1.STATIKA FLUIDOV

Splošna enačba statike:

dp= -ρgdz

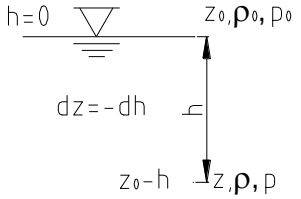
a) Spreminjanje tlaka pri nestisljivem fluidu

$$p(z) = p_0 + \rho_0 g(z - z_0) \quad ; \quad \rho = const = \rho_0$$

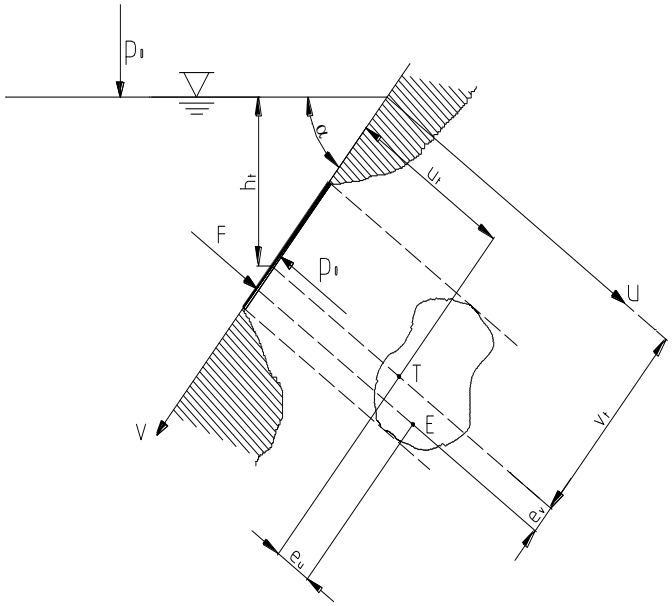
b) Gostota in spreminjanje tlaka pri stisljivem fluidu

$$\rho = \frac{\rho_0 E}{E - \rho_0 gh}$$

$$p = p_0 + E \ln \frac{E}{E - \rho_0 gh}$$



c) Sila na potopljeno ravno ploskev



$$e_v = \frac{J_{u_t}}{v_t A} \qquad e_u = \frac{J_{uv_t}}{v_t A}$$

$$F = \rho_0 g \sin \alpha v_t A = \rho_0 g h_t A$$

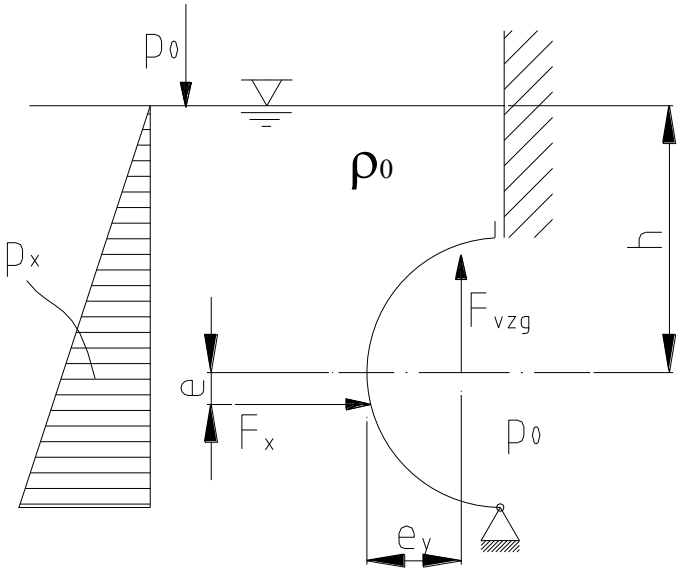
$$S_u = v_t A$$

d) Vzgon (ρ=konst.)

$$\vec{F} = -\int_A p\vec{n}dA =$$

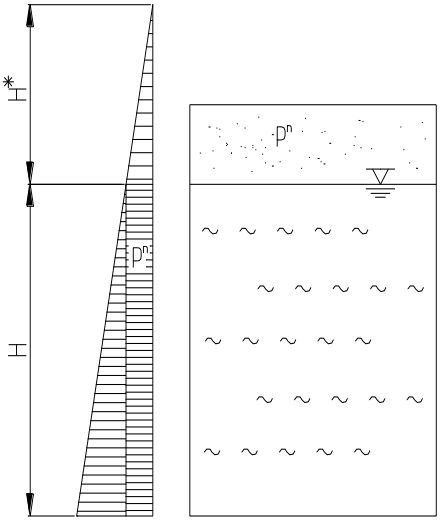
$$= -\int_V \vec{\nabla} p dV \Rightarrow F_{vzg} = \rho g V$$

$$\vec{F} = (0,0,F_z)$$

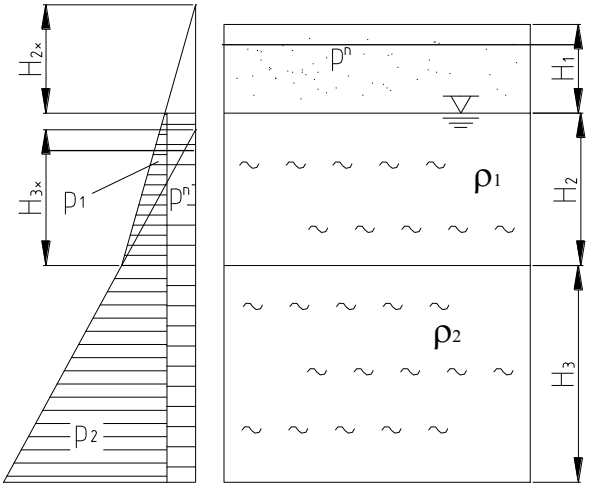


e) Navidezni dvig gladine

$$H^* = \frac{p^n}{\rho g}$$



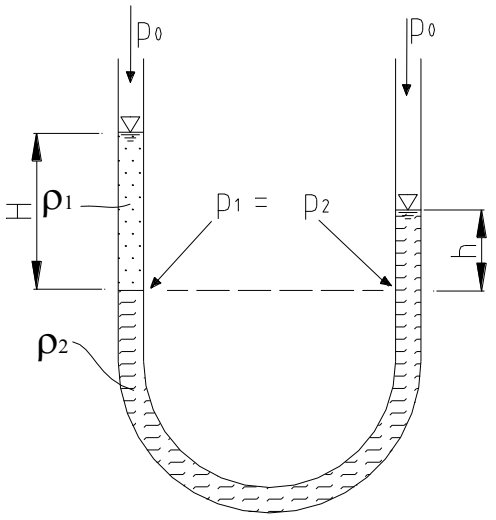
$$H_3^* = \frac{p^n}{\rho_2 g} + \frac{\rho_1}{\rho_2} H_2$$



f) U-cev

$p_1 = p_2$

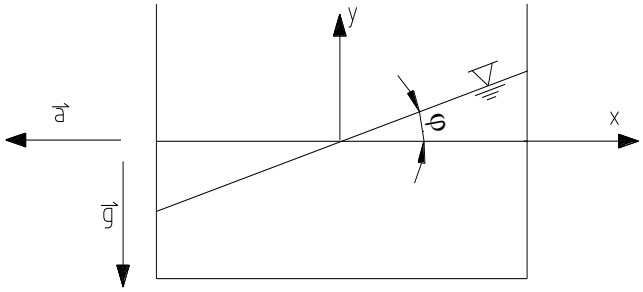
$\rho_1 H = \rho_2 h$



g) Relativno mirovanje

- Translacija

$$\vec{a} = -\frac{1}{\rho}\vec{\nabla}p + \vec{g}$$



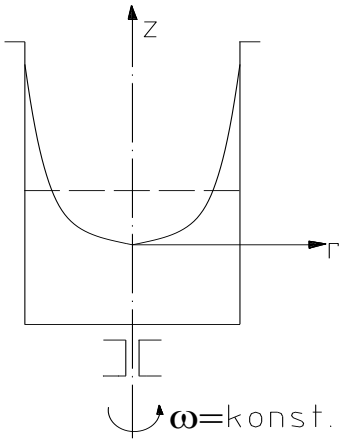
Enačba gladine:

$$\Delta p = 0 = -\rho a_x x - \rho(g + a_y) y$$

$$y = -\frac{a_x}{g + a_y} x$$

$$tg\varphi = -\frac{a_x}{g + a_y}$$

- Rotacija (uvedemo cilindrične koordinate):



$$\vec{\nabla}p = \left(\frac{\partial p}{\partial r}, \frac{1}{r}\frac{\partial p}{\partial \varphi}, \frac{\partial p}{\partial z}\right)$$

$$dp = \rho r \omega^2 dr - \rho g dz = 0$$

Enačba gladine (ω=konst.)

$$z(r) = \frac{\omega^2}{2g} r^2$$

$$\tan\alpha = \frac{r\omega^2}{g}$$

2. KINEMATIKA FLUIDOV

a) Kartezijev koordinatni sistem

$\vec{v} = (v_x, v_y, v_z)$

Enačba tokovnic:

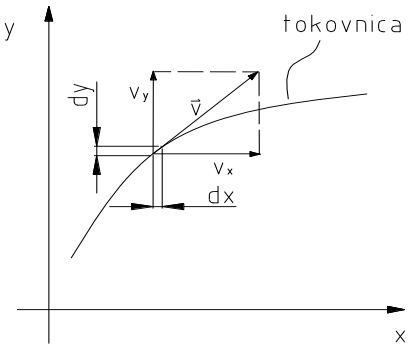
$$\frac{dy}{v_y} = \frac{dx}{v_x} = \frac{dz}{v_z}$$

Operatorja:

$$div(\vec{v}) = \vec{\nabla}\vec{v} = (\frac{\partial v_x}{\partial x} + \frac{\partial v_y}{\partial v} + \frac{\partial v_z}{\partial z})$$

$$rot(\vec{v}) = \begin{bmatrix} \frac{\partial v_z}{\partial y} - \frac{\partial v_y}{\partial z} \\ \frac{\partial v_x}{\partial z} - \frac{\partial v_z}{\partial x} \\ \frac{\partial v_y}{\partial x} - \frac{\partial v_x}{\partial y} \end{bmatrix}$$

za ravninsko gibanje [(x,y) ravnina] potrebujemo samo člen pri $\vec{k}$;



b) Cilindrični koordinatni sitem:

$\vec{v} = (v_r, v_\varphi, v_z)$

Enačba tokovnic:

$$\frac{dr}{v_r} = \frac{dz}{v_z} = r\frac{d\varphi}{v_\varphi}$$

$$div(\vec{v}) = (\frac{\partial v_r}{\partial r} + \frac{v_r}{r} + \frac{1}{r}\frac{\partial v_\varphi}{\partial \varphi} + \frac{\partial v_z}{\partial z}) = 0$$

$$rot(\vec{v}) = \vec{\nabla} \times \vec{v} = \vec{i}_r(\frac{1}{r}\frac{\partial v_z}{\partial \varphi} - \frac{\partial v_\varphi}{\partial z}) +$$

$$\vec{i}_\varphi(\frac{\partial v_r}{\partial z} - \frac{\partial v_z}{\partial r}) +$$

$$\vec{i}_z(\frac{\partial v_\varphi}{\partial r} - \frac{1}{r}\frac{\partial v_r}{\partial \varphi} + \frac{v_\varphi}{r})$$

- Pri nestisljivih fluidih (tekočinah):

$\rho = const. \Rightarrow div(\vec{v}) = 0$

- Vrtinčnost:

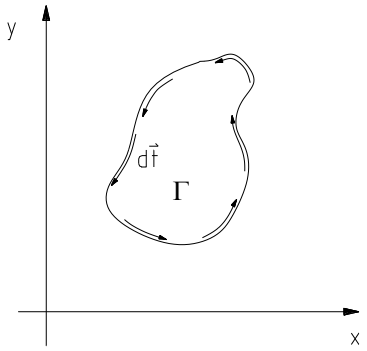
$$rot(\vec{v}) = \vec{\nabla} \times \vec{v} = 2\vec{\omega} \Rightarrow \omega = \frac{1}{2}\left|rot(\vec{v})\right|$$

- Kontinuitetna enačba:

$$\frac{\partial \rho}{\partial t} + div(\rho\vec{v}) = 0$$

- Cirkulacija:

$$d\Gamma = \vec{v}d\vec{t} \Rightarrow \Gamma = \oint_C \vec{v}d\vec{t} = 2\oint_A \vec{\omega}d\vec{A};$$



- Stokesov snovni odvod

$$\vec{a} = \frac{D\vec{v}}{Dt} = \frac{\partial \vec{v}}{\partial t} + \frac{\partial \vec{v}}{\partial x}v_X + \frac{\partial \vec{v}}{\partial y}v_Y + \frac{\partial \vec{v}}{\partial z}v_Z =$$

$$= \dot{\vec{v}} + \left(\vec{v}\vec{\nabla}\right)\vec{v}$$

- Pretok

$$Q = \int_A \vec{v}\vec{n}dA$$