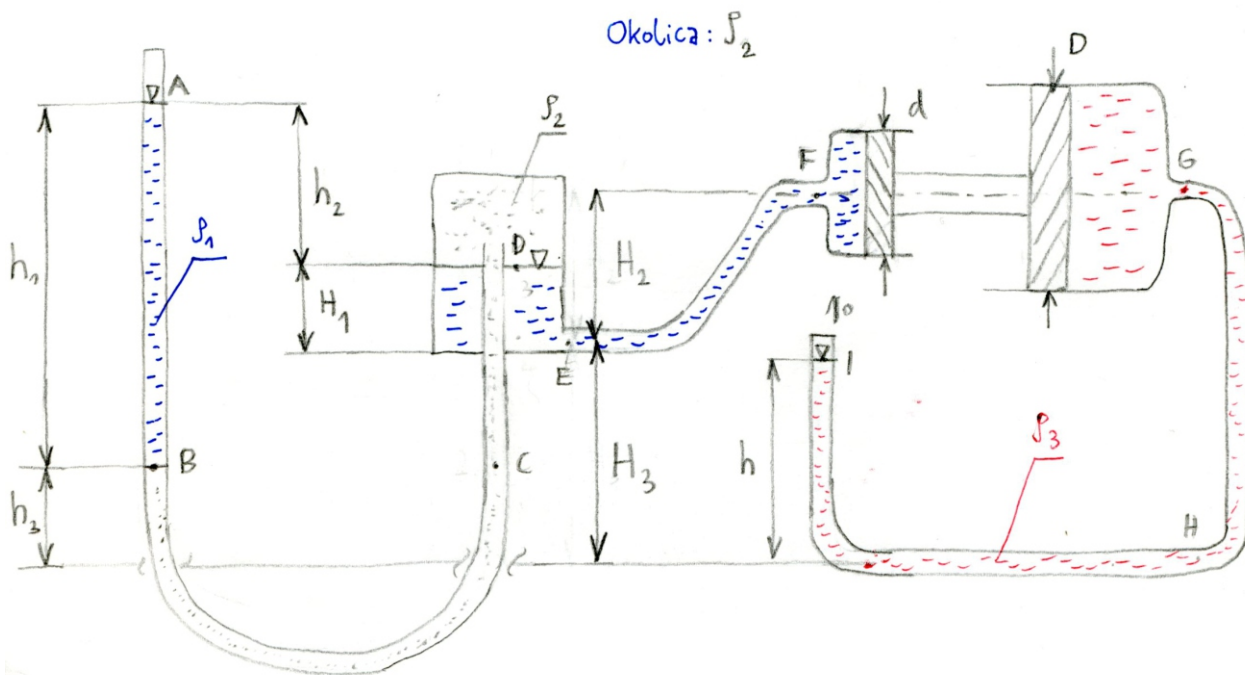


Naloga 2. Določi višino stolpca h, da bo sistem v ravnovesju.



Podatki:

$$\rho_1 = 1000 \frac{\text{kg}}{\text{m}^3} \quad H_1 = 1,5 \text{ m} \quad h_{n1} = 8 \text{ m} \quad g = 9,807 \frac{\text{m}}{\text{s}^2}$$

$$\rho_2 = 1,25 \frac{\text{kg}}{\text{m}^3} \quad H_2 = 5 \text{ m} \quad h_2 = 5,4 \text{ m} \quad d = 0,4 \text{ m}$$

$$\rho_3 = 284 \frac{\text{kg}}{\text{m}^3} \quad H_3 = \frac{3,4}{\cancel{2,2}} \text{ m} \quad h_3 = 2,2 \text{ m} \quad D = 1 \text{ m}$$

$$h = ?$$

Podatki:

$$\rho_1 = 1000 \frac{\text{kg}}{\text{m}^3} \quad H_1 = 1,5 \text{ m} \quad h_1 = 8 \text{ m} \quad g = 9,807 \frac{\text{m}}{\text{s}^2}$$

$$\rho_2 = 1,25 \frac{\text{kg}}{\text{m}^3} \quad H_2 = 5 \text{ m} \quad h_2 = 5,4 \text{ m} \quad d = 0,4 \text{ m}$$

$$\rho_3 = 284 \frac{\text{kg}}{\text{m}^3} \quad H_3 = \frac{3,4}{1,17} \text{ m} \quad h_3 = 2,2 \text{ m} \quad D = 1 \text{ m}$$

$h = ?$

$$\rightarrow \tau_B = \tau_A + \rho_1 g h_1$$

$$\tau_C = \tau_B$$

$$\tau_D = \tau_C - \rho_2 g (h_1 + h_3 - h_2)$$

$$\tau_E = \tau_D + \rho_1 g H_1$$

$$\tau_F = \tau_E - \rho_1 g H_2$$

$$\tau_G = \frac{d^2}{D^2} \cdot \tau_F$$

$$\tau_H = \tau_G + \rho_3 g (H_2 + H_3)$$

$$\tau_0 = \tau_I = \tau_H - \rho_3 g h$$

$$\tau_A = \tau_I - \rho_2 g (h_1 + h_3 - h)$$

$$\tau_I = \tau_0$$

$$\tau_G \cdot \frac{\pi D^2}{4} = \tau_F \cdot \frac{\pi d^2}{4}$$

Ravnovesje sil na ločilu

$$\rightarrow \tau_C = \tau_A + \rho_1 g h_1$$

$$\tau_D = \tau_A + \rho_1 g h_1 - \rho_2 g (h_1 + h_3 - h_2)$$

$$\tau_E = \tau_A + \rho_1 g h_1 - \rho_2 g (h_1 + h_3 - h_2) + \rho_1 g H_1 = \tau_A + \rho_1 g (h_1 + H_1) - \rho_2 g (h_1 + h_3 - h_2)$$

$$\tau_F = \tau_A + \rho_1 g (h_1 + H_1) - \rho_1 g H_2 - \rho_2 g (h_1 + h_3 - h_2) = \tau_A + \rho_1 g (h_1 + H_1 - H_2) - \rho_2 g (h_1 + h_3 - h_2)$$

$$\tau_G = \left[ \tau_A + \rho_1 g (h_1 + H_1 - H_2) - \rho_2 g (h_1 + h_3 - h_2) \right] \frac{d^2}{D^2}$$

$$\tau_H = \left[ \tau_A + \rho_1 g (h_1 + H_1 - H_2) - \rho_2 g (h_1 + h_3 - h_2) \right] \frac{d^2}{D^2} + \rho_3 g (H_2 + H_3)$$

$$\tau_I = \left[ \tau_A + \rho_1 g (h_1 + H_1 - H_2) - \rho_2 g (h_1 + h_3 - h_2) \right] \frac{d^2}{D^2} + \rho_3 g (H_2 + H_3 - h) = \tau_0$$

$$\tau_0 = \tau_A = \tau_0 - \rho_2 g (h_1 + h_3 - h)$$

$$\rightarrow \tau_0 = \left[ \tau_0 - \rho_2 g (h_1 + h_3 - h) + \rho_1 g (h_1 + H_1 - H_2) - \rho_2 g (h_1 + h_3 - h_2) \right] \frac{d^2}{D^2} + \rho_3 g (H_2 + H_3 - h)$$

$$\rho_0 \frac{D^2}{d^2} - \rho_3 g \frac{D^2}{d^2} (h_2 + H_2 + H_3 - h) = \rho_0 - \rho_2 g (2(h_1 + h_3) - h_2 - h) + \rho_1 g (h_1 + H_1 - H_2)$$

$$\rho_0 \left( \frac{D^2}{d^2} - 1 \right) - \rho_3 g (H_2 + H_3) + \rho_3 g \frac{D^2}{d^2} h = \rho_2 g h - \rho_2 g (2(h_1 + h_3) - h_2) + \rho_1 g (h_1 + H_1 - H_2)$$

$$\rho_0 \left( \frac{D^2}{d^2} - 1 \right) - \rho_1 g (h_1 + H_1 - H_2) + \rho_2 g (2(h_1 + h_3) - h_2) - \rho_3 g (H_2 + H_3) = g h \cdot \left( \rho_2 - \rho_3 \frac{D^2}{d^2} \right)$$

$$h = \frac{\rho_0 \left( \frac{D^2}{d^2} - 1 \right) - \rho_1 g (h_1 + H_1 - H_2) + \rho_2 g (2(h_1 + h_3) - h_2)}{g \left( \rho_2 - \rho_3 \frac{D^2}{d^2} \right)} =$$

$$= \frac{1 \cdot 10^5 \text{ Pa} \left( \frac{(1\text{ m})^2}{(0,4\text{ m})^2} - 1 \right) - 1000 \frac{\text{kg}}{\text{m}^3} \cdot 9,807 \frac{\text{m}}{\text{s}^2} (8\text{ m} + 1,5\text{ m} - 5\text{ m}) + 1,25 \frac{\text{kg}}{\text{m}^3} \cdot 9,807 \frac{\text{m}}{\text{s}^2} \cdot (2(8\text{ m} + 2,2\text{ m}) - 5,4\text{ m})}{9,807 \frac{\text{m}}{\text{s}^2} \left( 1,25 \frac{\text{kg}}{\text{m}^3} - 284 \frac{\text{kg}}{\text{m}^3} \cdot \frac{(1\text{ m})^2}{(0,4\text{ m})^2} \right)} =$$

$$= 1427,644\text{ m} = \boxed{-27,653\text{ m}}$$

Komentar: Negativna višina oz. dejstvo, da je  $h < 0$ , je posledica tega, da je v sistem vgrajen bat, zaradi katerega je razmerje tlakov  $\frac{p_G}{p_F} = \frac{d^2}{D^2}$ , in je posledično tlak v točki G g redkejši manjši.

Če je  $d = D$ , je  $h > 0$ .