Section-2

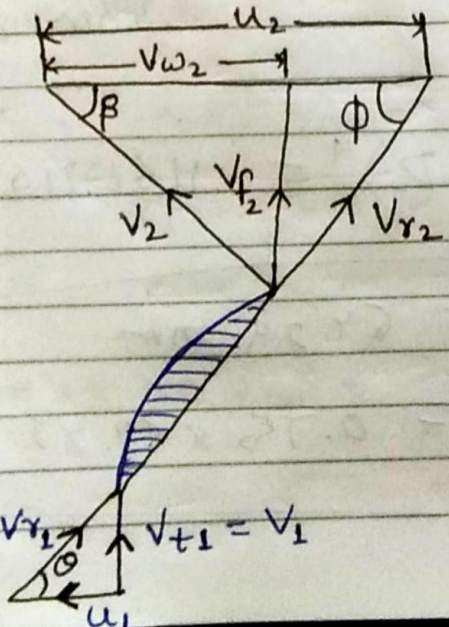
Ans-1 Given : Speed, $N = 1000$ rpm,
Head, $H_m = 40$ m
Velocity of flow, $V_{f_1} = V_{f_2} = 2.5$ m/sec,
Vane angle at outlet, $\phi = 40^\circ$
Outer dia of impeller $D_2 = 500$ mm
$= 0.50$ m
Inner dia of impeller, $D_1 = D_2/2 = 0.50/2 = 0.25$ m
width at outlet, $B_2 = 50$ mm $= 0.05$ m

To find : Vane angle at inlet, work done by impeller, Manometric efficiency.

(i) Tangential velocity of impeller at inlet and outlet are

$$u_1 = \frac{\pi D_1 N}{60} = \frac{\pi \times 0.25 \times 1000}{60} = 13.09 \text{ m/sec}$$

$$u_2 = \frac{\pi D_2 N}{60} = \frac{\pi \times 0.50 \times 1000}{60} = 26.18 \text{ m/sec}$$



(ii) Discharge is given by, $Q = \pi D_2 B_2 \times V_{f_2}$

$= \pi \times 0.50 \times 0.05 \times 2.5 = 0.19635 \ m^3/sec$

- Vane angle at inlet (θ).

From inlet velocity triangle, $\tan\theta = V_{f_1} / u_1 = 2.5 / 13.09 = 0.91$

$\theta = \tan^{-1}(0.183) = 10.813°$

- Work done by impeller on water per second is

$= (W/g) \times V_{w_2} u_2 = (\rho g Q / g) \times V_{w_2} \times u_2$

$= 1000 \times 0.19635 \times V_{w_2} \times 26.18$ ——— (1)

But from outlet velocity triangle, we have

$$\tan\phi = \frac{V_{f_2}}{u_2 - V_{w_2}}$$

$$\Rightarrow \tan 40° = \frac{2.5}{(26.18 - V_{w_2})}$$

$$\therefore \quad V_{w_2} = 23.2 \ m/sec$$

Substituting this value of V_{w_2} in eq (1) we get

The work done by impeller

$= 1000 \times 0.19635 \times 23.2 \times 26.18$

$= 119258.28 \ N\text{-}m/sec$

- Manometric efficiency (η_{man}) is given by

$\eta_{man} = gH_m / V_{w_2} u_2 = 9.81 \times 40 / 23.2 \times 26.18$

$= 0.646$

$\eta_{man} = 64.6\%$