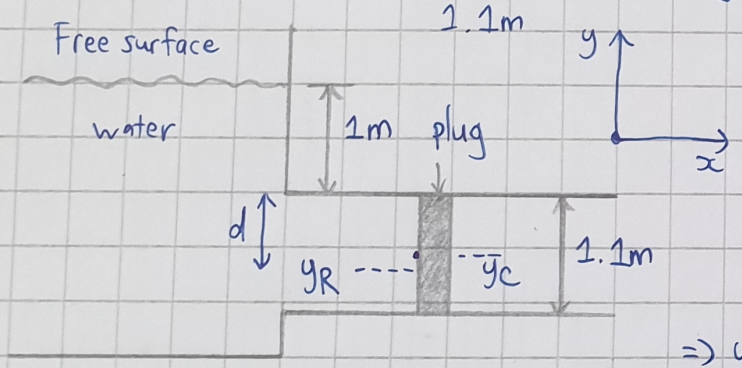
Nguyen Xuan Binh 887799 Round 1 Problem 3

A large, open tank has water. The tank is connected to a 1.1 m high, rectangular shaped pipe. The rectangle shaped plug is used to seal the pipe. Determine the magnitude, direction, and location of the force of the water on the plug ($\rho_{water} = 1000\ kg/m^3$) and width of plug is



We have: $y_c = 1 + 1.1/2 = 1.55\ m$

Moment around centroid:

$$I_{xc} = \frac{1}{12} ba^3 = \frac{1}{12}(1.1)(1.1)^3$$

$$= 1.4641/12\ kg\,m^2$$

$$\Rightarrow y_R = \frac{I_{xc}}{y_c A} + y_c = \frac{1.4641/12}{1.55.(1.1)^2} + 1.55$$

$$\Rightarrow y_R = \frac{751}{465} \approx 1.615\ m \text{ (location of force from free surface)}$$

$$\Rightarrow d = y_R - 1 \approx 0.615\ m \text{ (location of force from top of the pipe)}$$

Its direction is normal to the plug inside the pipe at depth y_R

- Magnitude of the force

$$F_R = \rho g y_c A = 1000\ kg/m^3 \cdot 9.81\ m/s^2 \cdot 1.55m \cdot (1.1)^2 m^2 = 18398.655\ N$$

$$\Rightarrow F_R \approx 18.398\ kN$$