ANSI/AISC 360-22
An American National Standard

Specification for Structural Steel Buildings

August 1, 2022

Supersedes the *Specification for Structural Steel Buildings* dated June 7, 2016, and all previous versions

Approved by the Committee on Specifications

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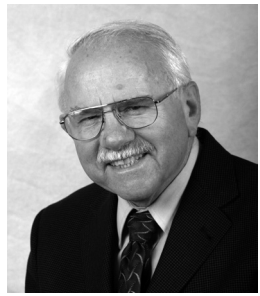
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DEDICATION



Theodore V. Galambos, P.E., Ph.D., DM.ASCE, M.NAE

This edition of the AISC Specification is dedicated to Dr. Theodore (Ted) V. Galambos, a long-time member of the AISC Committee on Specifications and several of its Task Committees. His pivotal research and publications on the load and resistance factor design (LRFD) method transformed the AISC Specification. This method of designing steel buildings was first introduced in the 1986 AISC *Load and Resistance Factor Design Specification for Structural Steel Buildings*. Ted led the effort to adopt this new method and helped maintain it through numerous editions of the Specification. Ted was also the co-author of the *Development of a Probability Based Load Criterion for American National Standard*, the document on which ASCE/SEI 7 is based. For his contributions to research, development, and teaching of behavior, analysis, and design of steel structures, and application of probabilistic methods, Ted was elected as a member of the National Academy of Engineering in 1979 and as a Distinguished Member of the American Society of Civil Engineers (ASCE) in 1990.

In addition to his work on code committees, Ted has been directly involved with numerous other publications that have promoted the state-of-the-art of structural steel design and construction, including as author of *Structural Members and Frames* (1968) and senior author of *Basic Steel Design with LRFD* (1996), as well as serving as editor of the 4th and 5th editions of the *Guide to Stability Design Criteria for Metal Structures* (1988, 1998). He has also continually demonstrated a commitment to the practice of engineering by serving as a consultant to industry through his activities with AISC, the Steel Joist Institute, and the American Iron and Steel Institute.

After receiving his doctorate from Lehigh University in 1959, Ted became a Research Assistant Professor at Lehigh University. In the late 1950s and early 1960s, his research focused on the stability behavior and plastic design of steel beam-columns and multistory steel frames. While at Lehigh, he conducted fundamental tests on the inelastic behavior of steel wide-flange members. In 1965, Ted moved to Washington University in St. Louis as the first holder of the Harold D. Jolley Professorship, and he served as Department Chair from 1970 to 1978. At this time, Ted also began his ground-breaking research on LRFD of structures. Ted was appointed the James L. Record Professor of Civil Engineering at the University of Minnesota in 1981, where he continued a distinguished record of research, teaching, and service through professional committee activities, including ASCE, the Structural Stability Research Council, the Transportation Research Board, and the International Association for Bridge and Structural Engineering.

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As a professor, Ted is a beloved teacher who instructed many future engineers in steel design with an exemplary blending of theory and practice. Ted's commitment to sharing his knowledge, his willingness to mentor several generations of young researchers, and his strong ethical standards have made him one of the giants of his generation. His contributions on the behavior of steel structures will have a lasting impact on the structural engineering profession.

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PREFACE

(This Preface is not part of ANSI/AISC 360-22, *Specification for Structural Steel Buildings*, but is included for informational purposes only.)

This Specification is based upon past successful usage, advances in the state of knowledge, and changes in design practice. The 2022 American Institute of Steel Construction's *Specification for Structural Steel Buildings* provides an integrated treatment of allowable strength design (ASD) and load and resistance factor design (LRFD), and replaces earlier Specifications. As indicated in Chapter B of the Specification, designs can be made according to either ASD or LRFD provisions.

This ANSI-approved Specification has been developed as a consensus document using ANSI-accredited procedures to provide a uniform practice in the design of steel-framed buildings and other structures. The intention is to provide design criteria for routine use and not to provide specific criteria for infrequently encountered problems that occur in the full range of structural design.

This Specification is the result of the consensus deliberations of a committee of structural engineers with wide experience and high professional standing, representing a wide geographical distribution throughout the United States. The committee includes approximately equal numbers of engineers in private practice and code agencies, engineers involved in research and teaching, and engineers employed by steel fabricating and producing companies. The contributions and assistance of more than 50 additional professional volunteers working in task committees are also hereby acknowledged.

The Symbols, Glossary, Abbreviations, and Appendices to this Specification are an integral part of the Specification. A nonmandatory Commentary has been prepared to provide background for the Specification provisions and the user is encouraged to consult it. Additionally, nonmandatory User Notes are interspersed throughout the Specification to provide concise and practical guidance in the application of the provisions.

A number of significant technical modifications have also been made since the 2016 edition of the Specification, including the following:

- A new table is incorporated into Section A3 that lists allowable grades and strengths and other specific limitations of referenced materials.
- Section J3 adopts ASTM F3148 bolts that provide a strength of 144 ksi. A new combined installation method is incorporated into Chapter J applicable to these bolts by reference to the RCSC *Specification*.
- Section A4 provides a detailed list related to what information must be provided on structural design documents. These criteria have been moved from the *Code of Standard Practice for Structural Steel Buildings*.
- A new Section A5, Approvals, is added to specifically address the review and approval of approval documents.
- A new Section B8, Dimensional Tolerances, is added to clarify that the provisions of the Specification are based on specific tolerances provided in the *Code of Standard Practice* and referenced ASTM standards.
- Provisions are added in Section E4 for doubly symmetric I-shaped compression members to address lateral bracing that is offset from the shear center.

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- For flexural strength of members with holes in the tension flange, it is clarified that the Section F13.1 provisions apply only to bolt holes.
- Provisions are added to Chapter G to permit tension field action in end panels.
- Provisions are added to Chapter H for HSS subjected to combined forces, to include biaxial bending and shear.
- Provisions are added to Chapter I for longitudinal and transverse reinforcing steel requirements for filled composite columns and for both encased composite and filled composite beams.
- Chapter I now includes additional stiffness and strength provisions for concrete filled composite plate shear walls consisting of two steel plates connected by tie bars.
- Provisions for the design of rectangular filled composite members constructed from materials with strengths above the limits noted in Chapter I are added in a new Appendix 2.
- Section J2 provides revised requirements to qualify partial-joint-penetration groove welds with effective throats larger than those prescribed in AWS D1.1/D1.1M.
- Requirements regarding the use of low-hydrogen electrodes as they relate to minimum size fillet welds are revised in Table J2.4.
- The directional strength increase for transversely loaded fillet welds is rewritten and prohibited for use in the ends of rectangular HSS.
- An alternative bolt tensile strength based on the net tensile area of bolts is added.
- Added limit states for rectangular HSS moment connections in Chapter K.
- Section N4 now addresses coating inspection personnel requirements.
- A new Section N8, Minimum Requirements for Shop or Field Applied Coatings, is added.
- Appendix 2, Design for Ponding, is removed and replaced with updated guidance on this topic in Section B3.10.
- Appendix 3 clarifies hole forming provisions for elements subjected to fatigue.
- Appendix 4 incorporates temperature-dependent stress-strain equations from the Eurocode to provide material properties for steel at elevated temperatures.
- Prescriptive steel fire-protection design equations and related information based on standard ASTM E119 fire tests are incorporated into Appendix 4.
- Appendix 4, Section 4.4d, Design by Simple Methods of Analysis, includes provisions for compressive strength in filled composite columns and for compression in filled composite plate shear walls.
- Provisions for calculating rivet strength are added in Appendix 5.

This Specification was approved by the Committee on Specifications:

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The Committee gratefully acknowledges AISC Board Oversights, Matt Smith and Duff Zimmerman; advisory members, Carlos Aguirre and Tiziano Perea; and the following task committee and staff members for their involvement in the development of this document.

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SYMBOLS

Definitions for the symbols used in this standard are provided here and reflect the definitions provided in the body of this standard. Some symbols may be used and defined multiple times throughout the document. The section or table number shown in the right-hand column of the list identifies the first time the symbol is used in this document. Symbols without text definitions are omitted.

Symbol	Definition	Section
A_{BM}	Area of the base metal, in.^{2} (mm^2)	J2.4
A_b	Nominal unthreaded body area of bolt or threaded part, in.^{2} (mm^2)	J3.7
A_b	Nominal body area of undriven rivet, in.^{2} (mm^2)	App. 5.3.2a
A_c	Area of concrete, in.^{2} (mm^2)	I1.5
A_c	Area of concrete slab within effective width, in.^{2} (mm^2)	I3.2d
A_c	Area of concrete infill, in.^{2} (mm^2)	I4.2
A_e	Effective net area, in.^{2} (mm^2)	D2
A_e	Summation of the effective areas of the cross section based on reduced effective widths, b_e, d_e, or h_e, or the area as given by Equation E7-6 or E7-7, in.^{2} (mm^2)	E7
A_e	Effective area, in.^{2} (mm^2)	E7.2
A_{fc}	Area of compression flange, in.^{2} (mm^2)	G2.2
A_{fg}	Gross area of tension flange, calculated in accordance with Section B4.3a, in.^{2} (mm^2)	F13.1
A_{fn}	Net area of tension flange, calculated in accordance with Section B4.3b, in.^{2} (mm^2)	F13.1
A_{ft}	Area of tension flange, in.^{2} (mm^2)	G2.2
A_g	Gross area of angle, in.^{2} (mm^2)	F10.2
A_g	Gross area of member, in.^{2} (mm^2)	B4.3a
A_g	Gross area of eyebar body, in.^{2} (mm^2)	D6.1
A_g	Gross area of composite member, in.^{2} (mm^2)	I2.1a
A_g	Gross cross-sectional area of member, in.^{2} (mm^2)	K1.1
A_{gv}	Gross area subjected to shear, in.^{2} (mm^2)	J4.2
A_n	Net area of member, in.^{2} (mm^2)	B4.3b
A_n	Area of directly connected elements, in.^{2} (mm^2)	Table D3.1
A_{nt}	Net area subjected to tension, in.^{2} (mm^2)	J4.3
A_{nv}	Net area subjected to shear, in.^{2} (mm^2)	J4.2
A_{pb}	Projected area in bearing, in.^{2} (mm^2)	J7
A_s	Area of steel section, in.^{2} (mm^2)	I1.5
A_s	Cross-sectional area of structural steel section, in.^{2} (mm^2)	I2.1b
A_s	Cross-sectional area of column, in.^{2} (mm^2)	App. 4.3.2a
A_{sa}	Cross-sectional area of steel headed stud anchor, in.^{2} (mm^2)	I8.2a
A_{sf}	Area on the shear failure path, in.^{2} (mm^2)	D5.1
A_{sr}	Area of continuous longitudinal reinforcing bars, in.^{2} (mm^2)	I2.1a
A_{sr}	Area of developed longitudinal reinforcing steel within the effective width of the concrete slab, in.^{2} (mm^2)	I3.2d.2

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Symbol	Definition	Section
A_{sw}	Area of steel plates in the direction of in-plane shear, in.^{2} (mm^2)	I1.5
A_T	Nominal forces and deformations due to the design-basis fire defined in Section 4.2.1	App. 4.1.4
A_t	Net area in tension, in.^{2} (mm^2)	App. 3.4
A_v	Shear area of the steel portion of a composite member, in.^{2} (mm^2)	I4.2
A_w	Area of web, the overall depth times the web thickness, dt_w, in.^{2} (mm^2)	G2.1
A_w	Area of web or webs, taken as the sum of the overall depth times the web thickness, dt_w, in.^{2} (mm^2)	G4
A_{we}	Effective area of the weld, in.^{2} (mm^2)	J2.4
A_{wel}	Effective area of longitudinally loaded fillet welds, in.^{2} (mm^2)	J2.4
A_{wet}	Effective area of transversely loaded fillet welds, in.^{2} (mm^2)	J2.4
A_1	Loaded area of concrete, in.^{2} (mm^2)	I6.3a
A_1	Area of steel concentrically bearing on a concrete support, in.^{2} (mm^2)	J8
A_2	Maximum area of the portion of the supporting surface that is geometrically similar to and concentric with the loaded area, in.^{2} (mm^2)	J8
B	Overall width of rectangular HSS member, measured 90° to the plane of the connection, in. (mm)	Table D3.1
B	Overall width of rectangular HSS chord member, measured 90° to the plane of the connection, in. (mm)	K1.1
B	Flange width of rectangular cross section, in. (mm)	App. 2.1.4
B_b	Overall width of rectangular HSS branch member or plate, measured 90° to the plane of the connection, in. (mm)	K1.1
B_e	Effective width of rectangular HSS branch member or plate for local yielding of the transverse element, in. (mm)	K1.1
B_{ep}	Effective width of rectangular HSS branch member or plate for punching shear, in. (mm)	K1.1
B_1	Multiplier to account for P-δ effects	App. 8.1.1
B_2	Multiplier to account for P-Δ effects	App. 8.1.1
C	HSS torsional constant, in.^{3} (mm^3)	H3.1
C	Compressive force due to unfactored dead load and live load, kips (kN)	App. 4.3.2b
C_b	Lateral-torsional buckling modification factor for nonuniform moment diagrams when both ends of the segment are braced	F1
C_f	Constant from Table A-3.1 for the fatigue category	App. 3.3
C_m	Equivalent uniform moment factor, assuming no relative translation of member ends	App. 8.1.2
C_r	Reduction factor for shear rupture on pin-connected members	D5.1
C_{v1}	Web shear strength coefficient	G2.1
C_{v2}	Web shear buckling coefficient	G2.2
C_w	Warping constant, in.^{6} (mm^6)	E4
C_1	Coefficient for calculation of effective rigidity of encased composite compression member	I2.1b
C_1, C_2, C_3, C_4	Material dependent constants prescribed in specified rated assembly	App. 4.3.2a
C_2	Edge distance increment, in. (mm)	Table J3.5

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Symbol	Definition	Section
C_3	Coefficient for calculation of effective rigidity of filled composite compression member	I2.2b
D	Nominal dead load, kips (N)	B3.9
D	Width of stiffened element, taken as the outside diameter of round HSS, in. (mm)	B4.1b
D	Outside diameter of round HSS, in. (mm)	Table D3.1
D	Outside diameter of round HSS chord member, in. (mm)	K1.1
D	Heated perimeter of the beam, in. (mm)	App. 4.3.2b
D	Heated perimeter of the column, in. (mm)	App. 4.3.2a
D	Inside heated perimeter of the gypsum board, in. (mm)	App. 4.3.2a
D	Outside diameter for circular columns, outside dimension for square columns, or least outside dimension for rectangular columns, in. (mm)	App. 4.3.2b
D	Nominal dead load rating	App. 5.4.2
D_b	Outside diameter of round HSS branch member, in. (mm)	K1.1
D_u	A multiplier that reflects the ratio of the mean installed bolt pretension to the specified minimum bolt pretension	J3.9
D_1	Heated perimeter of substitute beam or girder, in. (mm)	App. 4.3.2c
E	Modulus of elasticity of steel = 29,000 ksi (200 000 MPa)	Table B4.1a
$E(T)$	Modulus of elasticity of steel at elevated temperature, ksi (MPa)	App. 4.2.3b
E_c	Modulus of elasticity of concrete = $w_c^{1.5}\sqrt{f_c'}$, ksi ($0.043w_c^{1.5}\sqrt{f_c'}$, MPa)	I1.5
$E_c(T)$	Modulus of elasticity of concrete at elevated temperature, ksi (MPa)	App. 4.2.3b
E_s	Modulus of elasticity of steel = 29,000 ksi (200 000 MPa)	I1.5
$(EI)_{eff}$	Effective stiffness of composite section, kip-in.^{2} (N-mm^2)	I2.1b
$F(T)$	Engineering stress at elevated temperature, ksi (MPa)	App. 4.2.3b
F_c	Available stress in chord member, ksi (MPa)	K1.1
$F_c(T)$	Concrete compressive stress, ksi (MPa)	App. 4.2.3b
F_{ca}	Available axial stress at the point of consideration, determined in accordance with Chapter E for compression or Section D2 for tension, ksi (MPa)	H2
F_{cbw}, F_{cbz}	Available flexural stress at the point of consideration, determined in accordance with Chapter F, ksi (MPa)	H2
F_{cr}	Critical stress, ksi (MPa)	F2.2
F_{cr}	Lateral-torsional buckling stress for the section as determined by analysis, ksi (MPa)	F12.2
F_{cr}	Local buckling stress for the section as determined by analysis, ksi (MPa)	F12.3
F_{cr}	Buckling stress for the section as determined by analysis, ksi (MPa)	H3.3
F_e	Elastic buckling stress, ksi (MPa)	E3
F_{el}	Elastic local buckling stress determined according to Equation E7-5 or an elastic local buckling analysis, ksi (MPa)	E7.1
F_{EXX}	Filler metal classification strength, ksi (MPa)	Table J2.5
F_{in}	Nominal bond stress, ksi (MPa)	[illegible]

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Symbol	Definition	Section
F_L	Nominal compression flange stress above which the inelastic buckling limit states apply, ksi (MPa)	F4.2
F_n	Nominal stress, ksi	E3
F_n	Critical buckling stress for structural steel section of filled composite members, ksi (MPa)	I2.2b
F_n	Nominal tensile stress, F_{nt}, or shear stress, F_{nv}, from Table J3.2, ksi (MPa)	J3.7
F_{nBM}	Nominal stress of the base metal, ksi (MPa)	J2.4
F_{nt}	Nominal tensile stress from Table J3.2, ksi (MPa)	J3.7
F_{nt}	Nominal tensile strength of the driven rivet from Table A-5.3.1, ksi (MPa)	App. 5.3.2a
$F_{nt}(T)$	Nominal tensile strength of the bolt, ksi (MPa)	App. 4.2.3b
F'_{nt}	Nominal tensile stress modified to include the effects of shear stress, ksi (MPa)	J3.8
F_{nv}	Nominal shear stress from Table J3.2, ksi (MPa)	J3.7
F_{nv}	Nominal shear strength of the driven rivet from Table A-5.3.1, ksi (MPa)	App. 5.3.2a
$F_{nv}(T)$	Nominal shear strength of the bolt, ksi (MPa)	App. 4.2.3b
F_{nw}	Nominal stress of the weld metal, ksi (MPa)	J2.4
$F_p(T)$	Proportional limit at elevated temperature	App. 4.2.3b
F_{SR}	Allowable stress range, ksi (MPa)	App. 3.3
F_{TH}	Threshold allowable stress range, maximum stress range for indefinite design life from Table A-3.1, ksi (MPa)	App. 3.3
F_u	Specified minimum tensile strength, ksi (MPa)	D2
F_u	Specified minimum tensile strength of a steel headed stud anchor, ksi (MPa)	I8.2a
F_u	Specified minimum tensile strength of the connected material, ksi (MPa)	J3.11
F_u	Specified minimum tensile strength of HSS chord member material, ksi (MPa)	K1.1
$F_u(T)$	Specified minimum tensile strength at elevated temperature, ksi (MPa)	App. 4.2.3b
F_{ub}	Specified minimum tensile strength of HSS branch member material, ksi (MPa)	K1.1
F_y	Specified minimum yield stress, ksi (MPa). As used in this Specification, "yield stress" denotes either the specified minimum yield point (for those steels that have a yield point) or specified yield strength (for those steels that do not have a yield point)	Table B4.1a
F_y	Specified minimum yield stress of the type of steel being used, ksi (MPa)	E3
F_y	Specified minimum yield stress of the column web, ksi (MPa)	J10.6
F_y	Specified minimum yield stress of HSS chord member material, ksi (MPa)	K1.1
F_y	Specified minimum yield stress of the compression flange, ksi (MPa)	App. 8.2

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Symbol	Definition	Section
$F_y(T)$	Specified minimum yield stress of steel at elevated temperature, ksi (MPa)	App. 4.2.3b
F_{yb}	Specified minimum yield stress of HSS branch member or plate material, ksi (MPa)	K1.1
F_{yf}	Specified minimum yield stress of the flange, ksi (MPa)	J10.1
F_{ysr}	Specified minimum yield stress of reinforcing steel, ksi (MPa)	I2.1b
F_{yst}	Specified minimum yield stress of the stiffener material, ksi (MPa)	G2.4
F_{yw}	Specified minimum yield stress of the web material, ksi (MPa)	G2.3
$F_{y,max}$	Maximum permitted yield stress of steel, ksi (MPa)	App. 2.1.4
G	Shear modulus of elasticity of steel = 11,200 ksi (77 200 MPa)	E4
$G(T)$	Shear modulus of elasticity of steel at elevated temperature, ksi (MPa)	App. 4.2.3b
G_c	Shear modulus of concrete = $0.4E_c$, ksi (MPa)	I1.5
G_s	Shear modulus of steel = 11,200 ksi (77 200 MPa), ksi (MPa)	I1.5
H	Overall height of rectangular HSS member, measured in the plane of the connection, in. (mm)	Table D3.1
H	Flexural constant	E4
H	Maximum transverse dimension of rectangular steel member, in. (mm)	I6.3c
H	Overall height of rectangular HSS chord member, measured in the plane of the connection, in. (mm)	K1.1
H	Web depth of rectangular cross section, in. (mm)	App. 2.1.4
H	Ambient temperature thermal capacity of the steel column, Btu/ft-°F (kJ/m-K)	App. 4.3.2a
H	Total story shear, in the direction of translation being considered, produced by the lateral forces used to compute Δ_H, kips (N)	App. 8.1.3
H_b	Overall height of rectangular HSS branch member, measured in the plane of the connection, in. (mm)	K1.1
I	Moment of inertia in the plane of bending, in.^{4} (mm^4)	App. 8.1.2
I_c	Moment of inertia of the concrete section about the elastic neutral axis of the composite section, in.^{4} (mm^4)	I1.5
I_s	Moment of inertia of steel shape about the elastic neutral axis of the composite section, in.^{4} (mm^4)	I1.5
I_{sr}	Moment of inertia of reinforcing bars about the elastic neutral axis of the composite section, in.^{4} (mm^4)	I2.1b
I_{st}	Moment of inertia of transverse stiffeners about an axis in the web center for stiffener pairs, or about the face in contact with the web plate for single stiffeners, in.^{4} (mm^4)	G2.4
I_{st1}	Minimum moment of inertia of transverse stiffeners required for development of the full shear post buckling resistance of the stiffened web panels, $V_r = V_{c1}$, in.^{4} (mm^4)	G2.4
I_{st2}	Minimum moment of inertia of transverse stiffeners required for development of web shear buckling resistance, $V_r = V_{c2}$, in.^{4} (mm^4)	G2.4
I_x, I_y	Moment of inertia about the principal axes, in.^{4} (mm^4)	E4
I_y	Moment of inertia about the y-axis, in.^{4} (mm^4)	F2.2

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Symbol	Definition	Section
I_{yeff}	Effective out-of-plane moment of inertia, in.^{4} (mm^4)	App. 6.3.2a
I_{yc}	Moment of inertia of the compression flange about the y-axis, in.^{4} (mm^4)	F4.2
I_{yt}	Moment of inertia of the tension flange about the y-axis, in.^{4} (mm^4)	App. 6.3.2a
J	Torsional constant, in.^{4} (mm^4)	E4
K	Effective length factor	E2
K_c	Ambient temperature thermal conductivity of the concrete, Btu/hr-ft-°F (W/m-K)	App. 4.3.2a
K_c	Thermal conductivity of concrete or clay masonry unit, Btu/hr-ft-°F (W/m-K)	App. 4.3.2a
K_x	Effective length factor for flexural buckling about x-axis	E4
K_y	Effective length factor for flexural buckling about y-axis	E4
K_z	Effective length factor for torsional buckling about the longitudinal axis	E4
L	Nominal live load, kips (N)	B3.9
L	Laterally unbraced length of member, in. (mm)	E2
L	Length of member between work points at truss chord centerlines, in. (mm)	E5
L	Length of member, in. (mm)	H3.1
L	Laterally unbraced length of element, in. (mm)	J4.4
L	Nominal occupancy live load, kips (N)	App. 4.1.4
L	Interior dimension of one side of a square concrete box protection, in. (mm)	App. 4.3.2a
L	Nominal live load rating	App. 5.4.2
L	Length of span, in. (mm)	App. 6.3.2a
L	Height of story, in. (mm)	App. 7.3.2
L_b	Length between points that are either braced against lateral displacement of compression flange or braced against twist of the cross section, in. (mm)	F2.2
L_b	Laterally unbraced length of member, in. (mm)	F10.2
L_b	Length between points that are either braced against lateral displacement of the compression region, or between points braced to prevent twist of the cross section, in. (mm)	F11.2
L_b	Largest laterally unbraced length along either flange at the point of load, in. (mm)	J10.4
L_{br}	Unbraced length within the panel under consideration, in. (mm)	App. 6.2.1
L_{br}	Unbraced length adjacent to the point brace, in. (mm)	App. 6.2.2
L_c	Effective length of member, in. (mm)	E2
L_c	Effective length of member for buckling about the minor axis, in. (mm)	E5
L_c	Effective length of built-up member, in. (mm)	E6.1
L_c	Column effective length, ft (mm)	App. 4.3.2b
L_{cx}	Effective length of member for buckling about x-axis, in. (mm)	E4
L_{cy}	Effective length of member for buckling about y-axis, in. (mm)	E4
L_{cz}	Effective length of member for buckling about longitudinal axis, in. (mm)	E4

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Symbol	Definition	Section
L_{c1}	Effective length in the plane of bending, calculated based on the assumption of no lateral translation at the member ends, set equal to the laterally unbraced length of the member unless analysis justifies a smaller value, in. (mm)	App. 8.1.2
L_{in}	Load introduction length, determined in accordance with Section I6.4, in. (mm)	I6.3c
L_p	Limiting laterally unbraced length for the limit state of yielding, in. (mm)	F2.2
L_r	Limiting laterally unbraced length for the limit state of inelastic lateral-torsional buckling, in. (mm)	F2.2
L_r	Nominal roof live load	App. 5.4.2
L_v	Distance from maximum to zero shear force, in. (mm)	G5
L_x, L_y, L_z	Laterally unbraced length of the member for each axis, in. (mm)	E4
M_A	Absolute value of moment at quarter point of the unbraced segment, kip-in. (N-mm)	F1
M_B	Absolute value of moment at centerline of the unbraced segment, kip-in. (N-mm)	F1
M_{br}	Required flexural strength of the brace, kip-in. (N-mm)	App. 6.3.2a
M_C	Absolute value of moment at three-quarter point of the unbraced segment, kip-in. (N-mm)	F1
M_c	Available flexural strength, $\phi_b M_n$ or M_n/Ω_b, determined in accordance with Chapter F, kip-in. (N-mm)	H1.1
M_c	Design flexural strength, determined in accordance with Section I3, kip-in. (N-mm)	I5
M_c	Allowable flexural strength, determined in accordance with Section I3, kip-in. (N-mm)	I5
$M_{c\text{-}ip}$	Available strength for in-plane bending, kip-in. (N-mm)	Table K4.1
$M_{c\text{-}op}$	Available strength for out-of-plane bending, kip-in. (N-mm)	Table K4.1
M_{cr}	Elastic lateral-torsional buckling moment, kip-in. (N-mm)	F10.2
M_{cx}	Available lateral-torsional strength for major-axis flexure determined in accordance with Chapter F using $C_b = 1.0$, kip-in. (N-mm)	H1.3
M_{cx}	Available flexural strength about x-axis for the limit state of tensile rupture of the flange, $\phi_b M_n$ or M_n/Ω_b, determined according to Section F13.1, kip-in. (N-mm)	H4
M_{cx}, M_{cy}	Available flexural strength, $\phi_b M_n$ or M_n/Ω_b, determined in accordance with Chapter F, kip-in. (N-mm)	H3.2
M_{lt}	First-order moment using LRFD or ASD load combinations, due to lateral translation of the structure only, kip-in. (N-mm)	App. 8.1.1
M_{max}	Absolute value of maximum moment in the unbraced segment, kip-in. (N-mm)	F1
M_{mid}	Moment at middle of unbraced length, kip-in. (N-mm)	App. 1.3.2c
M_n	Nominal flexural strength, kip-in. (N-mm)	F1
M_n	Nominal flexural strength at ambient temperature calculated in accordance with provisions of Chapter I, kip-in. (N-mm)	App. 4.2.4d

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Symbol	Definition	Section
M_n	Nominal flexural strength due to yielding at ambient temperature determined in accordance with the provisions in Section F2.1, kip-in. (N-mm)	App. 4.2.4e
M_{nt}	First-order moment using LRFD or ASD load combinations, with the structure restrained against lateral translation, kip-in. (N-mm)	App. 8.1.1
M_p	Plastic moment, kip-in. (N-mm)	Table B4.1b
M_p	Moment corresponding to plastic stress distribution over the composite cross section, kip-in. (N-mm)	I3.4b
M_{pf}	Plastic moment of a section composed of the flange and a segment of the web with a depth, d_e, kip-in. (N-mm)	G2.3
M_{pm}	Smaller of M_{pf} and M_{pst}, kip-in. (N-mm)	G2.3
M_{pst}	Plastic moment of a section composed of the end stiffener plus a length of web equal to d_e plus the distance from the inside face of the stiffener to the end of the beam, except that the distance from the inside face of the stiffener to the end of the beam shall not exceed $0.84t_w\sqrt{E/F_y}$ for calculation purposes, kip-in. (N-mm)	G2.3
M_r	Required flexural strength, determined in accordance with Chapter C, using LRFD or ASD load combinations, kip-in. (N-mm)	H1.1
M_r	Required flexural strength, determined in accordance with Section I1.5, using LRFD or ASD load combinations, kip-in. (N-mm)	I5
M_r	Required flexural strength using LRFD or ASD load combinations, kip-in. (N-mm)	J10.4
M_r	Required flexural strength of the beam within the panel under consideration, using LRFD or ASD load combinations, kip-in. (N-mm)	App. 6.3.1a
M_r	Largest of the required flexural strengths of the beam within the unbraced lengths adjacent to the point brace, using LRFD or ASD load combinations, kip-in. (N-mm)	App. 6.3.1b
M_r	Required second-order flexural strength using LRFD or ASD load combinations, kip-in. (N-mm)	App. 8.1.1
M_{ro}	Required flexural strength in the HSS chord member at a joint, on the side of joint with lower compression stress for round HSS and higher compression stress for rectangular HSS, kip-in. (N-mm)	K1.3
$M_{r\text{-}ip}$	Required in-plane flexural strength in branch using LRFD or ASD load combinations, kip-in. (N-mm)	Table K4.1
$M_{r\text{-}op}$	Required out-of-plane flexural strength in branch using LRFD or ASD load combinations, kip-in. (N-mm)	Table K4.1
M_{rx}	Required flexural strength at the location of the bolt holes, determined in accordance with Chapter C, using LRFD or ASD load combinations, positive for tension and negative for compression in the flange under consideration, kip-in. (N-mm)	H4
M_{rx}, M_{ry}	Required flexural strength, determined in accordance with Chapter C, using LRFD or ASD load combinations, kip-in. (N-mm)	H3.2
M_u	Required flexural strength at elevated temperature, determined using the load combination in Equation A-4-1 and greater than $0.01M_n$, kip-in. (N-mm)	App. 4.2.4e

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Symbol	Definition	Section
M_y	Moment at yielding of the extreme fiber, kip-in. (N-mm)	Table B4.1b
M_y	Yield moment about the axis of bending, kip-in. (N-mm)	F9.1
M_y	Yield moment calculated using the geometric section modulus, kip-in. (N-mm)	F10.2
M_y	Yield moment corresponding to yielding of the tension flange and first yield of the compression flange, kip-in. (N-mm)	I3.4b
M_{yc}	Yield moment in the compression flange, kip-in. (N-mm)	F4.1
M_{yt}	Yield moment in the tension flange, kip-in. (N-mm)	F4.4
M_1'	Effective moment at the end of the unbraced length opposite from M_2, kip-in. (N-mm)	App. 1.3.2c
M_1	Smaller moment at end of unbraced length, kip-in. (N-mm)	App. 1.3.2c
M_2	Larger moment at end of unbraced length, kip-in. (N-mm)	App. 1.3.2c
N_i	Notional load applied at level i, kips (N)	C2.2b
N_i	Additional lateral load applied at any level, kips (N)	App. 7.3.2
P_{br}	Required strength of end and intermediate point braces, kips (N)	App. 6.2.2
P_c	Available compressive strength, $\phi_c P_n$ or P_n/Ω_c, determined in accordance with Chapter E, kips (N)	H1.1
P_c	Available tensile strength, $\phi_t P_n$ or P_n/Ω_t, determined in accordance with Chapter D, kips (N)	H1.2
P_c	Available compressive strength in plane of bending, kips (N)	H1.3
P_c	Available tensile or compressive strength, ϕP_n or P_n/Ω, determined in accordance with Chapter D or E, kips (N)	H3.2
P_c	Available axial strength for the limit state of tensile rupture of the net section at the location of bolt holes, $\phi_t P_n$ or P_n/Ω_t, determined in accordance with Section D2(b), kips (N)	H4
P_c	Allowable axial strength, determined in accordance with Section I2, kips (N)	I5
P_c	Design axial strength, determined in accordance with Section I2, kips (N)	I5
P_c	Available axial strength obtained from Table K3.1, kips (N)	Table K4.1
P_{cy}	Available compressive strength out of the plane of bending, kips (N)	H1.3
P_e	Elastic critical buckling load determined in accordance with Chapter C or Appendix 7, kips (N)	I2.1b
$P_{e\ story}$	Elastic critical buckling strength for the story in the direction of translation being considered, kips (N)	App 8.1.3
P_{e1}	Elastic critical buckling strength of the member in the plane of bending, kips (N)	App. 8.1.2
P_{lt}	First-order axial force using LRFD or ASD load combinations, due to lateral translation of the structure only, kips (N)	App. 8.1.1
P_{mf}	Total vertical load in columns in the story that are part of moment frames, if any, in the direction of translation being considered, kips (N)	App. 8.1.3
P_n	Nominal compressive strength, kips (N)	E1
P_n	Nominal axial strength, kips (N)	App. 2.1.4
P_n	Nominal compressive strength at ambient temperature determined in accordance with Section E3, kips (N)	App. 2.1.4

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Symbol	Definition	Section
P_{no}	Nominal axial compressive strength without consideration of length effects, kips (N)	I2.1b
P_{ns}	Cross-section compressive strength, kips (N)	C2.3
P_{nt}	First-order axial force using LRFD or ASD load combinations, with the structure restrained against lateral translation, kips (N)	App. 8.1.1
P_p	Nominal bearing strength, kips (N)	J8
P_p	Plastic axial compressive strength, kips (N)	I2.2b
P_r	Required axial compressive strength using LRFD or ASD load combinations, kips (N)	C2.3
P_r	Required compressive strength determined in accordance with Chapter C using LRFD or ASD load combinations, kips (N)	H1.1
P_r	Required tensile strength determined in accordance with Chapter C using LRFD or ASD load combinations, kips (N)	H1.2
P_r	Required axial strength determined in accordance with Chapter C using LRFD or ASD load combinations, kips (N)	H3.2
P_r	Required axial strength of the member at the location of the bolt holes determined in accordance with Chapter C using LRFD or ASD load combinations, positive in tension and negative in compression, kips (N)	H4
P_r	Required axial strength, determined in accordance with Section I1.5 using LRFD or ASD load combinations, kips (N)	I5
P_r	Required external force applied to the composite member, kips (N)	I6.2a
P_r	Required axial strength using LRFD or ASD load combinations, kips (N)	J10.6
P_r	Required axial strength in branch using LRFD or ASD load combinations, kips (N)	Table K4.1
P_r	Required axial strength of the column within the panel under consideration using LRFD or ASD load combinations, kips (N)	App. 6.2.1
P_r	Largest of the required axial strengths of the column within the unbraced lengths adjacent to the point brace using LRFD or ASD load combinations, kips (N)	App. 6.2.2
P_r	Required second-order axial strength using LRFD or ASD load combinations, kips (N)	App. 8.1.1
P_{ro}	Required axial strength in the HSS chord member at a joint, on the side of joint with lower compression stress for round HSS and higher compression stress for rectangular HSS, kips (N)	K1.3
P_{story}	Total vertical load supported by the story using LRFD or ASD load combinations, as applicable, including loads in columns that are not part of the lateral force-resisting system, kips (N)	App. 8.1.3
P_u	Required axial strength in compression using LRFD load combinations, kips (N)	App. 1.3.2b
P_u	Required compressive strength at elevated temperature, determined using the load combination in Equation A-4-1, kips (N)	App. 4.2.4e
P_y	Axial yield strength of the column, kips (N)	J10.6
Q_{ct}	Available tensile strength, determined in accordance with Section I8.3b, kips (N)	I8.3c

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Symbol	Definition	Section
Q_{cv}	Available shear strength, determined in accordance with Section I8.3a, kips (N)	I8.3c
Q_f	Chord-stress interaction parameter	J10.3
Q_n	Nominal shear strength of one steel headed stud or steel channel anchor, kips (N)	I3.2d
Q_{ne}	Nominal tested strength of shear connections, kips (N)	I8.4b
Q_{nt}	Nominal tensile strength of steel headed stud anchor, kips (N)	I8.3b
Q_{nv}	Nominal shear strength of steel headed stud anchor, kips (N)	I8.3a
Q_{rt}	Required tensile strength, kips (N)	I8.3c
Q_{rv}	Required shear strength, kips (N)	I8.3c
R	Radius of joint surface, in. (mm)	Table J2.2
R	Transition radius, in. (mm)	Table A-3.1
R	Fire endurance at equilibrium moisture conditions, min	App. 4.3.2a
R	Fire resistance, min	App. 4.3.2a
R	Fire-resistance rating of column assembly, hr	App. 4.3.2a
R	Fire-resistance rating, hr	App. 4.3.2b
R	Nominal load due to rainwater or snow, exclusive of ponding contribution	App. 5.4.2
R_a	Required strength using ASD load combinations	B3.2
R_{FIL}	Reduction factor for joints using a pair of transverse fillet welds only	App. 3.3
R_n	Nominal strength	B3.1
R_n	Nominal bond strength, kips (N)	I6.3c
R_n	Nominal slip resistance, kips (N)	J1.8
R_n	Nominal strength of the connected material, kips (N)	J3.11
R_n	Nominal yielding strength at ambient temperature determined in accordance with Section D2, kips (N)	App. 4.2.4e
R_o	Fire endurance at zero moisture content, min	App. 4.3.2a
R_{pc}	Web plastification factor, determined in accordance with Section F4.2(c)(6)	F4.1
R_{pg}	Bending strength reduction factor	F5.2
R_{PJP}	Reduction factor for reinforced or nonreinforced transverse partial-joint-penetration (PJP) groove welds	App. 3.3
R_{pt}	Web plastification factor corresponding to the tension flange yielding limit state	F4.4
R_u	Required tensile strength at elevated temperature, determined using the load combination in Equation A-4-1 and greater than $0.01R_n$, kips (N)	App. 4.2.4e
R_u	Required strength using LRFD load combinations	B3.1
S	Elastic section modulus about the axis of bending, in.^{3} (mm^3)	F7.2
S	Nominal snow load, kips (N)	App. 4.1.4
S_c	Elastic section modulus, in.^{3} (mm^3)	F9.4
S_c	Elastic section modulus to the toe in compression relative to the axis of bending, in.^{3} (mm^3)	F10.3
S_e	Effective section modulus determined with the effective width of the compression flange, in.^{3} (mm^3)	F7.2

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Symbol	Definition	Section
S_{ip}	Effective elastic section modulus of welds for in-plane bending, in.^{3} (mm^3)	K5
S_{min}	Minimum elastic section modulus relative to the axis of bending, in.^{3} (mm^3)	F12
S_{op}	Effective elastic section modulus of welds for out-of-plane bending, in.^{3} (mm^3)	K5
S_x	Elastic section modulus taken about the x-axis, in.^{3} (mm^3)	F2.2
S_x	Minimum elastic section modulus taken about the x-axis, in.^{3} (mm^3)	F13.1
S_{xc}, S_{xt}	Elastic section modulus referred to compression and tension flanges, respectively, in.^{3} (mm^3)	Table B4.1b
S_y	Elastic section modulus taken about the y-axis, in.^{3} (mm^3)	F6.1
T	Elevated temperature of steel due to unintended fire exposure, °F (°C)	App. 4.2.4d
T	Temperature of steel, °F (°C)	App. 4.2.4d
T_a	Required tension force using ASD load combinations, kips (kN)	J3.10
T_b	Minimum fastener pretension given in Table J3.1 or Table J3.1M, kips (kN)	J3.9
T_c	Available torsional strength, $\phi_T T_n$ or T_n/Ω_T, determined in accordance with Section H3.1, kip-in. (N-mm)	H3.2
T_{cr}	Critical temperature in °F (°C)	App. 4.2.4e
T_e	Equivalent thickness of concrete or clay masonry unit, in accordance with ACI 216.1 (ACI 216.1M), in. (mm)	App. 4.3.2a
T_r	Required torsional strength, determined in accordance with Chapter C, using LRFD or ASD load combinations, kip-in. (N-mm)	H3.2
T_u	Required tension force using LRFD load combinations, kips (kN)	J3.10
T_1	Thickness of fire protection materials calculated for the substitute beam or girder, in. (mm)	App. 4.3.2c
U	Shear lag factor	D3
V'	Nominal shear force between the steel beam and the concrete slab transferred by steel anchors, kips (N)	I3.2d
V_{br}	Required shear strength of the bracing system, kips (N)	App. 6.2.1
V_c	Available shear strength, $\phi_v V_n$ or V_n/Ω_v, determined in accordance with Chapter G, kips (N)	H3.2
V_{c1}	Available shear strength calculated with V_n as defined in Section G2.1 or G2.2. as applicable, kips (N)	G2.4
V_{c2}	Available shear strength, kips (N)	G2.4
V_n	Nominal shear strength, kips (N)	G1
V_r	Required shear strength in the panel being considered, kips (N)	G2.4
V_r	Required shear strength, determined in accordance with Chapter C, using LRFD or ASD load combinations, kips (N)	H3.2
V_r'	Required shear force to be transferred to the steel or concrete, kips (N)	I6.1
W	Nominal weight of steel shape, lb/ft (kg/m)	App. 4.3.2a
W	Weight of columns, lb/ft (kg/m)	App. 4.3.2a
W	Average weight of column, lb/ft (kg/m)	App. 4.3.2a
W	Weight of beam or girder, lb/ft (kg/m)	App. 4.3.2a

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Symbol	Definition	Section
W'	Total weight of steel shape and gypsum wallboard protection, lb/ft (kg/m)	App. 4.3.2a
W_1	Weight of substitute beam or girder, lb/ft (kg/m)	App. 4.3.2c
Y_i	Gravity load applied at level i from the LRFD load combination or ASD load combination, as applicable, kips (N)	C2.2b
Z	Plastic section modulus taken about the axis of bending, in.^{3} (mm^3)	F7.1
Z_b	Plastic section modulus of branch taken about the axis of bending, in.^{3} (mm^3)	K4.1
Z_x	Plastic section modulus taken about the x-axis, in.^{3} (mm^3)	Table B4.1b
Z_y	Plastic section modulus taken about the y-axis, in.^{3} (mm^3)	F6.1
a	Shortest distance from edge of pin hole to edge of member measured parallel to the direction of force, in. (mm)	D5.1
a	Distance between connectors, in. (mm)	E6.1
a	Clear distance between transverse stiffeners, in. (mm)	F13.2
a	Detail length, in. (mm)	Table A-3.1
a_w	Ratio of 2 times the web area in compression to the compression flange area	F13.2
b	Width of compression element as shown in Table B4.1, in. (mm)	B4.1
b	Width of the element, in. (mm)	E7.1
b	Width of compression flange as defined in Section B4.1b, in. (mm)	F7.2
b	Width of leg, in. (mm)	F10.2
b	Full width of leg in compression, in. (mm)	F10.3
b	Width of the leg resisting the shear force or depth of tee stem, in. (mm)	G3
b	Largest clear distance between rows of steel anchors or ties, in. (mm)	I1.6a
b	Thickness of attachment, in. (mm)	Table A-3.1
b_{cf}	Width of column flange, in. (mm)	J10.6
b_e	Effective width, in. (mm)	E7.1
b_f	Width of flange, in. (mm)	B4.1
b_f	Width of column flange, in. (mm)	App. 4.3.2a
b_{fc}	Width of compression flange, in. (mm)	F4.2
b_{ft}	Width of tension flange, in. (mm)	G2.2
b_l	Length of longer leg of angle, in. (mm)	E5
b_p	Smaller of the dimensions a and h, in. (mm)	G2.4
b_s	Length of shorter leg of angle, in. (mm)	E5
b_s	Stiffener width for one-sided stiffeners; twice the individual stiffener width for pairs of stiffeners, in. (mm)	App. 6.3.2a
c	Distance from the neutral axis to the extreme compressive fibers, in. (mm)	App. 6.3.2a
c_c	Ambient temperature specific heat of concrete, Btu/lb-°F (kJ/kg-K)	App. 4.3.2a
c_1	Effective width imperfection adjustment factor determined from Table E7.1	E7.1
d	Full depth of the section, for stems of tees, in. (mm)	B4.1a
d	Depth of section, in. (mm)	Table D3.1

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Symbol	Definition	Section
d	Depth of section from which the tee was cut, in. (mm)	Table D3.1
d	Diameter of pin, in. (mm)	D5.1
d	Depth of tee or width of web leg in tension, in. (mm)	F9.2
d	Depth of tee or width of web leg in compression, in. (mm)	F9.2
d	Nominal diameter of fastener, in. (mm)	J3.4
d	Diameter, in. (mm)	J7
d	Full nominal depth of member, in. (mm)	J10.2
d	Depth of column, in. (mm)	App. 4.3.2a
d_b	Depth of beam, in. (mm)	J10.6
d_b	Nominal diameter (body or shank diameter), in. (mm)	App. 3.4
d_c	Depth of column, in. (mm)	J10.6
d_e	Effective width for tees, in. (mm)	E7.1
d_h	Diameter of hole, in. (mm)	D5.1
d_m	Density of the concrete or clay masonry unit, lb/ft^3 (kg/m^3)	App. 4.3.2a
d_{sa}	Diameter of steel headed stud anchor, in. (mm)	I8.1
d_{tie}	Effective diameter of the tie bar, in. (mm)	I1.6b
e	Eccentricity in a truss connection, positive being away from the branches, in. (mm)	K3.1
$e_{mid\text{-}ht}$	Distance from the edge of steel headed stud anchor shank to the steel deck web, in. (mm)	I8.2a
f'_c	Specified compressive strength of concrete, ksi (MPa)	I1.2a
f'_c	28-day compressive strength of concrete, ksi (MPa)	App. 4.3.2b
$f'_c(T)$	Specified compressive strength of concrete at elevated temperature, ksi (MPa)	App. 4.2.3b
f_{ra}	Required axial stress at the point of consideration, determined in accordance with Chapter C, using LRFD or ASD load combinations, ksi (MPa)	H2
f_{rbw}, f_{rbz}	Required flexural stress at the point of consideration, determined in accordance with Chapter C, using LRFD or ASD load combinations, ksi (MPa)	H2
f_{rv}	Required shear stress using LRFD or ASD load combinations, ksi (MPa)	J3.8
g	Transverse center-to-center spacing (gage) between fastener gage lines, in. (mm)	B4.3b
g	Gap between toes of branch members in a gapped K-connection, neglecting the welds, in. (mm)	K3.1
h	Width of compression element as shown in Table B4.1, in. (mm)	B4.1
h	Depth of web, as defined in Section B4.1b, in. (mm)	F7.3
h	Clear distance between flanges less the fillet at each flange, in. (mm)	G2.1
h	For built-up welded sections, the clear distance between flanges, in. (mm)	G2.1
h	For built-up bolted sections, the distance between fastener lines, in. (mm)	G2.1

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Symbol	Definition	Section
h	Width resisting the shear force, taken as the clear distance between the flanges less the inside corner radius on each side for HSS or the clear distance between flanges for box sections; for built-up welded sections, the clear distance between flanges; for built-up bolted sections, the distance between fastener lines, in. (mm)	G4
h	Flat width of longer side, as defined in Section B4.1b(d), in. (mm)	H3.1
h	Total nominal thickness of Type X gypsum wallboard, in. (mm)	App. 4.3.2a
h	Thickness of the concrete cover, measured between the exposed concrete and nearest outer surface of the encased steel column section, in. (mm)	App. 4.3.2a
h	Thickness of sprayed fire-resistant material, in. (mm)	App. 4.3.2a
h_c	Twice the distance from the center of gravity to the following: the inside face of the compression flange less the fillet or corner radius, for rolled shapes; the nearest line of fasteners at the compression flange or the inside faces of the compression flange when welds are used, for built-up sections, in. (mm)	B4.1b
h_e	Effective width for webs, in. (mm)	E7.1
h_f	Factor for fillers	J3.9
h_o	Distance between flange centroids, in. (mm)	E4
h_p	Twice the distance from the plastic neutral axis to the nearest line of fasteners at the compression flange or the inside face of the compression flange when welds are used, in. (mm)	B4.1b
h_1	Concrete slab thickness above steel deck, in. (mm)	App. 4.3.2f
h_2	Depth of steel deck, in. (mm)	App. 4.3.2f
k	Distance from outer face of flange to the web toe of fillet, in. (mm)	J10.2
k_E, k_p, k_y	Retention factors for steel	App. 4.2.3b
k_{Ec}, k_c	Retention factors for concrete	App. 4.2.3b
k_b	Retention factor for high-strength bolts	App. 4.2.3b
k_c	Coefficient for slender unstiffened elements	Table B4.1
k_{ds}	Directional strength increase factor	J2.4
k_{sb}	Retention factor depending on bottom flange temperature, T, as given in Table A-4.2.4	App. 4.2.4d
k_v	Web plate shear buckling coefficient	G2.1
l	Actual length of end-loaded weld, in. (mm)	J2.2
l	Length of connection, in. (mm)	Table D3.1
l_a	Length of channel anchor, in. (mm)	I8.2b
l_b	Bearing length of the load, measured parallel to the axis of the HSS member (or measured across the width of the HSS in the case of loaded cap plates), in. (mm)	K2.1
l_b	Length of bearing, in. (mm)	J7
l_c	Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material, in. (mm)	J3.11
l_e	Total effective weld length of groove and fillet welds to HSS for weld strength calculations, in. (mm)	K5

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Symbol	Definition	Section
l_{end}	Distance from the near side of the connecting branch or plate to end of chord, in. (mm)	K1.1
l_{ov}	Overlap length measured along the connecting face of the chord beneath the two branches, in. (mm)	K3.1
l_p	Projected length of the overlapping branch on the chord, in. (mm)	K3.1
l_1	Largest upper width of deck rib, in. (mm)	App. 4.3.2f
l_2	Bottom width of deck rib, in (mm)	App. 4.3.2f
l_3	Width of deck upper flange, in (mm)	App. 4.3.2f
m	Equilibrium moisture content of concrete by volume, %	App. 4.3.2a
m	Moisture content of the concrete slab, %	App. 4.3.2f
n	Number of braced points within the span	App. 6.3.2a
n	Threads per inch (per mm)	App. 3.4
n_b	Number of bolts carrying the applied tension	J3.10
n_s	Number of slip planes required to permit the connection to slip	J3.9
n_{SR}	Number of stress range fluctuations in design life	App. 3.3
p	Inner perimeter of concrete or clay masonry protection, in. (mm)	App. 4.3.2a
p	Pitch, in. per thread (mm per thread)	App. 3.4
p_b	Perimeter of the steel-concrete bond interface within the composite cross section, in. (mm)	I6.3c
p_c	Concrete density, lb/ft^3 (kg/m^3)	App. 4.3.2a
r	Radius of gyration, in. (mm)	E2
r_a	Radius of gyration about the geometric axis parallel to the connected leg, in. (mm)	E5
r_i	Minimum radius of gyration of individual component, in. (mm)	E6.1
$\overline{r}_o$	Polar radius of gyration about the shear center, in. (mm)	E4
r_t	Effective radius of gyration for lateral-torsional buckling. For I-shapes with a channel cap or a cover plate attached to the compression flange, radius of gyration of the flange components in flexural compression plus one-third of the web area in compression due to application of major-axis bending moment alone, in. (mm)	F4.2
r_x	Radius of gyration about x-axis, in. (mm)	E4
r_y	Radius of gyration about y-axis, in. (mm)	E4
r_y	Radius of gyration about minor axis, in. (mm)	App. 1.3.2c
r_z	Radius of gyration about the minor principal axis, in. (mm)	E5
s	Longitudinal center-to-center spacing (pitch) of any two consecutive bolt holes, in. (mm)	B4.3b
s_t	Largest clear spacing of the ties, in. (mm)	I1.6b
t	Design wall thickness of HSS member, in. (mm)	B4.2
t	Thickness of plate, in. (mm)	D5.1
t	Thickness of wall, in. (mm)	E7.2
t	Thickness of angle leg, in. (mm)	F10.2
t	Thickness of angle leg or tee stem, in. (mm)	G3
t	Thickness of web, in. (mm)	G4
t	Thickness of connected material, in. (mm)	J3.11
t	Total thickness of fillers, in. (mm)	J3.11

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Symbol	Definition	Section
t	Design wall thickness of HSS chord member, in. (mm)	K1.1
t	Distance from the neutral axis to the extreme tensile fibers, in. (mm)	App. 6.3.2a
t_b	Design wall thickness of HSS branch member or thickness of plate, in. (mm)	K1.1
t_{cf}	Thickness of column flange, in. (mm)	J10.6
t_f	Thickness of flange, in. (mm)	F3.2
t_f	Thickness of the loaded flange, in. (mm)	J10.1
t_f	Thickness of channel anchor flange, in. (mm)	I8.2b
t_{fc}	Thickness of compression flange, in. (mm)	F4.2
t_p	Thickness of tension loaded plate, in. (mm)	App. 3.3
t_{sc}	Thickness of composite plate shear wall, in. (mm)	I1.6b
t_{st}	Thickness of web stiffener, in. (mm)	App. 6.3.2a
t_w	Thickness of web, in. (mm)	F4.2
t_w	Thickness of channel anchor web, in. (mm)	I8.2b
t_w	Thickness of column web, in. (mm)	J10.6
t_w	Smallest effective weld throat thickness around the perimeter of branch or plate, in. (mm)	K5
t_w	Thickness of beam web, in. (mm)	App. 6.3.2a
w	Width of plate, in. (mm)	Table D3.1
w	Width of cover plate, in. (mm)	F13.3
w	Size of weld leg, in. (mm)	J2.2b
w	Subscript relating symbol to major principal axis bending	H2
w	Leg size of the reinforcing or contouring fillet, if any, in the direction of the thickness of the tension-loaded plate, in. (mm)	App. 3.3
w_c	Weight of concrete per unit volume ($90 \le w_c \le 155$ lb/ft^3 or $1500 \le w_c \le 2500$ kg/m^3)	I1.5
w_r	Average width of concrete rib or haunch, in. (mm)	I3.2c
x	Subscript relating symbol to major-axis bending	H1.1
x_a	Bracing offset distance along x-axis, in. (mm)	E4
x_o, y_o	Coordinates of the shear center with respect to the centroid, in. (mm)	E4
$\bar{x}$	Eccentricity of connection, in. (mm)	Table D3.1
y	Subscript relating symbol to minor-axis bending	H1.1
y_a	Bracing offset distance along y-axis, in. (mm)	E4
z	Subscript relating symbol to minor principal axis bending	H2
Δ	First-order interstory drift due to the LRFD or ASD load combinations, in. (mm)	App. 7.3.2
Δ_H	First-order interstory drift, in the direction of translation being considered, due to lateral forces, in. (mm)	App. 8.1.3
Ω	Safety factor	B3.2
Ω_b	Safety factor for flexure	I5
Ω_c	Safety factor for compression	I5
β	Reduction factor	J2.2b
β	Width ratio; the ratio of branch diameter to chord diameter for round HSS; the ratio of overall branch width to chord width for rectangular HSS	K2

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Symbol	Definition	Section
β_T	Overall brace system required stiffness, kip-in./rad (N-mm/rad)	App. 6.3.2a
β_{br}	Required shear stiffness of the bracing system, kip/in. (N/mm)	App. 6.2.1
β_{br}	Required flexural stiffness of the brace, kip/in. (N/mm)	App. 6.3.2a
β_{eff}	Effective width ratio; the sum of the perimeters of the two branch members in a K-connection divided by eight times the chord width	K1.1
β_{sec}	Web distortional stiffness, including the effect of web transverse stiffeners, if any, kip-in./rad (N-mm/rad)	App. 6.3.2a
β_w	Section property for single angles about major principal axis, in. (mm)	F10.2
γ	Chord slenderness ratio; the ratio of one-half the diameter to the wall thickness for round HSS; the ratio of one-half the width to wall thickness for rectangular HSS	K1.1
$\varepsilon(T)$	Engineering strain at elevated temperature, in./in.(mm/mm)	App. 4.2.3b
$\varepsilon_c(T)$	Concrete compressive strain, in./in. (mm/mm)	App. 4.2.3b
$\varepsilon_{cu}(T)$	Concrete strain corresponding to $f_c'(T)$ at elevated temperature, in./in. (mm/mm)	App. 4.2.3b
$\varepsilon_p(T)$	Engineering strain at the proportional limit at elevated temperature, in./in. (mm/mm)	App. 4.2.3b
$\varepsilon_u(T)$	Ultimate strain at elevated temperature, in./in. (mm/mm)	App. 4.2.3b
$\varepsilon_y(T)$	Engineering yield strain at elevated temperature, in./in. (mm/mm)	App. 4.2.3b
ζ	Gap ratio; the ratio of the gap between the branches of a gapped K-connection to the width of the chord for rectangular HSS	K3.1
η	Load length parameter, applicable only to rectangular HSS; the ratio of the length of contact of the branch with the chord in the plane of the connection to the chord width	K1.1
θ	Angle between the line of action of the required force and the weld longitudinal axis, degrees	J2.4
θ	Acute angle between the branch and chord, degrees	K1.1
λ	Width-to-thickness ratio for the element as defined in Section B4.1	E7.1
λ_p	Limiting width-to-thickness ratio (compact/noncompact)	Table B4.1b
λ_{pf}	Limiting width-to-thickness ratio for compact flange, as defined in Table B4.1b	F3.2
λ_{pw}	Limiting width-to-thickness ratio for compact web, as defined in Table B4.1b	F4.2
λ_r	Limiting width-to-thickness ratio (noncompact/slender)	Table B4.1b
λ_r	Limiting width-to-thickness ratio (nonslender/slender)	Table B4.1a
λ_{rf}	Limiting width-to-thickness ratio for noncompact flange, as defined in Table B4.1b	F3.2
λ_{rw}	Limiting width-to-thickness ratio for noncompact web, as defined in Table B4.1b	F4.2
μ	Mean slip coefficient for Class A or B surfaces, as applicable, or as established by tests	J3.9
ρ_{sr}	Reinforcement ratio for continuous longitudinal reinforcement	I2.1
ρ_w	Maximum shear ratio within the web panels on each side of the transverse stiffener	G2.1

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