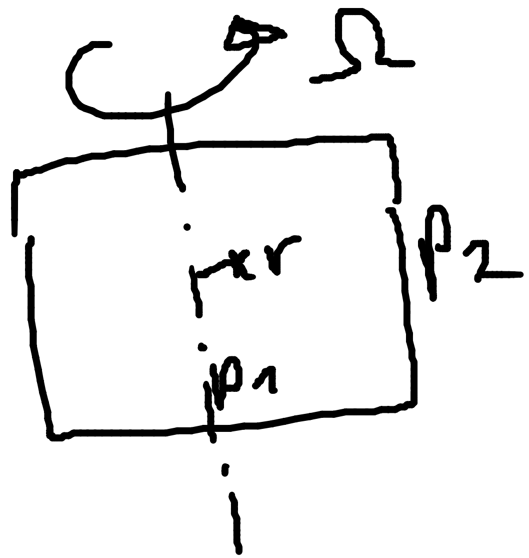
Sprechstunde

Mo 10 - 12

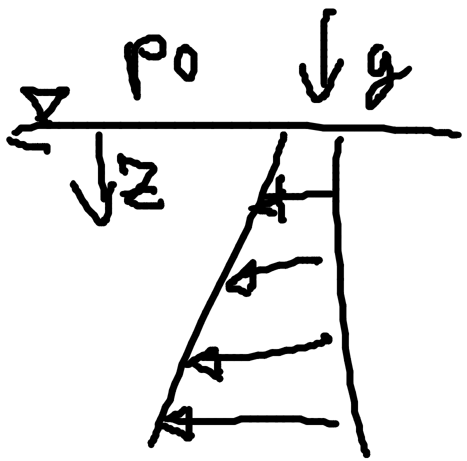
Prof. Dr. Ing. Peter Pelz
Sommersemester 2012
Einführung in die Hydrodynamik
Hörsaalübung 1


Ω
r
p_2
p_1

hydrostatische Grundgleichung

$$\nabla p = \varrho \vec{k} \quad (\text{Spurk } 5.4)$$

$$\nabla p = \frac{\partial}{\partial x} p \, \vec{e}_x + \frac{\partial}{\partial y} p \, \vec{e}_y + \frac{\partial}{\partial z} p \, \vec{e}_z$$



$$\frac{\partial p}{\partial z} = \varrho g \quad \Big| \quad k = g \vec{e}_z$$

$$\int_{p_0}^{p} d\bar{p} = \int_0^z \varrho g \, d\bar{z}$$

$$p - p_0 = \varrho g z \quad \Big| \quad p = p_0 + \varrho g z$$

$$\nabla p = \varrho \vec{k} \qquad \vec{k} = \Omega^2 r \vec{e}_r$$

$$\vec{e}_r: \frac{\partial p}{\partial r} = \varrho \Omega^2 r \quad \Big| \quad \vec{e}_\varphi: \cancel{\frac{1}{r}\frac{\partial p}{\partial \varphi} = 0} \quad \Big| \quad e_z: \cancel{\frac{\partial p}{\partial z} = 0}$$

ideales Gasgesetz $p = \varrho R T \rightarrow \varrho = \frac{p}{RT}$

$$\frac{\partial p}{\partial r} = \frac{p}{RT}\Omega^2 r$$

$$\frac{\partial p}{\partial r} = \frac{p}{RT}\Omega^2 r$$

$$\int_{p_1}^{p} \frac{d\bar{p}}{\bar{p}} = \frac{\Omega^2}{RT}\int_0^r \bar{r}\, d\bar{r}$$

$$\ln\left(p/p_1\right) = \frac{\Omega^2}{RT}\frac{r^2}{2} \quad \Big|\, p_1 \cdot \exp(\ldots)$$

$$\underline{\underline{p = p_1 \exp\left(\frac{\Omega^2}{2RT} r^2\right)}}$$

TECHNISCHE UNIVERSITÄT DARMSTADT

FLUID SYSTEM TECHNIK

Einführung in die Hydrodynamik

Vorrechenübung

$$m_A = m_B$$

$$\iiint_V \varrho_A \boxed{dV} = \iiint_V \varrho_B \, dV$$

$$2\cancel{\int_0^H}\int_0^{2\pi}\int_0^{r_0} \frac{p_0}{\cancel{RT}} \boxed{r\,dr\,d\varphi\,\cancel{dz}} = \cancel{\int_0^H}\int_0^{2\pi}\int_0^{r_0} \frac{p_1 \exp\left(\frac{\Omega^2 r^2}{2RT}\right)}{\cancel{RT}} r\,dr\,\cancel{d\varphi}\,\cancel{dz}$$

$$\frac{p_0}{\cancel{RT}} \frac{r_0^2}{2} = p_1 \left[\exp\left(\frac{\Omega^2 r^2}{2RT}\right) - 1\right] \frac{RT}{\Omega^2}$$

$$p_1 = \frac{p_0\, r_0^2\, \Omega^2}{2RT\left[\exp\left(\frac{\Omega^2 r_0^2}{2RT}\right) - 1\right]}$$