# 1 Basic Design Values

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.

<table>
<thead>
<tr>
<th>Condition</th>
<th>ASD</th>
<th>LRFD</th>
<th>Related Info</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tension</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$0.6F_y A_g \leq 0.5F_u A_e$</td>
<td>$0.9F_y A_g \leq 0.75F_u A_e$</td>
<td>For $A_e$, see AISC Specification Equation D3-1.</td>
</tr>
<tr>
<td><strong>Bending</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong Axis</td>
<td>$L_b \leq L_p$, $0.66F_y S_x$</td>
<td>$0.99F_y S_x$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$L_p &lt; L_b \leq L_r$, Use linear interpolation between $L_p$ and $L_r.$</td>
<td>$0.42F_y S_x$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$L_b = L_r$, $0.63F_y S_x$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak Axis</td>
<td>$0.9F_y S_y$</td>
<td>$1.35F_y S_y$</td>
<td></td>
</tr>
<tr>
<td><strong>Shear</strong> (in strong axis)</td>
<td>$0.4F_y A_w$</td>
<td>$0.6F_y A_w$</td>
<td>See Note 1.2.</td>
</tr>
<tr>
<td><strong>Compression</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$L_c / r \leq 800 / \sqrt{F_y}$</td>
<td>$0.6F_y A_g (0.658)^p$</td>
<td>$0.9F_y A_g (0.658)^p$</td>
<td></td>
</tr>
<tr>
<td>$L_c / r &gt; 800 / \sqrt{F_y}$</td>
<td>$150,000 A_g (L_c / r)^2$</td>
<td>$226,000 A_g (L_c / r)^2$</td>
<td>$P = \frac{F_y (L_c / r)^2}{286,000}$ See Note 1.3.</td>
</tr>
</tbody>
</table>

**Notes**

1. 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).

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 $A_w = 1.8b f t$. :

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

### Basic Design Values

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<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>( F_u ) (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>(ASTM F3125 Grades A325 and F1852)</td>
<td>120</td>
</tr>
<tr>
<td>Group B</td>
<td>(ASTM F3125 Grades A490 and F2280)</td>
<td>150</td>
</tr>
<tr>
<td>Group C</td>
<td>(ASTM F3043 and F3111)</td>
<td>200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Welds</th>
<th>( F_{\text{EXX}} ) (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition</th>
<th>ASD</th>
<th>LRFD</th>
<th>Related Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension (Bolts)</td>
<td>( 0.38F_uA_b )</td>
<td>( 0.56F_uA_b )</td>
<td>—</td>
</tr>
<tr>
<td>Shear (Bolts)</td>
<td>( 0.23F_uA_b )</td>
<td>( 0.34F_uA_b )</td>
<td>Multiply by 1.25 for X bolts.</td>
</tr>
<tr>
<td>Slip Resistance (Bolts)</td>
<td>( 0.12F_uA_b )</td>
<td>( 0.18F_uA_b )</td>
<td>Per slip plane. See Note 2.1.</td>
</tr>
<tr>
<td>Bearing (Bolts)</td>
<td>( 1.2d_bF_u )</td>
<td>( 1.8d_bF_u )</td>
<td>See Note 2.2.</td>
</tr>
<tr>
<td>Tearout (Bolts)</td>
<td>( 0.6l_cF_u )</td>
<td>( 0.9l_cF_u )</td>
<td></td>
</tr>
<tr>
<td>Shear (Welds)</td>
<td>( 0.3F_{\text{EXX}}A_{\text{we}} \leq 0.3F_uA_{BM} )</td>
<td>( 0.45F_{\text{EXX}}A_{\text{we}} \leq 0.45F_uA_{BM} )</td>
<td>See Note 2.3.</td>
</tr>
<tr>
<td>PJ P Groove Welds</td>
<td>Tension</td>
<td>( 0.32F_{\text{EXX}}A_w \leq 0.5F_uA_{BM} )</td>
<td>( 0.48F_{\text{EXX}}A_w \leq 0.75F_uA_{BM} )</td>
</tr>
<tr>
<td>PJ P Groove Welds</td>
<td>Compression</td>
<td>( 0.48F_{\text{EXX}}A_w \leq 0.6F_yA_{BM} )</td>
<td>( 0.72F_{\text{EXX}}A_w \leq 0.9F_yA_{BM} )</td>
</tr>
<tr>
<td>CJP Groove Welds</td>
<td>Strength equal to base metal.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes

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. For LSL holes perpendicular to load direction, multiply by 0.83.
3. For fillet welds, multiply by 1.5 for transverse loading (90-degree load angle). For other load angles, see AISC Specification Section J2.
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.
### HSS Members

<table>
<thead>
<tr>
<th>Condition</th>
<th>ASD</th>
<th>LRFD</th>
<th>Related Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension</td>
<td>$0.6F_yA_g \leq 0.5F_uA_e$</td>
<td>$0.9F_yA_g \leq 0.75F_uA_e$</td>
<td>For $A_e$, see AISC Specification Equation D3-1.</td>
</tr>
<tr>
<td>Bending</td>
<td>Rectangular HSS</td>
<td>$0.66F_yS$</td>
<td>See Note 3.1.</td>
</tr>
<tr>
<td></td>
<td>Round HSS and Pipe</td>
<td>$0.78F_yS$</td>
<td>See Note 3.2.</td>
</tr>
<tr>
<td>Shear</td>
<td>Rectangular HSS</td>
<td>$0.36F_yA_w$</td>
<td>See Note 3.3.</td>
</tr>
<tr>
<td></td>
<td>Round HSS and Pipe</td>
<td>$0.18F_yA_g$</td>
<td>See Note 3.4.</td>
</tr>
<tr>
<td>Compression</td>
<td>$L_c/r \leq 800/\sqrt{F_y}$</td>
<td>$0.6F_yA_g(0.658)^p$</td>
<td>$P = \frac{F_y(L_c/r)^2}{150,000A_g}$</td>
</tr>
<tr>
<td></td>
<td>$L_c/r &gt; 800/\sqrt{F_y}$</td>
<td>$0.9F_yA_g(0.658)^p$</td>
<td>$P = \frac{226,000A_g}{(L_c/r)^2}$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Nominal Wall Thickness, in.</th>
<th>7⁄₈</th>
<th>3⁄₄</th>
<th>5⁄₈</th>
<th>1⁄₂</th>
<th>7⁄₁₆</th>
<th>1⁄₄</th>
<th>3⁄₁₆</th>
<th>1⁄₈</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bending</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flange</td>
<td>22</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Web</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>20</td>
<td>18</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Shear</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>20</td>
<td>18</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Compression</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

*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 $A_g$.

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Analysis and Design

Basic Design Values

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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.

<table>
<thead>
<tr>
<th>Design Story Drift Limit</th>
<th>Load Ratio from Step 3 (times 1.6 for ASD, 1.0 for LRFD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>H/100</td>
<td>1</td>
</tr>
<tr>
<td>H/200</td>
<td>1</td>
</tr>
<tr>
<td>H/300</td>
<td>1</td>
</tr>
<tr>
<td>H/400</td>
<td>1</td>
</tr>
<tr>
<td>H/500</td>
<td>1</td>
</tr>
</tbody>
</table>

When ratio exceeds 1.5, simplified method requires a stiffer structure.

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

<table>
<thead>
<tr>
<th>Effective Length</th>
<th>Forces and Moments</th>
<th>Limitations</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-Order Analysis Method—second-order effects captured from effects of additional lateral load</td>
<td>$K = 1$ for all frames (see Note 4.2)</td>
<td>From analysis</td>
<td>$\Delta_{2nd}/\Delta_{1st} \leq 1.5$; axial load limited</td>
</tr>
<tr>
<td>Effective Length Method—second-order analysis with 0.2% of total gravity load as lateral load in gravity-only combinations (see Note 4.3)</td>
<td>$K = 1$, except for moment frames with $\Delta_{2nd}/\Delta_{1st} &gt; 1.1$</td>
<td>From analysis (see Note 4.3)</td>
<td>$\Delta_{2nd}/\Delta_{1st} \leq 1.5$</td>
</tr>
<tr>
<td>Direct Analysis Method—second-order analysis with no lateral load and reduced $EI$ and $AE$ (see Note 4.3)</td>
<td>$K = 1$ for all frames</td>
<td>From analysis (see Note 4.3)</td>
<td>None</td>
</tr>
</tbody>
</table>

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.