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1. The fluid flowing in Fig. 1 has a viscosity μ = 0.0010 lb·s/ft^2. Calculate the shear stress at the boundary (i.e., at $y = 0$) and at a point 3" from the boundary, assuming (a) straight-line velocity distribution, $u = 15y$, and (b) a parabolic velocity distribution, $u = 45 - 5(3 - y)^2$.

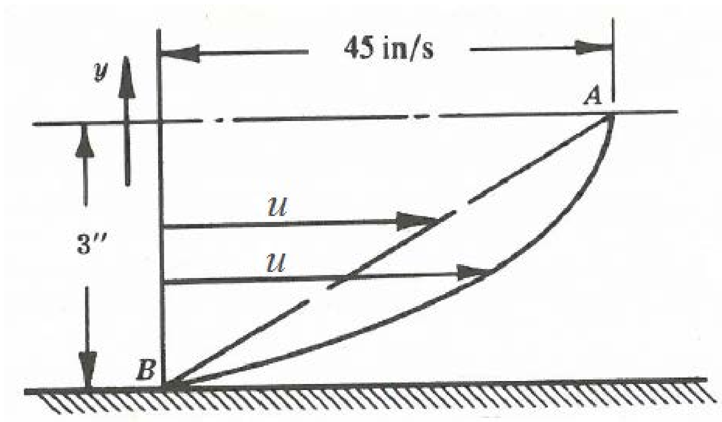

Fig. 1

2. Determine the magnitude and location of the horizontal and vertical components of the force due to water acting on curved surface *AB* in Fig. 2(left). The width of the gate (into the paper) is 10 ft. Use the geometric properties if needed. (Note: γ_{water} = 62.4 lb/ft^3).

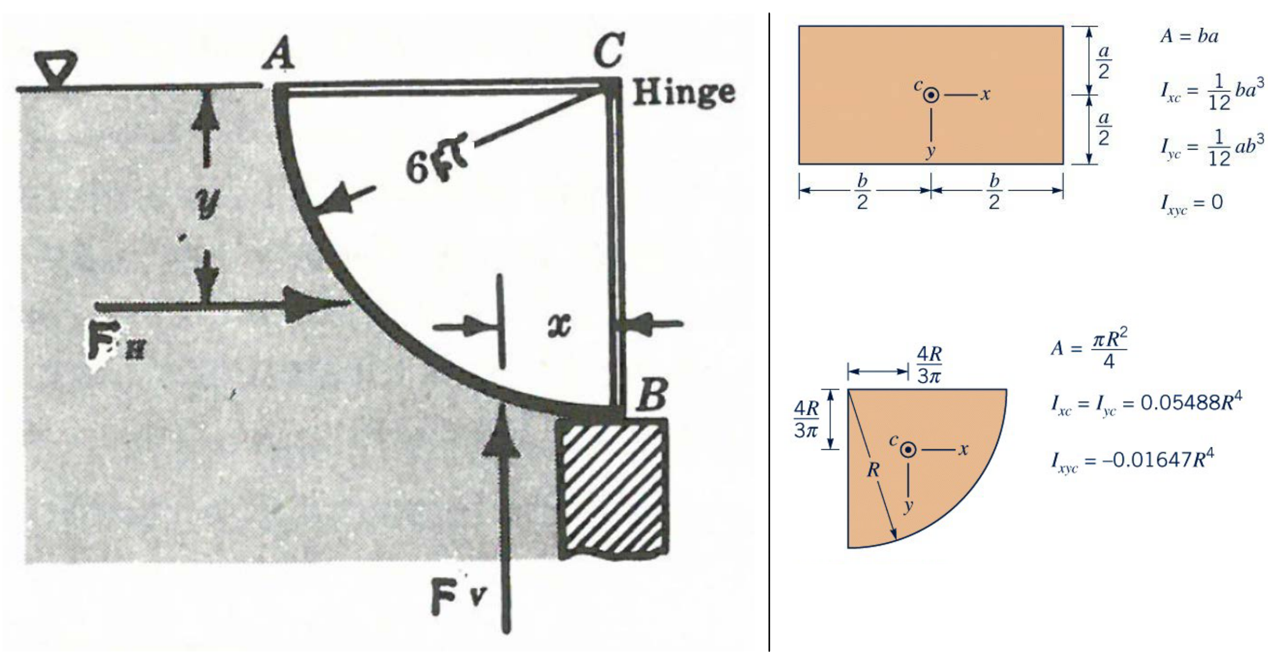

Fig. 2

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3. A Venturi meter having a throat diameter of 150 mm is installed in a horizontal 300-mm-diameter water pipe, as shown in Fig. 3. Neglecting losses, determine the difference in level (h) of the mercury columns of the differential manometer attached to the Venturi meter if the flow rate is 0.142 m^3/s. (Note: Use γ = 9,780 N/m^3 for water and SG = 13.6 for mercury)

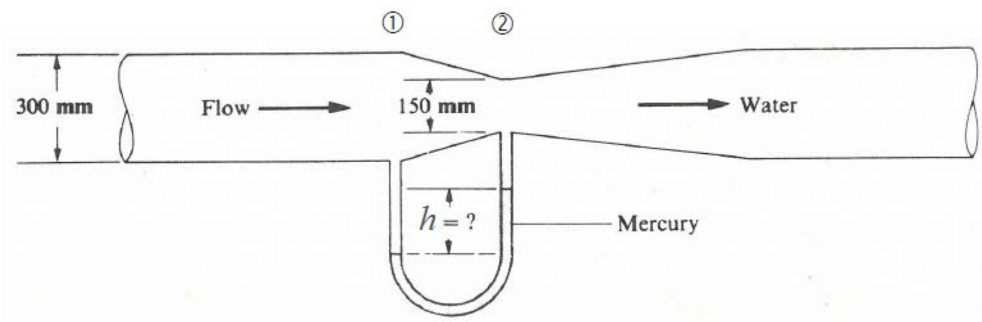

Fig. 3

4. For the steady two-dimensional flow shown in Fig. 4, the scalar components of the velocity field are $u = -x$ and $w = z$. Find the scalar components of (a) the acceleration (a_x, a_z) and (b) the pressure gradient $\left(\frac{\partial p}{\partial x}, \frac{\partial p}{\partial z}\right)$ at point 1 (x=0.5m, z=0.1m), respectively. For part (b), use the Euler equation, $\rho \underline{a} = \rho \underline{g} - \nabla p$, where $\nabla p = \frac{\partial p}{\partial x}\hat{\boldsymbol{\imath}} + \frac{\partial p}{\partial z}\hat{\boldsymbol{k}}$, acceleration $\underline{a} = a_x\hat{\boldsymbol{\imath}} + a_z\hat{\boldsymbol{k}}$, gravity $\underline{g} = -g\hat{\boldsymbol{k}}$, and density ρ = 1.23 kg/m^3.

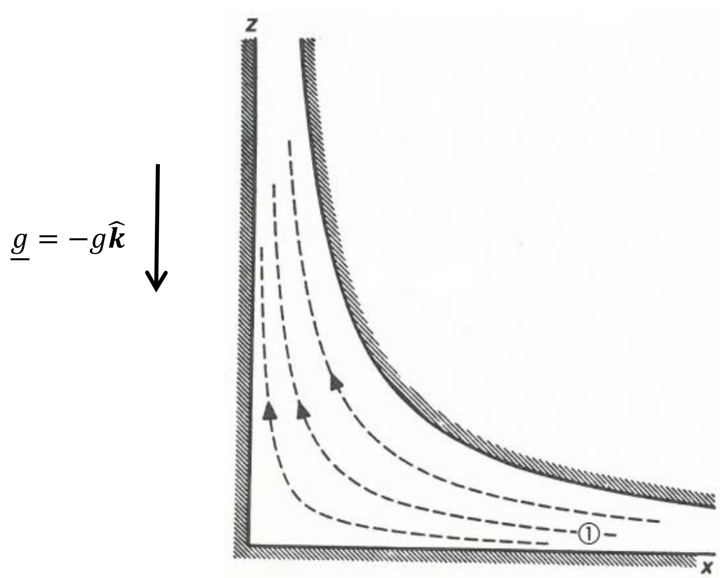

Fig. 4