

Bulk Feed Storage Bins

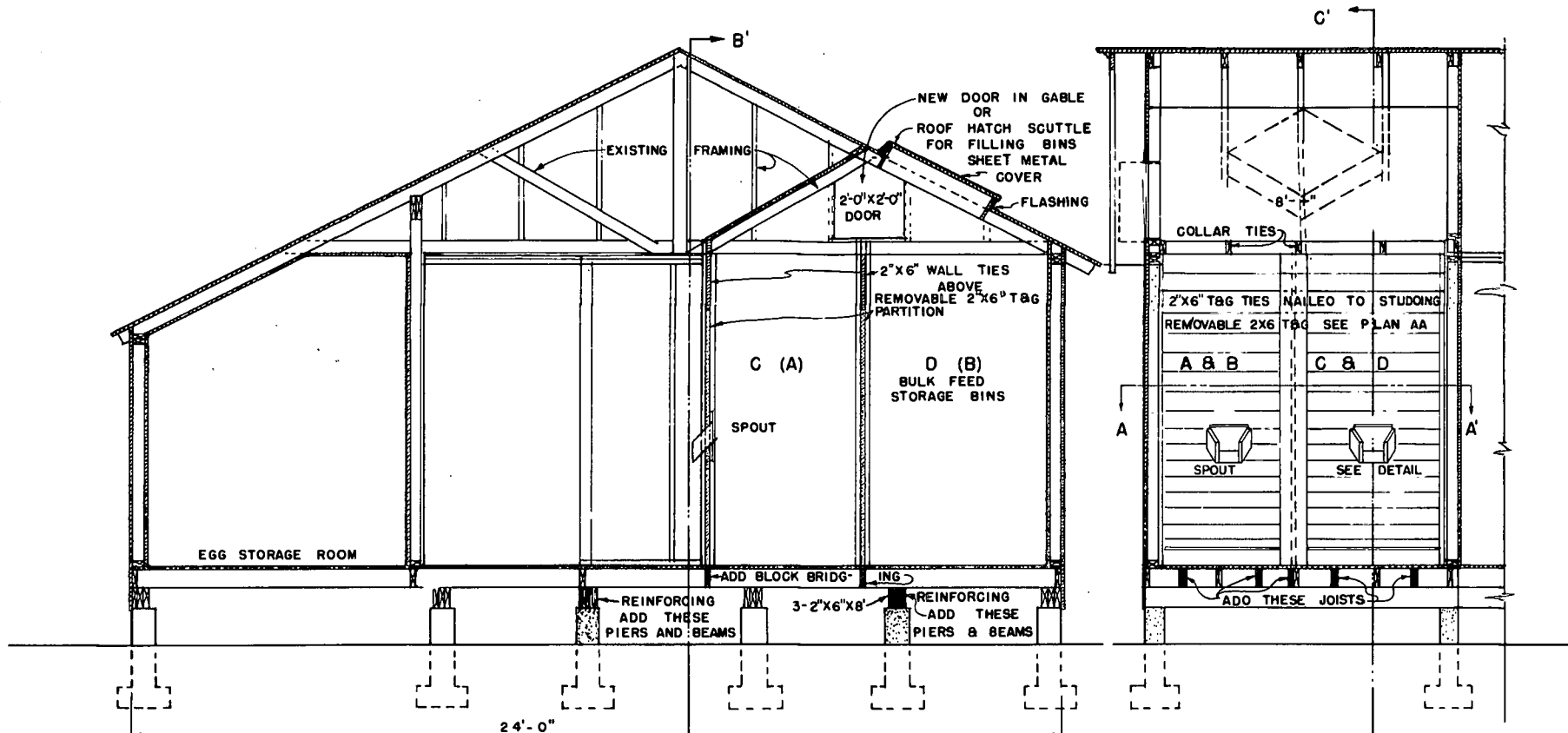
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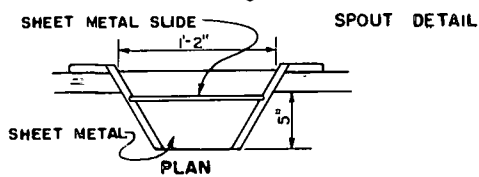
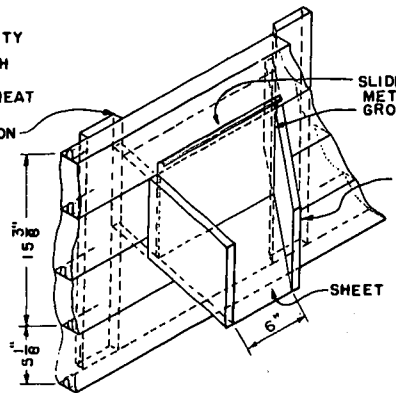
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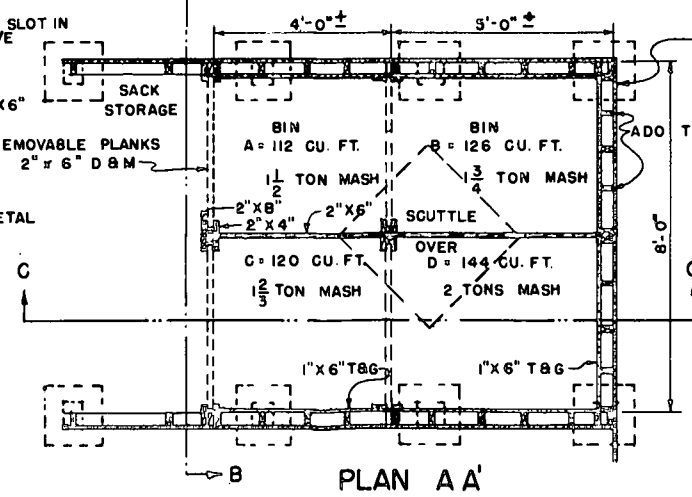


TOTAL CAPACITY
7-8 TONS MASH
OR
12-13 TONS WHEAT

1" X 4" CLEAT ON EACH SIDE



CROSS SECTION CC'



CROSS SECTION BB'

ADD 1/8" X 1 1/2" STRAP IRON TIE AROUND CORNER AT SILL & PLATE TO PREVENT SPREADING

ADD THESE STUDING

FIGURE 5
BULK FEED STORAGE BINS
FOR O.S.C. LAYING HOUSE
(PLAN NO. 2.88-1A)

Bulk Feed Storage Bins

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Bulk storage bins for dairy and poultry feed can save you time and work. You should plan and build bins to fit your special needs. This pamphlet discusses some of the problems you will want to consider in building bins and sets forth sound building practices for meeting those problems.

Bulk storage of mash and grain is a little cheaper than storing in sacks. Any large saving over present storage costs, however, probably will be offset by the increased cost of constructing bulk storage bins. Your greatest saving will be in labor involved in handling the feed. You should first check to see if there is bulk delivery service in your area. If there is and you want to take advantage of labor-saving bulk storage, you should plan for inexpensive, economical, simple and efficient bins. All you may need to do is to reinforce a part of your present feed room by adding footings and doubling your floor joists and studding in the walls.

High bins with hopper bottoms for drawing off feed by gravity save labor. One of the Oregon State College bulk bins is designed to feed by gravity directly into an automatic feeder. This unit is similar to the Plan No. 2.882R (see Figure 1) now available in the Oregon State College Plan Service.* The operator should check occasionally to see that the mash is feeding down properly and switch to the full bin when one side of the double bin is empty.

Delivery Trucks

Large bulk feed delivery trucks, when fully loaded, weigh about 20 tons. The access road and any ramp leading to your bin will have to be designed to carry a heavy load of 20 tons or more. Be sure that the truck can turn or back into your bin-loading area. Some trucks are almost 12 feet high. You should be sure that there are no overhead obstructions such as tree limbs, electrical wires, and other obstacles that will interfere with truck movement. In planning the location of your bulk bin you will probably save time and money by asking the driver of your local feed and delivery trucks to stop at your farm. After you see the truck operate and talk to the driver, you will know about where to place the bins so that they will be easily serviced and you will have a much better understanding of some of the problems of bulk storage.

*Large scale detail plans are available from the Oregon Farm Building Plan Service, Department of Agricultural Engineering, Oregon State College, Corvallis. The cost is 25¢ per sheet, plus 35¢ per order to cover costs of handling.

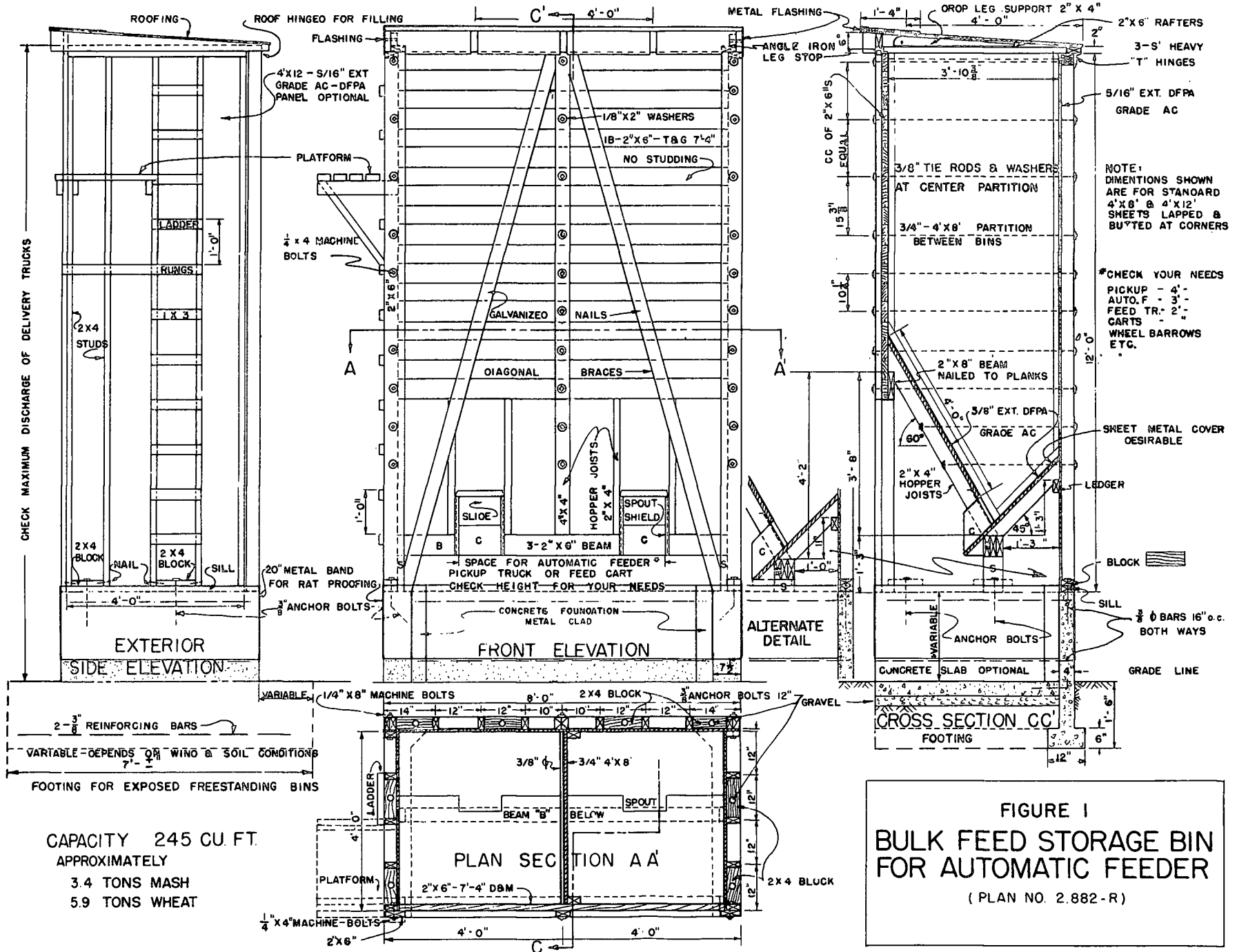


FIGURE 1
BULK FEED STORAGE BIN
FOR AUTOMATIC FEEDER
(PLAN NO. 2.882-R)

CAPACITY 245 CU. FT.
APPROXIMATELY
3.4 TONS MASH
5.9 TONS WHEAT

Mash Storage Space Requirements

Poultry mash requires about 72 cubic feet of storage space per ton. The mash itself weighs about 27 to 28 pounds per cubic foot. Dairy feeds are a little lighter and require more space, approximately 75 cubic feet per ton.

Grain Storage Requirements

<u>Grain</u>	<u>Lbs/cu.ft.</u>	<u>Lbs/bushel</u>	<u>Cu.ft/ton</u>	<u>Angle of repose on smooth board</u>
Wheat.....	48	60	42	25°
Shelled corn.....	44	55	45	27°
Barley.....	40	50	50	—
Oats.....	28	35	72	28°

(One bushel equals 1.244 cu. ft.)

Foundations and Footings

Good foundation and footing are important in the storage of concentrated heavy loads. The footing and foundation under the bin walls and floor should be designed large enough to support the load without cracking or settling. A crack in the foundation will permit settling. Settling will open the bin and result in loss by leakage, permit the entrance of rodents, and cause roof leaks. Water entering through such breaks will spoil the feed and decay the wood structural members of the building. Free standing bins will need to be anchored so that they will not be blown over by strong winds.

Floor Slab

A concrete slab resting on undisturbed earth will support either grain or mash. If a concrete slab is poured over a fill it may be necessary to reinforce the slab with steel bars or 6" x 6" welded wire fabric to keep the slab from cracking. A moistureproof asphalt impregnated expansion joint should be provided around the outside edge of the slab and an asphalt damp-proofing sheet should be located below the slab.

Piers

When the floor is carried on beams above the ground, it will be necessary to have piers and footings large enough to carry the load without settling. A bin designed for wheat will be strong enough to hold mash. The bins shown from the Oregon State College Plan Service are designed for wheat. If mash only is to be stored in the bins, the bins can be 50 to 60 per cent lighter. We have found by experience, however, that it is best to design the bin for the heavier loads. For example, if you are planning to store 10 tons of feed, it will probably be necessary to have 10 square feet of footing under the bin in addition to the piers supporting the roof and wall loads. That means that five piers each with footings 2 square feet (approximately 1'5" x 1'5") will be needed to carry the bin load without settling. If you know that the soil under your bin will support 2 tons per square foot, you can reduce the size of the footings accordingly. Five footings each 1 square foot (that is 12" x 12") will be all that is required. If you have fewer piers you must have larger footings in proportion.

Floor Framing

Wood floor joists and supporting beams should be designed to carry the extra heavy bin loads. For example, the floors in most of your buildings are designed to carry a load of about 40 to 50 pounds per square foot. If you pile wheat 8 feet deep on the floor, this load is nearly 400 pounds per square foot or about eight times what the floor was originally designed to carry. The size and the number of beams will have to be increased accordingly and the span or the distance between the supports will have to be reduced. In the Oregon State College Laying House this would require doubling the floor joists and adding a beam near the center of the span.

The following tables will guide you in selecting the floor joist sizes and spacing for framing under your bins. Note: The sizes listed are for #2 and better common grade Douglas-fir joists.

Safe depth of bin for wheat	Size of joist	Spacing of joist, center to center	Length of joist, max. space between beams or bearing walls	
4 ft. deep	2 x 4	12"	4 ft.	
	2 x 6	24"	5 "	
	2 x 6	16"	6 "	
	2 x 6	12"	7 "	
	2 x 8	24"	7 "	
	2 x 8	16"	8 "	
	2 x 8	12"	9 "	
	2 x 10	24"	8 "	
	2 x 10	16"	10 "	
	2 x 10	12"	11 "	
	5 ft. deep	2 x 6	24"	4 ft.
		2 x 6	16"	5+ "
2 x 6		12"	6 "	
2 x 8		24"	6+ "	
2 x 8		16"	7+ "	
2 x 8		12"	8 "	
2 x 10		24"	7 "	
2 x 10		16"	9 "	
2 x 10		12"	10 "	
2 x 12		24"	8 "	
2 x 12		16"	10 "	
2 x 12		12"	12 "	
6 ft. deep	2 x 6	24"	3 ft.	
	2 x 6	16"	5 "	
	2 x 6	12"	6 "	
	2 x 8	24"	5 "	
	2 x 8	16"	7 "	
	2 x 8	12"	8 "	

Safe depth of bin for wheat	Size of joist	Spacing of joist, center to center	Length of joist, max. space between beams or bearing walls	
6 ft. deep	2 x 10	24"	6 ft.	
	2 x 10	16"	8 "	
	2 x 10	12"	10 "	
	2 x 12	24"	7 "	
	2 x 12	16"	8 "	
	2 x 12	12"	11 "	
	7 ft. deep	2 x 6	16"	4 ft.
		2 x 6	12"	5 "
		2 x 8	24"	5 "
2 x 8		16"	6 "	
2 x 8		12"	7 "	
2 x 10		24"	6 "	
2 x 10		16"	8 "	
2 x 10		12"	9 "	
2 x 12		24"	7 "	
2 x 12		16"	9 "	
2 x 12		12"	11 "	
8 ft. deep		2 x 8	24"	4 + ft.
		2 x 8	16"	6 "
		2 x 8	12"	7 "
		2 x 10	24"	6 "
	2 x 10	16"	7 "	
	2 x 10	12"	8 + "	
	2 x 12	24"	6 + "	
	2 x 12	16"	8 "	
	2 x 12	12"	10 "	

Wall Framing

The walls must be extra strong to prevent bulging. The following table will guide you in selecting studs for wheat bins as shown. Note: The sizes are based on #2 and better common grade Douglas-fir.

Depth of bin (Length of studding)	Size of studding	Spacing of studding
4 feet	2" x 4"	24" cc
5 to 6 feet	2" x 4"	16" cc
7 to 8 feet	2" x 4"	12" cc
7 feet	2" x 6"	24" cc
8 feet	2" x 6"	16" cc
9 feet	2" x 6"	12" cc

In addition to reinforcing the side walls, it will be necessary to hold the studding walls together by means of ties at the top of the bin and angle straps at the corners. A diagonal brace across the top will stiffen the bins. Toe nailing the studdings to the plates will not be strong enough except for shallow bins.

The bin wall siding normally should be placed inside the studding so that the pressure will be against the studding. If the bins are shallow (only 4 or 5 feet deep) studding can be placed on the inside in order to gain more storage capacity. However, there will be more difficulty in getting the mash to flow as it hangs between the studding. When dry tongue and groove (also called dressed and matched or D & M) 2-inch planking is used, it is possible to eliminate the studding and obtain a much stronger type bin. Six-foot interior partitions made of planking require no studdings. If you have trouble in getting the mash to drop down, you can place a slip lining inside the planking. This can be of sheet metal or one of the smooth hard boards. This lining should not be nailed tightly to the wall all the way down, for if any settling in the wall should occur due to shrinkage the lining will buckle.

Walls for tall bins can be constructed flat on the ground, or on a jig table, and then raised into place section by section. Scaffolding is not needed if this is done.

Plywood Walls and Metal Tie Rods

If you wish to have a smooth inside wall that will not shrink and you do not object to cross ties inside the bin, you can use plywood instead of the 2-inch planking and sheet metal covering shown on some of the O.S.C. plans. In place of the dry 2 x 6 tongue and groove planking you can use vertical studding covered with 3/8-inch plywood. The Douglas Fir Plywood Association recommends 3/8-inch plywood placed inside vertical studding 16 inches on center with 3/8-inch tie rods spaced 2 feet on centers running across the bin both ways. For a bin 4 feet square, this would require cross ties 4' 9" long. These rods anchor horizontal girts to the studding. The horizontal girts should be spaced approximately 3 feet from center to center, with the girts near the bottom closer and those near the top can be spaced farther apart. The bin shown in O.S.C. Plan No. 2.883, 4' x 4' x 12', will hold about 2 tons of mash. See Figure 2.

Moistureproofing

You will find it best to waterproof outside walls of bins. You can do this by covering them with one of the following: wood siding or exterior grade plywood; strips and shingles or shakes; sheet metal; or sheathing and one of the composition sidings such as cement asbestos, or one of the weatherproof hardboards or asphalt composition siding. You will find that bins covered with the same material and painted or stained to match your other buildings will improve their appearance.

Flashing around the corners and openings is necessary. You should use galvanized iron flashing and galvanized zinc-coated nails when bins are exposed to the weather.

Openings for Filling Bins

Openings can be located in the roof or walls, or under protected eaves. In some cases it is possible but not desirable to fill the bins by passing the discharge spout through windows or doors into bins.

Openings should be located and designed so that the feed truck can be backed or driven alongside the bin. The spout from the truck should be long enough to reach the top. This is easiest to do if the opening is properly located on the roof and placed near the center of the bins. This position generally allows for maximum storage capacity.

It is very important that the opening be made watertight. A metal hood placed over a diamond-shaped opening can be flashed simply and reduces the danger of leakage. This diamond is formed by pointing one corner of a square scuttle up the roof. See Figure 3.

Roof Coverings

The roof covering is a matter of personal choice but it should blend with the roofs of your other buildings. Above all, have a good tight roof. The roof scuttles through which the bins are filled are constant sources of leakage unless they are properly flashed. Adequate two-piece flashing with a cap base flashing should be used. A cap cover flashing should be independent of the roof, which will allow the frame roof to give without breaking the metal flashing.

Rodentproofing

You will probably want to make your grain and mash storage bins ratproof. If the bins are located on posts or piers it is very easy to wrap the posts or piers with a strip of sheet metal approximately 18 inches high and located so that it just touches the masonry foundation. A common source of trouble is a hollow wall which rats can use as a safe retreat and a convenient runway. Hollow walls of any kind should be avoided or properly ratproofed. It is ideal to have a bin completely lined or covered with metal. In any case, the bin should have a metal-clad cover. The U. S. Department of Interior Fish and Wildlife Service has published a "Conservation Bulletin No. 19" dealing with ratproofing buildings and premises. There are so many different kinds of grain storage structures that it is impossible to discuss all of them here, but suggestions in the Department of Interior bulletin will aid considerably in reducing your loss through rodents.

Fumigation

It may be necessary at times to fumigate the storage bin and it is well to plan for this fumigation at the time the bin is constructed. Smooth, tight walls reduce the need for fumigation and aid the actual process. You should avoid laminated bin construction because the cracks make fumigation difficult.

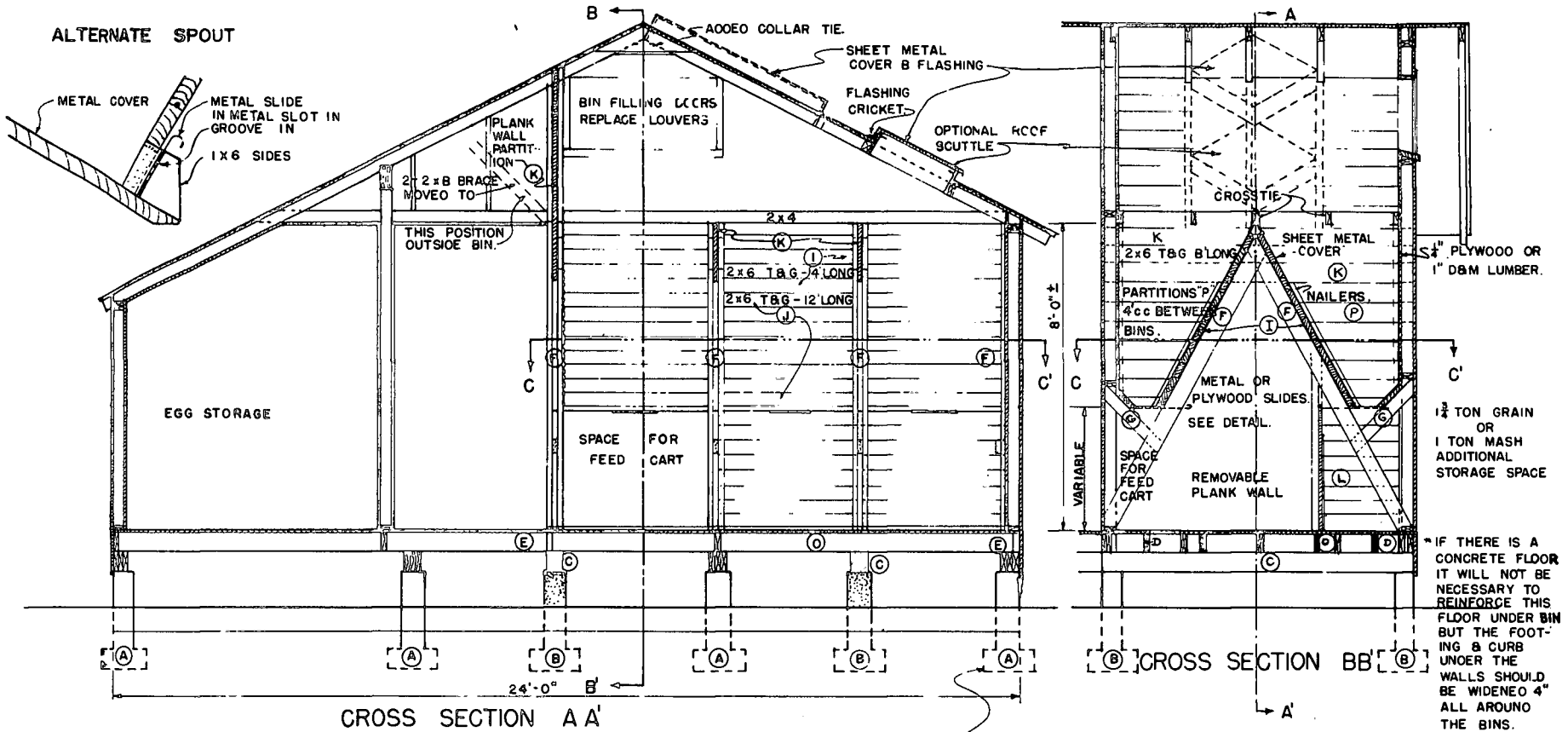
Spouts

Openings for emptying the bins should be equipped with spouts. Metal slides in the spout opening should move freely in metal grooves.

You will find that grooves cut across the grain in wood spouts will not prove satisfactory. Mash seems to bind the slide in the groove and keep the slide from closing the opening.

Hopper-Bottom Bins

You will find that grains and pellets will flow out of bins with a 45° slope. An angle of about 60° aids materially in unloading mash, and a metal lining on the hopper bottom will help. Hopper bottoms sloping to one side are more efficient than those with four-way slopes.



STORAGE CAPACITY
 4 TONS MASH AND $3\frac{1}{2}$ TONS WHEAT
 OR 6 TONS MASH TOTAL
 OR 10 TONS WHEAT

LEGEND - BILL OF MATERIALS

- (A) ORIGINAL FOOTINGS, 1'-4" x 1'-4" - 6" PIERS
- (B) NEW FOOTINGS, 4 EACH 1'-4" x 1'-4" - 6" PIERS
- (C) NEW BEAMS (GIRDER) SILLS, 2 EACH, 3-2" x 6"-6'
- (D) NEW FLOOR JOISTS UNDER POSTS, 4-2" x 6"-12'
- (E) NEW BLOCK BRIDGING HEADERS, 4-2" x 6"-2'
- (F) TRUSSED SLOPING STUDDING, 8-14-2" x 6"-8'
- (G) BRACES, (8-2" x 4"-2' & 8-1" x 4"-2')
- (H) STUDDING A000 REINFORCEMENTS, 12-2" x 4"-6'
- (I) HOPPER BOTTOM, 30-2" x 6" D & M-4'
- (J) HOPPER BOTTOM, 18-2" x 6" OBM-12'
- (K) PARTITIONS, 20-2" x 8" OBM-8'
- (L) OPTIONAL FLOOR BIN

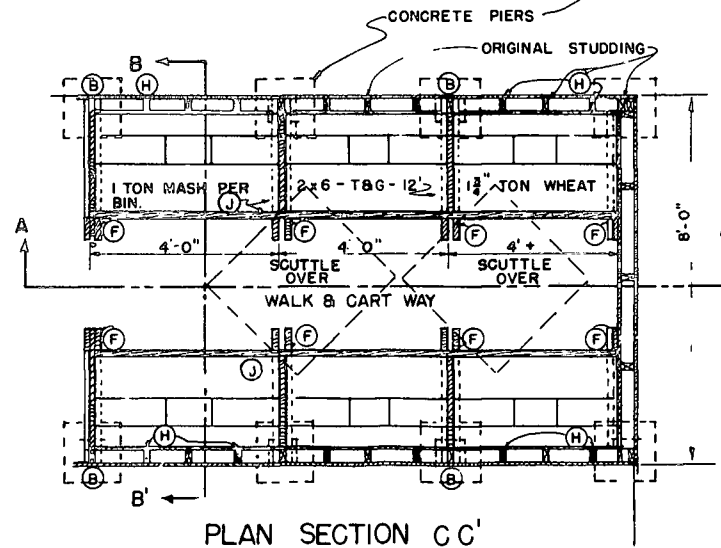
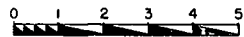


FIGURE 3
 HOPPER BOTTOM
 FEED STORAGE BINS
 FOR O.S.C. LAYING HOUSE

(PLAN NO. 2.881B)

A hopper-bottom bin located over an automatic feeder eliminates practically all man-handling of the feed. The O.S.C. Bulk Feed Bin Plan No. 2.882R (see Figure 1) is of this type. It has a capacity of 245 cubic feet and will hold about $3\frac{1}{2}$ tons of mash or almost 6 tons of wheat in its two units. It has two 4' x 4' compartments 12' deep. The bin can be located at one end or along the side of the poultry house, either outside or inside. If it is placed outside it should be covered with a water-proof siding and roof to make it weather tight. The plan shows a foundation that is variable in height to accommodate either an automatic feeder or your feed truck, whichever you desire. The four walls of this bin should be build flat on the ground or floor and then raised into position and bolted together. This saves building scaffolding and simplifies construction.

O.S.C. Laying House Plan

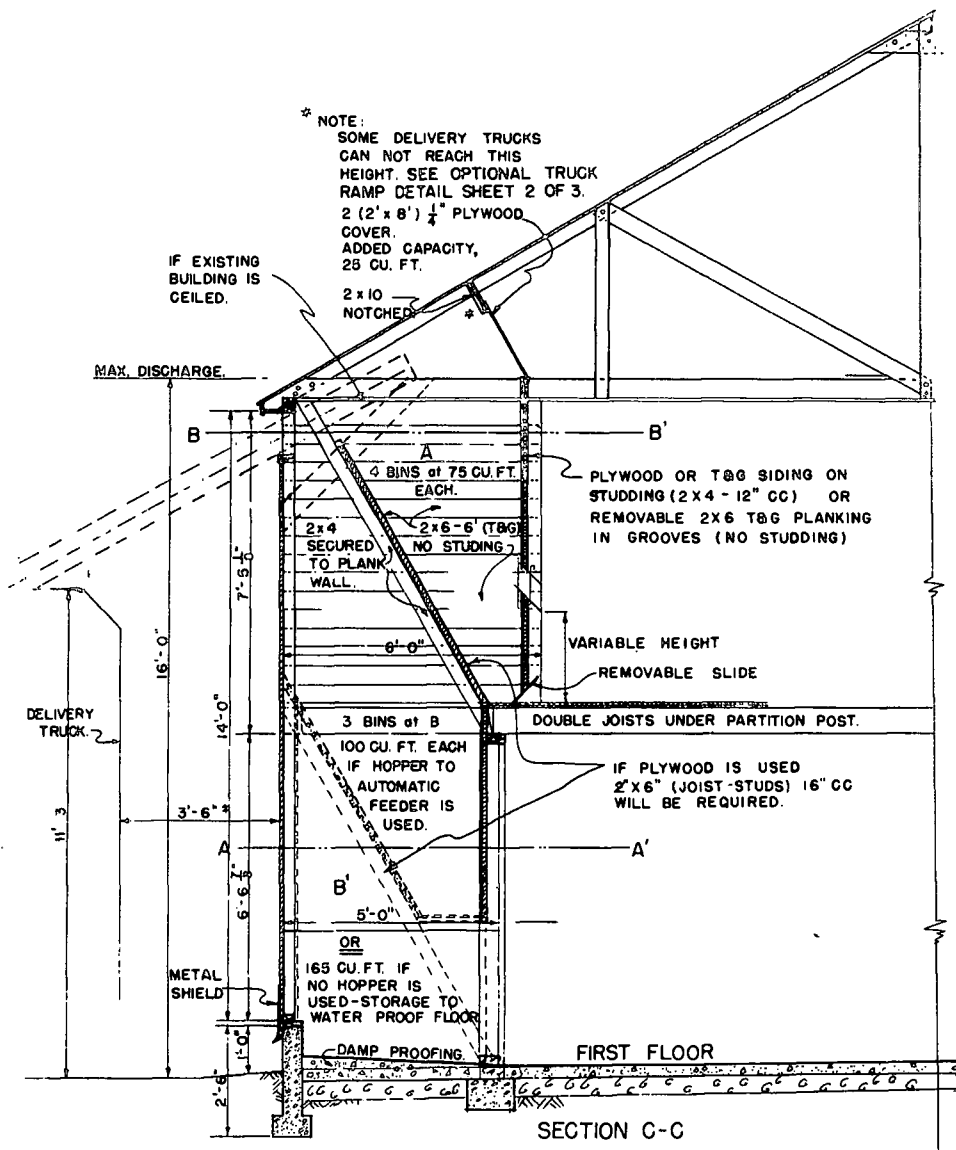
Small hopper-bottom bins can be installed in the feed room of the standard O.S.C. Laying House, Plan No. 2.88, if the walls and floors are reinforced as shown in Plan No. 2.88-1B. (See Figure 3.) Six one-ton mash bins can be placed so that feed carts can be placed directly under any one of the bins. (These same bins will hold about 10 tons of wheat.) Automatic self-feeders could be filled directly from three of these bins if the feed room is located at one end of the poultry house, or all six could feed directly down to feeder if the feed room is located in the middle of the house.

Two-Story Poultry House

Hopper-bottom bins can be constructed in the feed rooms of the standard Two-Story Poultry House, Plan No. 2.89-1A. (See Figure 4.) Four bins each holding slightly over a ton of mash can be located on the second floor and three hopper-bottom bins holding a total of about 4 tons of mash. If these bins on the first floor are constructed without the hopper bottom they would hold about 7 tons of wheat. An automatic self-feeder could be placed under bins on the first floor.

Bulk Storage Bins in O.S.C. Laying House

Floor to ceiling bulk storage bins can be installed in the standard O.S.C. Laying House, Plan No. 2.88, by reinforcing the floor and walls as shown on Plan No. 2.88-1A. (See Figure 5.) Four bins (two double bins) with a total capacity of about 7 tons of mash or 12 tons of wheat are provided. The bins can best be filled through a diamond-shaped scuttle in the roof.



CAPACITY

- 600 cu-ft. HOPPER BOTTOM BINS
- 8 1/2 TONS MASH or 14 TONS WHEAT.
- 800 cu-ft. FLAT BOTTOM BINS
- 11 TONS MASH or 18 TONS WHEAT.

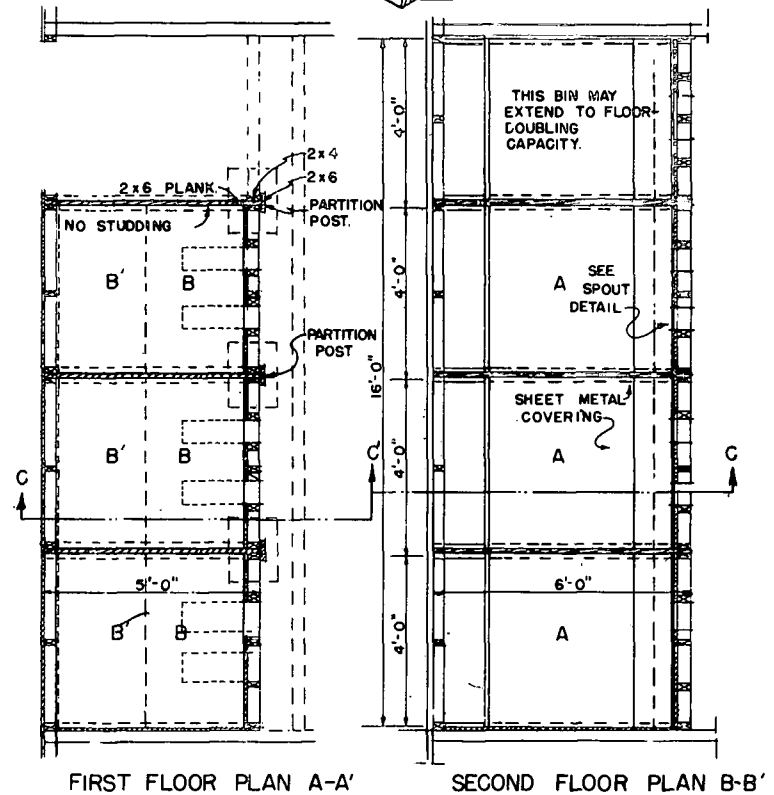
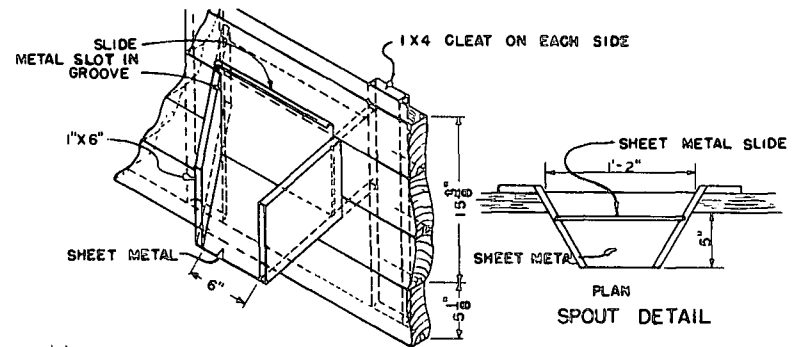


FIGURE 4
BULK FEED STORAGE BINS
FOR TWO STORY POULTRY HOUSE
(PLAN NO. 2.89-1A)