

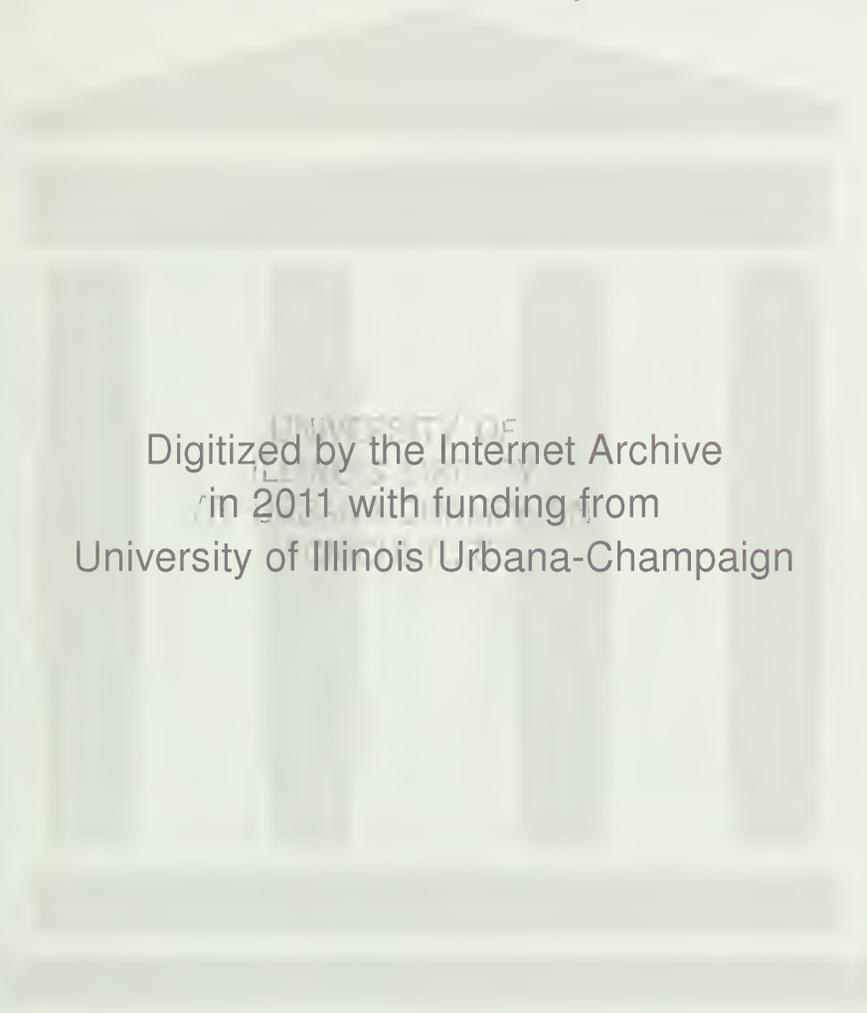
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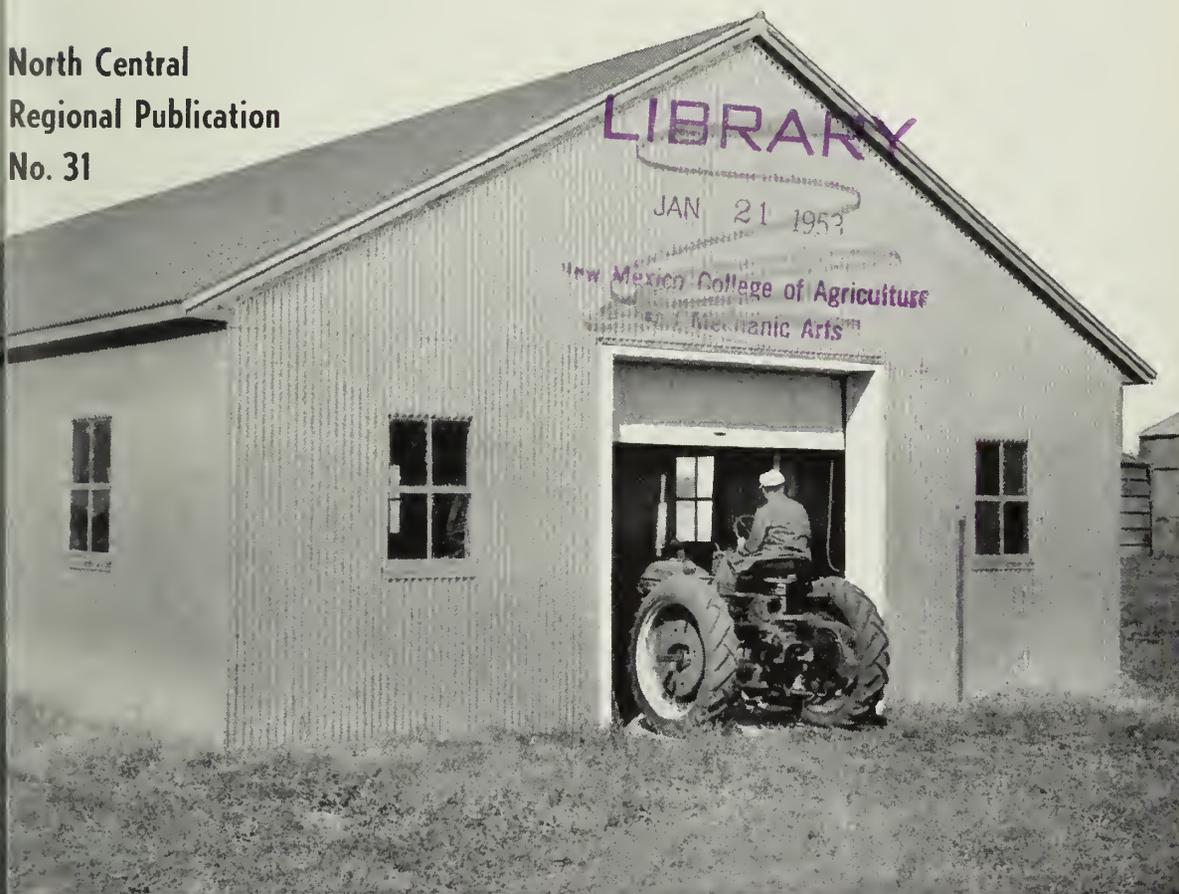


# FARM MACHINERY HOUSING

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## Farm Shops • Shop Equipment

North Central  
Regional Publication  
No. 31

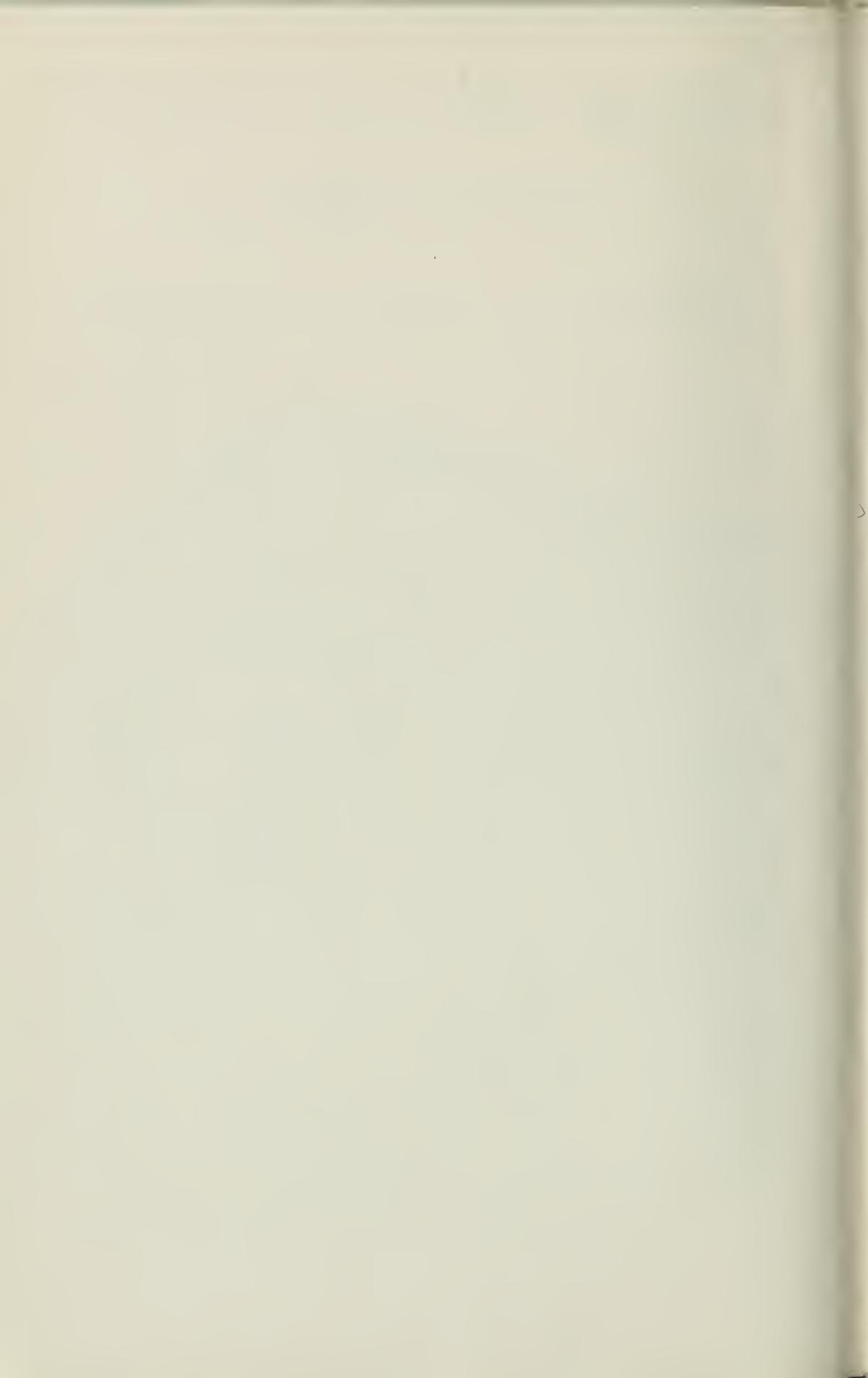


Agricultural Experiment Stations of Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin and U. S. Department of Agriculture cooperating



**Circular 702**

**UNIVERSITY OF ILLINOIS • COLLEGE OF AGRICULTURE  
EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS**



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# FARM MACHINERY HOUSING

## With suggestions for FARM SHOPS and SHOP EQUIPMENT

**T**HE SPEED with which our farms have been mechanized has outdated many of the older machine sheds. More storage and shelter space for both machinery and equipment is needed, as are also better accommodations for repair and servicing.

The structures and standards recommended here are suited in a general way to the whole of the North Central region (*see map on cover*), but various adjustments will of course have to be made to fit them to some parts of the region and to individual farms.

Working drawings of the numbered plans illustrated will be made available as Midwest Plan Service<sup>1</sup> designs, and will be distributed through the colleges of agriculture in the region. See page 30 for information on how to obtain these plans or other information on farm buildings.

### Planning the Machinery Building

Generally, if you are planning a new machinery building, you will want to think of it as a mechanical headquarters or "machinery center" for the farm. It should serve the following purposes:

**Storage** for tractors, trucks, and the more expensive or complex machines that demand extra-good care and protection. (The garage for the family car generally belongs near the dwelling or attached to it.)

**Shelter** for wagons, spreader, plows, and other machinery that either need some protection from the weather or that should be kept in an orderly arrangement.

**Shop** for storage of tools and supplies, repair and maintenance work, overhauling, working with tools, or doing winter work on the farm.

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<sup>1</sup> The Midwest Plan Service is a cooperative activity of the Colleges of Agriculture in the North Central states and Arkansas, New Mexico, and Oklahoma and the U. S. Department of Agriculture.

**Servicing**, such as greasing, refueling, inflating tires, and making adjustments.

While a single building is usually most satisfactory, some farmers prefer to combine garage, shop, and truck and tractor spaces in one building and to store the machinery in a larger shed.

### **Plan for the protection you need**

A fully enclosed building is generally recommended and is preferred by farmers throughout most of the North Central region. Such a building naturally comes nearest to providing complete protection against theft, loss, and damage from weather, dirt, animals, and birds.

In areas of light snow or rainfall, an open-front shelter or a shed with only a roof may be sufficient. This type is least expensive, if low cost is important. A good compromise is to have a closed building for the shop, tractor, and other more complex machines and an attached open shed for some of the rest. Whether this is advisable depends partly on the degree of protection necessary in your area.

In some locations farmers leave machinery outdoors the year round because they have a large number of machines or because they do not want to invest in shelter buildings. If you are in such a situation, pay particular attention to the suggestions on preparing machinery for storage given on page 20.

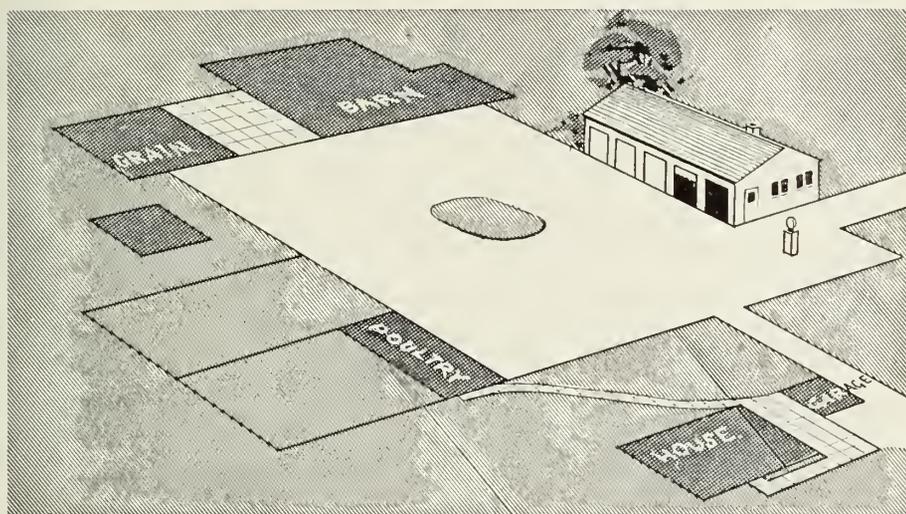
### **Think ahead when choosing a location**

It is important to locate the machinery building where it will fit into the farmstead for a long time to come. It should be near the service drives, within easy reach from the farmyard, and accessible for electric service and perhaps water lines (Fig. 1).

Following are the principal points to consider:

**Provide for good drainage.** This can be done either by building on ground that has a natural slope or by grading up to put the floor 6 to 12 inches above the ground, thus permitting surface water to drain away from the foundation.

**Allow space around the building.** Fire safety usually demands that machinery buildings be separated from other buildings by perhaps 30 feet or more. Space is also needed for turning, getting machines in and out, and temporary parking. It takes about 50 feet



One idea for locating the machinery building so that it is a safe distance from the other buildings and yet can be easily reached from the fields and from the farmyard. (Fig. 1)

in front of the doors to handle some of the power machines. If you use a fuel pump, allow room to get to it easily. It would be desirable to have a concrete apron in front of part of the building for use in washing, cleaning, and servicing machines.

It's a good idea to leave enough extra space that you can enlarge the building in the future if you want to, and still meet the above requirements.

**Avoid lost motion.** Select a site along one side of the farmyard to provide the most direct route from driveways and field lanes and through the building itself.

**Locate openings so they will be protected from weather.** The main doors and entrance should usually be in the south or east wall to provide protection from winter wind and to reduce the danger from ice on doors and approaches. Drifting of heavy snow may, however, be somewhat more troublesome on the south and east.

### **Plan for movement of machinery**

The less work it takes to put machines away, the more likely they are to be stored properly. One way to help provide for ease of movement is to use few if any interior posts. A self-supporting arched or gambrel roof or a gabled truss will make it possible to do away with

all interior posts. Since excellent trusses are available in laminated wood, welded or bolted steel, or wood with metal connectors, the truss is often the best solution. If interior posts are used, they should be placed in such a way as to reduce interference with machinery.

For ease of movement, also provide for drive-through lanes and make sure that the doors are large enough to accommodate your largest machinery. It is often necessary to have at least one of the doors 16 feet wide and 14 feet high.

### **Roughly calculate floor area**

You will need a floor space 12 feet wide and at least 20 feet long to accommodate a car, pickup truck, or tractor. More space will be needed for a tractor with attached trailer or machine. Four-row machinery may require a width of 16 feet. In addition, you will need space to move and park your machinery.

The general arrangements shown in the illustrations (Fig. 2), together with the summary of machinery measurements in the appendix, may be used as a guide.

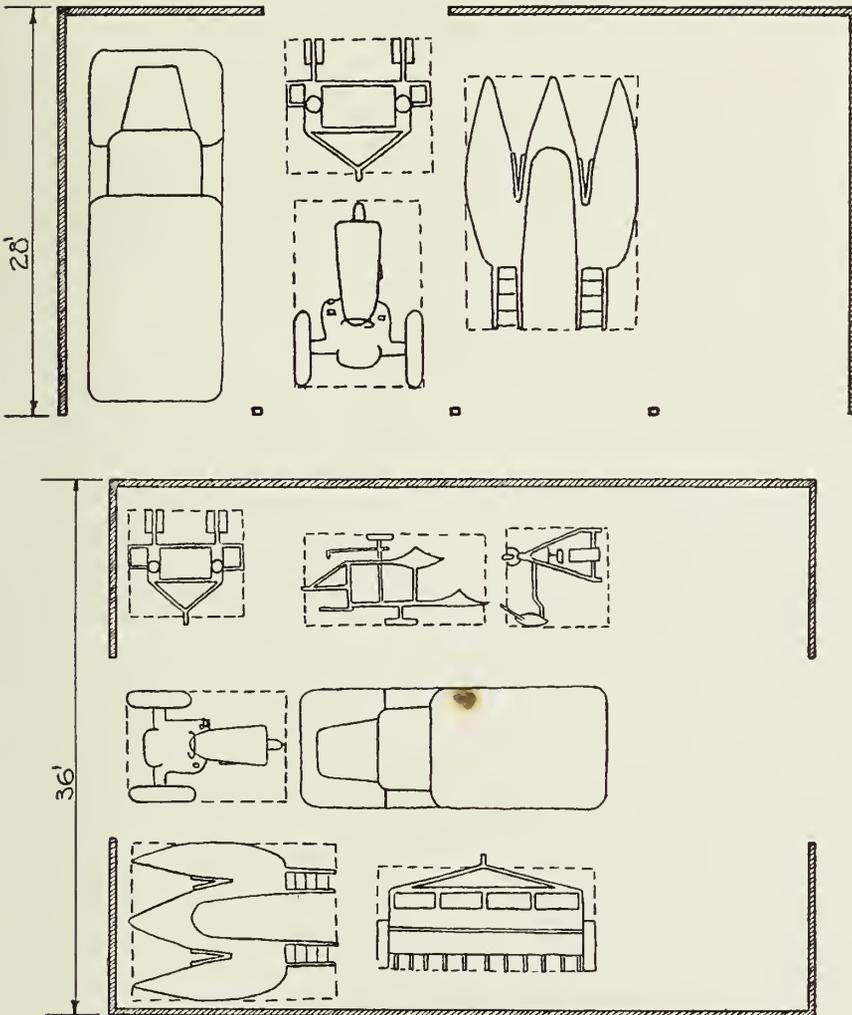
### **Organize space**

It is a waste of space to have an open driveway entirely through the storage building. And yet it is often necessary to drive through instead of backing out. The best solution is to plan a lane that is free from posts or general storage but that can be used for tractor, truck, wagons, or easily moved machines. This driveway may be either lengthwise or crosswise of the building.

Self-propelled equipment — trucks and tractors — should be kept in accessible places, such as in stalls or sections near the doorways or in the drive-through lane. To get an effective arrangement, plan to group machinery according to seasonal use and the frequency with which each machine has to be removed.

### **Decide on width, length, and height**

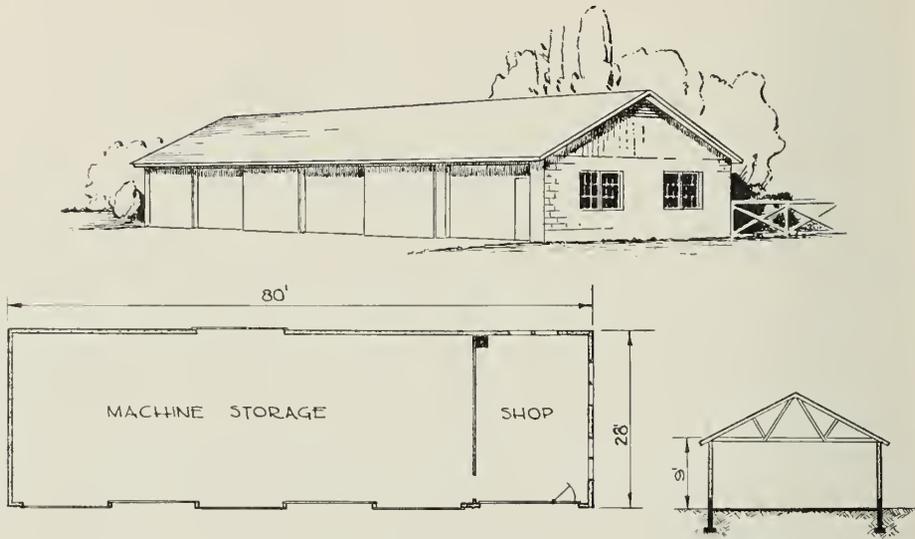
**Width.** Buildings with side openings should be at least 24 feet wide; 26 or 28 feet is even better to provide economical construction and to get enough width for satisfactory storage. Drive-through types need more than 32 feet. Beyond this, one width is about as good as another up to about 40 feet for on-farm construction. Commercial buildings for large farms may be 50 feet or more wide. Plan increases in width by 2-foot intervals to stay within common practice.



To be sure your building will be large enough, measure the width, length, and height of the equipment you expect to store and add a few inches for clearance. Top drawing shows equipment arranged in a side-entrance building; lower drawing shows a central drive-through type. (Fig. 2)

**Length.** After you have decided on the width you want, make the building long enough to provide the total floor area needed. Be sure to allow enough space for the farm shop if this is part of the plan (Fig. 3).

**Height.** A clear headroom of 9 to 10 feet is enough for most farm machinery. A few machines, however, are as tall as 14 feet. To handle these taller machines, it may sometimes be best to increase



A typical combination of machinery storage and shop space. Facing doors give a drive-through section, while the parallel doors give access to all parts of the storage space. The light roof truss provides a post-free interior, allowing for easy movement of machinery. Midwest Plan 74145. (Fig. 3)

the height of part of the building. Or by using arched or rigid rafter trusses ample headroom can be obtained through the center of the building and all that is necessary is to provide a high end door. With plenty of clearance through the center, the headroom near the side walls may be fairly low.

### Provide openings that are big enough

To allow for driving through, place facing doors in either the ends or the side walls of the building. Sometimes more than one pair of facing doors is desirable in the side walls.

Big machines and four-row equipment require an opening 16 feet wide and 14 feet high. Otherwise doorways 12 feet wide and 10 feet high will take care of most of the farm equipment to be stored. Shop doors may be the standard garage-door size (8 by 7 feet), since big machines are not ordinarily taken into the shop. One or more smaller doors — 3 by 7 feet — are also needed.

Put three or four standard windows in the shop. The enclosed machinery storage building needs only a few windows, or they may be left out altogether if electric lights are provided or if an open-front shed is used.

## Types of Machinery Storage

Machinery building types are commonly described according to the shape of the roof, the materials used in construction, the width of the building, the enclosure (whether complete or partial), or the way the openings and passages are placed.

For the purposes of this circular, building types are listed as (1) *side-entrance types*, in which the principal doors are along one side or all or part of one side is left entirely open (in addition one or more doors may be put in the opposite side or in one end) and (2) *central drive-through types*, which have large doors in each end, a driveway free of posts or fixed storage, and possibly an additional side door.

The choice of type may be dictated by the farmstead arrangement, the desired location for entrances and exits, and the width that is needed. Ordinarily the dividing line between the two types comes at about 32 feet in width. In the drive-through type, more than 32 feet is needed to allow space for the drive and for storage along the sides. If the width is 32 feet or less, it is best to have side entrances to get machines in and out.

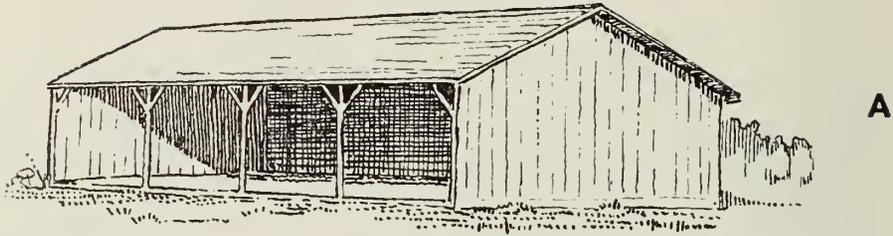
### Side-entrance type

Widths for this type are generally 24, 26, 28, or 32 feet (Fig. 4). Each section, or unit of length, is usually made 12 to 16 feet to accommodate a tractor, truck, single large machine, or several smaller ones. Most or all of the sections have an opening in the front or principal side, and one or more sections should have a door in the opposite side. There may also be a door in one end.

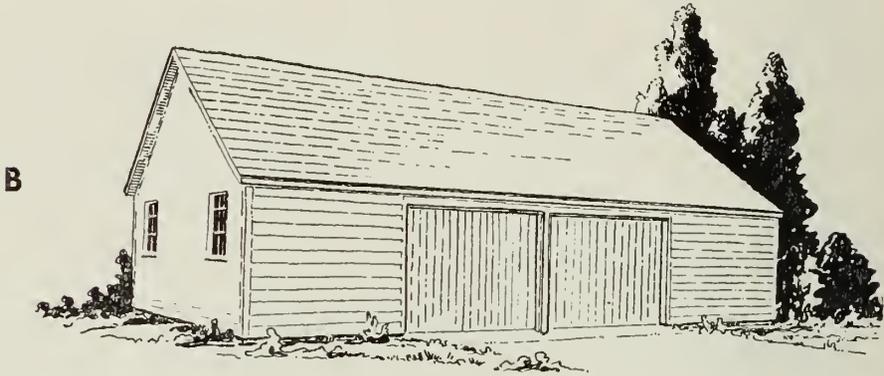
The side-entrance building lends itself especially well to the location of a shop at one end. Part of the building can be enclosed and part left open. If more space is needed, the building can be lengthened.

### Central drive-through type

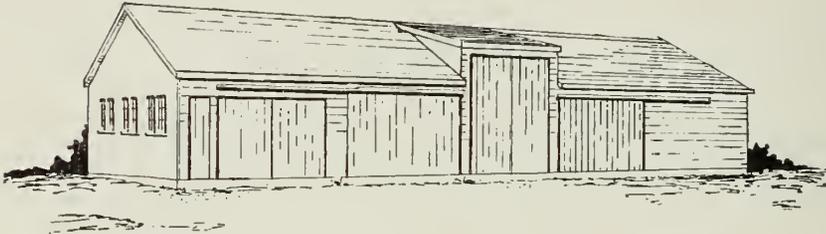
This type is usually built to provide high clearance and high end doors (Fig. 5). The building can be as narrow as 32 feet, but to provide convenient storage on each side of a driveway it should be 36 feet wide or wider. Often widths of 40 feet or more are used.



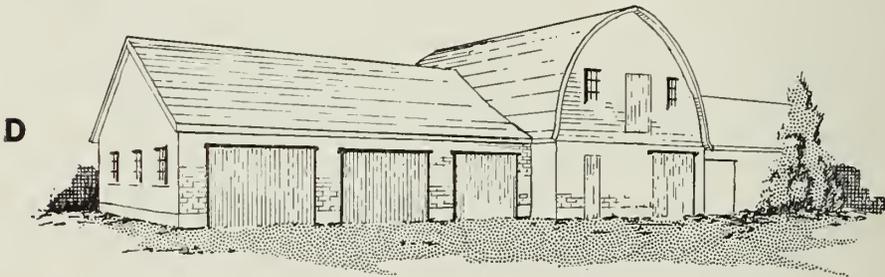
A



B



C

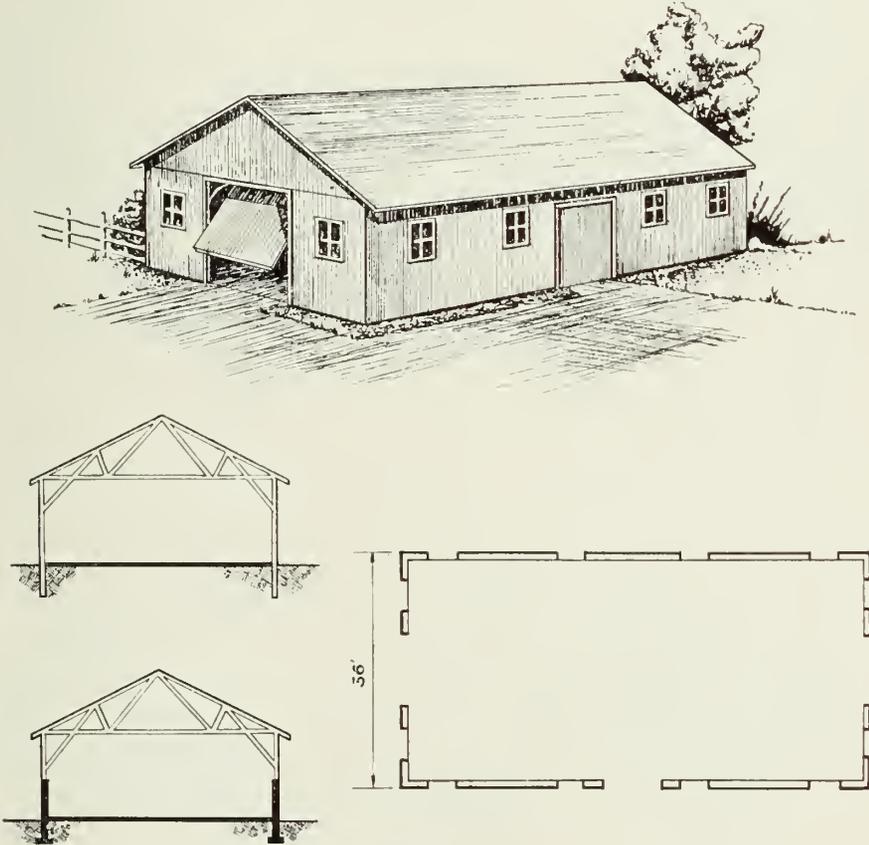


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#### Four side-entrance types of machinery storage buildings

- A — Open shed provides low-cost protection. Midwest Plan 74135 gives widths of 24 and 28 feet.
- B — Enclosed type gives more complete protection. Suggested widths are 26 and 28 feet. Midwest Plan 74136.
- C — This building is similar to "B" but has a raised center section for clearance of high machines. Midwest Plan 74137.
- D — Thirty-two feet wide, this building features shop and loft storage in center with two wings for storage. Midwest Plan 74138. (Fig. 4)

The central drive-through building is especially suited to the larger farms where big machines are used and ample storage is needed. The relatively large post-free space may be used not only for machinery storage but also for an indoor workroom, a rodent-proof seed room, storage of feed, fertilizer, and other farm supplies, and of course for shop and tool rooms.

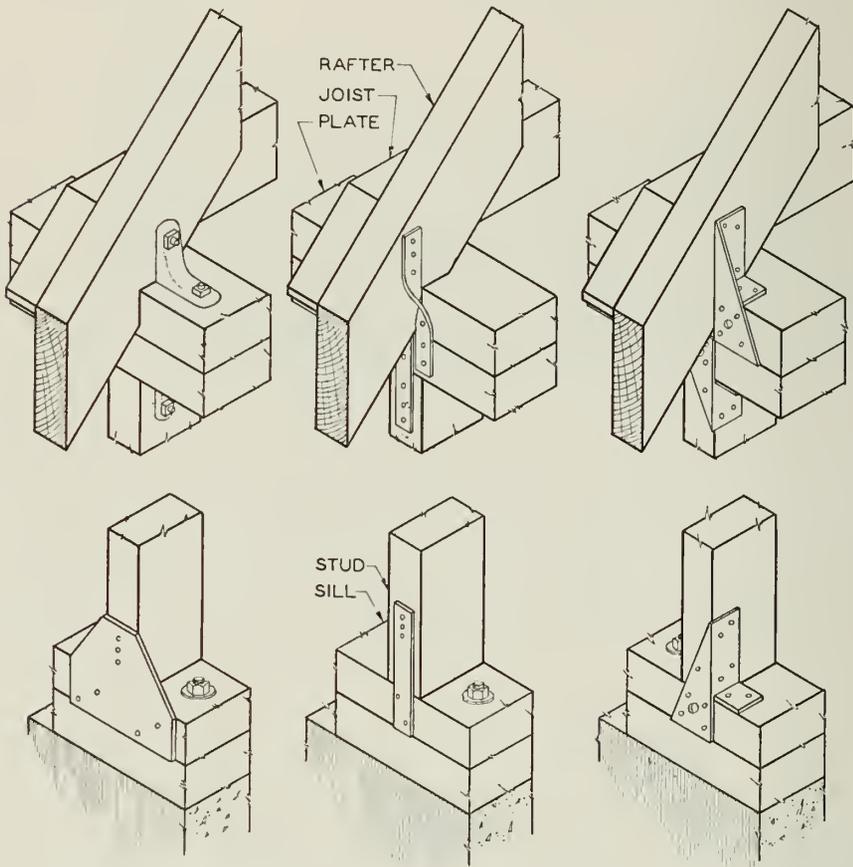


Central drive-through type of machinery storage building, with typical gable-roof construction and straight side walls. Midwest Plan 74140 has trussed roof frame for 32- and 36-foot widths. Midwest Plan 74141 is similar except that it has a pole frame. (Fig. 5)

### Construction of the Machinery Building

Building a machinery storage building is a relatively simple job. There are standard practices to follow and plans and recommendations available that make it possible to avoid the weaknesses found in many older buildings.

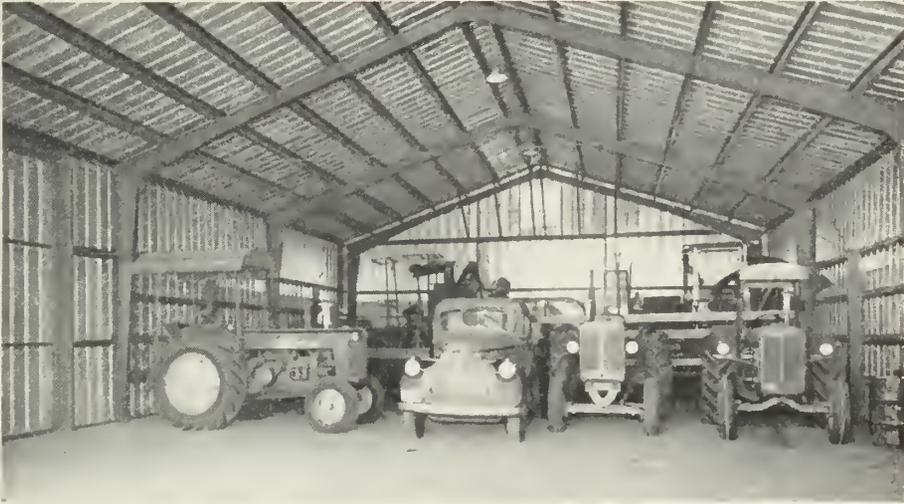
Chief attention should be given to strength and durability. It is essential to have a firm foundation, dry floor, weathertight walls and roof, and framing strong enough to support the roof span, possible snow loads, and the force of the wind. For protection against wind, give special consideration to anchors, ties, and braces (Fig. 6).



Details of foundation (*bottom*) and roof frames (*top*), showing the use of various anchors and connectors to obtain needed protection against wind damage. (Fig. 6)

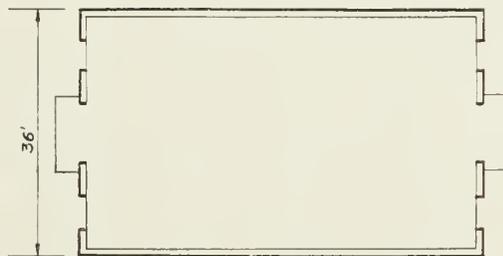
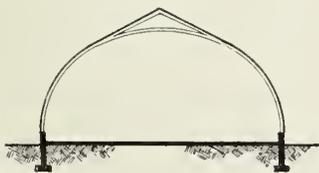
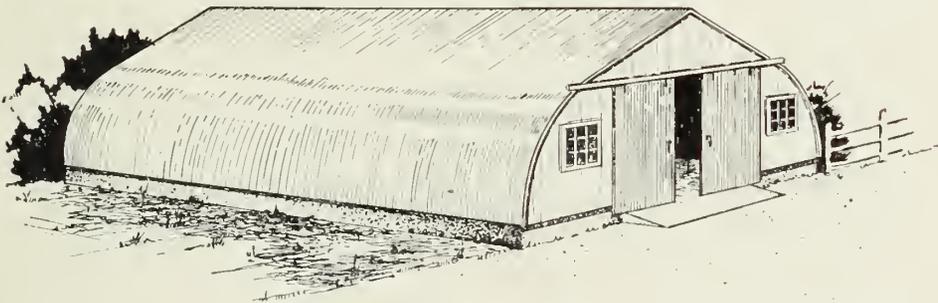
### Commercial buildings

Several manufacturers provide all the materials needed to construct machinery storage or other utility buildings. Entire prefabricated structures of steel, or of steel-welded frames with metal or other building sheets, are available (Fig. 7). Or principal parts, such as doors, windows, laminated arches, timber connectors, roof trusses, creosoted poles, and building sheets, may be bought and used



Prefabricated utility-type building for storage of machinery and equipment. Note the convenience of post-free space. (Fig. 7)

for on-the-job construction from your own plans (Fig. 8). It is important to follow the manufacturer's directions for assembling or using the materials. Some contractors or dealers are specially trained in the erection of manufactured buildings.



One common type of central drive-through building, either with metal frame and covering, or with laminated arches and conventional siding and roofing. Can be bought commercially or built on the job with gothic arch. See Midwest Plan 74139. (Fig. 8)

## Building plans

Detailed plans, or working drawings, for machinery storage buildings are available both from the colleges of agriculture and from commercial sources. In the North Central region, the Midwest Plan Service has plans for the commonly used types. The illustrations in this bulletin that are identified by plan number are for Midwest plans. They include recommended construction methods, measurements, and design. Therefore it is necessary to supplement them only with the brief suggestions which follow.

## Concrete foundations

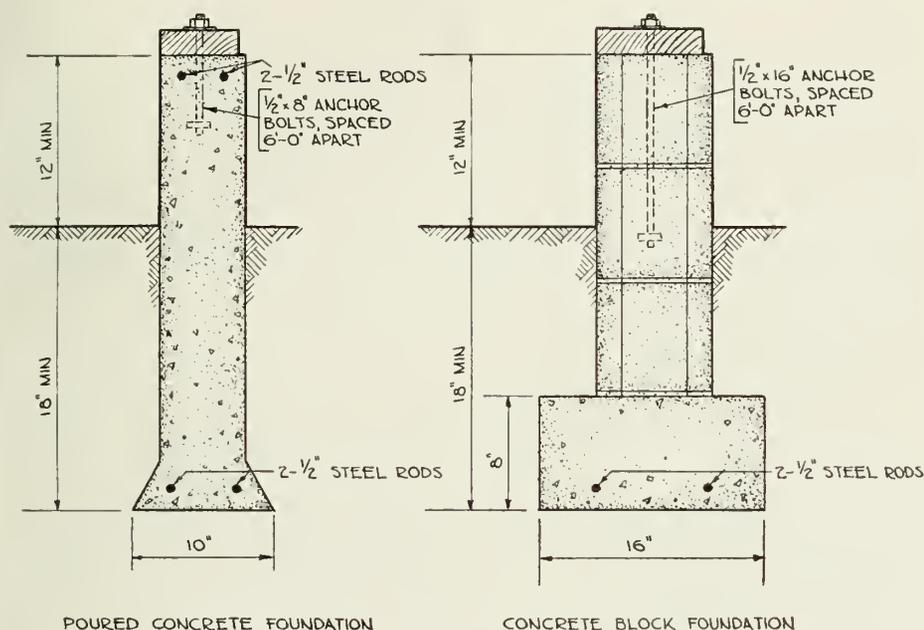
Concrete is the material most commonly used for foundations in masonry, wood-frame, and steel buildings (Fig. 9). Use either poured concrete for both footing and foundation wall, or poured concrete for footing, and concrete blocks or other masonry for the wall. In either case follow these suggestions:

**Extend the foundation into the ground** at least to firm soil and below the point where frost is likely to damage the foundation. If you use masonry walls, extend the footings below the frost line. The necessary depth will vary from 18 inches to 3 feet in different parts of the region. Consult local builders or county extension agents about this depth.

**Build the foundation far enough above ground** to protect wood or metal from dirt, ground moisture, and termites. This means the height should be at least 12 inches. Of course, the foundation may be carried higher, say 2, 3, or 4 feet, or to the window sill. With concrete blocks or structural tile, the masonry may be built to the full height of the wall. In that case the footings are widened, the walls are made 8 inches thick, and the roof frame is anchored at the top of the wall.

**Reinforce foundations** with two ½-inch steel rods laid horizontally in the footing. For best construction also use two rods in the upper part of poured foundations or two joint reinforcing strips in the top mortar joint of block walls. If the entire wall is made of masonry, strengthen and stiffen it with pilasters about every 16 feet.

**Anchor the building to foundation.** Set ½-inch-by-16-inch bolts at intervals of 6 to 8 feet in poured concrete or in mortar-filled cores



Footings, reinforcing, anchors, and minimum recommended measurements for concrete foundations. (Fig. 9)

of blocks. In attaching the sill, use large washers under the nuts. In some types of construction, uprights are attached to the foundation with metal fittings connected to anchored bolts.

**Set posts or columns on concrete.** Because the load is concentrated on the posts, they should be supported by relatively heavy footings set at the same depth as the wall footing. Make them 10 or 12 inches thick and 16 to 24 inches square. This does not apply to pole construction.

### Pole frame construction

In pole construction the usual foundation is omitted and the poles are set 4 to 5 feet in the ground. Use poles long enough to extend up to the roofline. Use 2-inch treated plank in place of the foundation above ground; generally at least two planks 10 or 12 inches wide are needed. Concrete floors are not ordinarily used with pole frames, but the shop or other parts of the building can be floored with a concrete slab.

## **Floors**

To insure dryness, grade up the floor level inside the building so that the top of the finished floor will be 6 to 8 inches above the outside surface. Make concrete floors 5 inches thick where machinery is to be stored or moved. Four inches is all right for shop and garage. To lower the cost, use a tamped earth fill or a 6-inch layer of gravel or crushed rock; cinders are not satisfactory. A concrete apron or approach is recommended in front of doorways.

## **Select good materials**

It is not necessary that construction materials be of top quality, but they should be sound and durable. For example, you can use native rough-sawed lumber instead of finished lumber for framing. You can make concrete with bank-run gravel if it is clean and reasonably well graded. The following points will serve as a guide in choosing materials:

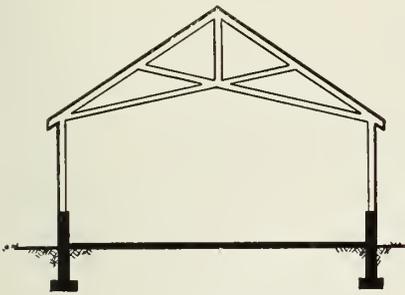
**Poles and treated lumber.** Use materials that are pressure-treated with creosote, penta, or other reliable preservative.

**Lumber.** No. 1 and No. 2 common southern yellow pine or Douglas fir are preferable for framing; No. 2 common for sheathing or inside partitions; and clear pine, fir, redwood, or cedar for exposed surfaces to be painted.

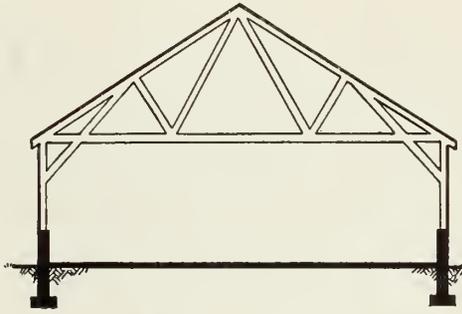
**Concrete.** Use a mixture of 1 part cement,  $2\frac{1}{4}$  parts sand, and 3 parts gravel, with not more than 6 gallons of water for each sack of cement, or a comparable ready-mix. With bank-run gravel, use one sack of cement to  $4\frac{1}{2}$  cubic feet of gravel. For laying blocks, use mortar made from 1 part cement, 1 part lime, and 6 parts mortar sand, or use a prepared mortar mix.

**Roofing.** Several types of roofing are satisfactory, the more common being aluminum, .024 inch thickness; steel, 28-gage equivalent, 2-ounce coating if available; wood shingles, No. 1 grade; asphalt strip or edge-fastened shingles, 210-pound or heavier; and cement-asbestos shingles in standard grades.

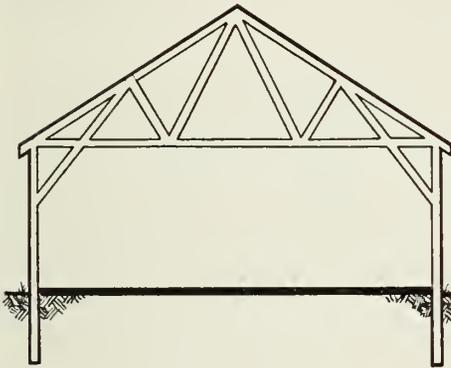
**Roof frames and types.** The decision as to roof structure will be affected by such things as total cost in relation to usable floor space; whether the roof is to be homemade or ready made; whether it



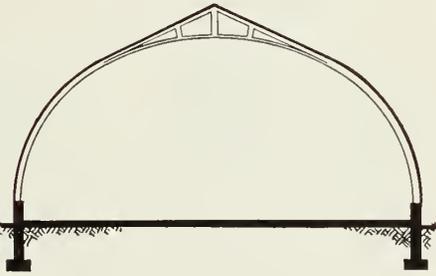
Midwest Plan 72010  
Scissors truss, 24 or 28 feet wide



Midwest Plan 72011  
Timber-connected standard trusses  
for 32- and 36-foot spans



Midwest Plan 72014  
Same as top right but  
with pole frame



Midwest Plan 72012 or 72013  
Gothic arch, bent or sawed rafters

Typical roof types. The gothic arch type may be made either with bent laminated rafters, Plan 72012, or with sawed rafters, Plan 72013. (Fig. 10)

matches other farm buildings; and what kind of trusses, arches, or frames are preferred (Fig. 10).

It is best to have a clear span inside the building, although a few supporting posts can be placed so as not to greatly interfere with operations. Headroom of 12 to 16 feet is usually needed through the center portion; more than that is of no particular value.

**Doors.** Overhead doors are easy to operate and relatively trouble-free. Although they are more expensive than other types, they are worth the cost over a period of years. A good solution is to use overhead doors on at least the one or two openings that are used most often. Sliding doors are also satisfactory and are less expensive than overhead doors. Use bird-proof track and roller bearing hangers. Set

center stops and guides at bottom of doors in concrete to prevent wind damage and to aid in opening and closing.

### **Preparing Machinery for Storage**

Before machinery is put into storage at the close of each season's use, the following things should be done:

**Clean** the machine thoroughly.

**Tighten bolts** and make needed adjustments.

**Remove old oil** and grease and lubricate.

**Make up a list** of parts and repairs that will be needed before the machine is used again.

**Put in an order** for replacements.

**Protect parts** that might rust by covering them with grease, or use a rust preventive.

**Paint** wood and metal parts where needed.

If machinery is left outdoors over winter, the following practices will help to give some degree of protection:

**Line up machines** in straight rows at right angles to the prevailing winter wind so that there will be less tendency for snow to drift over them.

**Raise the machines off the ground** by putting pieces of wood under wheels, disks, and shovels.

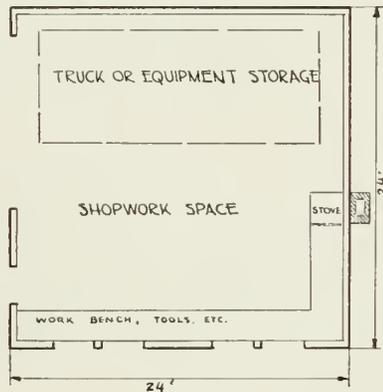
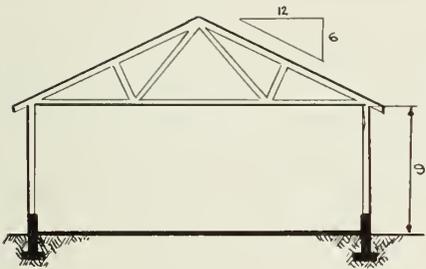
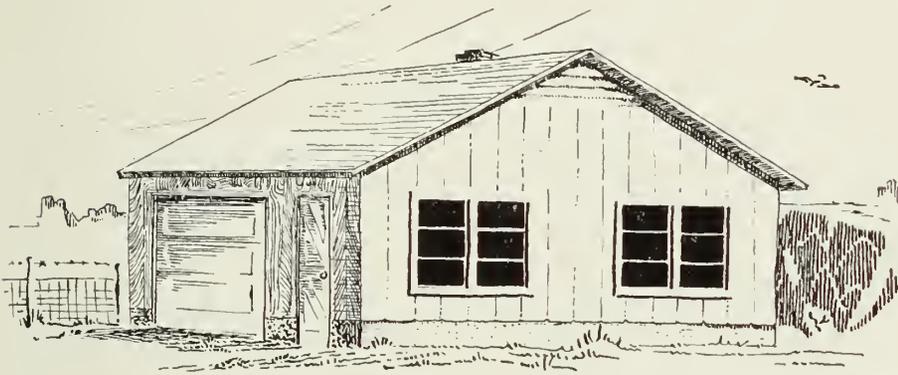
Use **protective measures**, such as removing belts and canvases and cleaning off chaff, straw, and dirt in addition to the usual precautions of greasing or treating with rust preventives.

### **Farm Shops**

The shop is recognized as being essential in modern farming as a place not only for doing repair and maintenance jobs, but also for keeping tools and parts and for building up facilities for interesting and profitable work. In planning, it is well to set off the space for a shop and decide on the size; then benches, cabinets, tools, and power equipment can be added at any time. The main problems are to find the best location for the shop; determine its size; get suitable construction, wiring, heating, and lighting; and list the equipment that can be used to best advantage.

## Location

For both convenience and economy, the farm shop should usually be in or attached to the machinery storage building. Sometimes it may be feasible to combine the shop with a garage or with tractor and truck spaces (Fig. 11), but it should rarely be separate. The shop should be near the lines of daily travel, preferably in or alongside the service yards. Then machines and equipment can easily be brought to the shop for repairs.



Although generally the shop should be part of the machinery storage building, it is sometimes more convenient to provide a separate shop in connection with storage space for truck or tractor. Midwest Plan 74103. (Fig. 11)

## Size

A space about 12 by 20 feet, or approximately the size of a one-car garage, is suitable for most farm needs, especially if other nearby space is available for storing bulky supplies and bringing up large

machines. Sizes up to 20 or 24 feet one way by 24 to 32 feet the other are ample for reasonably complete shop equipment and repair space.

### **Construction**

Enclose the shop area fully, and concrete the floor. Put windows in at least two walls. There should be one or more above the work bench and enough altogether to provide the equivalent of 1 square foot of glass for every 20 square feet of floor space. In the colder parts of the region, the shop should be insulated. Fill or batt insulation may be used overhead and board or blanket insulation in the side walls; or reflective insulation may be used.

If you should decide to install a block and tackle or a hoist for lifting motors or raising machines, be sure the shop plans provide extra overhead construction to take the heavy load.

### **Heating**

Some method of heating is needed in order to provide comfortable working conditions in winter. If a wood or coal stove is used, jacket the heater with a metal shield. Locate it where grease, shavings, and rubbish can be kept away from it. A circulating heater using oil or liquid petroleum gas is particularly good because it can be turned off when you leave the shop. Then there is no danger from smoldering fires.

Build a masonry flue with liner or a cement-asbestos or other fire-rated commercial flue for use with wood or coal stoves and forge or as a vent for oil or gas heaters. If wood or coal is used, top the flue with a spark arrester. A double flue is necessary to control drafts if both heater and forge are used.

### **Wiring**

Allow for generous use of electricity in the shop. It is usually advisable to install a 60-ampere service entrance with not fewer than four branch circuits. Besides the usual 115-volt outlets for lighting and small appliances, a separate 230-volt circuit with heavy wiring will be needed for electric welder and for motors larger than one-half horsepower. Safety demands that special outlets be used on the 230-volt line so that 115-volt appliance plugs cannot be inserted in them. Get information from your power supplier on safety and

installation codes, rules, and regulations. Employ experienced electricians to do the wiring.

The following general suggestions will serve as a guide in providing adequate electric service:

**Extend lighting** to other parts of the building where machinery and equipment are stored.

**Install an outside light** either on a pole or attached to the building to light the shop entrance and fuel servicing area.

Use **No. 12 wires**, or even No. 10, for the 115-volt wiring in and near the shop.

Use **ceiling lights** for general lighting in the shop; control them from a wall switch near the door.

**Put lights over work centers**, such as workbench, welder, power saw, and drill press. Locate where shadows will not fall on work space; have a pull switch for each light.

**Install convenience outlets** at work centers and at several other places in the shop for attaching power tools and trouble lamps. Put connection for arc welder near the door so that work can be done on machines outside the shop.

Use **approved wiring and appliances**. Buy only those that have labels showing approval by the Underwriters' Laboratory.

## Shop Equipment

### Tools

One of the best ways to build up a suitable shop is to clean and repair the tools you have and then expand by getting a few good pieces at a time as you find need for them and can justify the expense. In general, buy good or top quality rather than cheap or low-capacity pieces.

Build a list of the tools you want by studying catalogs or looking over the stocks in hardware or supply stores. Make your list under three headings: (1) hand tools, (2) special tools, and (3) power equipment.

**Hand tools.** Put most emphasis on the basic tools you will need for general work: bit brace with various auger bits and drills; 8 point crosscut saw, 5½ point rip saw, and hack saw; steel square and folding rule; wrenches; screwdrivers, pliers, and wire cutters;

hammers of various types; chisels and punches; files and rasps; wrecking bar; planes, bench vise, carpenter's level, and other common tools.

**Special tools.** Include such items as tool sharpeners, glass cutter, miter box, drawknife, tin snips, trowels, paint brushes, fencing tools, leather punch, and pipe wrenches.

**Power tools.** Most-wanted power equipment includes grinder, power saw, portable electric drill with a drill stand or a power drill press, electric arc welder or oxyacetylene welder, and air compressor.

**Other items.** The list above is by no means complete. You may want to include more elaborate things like a hoist, plumbing tools, band saw, and lathe, or a greater variety of small tools for carpentry, metal work, or machinery repair.

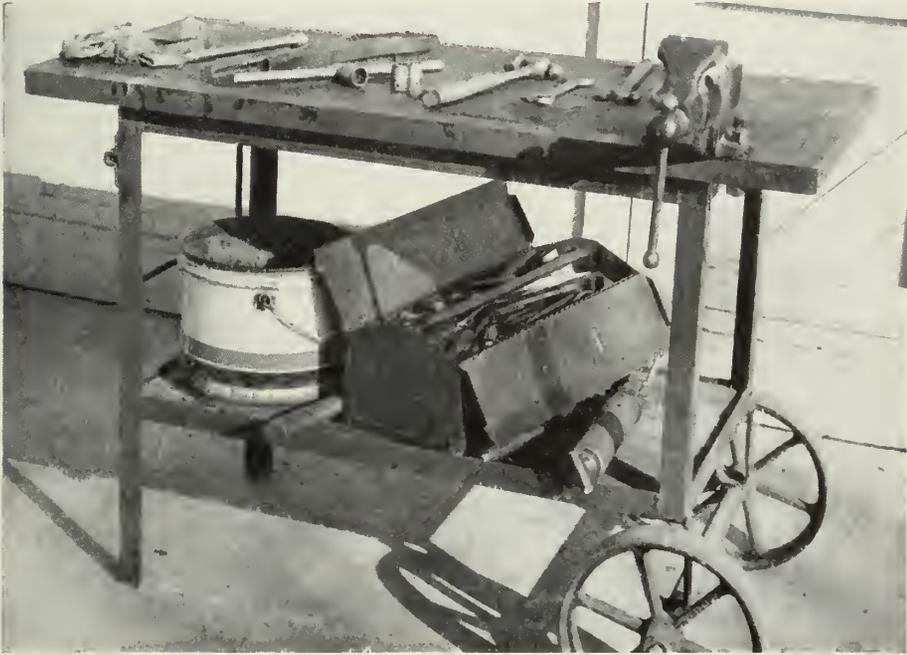
### Shop fixtures

These may be either simple or as elaborate and extensive as the space allows or the owner desires. The following items are, however, the most common ones:

**Workbench.** The workbench should preferably be built into the wall or fastened to it so that it will be solid and sturdy (Fig. 12). A good size range is 8 to 12 feet long, 24 to 32 inches wide, and 32 to 36 inches high.



This workbench is equipped with two vises — one for metalworking and one for woodworking. Extra sturdiness could be gained by building the entire top of 2-inch planks. (Fig. 12)



A portable workbench is particularly useful for repairing and servicing farm machines either indoors or outdoors. (Fig. 13)

**Portable bench.** It is convenient to have another small bench about 3 feet long, 20 inches wide, and 32 inches high, equipped with small wheels under one end (Fig. 13).

**Wall panels.** Board or plywood panels or shallow cabinets attached to the wall above or near the workbench and other work



Commonly used tools are brought within convenient reach by arranging them on a wall panel or, as shown here, in shallow cabinets which can be closed and locked. (Fig. 14)

centers make a good place to hang or store tools (Fig. 14). Paint the outline of each tool on the panel board to make it easy to put it back in place.

**Cabinets.** Enclosed cabinets are best for small, delicate, or expensive tools. Locks will give further protection.

**Shelves, bins, or cases.** Use any convenient arrangement for small supplies like nails, screws, bolts, etc.

### **Storage space**

**Storeroom.** Some bulk supplies can be kept in the shop — pipes and bars in a rack on the wall and lumber in straight piles or on racks that do not interfere with the working space. It is usually best, however, to keep bulky supplies in the machinery building, in an overhead loft, or in some other suitable place.

**Desk and file space.** Every shop needs a place to keep catalogs, instruction books, repair parts list, notebook, and other papers or records relating to fuel, repair work, and the like. These should be kept in a mouse-proof filing cabinet, bookcase, or desk.

## **Facilities for Servicing Equipment**

The various items needed for servicing equipment are ordinarily housed in the farm shop, the machinery storage building, or a separate structure. Facilities are needed for safe and convenient work in making adjustments, refueling, greasing, adding or changing oil, and inflating tires.

The best solution would perhaps be to have one central place where all of these services could be performed. But the fuel storage problem would prevent this. Moreover, some of the servicing must be done elsewhere than in the farm shop.

Even with the most careful handling, gasoline and other petroleum products are always potentially dangerous. They are a principal cause of farm fires, injury, and loss of life. But life and property can be reasonably safeguarded against these hazards by the right kind of storage and by careful handling.

### **Liquid fuels**

Permissible storage of fuel within a building is generally so limited that such a plan is impractical on most farms. The National Fire Protection Association states that fuel in containers of 60 gallons

or less may be stored inside a building provided it is used exclusively for storing flammable liquids and is located at least 40 feet from any other building. For the most part fuel in containers of 60 to 550 gallons should be stored out of doors and should be 40 feet from other buildings unless underground storage is provided.

**Aboveground storage.** Locate the tank or barrel at least 40 feet away from farm buildings in a place where tank trucks will have all-weather access to it and farm power units can be readily serviced (Fig. 15). Put exposed tanks in a shady place, or build a metal roof on poles to protect the tank. Locate where it will not mar the appearance of the farmstead.

**Underground storage.** Locating the underground tank and fuel pump 16 feet or more from the farm shop is probably the safest and most satisfactory method for a permanent installation.

This type of aboveground fuel tank is widely used because it can be moved into the fields or kept at the farmstead. It should be shaded in its fixed, or farmstead, location. (Fig. 15)

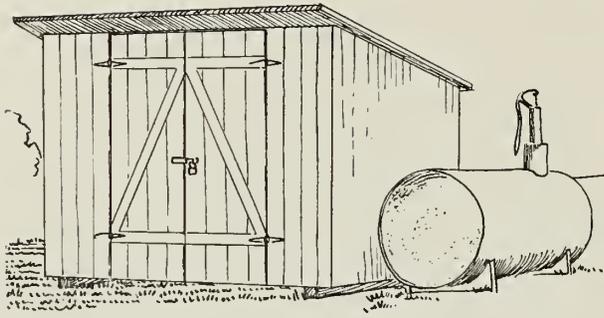


### Air compressor

The air compressor may be located wherever it will be most convenient — in the shop or machinery storage building, or under other shelter. The place is not especially important because tires do not have to be inflated often. If the compressor is located in the shop, however, the compressed air can be used for other things.

### Oil, grease, and lubricating equipment

It is most convenient to store oil, grease, and various other lubricants and lubricating equipment where the fuel is located. Then most of the servicing can be done at one stop. Keeping everything



A small storage building near the fuel tank to take care of lubricants and servicing equipment may be desirable on some farms.  
(Fig. 16)

under shelter affords protection and gives the farmstead a better appearance. One good solution would be to have a movable storage unit to hold funnels, oil cans, grease guns, and other small equipment, as well as oils and greases (Fig. 16). This unit would be similar to a movable hog house or to the service boxes on skids that are used by contractors and builders.

### Safety in and Around the Shop

Safety precautions are important both to protect the worker from accident and injury and to safeguard buildings and equipment.

**Practice good shop housekeeping.** Remove obstructions from work spaces, keep benches and tools clean and in good order, dispose of rubbish, keep floors clean and dry, and wipe up spilled grease and oil.

**Protect yourself.** Keep tools in working condition; wear safety goggles when using grinder; put guards on belts, gears, and pulleys; place blocks under machines that are hoisted or jacked up before working under them; and take special care in using power saws or other equipment that might cause injury.

**Guard against fumes.** Do not run an engine in a closed shop, unless you connect the exhaust pipe to the outside with flexible hose or iron pipe. Avoid breathing fumes from welding, particularly when welding galvanized metal.

**Prevent fire hazards.** Limit the amount of gasoline in the shop to small quantities in safety cans. Store inflammable liquids in approved containers, and handle carefully. Put oily rags and cotton

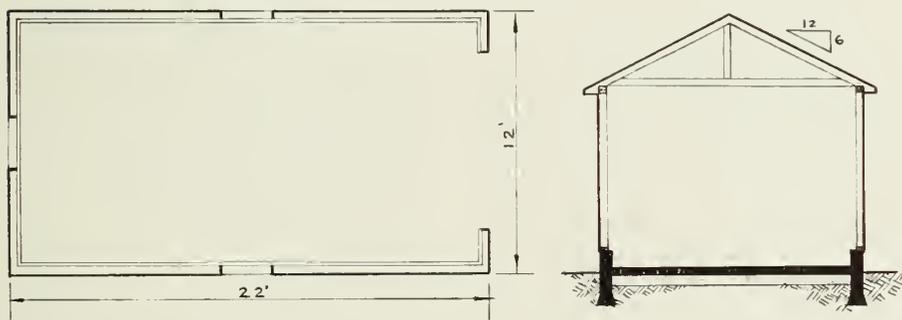
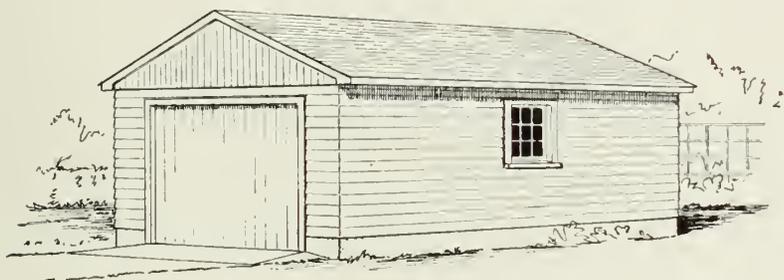
waste in closed metal containers. Shield burnable walls near the stove, forge, or welder with asbestos-cement board or sheet metal.

**Be ready for fires.** Keep pails or boxes of dry sand in the shop to extinguish oil fires. Have a carbon-dioxide or carbon-tetrachloride hand-type fire extinguisher just inside the shop door.

**Keep a first aid kit handy,** and use it immediately in case of accident, even for apparently minor cuts and scratches.

## Garages

On most farms the garage for the family car or cars should be located near the house rather than the farm buildings. It may be attached to the house, connected to it by a breezeway or covered passage, or placed near by but completely separated from it. The garage should conform to the house in such general features as roof line, siding, color, and quality of construction. In deciding on the



This typical one-car garage shows recommended measurements and construction. Details of materials, colors, and roof styles may be modified to match the farmhouse. Midwest Plan 74101. (Plan 74102 is similar, but for a two-car garage. Plan 74104 is for three cars.) (Fig. 17)

location for your garage, allow plenty of room for a straight approach and for backing out. For the sake of appearance when the door is open, it is best for the door not to face the road.

A single-car garage should be at least 12 feet wide and 20 feet long (Fig. 17). A width of 14 to 16 feet will allow room for limited storage, yard and garden tools, and supply cabinets. A length of 24 feet will provide space for a workbench or for storage.

A double garage should be at least 20 feet wide and 22 to 24 feet long with either two single doors or a double door 16 feet wide. The garage can be widened to three or more car spaces to accommodate the farm shop or to house extra cars, pickup truck, or tractor.

Garage construction is relatively simple. Follow the plans listed in this circular, or obtain plans from a builder or dealer. Use a concrete floor and foundation. Anchor a frame building to the foundation, and use cross ties at the plate line. The inside may or may not be lined. Install electric wiring, put in one or more windows, and add storage cabinets and shelving as desired.

### **How to Order Midwest Plans**

Any of the Midwest plans illustrated in this publication can be obtained from the colleges cooperating in the Midwest Plan Service. For information on how to get the plans, plan books, or other information on farm buildings, write to the Agricultural Extension Service of one of the following cooperating states:

Arkansas (Fayetteville)	Nebraska (Lincoln)
Illinois (Urbana)	New Mexico (State College)
Indiana (Lafayette)	North Dakota (Fargo)
Iowa (Ames)	Ohio (Columbus)
Michigan (East Lansing)	Oklahoma (Stillwater)
Minnesota (St. Paul)	South Dakota (Brookings)
Missouri (Columbia)	Wisconsin (Madison)

In Kansas write to the Engineering Extension Service at Manhattan.

Plans can often be obtained from the county agricultural extension agent or farm adviser.

## APPENDIX

### Storage Space for Tractor-Powered Farm Machines

Because machinery varies so much in kind, size, and number from one farm to another, the amount of storage space needed for it is a problem for each individual farm. Machine sizes differ among various makes; the next machine you buy may be different in size from the one it replaces. Some farmers want ample space around their stored machines, while others are willing to store compactly to save space.

In a machinery storage building, it is important to provide space for the largest machines you have — the 4-row equipment, field cultivators, hay rakes, combines, balers, and corn harvesters. They require large areas, wide stalls, and high doors.

In the following list, machines are grouped according to typical widths and lengths of floor space needed. Height must also be considered if machines to be stored are more than 9 feet high.

**Widths up to 8 feet** can be used to store such machines as tractor, hauling machinery, most plows, 7-foot and 8-foot disk harrows, rotary hoe, small grain drill, 2-row planter, trailer-type crop sprayer, windrower in transport position, 1-row binder, mower, hay loader, and harvesting machinery, except 2-row binder or picker.

**Widths from 9 to 12 feet** are needed for the following: stalk beater, 4-bottom disk plow, single disk harrow, 9-foot and 10-foot tandem disk harrows, offset disk harrow, 4-row cultivator, binder, most combines, 2-row corn picker, picker-sheller with tank removed, hay crusher, side delivery rake, and lime spreader.

**Widths between 12 feet and 16 feet** are needed for 4-row lister, field cultivator, rod weeder, most grain drills, most self-propelled combines, 2-row binder, and pickup baler. The widest door or storage space needed is 16 feet.

**Lengths of 12 feet** will accommodate tractor, tillage machinery (except tractor-plows), planting and seeding machinery, sprayer, stalk beater, hay crusher, and mower.

**Lengths from 12 to about 20 feet** are enough for other farm machinery except combine, mounted picker, and 1½-ton truck. These take up to 24 feet.

**Heights of more than 9 feet** are needed for relatively few farm machines. It is important to provide at least one door and the following *minimum heights* for the machines listed:

*Ten feet* for hay loader and small combine.

*Eleven feet* for 8-foot combine and corn sheller.

*Thirteen feet* for 12-foot and 14-foot combines, and self-propelled combines.

*Fourteen feet* for picker-sheller.

**Summary.** The minimum recommended dimension of 24 feet for the side-entrance type of machinery storage building accommodates the longest machine in common use on farms. Only a few machines are as wide as 16 feet. Height is important for machines that are 10 feet to 14 feet high.

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