Outstanding Unconnected Element

$A_m = A_g$

$1.67''$

$L6 \times 6 \times \frac{1}{2}$

$P_u \leq F_u A_e$

$V_y = 0.6 F_y$

$V_u = 0.6 F_u$

$F_y$

$F_u$

**3.4 STAGGERED FASTENERS**

FIGURE 3.13

Add $\frac{2a^2}{4g}$ for each slanted tear line

(a)

(b)

(c)
OLD NOTES

\[ A_g = b t \]
\[ A_{net} = b t - N d_n t \]
\[ A_{eff} = A_{net} \times U \quad \text{Shear lag factor} \]

\[ N = \text{number of holes in plane of failure} \]

\[ d_n = d_0 + \frac{1}{16} \text{" fit } + \frac{1}{16} \text{" damage} \]

\[ A_{\text{effective}} = ? \]

\[ f = \frac{P}{A_{\text{gross}}} \]

\[ f = \frac{P}{A_{\text{net}}} \times U \]
Rigid Plate Underneath

\[ U = \text{bolted} \]
\[ Ae = U Am \]
\[ Ae = Am \text{ for plates} \]

\[ P_{ TOTAL} = 900_k \]

\[ P_{a-a} = 900_k \]

\[ P_{b-b} = 800_k \]

\[ P_{c-c} = 600_k \]

\[ P_{d-d} = 300_k \]

\[ P = \left( \frac{\text{bolts remaining on that line and farther to the right}}{\text{total # bolts}} \right) P_{ TOTAL} \]

\[ P_{b-b} = \frac{8}{9} (900_k) = 800_k \]

\[ f_{a-a} = 900_k / A_e \]

\[ f_{b-b} = 800_k / A_e \]
If the amount of stagger is small enough, the influence of an offset hole may be

sponding to a staggered hole, use a reduced diameter, given by

\[ d' = d - \frac{s^2}{4g} \]

\[ \text{Added length} = + \frac{\Delta}{4g} \]  

(3.2)

where \( d \) is the hole diameter, \( s \) is the stagger, or pitch, of the bolts (spacing in the

the net width in a failure line consisting of both staggered and unstaggered holes is

\[ w_n = w_g - \Sigma d' \]

\[ = w_g - \Sigma \left( d - \frac{s^2}{4g} \right) \]

where \( w_n \) is the net width and \( w_g \) is the gross width. The second term is the sum of all

hole diameters, and the third term is the sum of \( s^2/4g \) for all inclined

lines in the fail-

\[ 0.6 Fu \]

\[ \text{Note: } Fu_n = 0.6 Fu \]

\[ \text{SOLUTION} \]

Compute the smallest net area for the plate shown in Figure 3.15. The holes are

for 1-inch-diameter bolts. Assume \( Fu = 1100 \text{ lb} \).

The effective hole diameter is \( 1 + \frac{1}{8} = 1\frac{1}{8} \) in. For line \( abde \),

\[ w_n = 16 - 2(1.125) = 13.75 \text{ in.} \]

Across plate

\[ A_n = (13.75 \text{ in.}) (\frac{3}{4} \text{ in.}) = 10.3 \text{ in.}^2 \]

\[ Fu = 1100 \text{ lb} \]
For line $abcde$,

$$w_n = 16 - 3(1.125) + \frac{2(3)^2}{4(3/4)} = 13.52 \text{ in.} \quad \text{Across plate & } A_n = (13.52'')(3/4)''$$

The second condition will give the smallest net area:

$$A_n = tw_n = 0.75(13.52) = 10.1 \text{ in.}^2$$

$$U = 1.0$$

Specification. If the shape is an angle, it can be visualized as a plate formed by "unfolding" the legs to more clearly identify the pitch and gage distances. AISC B4.3b specifies that any gage line crossing the heel of the angle be reduced by an amount that equals the angle thickness. Thus, the distance $g$ in Figure 3.16 is changed to $g = \text{gage}$.
EXAMPLE 3.7

An angle with staggered fasteners in each leg is shown in Figure 3.17. A36 steel is used, and holes are for 7/8-inch-diameter bolts.

a. Determine the design strength for LRFD.

SOLUTION

From the dimensions and properties tables, the gross area is \( A_g = 6.80 \text{ in.}^2 \). The effective hole diameter is \( 7/8 + 7/8 = 1 \text{ in.} \).

For line abdf, the net area is

\[
A_n = A_g - \Sigma t_v \times (d + h/2) = 6.80 - 0.5(1.0) \times 2 = 5.80 \text{ in.}^2
\]

For line abceg,

\[
A_n = 6.80 - 0.5(1.0) - 0.5 \left[ \frac{d}{1.0} - \frac{d^2}{4(2.5)} \right] - 0.5(1.0) = 5.413 \text{ in.}^2
\]

Because \( 1/10 \) of the load has been transferred from the member by the fastener at \( d \), this potential failure line must resist only \( 9/10 \) of the load. Therefore, the net area

\[
\frac{2}{3} \sqrt{g} \text{ for line } b/c = \frac{1.5}{2} \sqrt{4(2.5)} = 0.225
\]

FIGURE 3.17
From previous page for L 8 x 6 x 1/2

\[ \begin{align*}
6' & - \frac{x}{2} = 6 - 1/4 = 5.75' \\
8' & - \frac{x}{2} = 8 - 1/4 = 7.75'
\end{align*} \]

\[ g_3 = 3'' \]

\[ 2.25'' = g_1 \]

\[ g = 4.75'' \]

\[ q_2 \]

3 holes

\[ \text{line } bc \]

\[ A_{isc} \]

\[ A_n = A_{isc} - 3d \times t + \frac{a^2}{4g} \times t \]

\[ A_{isc} = 6.80 \text{ in}^2 = 3(1.0 \text{ in})(0.5 \text{ in}) + \frac{1.5 \text{ in}^2}{4(2.5'')} \times t \]

\[ = 5.41 \text{ in}^2 \]

\[ \frac{a^2}{4g} = \text{added length of slanted tear lines} \]
### Table 1-7 (continued)

**Angles**

**Properties**

<table>
<thead>
<tr>
<th>Shape</th>
<th>k</th>
<th>W</th>
<th>Area, A</th>
<th>Axis X-X</th>
<th>Flexural-Torsional Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in.</td>
<td>lb/ft</td>
<td>in.²</td>
<td>in.⁴</td>
<td>in.³</td>
</tr>
<tr>
<td>L3 3/4x4</td>
<td>0.75</td>
<td>22.2</td>
<td>0.06</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>L2 1/2x2</td>
<td></td>
<td>30</td>
<td>0.04</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>L2 1/3</td>
<td></td>
<td>33</td>
<td>0.04</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>L2 1/4x1</td>
<td></td>
<td>35</td>
<td>0.03</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>L2 2/3x1</td>
<td></td>
<td>36</td>
<td>0.03</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38</td>
<td>0.03</td>
<td>0.75</td>
<td>0.75</td>
</tr>
</tbody>
</table>

### Table 1-7A

**Workable Gages in Angle Legs, in.**

<table>
<thead>
<tr>
<th>g</th>
<th>6&quot; Leg</th>
<th>6&quot; Leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>4½</td>
<td>6</td>
</tr>
<tr>
<td>g₁</td>
<td>3</td>
<td>3½</td>
</tr>
<tr>
<td>g₂</td>
<td>3</td>
<td>3½</td>
</tr>
</tbody>
</table>

**Note:** Other gages are permitted to suit specific requirements subject to clearances and edge distance limitations.
of 5.413 in.² should be multiplied by 10% to obtain a net area that can be compared
with those lines that resist the full load. Use $A_n = 5.413(10\%) = 6.014$ in.² For line

\[8_{cd} = 3 + 2.25 - 0.5 = 4.75 \text{ in.}\]

\[A_n = 6.80 - 0.5(1.0) - 0.5\left[1.0 - \frac{(1.5)^2}{4(2.5)}\right] - 0.5\left[1.0 - \frac{(1.5)^2}{4(4.75)}\right] - 0.5\left[1.0 - \frac{(1.5)^2}{4(3)}\right]\]

\[abcde = 5.065 \text{ in.}^2\]

The last case controls; use

$A_n = 5.065$ in.²

Both legs of the angle are connected, so $U = 1.0$

$A_e = A_n = 5.065$ in.²

The nominal strength based on fracture is

$P_n = F_u A_e = 58(5.065) = 293.8$ kips

The nominal strength based on yielding is

$P_n = F_y A_g = 36(6.80) = 244.8$ kips

a. The design strength based on fracture is

$\phi P_n = 0.75(293.8) = 220$ kips

The design strength based on yielding is

$\phi P_n = 0.90(244.8) = 220$ kips

**Answer** Design strength = 220 kips.
For L 5\times 3\times \frac{1}{2} - New example for $\theta$

\[ \theta = 3'' + 1.75'' - \frac{1}{2}'' = 4.25'' \]

If used 2 bolts in 5'' leg

\[ \theta = 2'' + 1.75'' - \frac{1}{2}'' = 3.25'' \]
Pop Quiz 1/28/13

7/8" Bolt \( \phi \)

6" 

\[ P = ? \]

\[ F_u = 58 \]
\[ F_y = 36 \]
\[ \phi_{GSY} = 0.9 \]
\[ \phi_{NSR} = 0.75 \]
# Table 2–3

<table>
<thead>
<tr>
<th>Steel Type</th>
<th>ASTM Designation</th>
<th>Yield Stress (ksi)</th>
<th>Tensile Stress (ksi)</th>
<th>W</th>
<th>M</th>
<th>S</th>
<th>HP</th>
<th>C</th>
<th>MC</th>
<th>L</th>
<th>Rect.</th>
<th>Round</th>
<th>Pipe</th>
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<tbody>
<tr>
<td><strong>Carbon</strong></td>
<td>A36</td>
<td>36</td>
<td>50-80</td>
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<tr>
<td></td>
<td>A53 Gr. B</td>
<td>35</td>
<td>50</td>
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<td></td>
<td>Gr. B</td>
<td>42</td>
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<td>A510 Gr. C</td>
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<td>50</td>
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<tr>
<td></td>
<td>Gr. C</td>
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<td>50</td>
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<td>Gr. 55</td>
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<td>70-100</td>
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<tr>
<td><strong>High-Strength Low-Alloy</strong></td>
<td>A992</td>
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<td><strong>Corrosion Resistant High-Strength Low-Alloy</strong></td>
<td>A242</td>
<td>42</td>
<td>63</td>
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<tr>
<td><strong>Low-Alloy</strong></td>
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<td>A847</td>
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<td></td>
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</tr>
</tbody>
</table>

- **Table Note:**
  - ■ = Preferred material specification.
  - □ = Other applicable material specification, the availability of which should be confirmed prior to specification.
  - ○ = Material specification does not apply.

- **Footnotes:**
  1. For shapes with a flange thickness greater than 2 in. only.
  2. For shapes with a flange thickness greater than 1 1/2 in. and less than or equal to 2 in. only.
  3. For shapes with a flange thickness less than or equal to 1 1/2 in. only.

---

**American Institute of Steel Construction, Inc.**
EXAMPLE 3.8

SOLUTION

\[ A_n = A_g - \sum t_w \times (d^{1/2}) \]

\[ d = \text{bolt diameter} + \frac{1}{8} + \frac{1}{8} = \frac{3}{4} \text{ in.} \]

Line abe:

\[ A_n = A_g - t_w d = 3.82 - 0.437 \left( \frac{3}{4} \right) = 3.49 \text{ in}^2 \]

Line abcd:

\[ A_n = A_g - t_w (d \text{ for hole at } b) - t_w (d' \text{ for hole at } c) \]

\[ = 3.82 - 0.437 \left( \frac{3}{4} \right) = 0.437 \left( \frac{3}{4} \right) \]

\[ = 3.31 \text{ in}^2 \]

ANSWER

Smallest net area = 3.31 in.²

FIGURE 3.18

\[ U = 1 - \frac{N}{L} \]

see (62a & b)

\[ U = 1 - \frac{0.5}{114} \text{ in} \]

\[ = 0.936 \]

\[ A_e = A_m U = 3.31 \text{ in}^2 \times 0.936 = 3.097 \text{ in}^2 \]

\[ \phi = 0.9 \]

\[ \phi = 0.75 \]

\[ (\frac{2.14}{4.3^2}) = 0.33 \text{ in} \]

\[ P_u \]

for G54? NSR?
### Table 1-5

**C-Shapes Dimensions**

<table>
<thead>
<tr>
<th>Shape</th>
<th>Area, $A$</th>
<th>Depth, $d$</th>
<th>Web</th>
<th>Flange</th>
<th>Distance</th>
<th>Workable Gage</th>
<th>$r$</th>
<th>$h_o$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in.²</td>
<td>in.</td>
<td>in.</td>
<td>in.</td>
<td></td>
<td>in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C15x50</td>
<td>14.7</td>
<td>15.0</td>
<td>15</td>
<td>0.716</td>
<td>3/16</td>
<td>3 1/4</td>
<td>0.650</td>
<td>17/16</td>
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<td>×12.25</td>
<td>3.59</td>
<td>7.00</td>
<td>7</td>
<td>0.314</td>
<td>1/16</td>
<td>1/16</td>
<td>1/6</td>
<td>5/4</td>
</tr>
<tr>
<td>×9.8</td>
<td>2.87</td>
<td>7.00</td>
<td>7</td>
<td>0.210</td>
<td>1/16</td>
<td>1/16</td>
<td>1/6</td>
<td>5/4</td>
</tr>
<tr>
<td>C6x13</td>
<td>3.82</td>
<td>6.00</td>
<td>6</td>
<td>0.437</td>
<td>1/16</td>
<td>1/4</td>
<td>1/2</td>
<td>4/6</td>
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<td>×10.5</td>
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<td>6.00</td>
<td>6</td>
<td>0.314</td>
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<td>3/16</td>
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<td>4/6</td>
</tr>
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<td>×8.2</td>
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<td>6</td>
<td>0.200</td>
<td>1/16</td>
<td>3/16</td>
<td>1/2</td>
<td>4/6</td>
</tr>
</tbody>
</table>

---

*The actual size, combination and orientation of fastener components should be compared with the geometry of the cross section to ensure compatibility.  
— Indicates flange is too narrow to establish a workable gage.*
For $U = 1 - \frac{a}{h}$ for C6x13:

$$U = 1 - \frac{0.514}{8} = 0.936$$

### Table 1-5 (continued)

**C-Shapes**

**Properties**

<table>
<thead>
<tr>
<th>Nominal Wt. (lb/ft)</th>
<th>Shear Ctr. $e_0$</th>
<th>Axis X-X</th>
<th>Axis Y-Y</th>
<th>Torsional Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$I$</td>
<td>$S$</td>
<td>$r$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in.</td>
<td>in.</td>
<td>in.</td>
</tr>
<tr>
<td>50</td>
<td>0.563</td>
<td>404</td>
<td>53.8</td>
<td>5.24</td>
</tr>
<tr>
<td>40</td>
<td>0.767</td>
<td>348</td>
<td>46.5</td>
<td>5.43</td>
</tr>
</tbody>
</table>

13  | 0.380          | 17.3     | 5.78     | 2.13     | 7.29     | 1.05     | 0.638    | 0.524    | 0.514    | 1.35     | 0.318    | 0.237    | 7.19    | 2.37   | 0.856  |
10.5 | 0.466          | 15.1     | 5.04     | 2.22     | 6.18     | 0.860    | 0.561    | 0.529    | 0.580    | 1.14     | 0.256    | 0.128    | 5.91    | 2.48   | 0.842  |
8.2  | 0.599          | 13.1     | 4.35     | 2.34     | 5.16     | 0.687    | 0.488    | 0.536    | 0.512    | 0.987    | 0.199    | 0.0736   | 4.70    | 2.65   | 0.824  |
CHAPTER D
DESIGN OF MEMBERS FOR TENSION

This chapter applies to members subject to axial tension caused by static forces acting through the centroidal axis.

The chapter is organized as follows:

D1. Slenderness Limitations
D2. Tensile Strength
D3. Effective Net Area
D4. Built-Up Members
D5. Pin-Connected Members
D6. Eyebars

User Note: For cases not included in this chapter the following sections apply:

• B3.11 Members subject to fatigue
• Chapter H Members subject to combined axial tension and flexure
• J3 Threaded rods
• J4.1 Connecting elements in tension
• J4.3 Block shear rupture strength at end connections of tension members

D1. SLENDERNESS LIMITATIONS

There is no maximum slenderness limit for members in tension.

User Note: For members designed on the basis of tension, the slenderness ratio \( L/r \) preferably should not exceed 300. This suggestion does not apply to rods or hangers in tension.

D2. TENSILE STRENGTH

The design tensile strength, \( f_t P_u \), and the allowable tensile strength, \( P_u/\Omega_t \), of tension members shall be the lower value obtained according to the limit states of tensile yielding in the gross section and tensile rupture in the net section.

(a) For tensile yielding in the gross section:

\[
P_u = F_y A_g \quad \text{GSY} \quad (D2-1)
\]

\( \phi_t = 0.90 \) (LRFD) \quad \Omega_t = 1.67 (ASD)

(b) For tensile rupture in the net section:

\[
P_u = F_y A_g \quad \text{NSR} \quad (D2-2)
\]

\( \phi_t = 0.75 \) (LRFD) \quad \Omega_t = 2.00 (ASD)

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where
\[ A_e = \text{effective net area, in.}^2 \text{ (mm}^2\text{)} \]
\[ A_g = \text{gross area of member, in.}^2 \text{ (mm}^2\text{)} \]
\[ F_y = \text{specified minimum yield stress, ksi (MPa)} \]
\[ F_u = \text{specified minimum tensile strength, ksi (MPa)} \]

When members without holes are fully connected by welds, the effective net area used in Equation D2-2 shall be as defined in Section D3. When holes are present in a member with welded end connections, or at the welded connection in the case of plug or slot welds, the effective net area through the holes shall be used in Equation D2-2.

**D3. EFFECTIVE NET AREA**

The gross area, \( A_g \), and net area, \( A_n \), of tension members shall be determined in accordance with the provisions of Section B4.3. \[ \text{[16.1-18]} \]

The effective net area of tension members shall be determined as follows:

\[ A_e = A_n U \quad \text{(D3-1)} \]

where \( U \), the shear lag factor, is determined as shown in Table D3.1. \[ \text{[16.1-28]} \]

For open cross sections such as W, M, S, C or HP shapes, WT, ST, and single and double angles, the shear lag factor, \( U \), need not be less than the ratio of the gross area of the connected element(s) to the member gross area. This provision does not apply to closed sections, such as HSS sections, nor to plates.

**User Note:** For bolted splice plates \( A_e = A_n \leq 0.85 A_g \), according to Section J4.1. \[ \text{[16.1-129]} \]

**D4. BUILT-UP MEMBERS**

For limitations on the longitudinal spacing of connectors between elements in continuous contact consisting of a plate and a shape or two plates, see Section J3.5.

Either perforated cover plates or tie plates without lacing are permitted to be used on the open sides of built-up tension members. Tie plates shall have a length not less than two-thirds the distance between the lines of welds or fasteners connecting them to the components of the member. The thickness of such tie plates shall not be less than one-fiftieth of the distance between these lines. The longitudinal spacing of intermittent welds or fasteners at tie plates shall not exceed 6 in. (150 mm).

**User Note:** The longitudinal spacing of connectors between components should preferably limit the slenderness ratio in any component between the connectors to 300.
### TABLE D3.1
Shear Lag Factors for Connections to Tension Members

<table>
<thead>
<tr>
<th>Case</th>
<th>Description of Element</th>
<th>Shear Lag Factor, $U$</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All tension members where the tension load is transmitted directly to each of the cross-sectional elements by fasteners or welds (except as in Cases 4, 5 and 6).</td>
<td>$U = 1.0$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>All tension members, except plates and HSS, where the tension load is transmitted to some but not all of the cross-sectional elements by fasteners or longitudinal welds or by longitudinal welds in combination with transverse welds. (Alternatively, for W, M, S and HP, Case 7 may be used. For angles, Case 8 may be used.)</td>
<td>$U = 1 - \frac{\bar{x}}{l}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>All tension members where the tension load is transmitted only by transverse welds to some but not all of the cross-sectional elements.</td>
<td>$U = 1.0$ and $A_p =$ area of the directly connected elements</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Plates where the tension load is transmitted by longitudinal welds only.</td>
<td>$I \geq 2w \ldots U = 1.0$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$2w &gt; I \geq 1.5w \ldots U = 0.87$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$1.5w &gt; I \geq w \ldots U = 0.75$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Round HSS with a single concentric gusset plate</td>
<td>$I \geq 1.3D \ldots U = 1.0$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$D \leq I &lt; 1.3D \ldots U = 1 - \frac{\bar{x}}{l}$</td>
<td>$\bar{x} = \frac{D}{\pi}$</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Rectangular HSS with a single concentric gusset plate</td>
<td>$I \geq H \ldots U = 1 - \frac{\bar{x}}{l}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\bar{x} = \frac{B^2 + 2BH}{4(B + H)}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with two side gusset plates</td>
<td>$I \geq H \ldots U = 1 - \frac{\bar{x}}{l}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\bar{x} = \frac{B^2}{4(B + H)}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>W, M, S or HP Shapes or Tees cut from these shapes. (If $U$ is calculated per Case 2, the larger value is permitted to be used.)</td>
<td>$b_f \geq 2/3d \ldots U = 0.90$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$b_f &lt; 2/3d \ldots U = 0.85$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with web connected with 4 or more fasteners per line in the direction of loading</td>
<td>$U = 0.70$</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Single and double angles (If $U$ is calculated per Case 2, the larger value is permitted to be used.)</td>
<td>$U = 0.80$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with 4 or more fasteners per line in the direction of loading</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with 3 fasteners per line in the direction of loading (With fewer than 3 fasteners per line in the direction of loading, use Case 2.)</td>
<td>$U = 0.60$</td>
<td></td>
</tr>
</tbody>
</table>

$I$ = length of connection, in. (mm); $w$ = plate width, in. (mm); $\bar{x}$ = eccentricity of connection, in. (mm); $B$ = overall width of rectangular HSS member, measured 80° to the plane of the connection, in. (mm); $H$ = overall height of rectangular HSS member, measured in the plane of the connection, in. (mm)
3. Gross and Net Area Determination

3a. Gross Area

The gross area, $A_g$, of a member is the total cross-sectional area.

3b. Net Area

The net area, $A_n$, of a member is the sum of the products of the thickness and the net width of each element computed as follows:

In computing net area for tension and shear, the width of a bolt hole shall be taken as $\frac{1}{16}$ in. (2 mm) greater than the nominal dimension of the hole.

For a chain of holes extending across a part in any diagonal or zigzag line, the net width of the part shall be obtained by deducting from the gross width the sum of the diameters or slot dimensions as provided in this section, of all holes in the chain, and adding, for each gage space in the chain, the quantity $s^2/4g$,

where

$s =$ longitudinal center-to-center spacing (pitch) of any two consecutive holes, in. (mm)

$g =$ transverse center-to-center spacing (gage) between fastener gage lines, in. (mm)

For angles, the gage for holes in opposite adjacent legs shall be the sum of the gages from the back of the angles less the thickness.

For members without holes, the net area, $A_n$, is equal to the gross area, $A_g$.

User Note: Section J4.1(b) limits $A$ to a maximum of $0.85A_g$ for splice plates with holes.

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3.5 BLOCK SHEAR

For certain connection configurations, a segment or "block" of material at the end of the member can tear out. For example, the connection of the single-angle tension member shown in Figure 3.21 is susceptible to this phenomenon, called block shear.
The model used in the AISC Specification assumes that failure occurs by rupture (fracture) on the shear area and rupture on the tension area. Both surfaces contribute to the total strength, and the resistance to block shear will be the sum of the strengths of the two surfaces. The shear rupture stress is taken as 60% of the tensile ultimate.