

FLOORS AND FLOOR LOADS

Kinds of Loads. Two kinds of loads are carried by structures. Live loads consist of the weight of carriages, cranes or other handling devices and their supported loads, machinery, merchandise, persons or other moving objects, the support of which is the purpose of the structure, including also wind stresses. Dead loads consist of the actual weight of the structure itself with the walls, floors, partitions, roofs, and all other permanent construction and fixtures. The dead loads stress the structure at all times and it must, therefore, be proportioned to sustain them at all times without reduction. The live loads may be taken at their full values or reduced in accordance with the probabilities that the structure as a whole or its principal members will not be subject at all times to the full theoretical live loading.

Dead Loads. The permanent load should be calculated from known weights per unit of the material composing floors, partitions, walls, or other permanent construction. The weight assumed for the steel frame itself should be checked after the sections are determined and then the sizes readjusted if necessary.

Live Loads. Live loads vary with the character of the structures. In buildings they consist of uniform loads per square foot of floor area, concentrated loads, such as heavy safes, which may be applied at any point of the floor, and uniform loads per lineal foot of beams or girders. The load which produces the maximum bending moment or reaction is to be used in proportioning sections. The floor system between beams must of course be of sufficient strength to transmit any concentrated load to the beam.

In cities the minimum live loads to be used on the various classes of buildings are fixed by public ordinances, and are given on page 304 for the principal cities of the United States in accordance with the most recent building laws, which are intended to cover general conditions and do not include machinery or other concentrations. If such concentrations, like safes, armatures, generators, or printing presses, occur on floors, special provision should be made for them in the floor framing. Flat roofs of buildings which may be loaded with people, should be treated the same as floors and the same uniform live loads used as given in the table for dwellings, hotels or assembly rooms.

CARNEGIE STEEL COMPANY

FLOORS AND ROOFS

MINIMUM LIVE LOADS, POUNDS PER SQUARE FOOT

By Building Laws of Various Cities

Description of Building	New York, 1917	Chicago, 1919	Philadelphia, 1919	St. Louis, 1917	Boston, 1919	Cleveland, 1920	Baltimore, 1908	Pittsburgh, 1914	Cincinnati, 1917
Floors for Rooms									
Apartments and Dwellings.	40	40	70	50	50	70a	60	50	40
Asylums, Hospitals, etc...	100	50	70	50	50c			70	40
Detention Buildings, etc...	100	50			50c	80			60
Factories:									
Light manufacture....	120d	100d	120d	100d	125d		125d	125d	100d
Heavier manufacture...			150d	150d	250d		175d		150d
Hotels, Lodging Houses..	40	50	70	50	50c	70	60	70	40b
Office Buildings, etc.....	60	50	100	60b	75b	70b	75b	70	50b
Public Buildings:									
Municipal Buildings....	100				75c	100			100
Churches	100	100	120	75	100	80	75	125	100
Libraries, Museums....	100				100	125		200	
Theaters	100	100	120	100	100	80	75	125	100
Schools, Colleges, etc....	75	75		75	50	70	75	70	60
Stores, light goods	120	100	120	100	125	100b	125	125	100
" heavier goods.....			150	150	250		175		150
Warehouses.....			150	150	250		250	200	150
Floors for Assembly Halls, etc.									
Auditoriums, fixed seats..	100	100	120	100	100	80	75	125	100
" movable seats.....	100	100	120	100	100	125	125	125	100
Armories, Dance Halls, etc.	100	100			100	150		150	150
Miscellaneous									
Garages, Stables.....	120	100e		100	150e	150e	100		75
Corridors, Hallways.....	100	100		100	75f	70g			80g
Stairways, Fire Escapes..	100	100		100	75f	100h			80g
Sidewalks.....	300				250	200	200		300
Roofs:									
Flat, slope up to 20° (½)	40	25	30i	30	40	35i	40	50k	25
Steep, slope over 20° (½)	30	25	30i		25j	30i	20	50k	25
Wind Pressure	30l	20	30m	30	10-20n	20o	30	25	20p

a Dwellings, Cleveland, 60.

b First floors: St. Louis, 100; Boston, 125; Cleveland, 125; Baltimore, 150; Cincinnati, 100.

c Public floors of Hospitals, Hotels, Public Buildings, etc.: Boston, 100.

d Floor loads do not include the weight or the impact load of machinery.

e Garages, private: Chicago, 40; Boston, 75; Garages; public, upper floors: Cleveland, 100; Stables: Cleveland, 80.

f Corridors, stairways, etc., for Assembly Halls, Armories, etc.: Boston, 100.

g Except in Dwellings where floor loads are less.

h Stairways, etc., for Apartment Houses, 80; Dwellings, 60.

i Loads per square foot of superficial roof area; other roof loads are for the projected area.

j Loads include Wind Pressure: 10 pounds up to 2/3 slope, 15 up to 1/2 slope, 20 over 1/4 slope.

k Dead and live load; snow load 25 pounds, reduced 1 pound each degree between 20° and 45°.

l For buildings over 150 feet high, or where height is over 4 times least horizontal dimension.

m Wind pressure for high buildings in built-up districts: 25 pounds at tenth story, 2 1/2 pounds less for each story below and 2 1/2 pounds more for each story above, up to 35 pounds.

n For buildings 40 feet high, 10 pounds; up to 80 feet, 15 pounds; over 80 feet, 20 pounds.

o Wind pressure on curtain walls, 30 pounds.

p For buildings over 100 feet high, or where height is over 3 times the average width of base.

Reduced Live Loads. Floor beams in buildings should be computed to sustain floor by floor the full live and dead loads. It is not probable that all the floors will be fully loaded at all times, and, therefore, good practice permits a reduction of the theoretical live load in the computations of column sections. The New York and Pittsburgh building laws do not permit any reduction on columns supporting the roof and top floor. These building laws permit for buildings more than five stories in height on columns supporting each succeeding floor a reduction of 5 per cent of the total live floor load until 50 per cent is reached, which reduced load is to be used for the columns supporting the remaining floors. Pittsburgh building law, however, does not permit any reduction of live floor loads over 150 pounds per square foot (bulk storage). The Chicago building law requires columns to sustain the full live load on roofs, 85 per cent of the full live floor load on the top floor with a 5 per cent reduction on each succeeding floor down to 50 per cent.

When the character of the loading will permit, it is also considered good practice to reduce the live load on the main girders to which the primary supporting beams are framed. The amount of the reduction will depend on the probable distribution of the loads.

Foundation Loads. Footings should be so designed that the loads they sustain per unit of area shall be as nearly uniform as possible, and the dead loads carried by the footings should include the actual weight of the superstructure and foundations down to the bottom of the footing. The live load should be assumed to be the same as the live load in the lowest tier of columns or in the footings under walls. According to the proposed New York building law, the area of the footing which has the largest percentage of live load to total load shall be determined by dividing the total load by the unit working stress. From the area thus calculated all the other footings of the building shall be proportioned according to the ratios of their respective dead loads only. In no case shall the load per square foot under any portion of any footing due to the combined dead, live, and wind loads, exceed the safe sustaining power of the soil upon which the footing rests.

Fireproof Floor Systems. A modern office or mercantile building is essentially a steel framed structure which supports the dead load of the building and its contents and is itself protected on all sides by refractory materials. The floors are made fireproof by the use of terra cotta tiles or arches or of a composite flooring made of concrete or reinforced concrete. While brick arches may still be used in special locations where great floor strength is needed, and concrete arches are sometimes thrown between the beams,