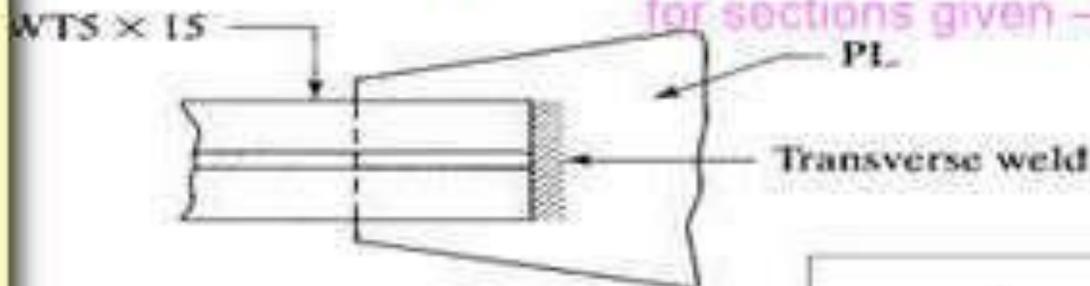


3-32. A WT5 × 15 consisting of A992 steel with a transverse weld to its flange only as shown in Fig. P3-32.

Determine the LRFD design strength and the ASD allowable strength for sections given –neglect block shear– fifth version.

U < 1
since
Only
yellow
part is
connec
ted



Use table 1-8 for Wt for data

FIGURE P3-32

Fy and Fu for A992



Table 1-8 (continued)
WT-Shapes
Dimensions

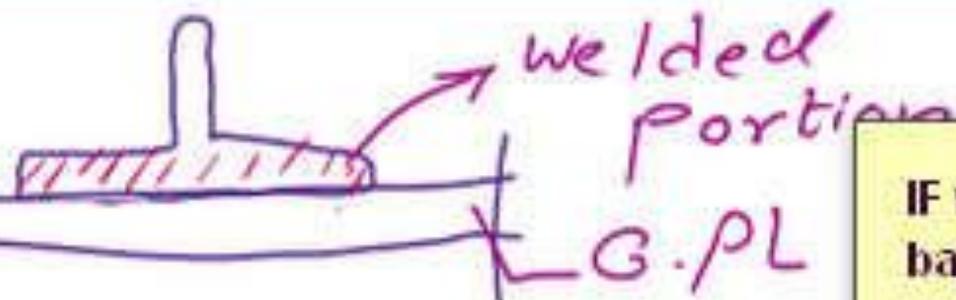
Shape	Area, A in. ²	Depth, d in.	Stem			Flange			Distance		Work- able Gage in.
			Thickness, tw in.	L/2 in.	Area in. ²	Width, bf in.	Thickness, tf in.	k			
								kmax in.	kmin in.		
WT5x15	4.42	5.24	5/16	3/16	1.57	5.81	5/16	1/2	0.810	1 1/8	2 3/4
x13 ^c	3.81	5.17	5/16	1/4	1.34	5.77	5/16	3/16	0.740	1 1/8	↓
x11 ^c	3.24	5.09	5/16	1/4	1.22	5.75	5/16	3/16	0.660	1 5/8	↓

A992 steel ⇒ Fy : 50 ksi
Fu : 65 ksi

Dim of WT5x15

A = 4.42 in²
tw = 0.30
bf = 5.81"
tf = 0.51"
d = 5.24"
B/E

Prepared by Eng. Maged Kamel.



IF we solve
based on Aisc -
2010

2010
TABLE D3.1
**Shear Lag Factors for Connections
to Tension Members**

Case	Description of Element	Shear Lag Factor, U	Example
1	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).	$U = 1.0$	—
2	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.)	$U = 1 - \bar{x}/l$	
3	All tension members where the tension load is transmitted only by transverse welds to some but not all of the cross-sectional elements.	$U = 1.0$ and $A_e =$ area of the directly connected elements	—

$$U = 1.0$$

$A_n =$ area of the connected elements

$$U_{min} = \frac{\text{Area Connected}}{\text{Total Area}}$$

Min. U value

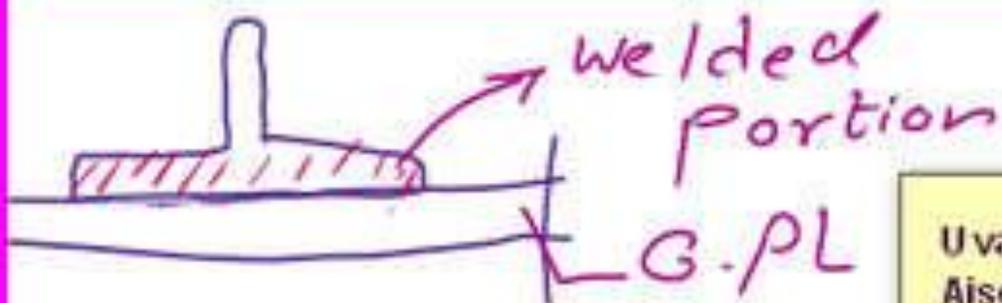
$$U_{min} = \frac{t_f \cdot b_f}{A} = \frac{5.81(0.51)}{4.42} = 0.67$$

But From Case #3 $\Rightarrow U = 1$

$$A_{connected} = 5.81(0.51) = 2.9631 \text{ inch}^2$$

$$A_{eff} = 2.9631$$

Prepared by Eng. Maged Kamel.



16.1-30

PIN-CONNECTED MEMBERS

[Sect. D5]

2016

U value based on
Aisc-360-2016

TABLE D3.1
Shear Lag Factors for Connections
to Tension Members

Case	Description of Element	Shear Lag Factor, U	Example
1	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).	$U = 1.0$	-
2	All tension members, except HSS, where the tension load is transmitted to some but not all of the cross-sectional elements by fasteners or by longitudinal welds in combination with transverse welds. Alternatively, Case 7 is permitted for W, M, S and HP shapes. (For angles, Case 8 is permitted to be used.)	$U = 1 - \frac{\bar{x}}{l}$	
3	All tension members where the tension load is transmitted only by transverse welds to some but not all of the cross-sectional elements.	$U = 1.0$ and $A_e =$ area of the directly connected elements	-
4	Plates, angles, channels with welds at heels, tees, and W-shapes with connected elements, where the tension load is transmitted by longitudinal welds only. See Case 2 for definition of \bar{x} .	$U = \frac{3\bar{x}^2}{3\bar{x}^2 + w^2} \left(1 - \frac{\bar{x}}{l}\right)$	

$$U = 1.0$$

$A_n =$ area of the connected elements

$$U_{min} = \frac{\text{Area Connected}}{\text{Total Area}}$$

$$U_{min} = \frac{t_f \cdot b_f}{A} = \frac{5.81(0.51)}{4.42}$$

$$U_{min} = 0.67$$

But From Case #3 $\Rightarrow U = 1$

$$A_{connected} = 5.81(0.51) = 2.9631 \text{ inch}^2$$

$$A_{epl} = (1)(2.961) = 2.9631 \text{ inch}^2$$

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As a result of the preceding information, the AISC Specification (D2) states that the nominal strength of a tension member, P_n , is to be the smaller of the values obtained by substituting into the following two expressions:

For the limit state of yielding in the gross section (which is intended to prevent excessive elongation of the member),

$$P_n = F_y A_g \quad \leftarrow \text{Limit state of Yielding} \quad (\text{AISC Equation D2-1})$$

$$\phi_t P_n = \phi_t F_y A_g = \text{design tensile strength by LRFD } (\phi_t = 0.9)$$

$$\frac{P_n}{\Omega_t} = \frac{F_y A_g}{\Omega_t} = \text{allowable tensile strength for ASD } (\Omega_t = 1.67)$$

For tensile rupture in the net section, as where bolt or rivet holes are present,

$$P_n = F_u A_e \quad \leftarrow \text{Limit state of Rupture} \quad (\text{AISC Equation D2-2})$$

$$\phi_t P_n = \phi_t F_u A_e = \text{design tensile rupture strength for LRFD } (\phi_t = 0.75)$$

$$\frac{P_n}{\Omega_t} = \frac{F_u A_e}{\Omega_t} = \text{allowable tensile rupture strength for ASD } (\Omega_t = 2.00)$$

$$\begin{array}{l}
 A_g = \text{Area of WT} \\
 = 4.42 \text{ inch}^2 \quad \text{Gross area}
 \end{array}
 \quad \& \quad
 \begin{array}{l}
 F_y = 50 \text{ ksi} \\
 F_u = 65 \text{ ksi}
 \end{array}
 \quad \left. \vphantom{\begin{array}{l} A_g \\ F_y \\ F_u \end{array}} \right\}
 \begin{array}{l}
 A_e = 2.961 \text{ inch}^2 \\
 \text{Effective area}
 \end{array}$$

Tensile strength $P_n = F_y \cdot A_g = 50(4.42) = 221 \text{ kips}$

$\phi = 0.90$ yielding LRFD Design

$R = 1.67$ LRFD tensile yielding

$\phi P_n = 0.90(221) = 198.90 \text{ kips}$ Tensile yielding

Tensile strength (rupture) $\Rightarrow \phi = 0.75$ & $R = 2.0$

LRFD tensile rupture

$P_n = F_{ult} \cdot A_e = 65(2.9631) = 192.60 \text{ kips}$

$\phi P_n = 0.75(192.60) = 144.45 \text{ kips}$

Choose 144.45 kips

Prepared by Eng. Maged Kamel.

\Rightarrow LRFD design is controlled by rupture

Prepared by Eng.Maged Kamel.

$A_g = \text{Area of WT} = 4.42 \text{ inch}^2$ & $F_y = 50 \text{ ksi}$
 $F_u = 65 \text{ ksi}$

Tensile Yielding

$A_e = 2.961 \text{ inch}^2$

Tensile strength $P_n = F_y \cdot A_g = 50(4.42) = 221 \text{ kips}$
 $\phi = 0.90$ yielding ASD Design

$R = 1.67$

$P_n = \frac{1}{1.67}(221) = 132.34 \text{ kips}$ Tensile yielding
 Tensile Rupture

Tensile strength (rupture) $\Rightarrow \phi = 0.75$ & $R = 2.0$

$P_n = F_{ult} \cdot A_e = 65(2.9631) = 192.465 \text{ kips}$

$\frac{1}{2} P_n = \frac{1}{2}(192.465) = 96.23 \text{ kips} \Rightarrow \text{ASD Design}$

Choose $\Rightarrow 96.23 \text{ kips}$ Prepared by Eng. Maged Kamel. Controlled by rupture