W-, S-, C-, and MC-Shapes

		F_y	F_u
W-, C-, and MC-Shapes	ASTM A992/A992M	50 ksi	65 ksi
S-Shapes	ASTM A572/A572M Grade 50	50 ksi	65 ksi

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Basic Design Values 1

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2022 AISC *Specification* (ANSI/AISC 360-22) may be less constrained and less conservative.

Condition			ASD	LRFD	Related Info
Tension			$0.6F_yA_g \le 0.5F_uA_e$	$0.9F_yA_g \le 0.75F_uA_e$	For A_e, see AISC *Specification* Equation D3-1.
Bending	Major Axis	$L_b \le L_p$	$0.66F_yS_x$	$0.99F_yS_x$	$L_p = \dfrac{300r_y}{\sqrt{F_y}}$ See Note 1.1. L_r and strength when $L_b > L_r$ are given in the AISC *Manual*.
		$L_p < L_b \le L_r$	Use linear interpolation between L_p and L_r.		
		$L_b = L_r$	$0.42F_yS_x$	$0.63F_yS_x$	
	Minor Axis		$0.9F_yS_y$	$1.35F_yS_y$	
Shear (in major axis)			$0.4F_yA_w$	$0.6F_yA_w$	See Note 1.2.
Compression	$L_c/r \le 800/\sqrt{F_y}$		$0.6F_yA_g(0.658)^P$	$0.9F_yA_g(0.658)^P$	$P = \dfrac{F_y\left(L_c/r\right)^2}{286{,}000}$ See Note 1.3.
	$L_c/r > 800/\sqrt{F_y}$		$\dfrac{150{,}000A_g}{\left(L_c/r\right)^2}$	$\dfrac{226{,}000A_g}{\left(L_c/r\right)^2}$	

Notes

1.1 Multiply equations given for strong axis with $L_b \le L_p$, or weak axis, by values in parentheses for W21×48 (0.99), W14×90 (0.97), W12×65 (0.98), W10×12 (0.99), W8×10 (0.99), W6×15 (0.94), and W6×8.5 (0.98).

1.2 Multiply equations given by 0.9 for W44×230, W40×149, W36×135, W33×118, W30×90, W24×55, W16×26, and W12×14 and all C- and MC-shapes. In weak axis, equations can be adapted by using $A_w = 1.8b_ft_f$.

1.3 Not applicable to slender shapes. For slender shapes, use A_e from AISC *Specification* Section E7 in place of A_g. For C- and MC- shapes, see AISC *Specification* Section E4.

2 Basic Design Values

Connected Parts

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2022 AISC *Specification* (ANSI/AISC 360-22) may be less constrained and less conservative.

Bolts	Group 120 (ASTM F3125/F3125M Grades A325 and F1852)	F_{ub} = 120 ksi
	Group 144 (ASTM F3148)	F_{ub} = 144 ksi
	Group 150 (ASTM F3125/F3125M Grades A490 and F2280)	F_{ub} = 150 ksi
	Group 200 (ASTM F3043 and F3111)	F_{ub} = 200 ksi

F_{ub} represents F_u of bolt material on this card.

Welds	F_{EXX} = 70 ksi

Condition			ASD	LRFD	Related Info
Bolts	**Tension**		$0.38F_{ub}A_b$	$0.56F_{ub}A_b$	—
	Shear (N bolts, per shear plane)		$0.23F_{ub}A_b$	$0.34F_{ub}A_b$	Multiply by 1.25 for X bolts.
	Slip Resistance (Class A, STD holes)		$0.12F_{ub}A_b$	$0.18F_{ub}A_b$	Per slip plane. See Note 2.1.
	Bearing		$1.2d_btF_u$	$1.8d_btF_u$	See Note 2.2.
	Tearout		$0.6l_ctF_u$	$0.9l_ctF_u$	
Welds	**Shear** (all welds except CJP)		$0.3F_{EXX}A_{we} \le 0.3F_uA_{BM}$	$0.45F_{EXX}A_{we} \le 0.45F_uA_{BM}$	See Note 2.3.
	PJP Groove Welds	**Tension**	$0.32F_{EXX}A_w \le 0.5F_uA_{BM}$	$0.48F_{EXX}A_w \le 0.75F_uA_{BM}$	See AISC *Specification* Section J2.1a.
		Compression (joint not finished to bear)	$0.48F_{EXX}A_w \le 0.6F_yA_{BM}$	$0.72F_{EXX}A_w \le 0.9F_yA_{BM}$	
	CJP Groove Welds		Strength equal to base metal.		—
Connected Parts	**Tension**		$0.6F_yA_g \le 0.5F_uA_e$	$0.9F_yA_g \le 0.75F_uA_e$	For A_e, see AISC *Specification* Equation D3-1.
	Shear		$0.4F_yA_g \le 0.3F_uA_n$	$0.6F_yA_g \le 0.45F_uA_n$	—
	Block Shear		$0.3F_uA_{nv} + 0.5U_{bs}F_uA_{nt}$	$0.45F_uA_{nv} + 0.75U_{bs}F_uA_{nt}$	See Note 2.4.
	Compression	$L_c/r \le 25$	$0.6F_yA_g$	$0.9F_yA_g$	—
		$L_c/r > 25$	Same as for W-shapes.		

Notes

2.1 For Class B multiply by 1.67. Multiply by values in parentheses for SSL perpendicular to load direction (1.0), OVS or SSL parallel to load direction (0.85), and LSL holes (0.70). Multiply by 0.85 if multiple fillers are used within grip.

2.2 For LSL holes perpendicular to load direction, multiply by 0.83.

2.3 For fillet welds, multiply by 1.5 for transverse loading (90-degree load angle) if strain compatibility of the various weld elements is considered. For other load angles, see AISC *Specification* Section J2.

2.4 For calculation purposes, F_uA_{nv} cannot exceed F_yA_{gv}. U_{bs} = 1.0 for a uniform tension stress; 0.5 for non-uniform tension stress.

Analysis and Design

Basic Design Values 3

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2022 AISC *Specification* (ANSI/AISC 360-22) may be less constrained and less conservative.

Simplified Method (see Note 4.1)

Step 1 Perform first-order elastic analysis. Use 0.002 times the total story gravity load as lateral load in gravity-only combinations.

Step 2 Establish the design story drift limit and determine the lateral load that produces that drift.

Step 3 Determine the ratio of the total story gravity load, P_{story}, to the lateral load, H, determined in Step 2 and divide by R_M. [α = 1.0 (LRFD); α = 1.6 (ASD)].

Step 4 Multiply first-order results by B_2 (i.e., the tabular value). K = 1, except for moment frames when the tabular value is greater than 1.1. Ensure the target drift limit in Step 2 is not exceeded.

Δ_H	$\frac{\alpha P_{story}}{R_M H}$										
	5	**10**	**20**	**25**	**30**	**40**	**50**	**60**	**80**	**100**	**120**
L/100	1.05	1.11	1.25	1.33	1.43					**B_2 > 1.50**	
L/200	1.03	1.05	1.11	1.14	1.18	1.25	1.33	1.43			
L/300	1.02	1.03	1.07	1.09	1.11	1.15	1.20	1.25	1.36	1.50	
L/400	1.01	1.03	1.05	1.07	1.08	1.11	1.14	1.18	1.25	1.33	1.43
L/500	1.01	1.02	1.04	1.05	1.06	1.09	1.11	1.14	1.19	1.25	1.32

Note Interpolation between values in the table may produce an incorrect result.

Elastic Methods

Elastic Methods	Effective Length	Forces and Moments	Limitations	*Specification* References
First-Order Analysis Method—second-order effects captured from effects of additional lateral load	K = 1 for all frames (see Note 4.2)	From analysis	$\Delta_{2nd}/\Delta_{1st} \le 1.5$; axial load limited	Appendix 7, Section 7.3
Effective Length Method—second-order analysis with 0.2% of total gravity load as lateral load in gravity-only combinations (see Note 4.3)	K = 1, except for moment frames with $\Delta_{2nd}/\Delta_{1st} > 1.1$	From analysis (see Note 4.3)	$\Delta_{2nd}/\Delta_{1st} \le 1.5$	Appendix 7, Section 7.2
Direct Analysis Method—second-order analysis with notional lateral load and reduced EI and AE (see Note 4.3)	K = 1 for all frames	From analysis (see Note 4.3)	None	Chapter C

Notes

$\Delta_{2nd}/\Delta_{1st}$ is the ratio of the second-order drift to first-order drift, which is also represented by B_2.

4.1 Derived from the effective length method, using B_1-B_2 approximation with B_1 taken equal to B_2. B_1 must not exceed B_2 and B_2 must not exceed 1.5. See AISC *Manual* Part 2 for discussion of limitations and additional details.

4.2 An additional amplification for member curvature effects is required for beam-columns.

4.3 The B_1-B_2 approximation (Appendix 8) can be used to accomplish a second-order analysis.

4 Basic Design Values

HSS Members

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2022 AISC *Specification* (ANSI/AISC 360-22) may be less constrained and less conservative.

		Round		Rectangular	
HSS	ASTM A500/A500M Grade C	$F_y = 50$ ksi	$F_u = 62$ ksi	$F_y = 50$ ksi	$F_u = 62$ ksi
	ASTM A1085/A1085M Grade A	$F_y = 50$ ksi	$F_u = 65$ ksi	$F_y = 50$ ksi	$F_u = 65$ ksi
Pipe	ASTM A53 Grade B	$F_y = 35$ ksi	$F_u = 60$ ksi	–	–

Condition		**ASD**	**LRFD**	**Related Info**
Tension		$0.6F_yA_g \le 0.5F_uA_e$	$0.9F_yA_g \le 0.75F_uA_e$	For A_e, see AISC *Specification* Equation D3-1.
Bending	Rectangular HSS	$0.66F_yS$	$0.99F_yS$	See Note 3.1.
	Round HSS and Pipe	$0.78F_yS$	$1.17F_yS$	See Note 3.2.
Shear	Rectangular HSS	$0.36F_yA_w$	$0.54F_yA_w$	See Note 3.3.
	Round HSS and Pipe	$0.18F_yA_g$	$0.27F_yA_g$	See Note 3.4.
Compression	$L_c/r \le 800/\sqrt{F_y}$	$0.6F_yA_g(0.658)^P$	$0.9F_yA_g(0.658)^P$	$P = \dfrac{F_y\left(L_c/r\right)^2}{286{,}000}$ See Note 3.5.
	$L_c/r > 800/\sqrt{F_y}$	$\dfrac{150{,}000A_g}{\left(L_c/r\right)^2}$	$\dfrac{226{,}000A_g}{\left(L_c/r\right)^2}$	

Table 3.1. Size Limits for Rectangular HSS, in.*

Nom. Wall Thickness, in.		1	7/8	3/4	5/8	1/2	3/8	5/16	1/4	3/16	1/8
Bending	Flange	24	24	20	16	12	10	8	6	5	3
	Web	34	34	34	34	24	20	16	14	10	7
Shear		34	34	34	34	24	20	18	14	10	7
Compression		34	24	24	20	16	12	10	8	6	4

*Table only covers up to 88-in. periphery

Notes

3.1 Not applicable if size limit from Table 3.1 at left is exceeded (see Section F7).

3.2 Not applicable if $D/t > 2{,}030/F_y$ (see Section F8).

3.3 Not applicable if size limit from Table 3.1 at left is exceeded (see Section G4).

3.4 Equations provided for shear yielding. See AISC *Specification* Section G5 for shear buckling provisions.

3.5 For rectangular HSS, if size limit from Table 3.1 at left is exceeded use A_e from AISC *Specification* Section E7 in place of A_g. For round HSS and Pipe where $D/t > 3{,}190/F_y$, use A_e from AISC *Specification* Section E7 in place of A_g.