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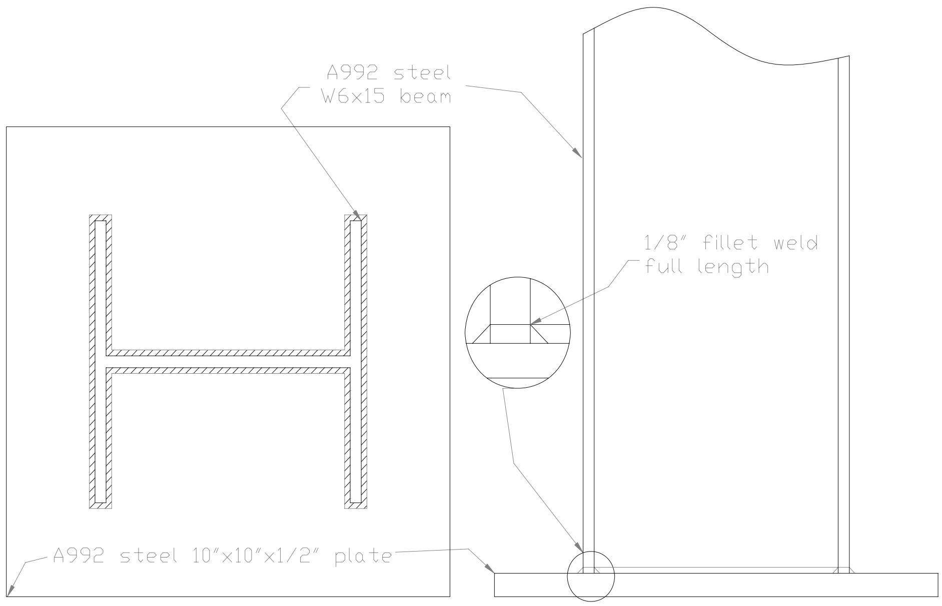
Sample calculations – connection 39



Equations

Effective throat dimension: $t_w = 0.707 D_w$

Base Material:

Cross section yielding: $\phi P_{ny} = 0.9(F_y)(A_e)$

Fracture on effective area: $\phi P_{nf} = 0.75(A_e)(F_u)$

$$\phi R_n = \min\begin{cases} \phi F_{BM} A_{BM} \\ \phi F_W A_W \end{cases} \geq P_u$$

$$\phi F_{BM} A_{BM} = \min\begin{cases} 0.75(t_{BM} L_w)(.6F_u) \\ 0.75F_u (UA_n) \\ 1.0A_g (0.6F_y) \end{cases}$$

Weld Strength:

$$\phi F_w A_w = 0.75 L_w t_w (0.6F_{Exx})$$

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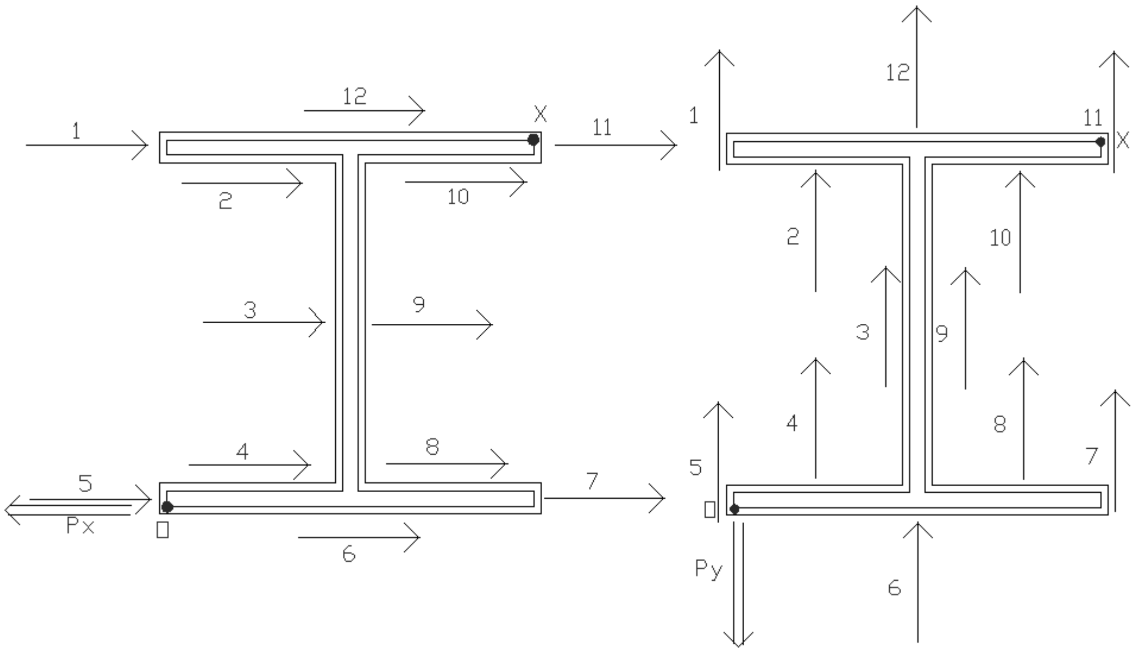
Free Body Diagrams



(distances in table below: omitted for schematic clarity)

Take the Moment about point X in both x and y directions to determine the limiting moment the weld can withstand. Px/y is centered about point O for the limiting P, but can act anywhere along the W-section. All weld forces are centered at the midpoint of the weld they correspond to and act at the joint of the weld and the W-section.

Weld	Length of weld (in) Lw	distance-x (in) Px	Distance-y (in) Py
1	.25	.125	6
2	2.875	.25	4.5625
3	5.5	3	3.125
4	2.875	5.75	4.5625
5	.25	5.875	6
6	6	6	3
7	.25	5.875	0
8	2.875	5.75	1.4375
9	5.5	3	2.875
10	2.875	.25	1.4375
11	.25	.125	0
12	6	0	3
Sum (Lw*P_)		106.5 in^2	106.5 in^2

To determine the limiting moment this weld can support: sum (Lw*3.182(k/in)*distance-x) and set equal to Px*L. Repeat changing distance-x to distance-y and set equal to Py*L.

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Calculations

- Effective throat dimension:

$$t_w = 0.707D_w = 0.707(1/8") = 0.0884"$$

- Base material strength:

$$\phi P_{ny} = 0.9(F_y)(A_e) = 0.9(50ksi)(4.43in^2) = 199.35\text{kips}$$

$$\phi P_{nf} = 0.75(A_e)(F_u) = 0.75(4.43in^2)(65ksi) = 215.96\text{kips}$$

- Connnection strength:

$$\phi R_n = \min\begin{cases}\phi F_{BM} A_{BM} \\ \phi F_W A_W\end{cases} \geq P_u$$

$$\phi F_w A_w = 0.75 L_w t_w (0.6F_{E80}) = 0.75(32.5")(0.0884")(0.6(80ksi)) = 103.4kips$$

$$\phi F_{BM} A_{BM} = \min\begin{cases}0.75(t_{BM} L_w)(.6F_u) = 0.75(.25")(32.5")(.6(65ksi)) = 237.66k \\ 0.75F_u(UA_n) = 0.75(65ksi)(1.0)(4.43in^2) = 215.96k \\ 1.0A_g(0.6F_y) = 1.0(4.43in^2)(0.6(50ksi)) = 132.9k\end{cases} = 132.9kips$$

$\phi R_n = 103.4kips$ → Weld strength will control.

- Weld strength per inch:

$$F_w A_w : 0.75(80ksi)(0.6(L_w)(0.0884") = 3.128 k/in$$

- Moment resistance capacity:

$$\sum M_y = \sum M_x : P_A L = 3.182(106.5in^2) = 338.9k \cdot in \text{ [in the y-direction]}$$