CE 319 F

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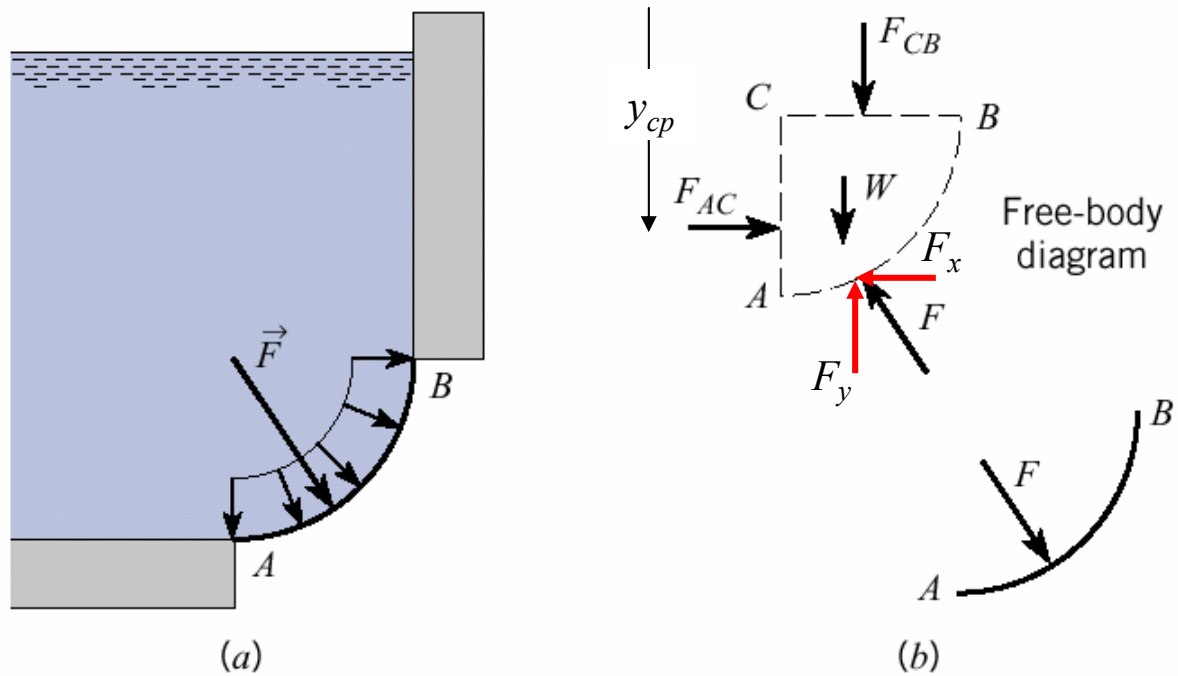
Elementary Mechanics of Fluids

Hydrostatic Forces on Curved Surfaces

Pressure on Curved Surface



$$\sum_x F = 0$$

$$= F_{AC} - F_x$$

$$F_{AC} = F_x$$

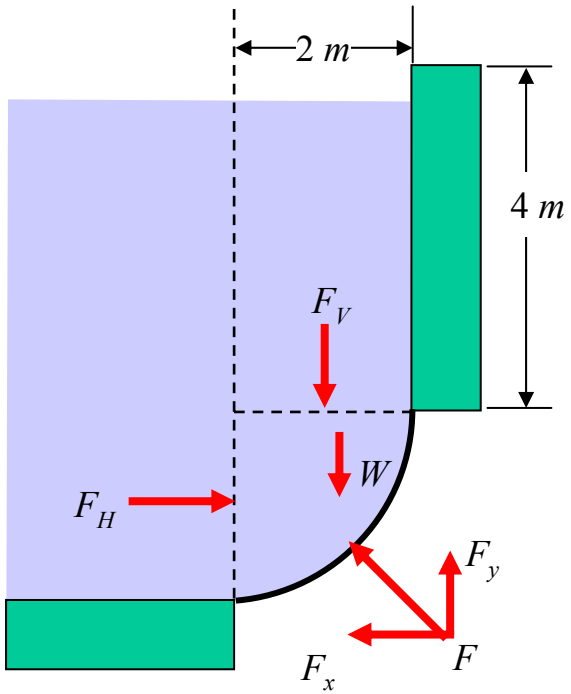
$$\sum_y F = 0$$

$$= F_y - F_{CB} - W$$

$$F_y = W + F_{CB}$$

Example (3.13)

Find: F



$$\sum_y F = 0 = F_y - F_V - W$$

$$F_V = \bar{p}A$$
$$= 9810 * 4 * 2 * 1$$
$$= 78.5\,kN$$

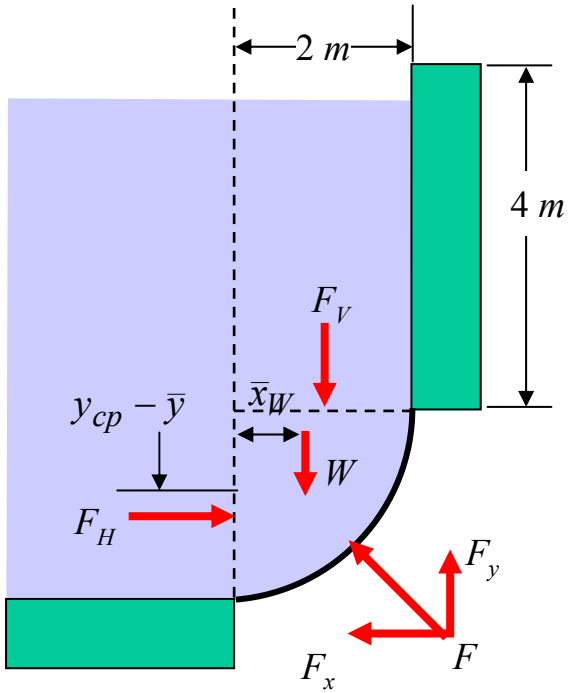
$$W = \gamma V = \gamma \frac{\pi}{4} r^2 * 1$$
$$= 9810 * 0.25 * \pi * 4 * 1$$
$$= 30.8\,kN$$

$$F_y = 30.8 + 78.5$$
$$F_y = 109.3\,kN$$

$$\sum_x F = 0 = F_H - F_x$$

$$F_x = \bar{p}A$$
$$= 5 * 9810 * 2 * 1$$
$$F_x = 98.1\,kN$$

Example (3.13)



$$y_{cp} - \bar{y} + \frac{\bar{I}}{\bar{y}A} = \frac{1*2^3/12}{5*2*1} = 0.067\,m$$

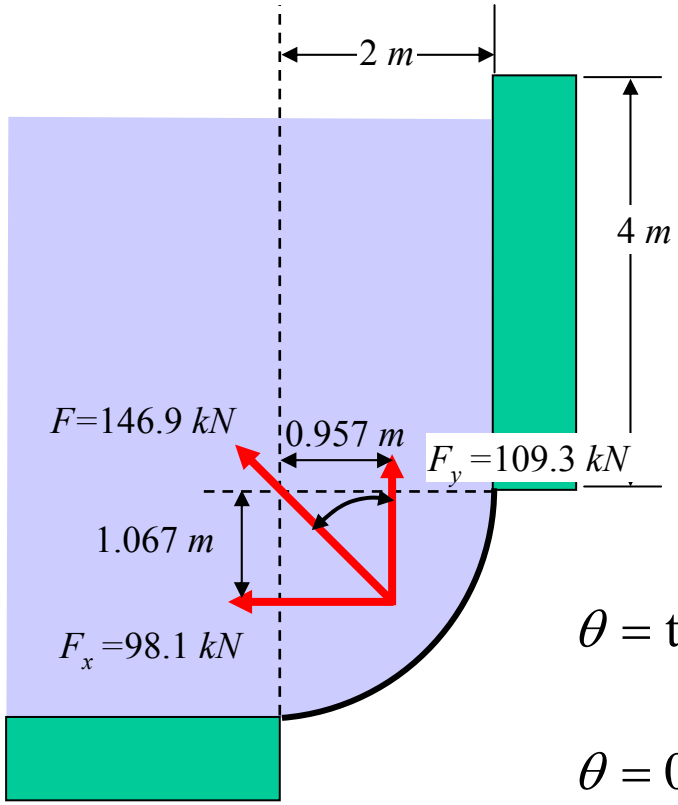
$$x_{cp}F_y = F_V*1 + W*\bar{x}_W$$

$$\bar{x}_W = \frac{4r}{3\pi} = 0.849\,m$$

$$x_{cp} = \frac{78.5*1 + 30.8*0.849}{109.3}$$

$$x_{cp} = 0.957\,m$$

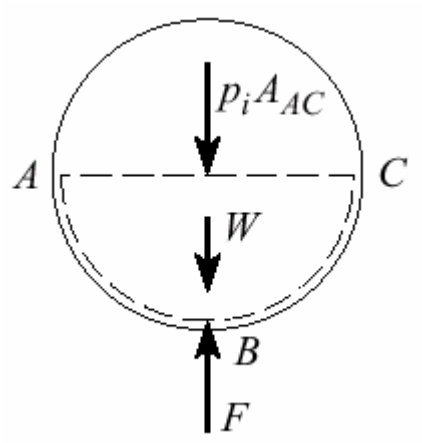
Example (3.13)

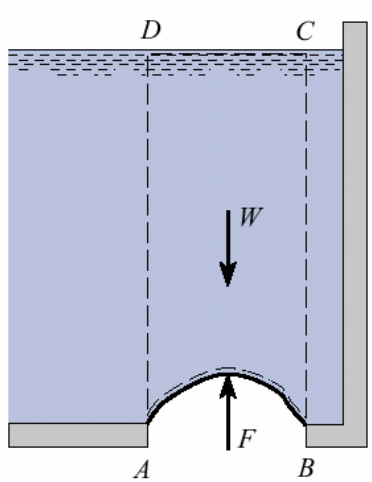


$$\theta = \tan^{-1}\frac{98.1}{109.3} = 0.8975\,rad$$

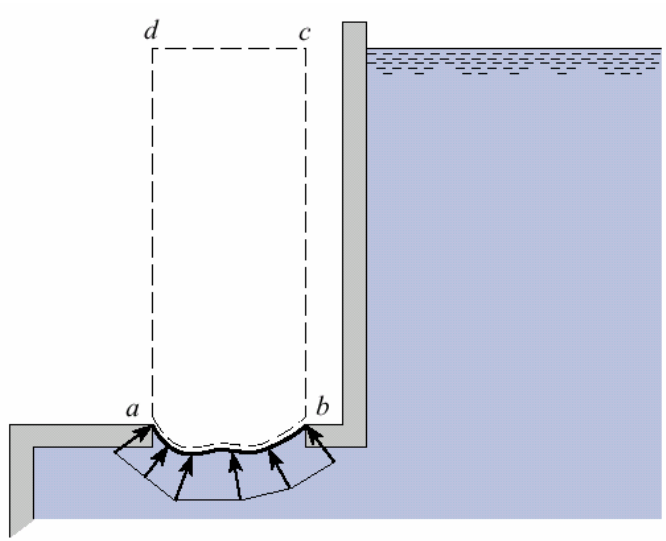
$$\theta = 0.8975\,rad * \frac{360\,deg}{2\pi\,rad}$$

$$\theta = 42^{o}$$





(a)

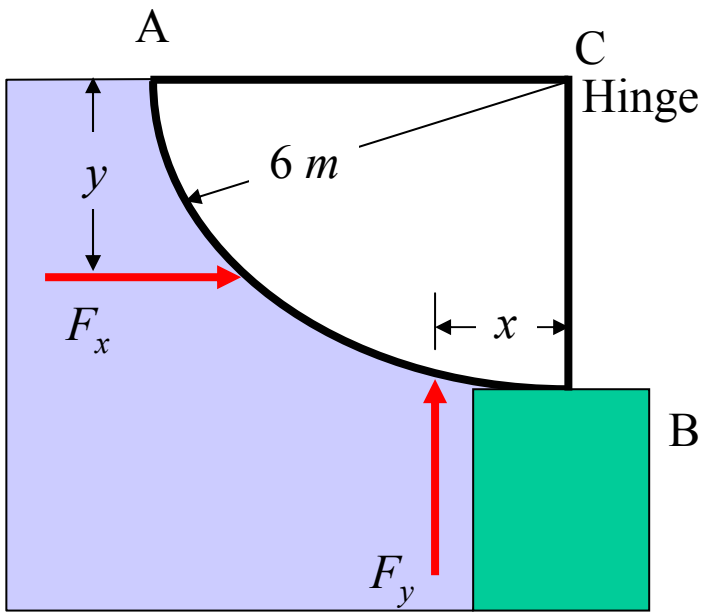


(b)

$$F = p_i A_{AC} + W$$

$$F = \gamma V_{ABCD} = W$$

Example



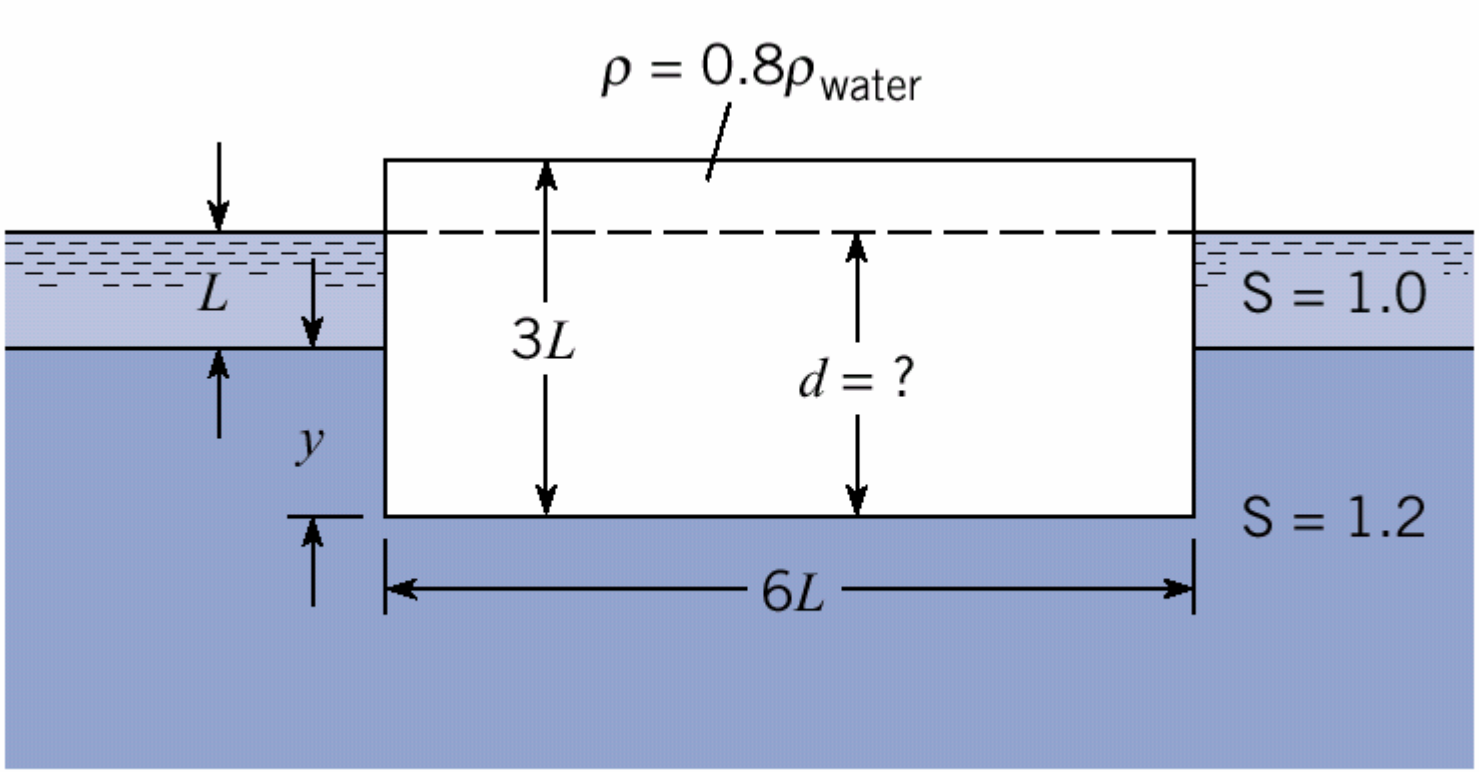
$$F_x = \gamma \bar{y} A_{CB}$$
$$= 9810 * 3 * 6 * 1$$
$$= 176.6\,kN$$

$$F_y = \gamma V_{ABC}$$
$$= 9810 * \frac{\pi 6^2}{4} * 1$$
$$= 277.4\,kN$$

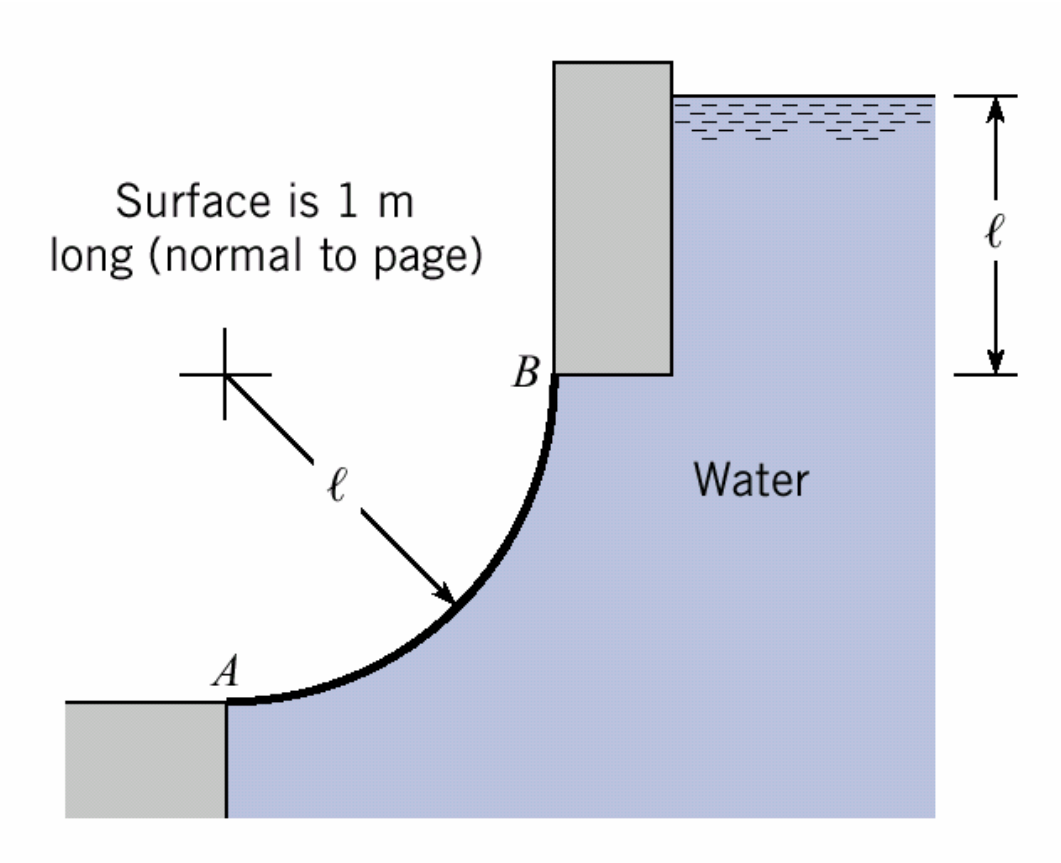
$$x = \frac{4r}{3\pi}$$
$$= \frac{4 * 6}{3 * \pi} = 2.55\,m$$

$$y - \bar{y} = \frac{1 * 6^3 / 12}{3 * 6 * 1}$$
$$= 1\,m$$

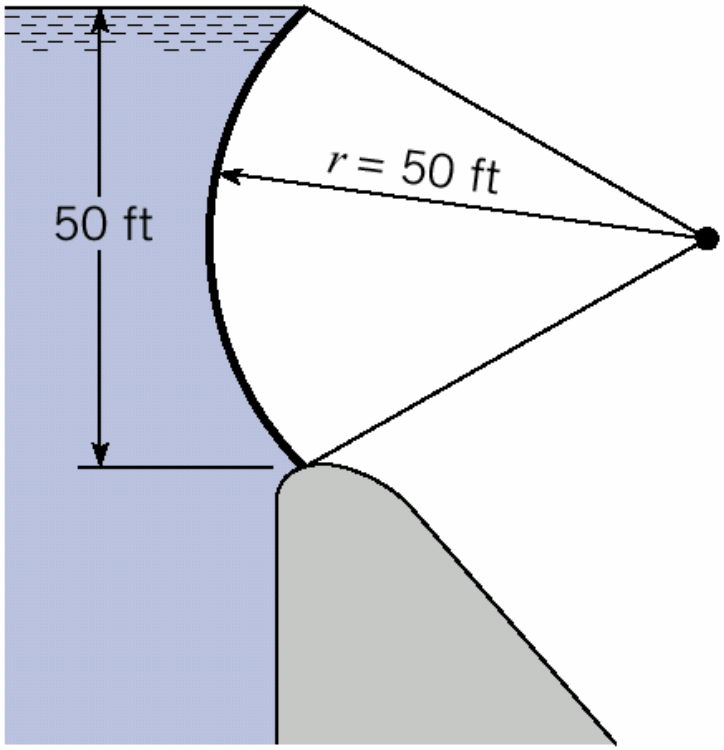
HW (3.118)



HW (3.128)



HW (3.129)



$$F_x = \bar{p}A$$

$$= 25\,ft * 62.4\,lbf / ft^3 * 40\,ft * 50\,ft$$

$$= 3{,}120{,}000\,lbf$$

$$F_y = \gamma \forall$$

$$= 62.4 * (\frac{60}{360}\pi * 50^2 - \frac{1}{2} * 50 * 50\cos 30^\circ) * 40$$

$$= 565{,}344\,lbf$$