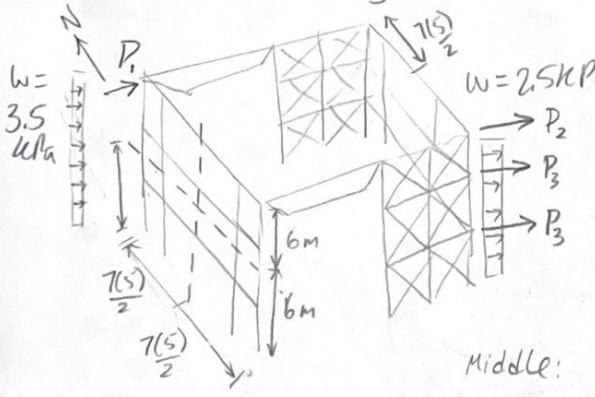
1st floor Brace along line A

Assume: brace only carries lateral loads

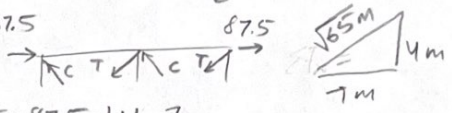


P_1 = windward force: $(3.5\,kPa)\left(\frac{7(5)}{2}m\right)(6m) = 367.5\,kN$

leeward $P_2 = (2.5\,kPa)\left(\frac{7(5)}{2}m\right)(2m) = 87.5\,kN$

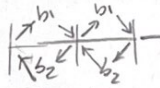
$P_3 = (2.5\,kPa)\left(\frac{7(5)}{2}m\right)(4m) = 175\,kN$

Top floor:



$\Sigma F_x = 367.5 + 87.5 - 4b_1\frac{7}{\sqrt{65}} = 0 \Rightarrow F_{b_1} = 130.95\,kN\ T/C$

Middle:



$\Sigma F_x = 4(130.95)\frac{7}{\sqrt{65}} + 175 - 4F_{b_2}\frac{7}{\sqrt{65}} = 0$

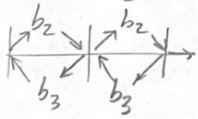
$\Rightarrow F_{b_2} = 181.32\,kN\ T/C$

Governing load combo = 0.9D + 1.4W

$\Rightarrow 1.4(231.69) \Rightarrow$

$T_f = C_f = 324.37$

Bottom:



$\Sigma F_x = 4(181.32)\left(\frac{7}{\sqrt{65}}\right) + 175 - 4b_3\frac{7}{\sqrt{65}} = 0 \Rightarrow F_{b_3} = 231.69\,kN$

W250x49 350W G40.20/21 $F_y = 350\,MPa$ $E = 200000\,MPa$ $G = 77000\,MPa$, Class

$A = 6260\,mm^2$ $I_x = 70.6(10^6)\,mm^4$ $I_y = 15.1(10^6)\,mm^4$ $r_x = 106\,mm$ $r_y = 49.2\,mm$

$J = 241(10^3)\,mm^4$ $C_w = 211(10^9)\,mm^6$ $d = 247\,mm$ $b = 202\,mm$ $t = 11\,mm$ $w = 7.4\,mm$

Braces are oriented so they buckle about strong axis if they buckle in the plane of the frame. By ¢10.3.1: Length = $\sqrt{65}\,m = 8062.26\,mm = L_x = L_y$ (no lateral bracing). And ideal conditions are assumed – ¢10.3.1, $k = 1.0$. Check slenderness, $k_x = k_y = 1.0$

¢10.4.2.1 $\frac{k_x L_x}{r_x} = 76.06 \le 200$ and $\frac{k_y L_y}{r_y} = \frac{(1.0)(8062.26)}{49.2} = 163.87 \le 200$ ✓

Check local buckling ¢13.3.1.1 (Table 1)

Web: $\frac{d-2t}{w} = \frac{247-2(11)}{7.4} = 30.405 < \frac{670}{\sqrt{F_y}} = \frac{670}{\sqrt{350}} = 35.8$ ✓

Flange: $\frac{b/2}{t} = \frac{202/2}{11} = 9.18 < 10.69 = \frac{200}{\sqrt{F_y}}$ ✓

Check compression ¢13.3.1.1

$C_r = \frac{\phi A F_y}{(1+\lambda^{2n})^{\frac{1}{n}}}$ $\phi = 0.9$ ¢13.1 $n = 1.34$ $\lambda = \sqrt{\frac{F_y}{F_e}}$ $F_{ex} = \frac{\pi^2 E}{\left(\frac{k_x L_x}{r_x}\right)^2} = \frac{\pi^2 E}{(76.06)^2} = 341.2$ $F_{ey} = \frac{\pi^2 E}{(163.87)^2} = 73.51$

$F_e = \min(F_{ex}, F_{ey}, F_{ez}) = F_{ey} = 73.51$ $F_{ez} = \left(\frac{\pi^2 E C_w}{k_z^2 L_z^2} + G\right)\frac{1}{A r_o^2} = 292.02$

where $k_z = 1.0$, $L_z = 8062\,mm$, $r_o^2 = r_x^2 + r_y^2$

$\lambda = \sqrt{\frac{350}{73.51}} = 2.18$

$C_r = \frac{(0.9)(6260)(350)}{\left(1+2.18^{2(1.34)}\right)^{\frac{1}{1.34}}} \cdot \frac{1\,kN}{1000\,N} = 379.67\,kN$

$U_f = \frac{C_f}{C_r} = \frac{324.37}{379.67} = 0.85$

¢13.2 Tension

$T_r = \phi A_g F_y = (0.9)(6260)(350) = 1971.9\,kN$, doesn't govern.