1 Basic Design Values

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2016 AISC *Specification* (ANSI/AISC 360-16) may be less constrained and less conservative.

W-, S-, C- and MC Shapes

W-Shapes	ASTM A992	F_y = 50 ksi	F_u = 65 ksi
S-, C- and MC-Shapes	ASTM A36	F_y = 36 ksi	F_u = 58 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	Strong Axis	$L_b \le L_p$	$0.66F_yS_x$	$0.99F_yS_x$	$L_p = \frac{300r_y}{\sqrt{F_y}}$ 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.		
		$L_b = L_r$	$0.42F_yS_x$	$0.63F_yS_x$	
	Weak Axis		$0.9F_yS_y$	$1.35F_yS_y$	
Shear (in strong axis)			$0.4F_yA_w$	$0.6F_yA_w$	See Note 1.2.
Compression	$L_c/r \le 800/\sqrt{F_y}$		$0.6F_yA_g(0.658)^P$	$0.9F_yA_g(0.658)^P$	$P = \frac{F_y(L_c/r)^2}{286{,}000}$ See Note 1.3.
	$L_c/r > 800/\sqrt{F_y}$		$\frac{150{,}000A_g}{(L_c/r)^2}$	$\frac{226{,}000A_g}{(L_c/r)^2}$	

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 (0.95) 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.

Connected Parts

Bolts	Group A (ASTM F3125 Grades A325 and F1852)	F_u = 120 ksi
	Group B (ASTM F3125 Grades A490 and F2280)	F_u = 150 ksi
	Group C (ASTM F3043 and F3111)	F_u = 200 ksi
Welds	F_{EXX} = 70 ksi	–

Basic Design Values 2

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Condition			ASD	LRFD	Related Info
Bolts	**Tension**		$0.38F_uA_b$	$0.56F_uA_b$	–
	Shear (N bolts, per shear plane)		$0.23F_uA_b$	$0.34F_uA_b$	Multiply by 1.25 for X bolts.
	Slip Resistance (Class A, STD holes)		$0.12F_uA_b$	$0.18F_uA_b$	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	$L_c/r \le 25$	$0.6F_yA$	$0.9F_yA$	–
		$L_c/r > 25$	Same as for W-shapes with $A_g = A$.		

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). 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.

3 Basic Design Values

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2016 AISC *Specification* (ANSI/AISC 360-16) may be less constrained and less conservative.

HSS Members

		Round		Rectangular	
HSS	ASTM A500 Grade C	F_y = 46 ksi	F_u = 62 ksi	F_y = 50 ksi	F_u = 62 ksi
	ASTM A1085 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.*

Nominal Wall Thickness, in.		⅞	¾	⅝	½	⅜	5⁄16	¼	3⁄16	⅛
Bending	Flange	22	20	16	12	10	8	6	5	3
	Web	24	24	24	24	20	18	14	10	7
Shear		24	24	24	24	20	18	14	10	7
Compression		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.

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P325-17C

Analysis and Design

Basic Design Values 4

This reference is based upon simplifying assumptions and arbitrarily selected limitations. Direct use of the 2016 AISC *Specification* (ANSI/AISC 360-16) 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 to the lateral load determined in Step 2. For ASD, multiply by 1.6.
Step 4. Multiply first-order results by the tabular value. K = 1, except for moment frames when the tabular value is greater than 1.1.

Design Story Drift Limit	Load Ratio from Step 3 (times 1.6 for ASD, 1.0 for LRFD)										
	0	5	10	20	30	40	50	60	80	100	120
H/100	1	1.1	1.1	1.3	**1.5**/1.4						**When ratio exceeds 1.5, simplified method**
H/200	1	1	1.1	1.1	1.2	1.3	**1.4**/1.3	**1.5**/1.4			**requires a stiffer**
H/300	1	1	1	1.1	1.1	1.2	1.2	1.3	**1.5**/1.4		**structure.**
H/400	1	1	1	1.1	1.1	1.1	1.2	1.2	1.3	**1.4**/1.3	1.5
H/500	1	1	1	1	1.1	1.1	1.1	1.2	1.2	1.3	1.4

Notes Where two values are provided, the value in **bold** is the value associated with R_M = 0.85. Interpolation between values in the table may produce an incorrect result.

Elastic Methods

Elastic Methods	Effective Length	Forces and Moments	Limitations	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	*Specification* Appendix 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)	$\Delta_{2nd}/\Delta_{1st} \le 1.5$	*Specification* Appendix 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	*Specification* 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.
4.2 An additional amplification for member curvature effects is required for columns in moment frames.
4.3 The B_1-B_2 approximation (Appendix 8) can be used to accomplish a second-order analysis within the limitation that $B_2 \le 1.5$. Also, B_1 and B_2 can be taken equal to the multiplier tabulated for the simplified method above.