CLIMATE CONTROL WITH AIR HANDLING UNITS - ESSENTIAL TIPS & RULES OF THUMB

Want to transform your spaces into comfortable, energy-efficient, and healthy indoor environments! Unlock the secrets to creating the perfect indoor environment with Air Handling Units (AHUs).

In this actionable and insightful 8-hour course, you'll master the art of climate control with AHUs and will gain a deep understanding of:

- AHU fundamentals and key components
- Choosing the perfect AHU type for your project
- Fan selection and control options for optimal airflow
- Heating and cooling coil performance and selection
- Air filter selection for optimal air quality
- Centralized vs. decentralized AHU systems
- AHU location and mechanical room planning
- Noise mitigation and acoustic design

Embedded within the course are essential metrics, practical tips, and handy rules of thumb to help you make well-informed decisions, avoiding costly mistakes with your AHU design.

You can find **Key Rules of Thumb in Annexure - 1** for quick and easy reference. These guidelines, metrics, and thumb rules are based on sound engineering practices and the author's experience, but they may vary depending on operating conditions and other factors. This document is a live resource that will be updated regularly as new information becomes available.

Let’s get started!

1. CHAPTER - 1: INTRODUCTION TO AIR HANDLING UNITS

An Air Handling Unit (AHU) conditions and circulates air throughout a building. Its primary functions include:

a. Regulates temperature and humidity.
b. Provides ventilation with fresh outdoor air.
c. Filters contaminants for clean air.
d. Delivers conditioned air through ducts.
e. Maintains room pressure differentials.

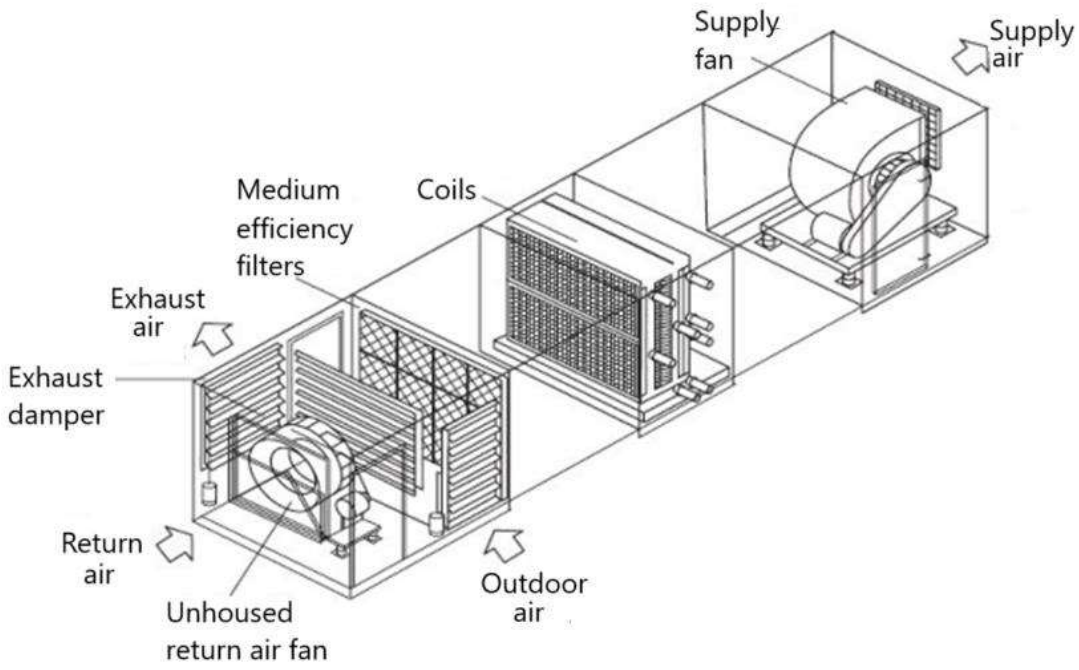


Figure 1. Air Handling Unit

1.1.Key Components and Functions

An AHU is an enclosure with fans, filters, coils, and dampers.

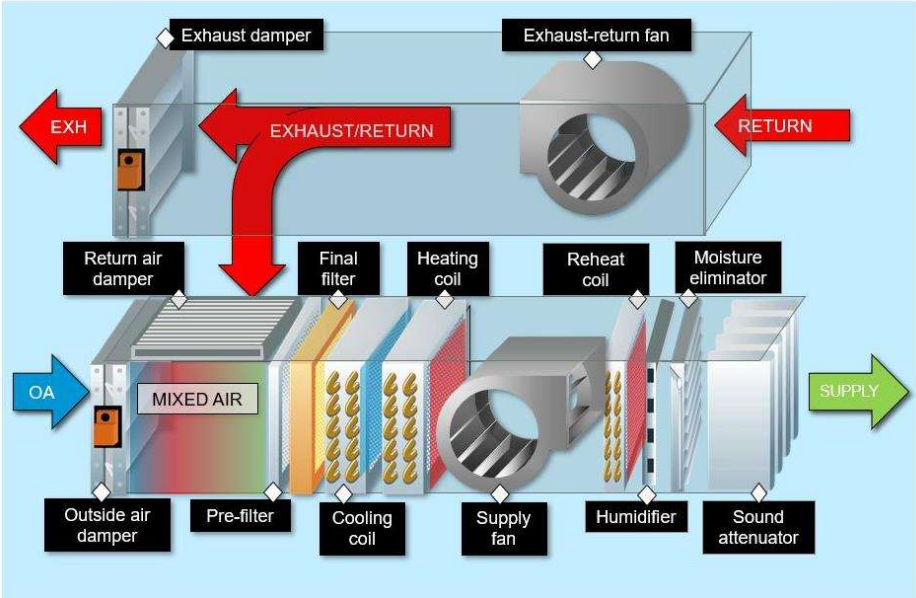


Figure 2. Key Components of an AHU

Table 1. AHU: Key Components and Functions

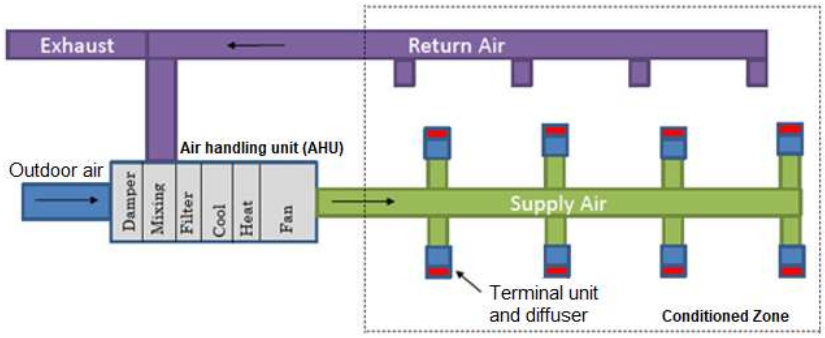
	Components	Function	Typical Details
	Fan	Circulates air within the AHU and throughout the facility.	Type: Centrifugal or Plug Fan; Capacity: Airflow volume (CFM) or Tonnage; Speed Control: VSD
	Heating/Cooling Coils	Controls air temperature by transferring heat.	Type: Finned Tube Coil; Material: Copper, Aluminum, or Stainless Steel; Capacity: BTU/hr.
	Filters	Removes airborne contaminants and maintains air quality.	Type: Pre-filters, Fine Filters, HEPA Filters; Efficiency: MERV rating; Pressure Drop: Resistance to airflow.
	Humidifiers/De humidifiers	Controls and adjusts air humidity levels.	Type: Steam, Spray, or Adiabatic; Capacity: Moisture addition or removal rate (lbs./hr.); Control: Humidistat or Controller
	Mixing Chamber	Mixes return and fresh air for desired conditions.	Design: Plenum Chamber or Mixing Box; Airflow Ratio: Proportion of return and fresh air
	Air Distribution	Distributes conditioned air to different areas.	Ductwork: Supply and Return Ducts; Dampers: Balancing and Volume

	Components	Function	Typical Details
			Control; Registers: Diffusers and Grilles
	Controls	Monitors and regulates AHU operation.	Sensors: Temperature, Humidity, Pressure; Controller: PLC; Setpoints: Desired temperature, humidity, etc.

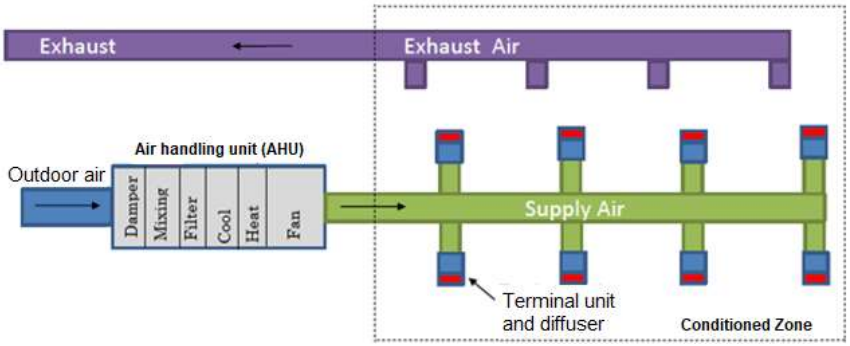
1.2. AHU Design Configuration

AHUs can be customized to meet building requirements and come in two basic designs:

a. Recirculation Units: Recycle a portion of indoor air, mixing it with fresh outdoor air for conditioning.
b. 100% Makeup Air Units: Exclusively handle fresh outdoor air without recirculating indoor air. Crucial for environments like hospitals, laboratories and cleanrooms.



Reciculation Type AHU



100% Outdoor Air AHU

Table 2. Recirculation Type Vs. 100% Outside Air AHU Comparison

	Parameter	Recirculation Type AHU	100% Outside Air AHU
	Ventilation Rates	10-30% outside air, balance recirculated air.	100% outdoor air, no recirculation.
	Pros	Energy-efficient, lower initial cost.	Superior IAQ, odor, and contaminant control.
	Cons	Risk of contaminant recirculation, CO2 buildup.	High energy consumption due to increased cooling/heating.
	Filtration	MERV 8+ filters, higher for better IAQ.	Minimum MERV 13+ to handle outdoor contaminants.
	Air Change Rates (ACH)	4-10 ACH (ASHRAE 62.1).	6-12+ ACH for high IAQ needs.
	Energy Recovery	Optional to reduce energy loss.	Recommended must for efficiency (per ASHRAE 90.1).
	Applications	Offices, residential, general spaces.	Labs, healthcare, high IAQ-demanding spaces.

1.3. AHU Selection

You need to consider the following parameters when selecting an AHU.

Table 3. Key Factors affecting AHU Selection

	Parameters	Rules of Thumb
	Airflow Rate	Determines AHU size and fan capacity; higher airflow requires larger coils and cross-sectional area.
	Heating & Cooling Load	Calculated in BTU/hr. or tons of refrigeration, influences airflow rate and coil size. High latent loads need more coil rows.
	Filtration Level	Higher MERV ratings (MERV 8+ for pre-filters, MERV 13+ for fine filters) improve air quality.
	Static Pressure	Typical range: 1-10 in. WG. Affects fan power and ductwork design based on internal and external resistance.
	Energy Efficiency	Optimize design with short ducts and efficient components (fans, motors, VFDs) to reduce energy use.
	Noise Level	Minimize sound with sound attenuators, acoustic insulation, and low air velocities (<1500 fpm main, <800 fpm branch ducts).

Table 4. AHU Performance Standards & Codes

	Standard/Code	Application
	ASHRAE Standard 62.1	Outdoor air ventilation for acceptable Indoor Air Quality
	ASHRAE Standard 52.2	Filter efficiency ratings
	ASHRAE Standard 90.1	Energy efficiency ratings for equipment (fan, motors, dampers etc.)
	AHRI 410/430	Standard for air handling units
	AMCA 210	Standard for air handling units, including sound and vibration limits
	Eurovent	European standard for AHU performance and energy efficiency
	NFPA 90	Installation of Air Conditioning and Ventilating Systems
	ISO 16814	International standard for AHU design and testing
	ISO 14001	Environmental Management System
	ISO 50001	Energy Management System
	SMACNA Standards	HVAC Systems and Equipment Duct design, installation, and testing

1.4.Space Planning for AHUs

AHU is a bulky equipment and it's important that the space requirements are evaluated upfront while meeting clearance, access, and safety requirements. Here's what to consider:

Table 5. AHU Space & Installation Considerations

	Factors	Rules of Thumb
	Size & Configuration	Ensure AHU fits allocated space, considering dimensions and special configurations.
	Clearance	Maintain at least 36 inches for accessibility, maintenance, and inspection.
	Headroom	Verify adequate headroom for installation and ductwork routing, especially in low-ceiling areas.
	Access	Ensure easy access for installation and maintenance; check door widths, hallways, and elevators.

	Factors	Rules of Thumb
	Support	Provide a sturdy foundation or support to handle AHU weight.
	Airflow & Ductwork	Optimize duct size, routing, and insulation to reduce pressure drops and improve airflow.
	System Integration	Coordinate with electrical, plumbing, and fire systems to prevent conflicts and ensure integration.
	Code Compliance	Follow local codes for installation, clearance, fire safety, and energy efficiency.

1.5.Airflow Rate of the AHU

The airflow rate of AHU correlates with the sensible load (Q) and desired temperature difference (ΔT) between supplied and returned air.

Equation 1. Airflow Rate

$$\text{Airflow (CFM)} = \frac{\text{Sensible load (Q)}}{1.08 \times \Delta T}$$

Where:

- Q is the sensible cooling load in BTU/h.
- ΔT is the temperature difference between the desired room temperature and the supply air temperature from the AHU in °F.
- 1.08 is a constant based on the air density and specific heat of the air.

Table 6. Estimating Cooling Load and Airflow Rates

	AHU Size/Capacity	Rules of Thumb
	Cooling Loads (Ton/sq. ft.)	1 Ton for 200 sq. ft. of floor area (for conceptual design and heavy applications such as high occupancy areas, gymnasium etc.). 1 Ton for 400 – 500 sq. ft. of floor area for energy efficient buildings with superior materials and insulation.
	Airflow Rate (CFM/Ton)	400 CFM/Ton for comfort cooling. 350–400 CFM/Ton for high latent load applications.
	Airflow Rate (CFM/sq. ft.)	1 – 2 CFM/sq. ft. of floor area. 1 CFM/sq. ft. reasonable for modern energy efficient building. You may use higher 2 CFM for conceptual design.