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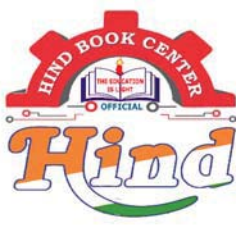
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HYDRAULIC MACHINE

-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.

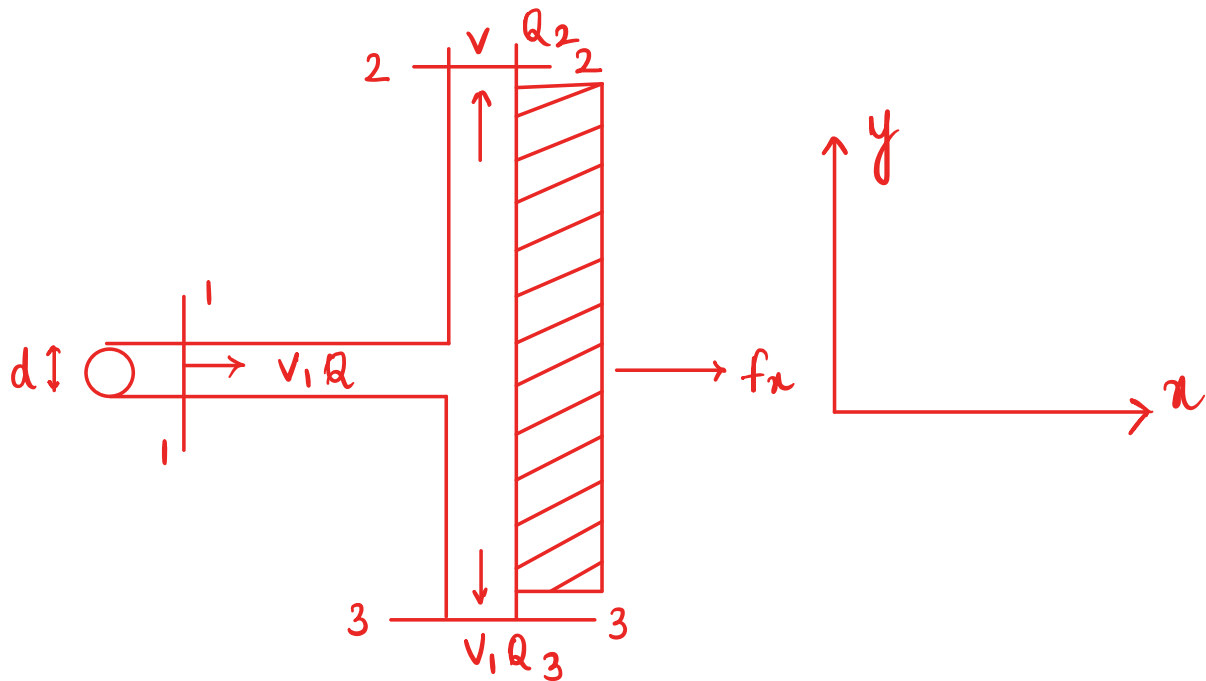
Dynamic force on jet of fluid = rate of change of linear momentum of jet (in given direction) in same direction.

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.

$$f_x = -(pQ(0) - pQv) = pQv.$$

$$= p(Av)v = pAv^2.$$

$$\boxed{f_x = pAv^2}$$



$$f_y = - [\{ pQ_2v + pQ_3(-v) \} - pQ(0)] \text{---} \textcircled{1}$$

$$Q_2 = Q_3 \text{---} \textcircled{2}$$

from $\textcircled{1}$ and $\textcircled{2}$, $f_y = 0$.

$$\text{Also, } Q = Q_2 + Q_3$$

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