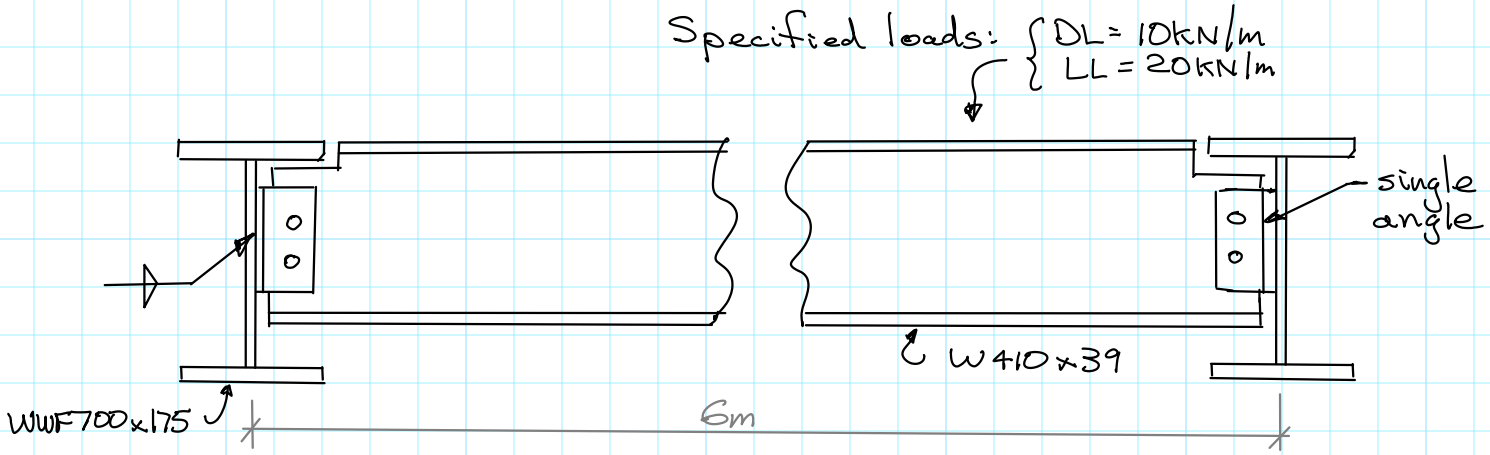
CIVE 3205

Example Bolt-3

In-class Feb 8, 2013

March 7, 2013

Example Bolt-3 Beam-Girder Connection



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

Design bolted portion of end connections.

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

Connection designed for shear force of:

$$V_f = (1.25\times10 + 1.5\times20)\frac{kN}{m} \times 6m \times \frac{1}{2}$$

$$V_f = 128\ kN$$

Bolts (1 bolt): Try 20M

Bearing:

W410x39 $w = 6.4mm$

angles try $102\times76\times9.5$ angle
$t = 9.53\ mm$

$$B_r = 3\times0.80\times1\times6.4mm\times20mm\times0.45\frac{kN}{mm^2}$$

$$= 138kN$$

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

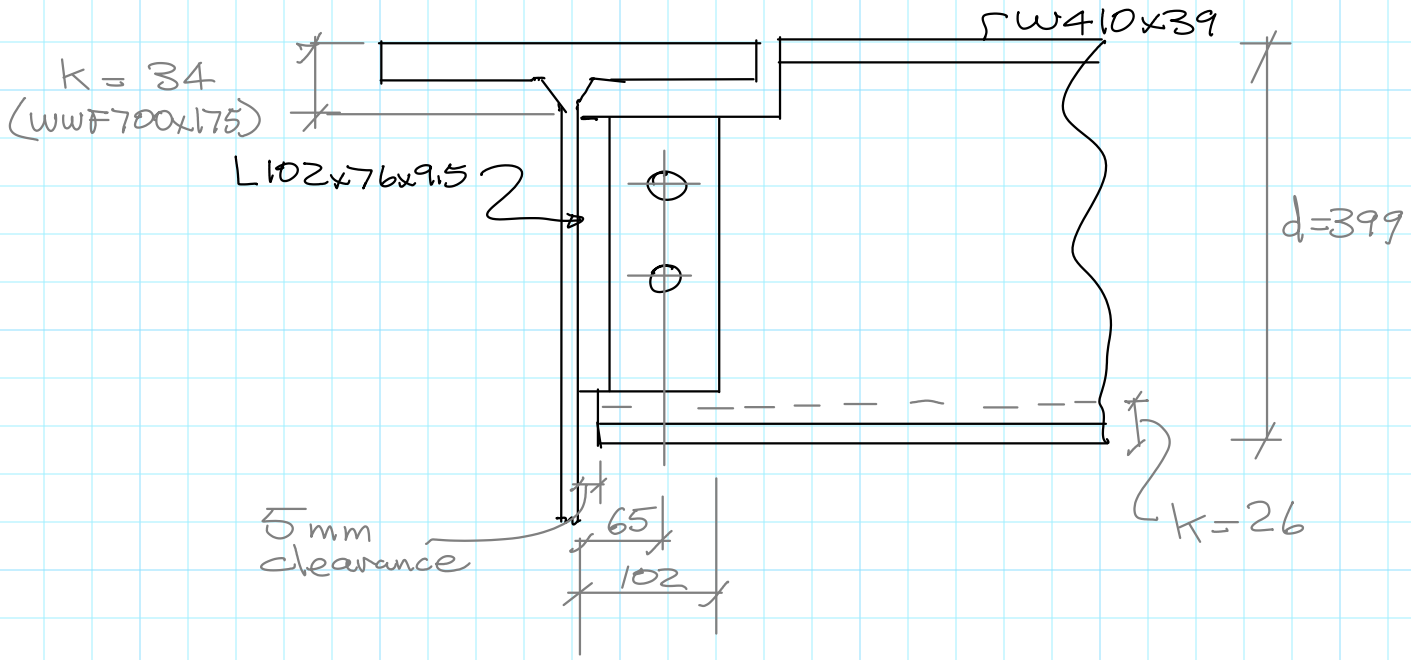
$$V_r = 0.6 \times 0.8 \times 1 \times 1 \times \pi \times \frac{20^2}{4} \times 0.83 \frac{kN}{mm^2} \times .7$$

$$= 87.5\ kN \leftarrow \text{governs}$$

# of bolts req'd

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

Details:



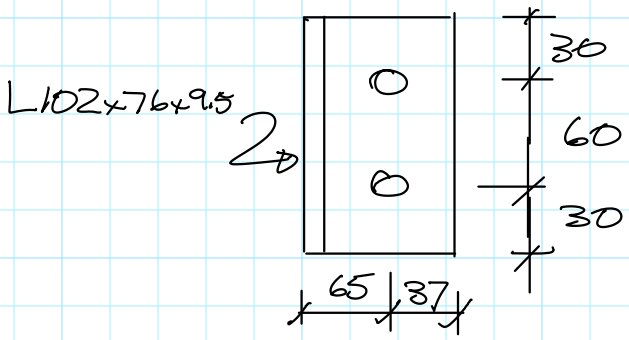
Max Length of angle

$$= 399 - 34 - 26 - 2 \times 5 \quad (5 = \text{clearance})$$

$$= 329\ mm$$

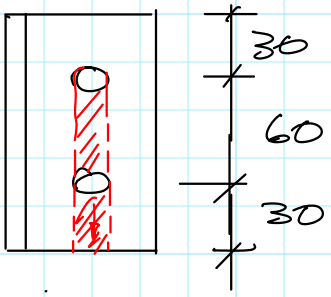
much longer than needed for 2 bolts.

Try 120 mm angle



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

Block Shear



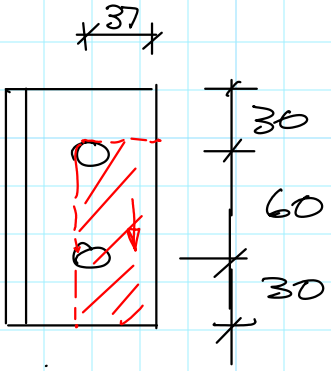
$A_n = 0$

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

$= 1715 \text{ mm}^2$

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

$= 309 \text{ kN} > 128 \text{ kN}$ O.K.



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

$= 238 \text{ mm}^2$

$U_t = 0.6$

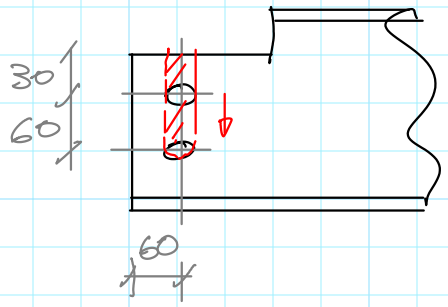
$A_{gv} = \frac{1715}{2} = 858 \text{ mm}^2$

$V_r = 0.75[0.6 \times 238 \times .45 + 0.6 \times 858 \times .4]$

$= 203 \text{ kN} > 128 \text{ kN}$ O.K.

∴ angle OK in block shear.

Beam Block Shear



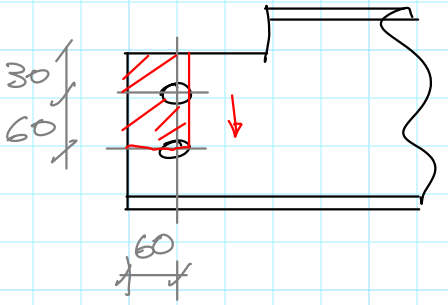
$A_n = 0$

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

$= 1152\ mm^2$

$V_r = 0.75 \times 0.6 \times 1152\ mm^2 \times .4\ \frac{kN}{mm^2}$

$= 207\ kN \quad > 128\ kN \quad OK$



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

$= 307\ mm^2$

$U_t = 0.9$

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

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

$= 197\ kN \quad > 128\ kN \quad OK$

∴ Block Shear in Beam is OK

Summary: