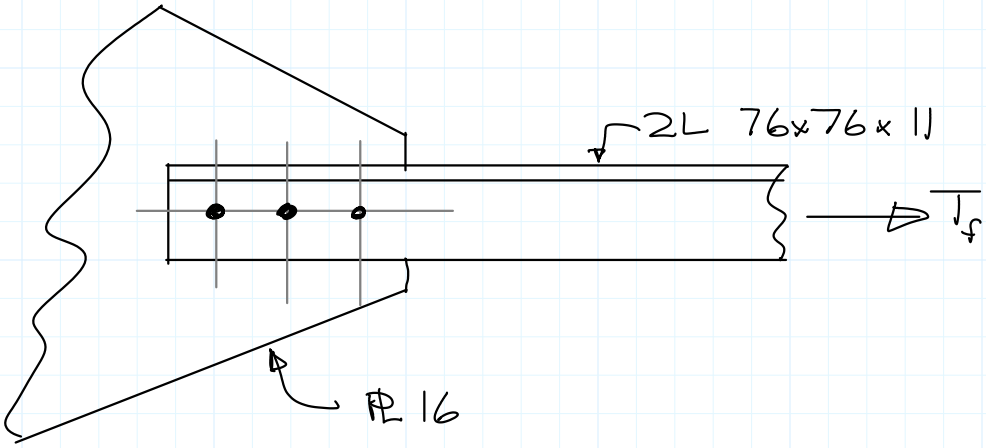
CIVE 3205

Example Bolt-2

(in class, Feb 6, 2013)
(and mistakenly labelled Bolt-1)

Revisions:
2018-03-15: checking comm. length, page 2.



Design bolted connection to develop full capacity of angles.

Use 350W Steel
$F_y = 350$ MPa
$F_u = 450$ MPa

A325M bolts
$F_u = 830$ MPa

Try M20 bolts, drilled holes

Capacity of 2 angles:

$A_g = 3140\ mm^2$ (p. 6-127)

Gross Yielding:

$$T_r = \phi A_g F_y$$
$$= 0.9 \times 3140\ mm^2 \times 0.35 \frac{kN}{mm^2}$$
$$= 989\ kN$$

Net Fracture:

$$A_n = 3140 - 22mm \times 11.1mm \times 2$$
$$= 2652\ mm^2$$

Estimate

$A_{ne} = 0.8 A_n$ (at least 4 bolts)

$$= 0.8 \times 2652$$
$$= 2122\ mm^2$$

$$T_r = \phi_u A_{ne} F_u$$
$$= 0.75 \times 2122\ mm^2 \times .45 \frac{kN}{mm^2}$$
$$= 716\ kN$$

Select bolts for $T_f = 716\ kN$

one bolt:

shear: $V_r = 0.6 \phi_b m n A_b F_u \times 0.7$ (threads intercepted)

$$= 0.6 \times 0.8 \times 2 \times 1 \times \frac{20^2}{4} \times 0.83 \times 0.7$$

$$= \underline{175\ kN} \quad \leftarrow \text{governs}$$

bearing: $V_r = 3 \phi_{br} d t n F_u$

$$= 3 \times .8 \times 20 \times 16 \times 1 \times .45$$
$$= 346\ kN$$

$$\#\ \text{of bolts req'd} = \frac{716\ kN}{175\ kN} = 4.09$$

$\therefore$ use 5 bolts.

min pitch $= 2.7d = 2.7 \times 20 = 54\ mm.$

use pitch $= 60\ mm.$

check connection length

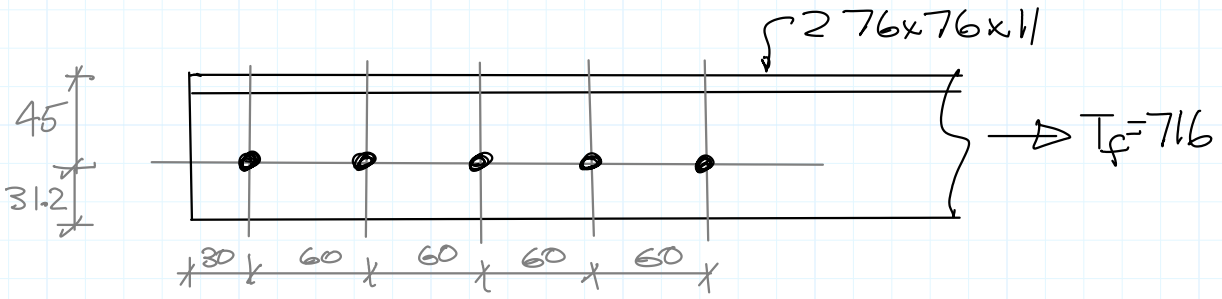
$L = 4 \times 60\ mm = 240\ mm$
(c-to-c of end bolts)

$L < 760\ mm$

$\therefore$ no strength reduction for long lap connects is required.

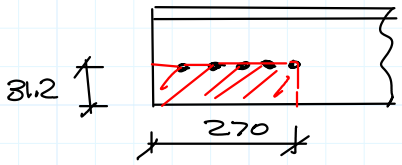
corrected Mar 15 2018

min edge distance
= 26 mm
min end distance
= 26 mm (flame cut ends)
use 30mm

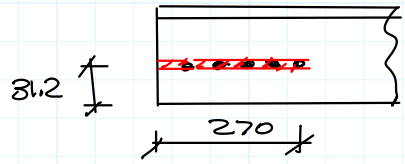


Check Block Shear, 2 angles:

$F_u = .45$
$\frac{F_y+F_u}{2} = .4$



$A_n = (31.2 - \frac{22}{2}) \times 11.1 \times 2 = 448\ mm^2$
$U_t = 0.6$
$A_{gv} = 270 \times 11.1 \times 2 = 5994\ mm^2$
$T_r = 0.75[.6 \times 448 \times .45 + .6 \times 5994 \times .4]$
$= 1170\ kN \quad > 716 \quad$ ok

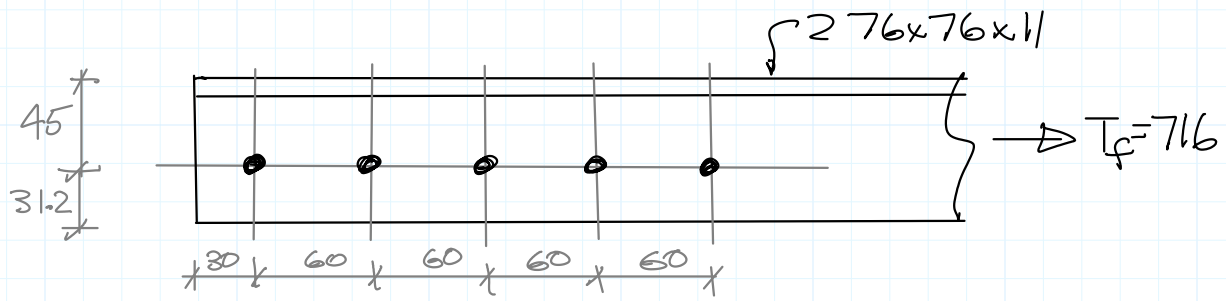


$A_n = 0$
$A_{gv} = 5994 \times 2 = 11990\ mm^2$
$T_r = .75 \times .6 \times 11990 \times .4$
$= 2160\ kN > 716$ ok

Similar pattern in gusset ℄

$T_r = \frac{16}{22.2} \times 2160 = 1560\ kN$
> 716 ok.

∴ USE:



5 M20 A325 bolts

T_r = 716 kN ⟵