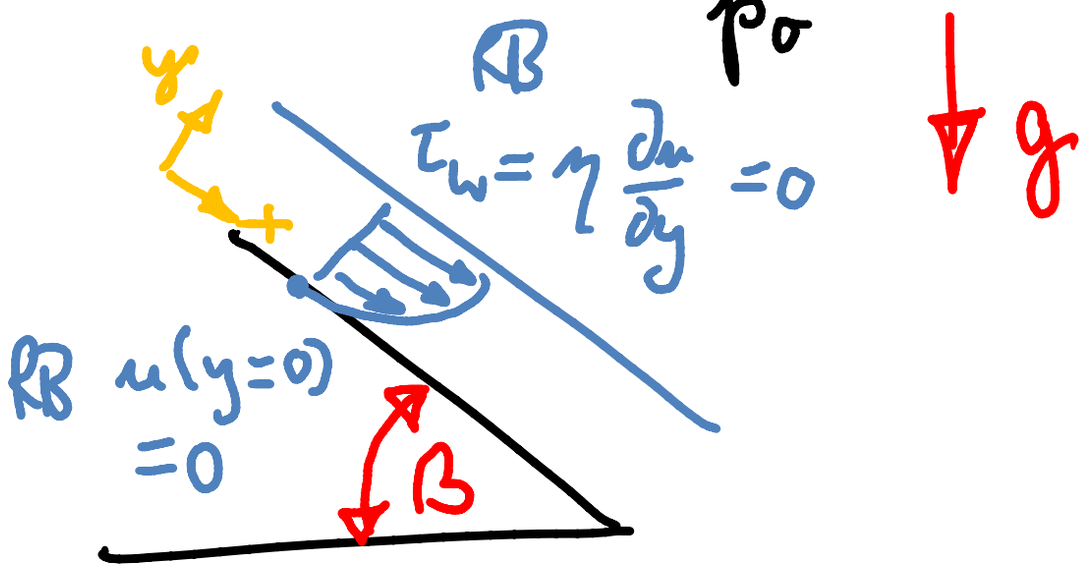
BONUSÜBUNG Filmströmung



Spurk 6.1.3

GG zwischen Schwerkraft und Reibungskräften

TECHNISCHE UNIVERSITÄT DARMSTADT
FLUID SYSTEM TECHNIK

Einführung in die Hydrodynamik
Vorrechenübung

Prof. Dr.-Ing. Peter Pelz
Sommersemester 2012
Übung 10 F 56

$$\rho\left(\frac{\partial u}{\partial t} + \frac{\partial u}{\partial x}u + \frac{\partial u}{\partial y}v\right) = -\frac{\partial p}{\partial x} + \rho g_x + \eta\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)u$$

$$\rho\left(\frac{\partial v}{\partial t} + \frac{\partial v}{\partial x}u + \frac{\partial v}{\partial y}v\right) = -\frac{\partial p}{\partial y} + \rho g_y + \eta\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)v$$

Navier-Stokes-Gleichungen

2D, inkompressibel, kartesisch

$$\frac{\partial p}{\partial x} = \rho g \sin\beta + \eta \frac{\partial^2 u}{\partial y^2}$$

$$\frac{\partial p}{\partial y} = -\rho g \cos\beta \qquad \text{RB } p(y=h) = p_0$$

$$p = p_0 - \rho g \cos\beta (y-h)$$

$$= p_0 + \rho g \cos\beta (h-y)$$

$$\eta \frac{\partial^2 u}{\partial y^2} = -\rho g \sin\beta$$

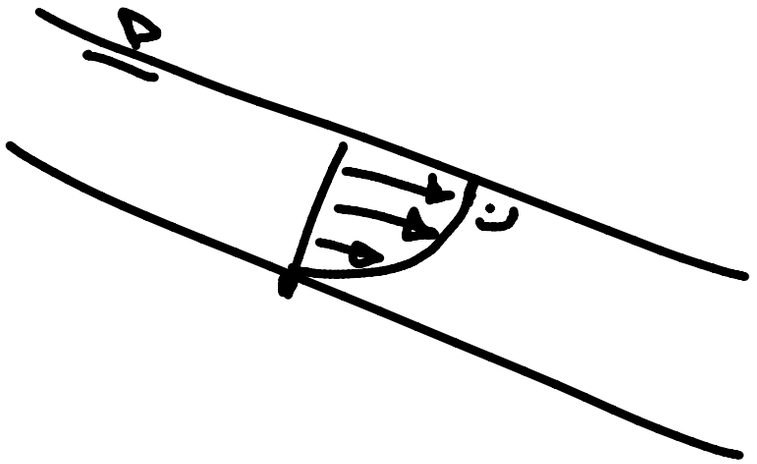
$$u = -\frac{\rho g \sin\beta}{2\eta}\left(y^2 + C_1 y + C_2\right)$$

$u(y=0) = 0$

$$\left.\frac{\partial u}{\partial y}\right|_{y=h} = 0 \qquad \left.2y + C_1\right|_{y=h} = 0$$

$$C_1 = -2h$$

$$u = \frac{\rho g \sin\beta}{2\eta}\left(2hy - y^2\right)$$



Viel Glück!

Prof. Dr.-Ing. Peter Pelz
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