

Cooling System and Cooling Tower

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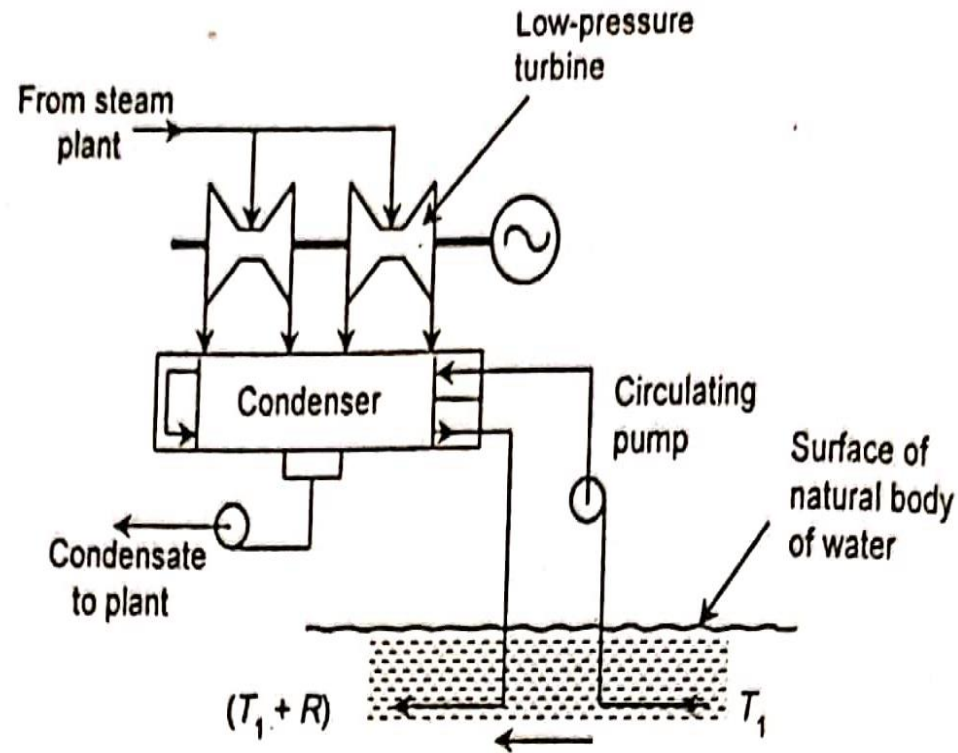
Circulating water system

It supplies cooling water to the turbine condensers and thus acts as a vehicle by which heat is rejected from the steam cycle to the environment

Classification of Circulating water system

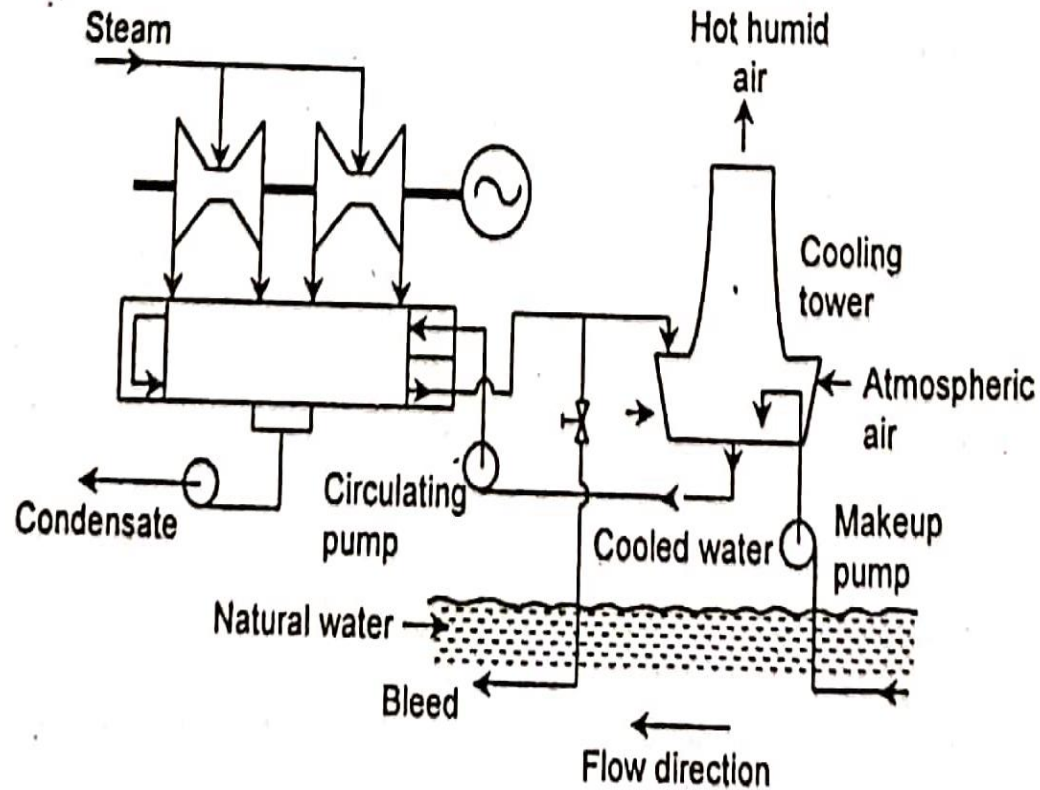
- Once-through Cooling System
- Closed-loop Cooling System
- Combination Cooling System

Once-through Cooling System



- In this case water is taken from a natural body of water such as lake, river or ocean and pumped through the condenser where it is heated and then discharged back to the source.

Closed-loop Cooling System



- Hot water coming out from the condenser is passed through a cooling device and is returned to the condenser with the help of a pump

COOLING TOWER

- The cooling towers are used in many applications in engineering. The main application are in power plants and refrigeration plants.
- Its function is to cool the hot water from the condenser by exposing it to the atmospheric air, so that the cold water may be used again for circulation.
- The cooling towers are used in steam power plants where there is a limited supply of cooling water.
- It is placed at a certain height (at about 9 meters from the ground level).
- The hot water falls down in radial sprays from a height and the atmospheric air enters from the base of tower.
- The partial evaporation of water takes place which reduces the temperature of circulating water.
- This cooled water is collected in the pond at the base of the tower and pumped into the condenser.

Factors Affecting the cooling of water in a cooling tower

- Size and height of cooling tower,
- Arrangement of plates in cooling tower,
- Velocity of air entering the cooling tower,
- Temperature of air,
- Humidity of air, and
- Accessibility of air to all parts of cooling tower.

Types of Cooling Towers

1. Wet Cooling Tower

➤ Mechanical Draught Cooling Towers

- Forced draught cooling towers
- Induced draught cooling towers

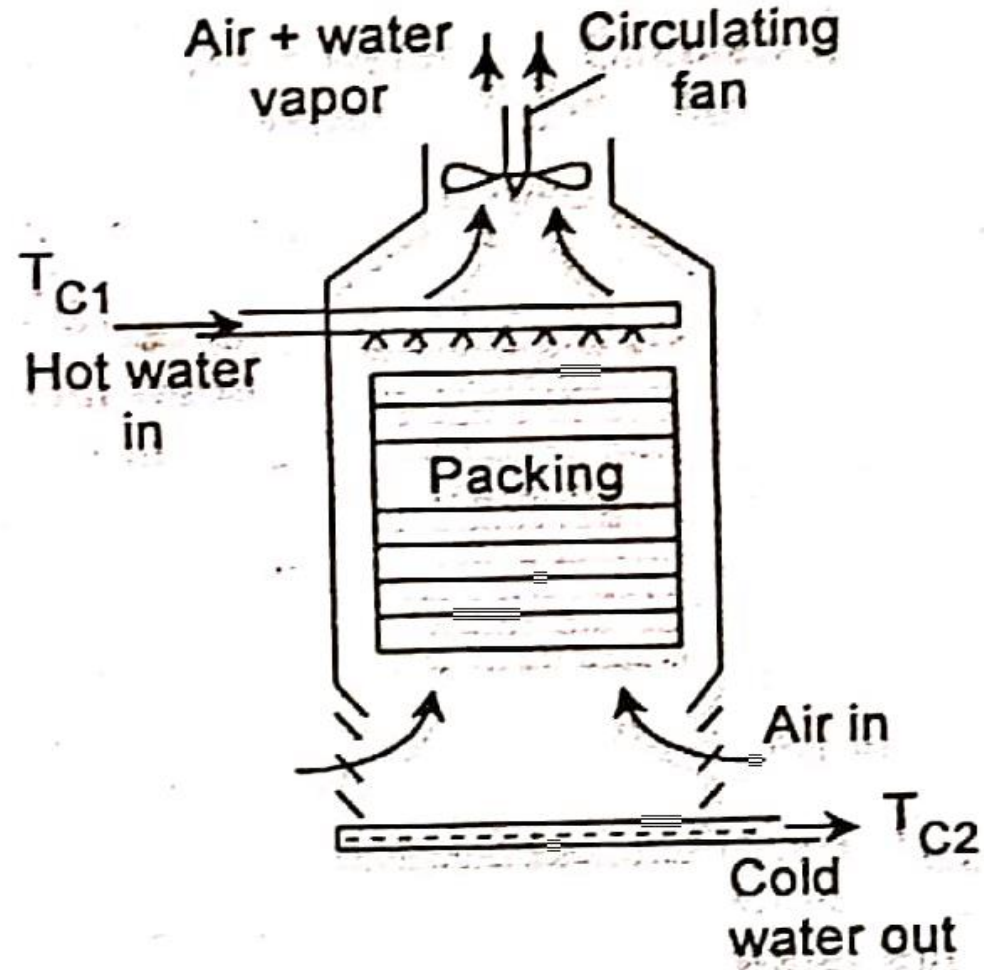
➤ Natural draught cooling towers

2. Dry Cooling Towers

➤ Direct Dry-Cooling Tower

➤ Indirect Dry-Cooling Towers

Wet Cooling Tower



- Wet cooling tower cool the hot water by dissipating heat to the environment through the mechanism of (i) addition of sensible heat to the air (ii) evaporation of a portion of the recirculation water itself. When operation in the open mode. (iii) addition of sensible heat to the natural body of water as a result of terminal temperature difference.
- Wet cooling tower employ a hot-water distribution system that showers or sprays the water evenly over a lattice work of closely set horizontal slats.

Mechanical Draught Cooling Towers

- In these towers the draught of air for cooling the tower is produced mechanically by means of propeller fans.
- These towers are usually built in cells or units, the capacity depending upon the number of cells used.

Forced draught cooling tower

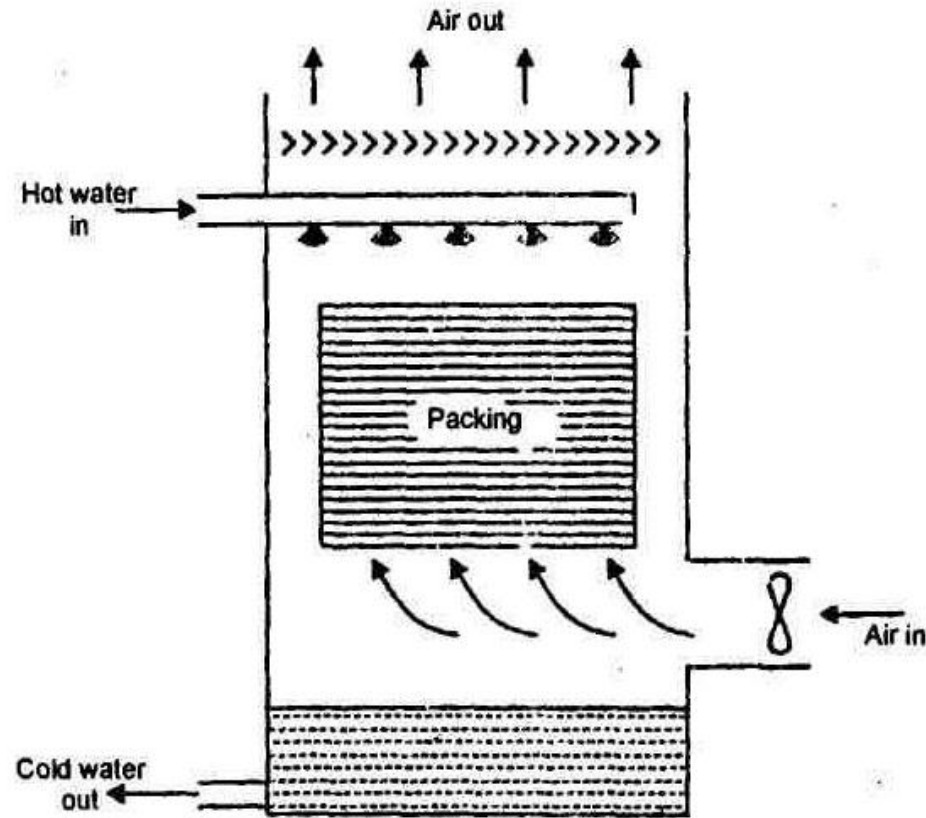


Fig. Forced draught cooling tower

- In Forced draught cooling tower, as shown in fig, the circulation of air is produced by means of fans placed at the base of the tower.

Induced draught cooling tower

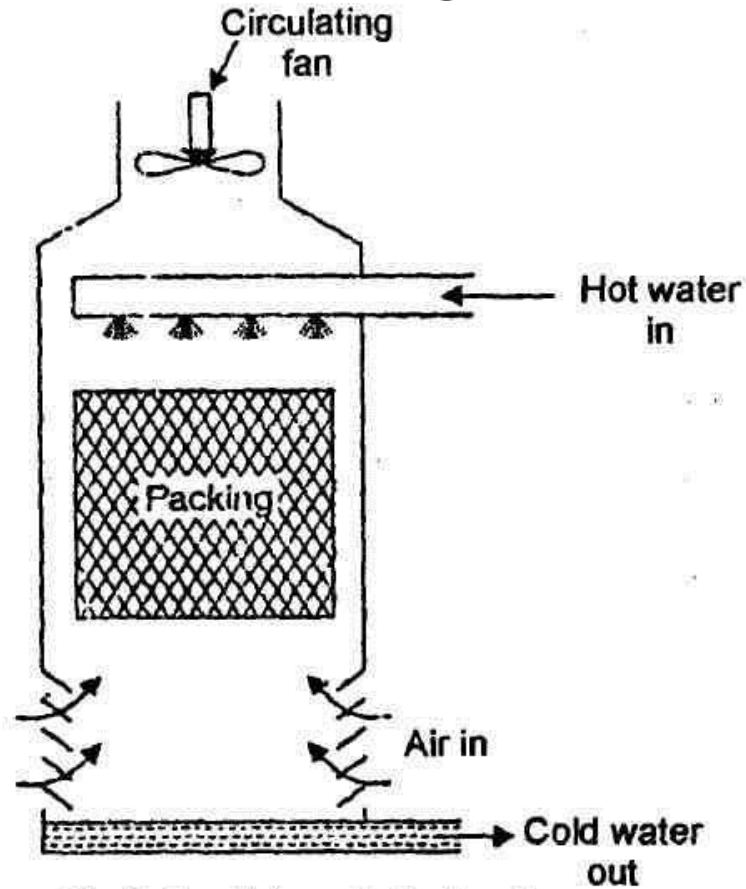


Fig. Induced draught Cooling tower

- In an Induced draught cooling tower, as shown in fig, the circulation of air is provided by means of fans placed at the top of the tower.

Natural draught cooling tower

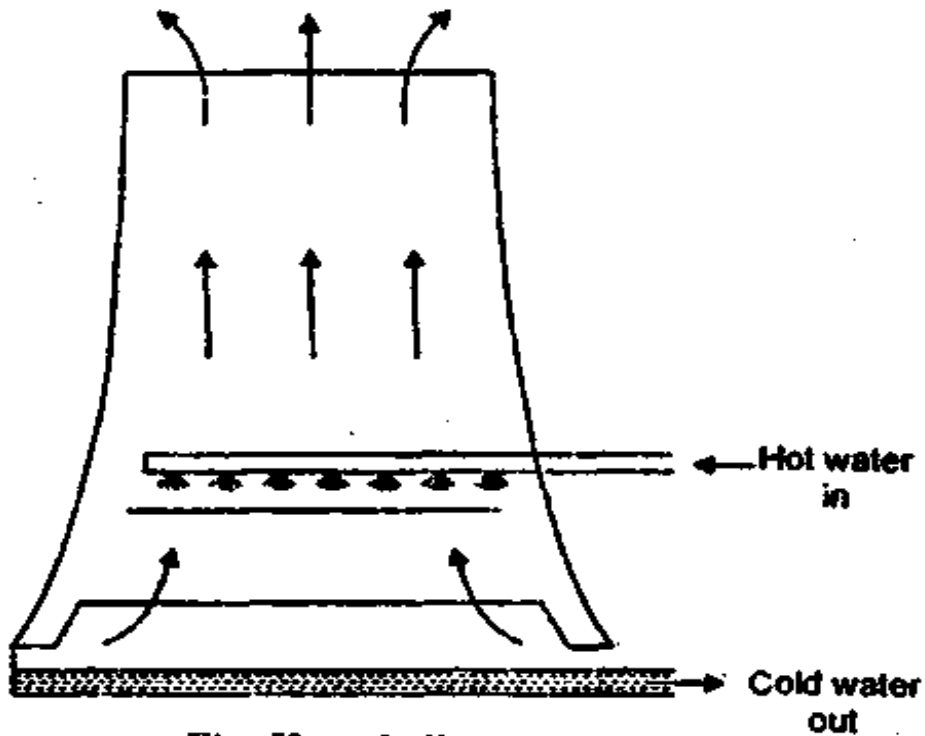
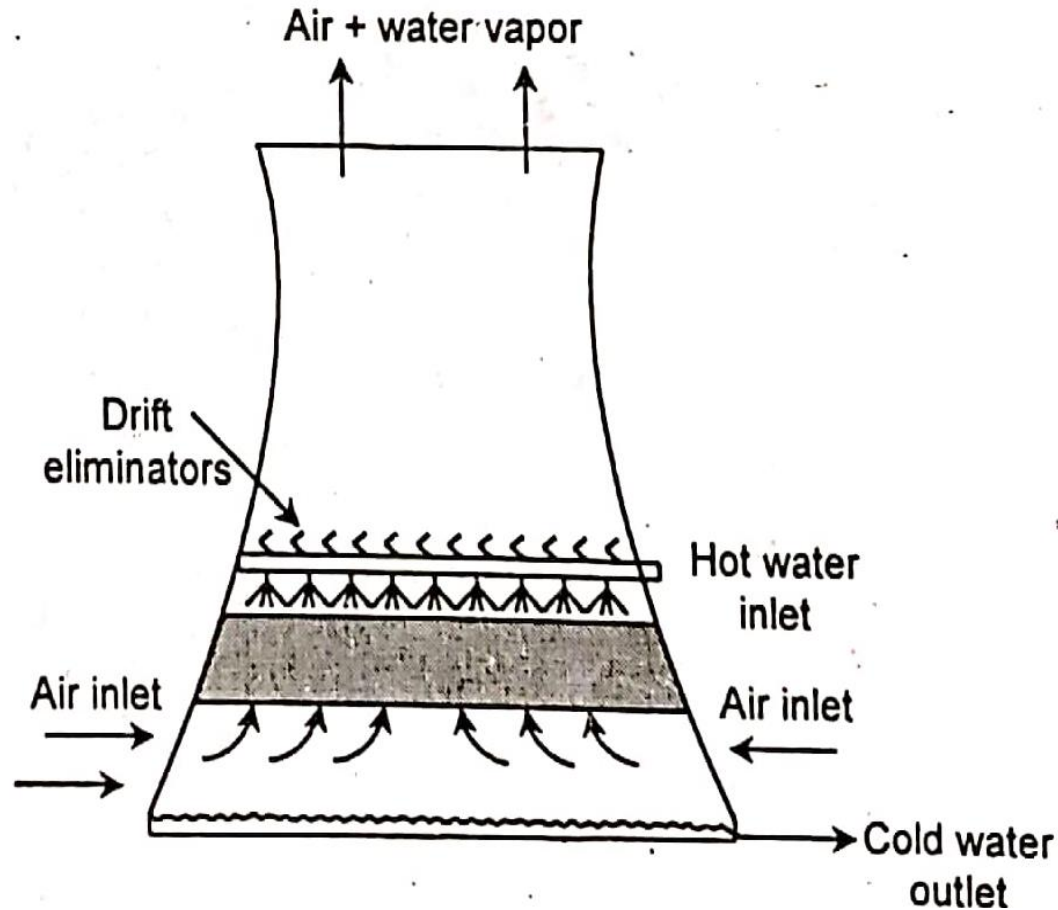


Fig. Hyperbolic cooling tower

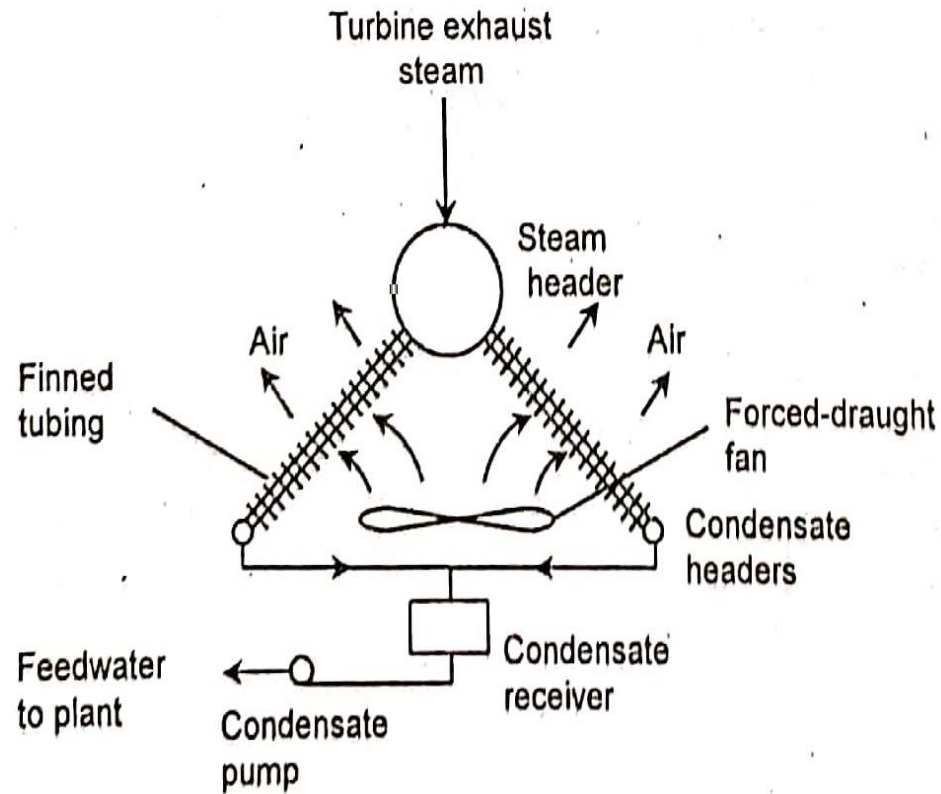
- In a natural draught cooling tower, as shown in fig., the circulation of air is produced by the pressure difference of air inside and outside the cooling tower.
- In this type of tower, the hot water from the condenser is pumped to the troughs and nozzles situated near the bottom.

Counter Flow Natural draught cooling tower



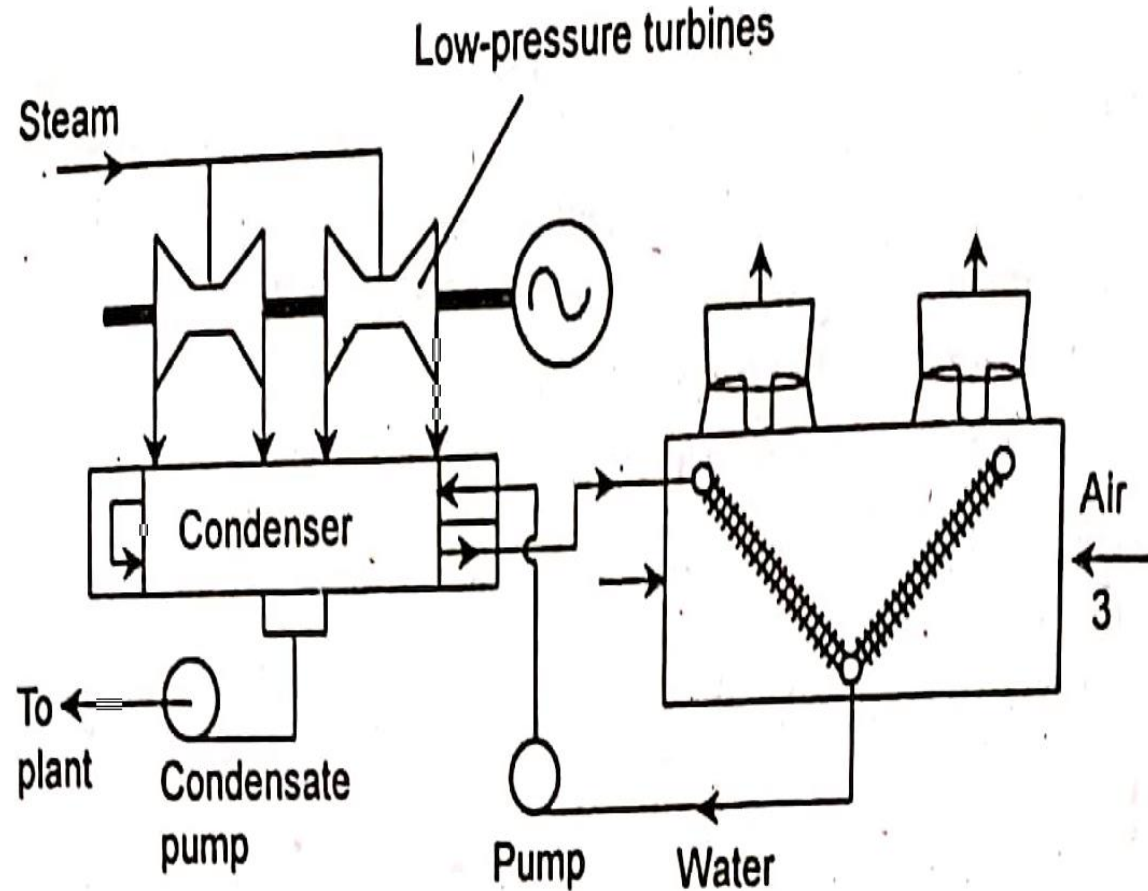
- In counter flow the fill is inside whereas in cross flow, the fill sits in a ring outside the tower outside the stilts
- Natural draught cooling tower are select under the following conditions
 - i. Cool humid climates
 - ii. Combination of low wet bulb temperature and high condenser water inlet and outlet temperatures
 - iii. Heavy winter loads

Direct Dry Cooling Towers



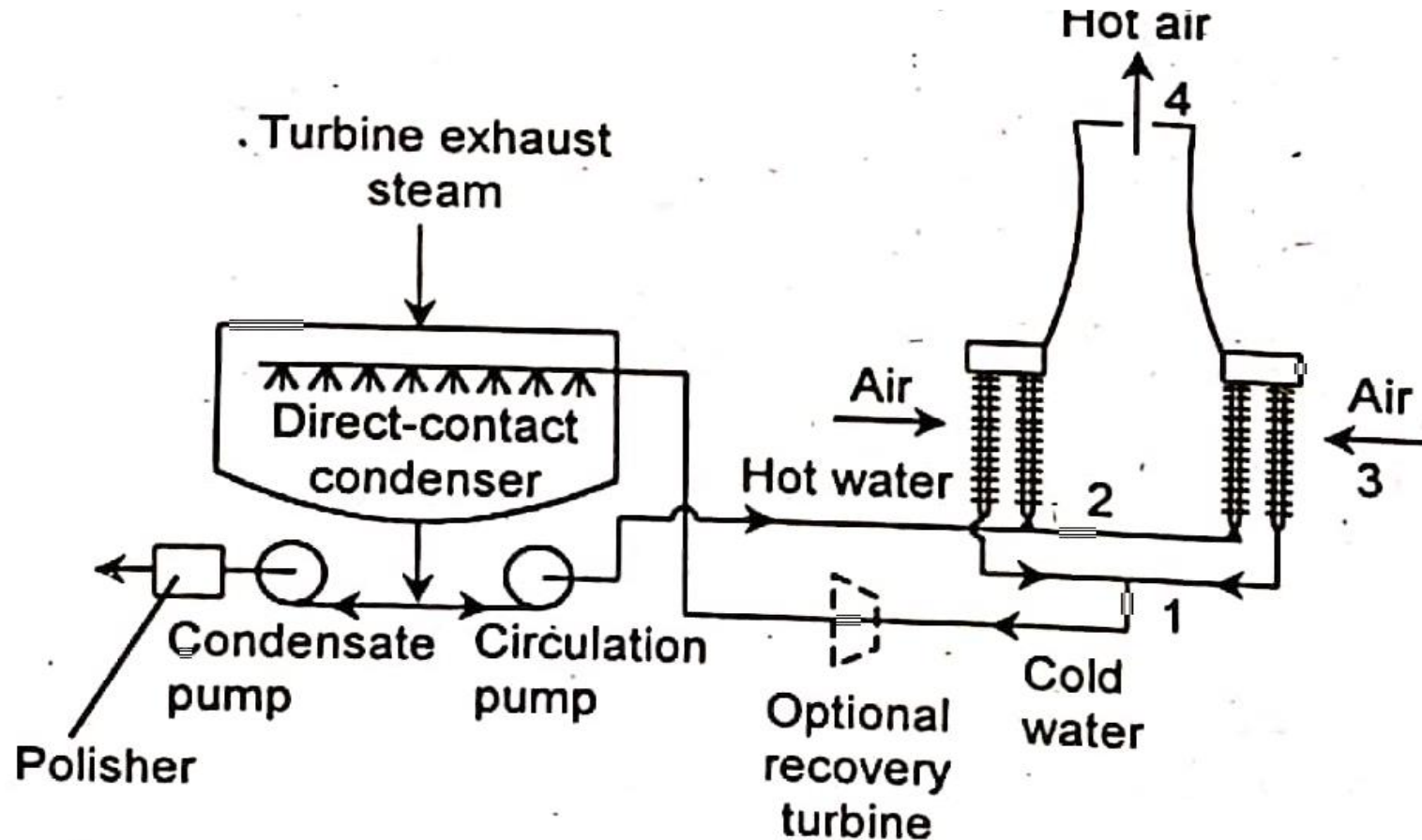
- Turbine exhaust steam is admitted to a steam header through large ducts to minimize pressure drop and is condensed as it flows downward through a large number of finned tubes or coil arranged in parallel which are cooled by atmospheric air flowing in a natural draught cooling tower or by forced draught fan

Indirect Dry Cooling Towers



- It uses a conventional surface condenser in which circulating water leaving the condenser goes through finned tubing cooled by atmospheric air in the tower.

Indirect Dry Cooling Towers with an open type condenser



THANK YOU