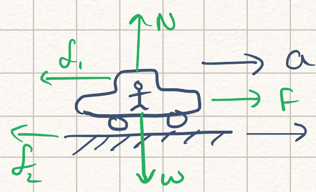
Momentum Equation $\Rightarrow$ $\vec{B} = \vec{m}$

$$\vec{m} = m\vec{v}$$



$$\Sigma \vec{F}_{ext} = m\bar{a} = m\left(\frac{d\bar{v}}{dt}\right) = \frac{dm\vec{v}}{dt} = \frac{d\vec{m}}{dt}$$

$$(\Sigma F_{ext} = ma)_x$$

$$\Sigma \vec{F}_{ext} = \frac{d\vec{m}}{dt}$$

Continuity Equation $\Rightarrow$

$$\frac{d\vec{m}_{sys}}{dt} = \frac{dm_{cv}}{dt} + (\dot{\vec{m}}_{out} - \dot{\vec{m}}_{in})$$

$$\frac{d\vec{m}}{dt} = \Sigma \vec{F}_{ext} = \cancel{\frac{d(m\vec{v})_{cv}}{dt}}^{\,0} + \rho Q(v_{out} - v_{in})$$

Steady State:

Q = Constant

vA = Constant

$\frac{dv}{dt} = 0$

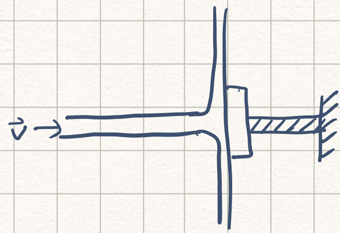
$$\therefore \frac{d\vec{m}}{dt} = \frac{dm\vec{v}}{dt}$$

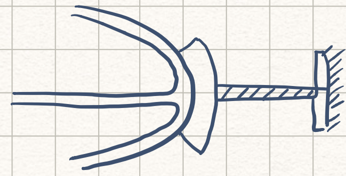
$$(m\vec{v}) = \dot{m}\vec{v}$$

$$\boxed{\Sigma \vec{F}_{ext} = \rho Q\,(V_{out} - V_{in})}$$

Momentum	Eq	
Continuity	Eq	+ Eulers Equation
Bernuollies	Eq	
Equlibrium	Eq	

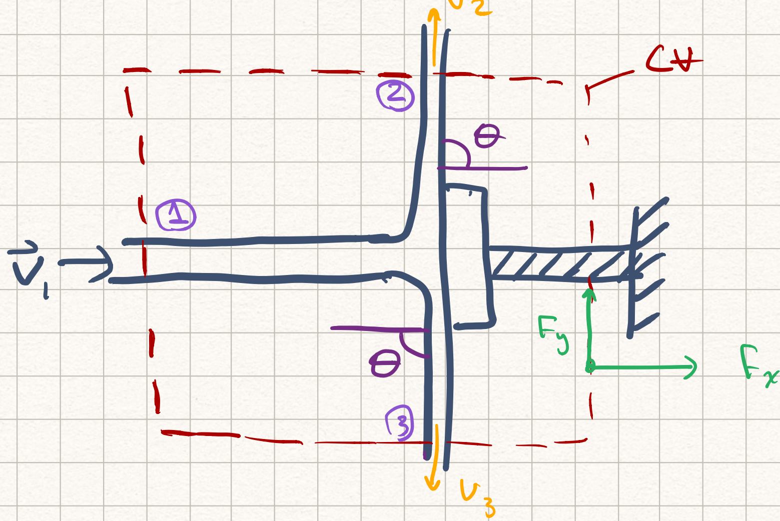
Ⓘ Vane





How to solve:

1 – CV
2 – FD
3 – $\rho Q (v_{out} - v_{in})$



① Bernuolli Equation

$$\cancel{\frac{P_1}{\gamma}}^{0} + \frac{V_1^2}{2g} + \cancel{z_1}^{0} = \cancel{\frac{P_2}{\gamma}}^{0} + \frac{V_2^2}{2g} + \cancel{z_2}^{0}$$

* in vane probleves $z_1 = z_2$

$$V_1 = V_2$$

$\therefore$ The same goes for ① and ③

$\Rightarrow V_1 = V_3$

$$\therefore \boxed{V_1 = V_2 = V_3 = V}$$

② Continuity Equation :

$$Q_1 = Q_2 + Q_3$$

$$\cancel{V_1} A_1 = \cancel{V_2} A_2 + \cancel{V_3} A_3$$

• from B.E.

$$\boxed{A_1 = A_2 + A_3}$$

$\Rightarrow A_2 = A_3$ * symitry

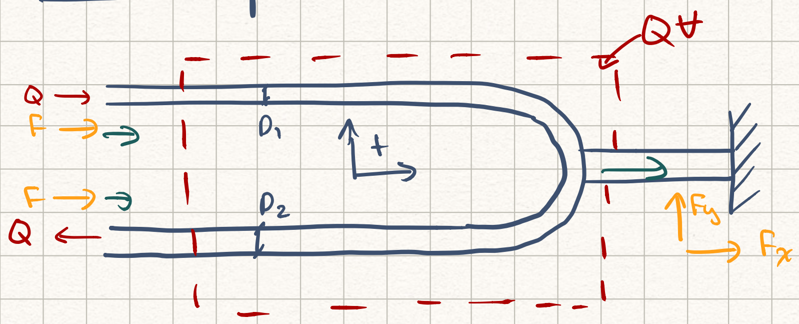
$$= \boxed{A_2 = A_3 = \frac{A_1}{2}}$$

③ Momentum Equation

$\times \cos\theta$

$$\boxed{\begin{aligned} F_x &= \rho\left[Q_2V_2\cos\theta - Q_3V_3 - Q_1V_1\right] \\ F_y &= \rho\left[Q_2V_2\sin\theta - Q_3V_3\sin\theta - 0\right] \end{aligned}}$$

II Pipe



① C∀
② FD

Continuity Eq.

$Q = vA$

$Q_1 = V_1 \dfrac{\pi D_1^2}{4}$

$Q_2 = V_2 \dfrac{\pi D_2^2}{4}$

$Q_1 = Q_2$

Momentum Eq

$\Sigma \vec{F}_{ext} = \rho Q\,(\vec{V}_{out} - \vec{V}_{in})$

$x \Rightarrow F_x + F_{p_1} + F_{p_2} = \rho\left[-Q_2V_2 - V_1Q_1\right]$

$y \Rightarrow F_y = 0$

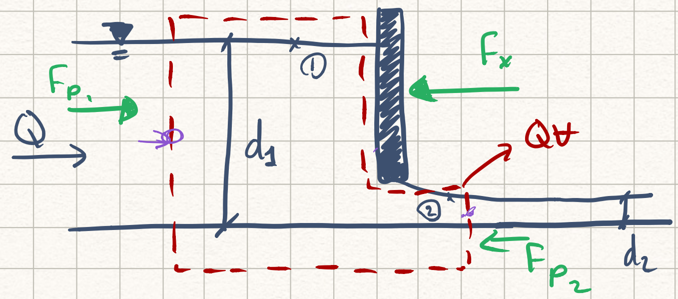
Force

$F_p = PA$

$P = \dfrac{F}{A}$ $\quad F = P \cdot A$

III GATES

$①$ - QU
$②$ - FD



BE. $\cancel{\frac{P_1}{\gamma}}^0 + \cancel{\frac{V_1^2}{2g}} + z_1 = \cancel{\frac{P_2}{\gamma}}^0 + \frac{V_2^2}{2g} + z_2$

$$d_1 - d_2 = \frac{V_2^2}{2g}$$

C.E. $Q_1 = Q_2$

$$V_1 d_1 = V_2 d_2 \Rightarrow V_1 = \frac{V_2 d_2}{d_1}$$

ME

$x \Rightarrow F_x + F_{p_1} - F_{p_2} = \rho Q [V_2 - V_1]$

$y \Rightarrow F_y = 0$

$F_{p_1} = \bar{P}_c A$

$F_{p_2} = \frac{1}{2} d_1 \gamma A_1$

$F_{p_2} = \frac{1}{2} d_2 \gamma A_2$