# List of Symbol Definitions

$a$ long dimension for a section subjected to torsion (in, mm);
acceleration due to gravity, 32.17 ft/sec$^2$, 9.81 m/sec$^2$;
unit area (in$^2$, ft$^2$, mm$^2$, m$^2$);
distance used in beam formulas (ft, m);
depth of the effective compression block in a concrete beam (in, mm)

$\mathcal{a}$ area bounded by the centerline of a thin walled section subjected to torsion (in$^2$, mm$^2$)

$A$ area, often cross-sectional (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_e$ net <u>effective</u> area, equal to the total area ignoring any holes and modified by the lag factor, $U$, (in$^2$, ft$^2$, mm$^2$, m$^2$) *(see $A_{net}$)*

$A_g$ gross area, equal to the total area ignoring any holes (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_{gv}$ gross area subjected to shear for block shear rupture (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_{net}$ net <u>effective</u> area, equal to the gross area subtracting any holes (in$^2$, ft$^2$, mm$^2$, m$^2$) *(see $A_e$)*

$A_{nt}$ net area subjected to tension for block shear rupture (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_{nv}$ net area subjected to shear for block shear rupture (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_p$ bearing area (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_{throat}$ area across the throat of a weld (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_s$ area of steel reinforcement in concrete beam design (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_{s'}$ area of compression steel reinforcement in concrete beam design (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_v$ area of concrete shear stirrup reinforcement (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_{web}$ web area in a steel beam equal to the depth x web thickness (in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_1$ area of column in spread footing design ((in$^2$, ft$^2$, mm$^2$, m$^2$)

$A_2$ projected bearing area of column load in spread footing design ((in$^2$, ft$^2$, mm$^2$, m$^2$)

*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;
rectangular column dimension in concrete footing design (in, mm, m);
distance used in beam formulas (ft, m)

$b_E$ effective width of the flange of a concrete T beam cross section (in, mm)

$b_f$ width of the flange of a steel or concrete T beam cross section (in, mm)

$b_o$ perimeter length for two-way shear in concrete footing design (in, ft, mm, m)

$b_w$ width of the stem of a concrete T beam cross section (in, mm)

B spread footing dimension in concrete design (ft, m);
dimension of a steel base plate for concrete footing design (in, mm, m)

$B_1$ factor for determining $M_u$ for combined bending and compression

$B_s$ width within the longer dimension of a rectangular spread footing that reinforcement must be concentrated within for concrete design (ft, m)

$c$ distance from the neutral axis to the top or bottom edge of a beam (in, mm, m);
rectangular column dimension in concrete footing design (in, mm, m);
the distance from the top of a masonry or concrete beam to the neutral axis (in, mm, m) (*see x*);
buckling and crushing interaction factor for wood columns (*see* $C_p$)

$c_i$ 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

$CL$, ℄ center line

$C$ compression label;
compression force (lb, kips, N, kN);
dimension of a steel base plate for concrete footing design (in, mm, m)

$C_b$ modification factor for LRFD steel beam design

$C_c$ column slenderness classification constant for steel column design;
compressive force in the concrete of a doubly reinforced concrete beam (lb, k, N, kN)

$C_D$ load duration factor for wood design

$C_F$ size factor for wood design

$C_f$ form factor for circular sections or or square sections loaded in plane of diagonal for wood design

$C_{fu}$ flat use factor for wood design

$C_F$ size factor for wood design

$C_H$ shear stress factor for wood design

$C_i$ incising factor for wood design

$C_L$ beam stability 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

$C_r$ repetitive member factor for wood design

$C_s$ compressive force in the compression steel of a doubly reinforced concrete beam (lb, k, N, kN)

$C_t$ temperature factor for wood design

$C_T$ buckling stiffness factor for wood truss design

$C_v$ web shear coefficient for steel design

$C_V$ glulam volume factor for wood design

$d$ diameter of a circle (in, mm, m);
depth, often cross-sectional (in, mm, m);
perpendicular distance from a force to a point in a moment calculation (in, mm, m);
critical cross section dimension of a rectangular timber column cross section related to the profile (axis) for buckling (in, mm, m);
effective depth from the top of a reinforced concrete beam to the centroid of the tensile steel (in, mm);
symbol in calculus to represent a very small change (like the greek letters for d, *see* $\delta$ & $\Delta$)

$d'$ effective depth from the top of a reinforced concrete beam to the centroid of the compression steel (in, mm)

$d_b$ depth of a steel W beam section (in, mm);
bar diameter of concrete reinforcement (in, mm)
nominal bolt diameter (in, mm)

$d_f$ depth of a steel W column flange (in, mm)

$d_x$ difference in the x direction between an area centroid and the centroid of the composite shape (in, mm)

$d_y$ difference in the y direction between an area centroid and the centroid of the composite shape (in, mm)

$D$ diameter of a circle (in, mm, m);
dead load for LRFD design

$DL$ dead load

$e$ dimensional change to determine strain *(see s or* $\varepsilon$*)* (in, mm);
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

$E_c$ modulus of elasticity of concrete (psi, ksi, kPa, MPa, GPa)

$E_{min}$ reference modulus of elasticity for stability (psi, ksi, kPa, MPa, GPa)

$E_{min\ n}$ reference nominal modulus of elasticity for stability with LRFD (psi, ksi, kPa, MPa, GPa)

$E_s$ modulus of elasticity of steel (psi, ksi, kPa, MPa, GPa)

$E'_{min}$ adjusted modulus of elasticity for stability (psi, ksi, kPa, MPa, GPa)

$E'_{min\ n}$ adjusted nominal modulus of elasticity for stability with LRFD (psi, ksi, kPa, MPa, GPa)

$f$ symbol for stress (psi, ksi, kPa, MPa)
symbol for function with respect to some variable; ie. *f*(t)

$f_a$ 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)

$f'_c$ concrete design compressive stress (psi, ksi, kPa, MPa)

$f_{cr}$ calculated column stress based on the critical column load $P_{cr}$ (psi, ksi, kPa, MPa)

$f_m$ calculated compressive stress in masonry (psi, ksi, kPa, MPa)

$f'_m$ masonry design compressive stress (psi, ksi, kPa, MPa)

$f_p$ calculated bearing stress (psi, ksi, kPa, MPa)

$f_s$ calculated steel stress for reinforced masonry (psi, ksi, kPa, MPa)

$f_t$ calculated tensile 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)

$f_{yt}$ yield stress of transverse reinforcement (psi, ksi, kPa, MPa)

$F$ force (lb, kip, N, kN);
capacity of a nail in shear (lb, kip, N, kN);
hydraulic fluid load for LRFD design

$F_a$ allowable axial stress (psi, ksi, kPa, MPa)

$F_b$ allowable bending stress (psi, ksi, kPa, MPa)

$F'_b$ allowable bending stress for ASD wood design (psi, ksi, kPa, MPa)

$F'_{bn}$ nominal bending stress for LRFD wood design (psi, ksi, kPa, MPa)

$F_c$ allowable compressive stress (psi, ksi, kPa, MPa);
critical unfactored compressive stress for LRFD steel design

$F_{c\perp}$ allowable compressive stress perpendicular to the wood grain (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)

$F_{cr}$ flexural buckling (column) stress in ASD and LRFD (psi, ksi, kPa, MPa)

$F'_c$ allowable compressive stress for ASD wood column design (psi, ksi, kPa, MPa)

$F'_{cn}$ nominal compressive stress for LRFD wood design (psi, ksi, kPa, MPa)

$F'^*_c$ intermediate compressive stress for ASD wood column design dependant on load duration (psi, ksi, kPa, MPa)

$F_e$ elastic critical buckling stress is steel design

$F_h$ force component in the horizontal direction (lb, kip, N, kN)

$F_{horizontal\text{-}resist}$ resultant frictional force resisting sliding in a footing or retaining wall (lb, kip, N, kN)

$F_n$ nominal strength in LRFD steel design (psi, ksi, kPa, MPa)
nominal tension or shear strength of a bolt (psi, ksi, kPa, MPa)

$F_p$ allowable bearing stress parallel to the wood grain (psi, ksi, kPa, MPa)

$F_{sliding}$ resultant force causing sliding in a footing or retaining wall (lb, kip, N, kN)

$F_t$ allowable tensile stress (psi, ksi, kPa, MPa)

$F_v$ allowable shear stress (psi, ksi, kPa, MPa);
allowable shear stress in a welded connection;
force component in the vertical direction (lb, kip, N, kN)

$F_v'$ allowable shear stress for ASD wood beam design (psi, ksi, kPa, MPa)

$F_{vn}'$ nominal shear stress for LRFD wood beam design (psi, ksi, kPa, MPa)

$F_x$ force component in the x coordinate direction (lb, kip, N, kN)

$F_w$ allowable weld stress (psi, ksi, kPa, MPa)

$F_y$ 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 *(also see SF)*

$g$ acceleration due to gravity, 32.17 ft/sec$^2$, 9.807 m/sec$^2$;
transverse center-to-center spacing (gage) between fastener gage lines (in, mm,)

$G$ shear modulus (psi, ksi, kPa, MPa, GPa);
relative stiffness of columns to beams in a rigid connection *(see $\Psi$)*

$h$ depth, often cross-sectional (in, ft, mm, m);
height (in, ft, mm, m);
sag of a cable structure (ft, m);
effective height of a wall or column (*see* $\ell_e$)

$h'$ effective height of a wall or column (*see* $\ell_e$)

$h_c$ height of the web in a W section (in, ft, mm, m) (*also see $t_w$)*

$h_f$ depth of a flange in a T section (in, ft, mm, m);
height of a concrete spread footing (in, ft, mm, m)

$H$ hydraulic soil load for LRFD design

$H_A$ horizontal load from active soil or water pressure (lb, k, N, kN)

$I$ moment of inertia (in$^4$, mm$^4$, m$^4$)

$\bar{I}$ moment of inertia about the centroid (in$^4$, mm$^4$, m$^4$) *)*

$\hat{I}$ moment of inertia about the centroid of a composite shape (in$^4$, mm$^4$, m$^4$)

$I_c$ moment of inertia about the centroid of a composite shape (in$^4$, mm$^4$, m$^4$)

$I_{min}$ minimum moment of inertia of $I_x$ and $I_y$ (in$^4$, mm$^4$, m$^4$)

$I_o$ moment of inertia about the centroid (in$^4$, mm$^4$, m$^4$)

$I_{transformed}$ moment of inertia of a multi-material section transformed to one material (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$^4$)

$j$ multiplier by effective depth of masonry section for moment arm, jd (*see d)*

$J$, $J_o$ polar moment of inertia (in$^4$, mm$^4$, m$^4$)

*k* kips (1000 lb);
shape factor for steel beams, $M_p/M_y$:
effective length factor for columns (*also K);*
distance from outer face of W flange to the web toe of fillet (in, mm);
multiplier by effective depth of masonry section for neutral axis, kd

*kg* kilograms

*klf* kips per linear foot (k/ft)

*ksf* kips per square foot ($k/ft^2$)

*ksi* kips per square inch ($k/in^2$)

*kN* kiloNewtons ($10^3$ N)

*kPa* kiloPascals ($10^3$ Pa)

*K* effective length factor with respect to column end conditions;
masonry mortar strength designation

$K_{cE}$ material factor for wood column design

$K_F$ format conversion factor for timber LRFD design

$\ell$ length (in, ft, mm, m);
cable span (ft, m)

$\ell_d$ development length of concrete reinforcement (in, ft, mm, m)

$\ell_{dc}$ development length of compression reinforcement in concrete footing design (in, ft, mm, m)

$l_{dh}$ development length for hooks (in, ft, mm, m)

$\ell_e$ effective length that can buckle for wood column design (in, ft, mm, m)

$\ell_n$ effective clear span for concrete one-way slab design (ft, m)

$l_{sc}$ lap splice length in compression for reinforcement (in, ft, mm, m)

*lb* pound force

*L* length (in, ft, mm, m);
live load for LRFD design;
spread footing dimension in concrete design (ft, m)

$L_b$ unbraced length of a steel beam in LRFD design (ft, m)

$L_c$ maximum unbraced length of a steel beam in ASD design for compression buckling limit (ft, m);
clear distance between the edge of a hole and edge of next hole or edge of the connected steel plate (in, ft, mm, m);
effective length of a steel member (in, ft, mm, m) *(see $L_e$)*

$L_{c1}$ effective length of a steel member in the plane of bending (in, ft, mm, m)

$L_d$ development length of reinforcement in concrete (ft, m)

$L_e$ effective length that can buckle for column design (ft, m)

$L_m$ projected length for bending in concrete footing design (ft, m)

$L_p$ limiting length of a steel beam in LRFD design for full plastic strength (ft, m)

$L_r$ roof live load in LRFD design;
limiting length of a steel beam in LRFD design for inelastic lateral-torsional buckling (ft, m)

$L_u$ maximum unbraced length of a steel beam in ASD design for stress limit of $0.6F_y$

*L'* length of the one-way shear area in concrete footing design (ft, 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);
masonry mortar strength designation

$M_a$ required bending moment in steel ASD beam design (unified) (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)

$M_B$ nominal moment capacity of a reinforced concrete beam at the balanced steel ratio ($\rho_b$) for limiting strains in both concrete and steel (lb-ft, kip-ft, N-m, kN-m)
moment value at half point of unbraced beam length for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)

$M_c$ allowable or design flexural strength for steel beam-columns (lb-ft, kip-ft, N-m, kN-m)
nominal moment capacity of a reinforced concrete beam based on compression force in a concrete section (lb-ft, kip-ft, N-m, kN-m) *(also see $M_n$)*

$M_C$ moment value at three quarter point of unbraced beam length for LRFD beam design (lb-ft, kip-ft, N-m, kN-m)

$M_m$ moment capacity of a reinforced masonry beam (lb-ft, kip-ft, N-m, kN-m)

$M_n$ nominal moment capacity of a reinforced concrete beam based on steel yielding and concrete design strength (lb-ft, kip-ft, N-m, kN-m)

$M_{nt}$ moment (ASD or LRFD) with the structure restrained against lateral translation for steel beam-columns (lb-ft, kip-ft, N-m, kN-m)

$M_{overturning}$ resulting moment from all forces on a footing or retaining wall causing overturning (lb-ft, kip-ft, N-m, kN-m)

$M_p$ internal bending moment when all fibers in a cross section reach the yield stress (lb-ft, kip-ft, N-m, kN-m) *(also see $M_{ult}$)*

$M_r$ required flexural strength for steel beam-columns (lb-ft, kip-ft, N-m, kN-m);
required nominal moment capacity based on design moment for reinforced concrete (lb-ft, kip-ft, N-m, kN-m) *(also see $M_n$)*

$M_{resis}$ resulting moment from all forces on a footing or retaining wall resisting overturning (lb-ft, kip-ft, N-m, kN-m)

$M_t$ nominal moment capacity of a reinforced concrete beam based on tensile force in the steel reinforcement (lb-ft, kip-ft, N-m, kN-m) *(also see $M_n$)*

$M_u$ factored moment calculated in concrete design from load factors (lb-ft, kip-ft, N-m, kN-m)

$M_{ult}$ internal bending moment when all fibers in a cross section reach the yield stress (lb-ft, kip-ft, N-m, kN-m) *(also see $M_p$)*

$M_y$ internal bending moment when the extreme fibers in a cross section reach the yield stress (lb-ft, kip-ft, N-m, kN-m)

$n$ number of truss joints, nails or bolts;
modulus of elasticity transformation coefficient from steel to concrete

*n.a.* neutral axis (axis connecting beam cross-section centroids)

$N$ Newtons;
bearing-type connection with bolt threads included in shear plane;
normal load (lb, kip, N, kN);
bearing length on a wide flange steel section (in, mm)
masonry mortar strength designation

*o.c.* on-center

$O$ point of origin;
masonry mortar strength designation

$p$ pitch of nail or bolt spacing (in, mm) (*also see s)*;
pressure (lb/in$^2$, lb/ft$^2$, kip/in$^2$, kip/ft$^2$, Pa, MPa);
reinforcement ratio in concrete beam design = $A_s$/bd (or possibly $A_s$/bt, $A_s$/bh) (no units) *(see* $\rho$ )

$p_A$ active soil pressure (lb/ft$^3$, kN/m$^3$)

$p_b$ balanced reinforcement ratio in concrete beam design *(see* $\rho_b$ )

*plf* pounds per linear foot (lb/ft)

*psf* pounds per square foot (lb/ft$^2$)

*psi* pounds per square inch (lb/in$^2$)

$P$ force, concentrated (point) load (lb, kip, N, kN)

$P_a$ required axial force in ASD steel design (unified) (lb, kip, N, kN)

$P_c$ available axial strength for steel unified design (lb, kip, N, kN)

$P_{cr}$ critical (failure) load in column calculations (lb, kip, N, kN)

$P_{e1}$ Euler buckling strength in steel unified design (lb, kip, N, kN)

$P_n$ maximum column load capacity in LRFD steel and concrete design (lb, kip, N, kN)

$P_o$ maximum axial force with no concurrent bending moment in a reinforced concrete column (lb, kip, N, kN)

$P_r$ required axial force in steel unified design (lb, kip, N, kN)

$P_u$ factored column load calculated from load factors in LRFD steel and concrete design (lb, kip, N, kN)

*Pa* Pascals (N/m$^2$)

$q$ shear flow (lb/in, kips/ft, N/m, kN/m)

$q_{allowed}$ allowable soil bearing pressure (lb/ft$^2$, kips/ft$^2$, N/m$^2$, Pa, MPa)

$q_{net}$ net allowed soil bearing pressure (lb/ft$^2$, kips/ft$^2$, N/m, Pa, MPa)

$q_u$ factored soil bearing pressure in concrete design from load factors (lb/ft$^2$, kips/ft$^2$, N/m, Pa, MPa)

$Q$ first moment area used in shearing stress calculations (in$^3$, mm$^3$, m$^3$)

$Q_{connected}$ first moment area used in shear 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)

$r_n$ nominal capacity per bolt in a connection (k/bolt or k/bolt/in.)

$r_o$ 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

$R_a$ required strength (ASD-unified) *(also see $V_a$, $M_a$)*

$R_n$ concrete beam design ratio = $M_u/bd^2$ ($lb/in^2$, MPa)
nominal value for LRFD design to be multiplied by $\phi$ *(also see $P_n$, $M_n$)*
nominal value for ASD design to be divided by the safety factor $\Omega$

$R_x$ 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 strain (change in length divided by length (no units);
displacement with respect to time (ft, m);
length of a segment of a thin walled section (in, mm);
pitch of nail spacing (in, mm) (*also see p)*;
spacing of stirrups in reinforced concrete beams (in, mm);
longitudinal center-to-center spacing of any two consecutive holes (in, mm)

*s.w.* self-weight

$S$ section modulus ($in^3$, $mm^3$, $m^3$);
snow load for LRFD design;
allowable strength of a weld for a given size (lb/in, kips/in, N/mm, kN/m);
masonry mortar strength designation

$S_{required}$ 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

*SF* safety factor *(see F.S.)*

*S4S* surface-four-sided

$t$ thickness (in, mm, m);
time (sec, hrs)

$t_f$ 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);
effect of thermal load for LRFD design

$U$ shear lag factor for bolted connections

$U_{bs}$ reduction coefficient for block shear rupture

$v$ velocity (ft/sec, m/sec, mi/h);
shear force per unit length (lb/ft, k/ft, N/m, kN/m) *(see q)*

$V$ shear force (lb, kip, N, kN)

$V_a$ required shear in steel ASD design (unified) (lb, kip, N, kN)

$V_c$ shear force capacity in concrete (lb, kip, N, kN)

$V_n$ nominal shear force capacity for concrete design (lb, kip, N, kN)

$V_s$ shear force capacity in steel (lb, kip, N, kN)

$V_u$ factored shear calculated in concrete design from load factors (lb, kip, N, kN)

$V_{u1}$ factored one-way shear calculated in concrete footing design from load factors (lb, kip, N, kN)

$V_{u2}$ factored two-way shear calculated in concrete footing design from load factors (lb, kip, N, kN)

$w$ load per unit length on a beam (lb/ft, kip/ft, N/m, kN/m);
load per unit area on a surface ($lb/ft^2$, $kip/ft^2$, $N/m^2$, $kN/m^2$):
width dimension (in, ft, mm, m)

$w_c$ weight of reinforced concrete per unit volume ($lb/ft^3$, $N/m^3$)

$w_u$ factored load per unit length on a beam from load factors (lb/ft, kip/ft, N/m, kN/m);
factored load per unit area on a surface from load factors ($lb/ft^2$, $kip/ft^2$, $N/m^2$, $kN/m^2$)

$W$ 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);
the distance from the top of a masonry or concrete beam to the neutral axis (in, mm, m) (*see c*)

$\bar{x}$ 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)

$z$ the distance from a unit area to a reference axis (in, ft, mm, m) *(also see $d_x$ and $d_y$)*

$Z$ plastic section modulus of a steel beam ($in^3$, $mm^3$)
lateral design value for a single fastener in a timber connection (lb/nail, k/bolt)

$'$ symbol for feet

$''$ symbol for inches

| | |
|---|---|
| # | symbol for pounds |
| = | symbol for equal to |
| ≈ | symbol for approximately equal to |
| ∝ | symbol for proportional to |
| ≤ | symbol for less than or equal to |
| ∫ | symbol for integration |
| $\alpha$ | coefficient of thermal expansion (/°C, /°F);<br>angle, in a math equation (degrees, radians)<br>method factor for $B_1$ for steel beam-column design |
| $\beta$ | angle, in a math equation (degrees, radians) |
| $\beta_c$ | ratio of long side to short side of the column in concrete footing design |
| $\beta_1$ | coefficient to determine the stress block height in concrete beam design |
| $\delta$ | elongation (in, mm) *(also see e)* |
| $\delta_P$ | elongation due to axial load (in, mm) |
| $\delta_s$ | shear deformation (in, mm) |
| $\delta_T$ | elongation due to change in temperature (in, mm) |
| $\Delta$ | beam deflection (in, mm);<br>an increment |
| $\Delta_{LL}$ | beam deflection due to live load (in, mm) |
| $\Delta_{max}$ | maximum calculated beam deflection (in, mm) |
| $\Delta_{TL}$ | beam deflection due to total load (in, mm) |
| $\Delta_x$ | beam deflection in beam diagrams and formulas (in, mm) |
| $\Delta T$ | change in temperature (°C, °F) |
| $\varepsilon$ | strain *(also see s)* |
| $\varepsilon_t$ | thermal strain |
| $\phi$ | diameter symbol;<br>angle of twist (degrees, radians);<br>resistance factor in LRFD steel design and reinforced concrete design |
| $\phi_b$ | resistance factor for flexure in LRFD design |
| $\phi_c$ | resistance factor for compression in LRFD design |
| $\phi_s$ | resistance factor for stability in timber LRFD design |
| $\phi_t$ | resistance factor for tension in LRFD design |
| $\phi_v$ | resistance factor for shear in LRFD design |
| $\lambda$ | time effect factor in LRFD timber design;<br>modification factor for reinforced concrete shear for lightweight materials |

$\lambda_c$ design constant for slenderness evaluation for steel columns in LRFD design

$\mu$ Poisson's ratio;
coefficient of static friction

$\gamma$ 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 (no units);
load factor in LRFD design
ratio of reinforcement width to width of column

$\gamma_D$ dead load factor in LRFD steel design

$\gamma_L$ live load factor in LRFD steel design

$\theta$ angle, in a trig equation (degrees, radians);
slope of the deflection of a beam at a point (degrees, radians)

$\pi$ pi (180°)

$\rho$ radial distance (in, mm);
radius of curvature in beam deflection relationships (ft, m);
reinforcement ratio in concrete beam design = $A_s$/bd (or possibly $A_s$/bt, $A_s$/bh) (no units)

$\rho_b$ balanced reinforcement ratio in concrete beam design

$\rho_g$ reinforcement ratio in concrete column design = $A_{st}/A_g$

$\rho_{max}$ maximum reinforcement ratio allowed in concrete beam design for ductile behavior

$\sigma$ engineering symbol for normal stress (axial or bending)

$\tau$ engineering symbol for shearing stress

$\upsilon_c$ shearing stress capacity in concrete design (psi, ksi, kPa, MPa)

$\omega$ load per unit length on a beam (lb/ft, kip/ft, N/m, kN/m) (*see w*);
load per unit area (lb/ft$^2$, kips/ft$^2$, N/m$^2$, Pa, MPa)

$\Sigma$ summation symbol

$\Omega$ safety factor for ASD of steel (unified)

$\Psi$ relative stiffness of columns to beams in a rigid connection *(see G)*