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Fluid Mechinery
BY- Shailender Sir

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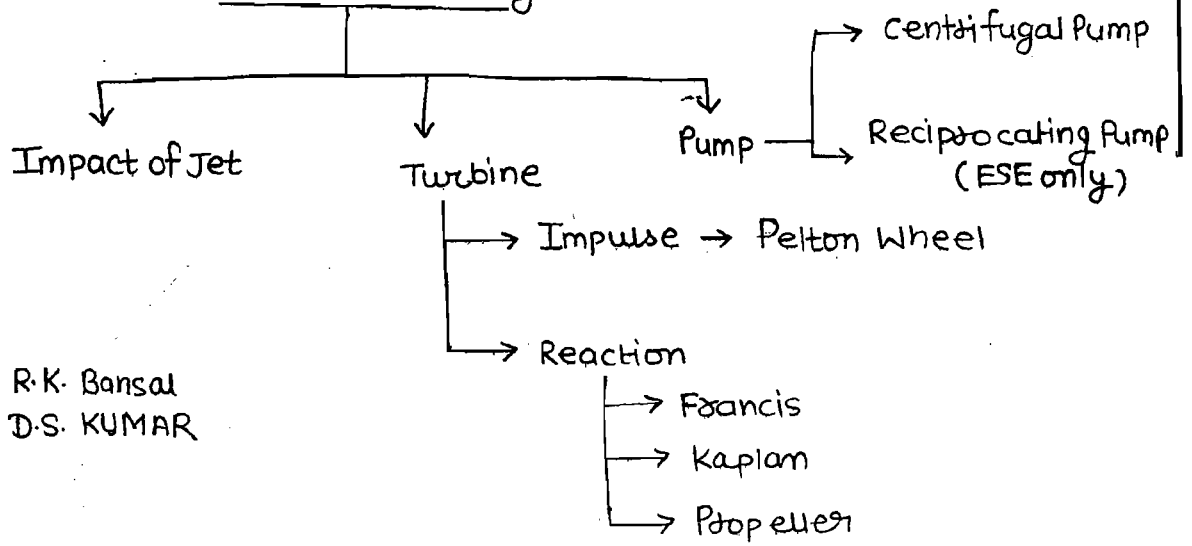
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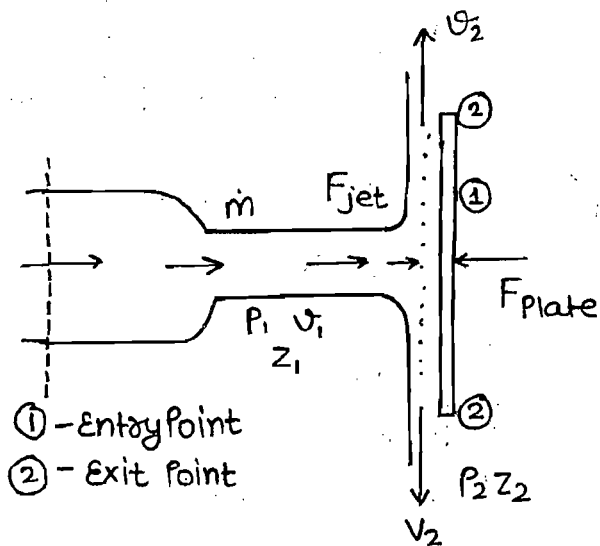
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Fluid Machinery



Book:-> R.K. Bansal
D.S. KUMAR

Impact of Jet : →



- ① - Entry Point
- ② - Exit Point

Water → Reaction force
Plate → Initial force

Newton's II Law

$F_{\text{Plate}} = \text{Rate of change in Linear Momentum of jet}$

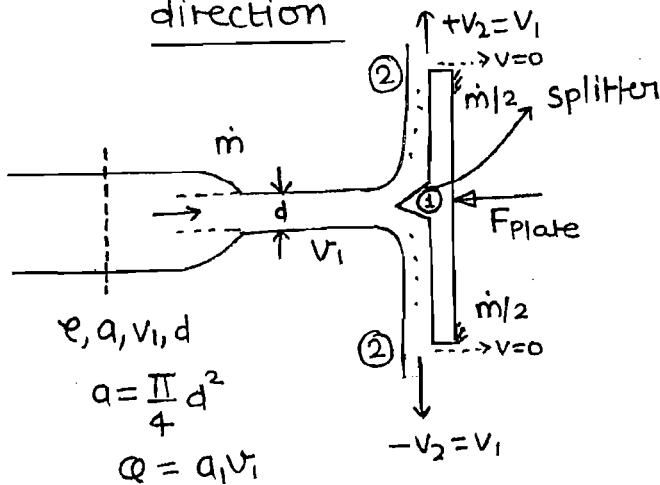
$F_{\text{Plate}} = (\text{Final} - \text{Initial}) \text{ momentum of water}$

$$F_{\text{jet}} = -F_{\text{plate}} = m\vec{v}_1 - m\vec{v}_2$$

$\dot{m} = \text{mass flow rate of water which strike the plate/body}$

Case: I

Jet strikes Stationary flat Plate in Normal direction



e, a, v_1, d
 $a = \frac{\pi d^2}{4}$
 $Q = a_1 v_1$

$P_1 = P_2 = P_{\text{atm}}$
 $z_1 = z_2$

$\rightarrow F_x = F_N = \dot{m} v_1$
 $= \rho a v_1^2 N$

$\rightarrow F_y = F_T = \dot{m} \times 0 - \left[\frac{\dot{m}}{2} \times v_2 + \frac{\dot{m}}{2} (-v_2) \right]$

$F_y = F_T = 0$

- Smooth Plate ($v_2 = v_1$)
- Rough Plate ($v_2 < v_1$)

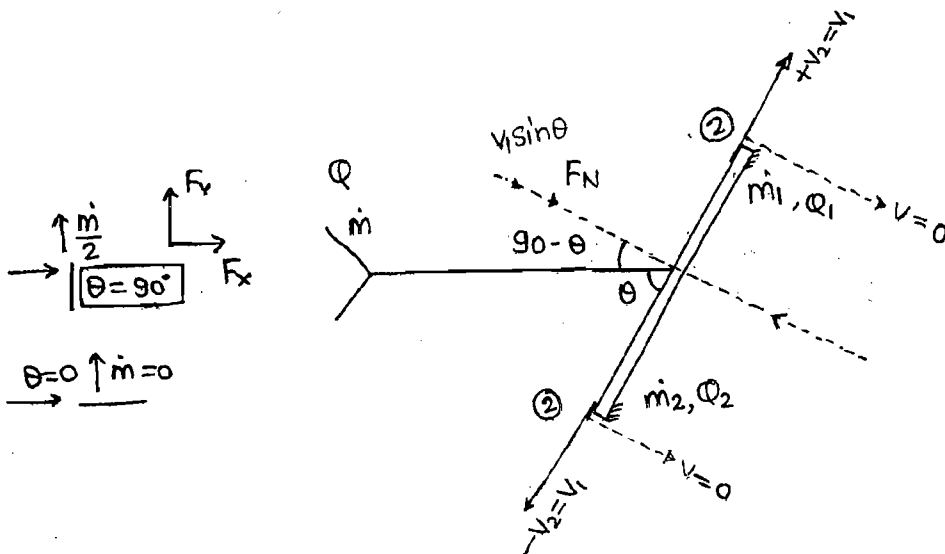
$\dot{m} = \rho a v_1 = \rho Q$

$\rightarrow F_x = F_N = \dot{m} v_1 - \left[\frac{\dot{m}}{2} \times 0 + \frac{\dot{m}}{2} \times 0 \right]$

NOTE → When Jet strikes over a ^{Flat} Plate then it will apply the force only in Normal direction to Plate, there will not be any force in tangential direction to Plate.

case: II

Jet Strikes stationary Inclined Plate



$$\dot{m} = \dot{m}_1 + \dot{m}_2 \Rightarrow \boxed{Q = Q_1 + Q_2} \rightarrow (1)$$

$$\boxed{\dot{m} = \rho a V_1 = \rho Q}$$

$$F_N = \dot{m} V_1 \sin \theta - [\dot{m}_1 x_0 + \dot{m}_2 x_0]$$

$$F_N = \dot{m} V_1 \sin \theta = \rho a V_1^2 \sin \theta$$

$$F_x = F_N \sin \theta = \rho a V_1^2 \sin^2 \theta$$

$$F_y = F_N \cos \theta = \rho a V_1^2 \sin \theta \cdot \cos \theta$$

$$\dot{m}_1, \dot{m}_2 / Q_1, Q_2 = ?$$

$$\therefore \boxed{F_T = 0}$$

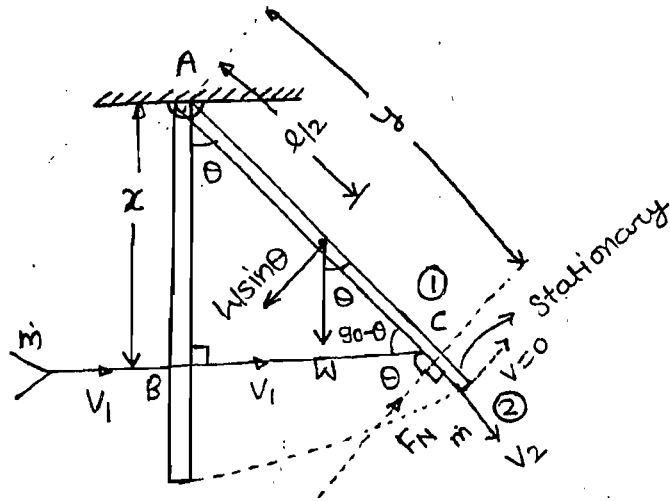
$$\rightarrow \dot{m} V_1 \cos \theta - (\dot{m}_1 x_0 + \dot{m}_2 x_0) = 0$$

$$\rho Q \cos \theta - Q_1 + Q_2 = 0 \rightarrow (11)$$

$$Q = Q_1 + Q_2 \rightarrow (1)$$

Case-III

Jet Strikes Vertical Hanging Plate



l = length of Plate

W = Weight of Plate = Mg

$$\rightarrow \sum M_A = 0$$

$$\rightarrow F_y \cdot y = W \sin \theta \cdot \frac{l}{2}$$

$$\rightarrow \dot{m} = \rho a v_1$$

$$\rightarrow F_N = \dot{m} v_1 \cos \theta - \dot{m} x_0$$

$$\boxed{F_N = \rho a v_1^2 \cos \theta} \quad (\text{Newton})$$

ΔABC

$$\cos \theta = \frac{x}{y} \Rightarrow y = \frac{x}{\cos \theta}$$

$$\rho a v_1^2 \cos \theta \cdot \frac{x}{\cos \theta} = W \sin \theta \cdot \frac{l}{2}$$

$$\boxed{\sin \theta = \frac{2 \rho a v_1^2 \cdot x}{W l}}$$