MILL BUILDING CONSTRUCTION

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CHAPTER I.

LOADS.

Mill buildings differ so greatly in character and purpose that it is impossible to formulate tables of dead weights which will suit all cases. The use to which the building is to be put, its location, the character of the roof covering, the presence or absence of cranes, etc., all affect the dead weight, and generally each case must be considered individually. For most purposes of design the loads may be divided into: (1) roof loads; (2) floor loads; (3) crane loads; (4) snow and wind loads, and (5) miscellaneous loads.

ROOF LOADS.—For making rough estimates the diagram of weights of roof trusses given in Fig. 1 will prove useful. These weights have been figured separately and do not quite agree with any of the published formulas. From this diagram, the table (Table I.) giving the weights of roof coverings and the table (Table III.) of wind and snow loads, the total weight to be carried is found. Were it possible to realize in actual practice the small sections required, the weight of trusses would be directly proportional to the load carried. Iron purlins weigh from 2 lbs. to 4 lbs. per square foot of ground covered, according to the spacing of the trusses. Good practice in the United States requires that roofs in northern latitudes shall be figured for at least 40 lbs. per square foot of roof surface.

FLOOR LOADS.—The Building Law of New York City requires that floors shall be proportioned to carry the following minimum loads per square foot: Office buildings, 100 lbs.; public halls, 120 lbs.; stores, factories, warehouses, etc., 150 lbs.; floors carrying heavy machinery, 250 lbs. to 400 lbs. In every case the floor must be strong enough to carry its maximum load. Mr. C. J. H. Woodbury, in his book on "The Fire Protection of Mills," gives a table of weights per square foot of floor of various kinds of merchandise, which is reprinted herewith (Table I.) and which will be found valuable in determining loads on floors.

CRANE LOADS.—For small traveling cranes of one or two tons capacity it is safe to consider the total weight of one end of the crane and its load as twice the capacity of the crane. For cranes

of larger capacities Table II. gives the maximum weight which will come on two carrying wheels at one end of the crane when the fully loaded trolley is at that end. The corresponding figures for the other end would be somewhat smaller, but not enough so to affect materially the construction of the building. From the figures in Table II. the strength of traveling crane runway girders and columns may be calculated.

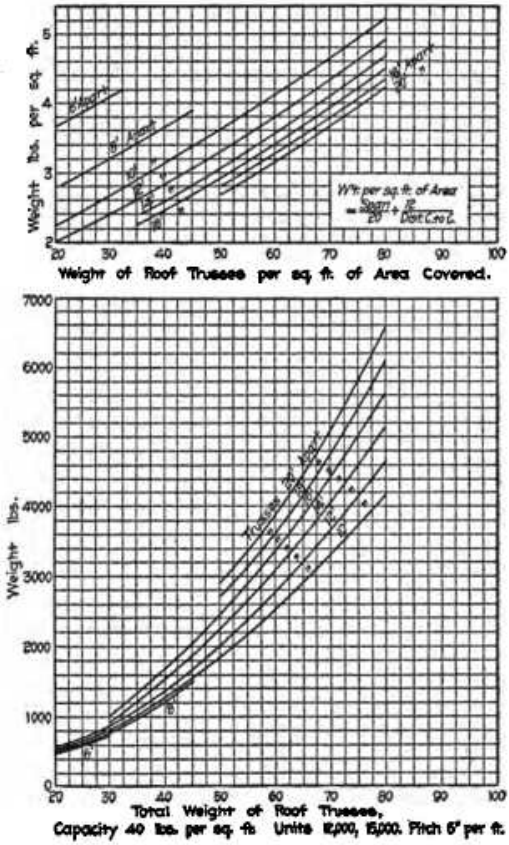

Fig. 1. Diagrams Showing Weights of Roof Trusses.

The strains due to the presence of jib cranes vary so greatly in number, character and intensity in different cases, that they do not admit of any general tabular statement. They must, however, be carefully figured in each case and fully provided for in the design. The principal strains produced will be in the lower chord bracing of the roof trusses, and the bending strains in the supporting columns.

SNOW AND WIND LOADS.—The pressure exerted by wind on roofs is in every case normal to the plane of the roof surface.

The amount of wind pressure usually assumed in proportioning framed structures is 30 lbs. per square foot on a vertical surface, which corresponds to a velocity of from 70 to 80 miles per hour. This velocity includes all storms except tornadoes, which cannot be provided for. Table III. gives the normal pressures on roof surfaces of different slopes for a pressure of 30 lbs. per square foot on a vertical surface.

Snow loads of from 10 lbs. to 20 lbs. per square foot of horizontal projection of the roof should be provided for. There are records of snow and ice deposits weighing 40 lbs. per square foot having formed on roofs in northern latitudes, but this is a very exceptional occurrence. When the roof has a pitch of 45° or more, snow load need not be considered. In New England latitudes, for roofs of ordinary pitch, it will be sufficient to assume 30 lbs. per square foot of roof surface for snow and wind loads combined. The maximum strains from wind and jib crane loads will so seldom occur together in the horizontal bracing that a combination need not be provided for. If they should occur at the same time, once in a year or so, the factor of safety will enable the metal to withstand the strain without injury.

The overturning effect of wind acting on the building as a whole and tending to revolve it about the bases of the leeward columns need be considered only in the case of tall narrow buildings. Wind acting on the sides of a building will necessitate the use of knee braces running from the columns to the bottom chords of the roof trusses, and the strains in these braces will be considerable. These strains will produce bending strains in the columns which must be provided for.

MISCELLANEOUS LOADS.—In special cases there will be other loads to provide for besides the more common roof, floor, crane, snow and wind loads just considered. The bottom chords of roof trusses are frequently employed to carry shafting, steam pipes, trolleys, etc. It is sometimes convenient also to have the roof trusses sufficiently strong to permit of a block and tackle being attached at any point to handle goods. The roof may require a ventilator and when it does this extra weight must be added to the roof loads. Columns in exposed places where they are liable to shocks from vehicles or merchandise should be made stronger than those built into brick walls.

SUMMARY OF LOADS.—The total roof loads per square

foot of roof, including weights of trusses for spans under 75 ft., is about as follows for different constructions of roofing:

Style of Construction.	Lbs. per sq. ft.
Corrugated iron, unboarded	8
" " on boards	11
Slate on laths	13
" " 1¼-in. boards	16
Tar and gravel	12
Shingles on laths	10
Tile	20-30

When any of these roofs are plastered below the rafters 10 lbs. per square foot should be added to the loads given. For spans greater than 75 ft. a weight of 4 lbs. per square foot should be added to the weights given. For snow and wind loads combined add for northern latitudes 30 lbs. per square foot to the loads given.

The weight of steel in the sides and roofs of mill buildings, without cranes, is from 4 lbs. to 6 lbs. per square foot of exposed surface for the frame only. Corrugated iron sheathing weighs from 1 lb. to 2 lbs. per square foot. These weights, with steel at 5 cts. per lb., make the cost of steel buildings from 25 cts. to 40 cts. per square foot of exposed surface. A rough approximate rule for calculating the extra weight of steel required in columns and girders when traveling cranes are used is as follows: Add 100 lbs. of steel per lineal foot of building for every five tons of crane capacity. This would give for a 5-ton crane an addition of 100 lbs. per lineal foot and for a 20-ton crane an addition of 400 lbs. per lineal foot.

METHODS OF CALCULATION.—Methods of calculation will not be touched upon in this book, since they may be found in any text-book upon the subject. Briefly enumerated, the cases to be considered in determining strains are the following:

(1) Strains in roof trusses and columns from permanent dead loads.

(2) Roof trusses on walls, strains from wind normal to the surface.

(3) Wind on side of building and roof, strains in trusses, columns and knee braces; (a) columns hinged at the base; (b) columns fixed at the base.

Partial loading can never cause maximum srains in the parts of a Fink truss as they may in other forms of roof trusses.