

Example 28 Design a pin connection for the end panel point of a truss (Fig. 48). The diagonal consists of two 15-in 50-lb channels with the toes out and carries 500 kips. The bottom chord consists of two 12-in 25-lb channels with the toes in and carries 300 kips. Use A235 Class E steel ($F_y = 37.5$ ksi) for pin and A36 steel for other components. AISC-ASD specification.

C15 \times 50: $t_w = 0.716$ in

C12 \times 25: $t_w = 0.387$ in $A = 7.35$ in²

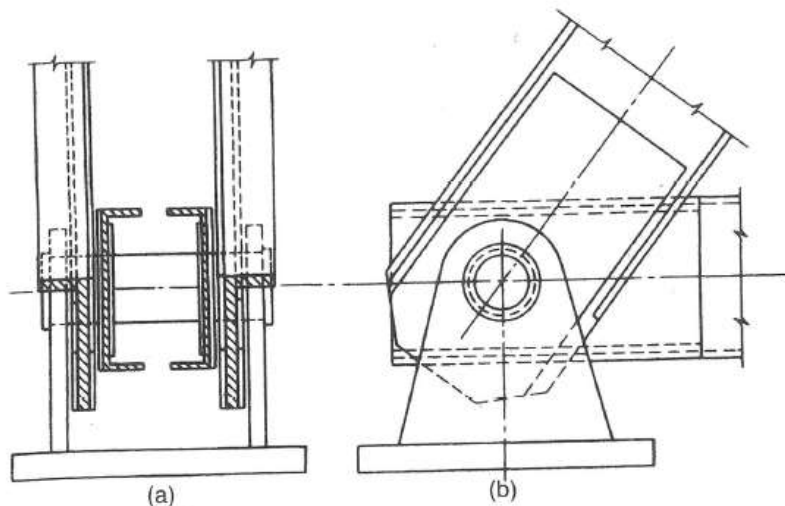


Fig. 48 Example 28.

Moment and shear on pin: $F_v = 400$ kips $F_H = 300$ kips (Fig. 48a)

Assume 1.75 in between centerlines of shoe and 15-in channel web and 1.5 in between centerlines of webs of 15- and 12-in channels (Fig. 49b and c).

$$M_v = 200 \times 1.75 = 350 \quad M_H = 150 \times 1.5 = 225 \text{ in-kips}$$

$$M = \sqrt{350^2 + 225^2} = 416 \text{ in-kips} \quad V = 300 \text{ kips}$$

Pin diameter:

$$F_b = 0.90 F_v = 0.90 \times 36.0 = 32.4 \text{ ksi}$$

$$F_v = 0.40 F_v = 0.40 \times 37.5 = 15.0 \text{ ksi}$$

$$d = \sqrt[3]{\frac{32M}{\pi F_b}} = \sqrt[3]{\frac{32 \times 416}{32.4 \pi}} = 5.08 \text{ in}$$

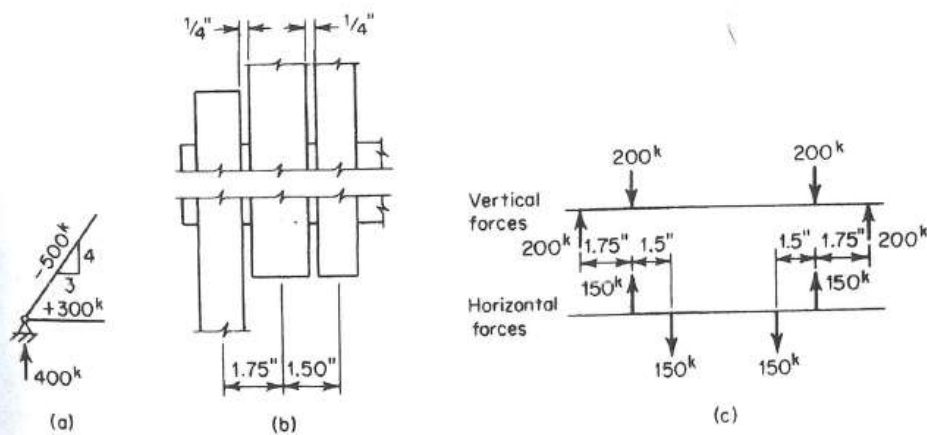


Fig. 49 Example 28.

$$d = \sqrt{\frac{4V}{\pi F_v}} = \sqrt{\frac{4 \times 200}{15\pi}} = 4.11 \text{ in}$$

Try 5-in pin.

Shoe and pin plate:

Bearing on A36:

$$F_y = 0.90 \times 36 = 32.4 \text{ ksi}$$

Shoe:

$$t = \frac{200}{32.4 \times 5} = 1.24 \text{ in} \quad \text{Use } 1\frac{1}{4} \text{ in}$$

Diagonal:

$$t = \frac{250}{32.4 \times 5} = 1.54 \text{ in}$$

Pin plates:

$$t = 1.54 - 0.716 = 0.82$$

Try $\frac{7}{16}$ -in plates, one each side of web.

Bottom chord:

$$t = \frac{150}{32.4 \times 5} = 0.927$$

Pin plates:

$$t = 0.927 - 0.287 = 0.540 \text{ in}$$

Try $\frac{5}{16}$ -in pin plates, one each side of web.

Diagonal:

$$\text{At pinhole } t = 0.716 + 0.875 = 1.591 \text{ in}$$

Bottom chord:

$$\text{At pinhole } t = 0.387 + 0.625 = 1.012 \text{ in}$$

Assume $\frac{1}{4}$ -in clearance.

$$\text{Shoe and diagonal c.c.} = \frac{1.25}{2} + 0.25 + \frac{1.591}{2} = 1.67 \approx 1.75 \text{ in}$$

$$\text{Diagonal and chord c.c.} = \frac{1.591}{2} + 0.25 + \frac{1.012}{2} = 1.55 \approx 1.50 \text{ in}$$

$$F_t = 0.45 F_y = 0.45 \times 36 = 16.2 \text{ ksi}$$

$$A = \frac{150}{16.2} = 9.26 \text{ in}^2 \text{ net}$$

$$\text{Max width inside plate} = T = 9\frac{7}{8} \text{ in}$$

Bottom chord at pinhole:

Make inside plate $9\frac{3}{4}$ in, outside plate 12 in.

$$A = 7.32 + 9.75 \times 0.312 + 12 \times 0.312 - 5.03(0.387 + 2 \times 0.313) = 9.01 < 9.26 \text{ in}^2$$

Make outside plate $12 \times \frac{3}{8}$, inside plate $9\frac{3}{4} \times \frac{5}{16}$.

$$A = 9.50 > 9.26 \text{ in}^2$$

Edge distance:

$$\text{Edge distance} \leq 4t \quad (\text{AISC-ASD D.3})$$

$$12 - 5.03 = 6.97 \text{ in} < 2 \times 4(0.375 + 0.387 + 0.312) = 8.60 \text{ in}$$

Net section beyond hole:

$$\frac{2}{3} \times 9.26 = 6.17 \text{ in}^2 \text{ required}$$

Use $8\frac{1}{2}$ -in end distance.