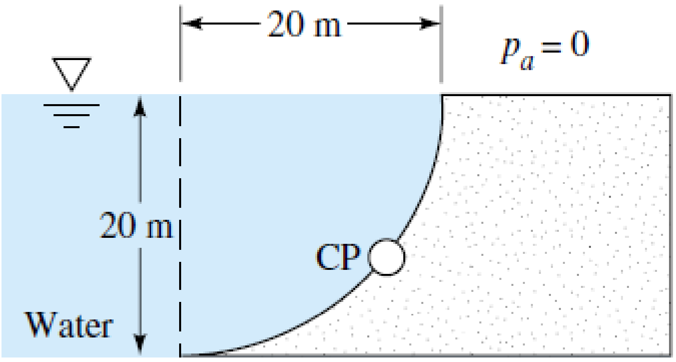
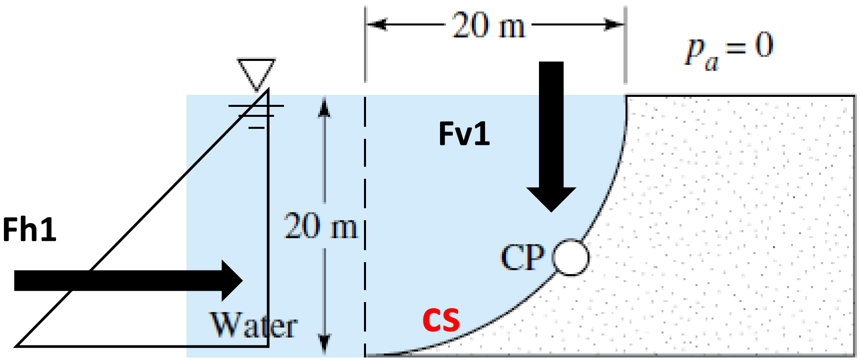
**Example 1:**

The dam in Figure is a quarter circle 50 m wide into the paper. Determine the horizontal and vertical components of hydrostatic force against the dam and the point CP where the resultant strikes the dam.




<u>Solution</u>




Fv1= [(r$^2$ *π)/4] * L* $\gamma_{water}$,  Fv1= [20$^2$ *π /4] * 50 * 9810= 154 * 10$^6$ N

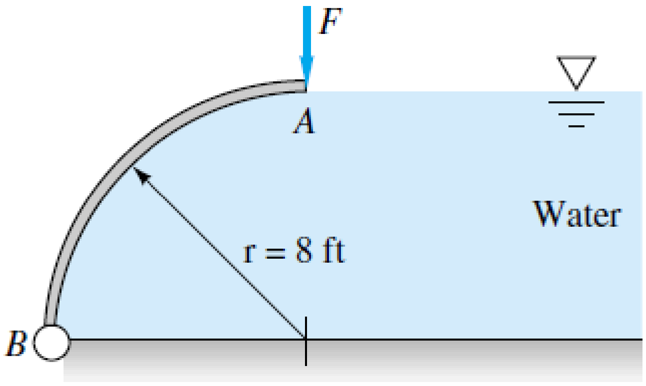
Fh1= [r * r)/2] * L* $\gamma_{water}$,  Fh1= [20 * 20/2] * 50 * 9810= 98.1 * 10$^6$ N

$F_R$= $\sqrt{Fv1^2 + Fh1^2}$,  $F_R$= $\sqrt{(154 * 10^6)^2 + (98.1 * 10^6)^2}$ = 182.6 * 10$^6$ N

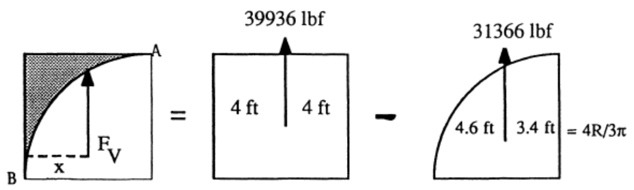
θ =tan$^{-1}$ (Fv1/Fh1),  θ =tan$^{-1}$ (154 * 10$^6$ /98.1 * 10$^6$) = 57.5°

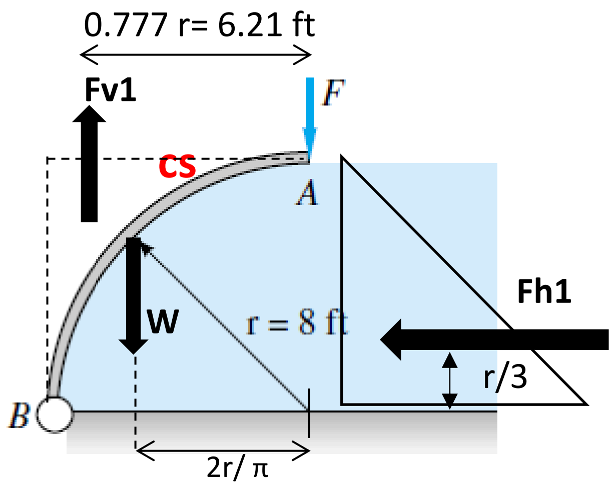
**Example 2:**

Gate AB in Fig. is a quarter circle 10 ft wide into the paper and hinged at B. Find the force ***F*** just sufficient to keep the gate from opening. The gate is uniform and weighs 3000 lbs.




Solution




Fv1= [(r * r) - ($r^2$ *π)/4] * L* $\gamma_{water}$,   Fv1= [(8 * 8) - ($8^2$ *π)/4] * 10* 62.4 = 8570.33 lbs

Fh1= [(r * r)/2] * L* $\gamma_{water}$,   Fh1= [(8 * 8)/2] * 10 * 62.4= 19968 lbs

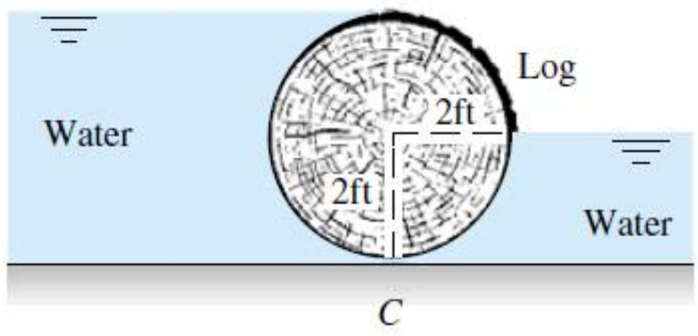
$\sum$ M@B =0, +

3000* (8- 2 * 8 / π) – 19968 * (8/3) – 8570.33 * (8 – 6.21) + 8 * F= 0

F= 7483.5 Ibs

**Example 3:** Homework

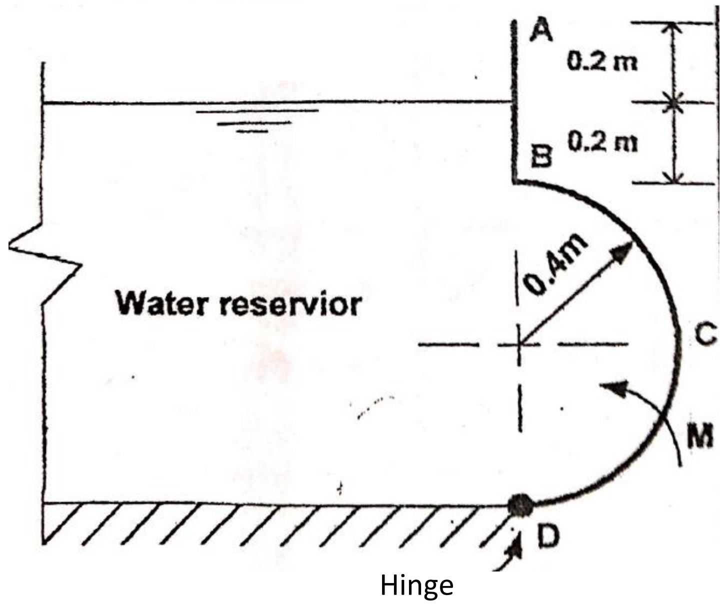
The 4-ft-diameter log (SG = 0.80) in Fig. is 8 ft long into the paper and dams' water as shown. Compute the net vertical and horizontal reactions at point C. $\gamma_{w}$,=62.4 pcf



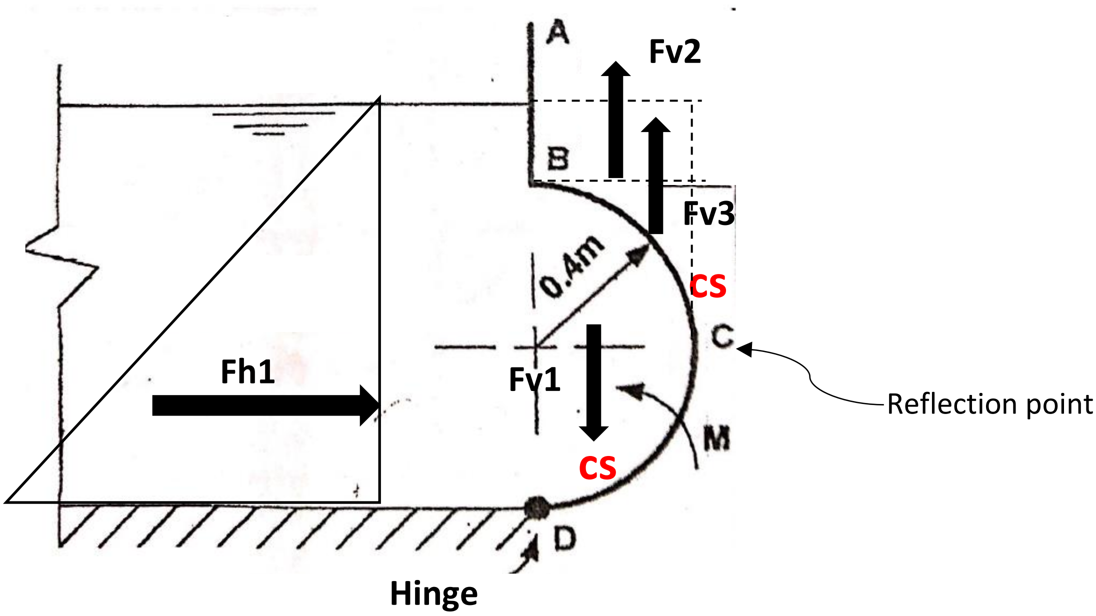

Answer: $C_x$= **2996 lbs**, $C_y$= **313 lbs.**

**Example 4:**

The gate ABCD represents the right side of the water reservoir shown in Fig. considering that the gate can be rotated about the hinge (D), what is the minimum moment (M) required for keeping the gate in position (not to rotate). Gate width 1.0 m



Solution




Fv1= [($r^2$ *π)/2] * L* $\gamma_{water}$,   Fv1= [$0.4^2$ *π /2] * 1 * 9810= 2465.5 N

Fv2= [area of rectangle] * L* $\gamma_{water}$,   Fv2= [0.2 *0.4] * 1 * 9810= 784.8 N

Fv3= [area of square- ($r^2$*π)/4] * L* $\gamma_{water}$,  Fv3= [0.4 *0.4 – $0.4^2$ *π /4] * 1 * 9810= 336. 84 N

Fh1= [h* h)/2] * L* $\gamma_{water}$,   Fh1= [1 * 1/2] * 1 * 9810= 4905 N

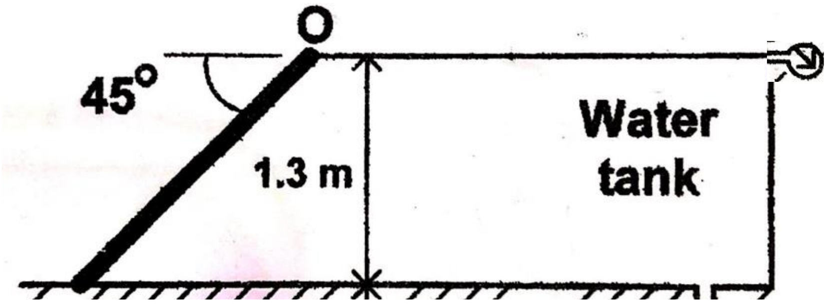
∑ M@D =0, ↷ +

4905 * (1/3) + 2465.5 * (4 * 0.4/3 * π) – 784.8 * 0.2 - 336. 84 * 0776 *0.4 - M= 0

M= 1791.91 Nm. ⤸

Note:

In the pressurised tank (whether we have **gauge reading** or **piezometer**), it is prerequisite to find water surface level to calculate the horizontal and vertical forces applied on the gate.




Case 1: Gauge pressure of 1000 Pa

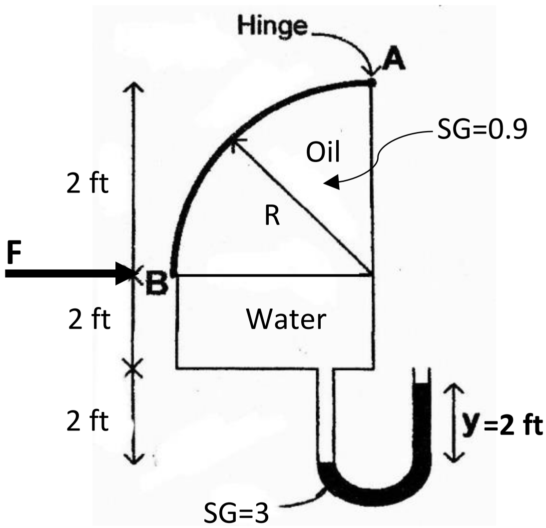
$$\frac{101.3 * 1000}{1000} = \frac{10.34\, m\ (H_2O)}{X}$$

Case 1: Gauge pressure of -2000 Pa

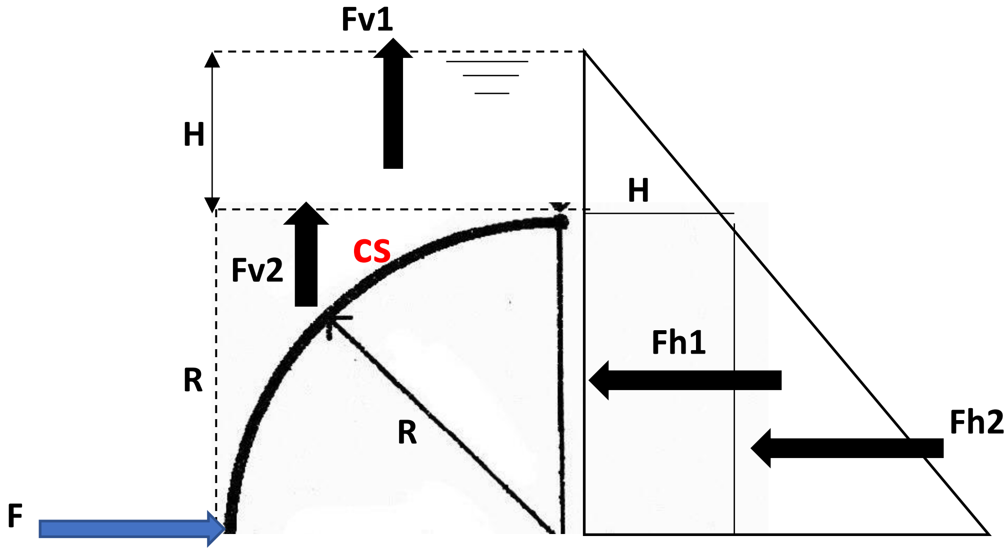
$$\frac{101.3 * 1000}{-2000} = \frac{10.34\, m\ (H_2O)}{X}$$

**Example 5:**

Gate AB in Fig. is a quarter circle 1 ft wide into the paper and hinged at A. Find the force ***F*** just sufficient to keep the gate from opening. Neglect the self-weight of the gate



Solution




First, we need to find **H** above of the tank

2 * 3 * 62.4 – 4 * 62.4 – 2 * 0.9 * 62.4 - H * 0.9 * 62.4 , H=0.2 ft

$Fv1= (R *H) * L* SG_{Oil} * \gamma_{water}$, Fv1= (2 * 0.2) * 1 * 0.9 * 62.4= 22.48 Ibs.

$Fv2= [(R * H) - (R^2 *\pi)/4] * L* SG_{Oil} * \gamma_{water}$, $Fv2= [(2 * 0.2)- (2^2 *\pi)/4]*1*0.9*62.4=$ 48.24 Ibs

$Fh1= (R *H) * L* SG_{Oil} * \gamma_{water}$, Fh1= (2 * 0.2) * 1 * 0.9 * 62.4= 22.48 Ibs.

$Fh2= (R *R/2) * L* SG_{Oil} * \gamma_{water}$, Fh2= (2 * 2/2) * 1 * 0.9 * 62.4= 112.41 Ibs.

$\sum M@A = 0$, (+ clockwise)

112.41* (2-2/3) + 22.48 * 1 + 48.24 *(0.777 *2) + 22.48 * 1 – 2 * F = 0

F= 101 Ibs.