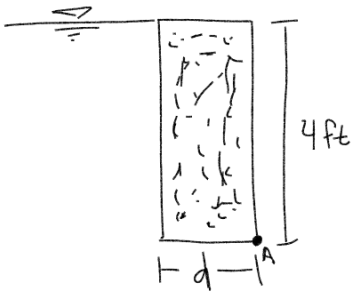
Statics
Hydro-Statics
Example 2

Determine the smallest distance, d, that will prevent the dam from tipping from the figure shown below:



$\gamma_{WATER} = 62.4\ lb/ft^3$

$\gamma_{concrete} = 70\ lb/ft^3$

FIND RESULTANT HYDROSTATIC FORCE → FIND THE TOTAL WEIGHT OF CONCRETE → TAKE A MOMENT ABOUT POINT A → SOLVE FOR "d"

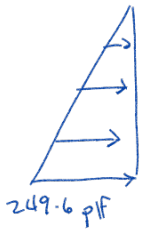
PRESSURE @ BOTTOM OF DAM:

$$P = \gamma z = 62.4\ lbs/ft^3\,(4\ ft) = 249.6\ psf$$

INTENSITY:

$$w = P(\text{WIDTH}) \rightarrow \text{WIDTH} = 1\ ft \rightarrow \text{CAN DESIGN PER FOOT OF DAM.}$$
$$= 249.6\ psf\,(1\ ft)$$
$$= 249.6\ plf$$

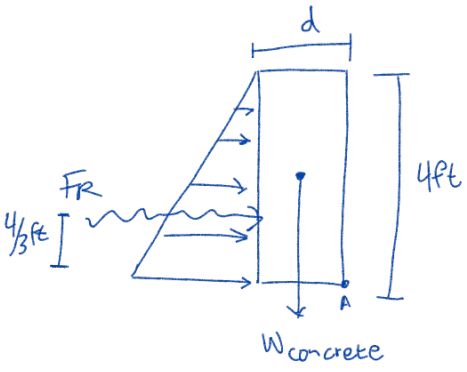
FORCE:



$$F_R = \frac{1}{2}(249.6\ plf)(4\ ft) = 499.2\ lbs$$

$$\text{WEIGHT OF CONCRETE} = (\gamma_{CONCRETE})(\text{Volume}_{concrete})$$
$$= (70\ lbs/ft^3)\underbrace{(4\ ft)(d)(1\ ft)}_{\text{height} \times \text{base} \times \text{width}}$$
$$= 280d$$

DRAW FBD



$\Sigma M_A = 0 \ (+\circlearrowright)$

$$F_R\left[\tfrac{4}{3}ft\right] - W_{concrete}\left[\tfrac{d}{2}\right] = 0$$

$$499.2165\left[\tfrac{4}{3}ft\right] - 280d\left[\tfrac{d}{2}\right] = 0$$

$$665.6\,lb\cdot ft - 140d^2 = 0$$

$$665.6\,lb\cdot ft = 140d^2$$

$$\therefore \quad d = \sqrt{665.6\,lb\cdot ft \,/\, 140}$$

$$= 2.18\,ft$$

$$\boxed{d_{min} = 2.2\,ft}$$