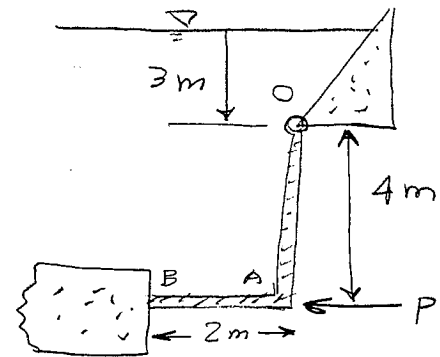


GIVEN: RIGID GATE, OAB  
HINGED AT O AND RESTS AT  
B. WIDTH IS 3 m. NEGLECT  
GATE WEIGHT AND FRICTION.

FIND: HORIZONTAL FORCE,  
P, TO HOLD GATE CLOSED.

SOLUTION:



WATER CREATES A MOMENT ABOUT POINT O

$$(\sum M_O = 0 = P \cdot 4m - F_H \cdot (y_R - 3) - F_V \cdot x_R)$$

Where

1.  $F_H = \gamma h_c A$  where

$$\gamma = 9800 \text{ N/m}^3 \text{ (Table 1.5)}$$

$$h_c = 3 + 2 = 5 \text{ m}$$

$$A = 4 \text{ m} \times 3 \text{ m} = 12 \text{ m}^2$$

$$\Rightarrow F_H = (9800 \text{ N/m}^3)(5 \text{ m})(12 \text{ m}^2) = 588 \text{ kN} \rightarrow$$

2.  $F_V = \gamma h_c A$  where

$$h_c = 3 \text{ m} + 4 \text{ m} = 7 \text{ m}$$

$$A = 2 \text{ m} \times 3 \text{ m} = 6 \text{ m}^2$$

$$\Rightarrow F_V = (9800 \text{ N/m}^3)(7 \text{ m})(6 \text{ m}^2) = 411.6 \text{ kN} \downarrow$$

(NOTE: this is the weight of the fluid above A-B!,  
 $W = \gamma V$ )

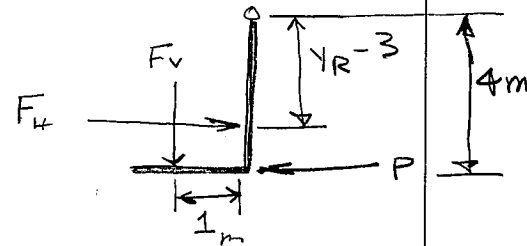
3.  $y_R = y_c + I_{xc} / y_c A$

$$y_c = h_c = 5 \text{ m}$$

$$I_{xc} = bh^3/12 \text{ (Fig 2.13, p. 47)}$$

$$= (3 \text{ m})(4 \text{ m})^3/12 = 16 \text{ m}^4$$

$$A = 12 \text{ m}^2$$



$$\Rightarrow Y_R = 5m + \frac{16m^4}{(5m)(12m^2)} = (5 + 0.27)m = 5.27m$$

4.  $X_R = 1m$

5. 
$$P = \frac{F_Y \cdot X_R + F_H(Y_R - 3m)}{4m}$$

$$= \frac{(411.6 \text{ kN})(1m) + (588 \text{ kN})(5.27 - 3m)}{4m}$$

$P = 436 \text{ kN}$

13-752 500 SHEETS, FILLER 5 SQUARE  
 42-281 50 SHEETS EYE/EASE 5 SQUARE  
 42-362 100 SHEETS EYE/EASE 5 SQUARE  
 42-363 100 SHEETS EYE/EASE 5 SQUARE  
 42-364 100 SHEETS EYE/EASE 5 SQUARE  
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 42-399 100 SHEETS EYE/EASE 5 SQUARE  
 42-400 100 SHEETS EYE/EASE 5 SQUARE

