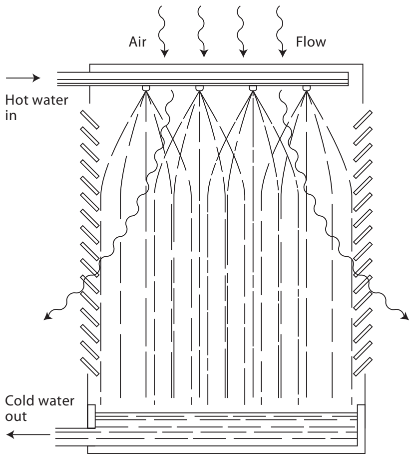
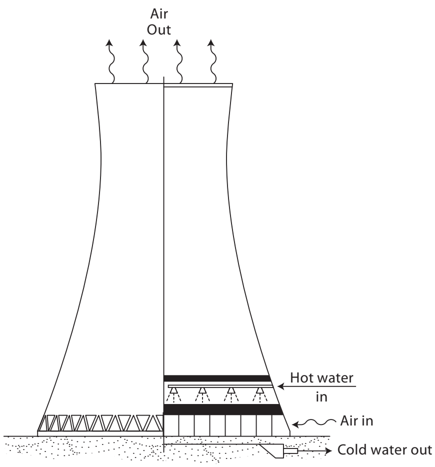
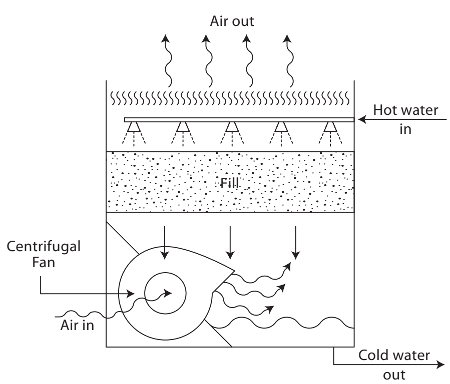
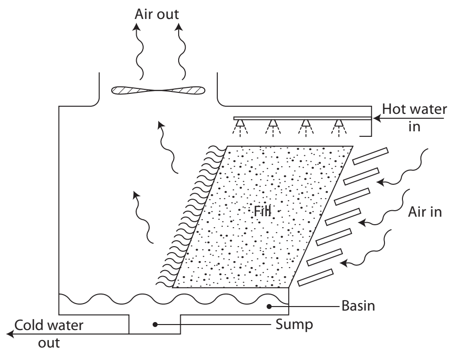
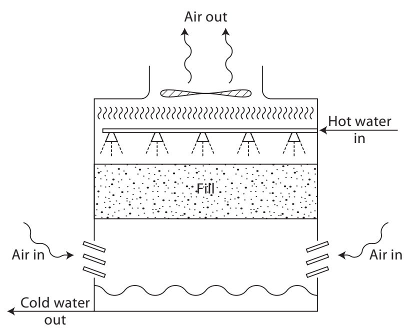
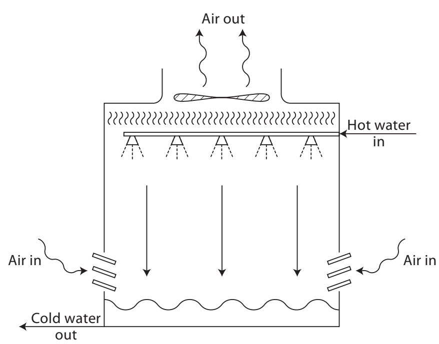
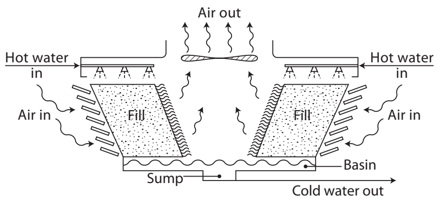
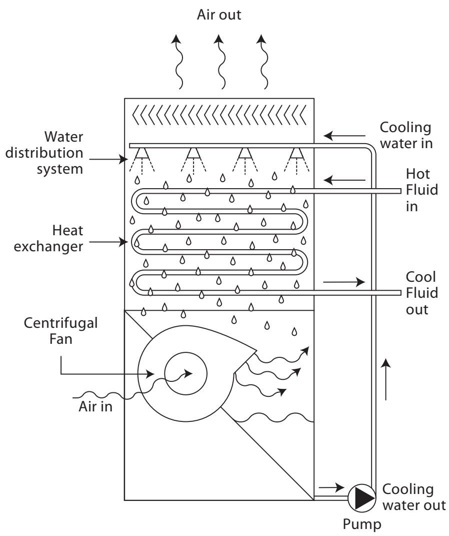
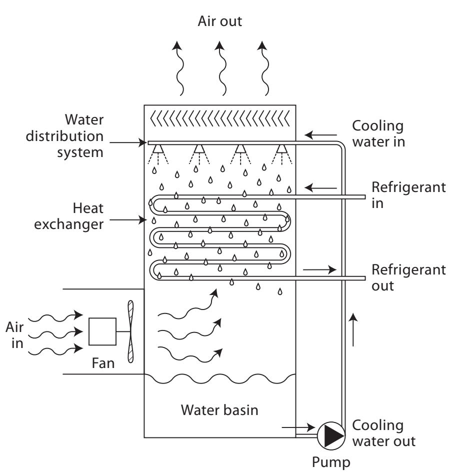
Table 2.1 COOLING TOWER TYPES AND CHARACTERISTICS

Tower type	Sketch (Typical)	Characteristics and application notes (Typical)
Natural draft spray tower	 Natural draft spray tower	• Air movement depends on induction forces. • Fluid movement is parallel or crossflow. • Low maintenance as no moving parts. • No recirculation of air occurs. • High pump head required as towers are high. • Unobstructed location necessary. • Performance depends on prevailing wind velocity and direction. • Capital cost almost as high as for mechanical draft tower. • Quiet operation and lower running costs. • Rarely used in HVAC&R systems.
Natural draft hyper-bolic tower	 Natural draft hyperbolic tower	• Stack effect increases with height. • Better and more consistent performance than atmospheric towers. • Low maintenance costs. • Not suitable for high dry bulb applications. • High capital cost due to size. • Close water temperature control difficult. • Used for high heat loads, large water flow rates and large approach temperatures. • Rarely used in HVAC&R systems. • Common in power generation and large industrial applications.
Forced draft tower	 Forced draft counterflow tower	• Fan situated at air intake. • High air entry and low exit velocities. • May be susceptible to recirculation. • Typically centrifugal fans with high resistance capability. • Generally noisier than towers with axial flow fans. • Generally incorporate fill. • Discharge and intake air may be ducted. • Fan, drive and motor located in dry air stream so less maintenance and corrosion is likely. • Fans located at lower level so less vibration and better access. • Higher fan power requirement. • Less physical space required for fan. • Generally zero performance at zero fan speed. • Common in HVAC&R applications.

Tower type	Sketch (Typical)	Characteristics and application notes (Typical)
Induced draft tower	 Induced draft, single flow cross flow tower with fill  Induced draft counter flow tower with fill	• Fan situated at air outlet usually at high level. • High air exit and low air entry velocities so less prone to recirculation. • Large fans with low speed and noise possible. • Lower drift potential. • Can operate with or without fill. • Fan, drive and motor located in moist air stream so electrical protection is required and more maintenance and corrosion is likely. • Fan more susceptible to vibration. • Less access for maintenance. • Generally smaller footprint than forced draft. • Generally up to 10–15% performance at zero fan speed. • Common in HVAC&R applications.
Counter-flow induced draft tower	 Induced draft counter flow tower without fill	• Vertical air movement is induced in opposition to the water flow across the fill. • Coldest water contacts the driest air for maximum performance. • Can be difficulties with access for maintenance. • Flexible air inlet location. • Air inlets on all sides reduce height and pump head. • Better suited to sub zero operation. • Good option with small packaged towers using centrifugal fans. • Common in HVAC&R applications.

<table>
<tr><th>Tower type</th><th>Sketch
(Typical)</th><th>Characteristics and application notes
(Typical)</th></tr>
<tr><td>Crossflow induced draft tower</td><td>

Induced draft double-flowcrossflow tower</td><td>
• Horizontal air movement is induced over the fill and water flows across the air stream.
• Generally a larger plan area but lower height.
• Better access for maintenance.
• Lower pump head required due to reduced height.
• Higher water loading reduces fouling potential.
• Risk of recirculation higher due to reduced height.
• Less tolerant of obstructions to airflow.
• Air inlets on two sides desirable.
• Good option with small packaged towers using propeller fans.
• Common in HVAC&R applications.</td></tr>
<tr><td>Fluid cooler</td><td>

Closed circuit cooling tower</td><td>
• A closed circuit cooling tower in which the process fluid does not contact the cooling air.
• Different types of fluids can be cooled including water, plating solutions, quenching oils, chemical solutions, gases, refrigerants and air.
• The fluid cannot contact the atmosphere.
• Only a small quantity of water is required in the open evaporating water circuit.
• Can be natural, forced or induced draft.
• Reduced water treatment and corrosion.
• Reduced pumping requirement.
• Can be heavier and larger than open circuit alternatives.
• Increased fan energy requirement.
• The tubes are sensitive to local dry areas caused by solid deposits.
• Common in industrial applications.</td></tr>
<tr><td>Evaporative condenser</td><td>

Evaporative condenser</td><td>
• See Fluid coolers.
• A closed circuit cooling tower in which the refrigerant is cooled or condensed directly in a closed coil.
• Can be air or water cooled or both.
• Refrigerant management issues may restrict system location or size.
• Sometimes referred to as DX systems.
• Common in industrial/refrigeration applications.</td></tr>
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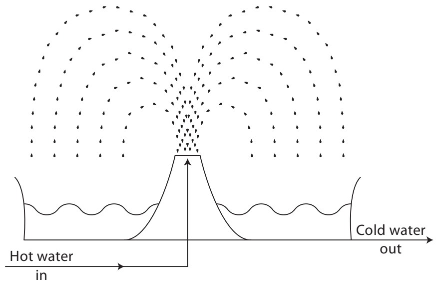
Tower type	Sketch (Typical)	Characteristics and application notes (Typical)
Ponds and fountains	 Fountain	• An attempt to combine the cooling tower heat rejection effect with an architectural water feature. • Water quality issues. • Public exposure issues. • Lower performance levels expected. • Performance depends on prevailing wind velocity and direction. • Rarely used in HVAC&R systems.