Selecting Steel Beams and Columns for Farm Buildings
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Selecting Steel Beams and Columns for Farm Buildings

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The use of steel beams and columns in farm buildings is increasing. The selection of the proper size is important. Different shapes can be used, such as I, channel, pipes, bar, and others, but due to the type of framing used in farm buildings, the I section is used for beams, and both the I and pipe sections are used for columns. These cross-sections are selected on the basis of the depth of I or the outside diameter of a pipe and the weight of the beam or column per foot of length. Tables 1 to 4 use these two dimensions to select a beam or column.

Fig. 1 illustrates the general problem and the terms used in this publication.

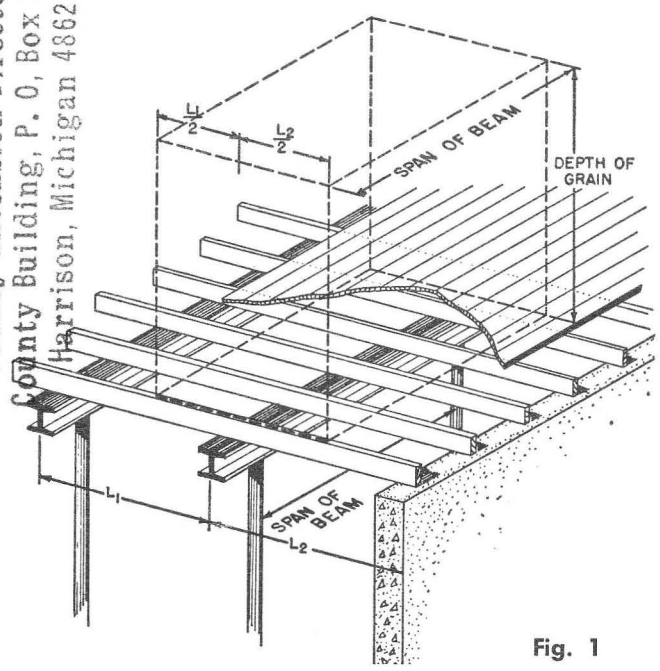

Fig. 1

In choosing floor supports, figure the maximum load that might be placed on the floor. If it is a hay mow, assume the mow filled to the ridge; if a grain bin, consider it to be full.

Information in this publication is based on the "Steel Construction Manual," AISC, 1952.

STEEL BEAMS

The load carried by a beam is illustrated by the cube shown in dashed lines in Fig. 1. The volume of the cube multiplied by the weight of the material per cubic foot gives the total load on the beam. Weights of common materials are given in Table 4.

Determine volume by multiplying length x width x height (all dimensions in feet). The dimensions of this cube are determined as follows: the length equals the span of the beam between columns; the width equals the sum of half of the joist span on each side of the beam; the height equals the maximum depth of the stored material.

Example 1:

Chopped hay is stored in a mow 19 feet deep. The posts under the beam are 11 feet apart, the joists on one side are 8 feet long, and on the other side they are 12 feet long. Find the size of a steel I-beam necessary to hold the load.

Dimensions used in finding the volume are:

Length = 11 feet; width = $\frac{8}{2} + \frac{12}{2}$ = 10 feet

Height = 19 feet

Volume = 11 × 10 × 19 = 2090 cu. ft.

Load = Volume × weight = 2090 cu. ft. × 8 pounds/cu. ft. = 16720 pounds

From Table 1, span 11 feet, load 16,720 pounds, select an 8-inch, 18.4-pound standard I-beam.

STEEL COLUMNS

Two shapes are commonly used for columns, an I or a round pipe. Tables 2 and 3 give the allowable loads for various lengths and sizes of columns.

Determining the load on a column is similar to the method used for beams. You can find the dimensions for figuring the volume and load as follows:

Length is equal to the sum of one half the length of the beam in each direction.

Width is equal to the sum of one half the length of the joists in each direction.

Height is equal to maximum depth of material to be stored (Fig. 1).

Example 2:

Find the size of an I section and pipe section columns for Example 1 if the columns are 7 feet long.

Dimensions for determining the volume are:

Length = $\frac{11}{2} + \frac{11}{2}$ = 11 feet

Width = $\frac{8}{2} + \frac{12}{2}$ = 10 feet

Height = 19 feet

Volume = 11 × 10 × 19 = 2090 cu. ft.

Load = 2090 cu. ft. × 8 pounds/cu. ft. = 16,720 pounds

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From Table 2, select a steel I column 7 feet long, 4 inches - 7.7 pounds/ft.

From Table 3, select a steel pipe column 7 feet long, 3 inches dia. - 7.58 pounds/ft.

All columns should be rigidly attached to the beams to prevent animals or farm implements from knocking the columns out of position. Welding a steel plate to the top and bottom of the column improves bearing and provides a means of connecting the column to the beam.

TABLE 1 — AMERICAN STANDARD I BEAMS

Beam size (inches)	Weight (pounds per foot)	Allowable load in thousands of pounds for beams laterally supported — Length of span (feet) 6	8	10	11	12	13	14	15	16
4	7.7	6.7	5.0							
	9.5	7.3	5.5							
5	10.0	10.7	8.0	6.4	5.8					
	14.75	13.3	10.0	8.0	7.3					
6	12.50	16.2	12.2	9.7	8.8					
	17.25	19.3	14.5	11.6	10.5					
7	15.3	23.0	17.3	13.9	12.6	11.6	10.7	9.9	9.2	
	20.0	27.0	20.0	16.0	14.5	13.3	12.3	11.4	10.7	
8	18.4	32.0	24.0	18.9	17.2	15.8	14.6	13.5	12.6	11.8
	23.0	36.0	27.0	21.0	19.4	17.8	16.4	15.2	14.2	13.3
10	25.4	54.0	41.0	33.0	30.0	27.0	25.0	23.0	22.0	20.0
	35.0	65.0	49.0	39.0	35.0	32.0	30.0	28.0	26.0	24.0
12	31.8	80.0	60.0	48.0	44.0	40.0	37.0	34.0	32.0	30.0
	35.0	84.0	63.0	50.0	46.0	42.0	39.0	36.0	34.0	32.0

Beams must be set so they cannot tip sideways when the load is applied.

TABLE 2 — AMERICAN STANDARD I COLUMNS

Size: Depth (inches)	Size: Weight (pounds per foot)	Allowable load (thousands of pounds) — Unbraced length (feet) 5	6	7	8	9
3	5.7	18	13.4	9.9	7.3	
	7.5	23	17.2	12.6	9.1	
4	7.7	26	22.0	16.6	12.7	9.5
	9.5	33	26.0	20.0	15.2	11.4
5	10.0	37	32.0	26.0	20.0	15.3
	14.75	54	46.0	36.0	28.0	22.0
6	12.5	49	44.0	38.0	31.0	25.0
	17.25	66	58.0	48.0	38.0	31.0

TABLE 3 — PIPE COLUMNS

Size: Diameter (inches)	Size: Weight (pounds per foot)	Allowable load (thousands of pounds) — Unbraced length (feet) 6	8	10	12	14
3	7.58	33.0	30.0	26.0	21.0	18.0
4	10.79	50.0	47.0	44.0	40.0	34.0
5	14.62	70.0	68.0	64.0	61.0	56.0
6	18.97	92.0	90.0	86.0	82.0	79.0
8	24.70	121.0	120.0	118.0	115.0	112.0

TABLE 4 — WEIGHT OF COMMON MATERIALS STORED IN FARM BUILDINGS

Material	Pounds per cubic foot	Material	Pounds per cubic foot
Barley	39	Baled Hay	8
Corn, ear	28	Chopped Hay	8
Corn, shelled	45	Long Hay	4 to 5
Oats	26	Potatoes	46
Rye	45	Apples	38
Pea Beans	48		
Soy Beans	48		
Wheat	48		

Driveways—Up to 10-ton load limit; 150 lbs. per square foot of floor area.