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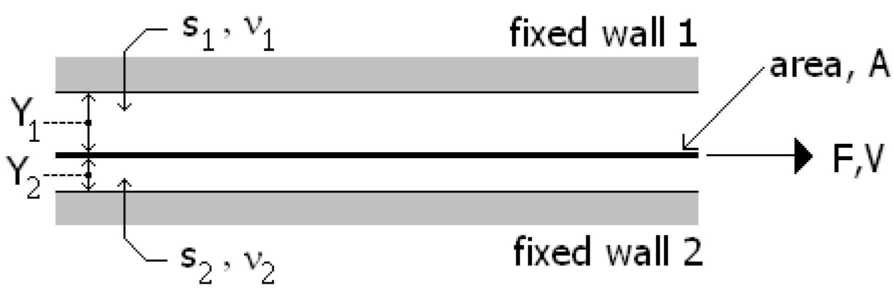
[1]. The figure below shows a thin flat plate of area $A = 0.2\ ft^2$ being pulled at a constant speed $V = 1.5\ ft/sec$ parallel to two fixed walls. The gaps between the fixed walls and the moving flat plate are filled with two different liquids. The liquid at the top gap has a specific gravity $s_1 = 1.2$, and a kinematic viscosity $\nu_1 = 0.001\ ft^2/sec$, while liquid at the bottom gap has a specific gravity $s_2 = 0.8$, and a kinematic viscosity $\nu_2 = 0.005\ ft^2/sec$. The gap thicknesses are $Y_1 = 0.10\ in$ and $Y_2 = 0.05\ in$, respectively. Determine the force F required to pull the flat plate. (Specific weight of water, $\gamma_w = 62.4\ lb/ft^3$)

[Use next page for calculations, if needed]



Solution: F = ________________________________

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Calculations for problem [1] (if needed):

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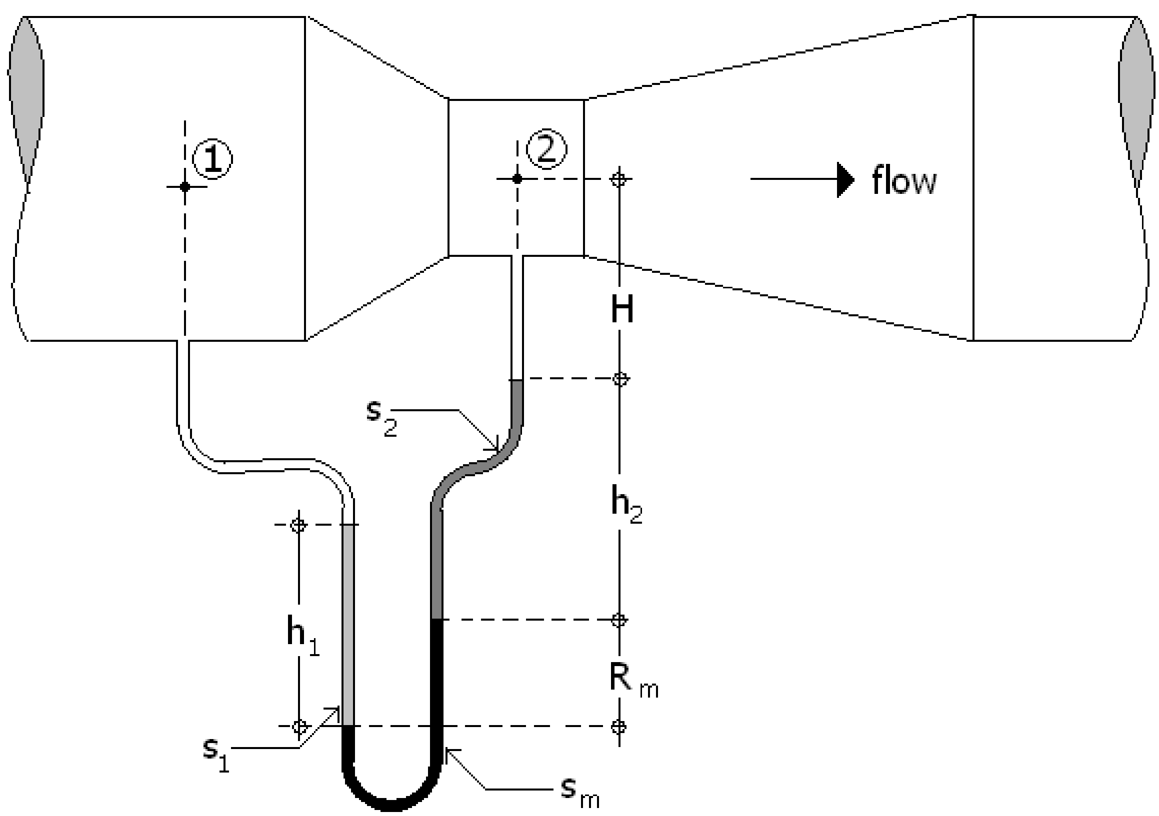
[2]. The figure below shows a Venturi meter in a pipeline carrying water. The main manometric fluid is mercury (specific density, $s_m = 13.56$), showing a manometer reading $R_m = 2\ in$. The upstream (left) leg of the manometer contains $h_1 = 4\ in$ of Merriam No.3 red manometric fluid with a specific density $s_1 = 1.8$, while the downstream (right) leg contains $h_2 = 6\ in$ of blue manometric fluid with a specific density $s_2 = 0.75$. Determine the pressure head drop between the upstream (1) and downstream (2) measuring points in the Venturi meter, i.e., determine:

$$\frac{\Delta p}{\gamma_w} = \frac{p_1 - p_2}{\gamma_w} = ?$$

where γ_w is the specific weight of water ($\gamma_w = 62.4\ lb/ft^3$). Notice that points (1) and (2) are located at the same level in the pipe centerline.

[Use next page for calculations]



Solution: $\Delta p/\gamma_w$ = ____________________________

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Calculations for problem [2]:

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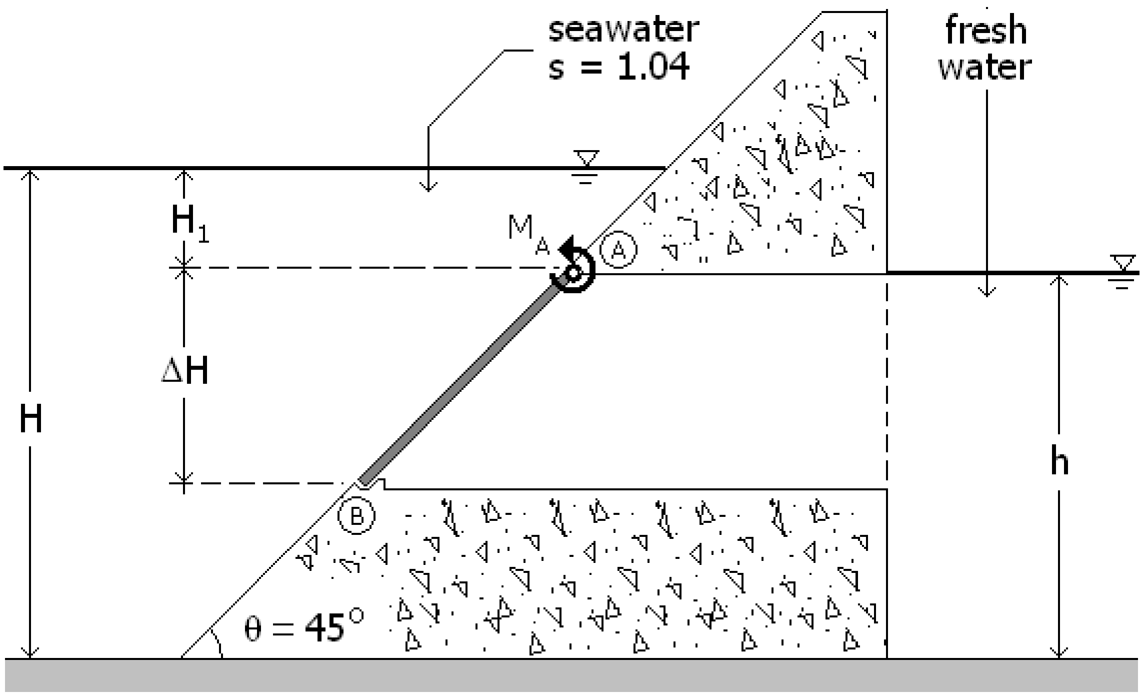
[3]. The figure below shows a square gate AB on the sloping face ($\theta = 45^o$) of a concrete dam used to contain seawater (specific gravity, $s = 1.04$). The gate, hinged at A and supported at B by a wedge, covers a square tunnel that connects the seawater to a freshwater reservoir. When the depth of seawater is $H = 6\ ft$, the top of the gate (point A) is submerged by an amount $H_1 = 2\ ft$, while the bottom of the gate (point B) is located at a depth $H_1+\Delta H$ with $\Delta H = 3\ ft$. When the depth of freshwater reaches the depth of point A, as shown, determine the net moment from the hydrostatic forces on gate AB about point A.

[Use next page for calculations]



Solution: M_A = ______________________________

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Calculations for problem [3]:

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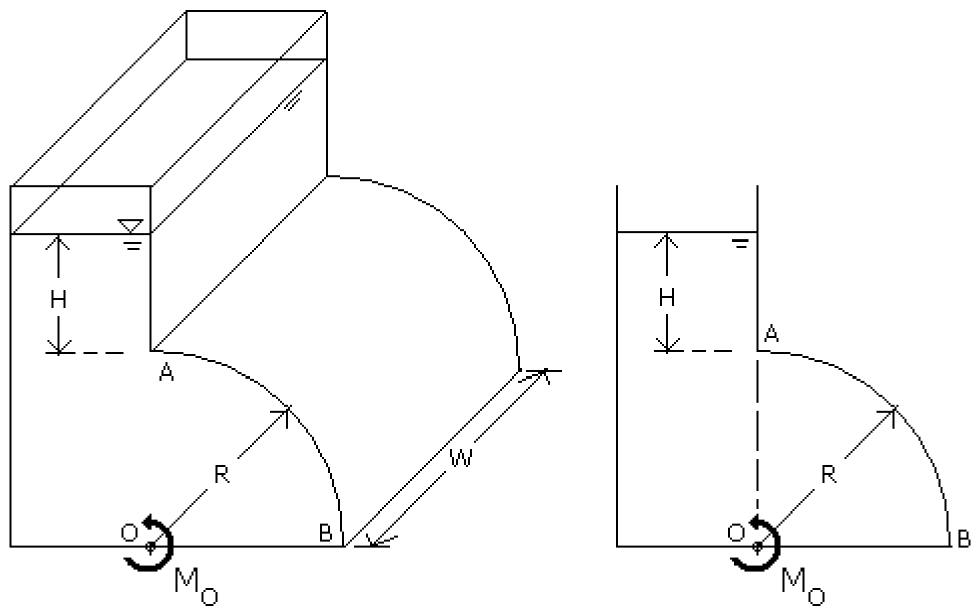
[4]. The figure below shows a steel tank composed of a rectangular section and a quarter of a circle (AB) of radius $R = 2.0\ m$. The tank is filled with water as shown. The tank width is $W = 3.0\ m$, and the water reaches a depth $H = 1.5\ m$ above the top of the circle. Determine the moment that the vertical component of the hydrostatic force on the circular segment AB produces about a horizontal axis through point O.

[Use next page for calculations, if needed]



Solution: M_O = ______________________________

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Calculations for problem [4] (if needed):