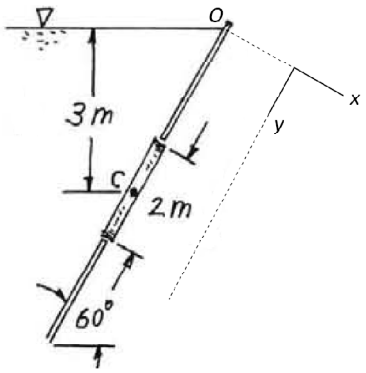
September 16, 2009

NAME

Fluids-ID

Quiz 2.

A circular 2-m-diameter gate is located on the sloping side of a swimming pool. The side of the pool is oriented 60° relative to the horizontal bottom, and the center of the gate is located 3 m below the water surface. Determine F_R and y_R, the magnitude of the water force acting on the gate and the point through which it acts, respectively. Use the following information to solve.



- $F_R = p_c \cdot A$ and $y_R = y_c + I_{xc}/(y_c \cdot A)$
  - p_c = Pressure at the centroid
  - A = Area of the gate
  - y_c = y coordinate of the centroid
  - $I_{xc} = \pi R^4/4$, where R is radius of the gate
- γ= 9.8 kN/m^3 for water

Solution:

1) F_R

$p_c = \gamma \cdot h_c$, where $h_C = 3\ m$ (+2 points)

$A = \frac{\pi D^2}{4}$ (+2 point)

$\therefore F_R = p_c \cdot A = \left(9.8\ \frac{kN}{m^3}\right)(3\ m)\left(\frac{\pi(2\ m)^2}{4}\right) = 94.2\ kN$ (+1 point)

2) y_R

$y_c = \frac{h_c}{\cos 30°} = \frac{3\ m}{\cos 30°} = 3.46\ m$ (+2 points)

$I_{xc} = \frac{\pi R^4}{4} = \frac{\pi(1\ m)^4}{4} = \frac{\pi}{4}\ m^4$ (+2 point)

$\therefore y_R = y_c + \frac{I_{xc}}{y_C \cdot A} = 3.46\ m + \frac{\frac{\pi}{4} m^4}{(3.46\ m)(\frac{\pi(2\ m)^2}{4})} = 3.53\ m$ (+1 point)