प्रधान मंत्री आवास योजना-शहरी
Pradhan Mantri Awas Yojana-Urban

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

Ministry of Housing and Urban Affairs
Government of India

Azadi Ka Amrit Mahotsav

bmtpc | giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

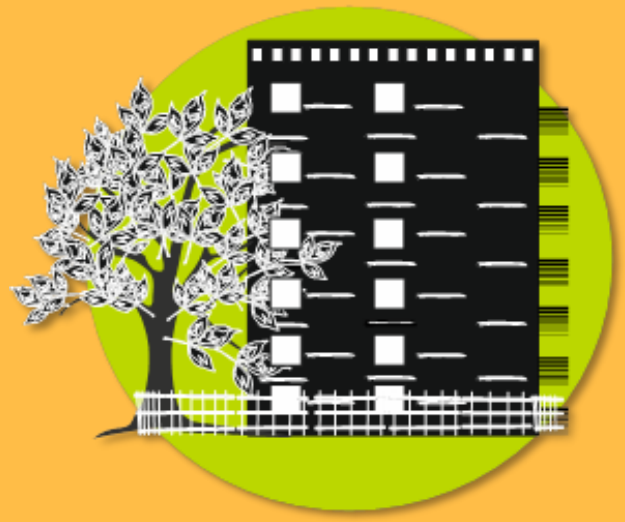
Session 4 – **Low-energy active comfort systems**

MMM dd, yyyy | Place

eds environmental design solutions

Wuppertal Institut

hunnarshālā FOUNDATION

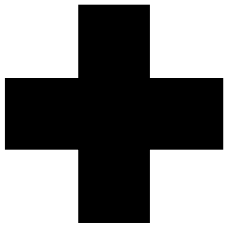


Why Low Energy Cooling Systems?

Why LECs?

FORM FOLLOWS FUNCTION

It's a given parameter

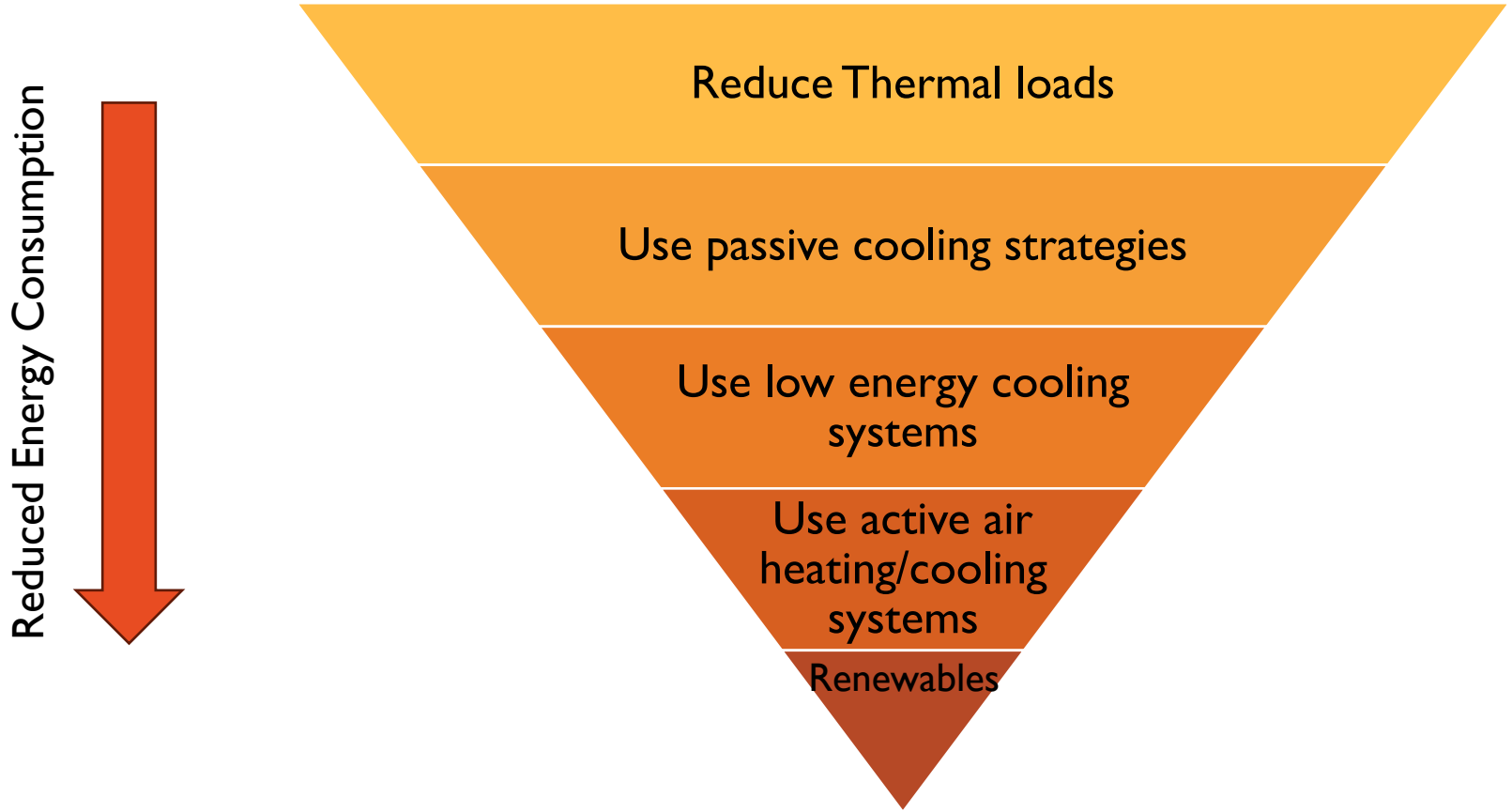


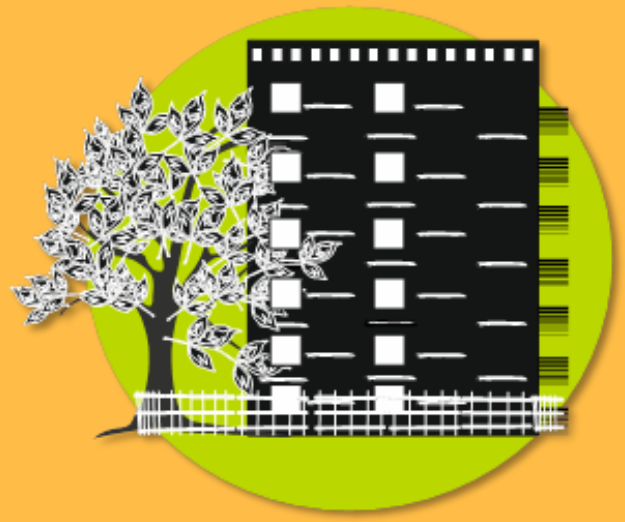
Climate and Sun

>> WAS THE NORM EARLIER
>> BECAME OPTIONAL LATER
>> IS NECESSARY NOW

Climate responsive
Passive design

Steps for climate responsive building design process

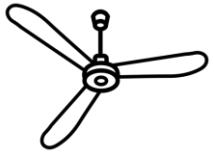




Types of Low Energy Cooling Systems

Ceiling Fans

Ceiling Fan



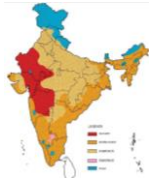
Use appropriate fan number & fan size as per the room size

Sweep size (mm)	Min. Service value (CMM/Watt)
> 1200	4.1
<= 1200	5.0

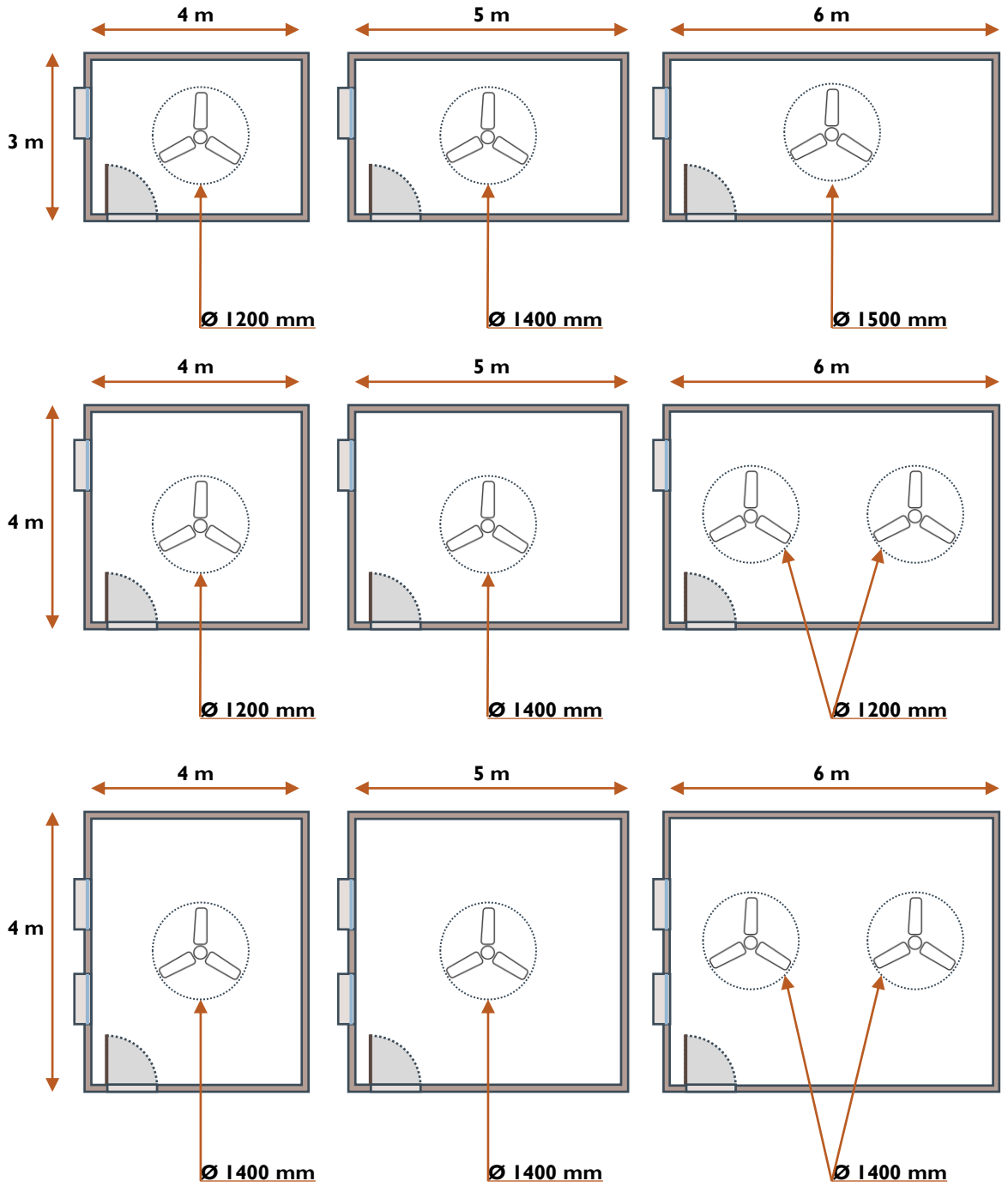
Sweep size (mm)	Min. Service value (CMM/Watt)
> 1200	4.6
<= 1200	5.5

Sweep size (mm)	Min. Service value (CMM/Watt)
> 1200	5.1
<= 1200	6.0

Star Label Requirements for Ceiling Fan. (Validity until December 31, 2024)

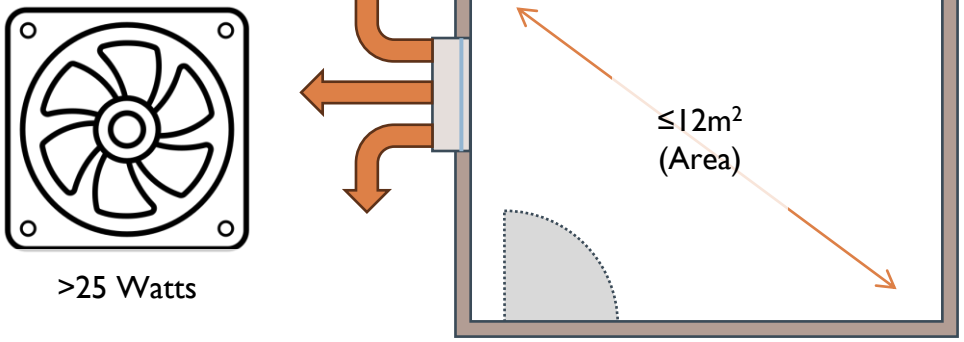


Applicable to all climate types

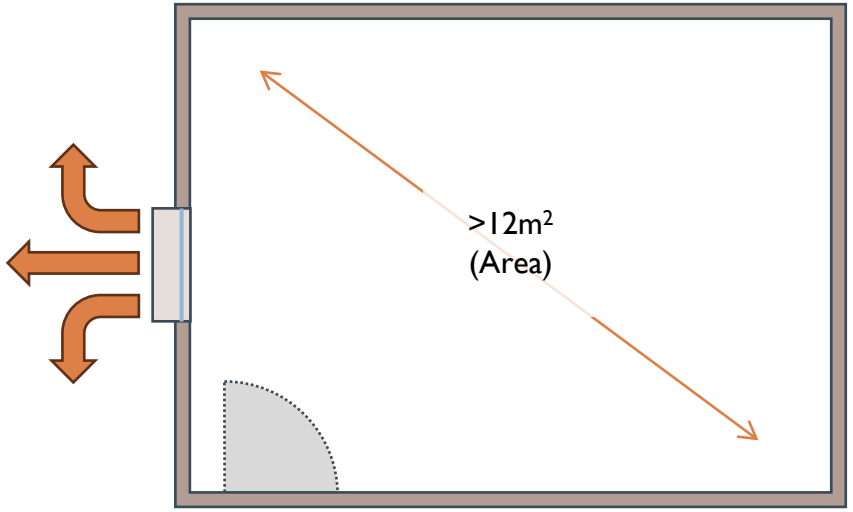


Exhaust Fans

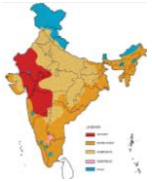
All kitchen, bath and lavatory spaces must maintain minimum ventilation to maintain health and hygiene. These spaces shall have provision to directly exhaust air outside.



>25 Watts



≥6 ACH



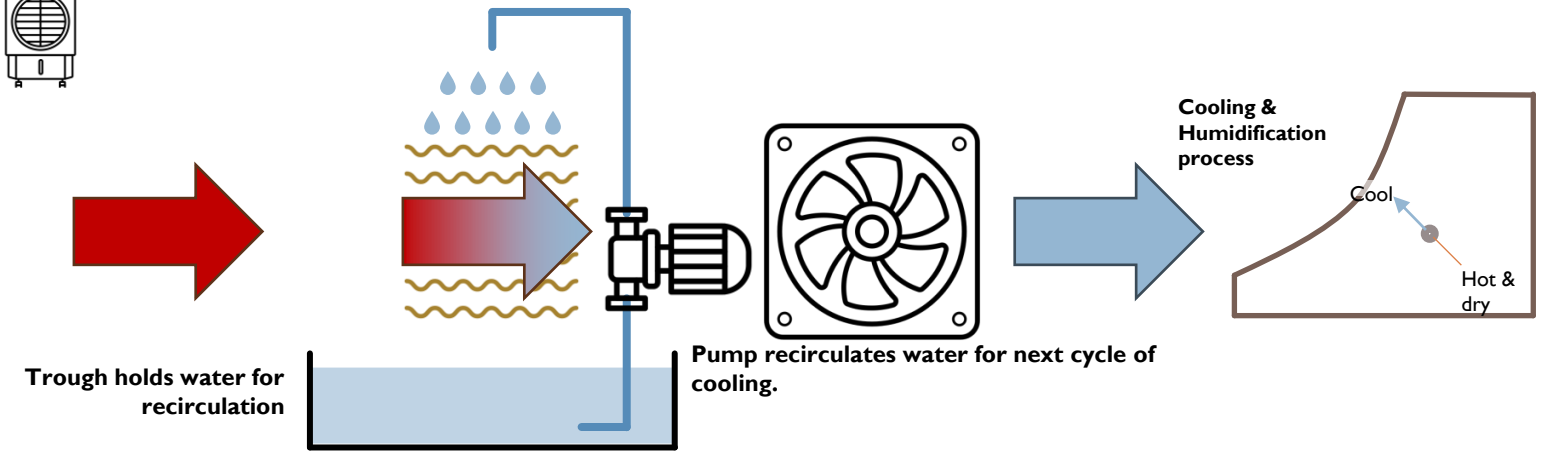
Applicable to all climate types

Desert Coolers

1 Hot air passes over wet filter media

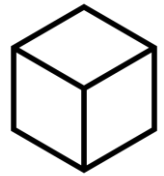
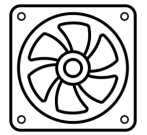
2 Hot-air loses heat to water and cools down

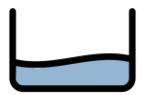
3 Cooled air delivered indoors via fan



Hot & Dry

Composite



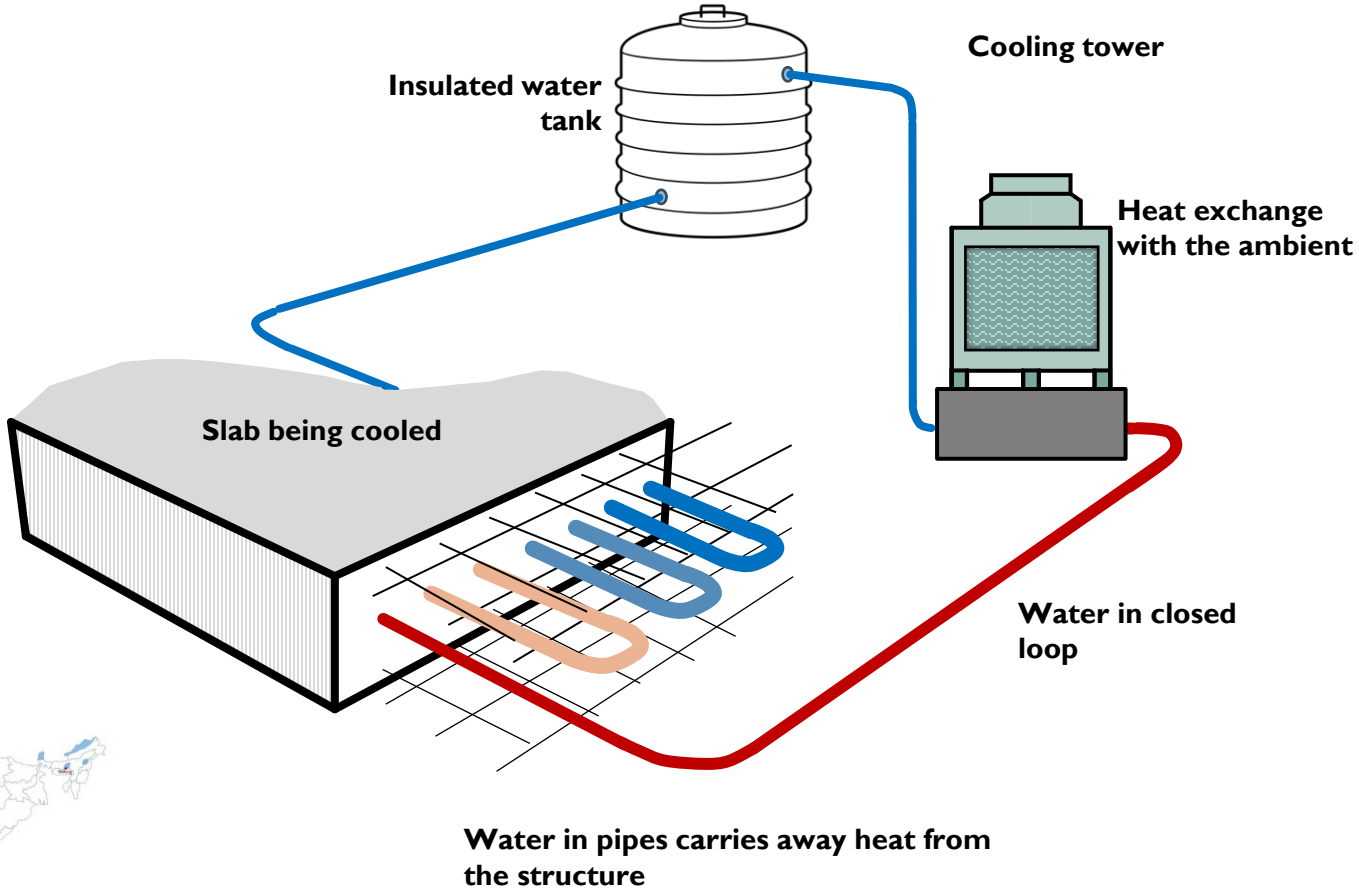

Space Volume (m^3)	Fan Dia (mm)	Cooling Pad Area (m^2)	Water Tank (litres)	Cooling Capacity (Tons)
30-50	300	1.3	40	1.0
40-60	400	1.9	60	1.2
80-120	450	2.1	80	2.0

Source: SP-41
(Subject to revision as per Star labelling requirements for desert cooler)

$$Cooling\ efficency = \frac{T_{db} - T'_{db}}{T_{db} - T_{wb}} \times 100$$

Structure Cooling System

- Building Thermal Mass: Utilizes the building's heavy thermal mass.
- Cooling Network: Embeds a network of cooling pipes within the structure.
- Heat Absorption: The pipes carry cool water to absorb and dissipate heat.
- Heat Discharge: Expels heat outside, often to a cooling tower.
- Continuous Operation: Maintains a closed-loop system for continuous heat/coolth removal.



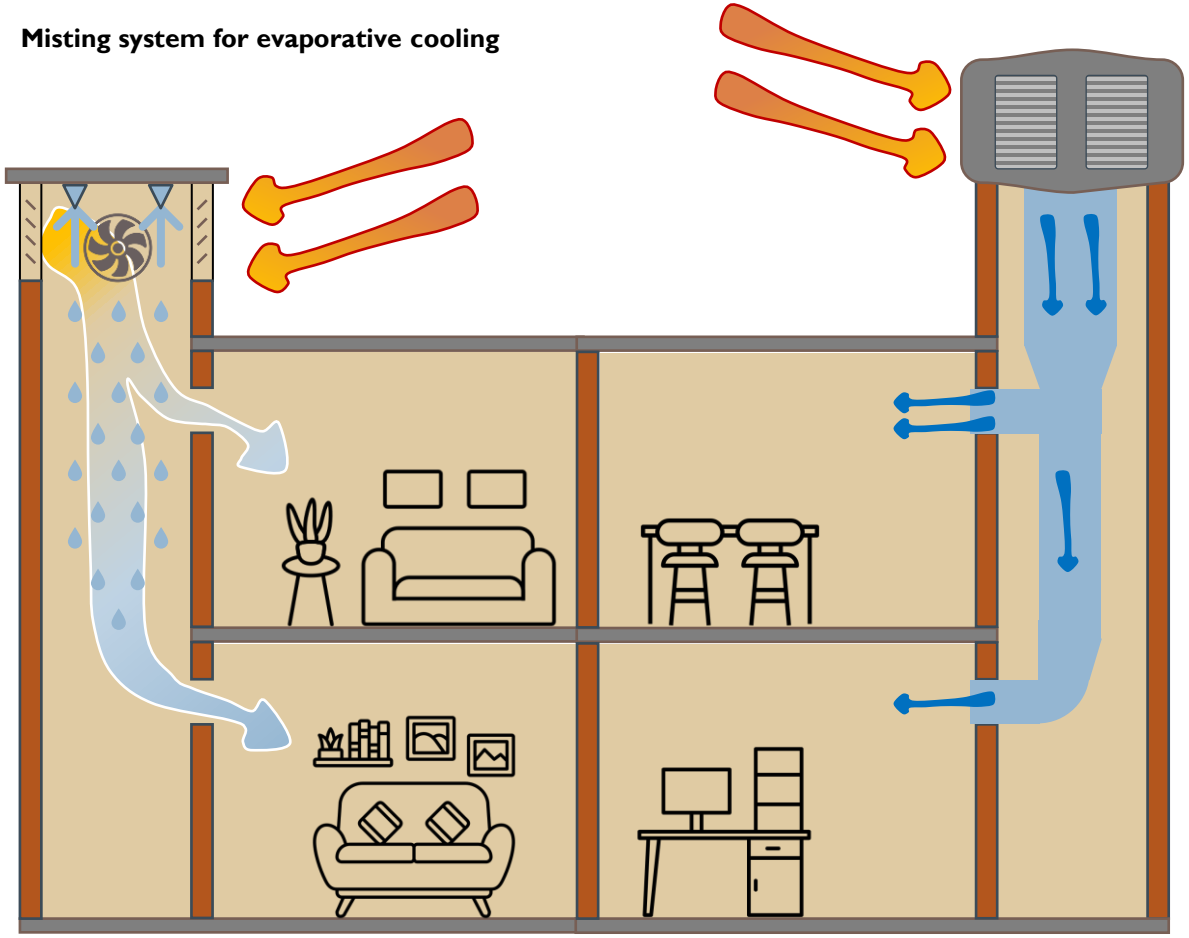
Downdraught systems

- Vertical Ventilation Shafts: Intake hot-dry air from the top.
- Evaporative Cooling: Cools incoming air.
- Denser, Cooler Air: Air with added humidity sinks down.
- Enhanced Ventilation: Utilizes downward draught for cooling and improved ventilation.
- Ideal for Hot-Dry Conditions: Particularly effective in such climates.

Hot & Dry

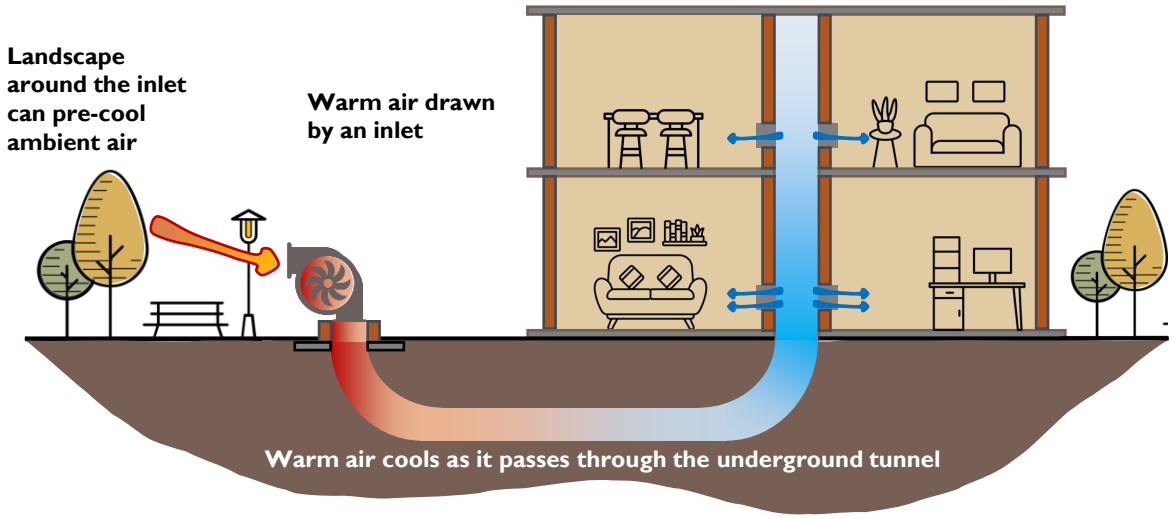
Composite

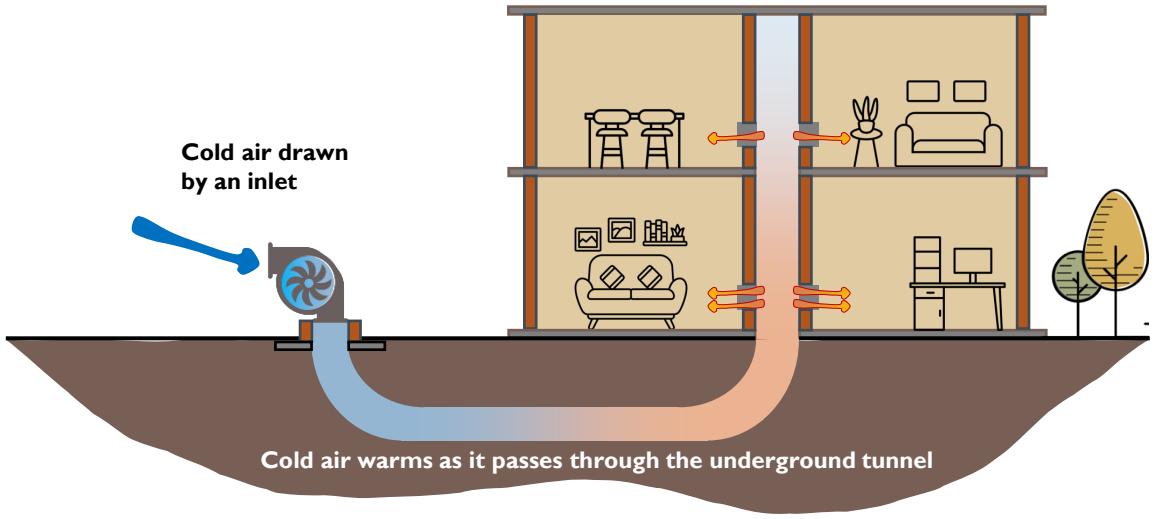
Misting system for evaporative cooling

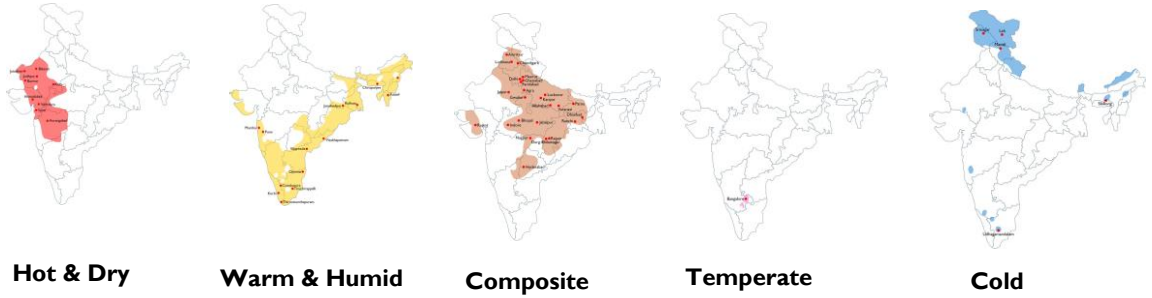


Evaporative cooler with ducted supply system

Earth-to-air heat exchange







Summer Operation: Hot air is cooled in underground tunnels and circulated indoors for cooling.

Winter Operation: Cold air is pre-heated in tunnels by absorbing heat from the earth to reduce heating system load.

Geo-thermal heat-pump coupled with radiant heating

Geothermal heat-pump system has three parts: ground loop, heat pump, and embedded hot-water distribution.

Offers energy-efficient heating and passive geothermal heating.

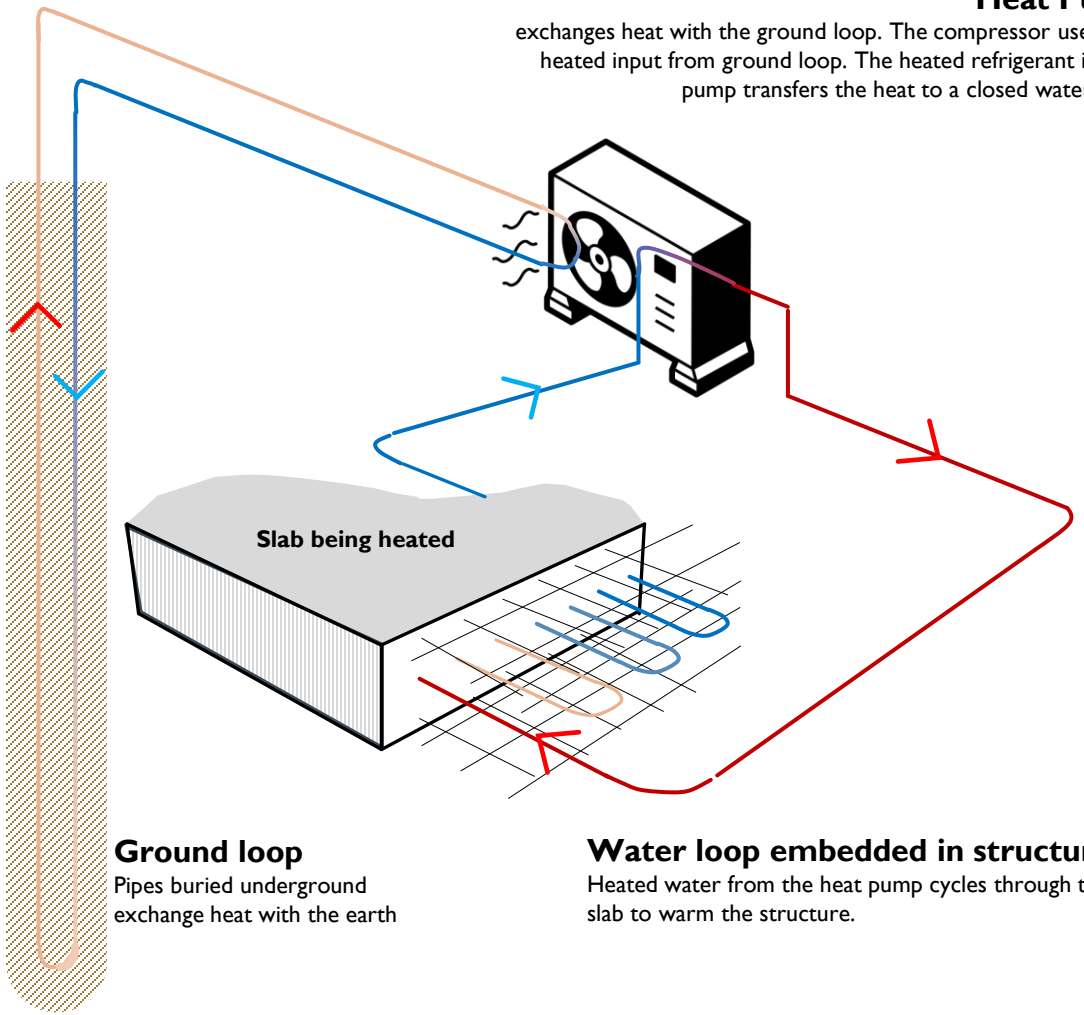
Pre-heated ground loop water reduces heat pump load.

Efficient heat distribution via a lower-temperature radiant slab.

Pipes can be placed vertically or horizontally (slinky) up to 2m deep.

Composite

Cold



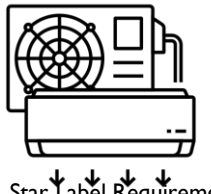
Star Labelling

Star labeling is important because it:

- Helps consumers compare energy efficiency.
- Reduces environmental impact.
- Drives market transformation.
- Saves consumers money through lower energy bills.

Hot & Dry | Warm & Humid | Composite | Temperate | Cold

Split-type Air Conditioner (Variable Speed)

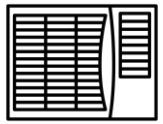


Cooling Watts	ISEER
<10,465	5.0

Default temperature setting of 24°C

Star Label Requirements for 5 Star Air Cooled Chiller (Validity until December 31, 2023)

Unitary-type Air Conditioner (Variable Speed)

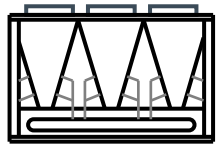


Cooling Watts	ISEER
<10,465	3.5

Default temperature setting of 24°C

Star Label Requirements for 5 Star Air Cooled Chiller (Validity until December 31, 2023)

Air Cooled Chiller

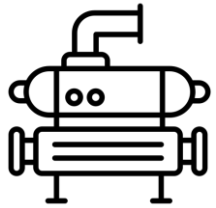


Cooling kW	Min COP*	ISEER
<260	2.4	4.4
>=260	2.6	4.7

Star Label Requirements for 5 Star Air Cooled Chiller (Validity until December 31, 2025)

*Minimum COP for Air Cooled Condenser (for 100% load)

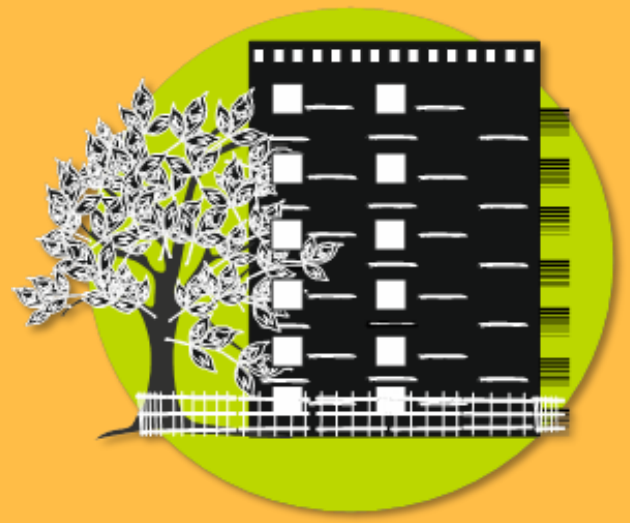
Water Cooled Chiller



Cooling kW	Min COP*	ISEER
<260	4.2	6.6
<530	4.7	7.4
<1050	5.0	8.2
<1580	5.2	8.7
>=1580	5.6	9.0

Star Label Requirements for 5 Star Water Cooled Chiller (Validity until December 31, 2025)

*Minimum COP for Water Cooled Condenser (for 100% load)



Thanks!