

1 Basic Design Values

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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			$0.6F_y A_g \leq 0.5F_u A_e$	$0.9F_y A_g \leq 0.75F_u A_e$	For A_e , see AISC <i>Specification</i> Equation D3-1.
Bending	Strong Axis	$L_b \leq L_p$	$0.66F_y S_x$	$0.99F_y S_x$	$L_p = \frac{300r_y}{\sqrt{F_y}}$ <p>See Note 1.1. L_r and strength when $L_b > L_r$ are given in the AISC <i>Manual</i>.</p>
		$L_p < L_b \leq L_r$	Use linear interpolation between L_p and L_r .		
		$L_b = L_r$	$0.42F_y S_x$	$0.63F_y S_x$	
	Weak Axis		$0.9F_y S_y$	$1.35F_y S_y$	
Shear (in strong axis)			$0.4F_y A_w$	$0.6F_y A_w$	See Note 1.2.
Compression	$L_c/r \leq 800/\sqrt{F_y}$		$0.6F_y A_g (0.658)^P$	$0.9F_y A_g (0.658)^P$	$P = \frac{F_y (L_c/r)^2}{286,000}$ <p>See Note 1.3.</p>
	$L_c/r > 800/\sqrt{F_y}$		$\frac{150,000A_g}{(L_c/r)^2}$	$\frac{226,000A_g}{(L_c/r)^2}$	

Notes

- Multiply equations given for strong axis with $L_b \leq L_p$, 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).
- 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 $A_w = 1.8b_f t_f$.
- 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

Basic Design Values 2

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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	–

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

Notes

- 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.
- For LSL holes perpendicular to load direction, multiply by 0.83.
- For fillet welds, multiply by 1.5 for transverse loading (90-degree load angle). For other load angles, see AISC Specification Section J2.
- For calculation purposes, $F_u A_{nv}$ cannot exceed $F_y A_{gv}$. $U_{bs} = 1.0$ for a uniform tension stress; 0.5 for non-uniform tension stress.

3 Basic Design Values

HSS Members

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		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		$0.6F_yA_g \leq 0.5F_uA_e$	$0.9F_yA_g \leq 0.75F_uA_e$	For A_e , see AISC <i>Specification</i> 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	$L_c/r \leq 800/\sqrt{F_y}$	$0.6F_yA_g(0.658)^P$	$0.9F_yA_g(0.658)^P$	$P = \frac{F_y(L_c/r)^2}{286,000}$ See Note 3.5.
	$L_c/r > 800/\sqrt{F_y}$	$\frac{150,000A_g}{(L_c/r)^2}$	$\frac{226,000A_g}{(L_c/r)^2}$	

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

Nominal Wall Thickness, in.		7/8	3/4	5/8	1/2	3/8	5/16	1/4	3/16	1/8
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

- Not applicable if size limit from Table 3.1 at left is exceeded (see Section F7).
- Not applicable if $D/t > 2,030/F_y$ (see Section F8).
- Not applicable if size limit from Table 3.1 at left is exceeded (see Section G4).
- Equations provided for shear yielding. See AISC *Specification* Section G5 for shear buckling provisions.
- 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 .

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.

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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 requires a stiffer structure.						
H/200	1	1	1.1	1.1	1.2							1.3
H/300	1	1	1	1.1	1.1	1.2	1.2	1.3	1.5/1.4			
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	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	$\Delta_{2nd}/\Delta_{1st} \leq 1.5$; axial load limited	<i>Specification</i> 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)	$\Delta_{2nd}/\Delta_{1st} \leq 1.5$	<i>Specification</i> 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	<i>Specification</i> 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 $B_2 \leq 1.5$. Also, B_1 and B_2 can be taken equal to the multiplier tabulated for the simplified method above.