Common Design Loads in Building Codes

Notation:

A = name for area
AASHTO = American Association of State Highway and Transportation Officials
ASCE = American Society of Civil Engineers
ASD = allowable stress design
D = dead load symbol
E = earthquake load symbol
F = hydraulic loads from fluids symbol
H = hydraulic loads from soil symbol
L = live load symbol
L_r = live roof load symbol
LRFD = load and resistance factor design
R = rainwater load or ice water load symbol
S = snow load symbol
SEI = Structural Engineering Institute
t = name for thickness
T = effect of material & temperature symbol
V = name for volume
w = name for distributed load
W = wind load symbol
= force due to a weight
= name for total force due to distributed load
γ = density or unit weight

Design Codes in General

Design codes are issued by a professional organization interested in insuring safety and standards. They are legally backed by the engineering profession. Different design methods are used, but they typically defined the *load cases or combination*, stress or strength limits, and deflection limits.

Load Types

Loads used in design load equations are given letters by *type:*

D = dead load

L = live load

L_r = live roof load

W = wind load

S = snow load

E = earthquake load

R = rainwater load or ice water load

T = effect of material & temperature

H = hydraulic loads from soil

F = hydraulic loads from fluids

Determining Dead Load from Material Weights

Material density is a measure of how much mass in a unit volume causes a force due to gravity. The common symbol for density is γ. When volume, V, is multiplied by density, a force value results:

$$W = \gamma \cdot V$$

Materials "weight" can also be presented as a weight per unit area or length. This takes into account that the volume is a thickness times an area: $V = t \cdot A$; so the calculation becomes:

$W = (weight/unit\ area) \cdot A$

$w = (weight/unit\ volume) \cdot t$ which is a weight per unit area

$w = (weight/unit\ volume) \cdot A$ which is a weight per unit length

Minimum Concentrated Loads

adapted from SEI/ASCE 7-10: Minimum Design Loads for Buildings and Other Structures

Location	*Concentrated load lb (kN)*
Catwalks for maintenance access	300 (1.33)
Elevator machine room grating (on area of 2 in. by 2 in. (50 mm by 50 mm))	300 (1.33)
Finish light floor plate construction (on area of 1 in. by 1 in. (25 mm by25 mm))	200 (0.89)
Hospital floors	1,000 (4.45)
Library floors	1,000 (4.45)
Manufacturing	
Light	2,000 (8.90)
Heavy	3,000 (13.40)
Office floors	2,000 (8.90)
Awnings and canopies	
Screen enclosure support frame	200 (0.89)
Roofs – primary members and subject to maintenance workers	300 (1.33)
School floors	1,000 (4.45)
Sidewalks, vehicular driveways, and yards subject to trucking (over wheel area of 4.5 in. by 4.5 in. (114 mm x 114 mm)	8,000 (35.60)
Stairs and exit ways on area of 2 in. by 2 in. (50 mm by 50 mm) non-concurrent with uniform load	300 (1.33)
Store floors	1,000 (4.45)

Allowable Stress Design (ASD)

Combinations of service (also referred to as *working)* loads are evaluated for maximum stresses and compared to allowable stresses. The allowed stresses are some fraction of limit stresses.

ASCE-7 (2010) combinations of loads:

1. D
2. $D + L$
3. $D + 0.75(L_r \text{ or } S \text{ or } R)$
4. $D + 0.75L + 0.75(L_r \text{ or } S \text{ or } R)$
5. $D + (0.6W \text{ or } 0.7E)$

6a. $D + 0.75L + 0.75(0.6W) + 0.75(L_r \text{ or } S \text{ or } R)$

6b. $D + 0.75L + 0.75(0.7E) + 0.75S$

7. $0.6D + 0.6W$
8. $0.6D + 0.7E$

When *F* loads are present, they shall be included with the same load factor as dead load *D* in 1 through 6 and 8.

When *H* loads are present, they shall have a load factor of 1.0 when adding to load effect, or 0.6 when resisting the load when permanent.

Load and Resistance Factor Design – LRFD

Combinations of loads that have been *factored* are evaluated for maximum loads, moments or stresses. These factors take into consideration how likely the load is to happen and how often. This "imaginary" worse case load, moment or stress is compared to a limit value that has been modified by a *resistance* factor. The resistance factor is a function of how "comfortable" the design community is with the type of limit, ie. yielding or rupture...

ASCE-7 (2010) combinations of factored nominal loads:

1. $1.4D$
2. $1.2D + 1.6L + 0.5(L_r \text{ or } S \text{ or } R)$
3. $1.2D + 1.6(L_r \text{ or } S \text{ or } R) + (L \text{ or } 0.5W)$
4. $1.2D + 1.0W + L + 0.5(L_r \text{ or } S \text{ or } R)$
5. $1.2D + 1.0E + L + 0.2S$
6. $0.9D + 1.0W$
7. $0.9D + 1.0E$

When *F* loads are present, they shall be included with the same load factor as dead load *D* in 1 through 5 and 7.

When *H* loads are present, they shall have a load factor of 1.6 when adding to load effect, or 0.9 when resisting the load when permanent.

Minimum Uniformly Distributed Live Loads

adapted from SEI/ASCE 7-10: Minimum Design Loads for Buildings and Other Structures

Location	*Uniform load psf (kN/m^2)*
Apartments (see Residential)	
Access floor systems	
Office use	50 (2.4)
Computer use	100 (4.79)
Armories and drill rooms	150 (7.18)
Assembly areas	
Fixed seats (fastened to floor)	60 (2.87)
Lobbies	100 (4.79)
Movable seats	100 (4.79)
Platforms (assembly)	100 (4.79)
Stage floors	150 (7.18)
Assembly areas (other)	100 (4.79)

Location	*Uniform load psf (kN/m^2)*
Balconies and decks	1.5 times the live load for the area served. Not required`to exceed 100 psf (4.79 kN/m2)
Catwalks for maintenance access	40 (1.92)
Corridors	
First floor	100 (4.79)
Other floors	same as occupancy served except as indicated
Dining rooms and restaurants	100 (4.79)
Dwellings (see Residential)	
Elevator machine room grating (on area of 2 in. by 2 in. (50 mm by 50 mm))	300 (1.33)
Finish light floor plate construction (on area of 1 in. by 1 in. (25 mm by 25 mm))	200 (0.89)
Fire escapes	100 (4.79)
On single-family dwellings only	40 (1.92)
Garages	
Passenger vehicles only	40 (1.92)
Helipads	60 (2.87)
Hospitals	
Operating rooms, laboratories	60 (2.87)
Patient rooms	40 (1.92)
Corridors above first floor	80 (3.83)
Hotels (see Residential)	
Libraries	
Reading rooms	60 (2.87)
Stack rooms	150 (7.18)
Corridors above first floor	80 (3.83)
Manufacturing	
Light	125 (6.00)
Heavy	250 (11.97)
Office buildings	
File and computer rooms shall be designed for heavier loads based on anticipated occupancy	
Lobbies and first floor corridors	100 (4.79)
Offices	50 (2.40)
Corridors above first floor	80 (3.83)
Penal institutions	
Cell blocks	40 (1.92)
Corridors	100 (4.79)
Recreational uses	
Bowling alleys, poolrooms, and similar uses	75 (3.59)
Dance halls and ballrooms	100 (4.79)
Gymnasiums	100 (4.79)
Reviewing stands, grandstands, and bleachers	100 (4.79)
Stadiums and arenas with fixed seats (fastened to the floor)	60 (2.87)
Residential	
One- and two-family dwellings	
Uninhabitable attics without storage	10 (0.48)
Uninhabitable attics with storage	20 (0.96)
Habitable attics and sleeping areas	30 (1.44)
All other areas except stairs	40 (1.92)
All other residential occupancies	
Private rooms and corridors serving them	40 (1.92)
Public rooms and corridors serving them	100 (4.79)

Location	*Uniform load psf (kN/m^2)*
Roofs	
Ordinary flat, pitched, and curved roofs	20 (0.96n
Roofs used for roof gardens	100 (4.79)
Roofs used for assembly occupancies	Same as occupancy served
Roofs used for other occupancies	As approved by authority having jurisdiction
Awnings and canopies	
Fabric construction supported by a skeleton structure	5 (0.24) nonreducible
Screen enclosure support frame	5 (0.24) nonreducible and based on the tributary area of the roof supported by the frame
All other construction	20 (0.96)
Schools	
Classrooms	40 (1.92)
Corridors above first floor	80 (3.83)
First-floor corridors	100 (4.79)
Scuttles, skylight ribs, and accessible ceilings	200 (0.89)
Sidewalks, vehicular driveways, and yards subject to trucking	250 (11.97)
Stairs and exit ways	100 (4.79)
One- and two-family dwellings only	40 (1.92)
Storage areas above ceilings	20 (0.96)
Storage warehouses (shall be designed for heavier loads if required for anticipated storage)	
Light	125 (6.00)
Heavy	250 (11.97)
Stores	
Retail	
First floor	100 (4.79)
Upper floors	75 (3.59)
Wholesale, all floors	125 (6.00)
Walkways and elevated platforms (other than exit ways)	60 (2.87)
Yards and terraces, pedestrian	100 (4.79)

Live load reductions are not permitted for specific types (see code).
Some occupancies must be designed for appropriate loads as approved by the authority having jurisdiction.
Library stack room floors have specified limitations (see code)
AASHTO lane loads should also be considered where appropriate.

Building Material Weights-AISC Manual of Load and Resistance Factor Design, 3rd ed.

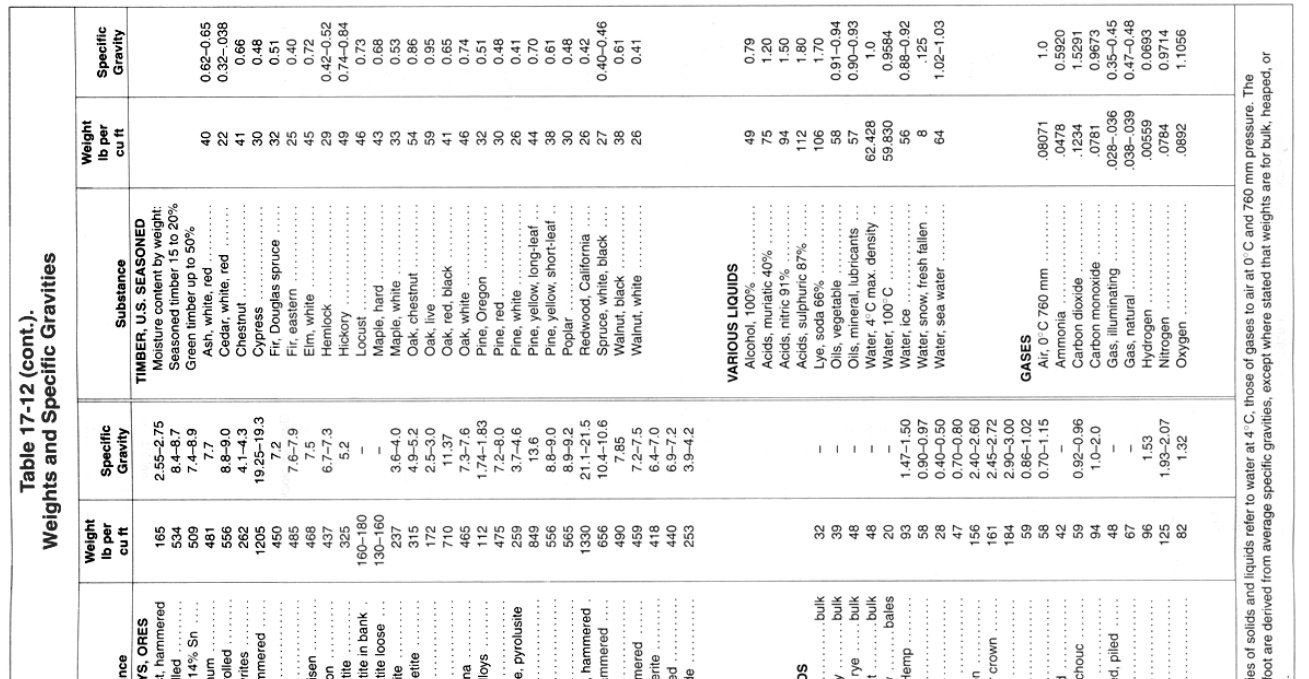

Table 17-12 (cont.).
Weights and Specific Gravities

Substance	Weight lb per cu ft	Specific Gravity
METALS, ALLOYS, ORES		
Aluminum, cast, hammered	165	2.55–2.75
Brass, cast, rolled	534	8.4–8.7
Bronze, 7.9 to 14% Sn	509	7.4–8.9
Bronze, aluminum	481	7.7
Copper, cast, rolled	556	8.8–9.0
Copper ore, pyrites	262	4.1–4.3
Gold, cast, hammered	1205	19.25–19.3
Iron, cast, pig	450	7.2
Iron, wrought	485	7.6–7.9
Iron, speigel-eisen	468	7.5
Iron, ferro-silicon	437	6.7–7.3
Iron ore, hematite	325	5.2
Iron ore, hematite in bank	160–180	–
Iron ore, hematite loose	130–160	–
Iron ore, limonite	237	3.6–4.0
Iron ore, magnetite	315	4.9–5.2
Iron slag	172	2.5–3.0
Lead	710	11.37
Lead ore, galena	465	7.3–7.6
Magnesium, alloys	112	1.74–1.83
Manganese	475	7.2–8.0
Manganese ore, pyrolusite	259	3.7–4.6
Mercury	849	13.6
Monel Metal	556	8.8–9.0
Nickel	565	8.9–9.2
Platinum, cast, hammered	1330	21.1–21.5
Silver, cast, hammered	656	10.4–10.6
Steel, rolled	490	7.85
Tin, cast, hammered	459	7.2–7.5
Tin ore, cassiterite	418	6.4–7.0
Zinc, cast, rolled	440	6.9–7.2
Zinc ore, blende	253	3.9–4.2
VARIOUS SOLIDS		
Cereals, oats ..... bulk	32	–
Cereals, barley ..... bulk	39	–
Cereals, corn, rye ..... bulk	48	–
Cereals, wheat ..... bulk	48	–
Hay and Straw ..... bales	20	–
Cotton, Flax, Hemp	93	1.47–1.50
Fats	58	0.90–0.97
Flour, loose	28	0.40–0.50
Flour, pressed	47	0.70–0.80
Glass, common	156	2.40–2.60
Glass, plate or crown	161	2.45–2.72
Glass, crystal	184	2.90–3.00
Leather	59	0.86–1.02
Paper	58	0.70–1.15
Potatoes, piled	42	–
Rubber, caoutchouc	59	0.92–0.96
Rubber goods	94	1.0–2.0
Salt, granulated, piled	48	–
Saltpeter	67	–
Starch	96	1.53
Sulphur	125	1.93–2.07
Wool	82	1.32
TIMBER, U.S. SEASONED		
Moisture content by weight:		
Seasoned timber 15 to 20%		
Green timber up to 50%		
Ash, white, red	40	0.62–0.65
Cedar, white, red	22	0.32–.038
Chestnut	41	0.66
Cypress	30	0.48
Fir, Douglas spruce	32	0.51
Fir, eastern	25	0.40
Elm, white	45	0.72
Hemlock	29	0.42–0.52
Hickory	49	0.74–0.84
Locust	46	0.73
Maple, hard	43	0.68
Maple, white	33	0.53
Oak, chestnut	54	0.86
Oak, live	59	0.95
Oak, red, black	41	0.65
Oak, white	46	0.74
Pine, Oregon	32	0.51
Pine, red	30	0.48
Pine, white	26	0.41
Pine, yellow, long-leaf	44	0.70
Pine, yellow, short-leaf	38	0.61
Poplar	30	0.48
Redwood, California	26	0.42
Spruce, white, black	27	0.40–0.46
Walnut, black	38	0.61
Walnut, white	26	0.41
VARIOUS LIQUIDS		
Alcohol, 100%	49	0.79
Acids, muriatic 40%	75	1.20
Acids, nitric 91%	94	1.50
Acids, sulphuric 87%	112	1.80
Lye, soda 66%	106	1.70
Oils, vegetable	58	0.91–0.94
Oils, mineral, lubricants	57	0.90–0.93
Water, 4°C max. density	62.428	1.0
Water, 100°C	59.830	0.9584
Water, ice	56	0.88–0.92
Water, snow, fresh fallen	8	.125
Water, sea water	64	1.02–1.03
GASES		
Air, 0°C 760 mm	.08071	1.0
Ammonia	.0478	0.5920
Carbon dioxide	.1234	1.5291
Carbon monoxide	.0781	0.9673
Gas, illuminating	.028–.036	0.35–0.45
Gas, natural	.038–.039	0.47–0.48
Hydrogen	.00559	0.0693
Nitrogen	.0784	0.9714
Oxygen	.0892	1.1056

The specific gravities of solids and liquids refer to water at 4°C, those of gases to air at 0°C and 760 mm pressure. The weights per cubic foot are derived from average specific gravities, except where stated that weights are for bulk, heaped, or loose material, etc.

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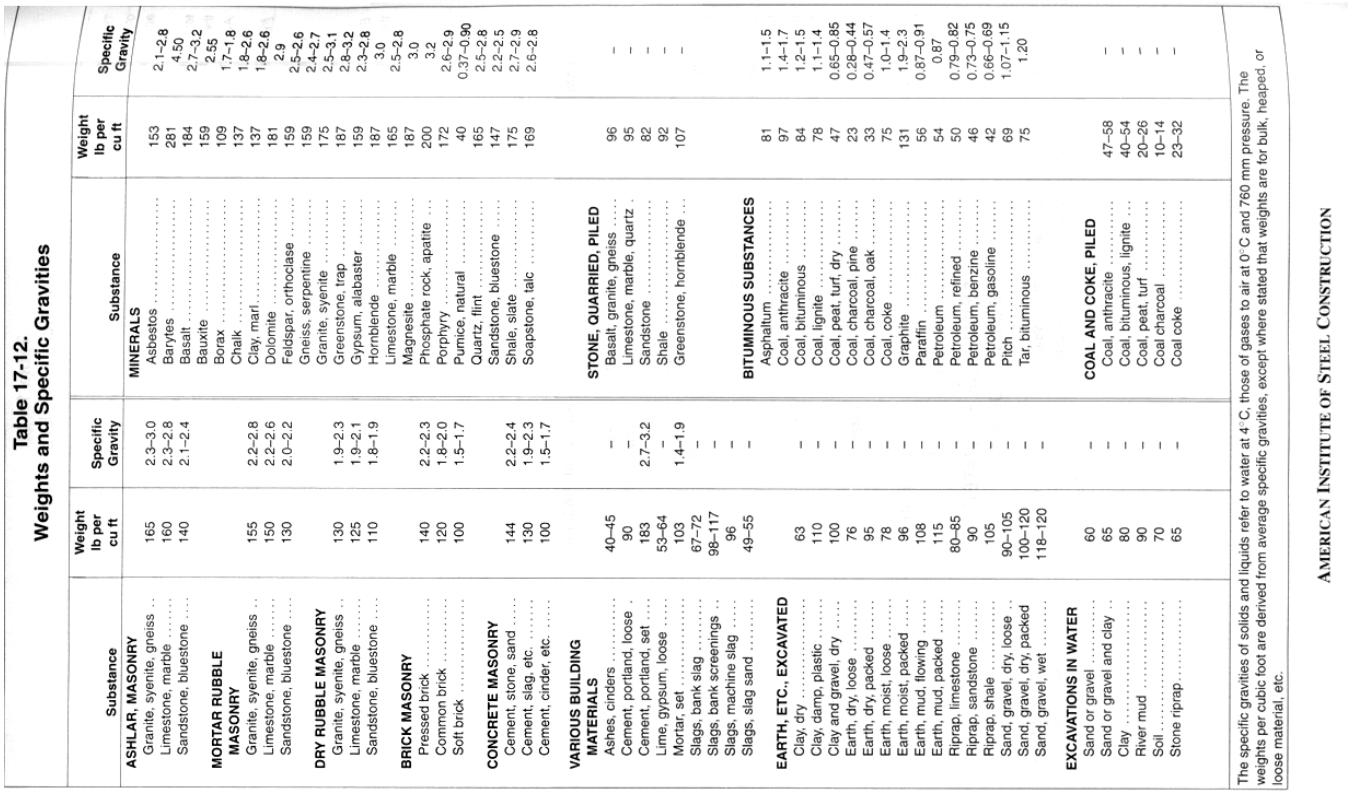

Table 17-12.
Weights and Specific Gravities

Substance	Weight lb per cu ft	Specific Gravity
ASHLAR, MASONRY		
Granite, syenite, gneiss	165	2.3–3.0
Limestone, marble	160	2.3–2.8
Sandstone, bluestone	140	2.1–2.4
MORTAR RUBBLE MASONRY		
Granite, syenite, gneiss	155	2.2–2.8
Limestone, marble	150	2.2–2.6
Sandstone, bluestone	130	2.0–2.2
DRY RUBBLE MASONRY		
Granite, syenite, gneiss	130	1.9–2.3
Limestone, marble	125	1.9–2.1
Sandstone, bluestone	110	1.8–1.9
BRICK MASONRY		
Pressed brick	140	2.2–2.3
Common brick	120	1.8–2.0
Soft brick	100	1.5–1.7
CONCRETE MASONRY		
Cement, stone, sand	144	2.2–2.4
Cement, slag, etc.	130	1.9–2.3
Cement, cinder, etc.	100	1.5–1.7
VARIOUS BUILDING MATERIALS		
Ashes, cinders	40–45	–
Cement, portland, loose	90	–
Cement, portland, set	183	2.7–3.2
Lime, gypsum, loose	53–64	–
Mortar, set	103	1.4–1.9
Slags, bank slag	67–72	–
Slags, bank screenings	98–117	–
Slags, machine slag	96	–
Slags, slag sand	49–55	–
EARTH, ETC., EXCAVATED		
Clay, dry	63	–
Clay, damp, plastic	110	–
Clay and gravel, dry	100	–
Earth, dry, loose	76	–
Earth, dry, packed	95	–
Earth, moist, loose	78	–
Earth, moist, packed	96	–
Earth, mud, flowing	108	–
Earth, mud, packed	115	–
Riprap, limestone	80–85	–
Riprap, sandstone	90	–
Riprap, shale	105	–
Sand, gravel, dry, loose	90–105	–
Sand, gravel, dry, packed	100–120	–
Sand, gravel, wet	118–120	–
EXCAVATIONS IN WATER		
Sand or gravel	60	–
Sand or gravel and clay	65	–
Clay	80	–
River mud	90	–
Soil	70	–
Stone riprap	65	–

Substance	Weight lb per cu ft	Specific Gravity
MINERALS		
Asbestos	153	2.1–2.8
Barytes	281	4.50
Basalt	184	2.7–3.2
Bauxite	159	2.55
Borax	109	1.7–1.8
Chalk	137	1.8–2.6
Clay, marl	137	1.8–2.6
Dolomite	181	2.9
Feldspar, orthoclase	159	2.5–2.6
Gneiss, serpentine	159	2.4–2.7
Granite, syenite	175	2.5–3.1
Greenstone, trap	187	2.8–3.2
Gypsum, alabaster	159	2.3–2.8
Hornblende	187	3.0
Limestone, marble	165	2.5–2.8
Magnesite	187	3.0
Phosphate rock, apatite	200	3.2
Porphyry	172	2.6–2.9
Pumice, natural	40	0.37–0.90
Quartz, flint	165	2.5–2.8
Sandstone, bluestone	147	2.2–2.5
Shale, slate	175	2.7–2.9
Soapstone, talc	169	2.6–2.8
STONE, QUARRIED, PILED		
Basalt, granite, gneiss	96	–
Limestone, marble, quartz	95	–
Sandstone	82	–
Shale	92	–
Greenstone, hornblende	107	–
BITUMINOUS SUBSTANCES		
Asphaltum	81	1.1–1.5
Coal, anthracite	97	1.4–1.7
Coal, bituminous	84	1.2–1.5
Coal, lignite	78	1.1–1.4
Coal, peat, turf, dry	47	0.65–0.85
Coal, charcoal, pine	23	0.28–0.44
Coal, charcoal, oak	33	0.47–0.57
Coal, coke	75	1.0–1.4
Graphite	131	1.9–2.3
Paraffin	56	0.87–0.91
Petroleum	54	0.87
Petroleum, refined	50	0.79–0.82
Petroleum, benzine	46	0.73–0.75
Petroleum, gasoline	42	0.66–0.69
Pitch	69	1.07–1.15
Tar, bituminous	75	1.20
COAL AND COKE, PILED		
Coal, anthracite	47–58	–
Coal, bituminous, lignite	40–54	–
Coal, peat, turf	20–26	–
Coal charcoal	10–14	–
Coal coke	23–32	–

The specific gravities of solids and liquids refer to water at 4°C, those of gases to air at 0°C and 760 mm pressure. The weights per cubic foot are derived from average specific gravities, except where stated that weights are for bulk, heaped, or loose material, etc.

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Table 17-13.
Weights of Building Materials

Materials	Weight lb per sq ft
CEILINGS	
Channel suspended system	1
Lathing and plastering	See Partitions
Acoustical fiber tile	1
FLOORS	
Steel deck	See Manufacturer
Concrete-Reinforced 1 in.	
Stone	12 1/2
Slag	11 1/2
Lightweight	6 to 10
Concrete-Plain 1 in.	
Stone	12
Slag	11
Lightweight	3 to 9
Fills 1 inch	
Gypsum	6
Sand	8
Cinders	4
Finishes	
Terrazzo 1 in.	13
Ceramic or Quarry Tile 3/4-in.	10
Linoleum 1/4-in.	1
Mastic 3/4-in.	9
Hardwood 7/8-in.	4
Softwood 3/4-in.	2 1/2
ROOFS	
Copper or tin	1
Corrugated steel	See Manufactuer
3-ply ready roofing	1
3-ply felt and gravel	5 1/2
5-ply felt and gravel	6
Shingles	
Wood	2
Asphalt	3
Clay tile	9 to 14
Slate 1/4 in.	10
Sheathing	
Wood 3/4 in.	3
Gypsum 1 in.	4
Insulation 1 in.	
Loose	1/2
Poured	2
Rigid	1 1/2

Materials	Weight lb per sq ft
PARTITIONS	
Clay tile	
3 in.	17
4 in.	18
6 in.	28
8 in.	34
10 in.	40
Gypsum block	
2 in.	9 1/2
3 in.	10 1/2
4 in.	12 1/2
5 in.	14
6 in.	18 1/2
Wood studs 2×4	
12–16 in. o.c.	2
Steel partitions	4
Plaster 1 in.	
Cement	10
Gypsum	5
Lathing	
Metal	1/2
Gypsum board 1/2 in.	2
WALLS	
Brick	
4 in.	40
8 in.	80
12 in.	120
Hollow concrete block (Heavy aggregate)	
4 in.	30
6 in.	43
8 in.	55
12 1/2 in.	80
Hollow concrete block (Light aggregate)	
4 in.	21
6 in.	30
8 in.	38
12 in.	55
Clay tile (Load bearing)	
4 in.	25
6 in.	30
8 in.	33
12 in.	45
Stone 4 in.	55
Glass block 4 in.	18
Window, Glass, Frame, & Sash	8
Curtain walls	See Manufacturer
Structural glass 1 in.	15
Corrugated Cement Asbestos 1/4 in.	3

For weights of other materials used in building construction, see Table 17-12.

Table 17-14.
Weights and Measures
United States System

LINEAR MEASURE

Inches	Feet	Yards	Rods	Furlongs	Miles
1.0 =	.08333 =	.02778 =	.0050505 =	.00012626 =	.00001578
12.0 =	1.0 =	.33333 =	.0606061 =	.00151515 =	.00018939
36.0 =	3.0 =	1.0 =	.1818182 =	.00454545 =	.00056818
198.0 =	16.5 =	5.5 =	1.0 =	.025 =	.003125
7,920.0 =	660.0 =	220.0 =	40.0 =	1.0 =	.125
63,360.0 =	5,280.0 =	1,760.0 =	320.0 =	8.0 =	1.0

SQUARE AND LAND MEASURE

Sq. Inches	Square Feet	Square Yards	Square Rods	Acres	Sq. Miles
1.0 =	.006944 =	.000772			
144.0 =	1.0 =	.111111			
1,296.0 =	9.0 =	1.0 =	.03306 =	.000207	
39,204.0 =	272.25 =	30.25 =	1.0 =	.00625 =	.0000098
43,560.0 =		4,840.0 =	160.0 =	1.0 =	.0015625
		3,097,600.0 =	102,400.0 =	640.0 =	1.0

AVOIRDUPOIS WEIGHTS

Grains	Drams	Ounces	Pounds	Tons
1.0 =	.03657 =	.002286 =	.000143 =	.0000000714
27.34375 =	1.0 =	.0625 =	.003906 =	.00000195
437.5 =	16.0 =	1.0 =	.0625 =	.00003125
7,000.0 =	256.0 =	16.0 =	1.0 =	.0005
14,000,000.0 =	512,000.0 =	32,000.0 =	2,000.0 =	1.0

DRY MEASURE

Pints	Quarts	Pecks	Cubic Feet	Bushels
1.0 =	.5 =	.0625 =	.01945 =	.01563
2.0 =	1.0 =	.125 =	.03891 =	.03125
16.0 =	8.0 =	1.0 =	.31112 =	.25
51.42627 =	25.71314 =	3.21414 =	1.0 =	.80354
64.0 =	32.0 =	4.0 =	1.2445 =	1.0

LIQUID MEASURE

Gills	Pints	Quarts	U.S. Gallons	Cubic Feet
1.0 =	.25 =	.125 =	.03125 =	.00418
4.0 =	1.0 =	.5 =	.125 =	.01671
8.0 =	2.0 =	1.0 =	.250 =	.03342
32.0 =	8.0 =	4.0 =	1.0 =	.1337
			7.48052 =	1.0

Example 1

Determine the controlling load combinations(s) using AISC-LRFD for a building column subject to the following service or nominal (unfactored) axial compressive loads: D = 30 k, L = 50 k, L_r = 10 k, W = 25 k, E = 40 k

Using a spreadsheet analysis:

LRFD (ASCE-7)		FACTORED LOAD
1.4*D*		
1.4*D*	=	42 kips
1.2*D* + 1.6*L* + 0.5(*L*$_r$ *or S or R*)		
1.2*D* + 1.6*L* + 0.5*L*$_r$	=	121
1.2*D* + 1.6(*L*$_r$ *or S or R*) + (*L* or 0.5*W*)		
1.2*D* + 1.6*L*$_r$ + *L*	=	102
1.2*D* + 1.6*L*$_r$ + 0.5*W*	=	64.5
1.2*D* + 1.6*L*$_r$ - 0.5*W*	=	39.5
1.2*D* + 1.0*W*+ *L* + 0.5(*L*$_r$ *or S or R*)		
1.2*D* + 1.0*W*+ *L* + 0.5*L*$_r$	=	116
1.2*D* - 1.0*W*+ *L* + 0.5*L*$_r$	=	66
1.2*D* + 1.0*E* + *L* + 0.2*S*		
1.2*D* + 1.0*E* + *L*	=	126
1.2*D* - 1.0*E* + *L*	=	46
0.9*D* + 1.0*W*		
0.9*D* + 1.0*W*	=	52
0.9*D* - 1.0*W*	=	2
0.9*D* + 1.0*E*		
0.9*D* + 1.0*E*	=	67
0.9*D* - 1.0*E*	=	-13
	Critical Factored Load	126 kips (C) -13 kips (T)

Example 2

EXAMPLE 2–4

Determine factored loads for the beam shown in Figure 2–16.

Solution

For the left half of the beam:

$$w_{u1} = 1.2w_D + 1.6w_L$$
$$w_{u1} = 1.2 \times 1.0 + 1.6 \times 2.0 = 4.4\ \text{kip/ft}$$

For the right half of the beam:

$$w_{u2} = 1.2w_D + 1.6w_L$$
$$w_{u2} = 1.2 \times 1.0 + 1.6 \times 0 = 1.2\ \text{kip/ft}$$

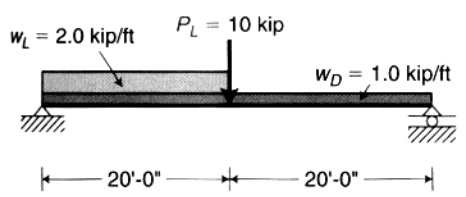

FIGURE 2–16 Example 2–4 (service loads).

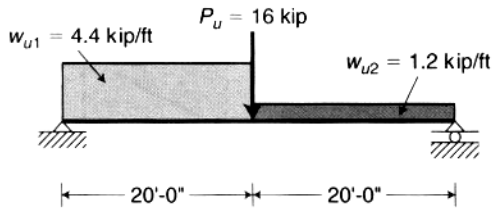

FIGURE 2–17 Example 2–4 (factored loads).

The concentrated load is a live load only:

$$P_u = 1.2P_D + 1.6P_L$$
$$P_u = 1.2 \times 0 + 1.6 \times 10 = 16\ \text{kip}$$

The factored loads on the beam are shown in Figure 2–17.