

Contoh 2.3. Flow through a circular Tube

(dikerjakan dgn tabel)

- asumsi :
1. steady state
 2. Laminer, ρ tetap.
 3. Newtonian, μ tetap
 4. $v_r = v_\theta = 0$, g searah z

Tabel 3.4.1. Pers. Kontinuitas : koor. silinder

$$\frac{\partial \rho}{\partial t} + \frac{1}{r} \frac{\partial}{\partial r} (\rho r v_r) + \frac{1}{r} \frac{\partial}{\partial \theta} (\rho v_\theta) + \frac{\partial}{\partial z} (\rho v_z) = 0$$

Tabel 3.4.3. dlm τ

$$\frac{\partial v_z}{\partial z} = 0 \rightarrow v_z = f(r)$$

Komponen z :

$$\rho \left(\frac{\partial v_z}{\partial t} + v_r \frac{\partial v_z}{\partial r} + \frac{v_\theta}{r} \frac{\partial v_z}{\partial \theta} + v_z \frac{\partial v_z}{\partial z} \right) = - \frac{\partial p}{\partial z}$$

$$- \left(\frac{1}{r} \frac{\partial}{\partial r} (r \tau_{rz}) + \frac{1}{r} \frac{\partial \tau_{\theta z}}{\partial \theta} + \frac{\partial \tau_{zz}}{\partial z} \right) + \rho g_z$$

$$\frac{1}{r} \frac{\partial}{\partial r} (r \tau_{rz}) = - \frac{\partial p}{\partial z} + \rho g = \frac{p_0 - p_L}{L} + \rho g$$

$$= \frac{\rho_0 - \rho_L}{L}$$

dlm σ : Pers. kontinuitas tabel 3.41 $\frac{\partial v_z}{\partial z} = 0$

Tabel 3.4.3 :

3 komponen :

$$\rho \left(\frac{\partial v_z}{\partial t} + v_r \frac{\partial v_z}{\partial r} + \frac{v_\theta}{r} \frac{\partial v_z}{\partial \theta} + v_z \frac{\partial v_z}{\partial z} \right) = - \frac{\partial p}{\partial z} + \mu \left[\frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial v_z}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 v_z}{\partial \theta^2} + \frac{\partial^2 v_z}{\partial z^2} \right] + \rho g_z$$

$$- \mu \left[\frac{1}{r} \frac{\partial}{\partial r} \left(r \frac{\partial v_z}{\partial r} \right) \right] = - \frac{\partial p}{\partial z} + \rho g$$

$$- \frac{d}{dr} \left(r \frac{dv_z}{dr} \right) = \left(\frac{\rho_0 - \rho_L}{\mu L} \right) r$$