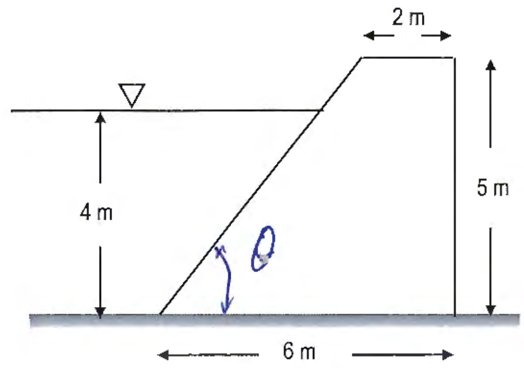
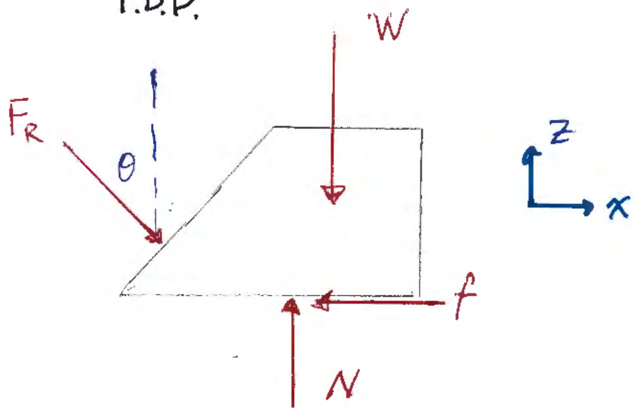
EXAMPLE: What a dam good problem!

A concrete dam has a specific weight $\gamma_{concrete} = 23.6\ kN/m^3$. The dam rests on a solid foundation. Ignoring atmospheric pressure, determine the minimum coefficient of static friction between the dam and the foundation to keep the damn from sliding. Assume the fluid is water with $\rho_{water} = 1000\ kg/m^3$.



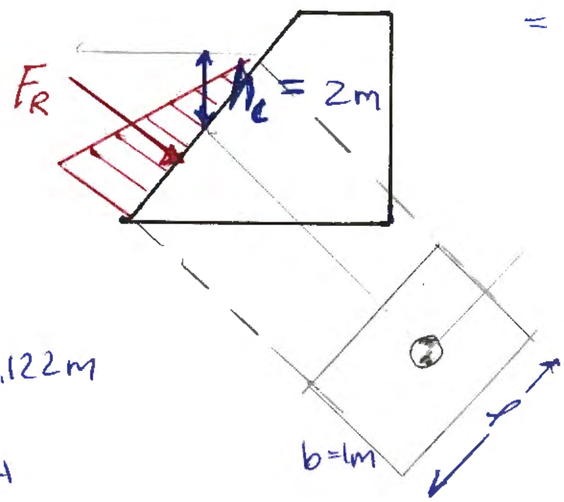
Concrete dam

F.B.D.



What is F_R ?

$$\theta = \tan^{-1}\left(\frac{5m}{(6-2)m}\right) = 51.3^\circ$$



$$F_R = P_c \cdot A = \rho g h_c (A)$$

$$= 1000 \frac{kg}{m^3} \cdot 9.81 \frac{m}{s^2} \cdot 2m \cdot 1m \cdot 5.122m$$

$$= 100{,}500 \frac{kg \cdot m}{s^2} = 100{,}500\ N$$

$$l = \frac{4m}{\sin\theta} = 5.122\ m$$

CoLM z direction

$$\frac{d}{dt}(P_z) = \sum F_z + \ldots \quad \text{closed system}$$

$$0 = -F_R \cos\theta + N - W$$

$$0 = -F_R \cos\theta + N - \gamma_{con} V_{DAM}$$

$$0 = 100{,}500\ N \cos(51.3^\circ) + N - 23{,}600 \frac{N}{m^3}\left[\frac{1}{2} \cdot 4m \cdot 2m \cdot 1m + 5m \cdot 2m \cdot 1m\right]$$

$$N = 535\ kN$$

CoLM, x-direction

$$\frac{d}{dt}(\cancel{\mathbb{P}_x}) = \Sigma F_x$$

$$0 = F_R \sin\theta - f$$

For minimum μ_s, $f = \mu_s N$. Therefore

$$0 = F_R \cdot \sin\theta - \mu_s N$$

$$\mu_s = \frac{F_R \cdot \sin\theta}{N} = \frac{100.5\ \cancel{kN} \cdot \sin(51.3°)}{535\ \cancel{kN}}$$

$$= 0.147$$ ANS

Note that the location of F_R was not important in this problem. It will be in the next one, though!