CIVE 3205
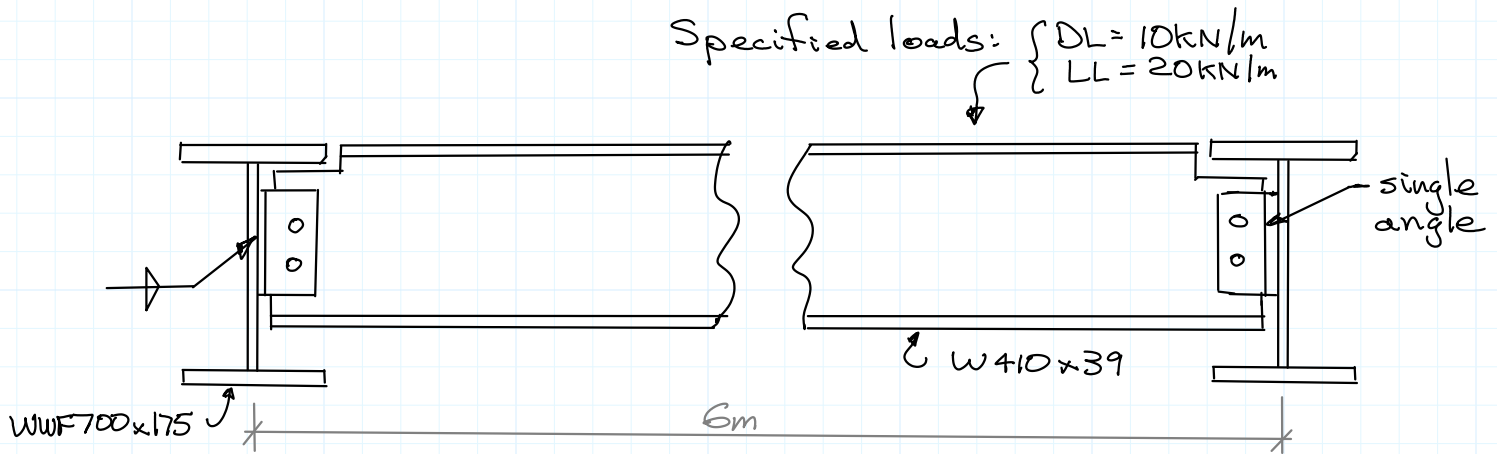## Example C30

Feb. 26, 2020

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Revisions:

- Feb 26/20: new posting.

Example Bolt-3   Beam - Girder Connection

Specified loads: $\begin{cases} DL = 10\,kN/m \\ LL = 20\,kN/m \end{cases}$

single angle

$\mathcal{C}$ W 410 × 39

WWF700 × 175

6m

Notes: − top flange of beam flush with top flange
of girder − requires coping of beam.
− single angle welded to web of girder &
bolted to web of beam
− use 350W steel & A325M bolts

Design bolted portion of end connections.

$$F_y = 350\,MPa \quad F_u = 450\,MPa \quad (steel)$$
$$F_u = 830\,MPa \quad (bolts)$$

Connection designed for shear force of:

$$V_f = (1.25 \times 10 + 1.5 \times 20)\frac{kN}{m} \times 6m \times \frac{1}{2}$$

$$V_f = 128\,kN$$

Bolts   (1 bolt):   Try 20M

Bearing:

    W410×39   w = 6.4 mm
    angles   try   102 × 76 × 9.5   angle
           t = 9.53 mm

$$B_r = 3 \times 0.80 \times 1 \times 6.4\,mm \times 20\,mm \times 0.45\frac{kN}{mm^2}$$

$$= 138\,kN$$

Shear   (assume threads intercepted)
(will be short bolts - 9.5 + 6.4 = 16mm
grip - 50mm long (p 6-161) will work)

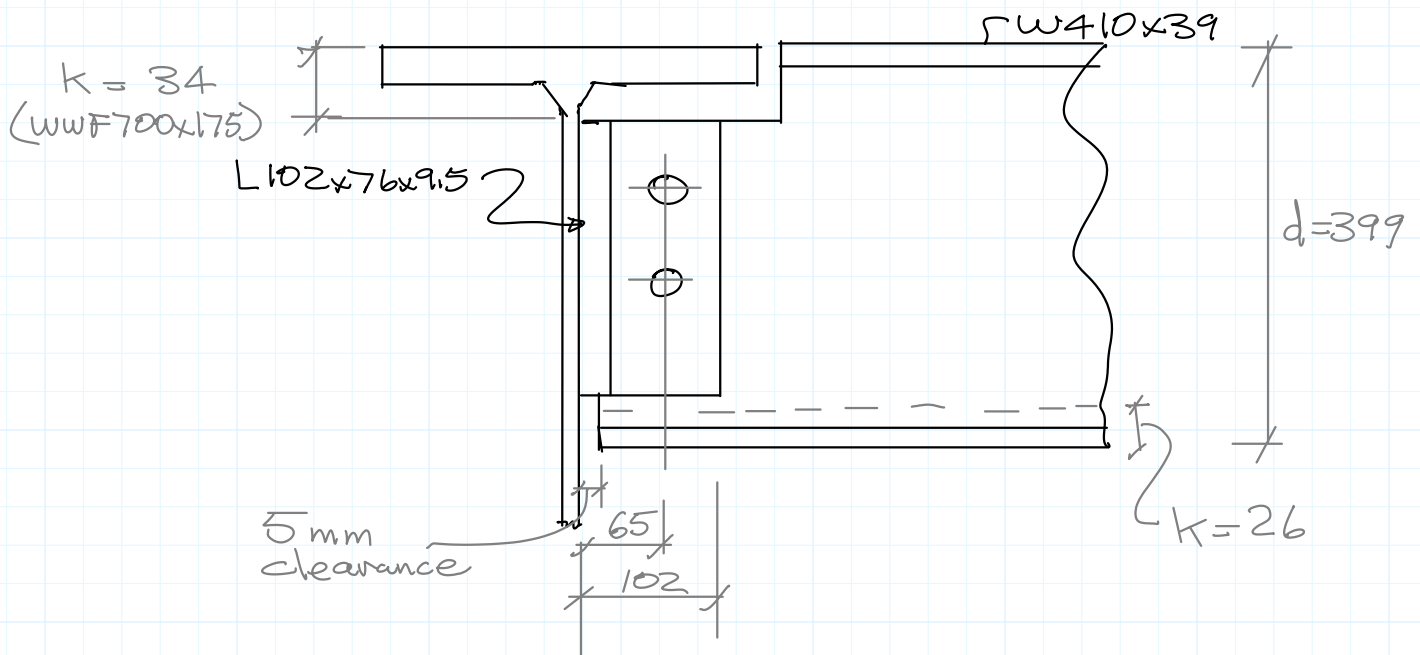$$V_r = 0.6 \times 0.8 \times 1 \times 1 \times \pi \times \frac{20^2}{4} \times 0.83 \frac{kN}{mm^2} \times .7$$

$$= 87.5 \, kN \quad \Leftarrow \text{ governs}$$

# of bolts req'd

$$= \frac{V_f}{V_r} = \frac{128}{87.5} = \underline{\underline{2}} \text{ bolts}$$

Details:

K = 34
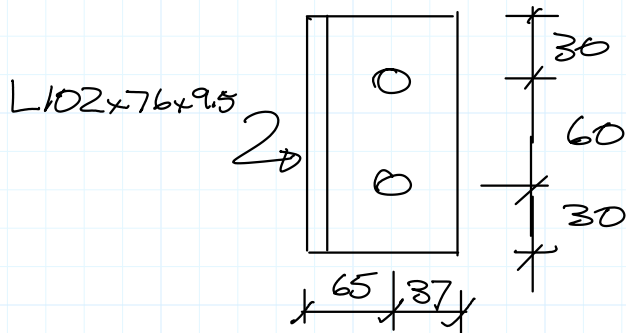(WWF700x175)

L102x76x9.5

W410x39

d = 399

k = 26

5 mm clearance

65

102

Max Length of angle

clearance

$$= 399 - 34 - 26 - 2 \times 5$$

$$= 329 \, mm$$

much longer than needed for 2 bolts.

Try 120 mm angle

L102x76x9.5

min edge & end
distance = 26 mm
O.K.

30
60
30

65 | 37

Block Shear

30
60
30
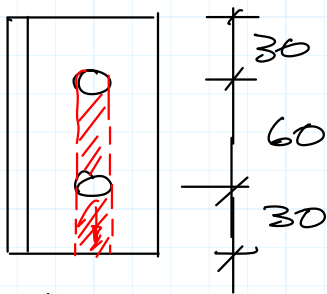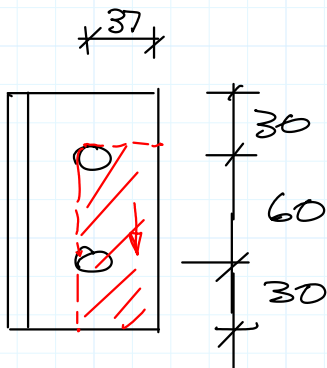
$A_n = 0$

$A_{gv} = 2 \times (60+30) \times 9.53$

$= 1715 \ mm^2$

$V_r = 0.75 \times 0.6 \times 1715 \ mm^2 \times \dfrac{.4 kN}{mm^2}$

$= 309 \ kN \ > 128 kN \qquad O.K.$

37

30
60
30

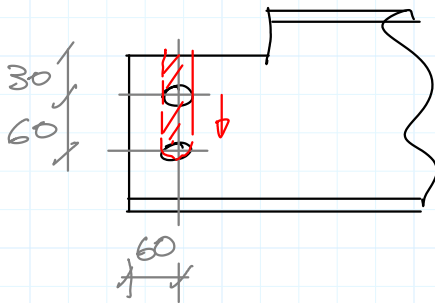$A_n = \left(37 - \dfrac{1}{2}(20+2+2)\right) \times 9.53$

$= 238 \ mm^2$

$U_t = 0.6$

$A_{gv} = \dfrac{1715}{2} = 858 \ mm^2$

$V_r = 0.75\left[0.6 \times 238 \times .45 \right.$

$\left. + 0.6 \times 858 \times .4\right]$

$= 203 \ kN \ > 128 \ kN \qquad O.K.$
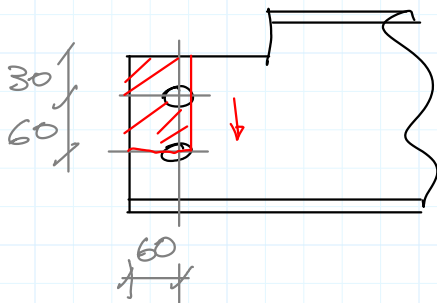
∴ angle OK in block shear.

Beam Block Shear

$A_n = 0$

$A_{gv} = (30 + 60) \times 6.4 \times 2$

$\qquad = 1152 \text{ mm}^2$

$V_r = 0.75 \times 0.6 \times 1152 \text{ mm}^2 \times 0.4\dfrac{kN}{mm^2}$

$\qquad = 207 \text{ kN} \quad > 128 \text{ kN} \quad OK$

$A_n = \left(60 - 24 \times \dfrac{1}{2}\right) \times 6.4 \text{ mm}$

$\qquad = 307 \text{ mm}^2$

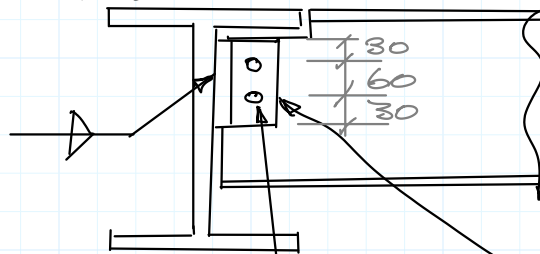$U_t = 0.9$

$A_{gv} = \dfrac{1152}{2} = 576 \text{ mm}^2$

$V_r = 0.75\left[.9 \times 307 \times .45 + .6 \times 576 \times .4\right]$

$\qquad = 197 \text{ kN} \quad > 128 \text{ kN} \qquad OK$

∴ Block Shear in Beam is OK

Summary:

WWF 700×175   W410×39

L102×76×9.5×120

2-A325M M20 bolts in
punched holes

Note: angle-to-web fillet weld must be designed
as an eccentrically loaded weld.
See HB p. 3-57.