattle in Illinois required 10 hours of labor per 100 pounds' gain. In Kansas the labor required for various systems of handling cattle ranged from one hour per head for cattle on grass for a 165-day season to nine hours per head for wintering, deferred feeding, or wintering and grazing.



Plan 72405 Semi-open shed. The 30-foot width permits a flexible arrangement of stalls, pens, and storage. With removable partitions, the shed can be used as a single unit. Animals can be fed inside. Space in front of the bunks may be used as a driveway or feed storage. A tight cross partition near the center may be needed in the colder parts of the region to reduce drafts.

Yards, feedlots, and feeding floors. Yard enclosures should be strong as well as safe for the animals. In small yards and corrals where the herd is closely confined, the fence should be built of planks and the gates of two-inch lumber frames and rough one-inch boards. A plank fence will serve as both an enclosure and a windbreak. For larger yards, heavy wire fencing sometimes with the wire doubled, and heavy posts set eight to 10 feet apart may be used.

For fattening cattle the feedlot area exclusive of bunks varies from a minimum of 30 square feet per head in paved lots, up to 150 square feet per head in unpaved yards. Breeding cattle require more yard space than fattening cattle.

Feedlots become unusually muddy in some areas. Hard surfacing may then be desirable to save feed, facilitate feeding and manure removal, and improve sanitary conditions. A six-inch surface of crushed limestone has been used with satisfactory results. Concrete is recommended for permanent flooring or paving. If the entire yard is not to be surfaced at one time, a paved strip 15 feet wide in front of the feed racks and around watering tanks will keep the stock out of the mud while they are feeding.

Feeding floors are usually five inches thick. In most areas the paving can be laid on the ground; but if drainage is poor, the concrete should be laid on a drained fill of packed stone or gravel. The surface should have a slope of about one-fourth inch per foot. An apron or cut-off wall should be extended 1½ to two feet into the ground under the edge of the floor. The floor should be finished with a wood float to leave an even gritty, nonslippery surface. The whole floor should be laid in one operation, preferably in sections about 10 feet square.

A low curb around the edge of the paving will hold the manure; however, some openings should be left to let rainwater escape. Sometimes a wide gutter or sump is built outside the yard to catch manure washed from the feeding lot. The need for nitrogen in the soil makes it worth while to prevent drainage losses and save the liquid portion of the manure.

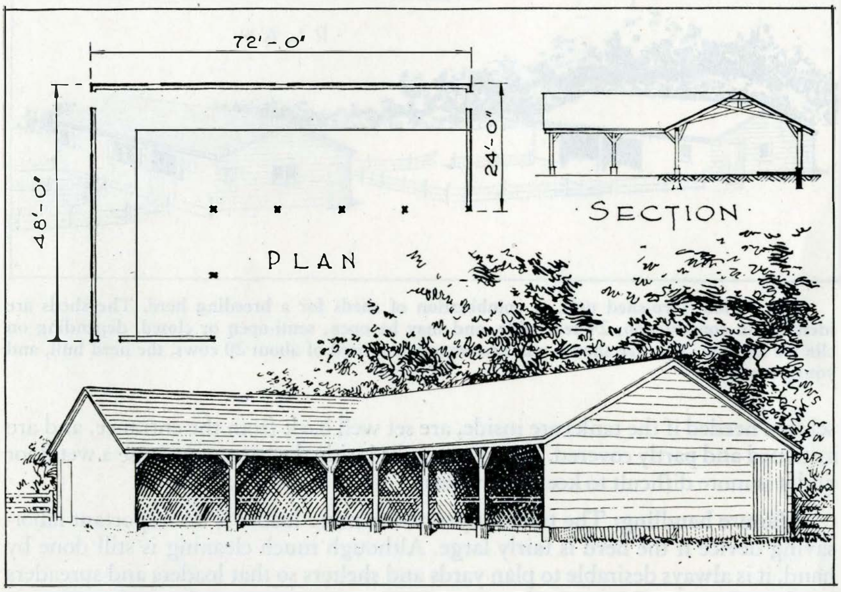
Feed storage. Feed requirements vary so widely that no single estimate can be used for calculating storage needs. The amounts depend upon length of pasture season, method of feeding, feed supplies, and management. Some operators purchase feed in truckload lots; others store purchased concentrates and feed produced on their own farms. Normally the storage capacity should be sufficient for all feed grain, corn, and silage grown on the farm, and to hold the supplies purchased.

Forage may or may not be stored under cover. In areas where weather conditions permit, hay is frequently stacked in the fields in loose, baled, or chopped form. A cheap cover of waterproof paper or wild grass may be used for protection. In other localities all forage is stored in or near the barns. Most cattlemen prefer to put legume hay under cover. It is not usually economical to store all the bedding inside the barn. Pole-framed sheds are sometimes used to store hay and bedding at the ground level. Other forms of low-cost storage include trench silos, wire and paper silos, movable grain bins, and snow-fence cribs.

Established beef cattle programs usually justify the building of more permanent types of cribs, bins, silos, hay sheds, and lofts. In planning for permanent structures, it is particularly important to include such labor-saving equipment as blowers, portable or stationary elevators, conveyors, hopper-bottom bins, and overhead bins which will hold several days' feed supply.

Feeding. The large-scale operator will find it desirable to use elevating, conveying, and processing equipment for feeding. Moving feed by hand is usually justified only if the herd is small or if it includes purebred animals that require special handling. Three general plans for reducing hand labor in feeding are used in the North-Central Region:

(1) Feed is hauled to feeders each day in trucks or wagons from silos, stacks, cribs, and bins located some distance from the yards. The conveyances are often filled directly from silo chutes, hopper-bottomed bins, grinder-blower pipes, and haystacks.

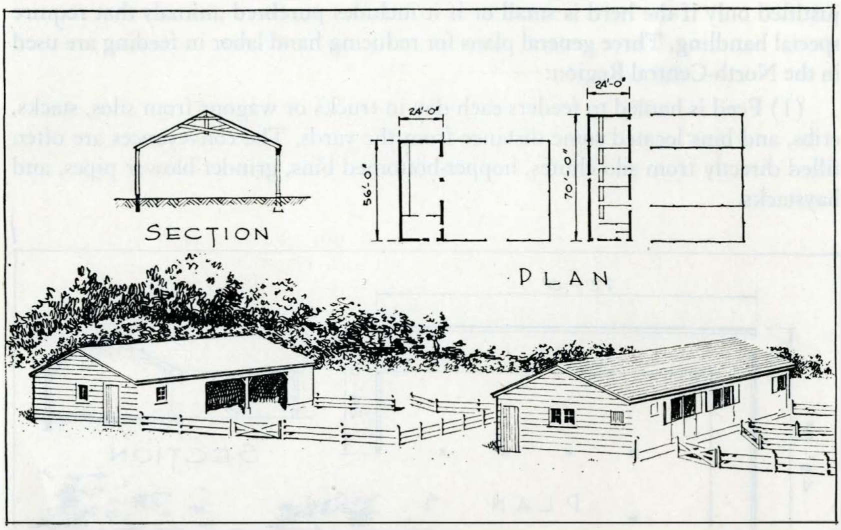


Plan 72411 L-shaped open shed 24 feet wide. Intended for location at the northwest corner of the feedlot. Wings are variable in length. One wing may be used to store hay and bedding. Plan 72401, not illustrated, is identical except it is 20 feet wide for use only as a shelter.

(2) Feed is conveyed from near-by storage to bunks, self-feeders or racks by means of blowers or overhead carriers or carts. Hay is stored or stacked next to feeding racks and is moved only short distances.

(3) A combination of wagon or truck and blower, cart, or trolley carriers is used for transferring the feed. Under this system, movable or stationary holding bins may be desirable near the feeding lot. Frequently a feed wagon parked in the lot serves as a holding bin. In the colder areas, hay barns attached to cattle sheds add to convenience in feeding. Silos should usually be located far enough away from the barn to permit the wagon to be filled from the chute.

Watering: Consumption of water by animals varies greatly with their size, the season, and the feed used. An allowance of 12 gallons per head per day is average. If surface water is not available, labor can be saved by having reliable power for pumping and by piping water under pressure to tanks or troughs where it will be available at all times. If the tanks are outside, tank heaters and perhaps tank covers and insulation will probably be needed in the colder areas. Heaters are



Plan 72406 Two-shed unit. A combination of sheds for a breeding herd. The sheds are identical in construction, 24 feet wide, and may be open, semi-open or closed, depending on climate and use. The size shown will accommodate a herd of about 20 cows, the herd bull, and young stock.

seldom needed if the tanks are inside, are set well back from the entrance, and are insulated and partly covered. However, tanks inside the barn may cause a wet floor and it is more difficult to keep them clean.

Manure handling: The tractor-operated manure loader is an important labor-saving device if the herd is fairly large. Although much cleaning is still done by hand, it is always desirable to plan yards and shelters so that loaders and spreaders can be driven to all parts without interference from posts, racks, and partitions. Paved feedlots and hard-surfaced floors in sheds facilitate removal of manure. About four tons of manure are produced by each feeder animal in a 200-day feeding period, although the amount varies with the quantity of bedding used.

Environmental Conditions

Temperature: Under most conditions there is no need to control the temperature in buildings used for beef cattle. The cattle can stand low temperatures. Fattening animals frequently have difficulty in dissipating heat from their bodies, and electric fans are occasionally used when highly-finished cattle are kept in closed barns.

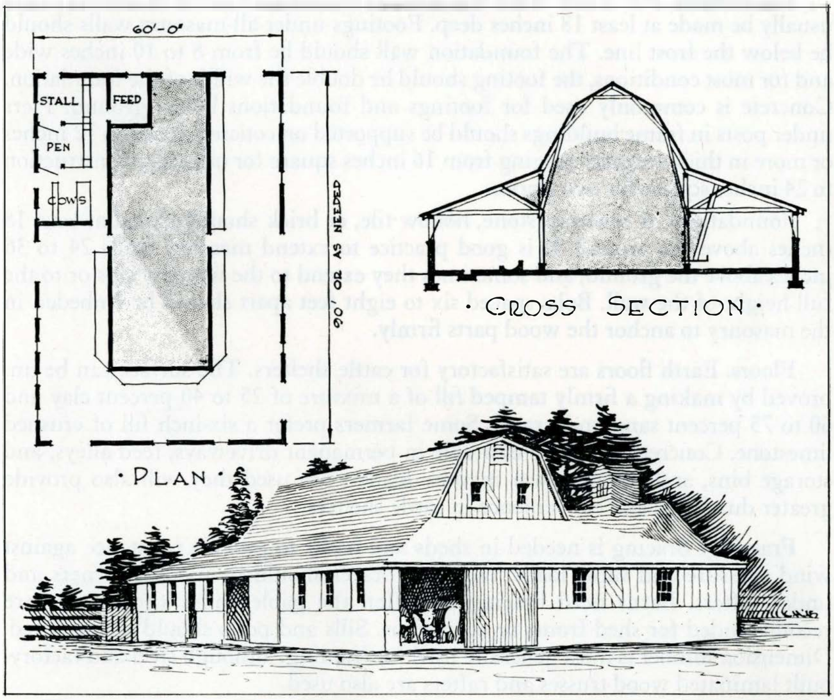
Natural shade is desirable in small pastures and feedlots, but steers appear to graze better without shade, according to experiences in such large pasture areas as the Kansas Bluestem region.

A closed building with a wall of single thickness usually provides enough protection for young calves and breeding stock even in severe weather. In colder areas, calves just starting on feed may need partially closed shelter for a time. Strawlofts in sheds or one-story barns reduce moisture condensation and frosting and tend to minimize temperature variations, but usually there is no need for insulation in either ceilings or sidewalls.

Ventilation, condensation, and frosting: In winter the warm air inside closed buildings where animals are housed picks up moisture from respiration and excrement. When there is a difference of several degrees between inside and outside temperatures, the moisture condenses on the cold surfaces. In freezing weather this condensation forms frost. It is harmful for stock to go from a moist, warm barn into the cold outside air. Excess moisture for prolonged periods also causes the structure to decay or deteriorate.

Open or semi-open sheds will have adequate circulation of air, and the difference between inside and outside temperatures should not be great enough to cause moisture trouble. In cold weather sufficient air movement can usually be provided in enclosed buildings. By opening the doors and windows on only one side of the building, drafts can be avoided.

Closed barns are not recommended in most areas and for most systems of production. Where this type of barn is used, it will usually be closed for only short periods, and for this reason there will be little need for a complete ventilating system. It is necessary, however, to remove moist, foul air from occupied buildings that are closed for longer periods. For this purpose one or more electric ventilating fans may be used, or circulation may be provided by means of a system of inlet and outlet ducts. The outlet ducts should extend to a point well above the ridge of the roof and should be covered with a cap or cupola. Fans should circulate about 3,000



Plan 72433 Combined storage and stock barn. For general-purpose use on farms where stock cattle or feeder cattle are kept. The 18-foot sheds can be adapted for cattle, dairy cows, sheep, or horses. The roof on center section may be gable, gambrel, or arched. Openings permit convenient use of manure loaders and provide protection from weather. Doors are omitted from openings on the east or south.

cubic feet of fresh air per hour per animal; the ventilating area provided by the ducts should be about 30 square inches per head.

Lighting: Windows are not necessary in open-front buildings which are used only for shelter. If the building is 24 feet wide or wider, or if it is fully or partly enclosed on four sides, it should have enough windows to admit light. A good ratio is one square foot of opening to 35 square feet of floor space in the part of the barn to be lighted. One window is needed for each box stall or closed room. Sills should be about five feet above the floor to protect windows against breakage. Window sash should be removable. Adequate artificial lighting can be provided by installing one electrical outlet for each 400 square feet of floor area.

To facilitate handling and showing animals, purebred breeders may wish to have more of both natural and artificial light than is recommended here.

Construction

Permanent cattle buildings should have structural qualities that enable them to (1) withstand wind and snow loads, (2) resist decay, insect damage, and destruction by animals, and (3) keep out rain, snow, and wind. The following statement of requirements conforms with generally recommended standards and permits the use of any suitable construction materials.

Foundation. For frame walls the foundation should extend to firm soil and usually be made at least 18 inches deep. Footings under all-masonry walls should be below the frost line. The foundation wall should be from 8 to 10 inches wide and for most conditions, the footing should be double the width of the foundation. Concrete is commonly used for footings and foundations below ground. Piers under posts in frame buildings should be supported on concrete footings 12 inches or more in thickness and ranging from 16 inches square for one-story construction to 24 inches square for two stories.

Foundations of concrete, stone, hollow tile, or brick should extend at least 18 inches above the ground. It is good practice to extend masonry walls 24 to 36 inches above the ground, and sometimes they extend to the window sills or to the full height of the wall. Bolts spaced six to eight feet apart should be embeded in the masonry to anchor the wood parts firmly.

Floors. Earth floors are satisfactory for cattle shelters. The surface can be improved by making a firmly tamped fill of a mixture of 25 to 40 percent clay and 60 to 75 percent sand and gravel. Some farmers prefer a six-inch fill of crushed limestone. Concrete floors are desirable in permanent driveways, feed alleys, and storage bins, and where power manure loaders are used they will also provide greater durability and convenience in cattle shelters.

Framing. Bracing is needed in sheds and barns to provide resistance against wind pressure and snow loads. Diagonal braces should be used at corners and under rafters. Barns need bracing to stiffen the gable ends; knee braces are recommended for shed fronts or on purlins. Sills and posts should be anchored. Dimension lumber is most generally used for framing, although steel and factory-built laminated wood trusses and rafters are also used.

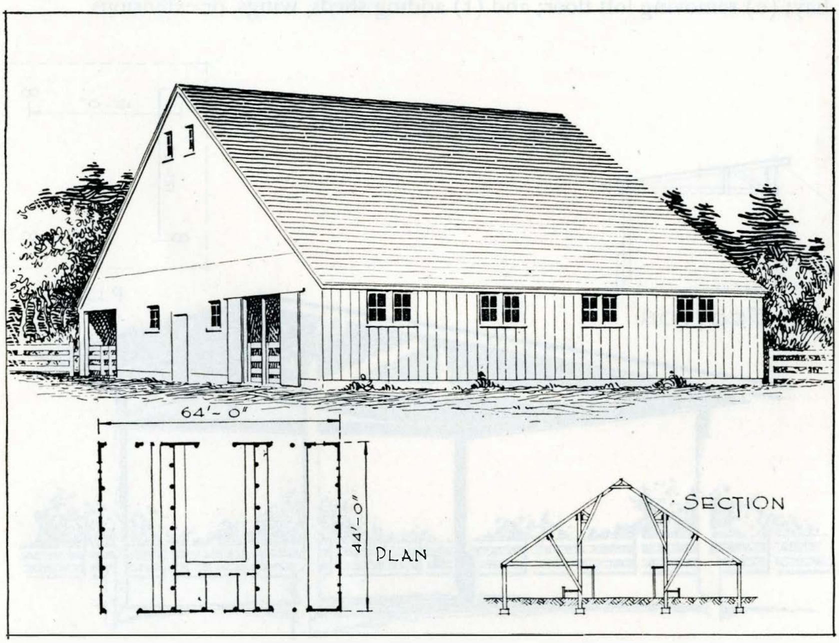
Siding. Siding for cattle barns or sheds usually consists of a single layer of material. Wood siding of either matched or plain boards is most common, but any material that is durable and weather-resistant should be satisfactory. Most sheet materials are subject to damage by animals, and some protection is required.

Using masonry within 4½ or 5 feet of the ground or buffer planks around the inside of the walls will help to prevent such damage.

Roofing. Roof coverings may be selected from among many types and grades. On permanent buildings the roofing should last at least 15 or 20 years without replacement. Among the more durable roofings are No. 1 wood shingles; cement-asbestos shingles; 28-gage, 2-ounce coated steel sheets; and 250-pound asphalt shingles. Lightweight, low-cost roofing is satisfactory for sectional or semipermanent sheds or for re-covering old buildings.

Low-cost construction. Straw sheds serve an important function as low-cost, semipermanent shelters. Poles set in the ground form the framework. Planks are nailed to the poles at the top and bottom and every three or four feet in between. Two- by 6-inch joists or larger are placed on top of the frame, at two- or three-foot intervals. The frame is covered with boards or wire fencing. The walls may be made of bales laid flat with the joints broken, or the whole top and sides may be covered with loose straw blown from the thresher. The straw covering should be five or six feet deep. Sheds might be overloaded by an extreme weight of snow and ice, and there is sometimes danger of collapse.

Pole-frame sheds or barns are frequently built without footings. The poles are set four feet into the ground for light buildings and five feet for larger structures. Durable native woods may be used. If the poles are bought they should be of softwood and pressure-treated with a preservative. For small or lightweight sheds the poles may be from four to five inches in top diameter; for the more substantial buildings they should be from six to seven inches.



Plan 72432 Pole-frame hay and stock barn. This barn is relatively low in cost and is adaptable for storage or for housing fattening cattle, cows, and calves. The livestock sections may be either 18 or 20 feet wide, and the length is variable in 12-foot units. Suitable for various combinations of stanchions, box stalls, and pens.

Remodeling

Within the next few years it is expected that much of the farm building improvement will consist of remodeling of buildings for beef cattle and rearrangement of yards and feed storages. In Illinois, for example, a survey made in 1945 showed that nearly one-third of the beef barns and sheds were so badly depreciated and in such poor repair that they should probably be replaced. Only 42.8 percent of the structural parts of barns were in good condition, and 33.8 percent of those in the sheds.

Except for limitations of location and size, it is usually possible to make about the same facilities in remodeled buildings as can be obtained by building a new structure. Some of the principal problems of remodeling are:

1. Relocating shelters and yards to provide a better relation with dwelling and other farm buildings and to get south and east exposure for yards.

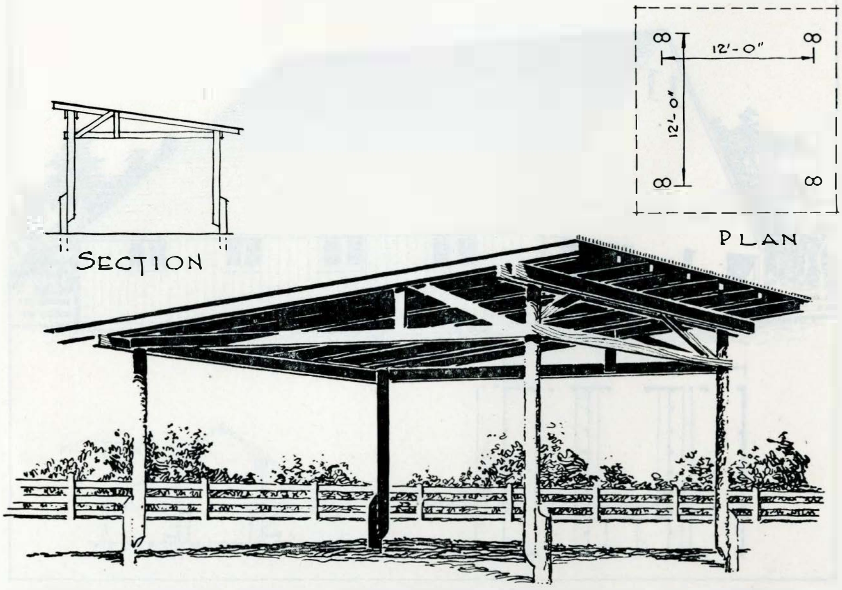
2. Grading and draining feedlots and hardsurfacing feedlots as needed.

3. Fencing, and arranging gates and lanes to facilitate feeding and manure removal.

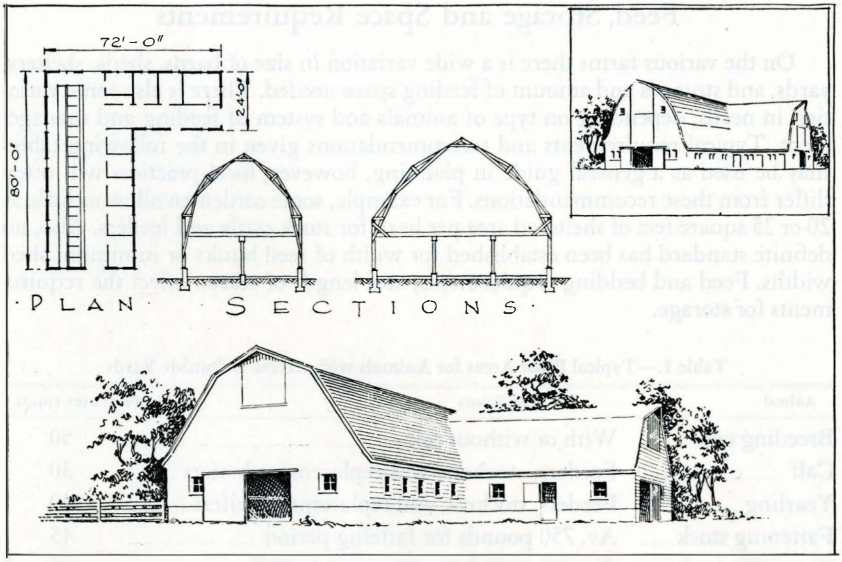
4. Providing water under pressure and insulated watertanks with a paved section around tanks.

5. Rearranging feed storage to reduce labor in feed handling and processing.

6. In general-purpose barns, making such changes as: (a) increasing the number of openings; (b) removing old equipment, such as horse stalls, pens, and box stalls; (c) installing hay feed-racks; (d) strengthening lofts for baled or chopped hay; (e) removing loft floor; and (f) adding sheds, wings, or extensions.



Plan 72407 This pole-frame structure provides summer shade when built as shown, or it can be extended in length, enclosed on three sides, and used as a shelter. Other possibilities are to cover the frame with straw; cover the frame with wood strips or wire and blow straw over it; or make a demountable shed by using panel construction for the part above the anchor posts.



Plan 72423 Two-story stock barn. Intended for the breeder who desires the most complete facilities for housing, handling, and showing his herd. Includes tie stalls, pens, and feed rooms. An alternate plan 72421 has a central feed alley with tie stalls omitted and space on each side for cattle. The features of either plan might be used in remodeling. The extension to main barn may be open or enclosed. It can be widened to 36 feet to provide space for pens on each side of driveway. Roof may be gambrel, as illustrated, or gable or arched.

(Inset) Plan 72422. Two-story purebred stock barn. Elaborate for most beef cattle production, and intended only for the breeder who wants this more expensive barn. Shown with gothic arch roof, however gambrel roof may be used.

Planning Aids

The colleges of agriculture cooperate in maintaining farm building plan services. Plans, bulletins, and circulars are available, and advice on individual problems may be obtained through correspondence. Each college of agriculture is the source of planning information for the state in which it is located. Various policies govern the distribution of blueprint plans in the states and information and plan lists may be obtained from county extension agents or from the college of agriculture. The illustrations in this bulletin and the blueprint plans of the structures are identified by the same plan numbers which are identical throughout the region.

In addition to the information that is available from the states, the following Farmers' Bulletins on the subject of farm structures may be obtained from the U. S. Department of Agriculture, Washington, D. C.:

- 1452 Painting on the Farm
- 1584 Feedlot and Ranch Equipment for Beef Cattle
- 1660 The Use of Logs and Poles in Farm Construction
- 1751 Roof Covering for Farm Buildings
- 1772 Use of Concrete on the Farm
- 1820 Silos—Types and Construction
- 1832 Farm Fences
- 1869 Foundations for Farm Buildings
- 77 (Leaflet) Bracing Farm Buildings

Manufacturers, trade associations, and materials dealers supply information on the characteristics and uses of their materials.

Feed, Storage and Space Requirements

On the various farms there is a wide variation in size of barns, sheds, shelters, yards, and storages and amount of feeding space needed. There is also some variation in needs, depending on type of animals and system of feeding and management. Typical requirements and recommendations given in the following tables may be used as a general guide in planning, however, local practices will often differ from these recommendations. For example, some cattlemen allow as little as 20 or 25 square feet of sheltered area per head for stock cattle and feeders. Also, no definite standard has been established for width of feed bunks or minimum shed widths. Feed and bedding requirements, and length of season affect the requirements for storage.

Table 1.—Typical Floor Areas for Animals with Access to Outside Yards

Animal	Conditions	Floor area (sq. ft.)
Breeding cow	With or without calf	50
Calf	Feeders, stockers, and replacement heifers	30
Yearling	Feeders, stockers, and replacement heifers	40
Fattening stock	Av. 750 pounds for fatteing period	45
Fattening stock	Av. 950 pounds for fattening period	50
Bull	In pen	120
Cow	In maternity pen	100 to 120
Cow	In standing stall 4′ wide, 5′ to 6′ long, platform only	22
Calf	Several in pen, each	20

Table 2.—Recommended Minimum Widths for Service Passages

Service passage	Conditions	Width
Feed alley	For feed cart	4′-0″
Driveway	For wagon, spreader, or truck	9′-0″
Doors and gate	Drive-through	9′-0″
Doors and gate	To small pens	4′-0″

Table 3.—Recommended Dimensions for Feeding Devices

Device	Conditions	Width
Feed bunk for grain or silage	Feed from both sides	3′-0″ to 3′-4″
	Feed from one side	2′-6″
Combined rack and bunk	Feed from both sides	5′-0″
	Feed from one side	2′-6″
Hay rack	At side of barn or pen	2′-6″

Trough height, 30″ for mature or fattening stock; 24″ for calves.
Trough length, 30″ for mature animals; 20″ for each calf.
Self-feeder trough length, 9″ per head (if feeder is kept filled).
Bunk or rack length for movable structures, 12′-0″ to 16′-0″.

Table 4.—Feed Requirements for Use in Calculating Storage Space

Animal	Conditions	Period	Material	Amount
Breeding cow	Including calf	200 days	Silage	5 tons[1]
Calf	With cow	Jan.-Feb. to grass	Grain	500 pounds
Stock calf	Well wintered	200 days	Silage	2.5 tons[1]
			Grain	600 pounds
			High-protein concentrate	200 pounds
Fattening animals	Variable	200 days	Hay equivalent	800 to 2400 pounds
			Grain	1100 to 4400 pounds[2]
			High-protein concentrate	300 pounds
All classes	Variable	Year	Bedding	None to 2000 pounds

[1]Or dry forage equivalent. Approximately 800 pounds dry forage estimated to replace one ton of silage. Estimates are based on maximum need, and may exceed average practice.

[2]As grain is increased, the hay equivalent is reduced.

Table 5.—Weight and Volume of Stored Feed and Capacity of Storages for Calculating Sizes and Planning Load-Carrying Structures

Feed	Unit	Weight (pounds)	Volume (cubic feet)*
Shelled corn	Bushel	56	1.25
Ear corn	Bushel	70	2.50
Oats	Bushel	32	1.25
Grain sorghum	Bushel	56	1.25
Wheat	Bushel	60	1.25
Rye	Bushel	56	1.25
Barley	Bushel	48	1.25
Sacked feed	Cubic foot	40 (est.)	
Fresh ground feed	Cubic foot	25 (est.)	
Silage (in trench)	Cubic foot	30 to 35	
(in silo)	Cubic foot	30 to 50	
Hay (long)	Ton		500
(chopped)	Ton		200
(baled)	Ton		200 to 220

*Approximations based on volumes:

Ear corn crib capacity in bushels is 4/10 the cubic feet of volume.

Shelled corn and small grain bin capacity in bushels is 8/10 the cubic feet of volume.

Loft capacity for long hay in tons is cubic feet of volume divided by 500.

Loft capacity for baled hay in tons is cubic feet of volume divided by 200 or number of bales times average weight per bale divided by 2000.

Loft capacity for chopped hay in tons is cubic feet of volume divided by 200.

Silo capacity in tons for trench or wire and paper silos is cubic feet of volume divided by 60.

Silo capacity varies in upright types with the depth of silage. See Farmers' Bulletin 1820.

NORTH CENTRAL REGIONAL PUBLICATIONS

No. 1 "Marketing Livestock in the Corn Belt Region," by Regional Livestock Marketing Research Committee. Issued by the South Dakota Agricultural Experiment Station Bulletin 365, November, 1942.

No. 2 "Improving Farm Tenure in the Midwest," by Regional Land Tenure Committee. Issued by the Illinois Agricultural Experiment Station Bulletin 502, June, 1944.

No. 3 "Trucking Livestock in the Corn Belt Region," by Regional Livestock Marketing Research Committee. Issued by the Missouri Agricultural Experiment Station Bulletin 479, June, 1944.

No. 4 "Preventing Farm Land Price Inflation in the Midwest," by Regional Land Tenure Committee. Issued by Iowa Experiment Station and Iowa Agricultural Extension Service, Popular Bulletin p72, March, 1945.

No. 5 "Capital Needed to Farm in the Midwest," by a Subcommittee of the Regional Land Tenure Committee. Issued by the Minnesota Agricultural Experiment Station Bulletin 389, January, 1946.

No. 6 "Beef Cattle Housing," by a Subcommittee of the Regional Farm Structures Coordinating Committee. Issued by the South Dakota Agricultural Experiment Station Bulletin 382, June, 1946.