1) $F_R = \rho g h_c A$

$= \rho g \frac{L \sin\theta}{2} L w$

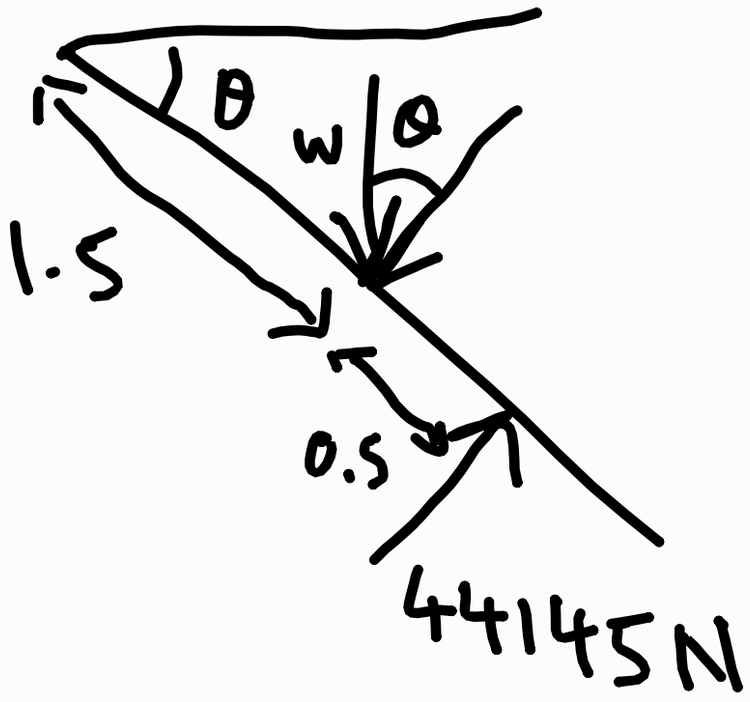
$= 1000 \times 9.81 \left(\frac{3^2 \sin 30^\circ}{2}\right)(2)$

$= 44145\,N$

$y_R = \frac{I_{xc}}{y_c A} + y_c$

$= \frac{\frac{1}{12}(2)(3)^3}{1.5(3)(2)} + 1.5$

$= 2\,m$



$W \cos 30^\circ (1.5) = 2 \times 44145$

$W = 67965.67369\,N$

$\simeq 68\,kN$

2) For the square part:

$$h_c = \frac{6}{2} = 3\,m$$

$$F_R = \rho g h_c A$$

$$= 1000 \times 9.81 (3)(6^2)$$

$$= 1059480\,N$$

$$y_R = \frac{I_{xc}}{y_c A} + y_c$$

$$= \frac{\frac{1}{12}(6)^4}{3(6)^2} + 3 = 4\,m$$

For the semicircular part:

$$\bar{y} = \frac{4r}{3\pi} = \frac{4 \times 3}{3\pi} = \frac{4}{\pi}$$

$$h_c = 6 + \frac{4}{\pi}$$

$$F_R = \rho g h_c A$$

$$= 1000 \times 9.81 \times \left(6 + \frac{4}{\pi}\right) \times \frac{1}{2}\pi(3^2)$$

$$= 100893.646\,N$$

$$y_R = \frac{I_{xc}}{y_c A} + y_c$$

$$= \frac{0.1098 \times 3^4}{\left(6 + \frac{4}{\pi}\right)\frac{1}{2}\pi(3)^2} + 6 + \frac{4}{\pi}$$

$$= 7.359735755 \text{ m}$$

Net moment $= 1059480(6-4) -$

$$(7.359735755 - 6) \times 1008693.646$$

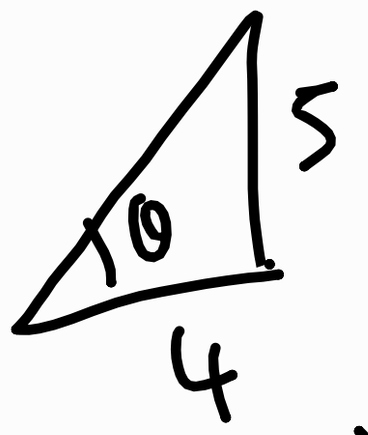
$$= 747403.1832$$

$$\approx 750 \text{kNm}$$

3) Calculating the force on a unit width:

$$F_R = \rho g h_c A$$

$$= 1000 \times 9.81 \times \frac{4}{2} \times \frac{4}{\sin(\tan^{-1}(\frac{5}{4}))}$$



$$\theta = \tan^{-1}\left(\frac{5}{4}\right)$$

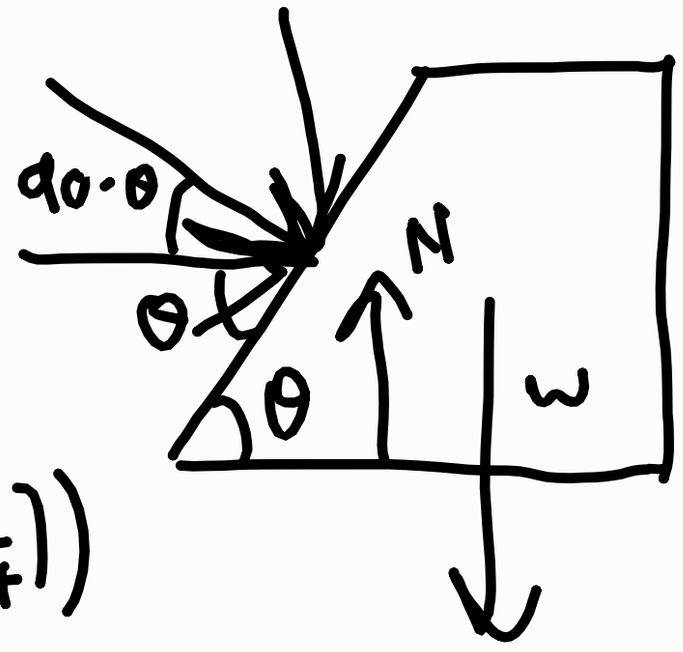
$$= 51.34019175°$$

$$= 100503.438\,N$$

$$F_{R_n} = 100503.438 \cos(90 - \tan^{-1}(\tfrac{5}{4}))$$

$$= 78480\,N$$

$$\simeq 78.5\,kN$$



$$F_{R_Y} = 100503.438 \sin(90 - \tan^{-1}(\tfrac{5}{4}))$$

$$= 62784\,N$$

$$\simeq 62.8\,kN$$

$$N = F_{R_Y} + W$$

$$= 62784 + 23.6 \times 10^3 (1)\left(\left(\frac{6+2}{2}\right)(5)\right)$$

$$= 534784\,N$$

3) $\mu_s N = F_{Rx}$

$$\mu_s(534784) = 78480$$

$$\mu_s = 0.146750837\overline{7}$$

$$\approx 0.147$$