Lecture

on

Sub: Fluid Machines

Code : MEC 206

Topic : Introduction to Fluid Machines

by

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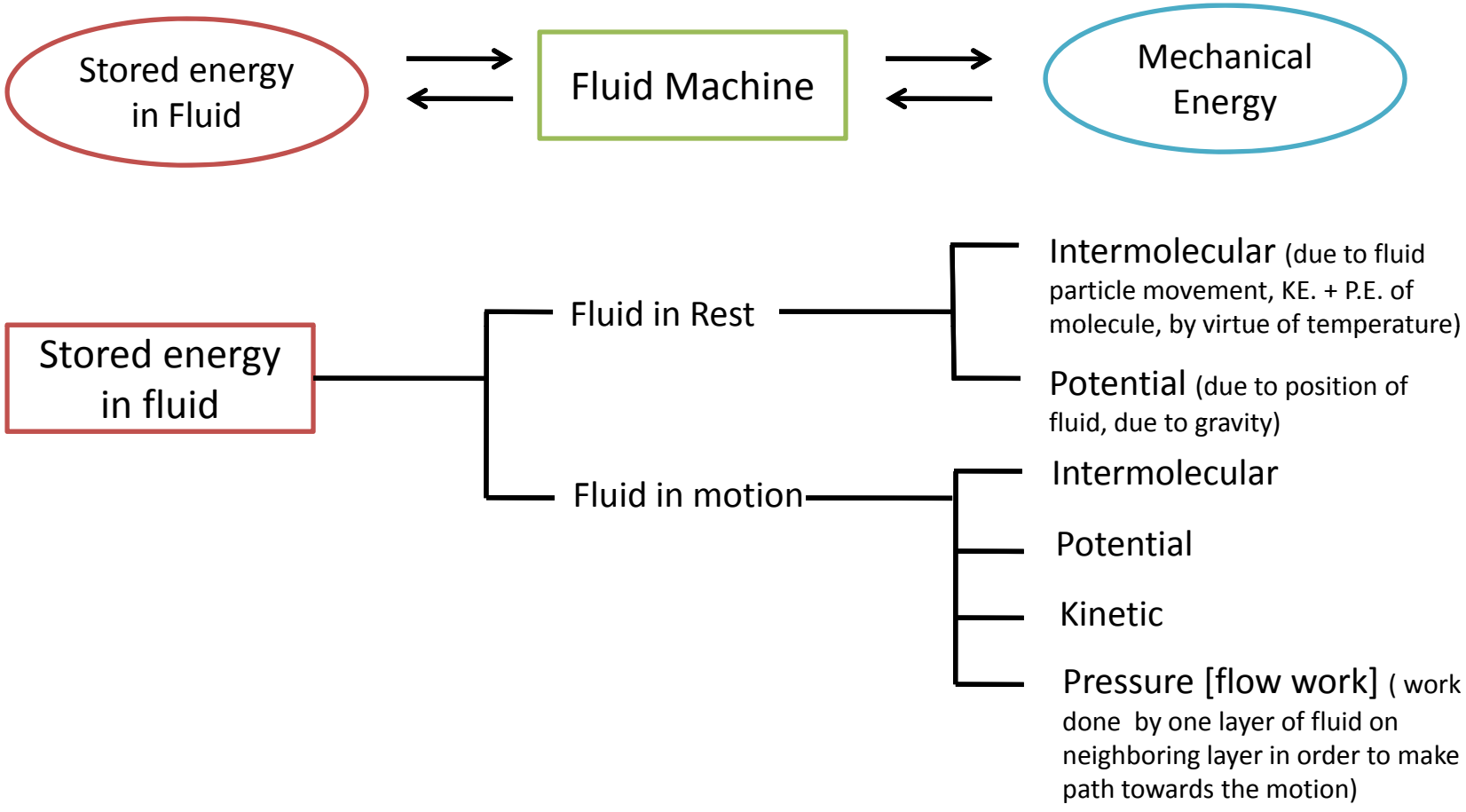
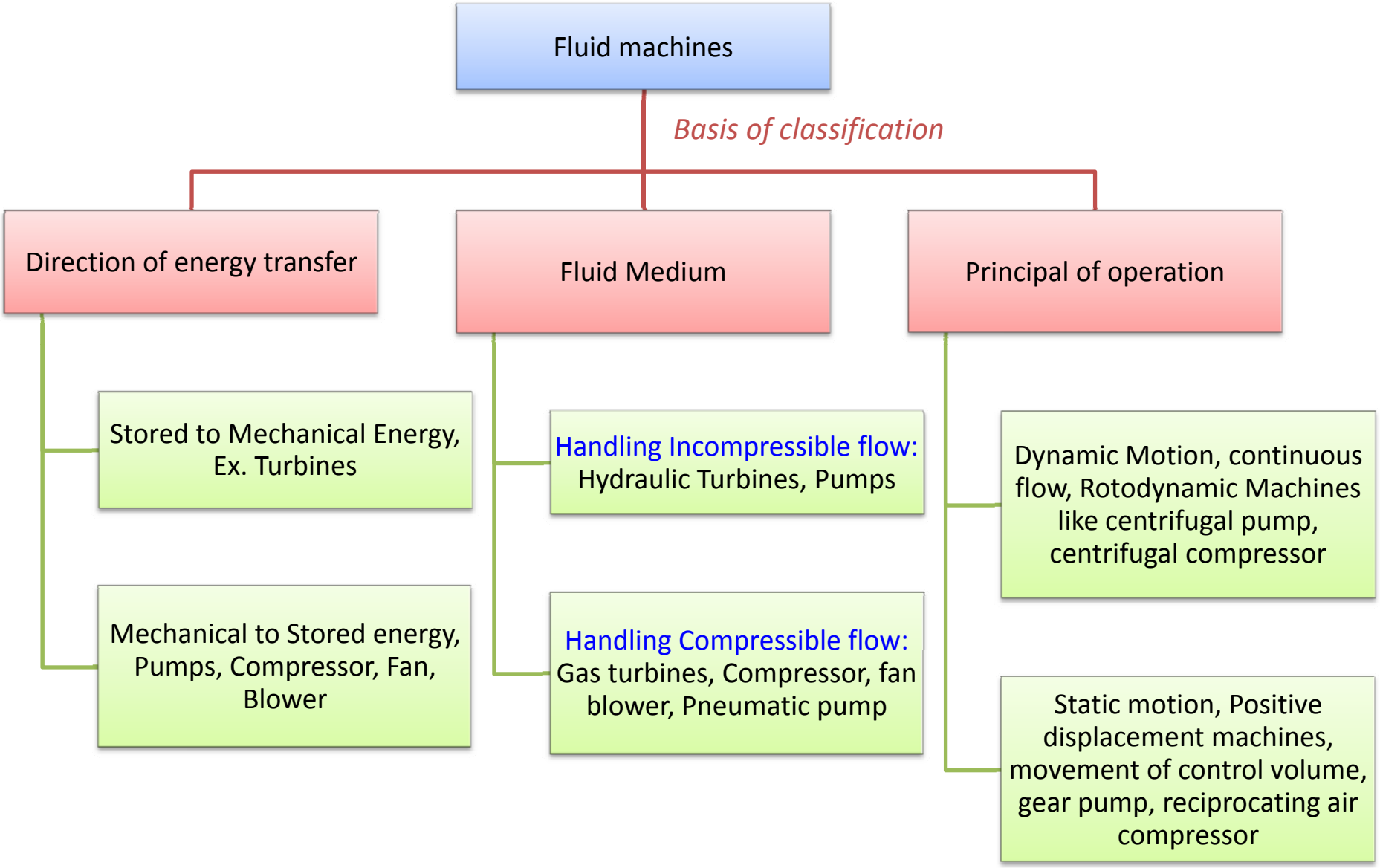
What is fluid Machine ?



Classification of fluid Machines



1.1. Flow Machinery. Definitions

Machines designed to move liquids and add energy to them are called pumps.

An operating pump changes the mechanical energy available from the motor into potential, kinetic, and thermal energy imparted to the liquid flow.

Machines moving gaseous fluids with a pressure ratio of up to 1.15* are known as fans.

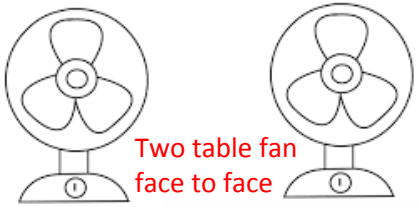
Compressors are artificially cooled, generally water-cooled, machines offering gas pressure ratios over 1.15.

Machines operating at gas pressure ratios above 1.15, yet without artificial cooling, are referred to as blowers.

Unlike pumps, machines changing fluid energy into mechanical energy are described as hydraulic motors.

In modern industrial practice in use are what are known as hydraulic transmissions, i.n. hydraulic devices designed to carry mechanical energy from the motor shaft to the shaft of the associated driven machine. A hydraulic transmission is a pump and a hydraulic motor built as a single unit. Hydraulic motors, pumps, and hydraulic transmissions comprise a class of fluid machinery.

shaft coupling



Two table fan face to face

Fluid coupling

* The pressure ratio ε is the outlet-to-inlet gas pressure ratio of a machine.

Classification based on energy interaction with the fluid and construction design of machine

Gas / steam turbine

Wind turbine

Fluid machinary

Chart 2

Hydraulic motors

Pumps

Hydraulic transmission of energy

Hydraulic turbines

Water wheels

Water-column (reciprocating) machines

Rotary hydraulic motors

Fluid coupling

Torque converter

Dynamic

Positive displacement

Jet

Pneumatic

Regenerative-turbine

Axial-flow

Centrifugal

Mixed-flow

Reciprocating

Rotary

Air lift, gas lift

Pneumatic units

Domestic fan (axial)

Radial blade centrifugal fan

Industrial axial fan

CPU axial fan

Air blower (radial)

axial blower

Mixed flow blower

axial compressor used in gas turbine

There are pumps: axial, radial, reciprocating, etc ….

Mixed flow compressor

onshore wind turbine (HAWT)

offshore wind turbine

Darrieus straight blade wind turbine

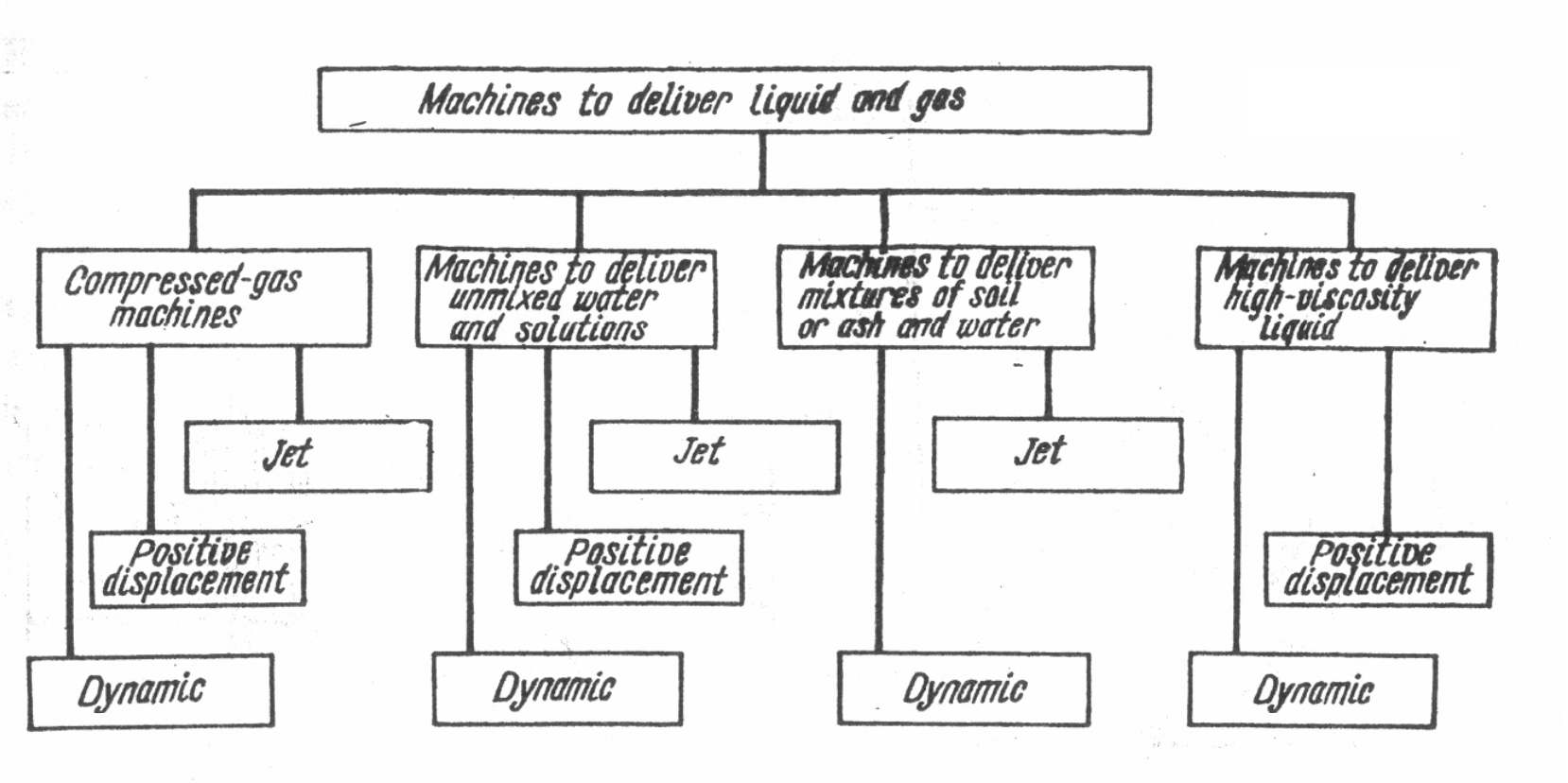
Darrieus helical blade wind turbine

H rotor wind turbine

Gas turbine rotor

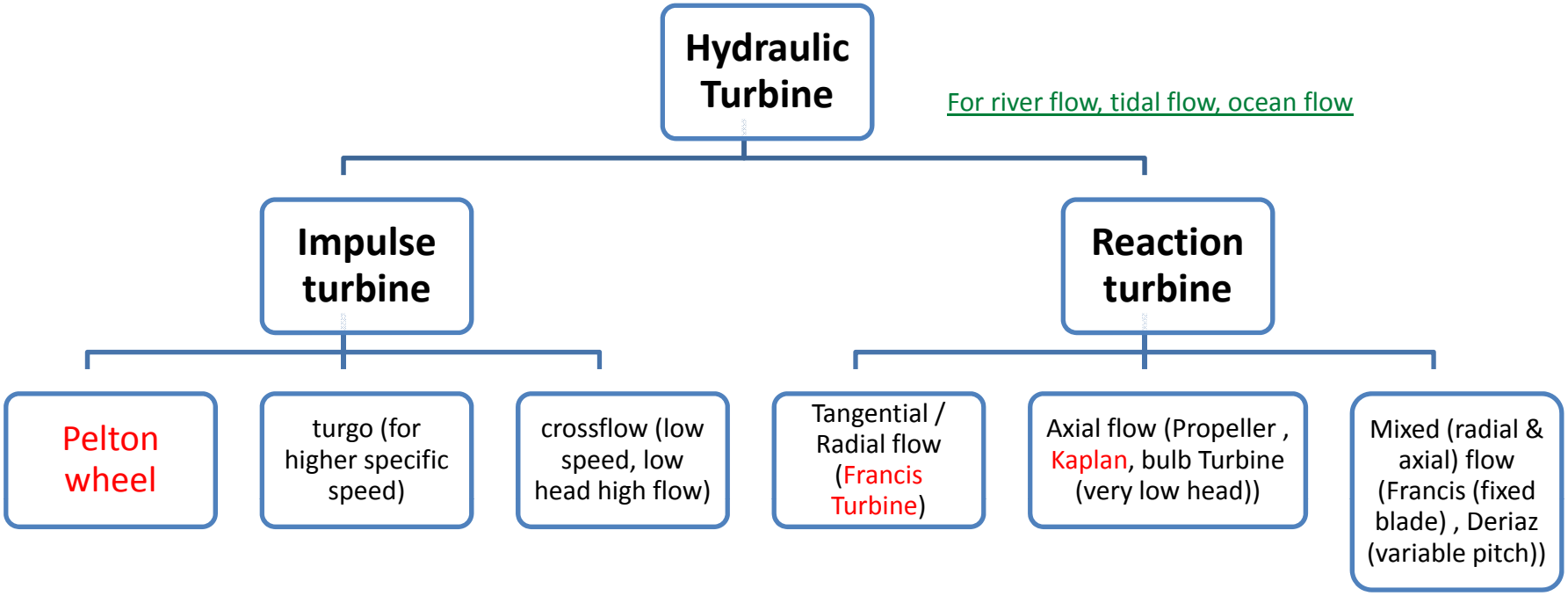
Steam turbine rotor

Classification of Pumps based on properties of the fluid being transferred and construction design



Video

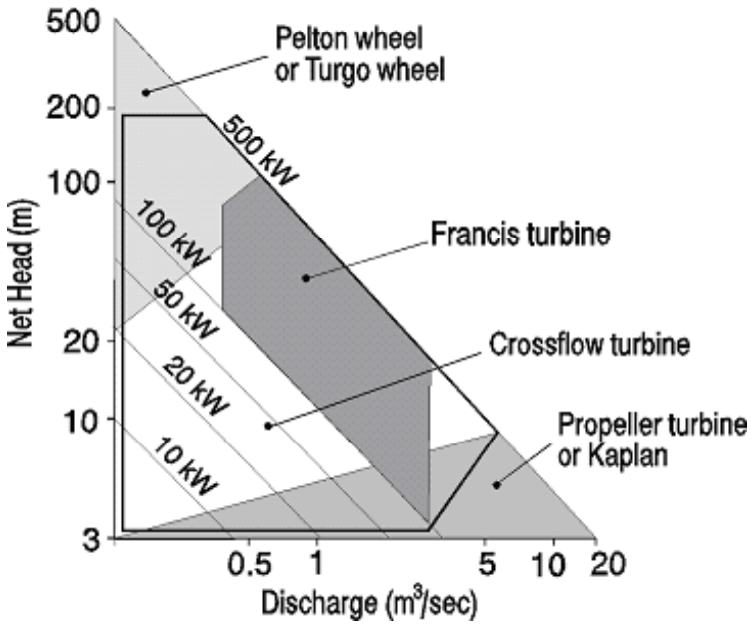
1. Operation of Hydropower Plant
2. Different types of Hydropower plant

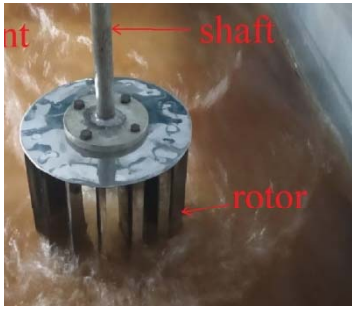


Depends on **head (H in m)** and **discharge (Q in m^3/s)** turbines are selected:

Low head plant < 15 m
Medium 15-70m
High head 71-250m
Very high head > 250 m

For very small head hydrokinetic turbine are used.

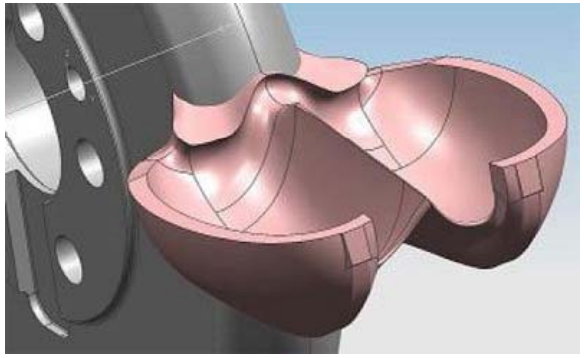




crossflow

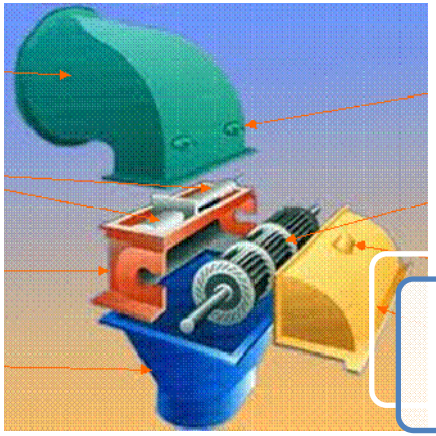
- **Hydraulic Turbine** — For river flow, tidal flow, ocean flow
  - **Impulse turbine**
    - Pelton wheel
    - turgo (for higher specific speed)
    - crossflow (low speed, low head high flow)
  - **Reaction turbine**
    - Tangential / Radial flow (Francis Turbine)
    - Axial flow (Propeller , Kaplan, bulb Turbine (very low head))
    - Mixed (radial & axial) flow (Francis (fixed blade) , Deriaz (variable pitch))

The main difference between the Turgo and Pelton turbine is the design of runner buckets. The runner of Turgo turbine is the half slice of Pelton turbine. Turgo turbine can handle faster water jet effectively due to its unique bucket design. Buckets in the Pelton turbine don't remove water quickly therefore, water in the bucket interferes with the incoming jet and also reduces the efficiency of the turbine. On the other hand buckets in Turgo turbine remove water from runner quickly. The angel of water jet also plays an important role in this regard. Usually, water jet hits the runner at the angle of 20 degrees.



Pelton

Turgo



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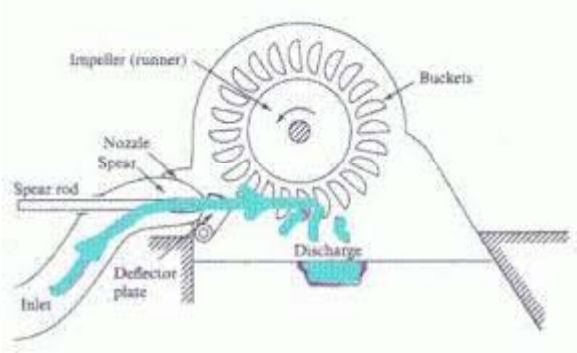
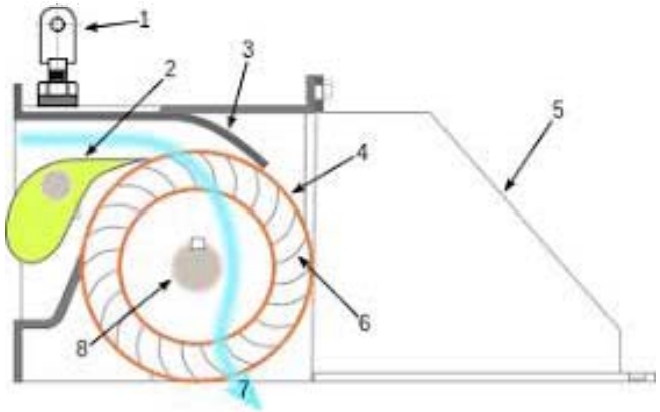
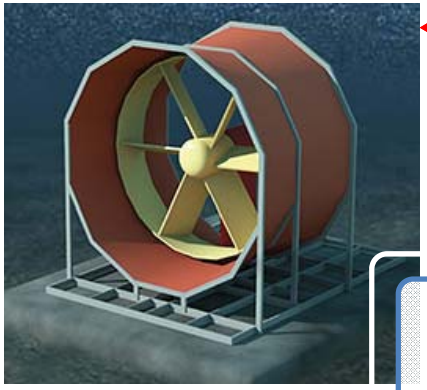
In a **cross-flow turbine** the water passes through the turbine transversely, or across the turbine blades. As with a water wheel, the water is admitted at the turbine's edge. After passing to the inside of the runner, it leaves on the opposite side, going outward. Passing through the runner twice provides additional efficiency. When the water leaves the runner, it also helps clean it of small debris and pollution. The cross-flow turbine is a low-speed machine that is well suited for locations with a low head but high flow.



Pelton



Crossflow



For river flow, tidal flow, ocean flow – Hydrokinetic Turbine is used. Only Kinetic energy of free stream is used.

Hydraulic Turbine

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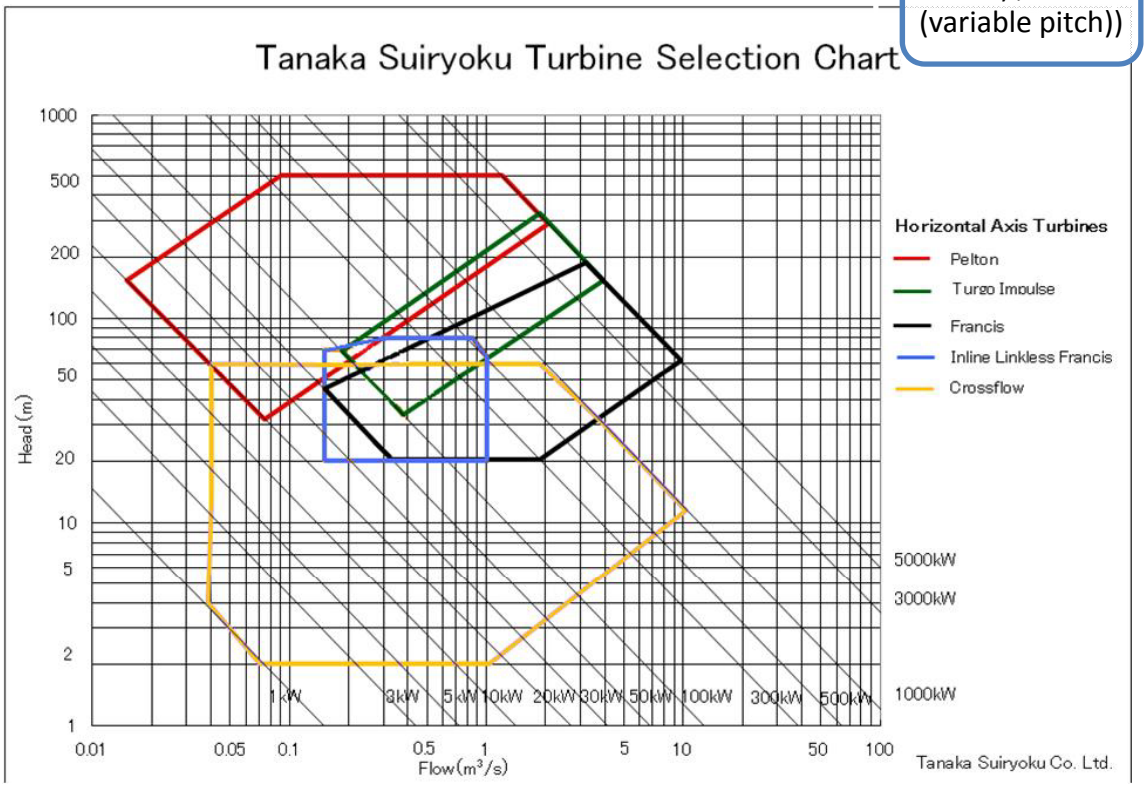
Pico Hydro Power Plants	< 5kW
Micro hydro electric plants	5kW-100 kW
Mini hydro electric plants	100kW to 1MW
Small hydro electric plants	1 MW to a few MW
Medium hydro electric plants	More than a few MW
Super hydro electric plants	More than 1000 MW



Thank you