3.3-3

$$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{0.775}{8} = 0.9031$$

$$A_e = A_g U = 2.48(0.9031) = 2.240 \text{ in.}^2$$

$$P_n = F_u A_e = 58(2.240) = 129.9 \text{ kips}$$

$P_n = 130$ kips

3.3-5

Gross section: $P_n = F_y A_g = 36(5.86) = 211.0$ kips

Net section: $A_n = 5.86 - \left(\frac{5}{8}\right)\left(1 + \frac{1}{8}\right)(2) = 4.454 \text{ in.}^2$

$$U = 1 - \frac{\bar{x}}{\ell} = 1 - \frac{1.03}{(3+3+3)} = 0.8856$$

$$A_e = A_n U = 4.454(0.8856) = 3.944 \text{ in.}^2$$

$$P_n = F_u A_e = 58(3.944) = 228.8 \text{ kips}$$

(a) The design strength based on yielding is

$$\phi_t P_n = 0.90(211.0) = 190 \text{ kips}$$

The design strength based on fracture is

$$\phi_t P_n = 0.75(228.8) = 172 \text{ kips}$$

The design strength is the smaller value: $\phi_t P_n = 172$ kips

Load combination 2 controls:

$$P_u = 1.2D + 1.6L = 1.2(50) + 1.6(100) = 220 \text{ kips}$$

Since $P_u > \phi_t P_n$, (220 kips > 172 kips), The member is not adequate.

3.3-6

For yielding of the gross section,

$$A_g = 5(1/4) = 1.25 \text{ in.}^2$$

$$P_n = F_y A_g = 36(1.25) = 45.0 \text{ kips}$$

For fracture of the net section, from AISC Table D3.1, case 4,

$$L/w = 7/5 = 1.4, \quad \therefore \; U = 0.75$$

$$A_e = A_g U = 1.25(0.75) = 0.9375 \text{ in.}^2$$

$$P_n = F_u A_e = 58(0.9375) = 54.38 \text{ kips}$$

a) The design strength based on yielding is

$$\phi_t P_n = 0.90(45.0) = 40.5 \text{ kips}$$

The design strength based on fracture is

$$\phi_t P_n = 0.75(54.38) = 40.8 \text{ kips}$$

The design strength for LRFD is the smaller value: $\underline{\phi_t P_n = 40.5 \text{ kips}}$

3.3-7

Gross section: $P_n = F_y A_g = 50(10.3) = 515.0 \text{ kips}$

Net section: $A_n = 10.3 - 0.520\left(\frac{7}{8} + \frac{1}{8}\right)(4) = 8.220 \text{ in.}^2$

Connection is through the flanges with four bolts per line.

$$\frac{b_f}{d} = \frac{6.56}{12.5} = 0.525 < \frac{2}{3} \qquad \therefore \; U = 0.85$$

$$A_e = A_n U = 8.220(0.85) = 6.987 \text{ in.}^2$$

$$P_n = F_u A_e = 65(6.987) = 454.2 \text{ kips}$$

(a) The design strength based on yielding is

$$\phi_t P_n = 0.90(515.0) = 464 \text{ kips}$$

The design strength based on fracture is

$$\phi_t P_n = 0.75(454.2) = 341 \text{ kips}$$

The design strength is the smaller value: $\underline{\phi_t P_n = 341 \text{ kips}}$

3.4-3

Gross section: $A_g = 8(3/8) = 3.0 \text{ in.}^2, \quad P_n = F_y A_g = 36(3.0) = 108 \text{ kips}$

Net section: Hole diameter $= \dfrac{1}{2} + \dfrac{1}{8} = \dfrac{5}{8}$ in.

$$A_n = A_g - \sum t_w \times (d \text{ or } d') = 3 - (3/8)(5/8) = 2.766 \text{ in.}^2$$

$$\text{or} \quad A_n = 3 - (3/8)(5/8) - (3/8)\left[5/8 - \frac{(3)^2}{4(2)}\right] = 2.954 \text{ in.}^2$$

$$\text{or} \quad A_n = 3 - (3/8)(5/8) - (3/8)\left[5/8 - \frac{(3)^2}{4(2)}\right] \times 2 = 3.141 \text{ in.}^2$$

$$\text{or} \quad A_n = [3 - (3/8)(5/8)(2)] \times \frac{6}{5} = 3.038 \text{ in.}^2$$

$$\text{or} \quad A_n = \left(3 - (3/8)(5/8) - (3/8)\left[5/8 - \frac{(2.5)^2}{4(2)}\right](2)\right) \times \frac{6}{5} = 3.460 \text{ in.}^2$$

Use $A_e = A_n = 2.766 \text{ in.}^2$

$$P_n = F_u A_e = 58(2.766) = 160.4 \text{ kips}$$

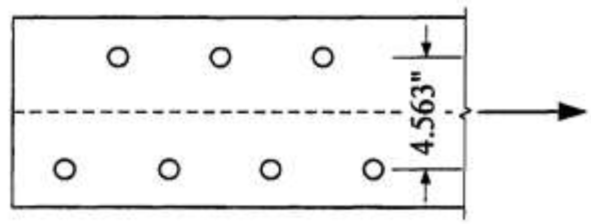
(a) Gross section: $\phi_t P_n = 0.90(108) = 97.2$ kips

Net section: $\phi_t P_n = 0.75(160.4) = 120$ kips $\qquad$ $\underline{\phi_t P_n = 97.2 \text{ kips}}$

3.4-6

Gross section: $P_n = F_y A_g = 36(3.31) = 119.2$ kips

Net section: Use a gage distance of $2.5 + 2.5 - \frac{7}{16} = 4.563$ in.



Hole diameter $= \frac{3}{4} + \frac{1}{8} = \frac{7}{8}$ in.

$$A_n = A_g - \sum t \times (d \text{ or } d')$$

$$= 3.31 - (7/16)(7/8) = 2.927 \text{ in.}^2$$

or $A_n = 3.31 - (7/16)(7/8) - (7/16)\left[\frac{7}{8} - \frac{(2)^2}{4(4.563)}\right] = 2.640 \text{ in.}^2$

Use $A_e = A_n = 2.640 \text{ in.}^2$, and $P_n = F_u A_e = 58(2.640) = 153.1$ kips

(a) Gross section: $\phi_t P_n = 0.90(119.2) = 107$ kips

Net section: $\phi_t P_n = 0.75(153.1) = 115$ kips

Gross section controls. $\underline{\phi_t P_n = 107 \text{ kips}}$