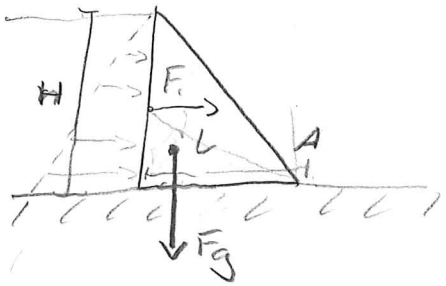
Strømning øving 3 Vegard G. Jordt

Oppg. 1a)

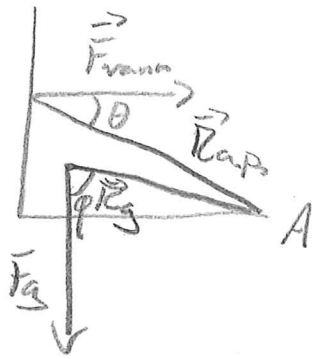


$$p = \rho_{vann} g h$$

$$dF_{vann} = p\,dA = p\,b\,dh$$

$$F_{vann} = b\int_0^H p(h)\,dh = b\rho_{vann} g \frac{1}{2} H^2$$

$$\tau_{vann} = \vec{F}_{vann} \times \vec{R}_{a.p.}, \quad a.p. = \text{angrepspunkt}$$



$$= F_{vann} \cdot R_{a.p.} \cdot \sin\theta$$

$$= F_{vann} \cdot R_{a.p.} \left(\frac{M_{a.p.}}{R_{a.p.}}\right)$$

$$\tau_{vann} = F_{vann} M_{a.p.}$$

$$\tau_g = F_g \cdot R_g \cdot \sin\varphi$$

$$\tau_g = F_g \cdot L_g$$

$$F_g = \rho_{sement} \cdot b \cdot \frac{1}{2} L H g$$

$$\tau_g = \tau_{vann}$$

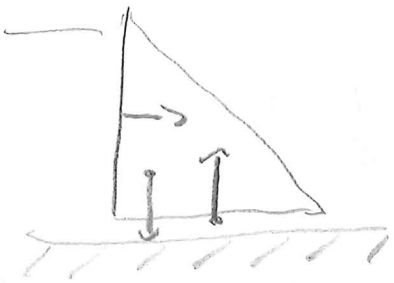
$$\rho_{sement}\, b \frac{1}{2} L H g \cdot \frac{2}{3} L = b \rho_{vann} g \frac{1}{2} H^2 \cdot \left(\frac{1}{3} H\right)$$

$$SG \cdot \frac{1}{3} L^2 = \frac{1}{6} H^2$$

$$SG = \frac{H^2}{2L^2} = \frac{8}{9}$$

1b) $\sum \tau = 0$

$\tau_g - \tau_{vann,1} - \tau_{vann,2} = 0$



$\tau_{vann,2} = p(H) \cdot Lb \cdot \frac{1}{2} L$

$= \frac{1}{2} \rho_{vann} g H L^2 b$

$\frac{1}{3} \rho_{sement} b g H L^2 = \frac{1}{6} \rho_{vann} b g H^3 + \frac{1}{2} \rho_{vann} b g H L^2$

$SG = \frac{H^2}{2L^2} + \frac{3}{2}$

$SG = \frac{43}{18}$

Oppg. 2)

$\rho_{vann} = \frac{m}{V_0} \rightarrow V_0 = \frac{m}{\rho_{vann}}$

$V_{nedsenket} = V_0 - \frac{\pi}{4} D^2 h$

$\rho_{væske} = \frac{m}{V_{nedsenket}} = \frac{m}{V_0 - \frac{\pi}{4} D^2 h}$

$V_0 - \frac{\pi}{4} D^2 h = \frac{m}{\rho_{væske}}$

$h = \frac{-m}{\frac{\pi}{4} D^2 \rho_{væske}} + \frac{m}{\rho_{vann}}$

$h = \frac{4m}{\rho_{vann} \pi D^2} \left(1 - \frac{1}{SG}\right)$

Opps 3)

mellom to plater:

$$q = \int_0^b \int_{-h}^{h} V_{max}\left(1-\left(\frac{y}{h}\right)^2\right) dy\, dz$$

$$= bV_{max}\left[y - \frac{y^3}{3h^2}\right]_{-h}^{h}$$

$$= bV_{max}\left(2h - \frac{2}{3}h\right)$$

$$\underline{q = bV_{max}\left(\frac{4}{3}h\right)}$$

$$\bar{V} = \frac{q}{A} = \frac{bV_{max}\left(\frac{4}{3}h\right)}{2hb}$$

$$\underline{\bar{V} = \frac{2}{3}V_{max}}$$

$$\tau_{yx} = \mu \left.\frac{\partial u_x}{\partial y}\right|_{y=h} = \left.\frac{V_{max}\,2\mu y}{h^2}\right|_{y=h} = \underline{\frac{-2\mu V_{max}}{h}}$$

For pipe:

$$q = \int_0^R \int_0^{2\pi} V_{max}\left(1-\left(\frac{r}{R}\right)^2\right) r\, d\theta\, dr$$

$$= 2\pi \cdot V_{max}\left(\frac{1}{2}R^2 - \frac{R^4}{4R^2}\right)$$

$$\underline{q = \pi V_{max}\left(R^2 - \frac{R^2}{2}\right)}$$

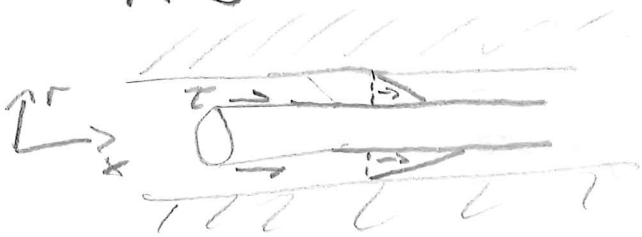
$$V_{Av} = \frac{q}{A} = \frac{\pi V_{max}\left(\frac{R^2}{2}\right)}{\pi R^2}$$

$$\underline{V_{Av} = \frac{1}{2}V_{max}}$$

$$\tau_{xy} = \mu \left.\frac{\partial u_x}{\partial r}\right|_{r=R}$$

$$\underline{\tau_{xy} = \frac{-2\mu V_{max}}{R}}$$

Oppg. 4)



$$\tau = \mu \frac{\partial U_x}{\partial r}$$

$U_x(R_2) = 0$

$U_x(R_1) = 1\ m/s$ (No-slip)

$\mu = \rho \nu$

$SG = \frac{\rho}{\rho_{vann}}$

$\frac{\partial U_x}{\partial r} = \frac{1}{R_2 - R_1}$

$\mu = \rho_{vann} \cdot SG \cdot \nu$

$\tau = \frac{F}{A} \rightarrow F = A\tau, \quad A = \pi D_1 L$

$F = \pi D_1 L \rho_{vann} \cdot SG \cdot \nu \left(\frac{1}{R_2 - R_1}\right)$

$F = 1{,}38\ kN$, må ha trykket en 10-er feil på kalkulatoren

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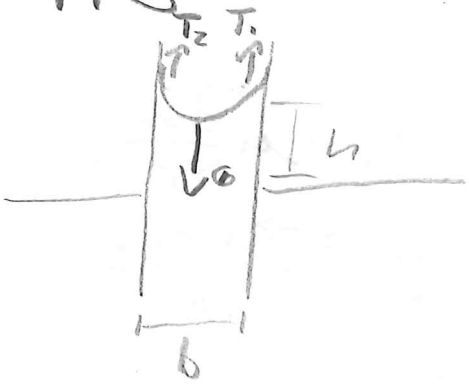
Oppg. 5)



$G = \rho g h b$, $[\rho] = \frac{kg}{m^2}$

$T_{z,1} = T \cos\theta \approx T$

$T_z = T_{z,1} + T_{z,2} = 2T$

(statisk system)

$2T = G$

$h = \frac{2T}{\rho g b}$