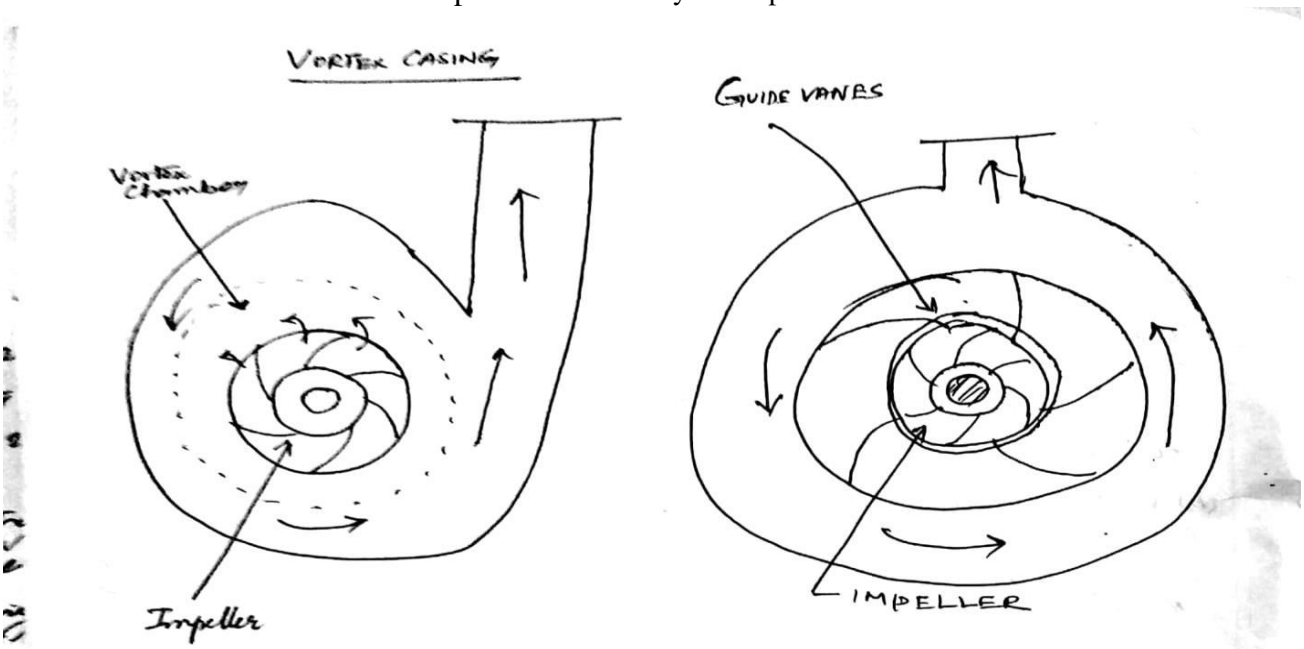
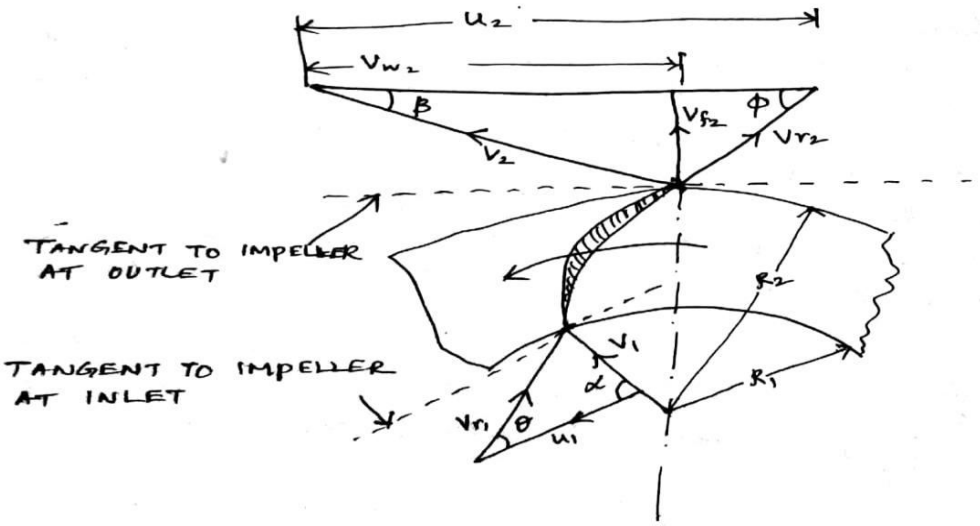


WORK DONE BY THE CENTRIFUGAL PUMP (OR BY IMPELLER) ON WATER



- In centrifugal pump, work is done by the impeller on the water.
- The water enters the impeller radially at inlet for best efficiency of the pump, which means the absolute velocity of water at inlet makes an angle of 90° with the direction of motion of the impeller at inlet.

Hence Angle $\alpha = 90°$

$V_{w1} = 0$

For drawing the velocity triangle, the same notations are used as that for turbines.

The velocity triangles at the inlet and outlet tips of the vanes fixed to an impeller.

Let N = Speed of the impeller in rpm

D_1 = diameter of impeller at inlet

u_1 = Tangential velocity of impeller at inlet.

$= \frac{\pi D_1 N}{60}$

D_2 = Diameter of impeller at outlet

u_2 = Tangential velocity of impeller at outlet

$= \frac{\pi D_2 N}{60}$

V_1 = Absolute velocity of water at inlet.

V_{r1} = Relative velocity of water at inlet.

α = Angle made by absolute velocity (V_1) at inlet with the direction of motion of vane.

θ = Angle made by relative velocity (V_{r1}) at inlet with the direction of motion of vane and V_2

V_{r2}, β and ϕ are the corresponding values at outlet

As the water enters the impeller radially which means the absolute velocity of water at inlet is in the radial direction and hence angle $\alpha = 90°$ and $V_{w1} = 0$.

A Centrifugal pump is the reverse of a radially inward flow reaction turbine. But in Case of a radially inward flow reaction turbine, the work done by the water on the runner per second per unit weight of the water striking per second is given by

$$= \frac{1}{g}\left[V_{w_1} u_1 - V_{w_2} u_2\right]$$

∴ work done by the impeller on the water per second per unit weight of water striking per second.

$$= -\text{ work done in Case of turbine}$$

$$= -\left[\frac{1}{g}\left(V_{w_1} u_1 - V_{w_2} u_2\right)\right]$$

$$= \frac{1}{g}\left[V_{w_2} u_2 - V_{w_1} u_1\right]$$

$$= \frac{1}{g} V_{w_2} u_2 \qquad (\because V_{w_1} = 0 \text{ here}) \qquad \text{——— (1)}$$

work done by impeller on water per second

$$= \frac{W}{g} V_{w_2} u_2 \qquad \text{——— (2)}$$

where W = weight of water = $\rho \times g \times Q$

Q = Volume of water

and Q = Area × velocity of flow = $\pi D_1 B_1 \times V_{f_1}$

$$Q = \pi D_2 B_2 \times V_{f_2} \qquad \text{——— (2-A)}$$

where B_1 and B_2 are width of impeller at inlet and outlet and V_{f_1} and V_{f_2} are velocities of flow at inlet and outlet.