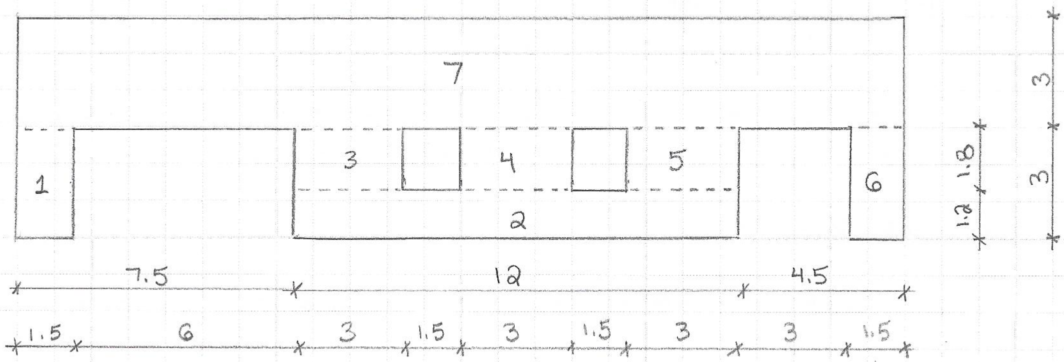
a) Rigidity of Wall



- walls 3,4,5 are in parallel & are all fixed-fixed
- wall 2 is in series with wall 3-4-5 & is fixed-fixed
- wall 1 is in parallel with wall 2-3-4-5 & wall 6 & is fixed-fixed
- wall 7 is in series with wall 1-2-3-4-5 & is a cantilever

$f'_m = 17$ MPa $\quad E_m = 850(17) = 14\,450$ MPa $\quad$ § 6.5.2

$t = 290$ mm

$E_m t = (14450)(290) = \underline{4.19 \times 10^6 \text{ N/mm}}$

Fixed - Fixed Walls

$$R_f = \frac{E_m t}{(h/l_w)^3 + 3(h/l_w)}$$

1) $\frac{h}{l_w} = \frac{3}{1.5} = 2 \qquad R_f^1 = \frac{4.19 \times 10^6}{(2)^3 + 3(2)} = 0.3 \times 10^6$ N/mm

2) $\frac{h}{l_w} = \frac{1.2}{12} = 0.1 \qquad R_f^2 = \frac{4.19 \times 10^6}{(0.1)^3 + 3(0.1)} = 13.9 \times 10^6$ N/mm

3) $\frac{h}{l_w} = \frac{1.8}{3} = 0.6 \qquad R_f^3 = \frac{4.19 \times 10^6}{(0.6)^3 + 3(0.6)} = 2.08 \times 10^6$ N/mm

4) $h/l_w = 1.8/3 \quad \therefore R_f^4 = 2.08 \times 10^6$ N/mm

5) $h/l_w = 1.8/3 \quad \therefore R_f^5 = 2.08 \times 10^6$ N/mm

6) $h/l_w = 3/1.5 \quad \therefore R_f^6 = 0.3 \times 10^6$ N/mm.

Cantilevered Walls

$$R_c = \frac{E_m t}{4(h/l_w)^3 + 3(h/l_w)}$$

7) $\frac{h}{l_w} = \frac{3}{24} = 0.125$ $\quad R_c^7 = \frac{4.19\times10^6}{4(0.125)^3 + 3(0.125)} = 10.9\times10^6$ N/mm

Sum Wall Rigidities

$R_{3+4+5} = 2.08\times10^6 + 2.08\times10^6 + 2.08\times10^6 = 6.24\times10^6$ N/mm

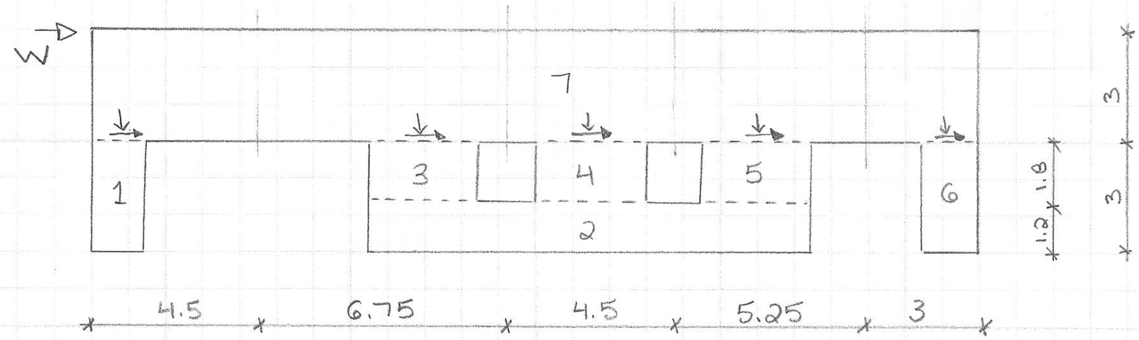
$\frac{1}{R_{2+3,4,5}} = \frac{1}{13.9\times10^6} + \frac{1}{6.24\times10^6}$ $\quad \therefore R_{2+345} = 4.31\times10^6$ N/mm.

$R_{1+2345+6} = 0.3\times10^6 + 4.31\times10^6 + 0.3\times10^6 = 4.91\times10^6$ N/mm

$\frac{1}{R_{123456+7}} = \frac{1}{4.91\times10^6} + \frac{1}{10.9\times10^6}$ $\quad \therefore R_{123456+7} = 3.39\times10^6$ N/mm

$\therefore$ total rigidity of the wall is 3.39×10^6 N/mm

b) Axial & Lateral Load on Each Pier



Axial Loads

D = 5 kN/m + self-weight of wall 7

SW = 6.32 kN/m^2 from Table B.1, t = 290, fully grouted, Class A

* axial loads on each pier will be divided by tributary area, as shown above

1) $D = (5\,kN/m + 6.32\,kN/m^2 \times 3m) \times 4.5m = 108\,kN$ (22.5 kN)

3) $D = (5\,kN/m + 6.32\,kN/m^2 \times 3m) \times 6.75m = 162\,kN$ (33.8 kN)

4) $D = (5\,kN/m + 6.32\,kN/m^2 \times 3m) \times 4.5m = 108\,kN$ (22.5 kN)

5) $D = (5\,kN/m + 6.32\,kN/m^2 \times 3m) \times 5.25m = 126\,kN$ (26.3 kN)

6) $D = (5\,kN/m + 6.32\,kN/m^2 \times 3m) \times 3m = 71.9\,kN$ (15 kN)

← not including self-weight

Lateral Loads

- divide W = 300 kN based on wall rigidities
- divide W between 1, 2345, and 6
- then divide 2345 into 3, 4, and 5

$$V_1 = \frac{R_f^1}{R_{123456}} \times W = \frac{0.3 \times 10^6}{4.91 \times 10^6} \times 300 = 18.3\,kN$$

$$V_6 = \frac{R_f^6}{R_{123456}} \times W = \frac{0.3 \times 10^6}{4.91 \times 10^6} \times 300 = 18.3\,kN$$

$$V_{2345} = \frac{R_{2345}}{R_{123456}} \times W = \frac{4.31 \times 10^6}{4.91 \times 10^6} \times 300 = 263.3\,kN$$

$$V_3 = V_4 = V_5 = \frac{1}{3} V_{2345} = \frac{1}{3} \times 263.3\,kN = 87.8\,kN$$

Load Combinations

Consider both $1.25D + 1.4W$ and $0.9D + 1.4W$ on each pier to consider overturning

Pier	D (kN)	W (kN)	0.9D (kN)	1.25D (kN)	1.4W (kN)
1	108	18.3	97.2	135	25.6
3	162	87.8	146	203	123
4	108	87.8	97.2	135	123
5	126	87.8	113	158	123
6	71.9	18.3	64.7	89.9	25.6