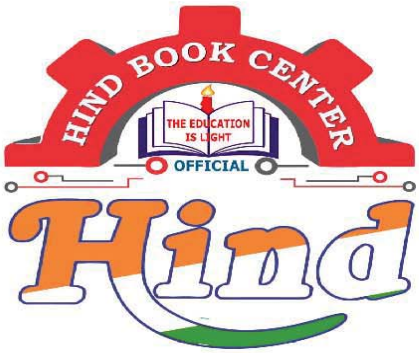

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HYDRAULIC MACHINE

-JASPAL SINGH
(Ex IES)

• Dynamic action of fluid

→ A stream of fluid entering in machine (turbine, pump, motor) has fixed or definite direction.

→ A force would be required to be acted on fluid to a change its velocity (either in direction or in magnitude).

→ The fluid also exert the same amount of force on the machine as is being acting on it (according to Newton's third law of motion).

→ Also, this force is exerted by the fluid on the machine or its compon-

ent is by virtue of motion and is termed as "DYNAMIC FORCE" (and must not be confused with the hydrostatic force).

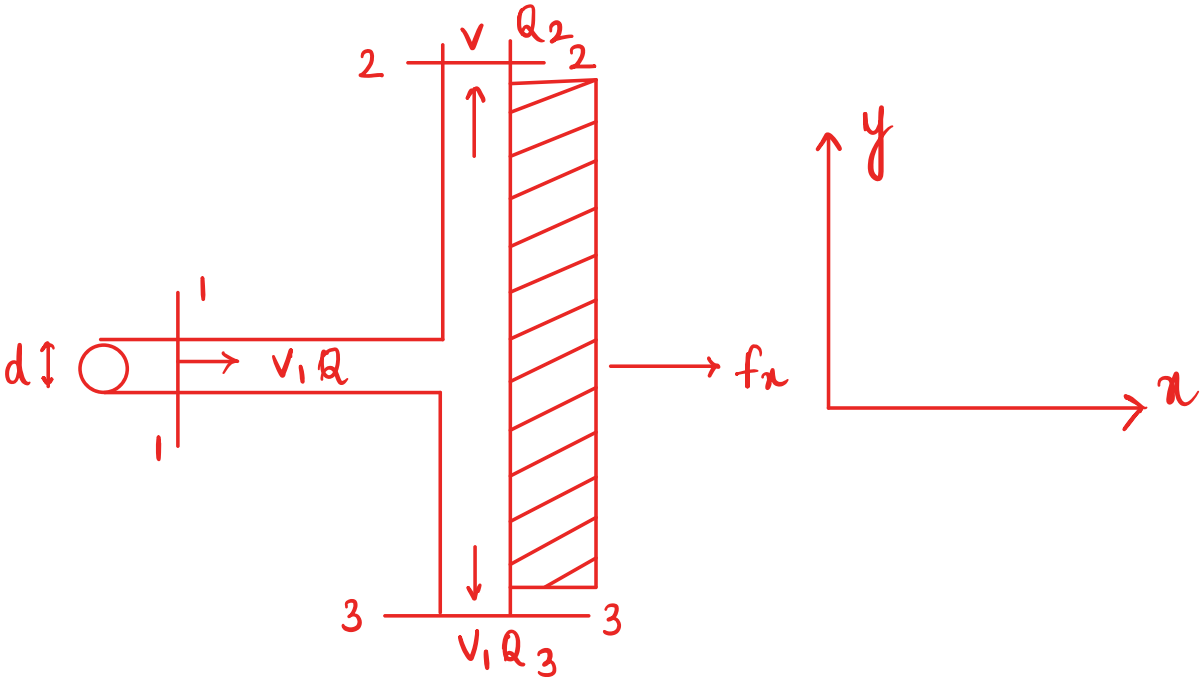
→ Thus, dynamic force on jet of fluid can be computed using momentum equation.

Dynamic force on jet of fluid = rate of (In given direction) change of linear momentum of jet in same direction.

Also force on machine or component = force on jet of fluid.

I. Force Exerted by fluid jet on stationary plate (flat).

a) Plate held normal to the jet.



→ If plate is frictionless, using energy equation between 1-1, 2-2, 3-3.

$$\frac{P_1}{\gamma} + z_1 + \frac{V_1^2}{2g} = \frac{P_2}{\gamma} + z_2 + \frac{V_2^2}{2g} + h_2$$

$$= \frac{P_3}{\gamma} + z_3 + \frac{V_3^2}{2g} + h_3.$$

$$V_1 = V_2 = V_3 = V$$

Now force exerted by jet on the plate = − force exerted on jet by plate.

$$f_x = -(\rho Q(0) - \rho Q V) = \rho Q V.$$

$$= \rho (AV) V = \rho A V^2.$$

$$\boxed{f_x = \rho A V^2}$$

$$f_y = -[\{\rho Q_2 V + \rho Q_3 (-V)\} - \rho Q (0)] \quad \text{—①}$$

$$Q_2 = Q_3 \quad \text{——⑪}$$

from ① and ⑪, $f_y = 0$.

Also, $Q = Q_2 + Q_3$

$$\Rightarrow Q_2 = Q_3 = \frac{Q}{2}.$$