HVAC FOR ALL

Beginner friendly

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TOPIC

1. HVAC Introduction
2. Psychrometry
3. Cooling load & calculation
4. Distribution in systems
5. Equipments
6. Systems
7. Controls
8. Application

Engineering - Definition

It is science combined with Mathematics

Water will boil at 100°C at atmospheric pressure of 1 bar

Weight of the air = 1bar

At higher altitudes, air pressure drops, so water boils at a lower temperature.

Pressure ↓ = Water boiling point ↓

HVAC = comfort for living, comfort for systems

The following factors affect our comfort:

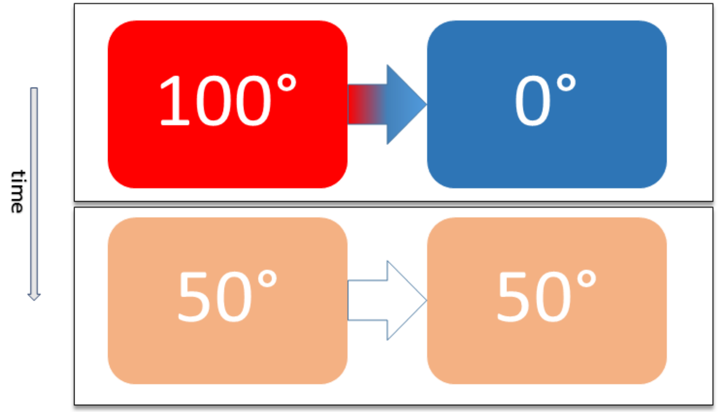
1. Temperature
2. Humidity
3. Air flow
4. Fresh Air
5. Clean Air
6. Noise Level

Heat & Heat transfer are the key concept for creating comfort

Heat is a form of energy.

Heat flows from hot → cold.

When two bodies reach the same temperature, heat transfer stops (Thermal Equilibrium).



Methods of Heat Transfer:

Conduction → through solids

Convection → through liquids & gases

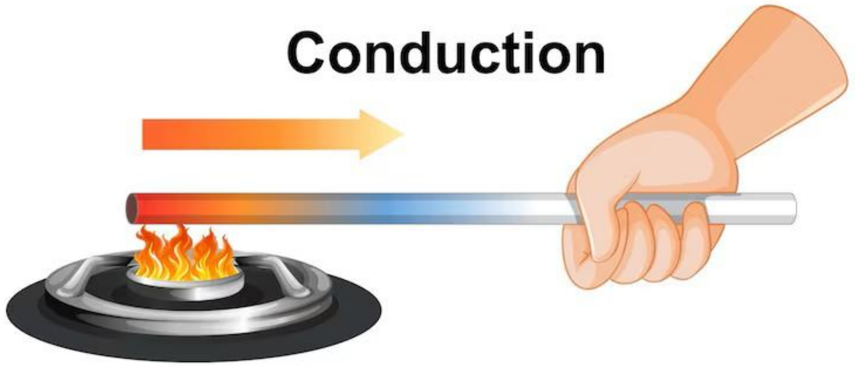
Radiation → needs no medium

Conduction:

Occurs only in solids.

Particles vibrate and pass energy to the neighboring particles.

Heat flows through solids with no visible movement.



Convection:

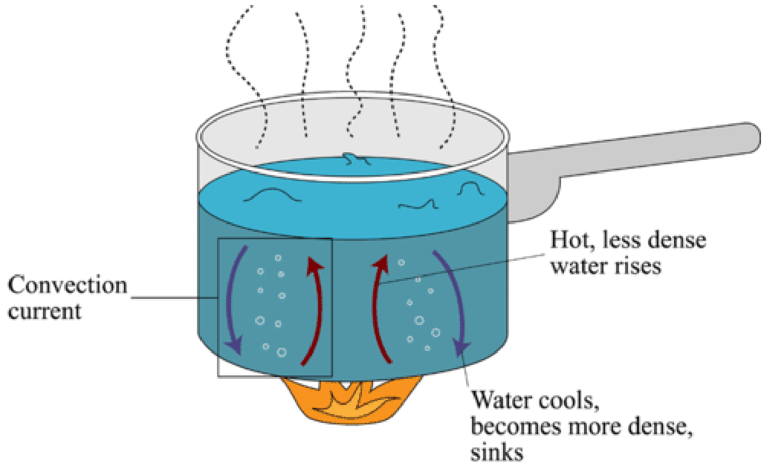
Occurs in liquids & gases.

Illustration; Pour water in a pot, apply heat. When the water at the bottom of the pot is heated it expands.

The heated/expanded water becomes less dense than the surrounding water and rises to the top of the pot.

Water at the top of the pot is less dense and therefore sinks.

This differences in the densities of water creates a convection current.



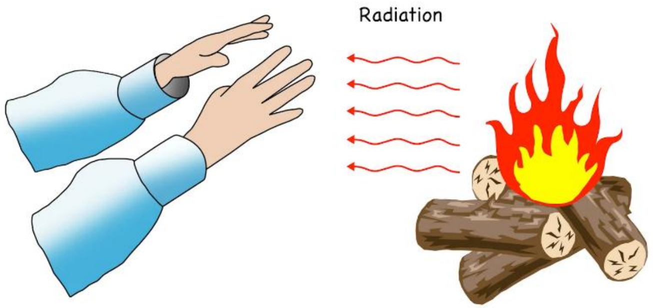
Radiation:

Needs no medium. Can occur in a vacuum.

Transfers heat via electromagnetic waves (infrared).

All objects emit & absorb heat.

Dull/dark surfaces radiate better than shiny ones.



Total Heat/Enthalpy:

Sensible Heat

Latent Heat

Total Heat = Sensible heat + Latent Heat.

Sensible Heat:

The heat that,

Changes the temperature of a substance without changing the state/phase of the substance.
It is Heat that can be *sensed. Can be measured with a dry bulb thermometer*

Boiled water = Sensible Heat only (temperature change).

Latent Heat:

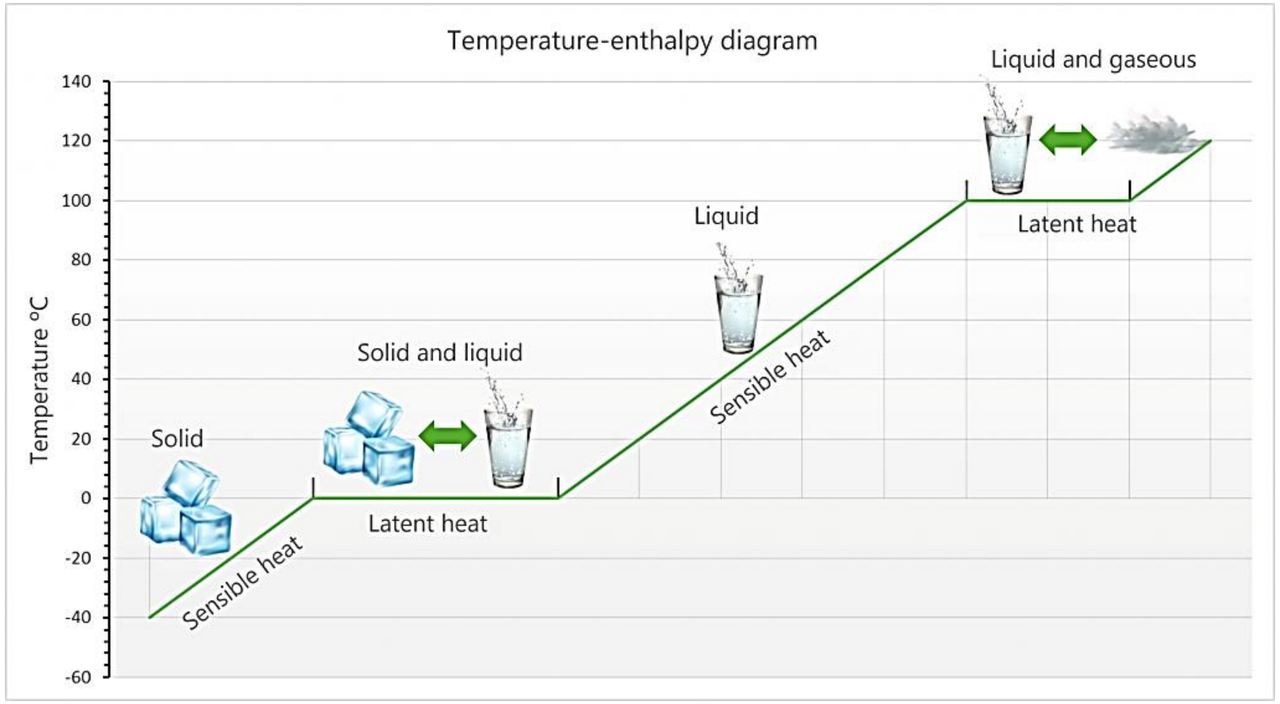
The heat that,

Changes the state/phase of a substance without changing the temperature of the substance.

It is a hidden heat.

When boiling water becomes steam, the temperature during boiling stays about the same, but water changes form.

Energy is being used “hiddenly” for the phase change.



Therefore, Steam is hotter than boiled water because it is the

Total heat of Sensible heat and Latent Heat

What is Air Conditioning:

It is the treatment of air by controlling:

- Temperature.

- Humidity.

- Air flow and

- Air quality in a conditioned space.

Why do we need air conditioning?

There are two main purposes

1. Comfort: Control temperature & humidity for people. Create a comfortable and healthy environment for human occupancy.

2. Process: Control temperature & humidity for things or products. Maintain precise conditions for equipment, manufacturing or storage.

Comfort Air Condition

Temperature (22°C — 24°C).

Relative Humidity (40 % - 60%).

Good air flow — to maintain even temperature throughout the space.

Fresh Air — As per ASHRAE standards to maintain proper oxygen levels.

Clean Filtered air — free from dust & particles.

Low Noise — Minimize noise to improve human efficiency & comfort.

Heat is Transferred from our body by:-

- Conduction
- Convection
- Radiation
- Evaporation

Parameter	Value
Human Body Temperature	37°C
Delta T (ΔT)	10°C
Required Room Temperature	37 - 10 = 27°C

A Partition Wall is an unconditioned interior wall separating conditioned and unconditioned spaces.

Heat always travels from HOT → COLD.

If we have 2 space – a room and a toilet. Temperature in the toilet is 30°C and room is 23°C.

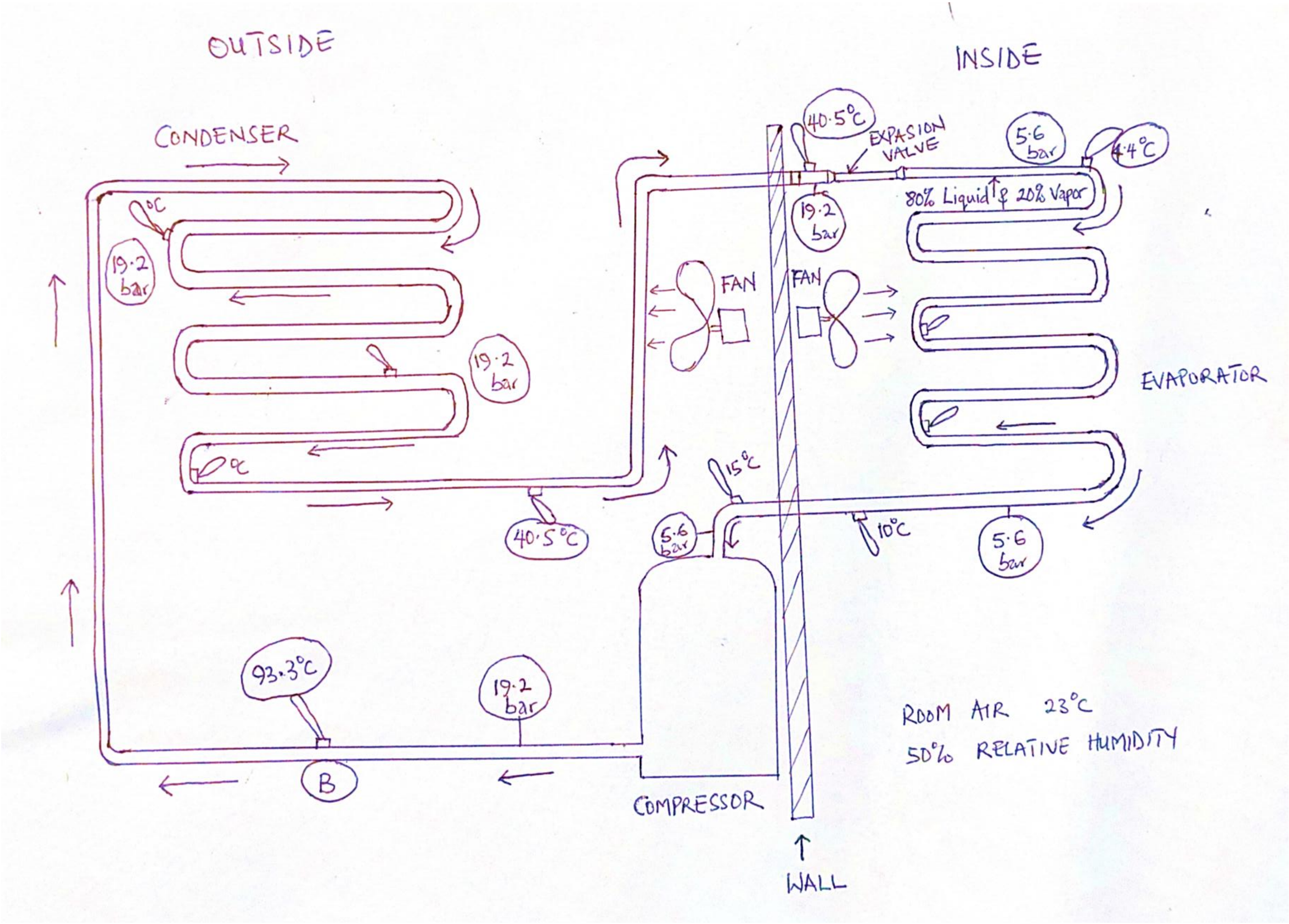
Heat transfers through the partition wall into the 23°C conditioned room.

This means the air conditioning system have to work harder to maintain the 23°C room temperature.

Type of Air Conditioning System

1. Window type air conditioning
2. Decorative Split AC units
3. Ducted type Split AC units
4. Packaged AC units
5. Chilled Water Air Conditioning System
6. District Cooling Air Conditioning System

Inside a typical Air Conditioning system



REFRGERANT	BOILING POINT AT ATMOSPHERIC PRESSURE	High Side		Low Side	
		Working Pressure (High Side)	Boiling Point	Working Pressure (High Side)	Boiling Point
WATER	100°C				
HFC – 134A	- 26.1°C	12.28 bar	48.8°C	3.4 bar	4.0°C
HCFC – 22	- 40.5°C	19.2 bar	49.5°C	5.6 bar	4.0°C
	- 52.2°C	21.6 bar	48.8°C	6.4 bar	4.0°C

Air Cooled Vs Water Cooled Chillers

Air Cooled Chiller (cools refrigerant using air)

Advantages:

- Lower installed cost
- Quicker availability
- No cooling tower or condenser pumps required
- Less maintenance
- No mechanical room required
- Best for applications up to 3517 kWt

Water Cooled Chiller (cools refrigerant using water)

Advantages:

- Higher efficiency
- Custom selections in larger sizes
- Large kw capabilities
- Indoor chiller location
- Longer life
- Best for applications up to 123000 kWt

District Cooling System

A centralized cooling system that supplies chilled water to multiple buildings in a district/area — like how electricity is supplied to homes and buildings.

Works like electricity supply — produced centrally & distributed.

All buildings in one area connected to one central plant.

Chilled water distributed via underground insulated pipes.

Cooling Load Calculation / Heat Gain Calculation

~~It's not Heat Load Calculation~~

Estimated - Heat generated by people

Level of activity	Sensible heat gain	Latent heat gain
Moderately active work (Office)	75W	55W
Standing light work or walking (Store)	75W	55W
Light bench work (Factory)	80W	140W
Heavy work (Factory)	170W	255W
Athletics (Gymnasium/Auditorium/stage)	210W	315W

Cooling Load Components:

Cooling Load Components	Sensible Load	Latent Load	Space Load	Coil Load
Conduction through roof, walls, window and sunlights	Yes	-	Y	Y
Solar radiation through window, skylights	Y	-	Y	Y
Conduction through ceiling interior partition wall and floor	Y	-	Y	Y
People	Y	Y	Y	Y
Lights	Y		Y	Y
Equipments/appliances	Y	Y	Y	Y
Infiltration	Y	Y	Y	Y
Ventilation	Y	Y	-	Y
System heat gains	Y	-	-	Y

Cooling Load Calculations

<u>Parameters to consider:</u>

External dimension.

Glass Area.

Net wall area.

Net ceiling and floor area.

Transmission coefficients (U-Factors).

Structural weight and colors.

Occupancy.

Internal loads.

Essential knowledge before starting an HVAC installation

Building

Architect
[Creator of the Building]

Structural Engineer
[Strength Provider of the building]

MEP Engineer
[Life given to the building]

Architect

Responsible for the overall building design.

Decides building facade, shape, appearance Internal layout, spaces & aesthetics.

Structural Engineer

Provides structural integrity to the building.

Ensures building can withstand loads & forces, Horizontal members that carry floor & roof loads (beams),

Vertical members that transfer loads to foundation (columns).

MEP Engineer

Mechanical, Electrical & Plumbing (MEP) Engineer. Ensures building comfort and safety by coordinating with architectural and structural teams.

M

- HVAC
- Fire fighting

E

- Lighting
- Fire alarm
- Power
- Containment

P

- Domestic water system
- Drainage system

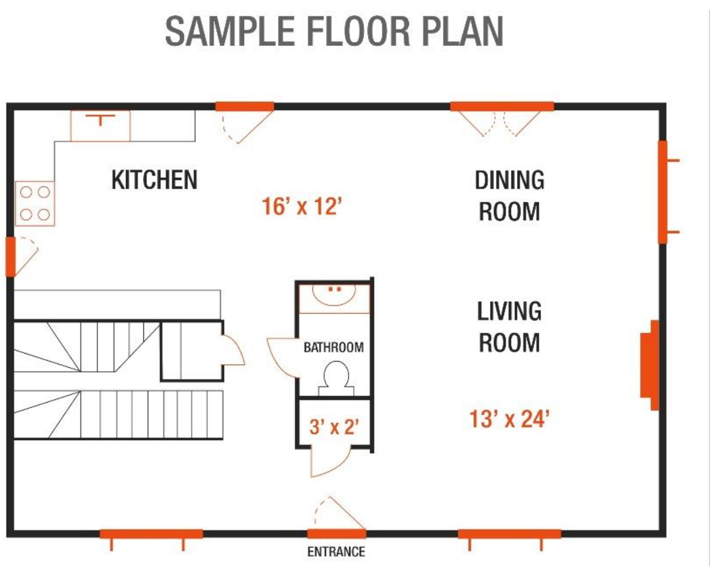
ARCHITECTURAL DRAWINGS

Architectural Drawings. These include floor plans, sectional and elevational drawings, window details, and reflected ceiling plans (RCP).

Floor plan drawings:

A top-view projection of each building floor, provided by the architect.

Key areas to review as an engineer:



North Orientation – Identify north first, then determine south, east, and west for accurate exposure load calculations.

Building Grids – Help locate rooms; grid spacing is consistent across all floors.

AC Zones – HVAC engineer decides which rooms are air-conditioned and which are left unconditioned.

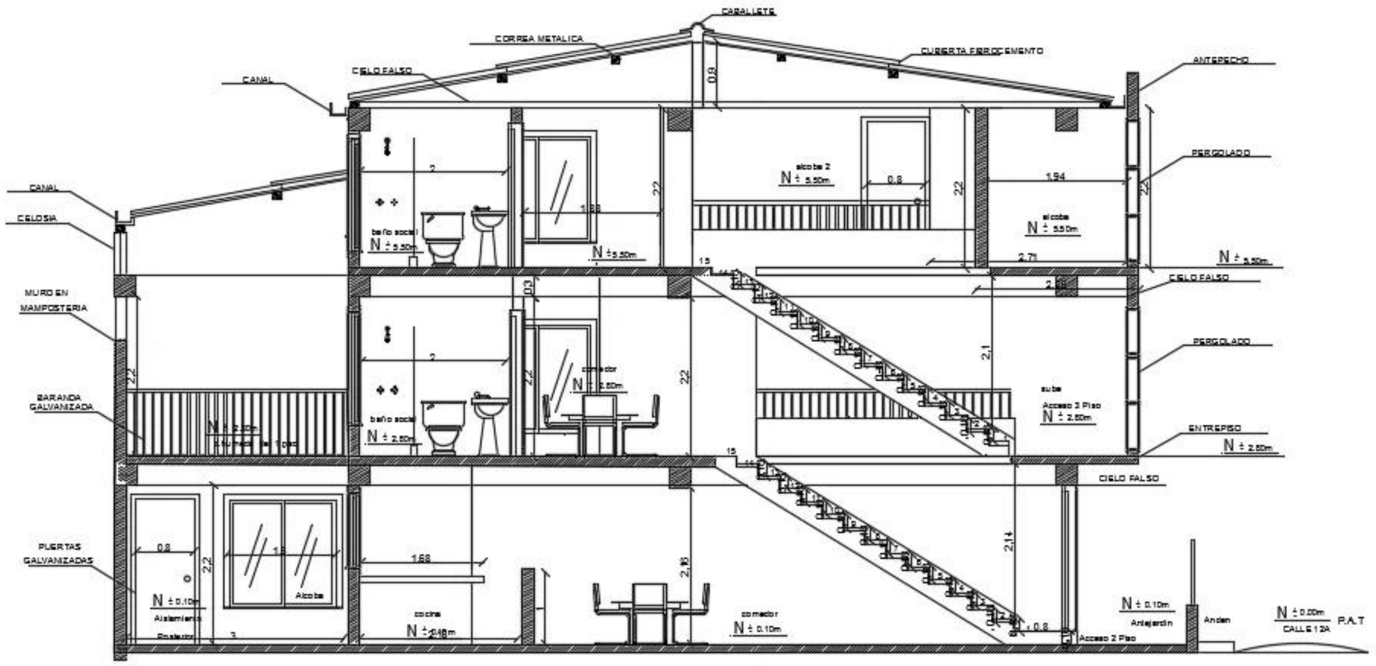
Sectional Marks – Referenced from the floor plan drawings.

SSL & FFL – SSL = Structural Slab Level; FFL = Finished Floor Level.

Glass/Windows – Identify windows on exposed walls subject to solar radiation.

<u>Sectional drawing</u>:

Sectional drawings are based on sectional marks from the floor plan.
The architect projects the side view within the marked range, showing room heights, ceiling heights, and void spaces.
The level of detail shown depends on the sectional mark indicated in the floor plan.



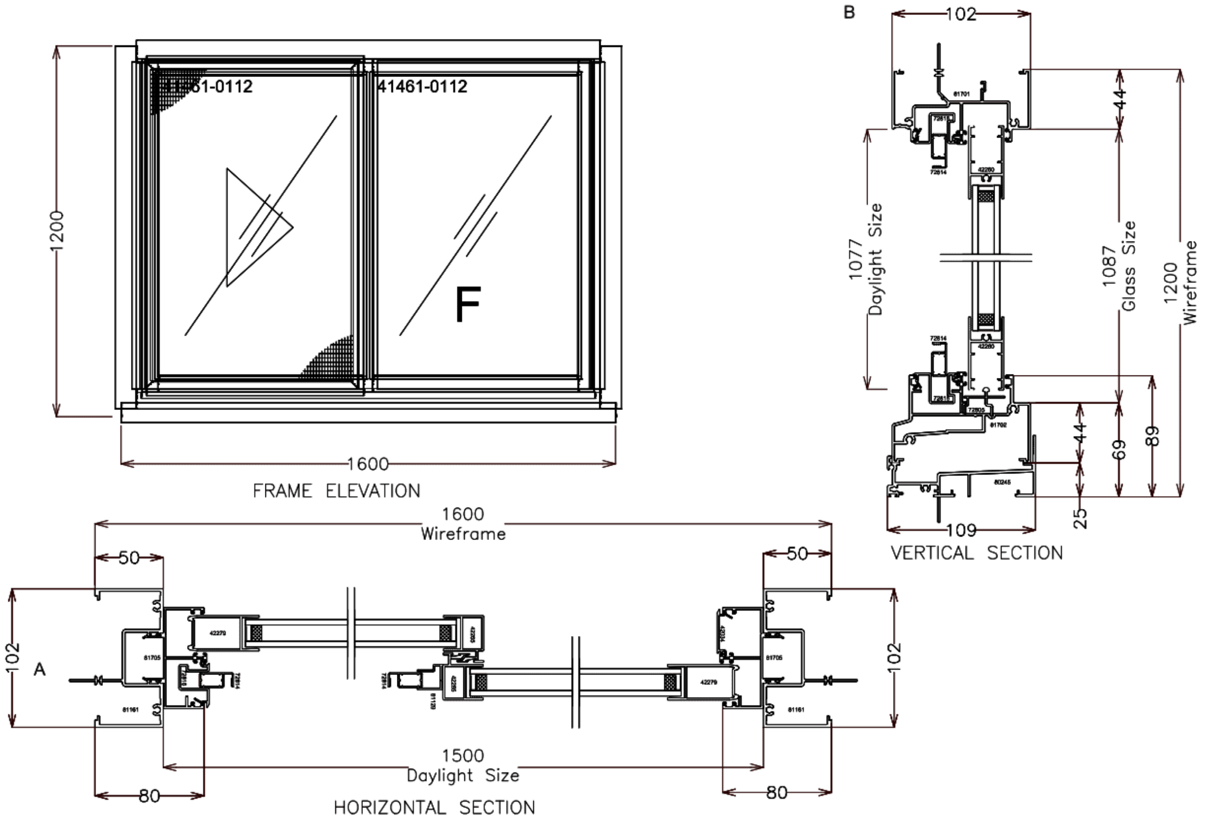
Elevation drawing:

A front-view projection of the building — like what you'd see standing in real life.
It can be either interior or exterior and is used to understand the building's exterior appearance and identify glass/windows exposed to solar radiation.

Window Detail Drawing:

Provided by the architect to give clear details on all glass, windows, and doors in the building.

For HVAC, the design engineer uses these details to calculate solar radiation load.

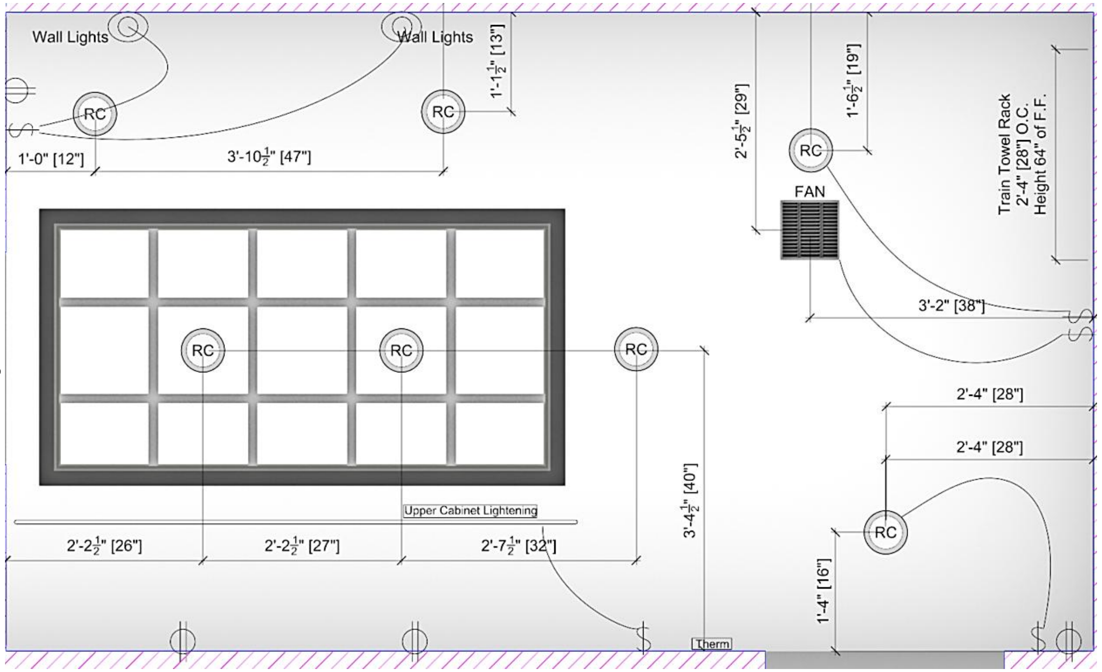


<u>RCP (Reflected Ceiling Plan) Drawing</u>:

Provided by the architect to show the ceiling layout of each room/floor.

Key information extracted:

Type of false ceiling.
Ceiling height (e.g., 2.8m AFFL – Above Finished Floor Level).
Ceiling exposed and non-ceiling areas.
Void space calculations.
Air terminal placement and selection.



The HVAC design engineer selects and positions air terminals (grilles and diffusers) based on the RCP layout, coordinating with other ceiling fixtures such as sprinklers and detectors.

Structural Drawings:

Structural drawings translate the architect's concept into precise specifications for constructing the building on site.

Key information an HVAC engineer extracts:

Slab and beam openings, beam locations and schedule, SSL levels, structural sections, and slab thickness.

Three Types of Ceiling Height (from Structural Drawings)

Floor Height = L01 Floor SSL – L02 Floor SSL.

Ceiling Height = BOFL (Bottom of Floor Level) – FFL.

Clear Height = FFL – BOF/C (Bottom of False Ceiling).

AIR TERMINAL (Diffusers)

#	Type	Airflow	Typical Space
1	SLSD – Supply Linear Slot Diffuser	Vertical	Office room
2	SLBG – Supply Linear Bar Grille	Horizontal	Corridor
3	SCD/SD – Supply Ceiling/Square Diffuser	Vertical	Kitchen, Lobby
4	SG – Grilles & Register	Horizontal	Plant room
5	Disc Valve – Round shape	Vertical	Toilet
6	Jet Nozzle	Horizontal	High ceiling spaces
7	Flow Bar Diffuser	Vertical	—

SCD/SD Notes:

Max Face Velocity: 2.5 m/s
Noise Criteria: <25 NC (Office) / <30 NC (Kitchen & Cleaner)

Space diffusion

A critical aspect of HVAC design where branch duct sizes depend on the type of air terminal selected.

<u>Key Points:</u>

Minimum Clearance – 50mm to be maintained between two connecting ducts.

Diffuser Selection – Air terminal selection is based purely on the architect's ceiling type, ensuring: No aesthetic impact & Smooth air flow distribution.

Neck Size – Only the neck size should be considered when connecting to the main duct.

Square Ceiling Diffusers

Square Ceiling Diffusers Suitable for Vertical Throw

Standard Sizes (mm)

150 x 150

225 x 225

300 x 300

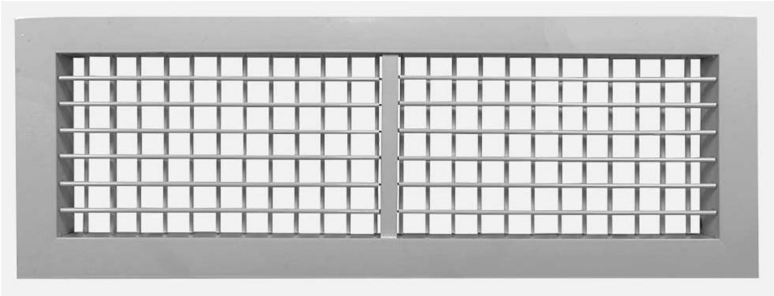
450 x 450

500 x 500

625 x 625

Linear Bar Grille Suitable for Horizontal Throw

Supply Grille and Registers (Horizontal throw)



Supply Grille and Registers Suitable for Horizontal Throw.
Standard sizes available and to be selected as per the diffuser catalogue.

Linear Slot Diffuser Suitable for Vertical Throw

Key Selection Criteria:

Number of Slots – Selected based on airflow while considering NC (Noise Criteria) level.
Slot Limitation – Maximum 2 slots, not more than 3 slots, to maintain aesthetic appearance.

Flow Bars

Flow Bars Suitable for Vertical Throw.
Compatible with both Horizontal and Vertical Throw.
Only recommended in high ceiling areas (ceiling height > 8 meters).

Circular/Jet Diffusers Suitable for Vertical Throw.
Aesthetically appealing.
Recommended in both ceiling and non-ceiling areas.
Ideal where aesthetic clarity is required.

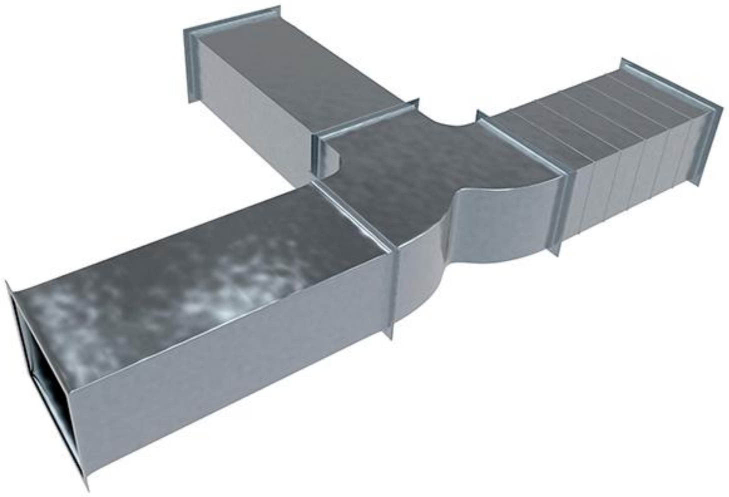
Disc Valve Suitable for Vertical Suction.
Used predominantly for Toilet Extract as diffusers.

Duct Design

A duct is an air transport medium for carrying air from one place to another.

Factors to be Considered for Duct Design:

#	Factor
1	Space Availability
2	Balancing
3	Space Diffuser
4	Duct Heat Gain
5	Duct Leakage
6	Operating Cost
7	Initial Investment Cost
8	Noise & Vibration
9	Fire & Smoke Control



Duct Sizing: Ducts are sized based on friction loss / pressure loss with the following parameters:

Parameter	Value
Friction Loss	0.5 Pa/m to 0.6 Pa/m
Duct Velocity	2.5 m/s to 8 m/s
Duct Aspect Ratio	1:1 to 1:4 *(must be strictly followed)*
Clearance (Top & Bottom)	100mm *(for duct support)*

Space Availability *(Major Factor)*

Reference	Drawing Source
SSL Level	Structural Drawing
FFL	Floor Plan Drawing
Ceiling Height	RCP Drawing

Duct Thickness is based on the pressure of the duct system

Note:
Space availability is the major factor in duct sizing.
Aspect ratio of 1:1 to 1:4 must be strictly followed.
100mm clearance recommended on both top and bottom of duct for support purposes.

DUCTING STANDARDS

DW Standard
DW144
DW171 – Fire Rated & Ventilation Ducts

SMACNA
Sheet Metal Air Conditioning Contractors' National Association

DUCTING CLASSIFICATION

S.NO.	Type of Duct	Static Pressure Limit (Pa)		Velocity(m/s)
		+ (Discharge)	- (Suction)	
1.	Class A (Low Pressure Duct)	500	500	10
2.	Class B (Medium Pressure Duct)	1000	750	20
3.	Class C (High Pressure Duct)	2000	750	40

Duct heat gain

Duct Heat Gain - Insulation is provided to prevent heat entering the duct.

Insulation Materials (Density: 45 kg/m^3)

- Fibre Glass
- Rock Wool
- Phenolic Foam

Insulation Thickness

Type	Thickness	Application
Internal	25mm	Ducts in void/above conditioned space
External	50mm	Ducts exposed outside

Duct Leakage – Vapour Barrier Coating to prevent insulation breakage:

- Aluminum Foil Tape
- Galvatite Paint
- Glass Tissue

Duct Air Velocities

Location	Velocity (m/s)
Primary Duct in Plant Areas	6 – 9
Primary Risers	6 – 9
Secondary Horizontal Distribution	5
Stairwell Pressurization Risers	10
Car Park Extract and Supply Air	6 – 9
Smoke Extract Riser	10
Kitchen Extract	8 – 9 *(min. 8 m/s to avoid sedimentation)*
Main Ductwork at FCUs	3 – 4
Branch Ductwork at FCUs	3 – 4
Terminal Branches	2.5

SMACNA – Duct Materials

Material	Applications	Advantages	Limitations	Remarks
Galvanized Steel	Most air handling systems	Strong, rigid, durable, rust resistant, weldable	Heavy, poor corrosion resistance above 200°C	Widely used; can be painted
Carbon Steel (Black Iron)	Breeching, flues, stacks, high temp & kitchen systems	Strong, rigid, non-porous, paintable	Heavy, poor corrosion resistance	Used when no minimum content specified
Stainless Steel	Kitchen exhaust, moisture & fume exhaust	High corrosion resistance, high polish	Costly, difficult to work, limited availability	Various alloys available
Aluminium	Moisture laden air (salt free), louvres, ornamental	Lightweight, moisture corrosion resistant	Low strength, costly, difficult to weld, high thermal expansion	Various alloys available
PVC	Exhaust systems, underground ducts	Corrosion resistant, lightweight, easily modified	Costly, thermal shock issues, code acceptance	—
Fabric (Polyester)	Food, warehousing, retail, sports, offices	Lightweight, low cost, easy install, low noise, no condensation	Non-rigid, unsuitable for fire ductwork, damage during replacement	—

Pre-Insulated Duct *(Cost effective – Most recommended for offices)*
- Polyurethane foam insulation – 20mm thickness.
- Faced on both sides with Aluminium foil.
- Lightweight & easy to install.
- Not recommended in HOT zones.
- Durability is a major concern.

Flexible Duct *(Max. length – 1 meter)*
Material: Polyvinyl Aluminate.
Used to connect branch duct to plenum box of air terminals.

Size & Airflow Capacity:

Diameter	Airflow Range
DIA 150	1 – 40 L/S
DIA 200	1 – 80 L/S
DIA 250	1 – 120 L/S

Duct Sizing Methods
Friction Loss Method
Velocity Method

Types of Duct
Rectangular
Circular
100mm clearance required when two duct branches pass each other

Duct Accessories

Accessory	Description
VCD	Volume Control Damper
FD	Fire Damper

FD Types:
- MSD – Multi Smoke Damper
- MD – Motorized Damper *(Used for Fire Control)*

Volume Control Damper (VCD)
Used to control air volume inside ductwork — *Manual control only*

VCD Positions

- ¼ Open
- ¾ Open
- Fully Open
- Shut

Clearance Requirement 80–100mm clearance between ducting & VCD

Types of VCD

Type	Recommendation
Parallel Blade VCD	Less preferred
Opposed Blade VCD	Recommended

Noise & Vibration Control

Noise
HVAC is one of the major sources of interior noise
Equipment must be carefully selected and spaces properly designed
Goal: Maintain acceptable sound levels in:

- Occupied spaces
- Surrounding community

Vibration

- HVAC operation causes mechanical vibration
- Propagates through structure-borne paths:
  - Piping
  - Ductwork
  - Mounts
- Can cause:
  - Direct discomfort
  - Secondary noise from vibrating walls, floors & piping

<u>Noise Control in Fan Coil Unit (FCU)</u>

Acoustic Lining

- Provided inside ductwork to reduce fan noise transmission
- Material: Fiber Glass or Rockwool
- Thickness: 25mm | Density: 48 kg/m³
- Finish: Grey cloth facing
- Coverage: Up to 3 meters from the unit

Key Requirements

Requirement	Detail
Lining Coverage	3m from unit
Thickness	25mm
Density	48 kg/m³

Important Rules

- Duct must not connect directly to FCU — Plenum box is mandatory
- Flexible duct must be connected first at the AHU mouth

AHU Vibration Isolation *(Mounted Above)*
- Neoprene Pad Rubber
- Inertia Base
- Plinth – Prevents floor damage
- FFL *(Finished Floor Level)*

Note for Insulation
- Important on supply conditioned air
- Critical in kitchens due to high condensation
- Internal insulation – Duct inside ceiling
- External insulation – Duct coming from outside

Fire Damper (FD) Rules

Rule	Detail
Curtain FD	Has **fusible link** – melts during fire
Access Panel	**Mandatory** when FD is installed
Fire Rated Duct crossing Fire Rated Wall	**No FD needed**
Motorized FD	**Linked to Fire Alarm**

General Rules
- Relocatable wall height must not exceed ceiling
- Supply air flow direction is decided by furniture position

Noise Control in AHU / FAHU

Sound Attenuator

- Provided on both sides of ductwork: Supply Side & Return Side
- Purpose: Reduce noise transmission from AHU/FAHU fans

Sound Attenuator Sizing

Parameter	Requirement
Size	Equal to or 1.5x the duct size *(Thumb Rule)*
Minimum Length	1.1 meters

Actual size selection must be verified with an Acoustic Engineer

Key Rules

Rule	Detail
Branch Duct	Taken only after the sound attenuator
Sound Attenuator Position	Fitted on both supply & return sides

Note: Sound attenuator sizing provided is a thumb rule only. Always consult an Acoustic Engineer for final selection and verification.

Design Guidelines for HVAC-Related Background Sound in Rooms

Building Type	Room Category	NC Level
Residences & Apartments	Living Areas, Bathrooms, Kitchen, Utility Rooms	30/20
Condominiums	Bathrooms, Kitchen, Utility Rooms	35/25
Hotels/Motels	Individual Rooms or Suites	30/20
	Meeting/Banquet Rooms	30/20
	Corridors & Lobbies	40
	Service/Support Areas	40
Hospitals & Clinics	Patient Rooms	30/20
	General Wards	35/25
	Operating & Procedure Rooms	35/25
	Corridors & Lobbies	40
Churches & Mosques	General Assembly with Critical Music Programs	25
Libraries	—	30/20

Note:
- NC = Noise Criteria
- Lower NC values = Quieter environment required

Fire & Smoke Control

Fire Dampers – Purpose Prevent the spread of flames through ductwork from one part of a building to another.

Fire Damper Ratings:
Typical ratings are 3hr, 1.5hr, 1hr, and less than 1hr, indicating how long the damper maintains integrity when exposed to flames.

Types of Fire & Smoke Dampers
- Curtain Type Fire Damper (FD) – Passive damper using a fusible link that melts during fire.
- Motorized Smoke Fire Damper (MSFD) – Active damper, motor operated and linked to the fire alarm.
- Motorized Smoke Damper (MSD) – Active damper controlling smoke movement, linked to the fire alarm.

Curtain Type Fire Damper (FD)

Usage
- To be used wherever duct passes through a fire rated wall
- Must not be used in fire rated ducts
- Denoted by symbol "FD"

Access Door
- Must be provided wherever curtain type fire dampers are installed
- Purpose: To allow inspection of the fire damper after installation

Sizing
- Fire damper size must be equal to the duct size

Motorized Fire Smoke Dampers (MSFD & MSD)

MSFD – Usage
- To be used wherever duct passes through clean agent rooms

MSD – Usage
- To be used in fire rated ducts

Fire Rated Ducts Duct systems that remain operational during fire. Examples include:
- Car Park Extract
- Car Park Makeup
- Staircase Ducts
- Corridor Smoke Extract
- Corridor Makeup Ducts

Clean Agent System - Also known as Fire Suppression System.
Uses chemical agents to extinguish fire immediately

Rooms Covered by Clean Agent System:
- LV Room
- Server Room
- MV Room
- Main Electrical Room
- Control Room
- FCC Room
- CBS Room *(Central Battery Room)*

Fire Damper Selection Principle

Reference Always refer to Architect Drawings (FLS Drawings) for fire compartmentation details.

Selection Rule
- Curtain Type FD – wherever duct crosses a fire rated wall.
- MSFD – wherever duct crosses a clean agent room.

<u>Applicability</u>
This principle applies to all air conditioning and ventilation system ducts without exception.

HVAC System Design

DX System → Refrigent

Chilled Water System → Water

District Cooling System

Package Unit System

VRF

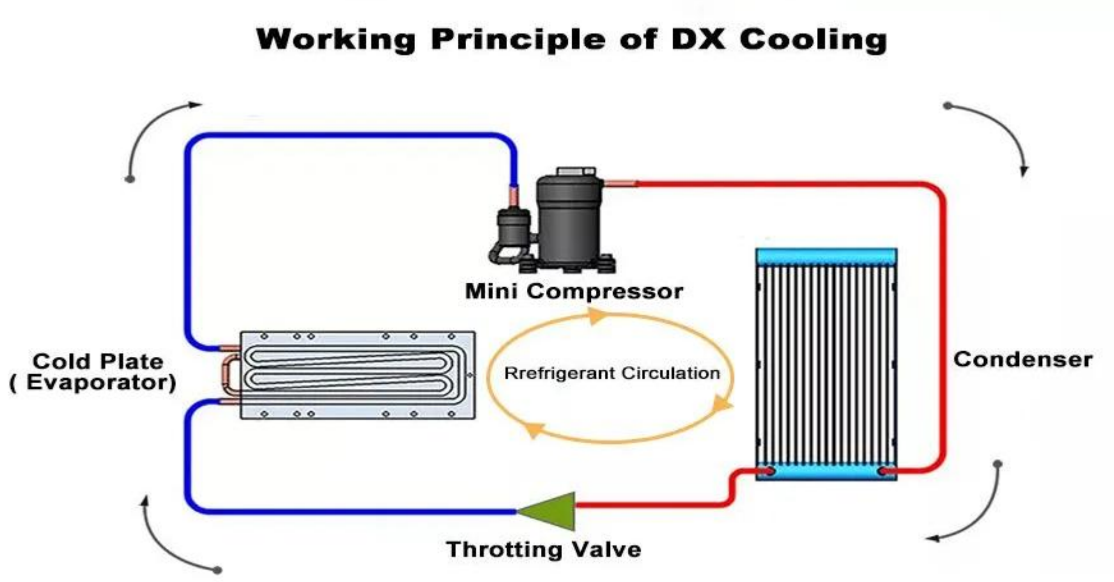
DX System (Direct Expansion)

The Most common type of cooling system.

Components
- Indoor Unit – Evaporator
- Outdoor Unit – Condenser
- Connected by refrigerant piping

Suitable for Small to medium spaces

Examples
- Split ACs
- Split Ducted ACs
- Window ACs



DX System – Key Notes

Power & Heat
- 1 Ton AC consumes 8 KW Power and removes 350 watts of heat
- Total Coil Load = Tonnage

Outdoor Unit
- Used for Phase Change

Drain
- Installed inside the room on the Evaporator
- Helps maintain the Relative Humidity (RH) level

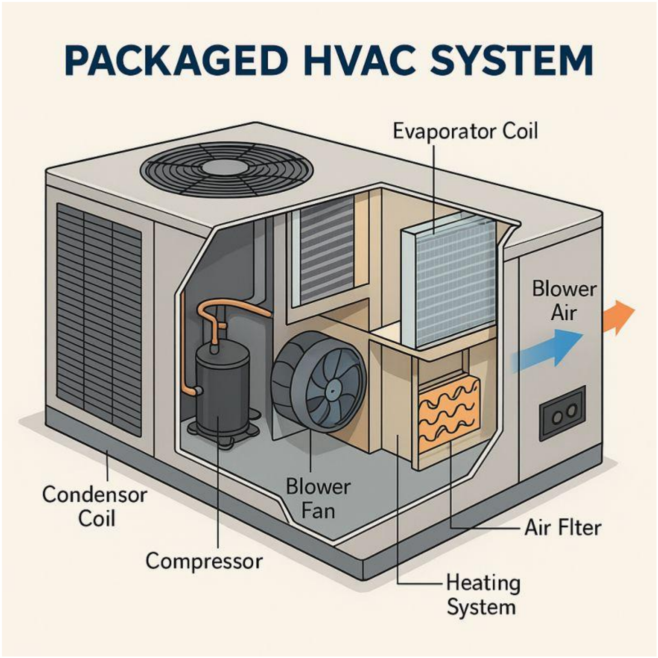
Humidity
- Humidity = amount of moisture in the air
- Good humid air can wipe out human sweat

Chilled Water System

Central chiller plant cools water which is circulated to air handling units, CRAHs, FCUs, and FAHUs in different zones.
Suitable For Large buildings or complexes.
High initial cost but efficient for large-scale cooling

Package Unit System

Overview Self-contained unit with all components housed in one casing.
Installation Installed on rooftops or outdoors.
Suitable For Larger spaces like commercial buildings, Villas, Restaurants etc.
Examples
- Reception Hall
- Auditorium



District Cooling System

Centralized cooling plant that distributes chilled water to multiple buildings in a district.

Key Features

- Highly energy efficient
- Reduces individual building's cooling infrastructure needs
- Common in urban areas

VRF System (Variable Refrigerant Flow)

Multiple indoor units connected to a single outdoor unit with individual control of each indoor unit.

Key Features

- Individual control of each indoor unit
- Energy efficient
- Expensive compared to DX system

Types of AC Equipment

- Wall Decorative Unit / Cassette Type (Airflow up to 600 L/S)
- Fan Coil Ducted Type (Limited up to 850 L/S, Maximum airflow range up to 1200 L/S)
- Package Unit (Maximum capacity per unit up to 3000 L/S)
- AHU / FAHU
- CRAC/ CRAH Unit (Intended specifically for server rooms)

Air System

CAV System (Constant Air Volume)

The supply airflow of a CAV remains constant while supply temperature varies.
Motor Type AC equipment must be equipped with a constant speed motor.

<u>Applicable Equipment</u>
- All FCUs
- Split Units

<u>Key Parameters</u>
- Supply Airflow → Constant
- Supply Temperature → Varies

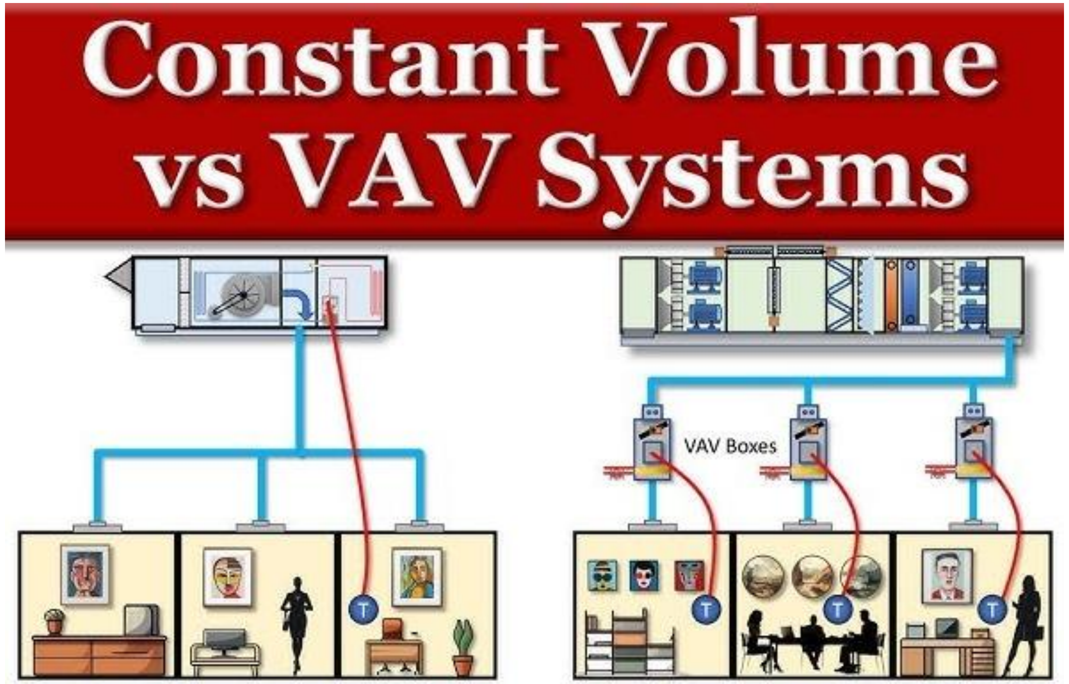
VAV SYSTEM (Variable Air Volume)

Supply temperature remains constant while airflow varies.
Motor Type AC equipment must be equipped with a VFD Drive. (AHU, FAHU, FANS)

Key Parameters

- Supply Airflow → Varies
- Supply Temperature → Constant

Additional Key Notes – CAV & VAV Systems



<u>Cost</u>
VAV System → Very Expensive

<u>AHU Installation</u>
Suspended AHU to be mounted at a maximum of 500mm height from the ceiling

<u>CAV System</u>
Delta T (Temperature Difference) is Constant

<u>VFD Drive</u>
VFD Drive is only used in AHU

<u>VAV Requirement</u>
To install a VAV system, a VFD Drive is mandatory

Cooling Load Calculation

Sensible Load (Qs) = 1.21 x Airflow x ΔT
- 1.21 = Constant
- Airflow = L/S
- ΔT = Temperature Difference

Latent Load (QL) = 3010 x Airflow x ΔT
- 3010 = Constant
- Airflow = L/S
- ΔH = Humidity Difference

Total Coil Load = Sensible Load (Qs) + Latent Load (QL)

<u>Key Notes</u>
- Total Coil Load = Tonnage
- Sensible Load accounts for temperature change
- Latent Load accounts for moisture/humidity change