

List of Symbol Definitions

- a long dimension for a section subjected to torsion (in, mm);
acceleration (ft/sec², m/sec²)
- \mathcal{A} area bounded by the centerline of a thin walled section subjected to torsion (in², mm²)
- A area, often cross-sectional (in², ft², mm², m²)
- A_e net effective area, equal to the total area ignoring any holes (in², ft², mm², m²) (*see* A_{net});
- A_g gross area, equal to the total area ignoring any holes (in², ft², mm², m²)
- A_{net} net effective area, equal to the gross area subtracting any holes (in², ft², mm², m²) (*see* A_e)
- A_p bearing area (in², ft², mm², m²)
- A_{throat} area across the throat of a weld (in², ft², mm², m²)
- A_{web} web area in a steel beam equal to the depth x web thickness (in², ft², mm², m²)
- ASD Allowable Stress Design
- b width, often cross-sectional (in, ft, mm, m);
narrow dimension for a section subjected to torsion (in, mm);
number of truss members
- b_f width of the flange of a steel beam cross section (in, mm)
- c distance from the neutral axis to the top or bottom edge of a beam (in, mm, m);
distance from the center of a circular shape to the surface under torsional shear strain (in, mm, m)
- c_i distance from the center of a circular shape to the inner surface under torsional shear strain (in, mm, m)
- c_o distance from the center of a circular shape to the outer surface under torsional shear strain (in, mm, m)
- c_1 coefficient for shear stress for a rectangular bar in torsion
- c_2 coefficient for shear twist for a rectangular bar in torsion
- CL, \mathcal{C} center line
- C compression label;
compression force (lb, kips, N, kN)
- C_b modification factor for moment in ASD & LRFD steel beam design, $C_b = 1$ for simply supported beams (0 moments at the ends)
- C_c column slenderness classification constant for steel column design
- C_D load duration factor for wood design
- C_F size factor for wood design
- C_m modification factor for combined stress in steel design
- C_M wet service factor for wood design
- C_p column stability factor for wood design
- C_t temperature factor for wood design

d	depth, often cross-sectional (in, mm, m); perpendicular distance from a force to a point in a moment calculation (in, mm, m)
d_x	difference in the x direction between an area centroid (\bar{x}) and the centroid of the composite shape (\hat{x}) (in, mm)
d_y	difference in the y direction between an area centroid (\bar{y}) and the centroid of the composite shape (\hat{y}) (in, mm)
D	diameter of a circle (in, mm, m); dead load for LRFD design
DL	dead load
e	eccentric distance of application of a force (P) from the centroid of a cross section (in, mm)
E	modulus of elasticity (psi; ksi, kPa, MPa, GPa); earthquake load for LRFD design
f	symbol for stress (psi, ksi, kPa, MPa)
f_a	calculated axial stress (psi, ksi, kPa, MPa)
f_b	calculated bending stress (psi, ksi, kPa, MPa)
f_c	calculated compressive stress (psi, ksi, kPa, MPa)
f_{cr}	calculated column stress based on the critical column load P_{cr} (psi, ksi, kPa, MPa)
f_t	calculated tensile stress (psi, ksi, kPa, MPa)
f_p	calculated bearing stress (psi, ksi, kPa, MPa)
f_x	combined stress in the direction of the major axis of a column (psi, ksi, kPa, MPa)
f_v	calculated shearing stress (psi, ksi, kPa, MPa)
f_y	yield stress (psi, ksi, kPa, MPa)
F	force (lb, kip, N, kN); capacity of a nail in shear (lb, kip, N, kN); symbol for allowable stress in design codes (psi, ksi, kPa, MPa)
F_a	allowable axial stress (psi, ksi, kPa, MPa)
F_b	allowable bending stress (psi, ksi, kPa, MPa)
F'_b	allowable bending stress for combined stress for wood design (psi, ksi, kPa, MPa)
F_c	allowable compressive stress (psi, ksi, kPa, MPa)
$F_{connector}$	resistance capacity of a connector (lb, kips, N, kN)
F_{cE}	intermediate compressive stress for ASD wood column design dependant on material (psi, ksi, kPa, MPa)
F'_c	allowable compressive stress for ASD wood column design (psi, ksi, kPa, MPa)
F^*_c	intermediate compressive stress for ASD wood column design dependant on load duration (psi, ksi, kPa, MPa)

F'_e	allowable buckling stress for combined bending steel design (psi, ksi, kPa, MPa)
F_t	allowable tensile stress (psi, ksi, kPa, MPa)
F_v	allowable shear stress (psi, ksi, kPa, MPa); allowable shear stress in a welded connection
F_x	force component in the x coordinate direction (lb, kip, N, kN)
F_y	force component in the y coordinate direction (lb, kip, N, kN); yield stress (psi, ksi, kPa, MPa)
F_u	ultimate stress a material can sustain prior to failure (psi, ksi, kPa, MPa)
$F.S.$	factor of safety
g	acceleration due to gravity, 32.17 ft/sec ² , 9.807 m/sec ²
G	shear modulus (psi; ksi, kPa, MPa, GPa)
h	depth, often cross-sectional (in, ft, mm, m); sag of a cable structure (ft, m)
I	moment of inertia (in ⁴ , mm ⁴ , m ⁴)
\bar{I}	moment of inertia about the centroid (in ⁴ , mm ⁴ , m ⁴)
I_c	moment of inertia about the centroid (in ⁴ , mm ⁴ , m ⁴)
I_{min}	minimum moment of inertia of I_x and I_y (in ⁴ , mm ⁴ , m ⁴)
I_x	moment of inertia with respect to an x-axis (in ⁴ , mm ⁴ , m ⁴)
I_y	moment of inertia with respect to a y-axis (in ⁴ , mm ⁴ , m ⁴)
J, J_o	polar moment of inertia (in ⁴ , mm ⁴ , m ⁴)
k	kips (1000 lb); shape factor for plastic design of steel beams, M_p/M_y
kg	kilograms
kN	kiloNewtons (10^3 N)
kPa	kiloPascals (10^3 Pa)
K	effective length factor with respect to column end conditions
K_{cE}	material factor for wood column design
ℓ	length (in, ft, mm, m); cable span (ft, m)
lb	pound force
L	length (in, ft, mm, m); live load for LRFD design
L_b	unbraced length of a steel beam in LRFD design (in, ft, mm, m)
L_c	maximum unbraced length of a steel beam in ASD design for maximum allowed bending stress (in, ft, mm, m)
L_e	effective length that can buckle for column design (in, ft, mm, m)
L_r	roof live load in LRFD design

L_p	maximum unbraced length of a steel beam in LRFD design for full plastic flexural strength (in, ft, mm, m)
L_r	maximum unbraced length of a steel beam in LRFD design for inelastic lateral-torsional buckling (in, ft, mm, m)
L_u	maximum unbraced length of a steel beam in ASD design for reduced allowed bending stress (in, ft, mm, m)
LL	live load
$LRFD$	Load and Resistance Factor Design
m	mass (lb-mass, g, kg); meters
mm	millimeters
M	moment of a force or couple (lb-ft, kip-ft, N-m, kN-m); bending moment (lb-ft, kip-ft, N-m, kN-m)
M_A	moment value at quarter point of unbraced beam length for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)
M_B	moment value at half point of unbraced beam length for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)
M_C	moment value at three quarter point of unbraced beam length for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)
M_n	nominal flexure strength with the full section at the yield stress for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)
M_p	(also M_{ult}) internal bending moment when all fibers in a cross section reach the yield stress (lb-ft, kip-ft, N-m, kN-m)
M_u	maximum moment from factored loads for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)
M_{ult}	(also M_p) internal bending moment when all fibers in a cross section reach the yield stress (lb-ft, kip-ft, N-m, kN-m)
M_y	internal bending moment when the extreme fibers in a cross section reach the yield stress (lb-ft, kip-ft, N-m, kN-m)
M_1	smaller end moment used to calculate C_m for combined stresses in a beam-column (lb-ft, kip-ft, N-m, kN-m)
M_2	larger end moment used to calculate C_m for combined stresses in a beam-column (lb-ft, kip-ft, N-m, kN-m)
MPa	megaPascals (10^6 Pa or 1 N/mm^2)
n	number of truss joints, nails or bolts
$n.a.$	neutral axis (axis connecting beam cross-section centroids)
N	Newtons ($\text{kg}\cdot\text{m}/\text{sec}^2$); bearing-type connection with bolt threads included in shear plane
O	point of origin
p	pitch of nail spacing (in, ft, mm, m)
P	force, concentrated (point) load (lb, kip, N, kN); axial load in a column or beam-column (lb, kip, N, kN)

P_{cr}	critical (failure) load in column calculations (lb, kip, N, kN)
P_n	nominal load strength capacity for LRFD design (lb, kip, N, kN)
P_u	maximum load from factored loads for LRFD design (lb, kip, N, kN)
Pa	Pascals (N/m^2)
q	shear flow (lb/in, kips/ft, N/m, kN/m)
Q	first moment area used in shearing stress calculations (in^3 , mm^3 , m^3)
$Q_{connected}$	first moment area used in shearing stress calculations for built-up beams (in^3 , mm^3 , m^3)
Q_x	first moment area about an x axis (using y distances) (in^3 , mm^3 , m^3)
Q_y	first moment area about an y axis (using x distances) (in^3 , mm^3 , m^3)
r	radius of a circle (in, mm, m); radius of gyration (in, mm, m)
r_o	polar radius of gyration (in, mm, m)
r_x	radius of gyration with respect to an x-axis (in, mm, m)
r_y	radius of gyration with respect to a y-axis (in, mm, m)
R	force, reaction or resultant (lb, kip, N, kN); radius of curvature of a beam (ft, m); rainwater or ice load for LRFD design; generic design quantity (force, shear, moment, etc.) for LRFD design
R_n	generic nominal capacity (force, shear, moment, etc.) for LRFD design
R_u	generic maximum quantity (force, shear, moment, etc.) from factored loads for LRFD design
R_x	reaction or resultant component in the x coordinate direction (lb, kip, N, kN)
R_y	reaction or resultant component in the y coordinate direction (lb, kip, N, kN)
s	length of a segment of a thin walled section (in, mm)
$s.w.$	self-weight
S	section modulus (in^3 , mm^3 , m^3); snow load for LRFD design; allowable strength per length of a weld for a given size (lb/in, kips/in, N/mm, kN/m)
$S_{required}$	section modulus required to not exceed allowable bending stress (in^3 , mm^3 , m^3)
S_x	section modulus with respect to the x-centroidal axis (in^3 , mm^3 , m^3)
S_y	section modulus with respect to the y-centroidal axis (in^3 , mm^3 , m^3)
SC	slip critical bolted connection
$S4S$	surface-four-sided
t	thickness (in, mm, m)
t_f	thickness of the flange of a steel beam cross section (in, mm, m)
t_w	thickness of the web of a steel beam cross section (in, mm, m)
T	tension label; tensile force (lb, kip, N, kN); torque (lb-ft, kip-ft, N-m, kN-m); throat size of a weld (in, mm)

V	shearing force (lb, kip, N, kN)
V_n	nominal shear strength capacity for LRFD beam design (lb, kip, N, kN)
V_u	maximum shear from factored loads for LRFD beam design (lb, kip, N, kN)
w	(also ω) load per unit length on a beam (lb/ft, kip/ft, N/m, kN/m)
W	weight (lb, kip, N, kN); total load from a uniform distribution (lb, kip, N, kN); wind load for LRFD design
x	a distance in the x direction (in, ft, mm, m)
\bar{x}	the distance in the x direction from a reference axis to the centroid of a shape (in, mm)
\hat{x}	the distance in the x direction from a reference axis to the centroid of a composite shape (in, mm)
X	bearing-type connection with bolt threads excluded from shear plane
y	a distance in the y direction (in, ft, mm, m); distance from the neutral axis to the y-level of a beam cross section (in, mm)
\bar{y}	the distance in the y direction from a reference axis to the centroid of a shape (in, mm)
\hat{y}	the distance in the y direction from a reference axis to the centroid of a composite shape (in, mm)
Z	plastic section modulus of a steel beam (in ³ , mm ³)
'	symbol for feet
"	symbol for inches
#	symbol for pounds
α	coefficient of thermal expansion (/°C, /°F); angle, in a math equation (degrees, radians)
β	angle, in a math equation (degrees, radians)
δ	elongation (in, mm)
δ_p	elongation due to axial load (in, mm)
δ_s	shear deformation (in, mm)
δ_T	elongation due to change in temperature (in, mm)
Δ	beam deflection (in, mm); an increment
Δ_{LL}	beam deflection due to live load (in, mm)
Δ_{max}	maximum calculated beam deflection (in, mm)
Δ_{TL}	beam deflection due to total load (in, mm)
ΔT	change in temperature (°C, °F)
ε	strain (no units)
ε_t	thermal strain (no units)

ϕ	diameter symbol; angle of twist (degrees, radians); resistance factor in LRFD steel design
ϕ_b	resistance factor for flexure in LRFD steel design
ϕ_c	resistance factor for compression in LRFD steel design
ϕ_t	resistance factor for tension in LRFD steel design
ϕ_v	resistance factor for shear in LRFD steel design
λ_c	design constant for slenderness evaluation for steel columns in LRFD design
μ	Poisson's ratio
γ	specific gravity of a material (lb/in ³ , lb/ft ³ , N/m ³ , kN/m ³); angle, in a math equation (degrees, radians); shearing strain; load factor in LRFD design
γ_D	dead load factor in LRFD steel design
γ_L	live load factor in LRFD steel design
θ	angle, in a trig equation (degrees, radians); slope of the deflection of a beam at a point (degrees, radians)
π	pi
ρ	radial distance (in, mm)
σ	engineering symbol for normal stress (axial or bending)
τ	engineering symbol for shearing stress
Σ	summation symbol
ω	(also w) load per unit length on a beam (lb/ft, kip/ft, N/m, kN/m)