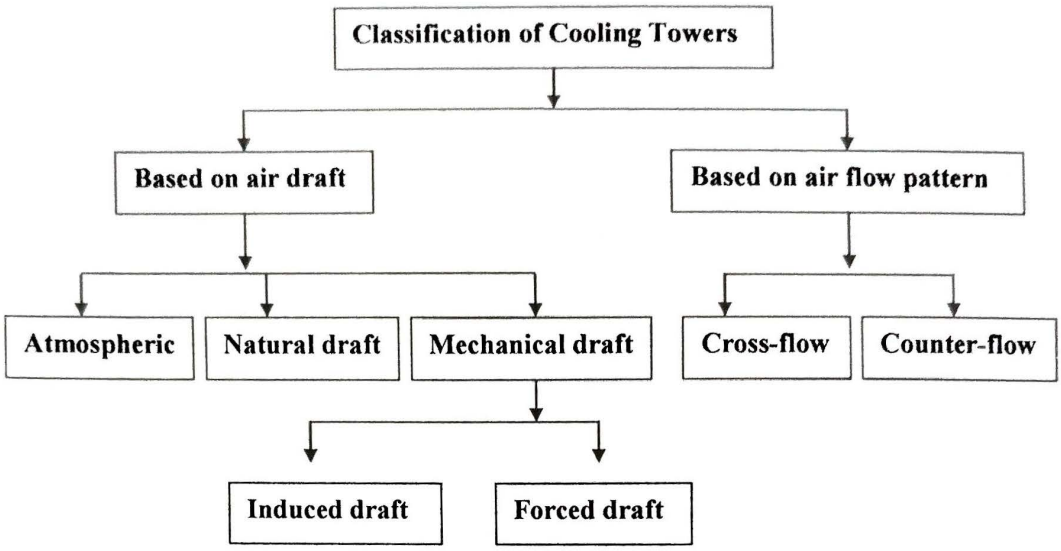
Types of equipment – Cooling Tower



(A) Atmospheric Towers

It is a big rectangular chamber with two opposite 'louvered' walls. Tower is packed with a suitable 'tower fill'. Atmospheric air enters the tower through louvers driven by its own velocity. Direction and velocity of wind greatly influence its performance. Figure 1 shows the schematic of the atmospheric cooling tower.

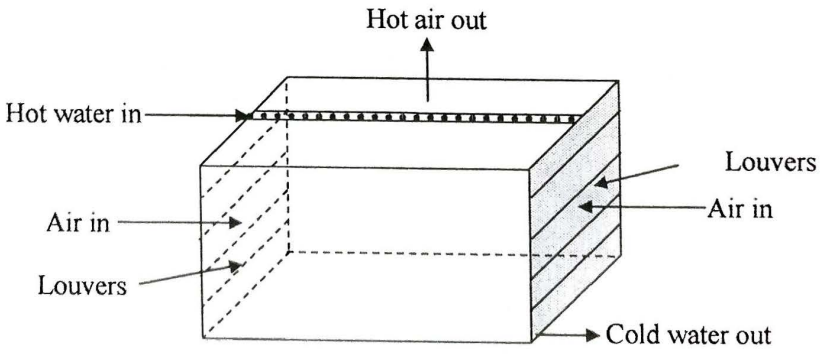


Figure 1: Schematic of atmospheric cooling tower.

(B) Natural Draft Towers

A natural draft cooling tower has a large reinforced concrete shell of hyperbolic shape (also called 'hyperbolic tower'). Natural flow of air occurs through the tower; hence it is called natural draft (refer Figure 2).

Factors responsible for creating natural draft

(a) A rise in temperature and humidity of air in the column reduces its density

(b) Wind velocity at the tower bottom

Fan is used to enhance the air flow rate in fan assisted natural draft tower. The typical diameter of tower is 150 m and capacity is 5,00,000 gallon/minute.

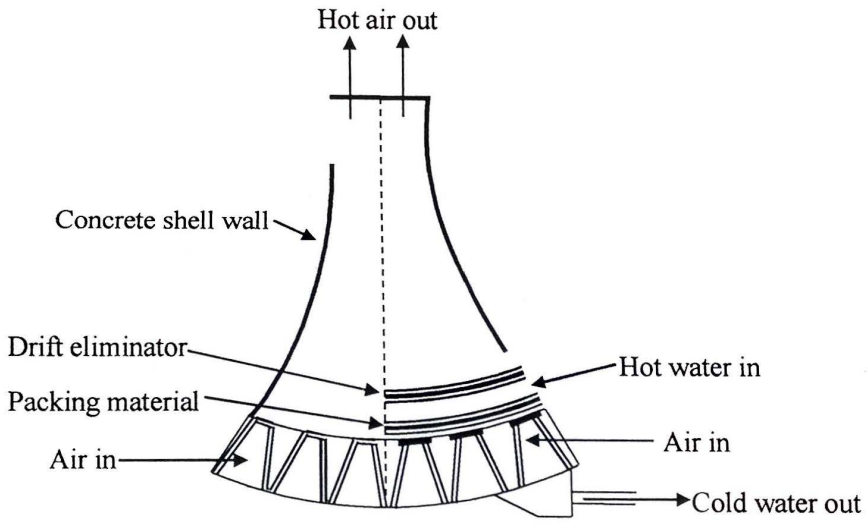


Figure 2: Schematic of natural draft tower.

Why hyperbolic shape?

(i) More packing materials can be placed at the bottom

(ii) The entering air gets smoothly directed towards the centre

(iii) Greater structural strength and stability

(C) Mechanical Draft Towers: forced draft towers and induced draft towers

Fans are used to move air through the tower in mechanical draft cooling towers. Two types of mechanical draft towers are there, namely, forced draft tower and induced draft tower.

Forced draft towers: It can be seen from Figure 3 that it has one or more fans located at the tower bottom to push air into tower.

Advantages:

(a) A part of the velocity head of air thrown by the blower is converted to pressure head on entering into the tower. It makes energy efficient than induced draft.

(b) Less susceptible to vibrations as fans are installed near the ground.

Disadvantages:

(a) Air flow through the packing may not be uniform

(b) Some of the warm and humid air may be recirculated back. Recirculation rate becomes low if the wind velocity is high. It is not popular except for small capacities.

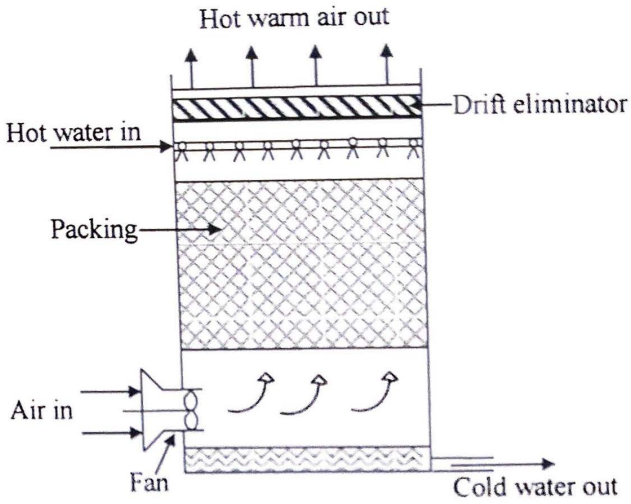


Figure 3: Schematic of forced draft towers.

Induced draft towers: One or more fans are installed at the top of the tower. Depending on the air inlet and flow pattern, induced draft towers are of two types, cross-flow and counter flow towers.

Major advantages of countercurrent induced draft cooling tower

(a) Relatively dry air contacts the coldest water at the bottom of the cooling tower

(b) Humid air is in contact with the warm water and hence maximum average driving force prevails for both heat and mass transfer.

Disadvantage of induced draft towers compared to forced draft towers

It consumes more horse power.

Cross-flow induced draft cooling tower requires less motor horse power than countercurrent induced draft cooling towers.

(D) Cross-current and counter-current

Cross-flow induced draft cooling tower supplies horizontal air flow along the packed height and requires less motor horse power than the counter-flow type. Additional 'cells' may be added to raise the capacity. The schematic of induced draft counter-flow and cross-flow cooling towers are presented in Figure 4 and Figure 5, respectively.

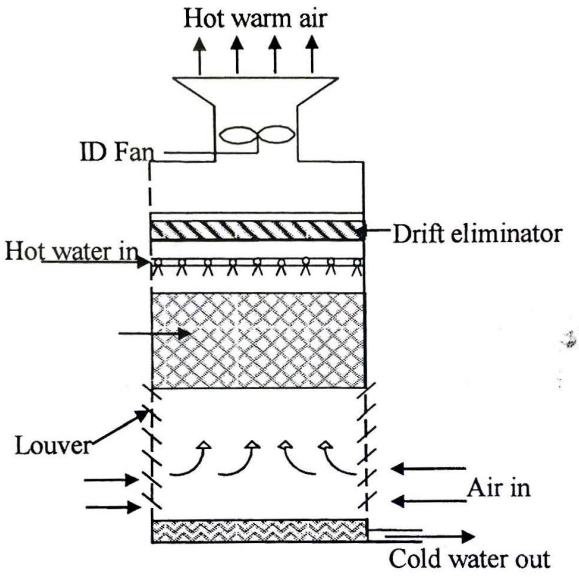


Figure 4: Schematic of mechanical draft counter-flow tower.

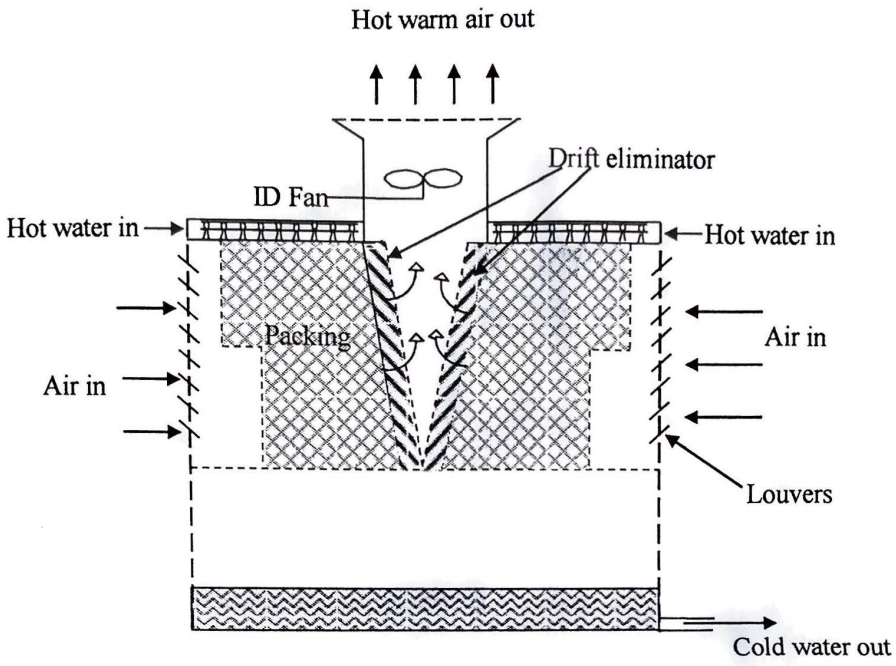


Figure 5: Schematic of mechanical draft cross-flow tower.