Lecturer: Thomas M. Murray, PhD
Emeritus Professor, Virginia Tech

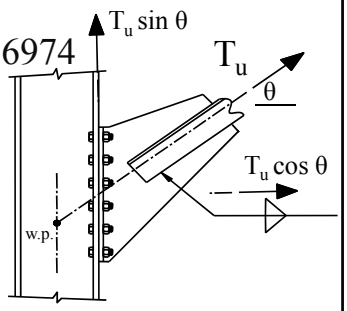
Welded-Bolted Light Bracing Connections

Example. Check Slip Resistance.

$T_u = 150$ kips $\phi = 0.85$ $\mu = 0.5$ $D_u = 1.13$
$h_f = 1.0$ $T_b = 28$ kips $n_s = 1$ $k_{sc} = 0.6974$

$\phi R_n = \phi \mu D_u h_f T_b n_s k_{sc}$ /bolt
$= 0.85 \times 0.50 \times 1.13 \times 1.0 \times 28 \times 1 \times 0.6974$
$= 9.35$ kips/bolt

$\sum \phi R_n = 9.35 \times 12 = 112$ k
$T_u \sin\theta = 150 \sin 40^o$
$= 96.4$ k < 112 k OK



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Heavy Bracing Connections

- Gusset plate is generally welded to beam and bolted to column.
- One new limit state: Gusset Plate Compression Buckling.
- Forces at beam and column determined using the Uniform Force Method.
- Beam-to-gusset plate weld is increased 25% to account for non-uniform distribution of forces along weld length.

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Heavy Bracing Connection Example

Estimate α and β

α:

Assume 7/16″ fillet welds

$L_w = 616/(2x1.392x7) = 31.6''$

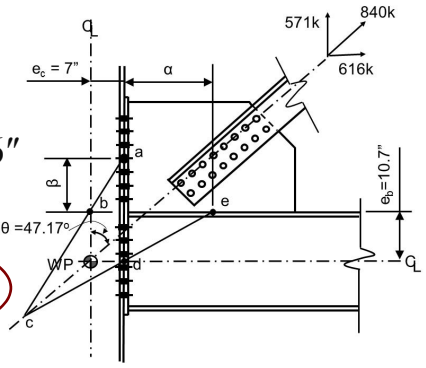
Try $\alpha = 17.5''$

β:

$$\beta = \frac{7.0+17.5}{\tan 47.17^0} - 10.7 = 12.0''$$

Try 7 rows 7/8″A490

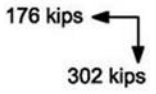
$\beta = 3+3x3 = 12''$

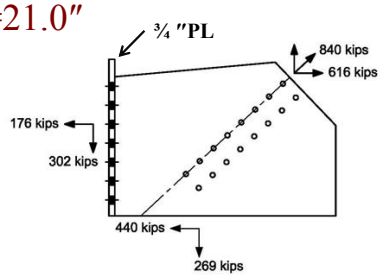


Heavy Bracing Connection Example

Design Gusset-to-End-Plate Weld

Fillet B.S. E70xx $L_w = 7x3.0 = 21.0''$





$$R_u = \sqrt{176^2 + 302^2} = 350\,k$$

$\theta = \tan^{-1}(176/302) = 30.2^0$

$D_{req'd} = 350/[(2x1.392x21.0)(1+0.5\sin^{1.5}30.2^0)$

$= 5.07\text{-}1/16s$ Min. – 5/16

Use 3/8″ Filet Welds B.S.

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Heavy Bracing Connection Example

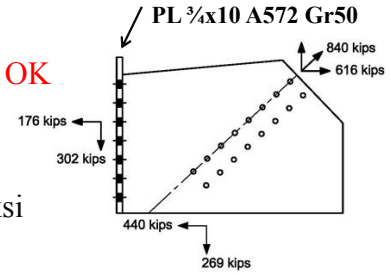
Check End-Plate to Col. Flange Bolt Strength

14 – 7/8″ A490-X Bolts $A_b = 0.601$ in^2 (No Prying)

$\phi R_{nt} = 0.75\, F'_{nt} A_b$ per bolt (J3-3a)

$r_{uv} = 302/14 = 21.6\text{k} < \phi V_n = 37.9\text{k}$ OK

$r_{ut} = 176/14 = 12.6\text{k}$



$f_{uv} = 21.6/0.601 = 35.9$ ksi ksi

and with $F_{nt} = 113$ ksi $F_{nv} = 84$ ksi

$$F'_{nt} = 1.3F_{nt} - \frac{F_{nt}}{\phi F_{nv}} f_{uv} \le F_{nt}$$

$$= 1.3x113 - \frac{113}{0.75x84} 35.9 = 82.5\text{ksi} < 113\text{ksi}$$

$\phi R_{nt} = 0.75x82.5x0.601 =$ 37.2k $\ge r_{ut} = 12.6\text{k}$ OK

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