



PROBLEM 3.94

3.94 For the plane rectangular gate ($l \times w$ in size), Figure (a), what is the magnitude of the reaction at A in terms of γ_w and the dimensions l and w ? For the cylindrical gate, Figure (b), will the magnitude of the reaction at A be greater than, less than, or the same as that for the plane gate? Neglect the weight of the gates.

$$(a) \quad F = \bar{p} A = (.25l + .5l \sin 45) \delta_w w l \\ = .604 \delta_w w l^2$$

$$y_{cp} - \bar{y} = \bar{I} / \bar{y} A = \frac{w l^3}{12} / \left(\frac{.25l + .5l}{\frac{.707}{\sin 45}} \right) (w l) \\ = .098l$$

$$\sum M_B = 0 \quad R_A l \cos 45 - F (.5l + .098l) = 0$$

$$\text{Plane gate: } \left. \begin{array}{l} F_H = F \cos 45 \\ F_V = F \sin 45 \end{array} \right\} R_A = .51 \delta_w w l^2 \\ = .427 \delta_w w l^2$$

$$\text{Curved gate: } F_x = \bar{p} A = (.25l + .5l \sin 45) \delta_w w l \\ = .427 \delta_w w l^2$$

$$F_V = .25l \times l \sin 45 \times w \times \delta_w \times l \\ + (l \sin 45)^2 \times w \times \delta_w \times l \\ - \frac{1}{4} \pi (l \sin 45)^2 \times w \delta_w \times l = .284 \delta_w w l^2$$

< F_V plane gate

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$$(a) \quad F = \bar{p}A = (.25l + .5l \times \frac{\sin 45^\circ}{.707}) \times \delta_w \times w \times l$$

$$= .604 \delta_w w l^2$$

$$y_{cp} - \bar{y} = \frac{\bar{I}}{gA} = \frac{wl^3}{12} / (.5l + .25l / \sin 45^\circ) w l$$

$$= .098 l$$

$$\sum M_B = 0 \quad R_A l \cos 45^\circ - F (.5l + .098l) = 0$$

$$R_A = .51 \delta_w w l^2$$

(5) Reaction curved surface less since F_H same but F_V less for curved surface since less volume of fluid above curved gate

Plane gate: $F_H = F \cos 45^\circ = .427 \delta_w w l^2$

$F_V = F \sin 45^\circ = .427 \delta_w w l^2$

Curved gate: $F_x = \bar{p}A = (.25l + .5l \sin 45^\circ) \delta_w \times w \times l$

\nearrow $F_{\text{on project}} = .427 \delta_w w l^2$

area \perp to horizontal component of interest

$$F_V = .25l \times l \sin 45^\circ \times w \times \delta_w$$

$$+ (l \sin 45^\circ)^2 \times w \times \delta_w$$

$$- \frac{1}{4} \pi (l \sin 45^\circ)^2 \times w \times \delta_w = .284 \delta_w w l^2 <$$