Beam-column connection designed for roof loads (B4/B5)

Governing load combo $= 1.25D + 1.5S + 1.0L$ where L is not considered ¢4.2.5.5

then $= 6.83$ kPa, trib width $= 7.0$ m, $w = 47.78$ kN/m

Bolted connection — $V_f = \frac{wl}{2} = \frac{(47.78)(7m)}{2} = \underline{167.24 \text{ kN}}$ Weld $= 1.5V_f = \underline{250.86 \text{ kN}}$

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

Angle: L152×L89×13 on each side of beam = W310×86, column is W250×58 (both sides of beam)

$d = 152$ $b = 88.9$ $I_x = 6.86(10^6)$ $w = 9.1$ mm

$t = 12.7$ mm $I_y = 1.77(10^6)$ $t = 13.5$ mm

$r_x = 48.6$ $r_y = 24.7$ ¢22.3.5 ¢28.4.1 (punched)

Bolts: A325M, $F_u = 830$ MPa, $d_b = 20$ mm $d_h = 20+2+2 = 24$ mm $A_b = 314$ mm $\phi_b = 0.8$ ¢13.1 double in shear

V_r $V_r = 0.6\phi_b n m A_b F_u (0.7) = (0.6)(0.8)(1)(2)(314)(830)(0.7) = 175.137$ kN/bolt ¢13.12.1.2 (intercepted threads)

By Table 3-14, $C \geq \frac{P_f}{V_r} = \frac{167.24}{175.137} = 0.955$ Given $L = 85$ mm, $b = 80$ mm, 2 bolts, we can linearly interpolate.

pick $C = 1.006$ $\begin{pmatrix} 1.09 & 0.92 \\ L=80 & L=100 \end{pmatrix}$. Final $V_r = (1.006)(175.137 \text{ kN}) = \underline{176.19 \text{ kN}}$ $\underline{U_F} = \frac{167}{176} = \underline{0.95}$

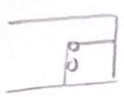
T_r

¢13.2 $\underline{T_r} = \phi_u(0.6(3683)(\frac{350+450}{2})) = \underline{622.9 \text{ kN/plate}} = 1326$ kN (Tearout in angle)

$U_t = 0.6$ $A_{gv} = (100+45)(2)(12.7 \text{ mm}) = 3683$ mm² $\phi_u = 0.75$ ¢13.1

Assume tearout in beam doesn't govern. Assume no shear lag.

T_r

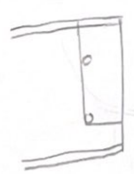


$A_{gv} = (100+45)(12.7) = 1841.5$ mm² $\phi_u = 0.75$ $U_t = 0.6$ ¢13.2

$A_n = (67 - \frac{24}{2})(12.7) = 698.5$ mm²

$T_r = 0.7[0.6(698.5)(450) + 0.6(1841.5)(400)]$

$= \underline{441.39 \text{ kN}}$ Block shear in angle



$A_{gv} = 1987.47$ mm² $\phi_u = 0.75$ $U_t = 0.9$ Coped beam.

$T_r = (0.7)[0.9(1987.47)(450) + 0.6(163.8)(\frac{350+450}{2})]$

$A_n = (30 - \frac{24}{2})(9.1) = 163.8$ mm² $= \underline{590.966 \text{ kN}}$ Block shear in beam.

$\phi_b = 0.8$ ¢13.1 $n = 2$ $t = 9.1$ (beam), $= 12.7$ (×2, plates),

B_r $d = 20$ mm, $F_u = 450$ MPa $B_r = 3\phi_b n t d F_u = 3(0.8)(2)(9.1)(20)(450) = \underline{393.12 \text{ kN}}$

$= 3(0.8)(2)(12.7)(2)(20)(450) = \underline{1097.2 \text{ kN}}$

Governing is B_r, beam, $> P_f$. ✓

Weld: $X_u = 490$ MPa ¢13.13.2.2 ¢16-108 $D \leq 0.75 t_{min} = 0.75(12.7) = 9.525$ mm → $t_{angle} = 12.7$ mm

$D = 6.5$ mm $L = 190$ mm $\theta = 0°$ $M_w = 1$ $D \geq 6$ mm (for $t_{max} = 13.5$ mm $t_{column} = 13.5$ mm,

¢13.13.2.2 $V_r = 0.67^2(190)(\frac{6.5}{\sqrt{2}})(490)(1+0.5\sin^2(\theta))(1.0) = 192.09$ kN × 2 welds $= 384.2$ kN > 250.86 kN ✓

$\underline{U_F} = \frac{250.86}{384.2} = \underline{0.65}$

$A_{gv} = \left[\left(\frac{310-16.3}{2}\right) + 50\right](9.1) + (16.3)(254) = 1717.17 + 270.3$

$= 1987.47$ mm²

t, 310×86

(Assume rolled edges are negligible).