Hydraulic Machines

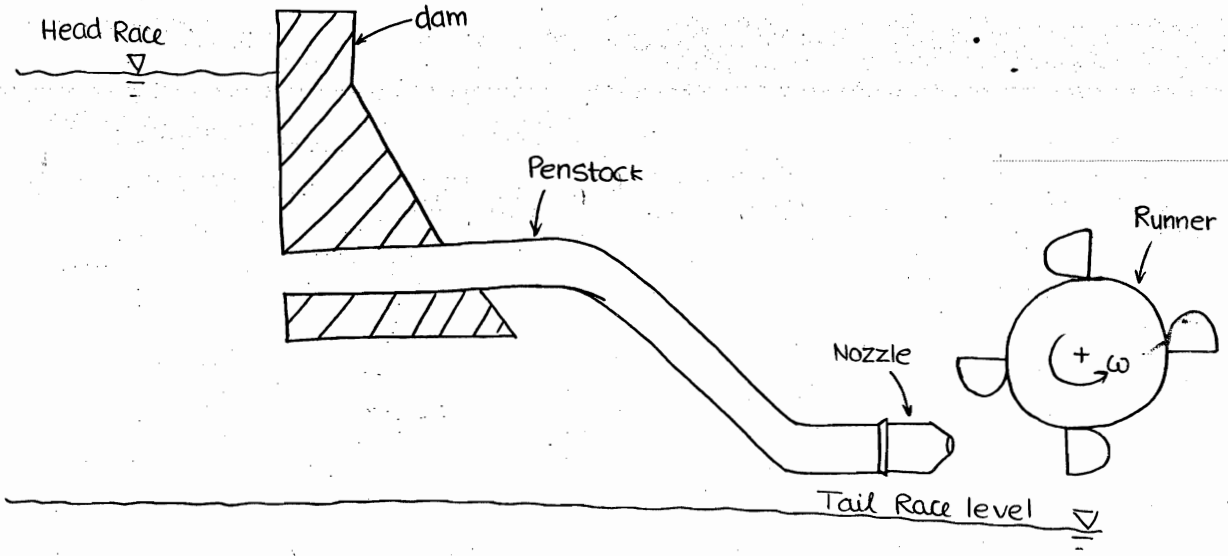
Flow in motion ⟶ Fluid dynamics

Classification of hydraulic Machines -

Work is done by the water (Ex- turbine)

Work is done on the water (Ex- Pump)

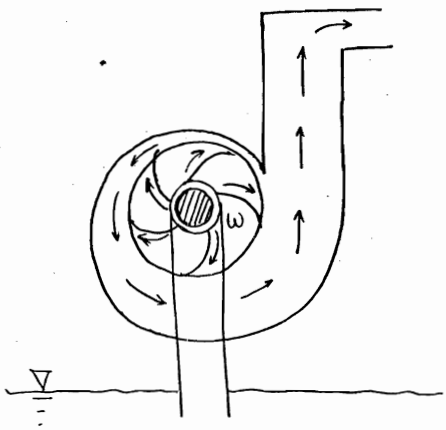
Layout of hydro electric Power plant -



Hydraulic Energy → Mechanical shaft power output → Electric Power Output

Turbine

Pump :-



Electric Energy → Mechanical shaft power input → Hydraulic Energy

Pump

In General-

Energy (Joule)

$= mgH$

$= \frac{1}{2} m V^2$

$= F \times (X)$ (Workdone)

Power (Joule/sec)

$= \dot{m} g H$

$= \frac{1}{2} \dot{m} V^2$

$= F \times u \left(\frac{\text{Workdone}}{\text{sec}}\right)$

$= T \times \omega$

Work done per sec per unit weight of water striking per sec

$= \frac{\text{Work done per sec}}{\dot{m} g} = H \text{ (m)}$

In General-

Water

(System)

A/C to Newton's 2nd law of motion

$$\vec{F} = \underbrace{\dot{m}\vec{V}_2}_{\text{Momentum of water leaving per sec.}} - \underbrace{\dot{m}\vec{V}_1}_{\text{Momentum of water entering per sec.}}$$

$\dot{m}$ = mass flow rate actually striking over vane.

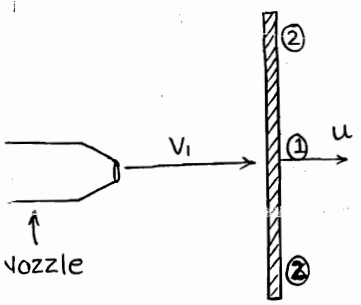
$\vec{F}$ = Force. applied on the water by the vane.

Force applied by the water on the vane $= -\vec{F}$

$= \dot{m}\vec{V}_1 - \dot{m}\vec{V}_2$

In General-

Notations :-



inlet of vane ⇒ 1

exit of vane ⇒ 2

$\vec{V}_1$ = absolute velocity of water at the inlet of vane

$\vec{u}_1$ = absolute " " vane " " " " "

$\vec{V}_{r_1}$ = Relative " " water " " " " "

$\vec{V}_2$ = Absolute velocity of water at the exit of vane.

$\vec{u}_2$ = Absolute " " vane " " " " "

$\vec{V}_{r_2}$ = Relative " " water " " " " "