VAV SYSTEMS:
HOW AIR FLOWS THROUGH THE EQUIPMENT

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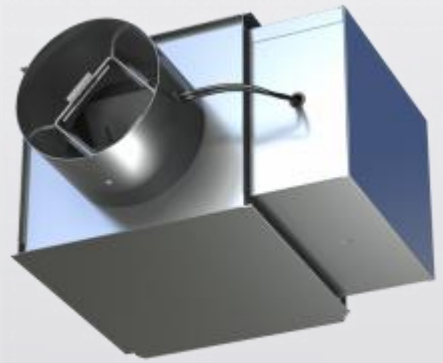
Background

- The purpose of Variable Air Volume (VAV) system is to add controllability to a diversity of occupancies using only one air handling unit.
- Constant volume system are found in homes
  - Either off or on.
  - **IF** you apply a constant volume system to a space with multiple heating/cooling load profiles
  - **THEN** someone will not be comfortable at different times of operation.

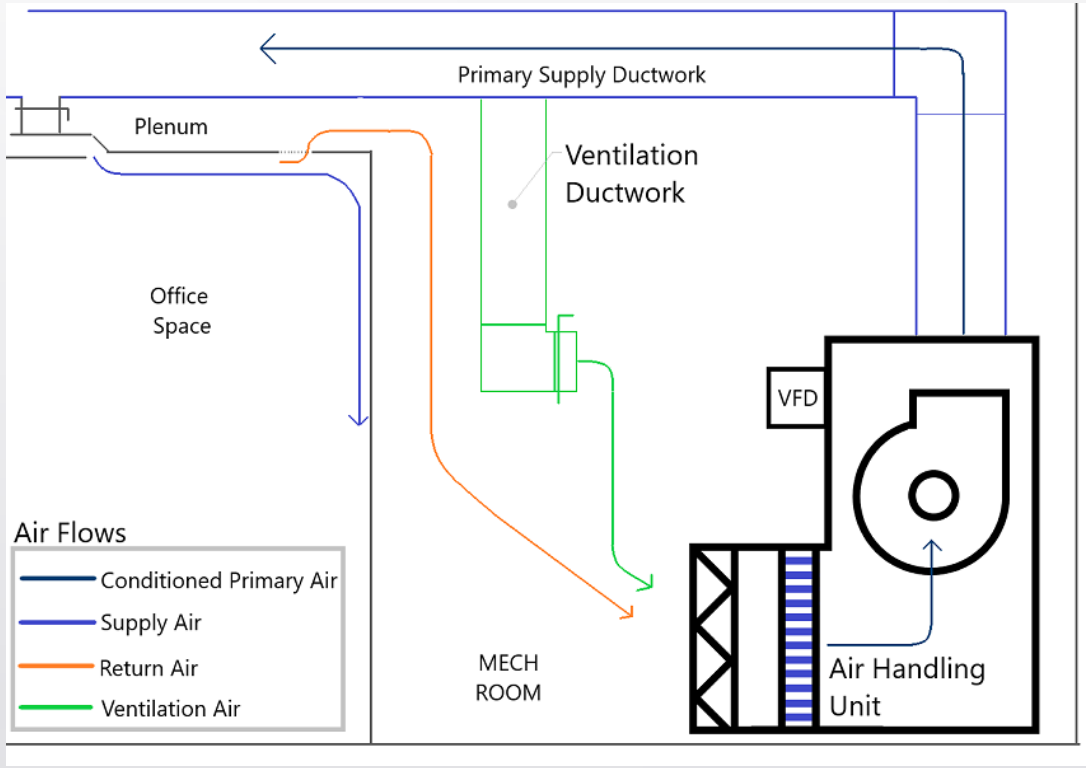
Fundamental Components of a VAV System



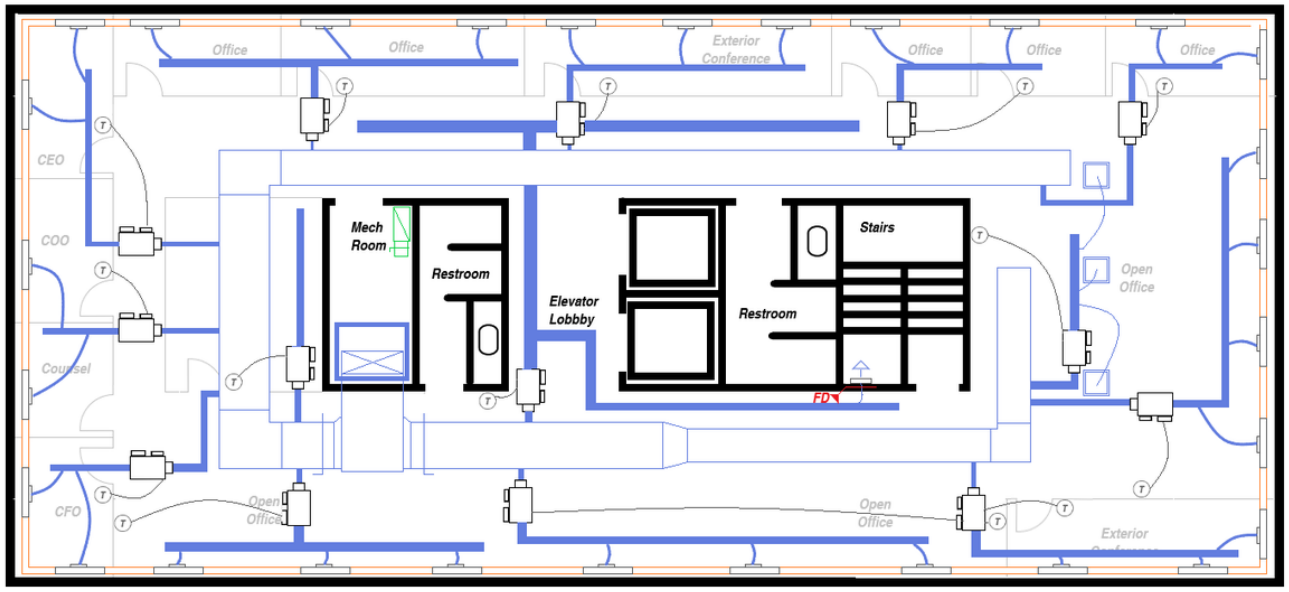
- Fundamental components include:
  - **Air handling unit**
  - **Primary ductwork**
  - **Terminal unit**
  - **Ductwork/air distribution that serves each zone**
- Each works to deliver right amount of air to a space to control desired temperature
- Critical to understand
  - How air flows through components of a VAV system
  - How it is controlled to deliver comfort

Air Handling Unit

- Fan in the unit delivers the right amount of air to the system.
  - Controlled with a Variable Frequency Drive (VFD) using a trim and response control sequence
- Air is distributed through the building via ductwork
  - Ultimately arrives in the room as supply air through grilles/diffusers
- Supply air is provided with a path to go back to the air handling unit as return air
  - Supply air passes through return air diffuser in the ceiling into the plenum above the space
  - This air then make its way through the plenum to the air handling unit
  - In the illustration, the mechanical room is open to the plenum. In some instances, there could be transfer ductwork
- Air handling unit also handles required ventilation air for the space
  - These two airflows combine in the mechanical room and go through the air handling unit to start the process all over again



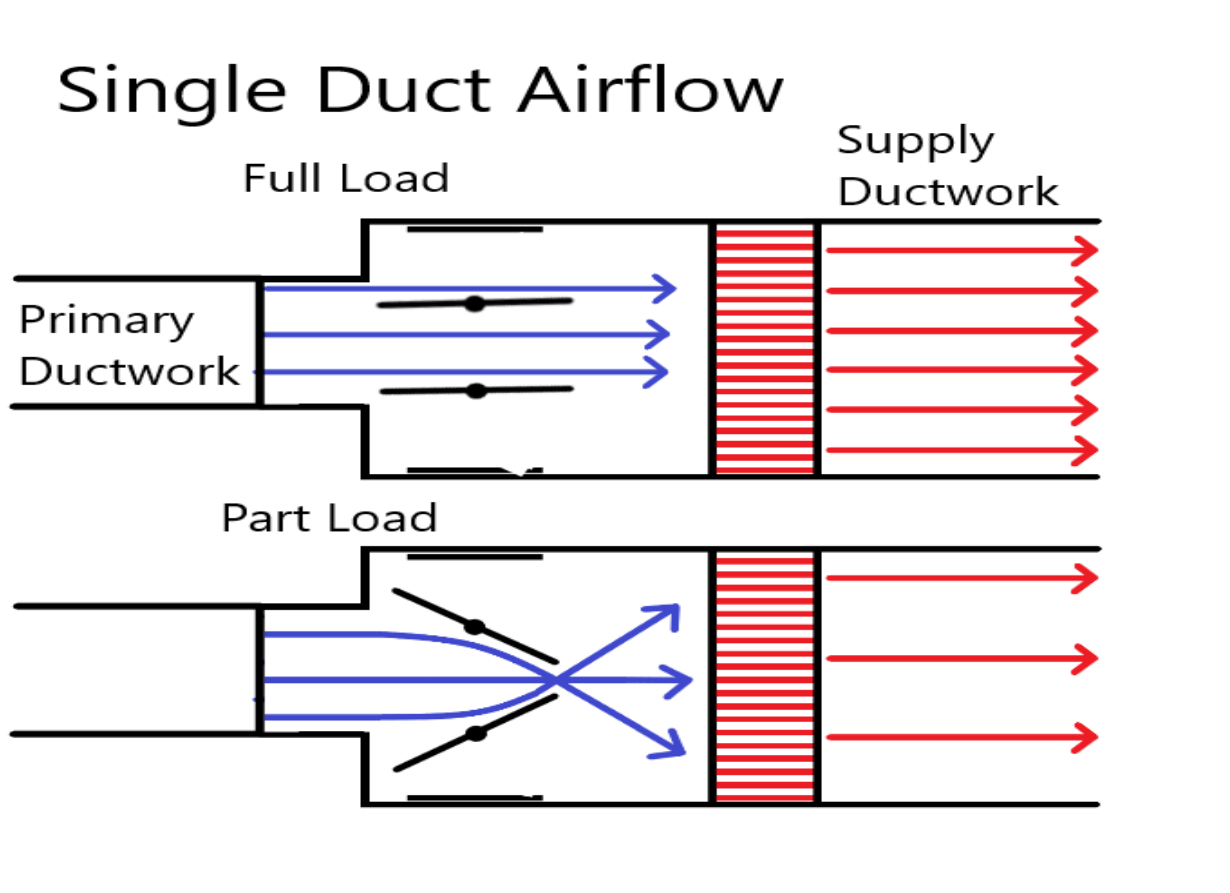
Terminal Units



- Terminal units are connected to the primary supply ductwork
  - Controls airflows to different zones
- Fan and VFD in the air handling unit respond to the needs of the space
  - Provide exact amount of air required
- Terminal unit configurations include:
  - Single duct
  - Parallel fan-powered
  - Series fan-powered units
  - Each has different airflow profiles

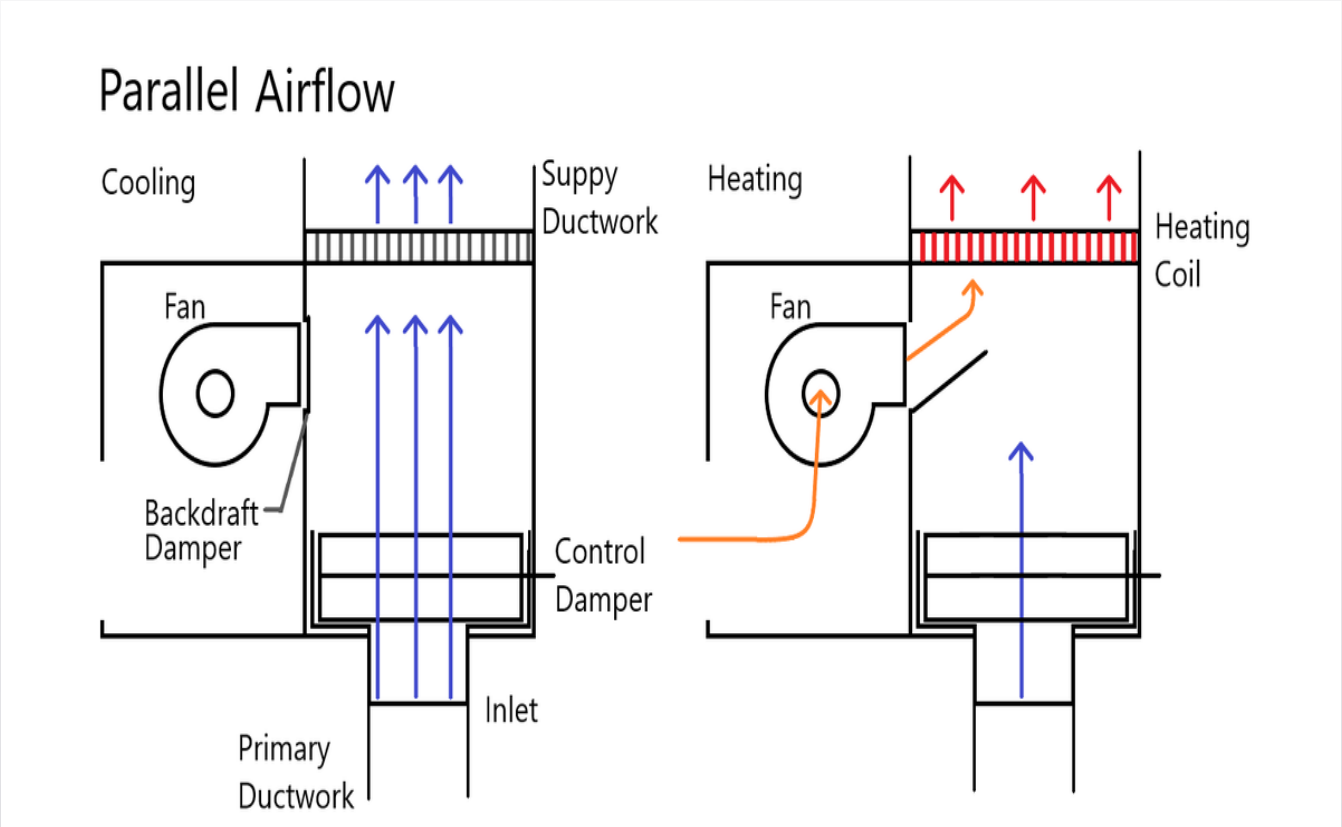
Terminal Units: Single Duct Units

- Single Duct terminal units include:
  - Airflow sensor
  - Actuator
  - Control damper
- May also have a heating coil
  - Dependent on system design
- The unit will respond to space thermostat to increase/decrease airflow to maintain set point
- Relies 100% on airflow from the air handling unit

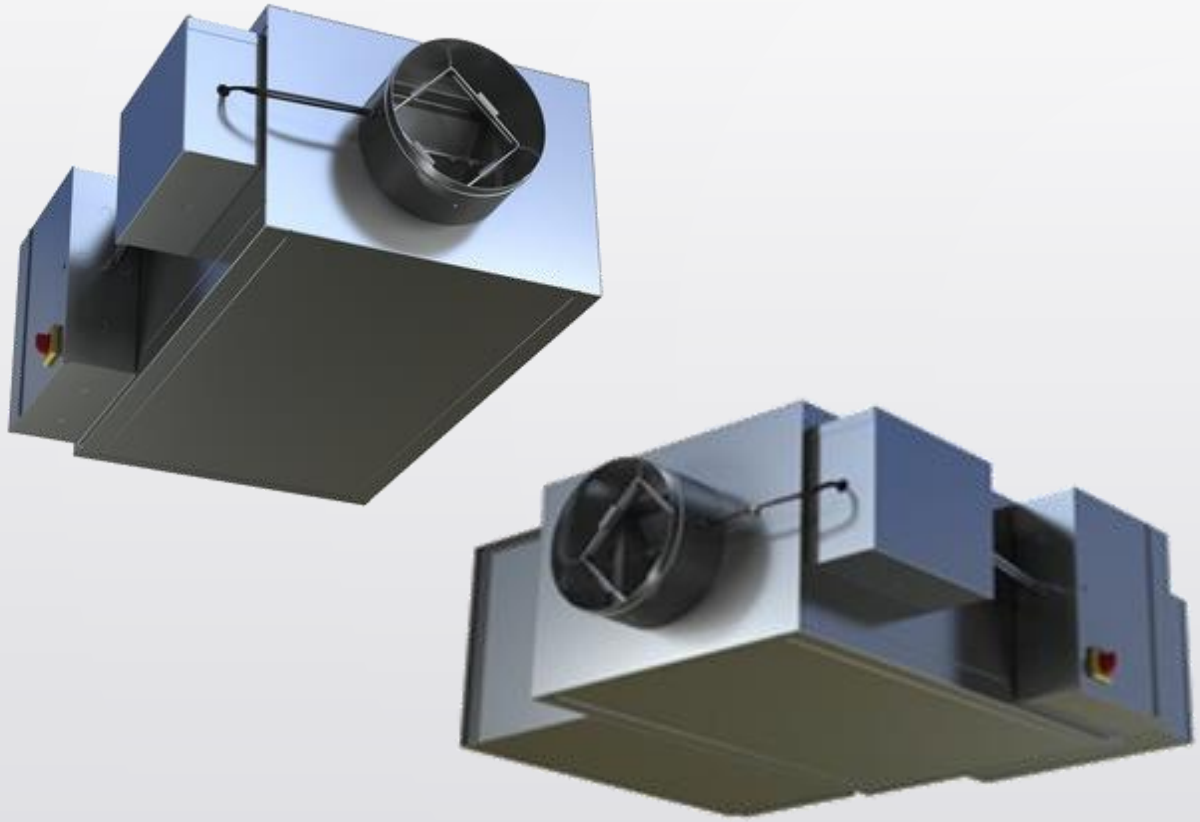


Terminal Units: Parallel Fan Powered Units

- Adds fan that is outside flow of the primary air.
- During cooling:
  - Unit acts the same as a single duct terminal unit
- When heating is required:
  - Primary air reduced to minimum ventilation rate and fan will operate to induce air from plenum
  - Mixture of primary and induced air is then passed through the heating coil and ultimately into the space



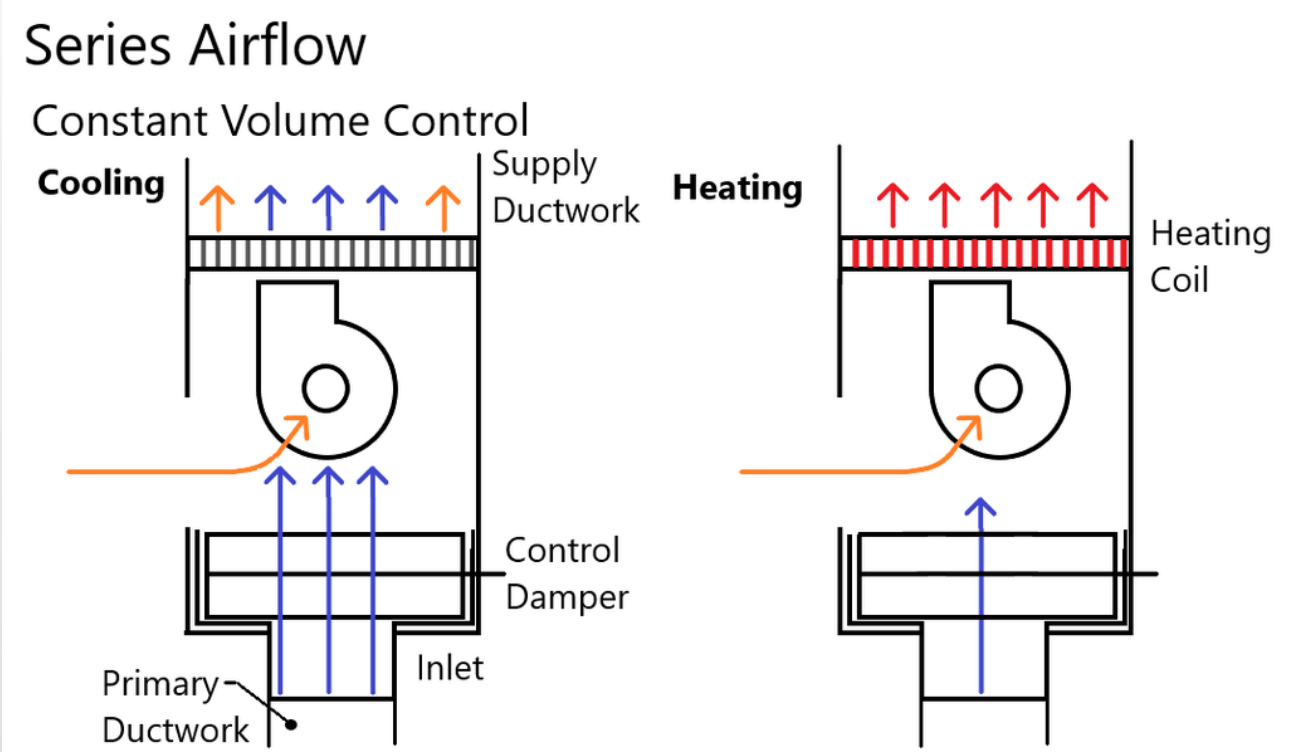
Terminal Units: Series Fan Powered Units



- Adds fan that is inside flow of the primary air.
- Fan must be operated simultaneously with AHU
- Airflow through a series unit depends on the control sequence selected
  - Constant Volume
  - Variable Volume

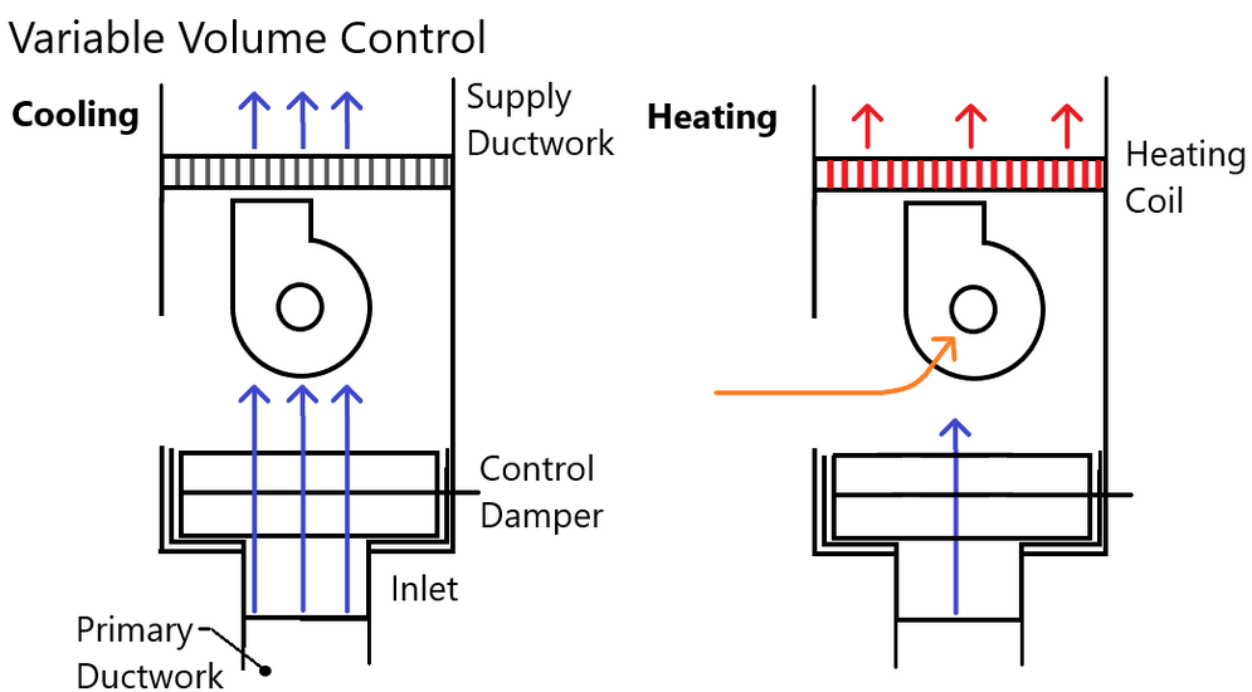
Terminal Units: Series Fan Powered Units
Constant Volume Control Sequence

- Unit delivers consistent amount of air throughout the operation of the building
- Amount of primary air and heating modulates in response to calls from thermostat
  - Result is constant volume, variable temperature supply
- Except at max load, fan is continuously inducing air from the plenum

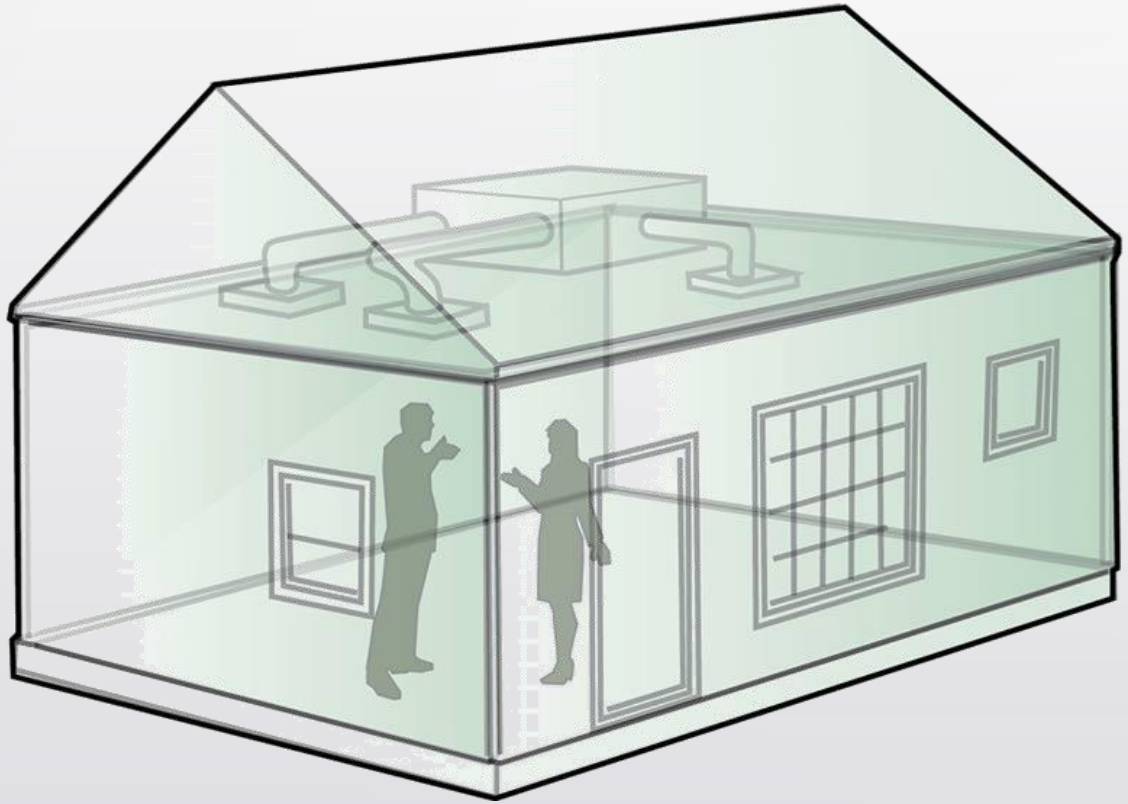


Terminal Units: Series Fan Powered Units
Variable Volume Control Sequence

- During cooling:
  1. Fan matches the primary airflow
     - Resulting in very little induced air into supply air
- During heating:
  1. Primary air reduces to a minimum ventilation rate
  2. Fan induces the right amount of plenum air to satisfy the space
     - Result is variable volume, constant temperature operation



Exhaust



- With constant supply of ventilation air
  - There must be a means of relieving the pressurization caused by airflow
- Some air exhausts through restroom fans and kitchen exhaust (if applicable)
- The rest must be either
  - Exhausted directly
  - Allowed to escape through a pressure relief damper
- While some pressurization is good for the building, too much can have a negative effect

Airflow

- Efficient airflow through a building and a VAV system is critical to an operating HVAC system
- Understanding how this equipment works together to maintain comfort in a building is critical to designing the right system for your application

Contact the Experts

- Learn more about Nailor Industries, Inc. Single Duct, Parallel & Series Fan Terminal Units along with their entire air handling/ air distribution line by going to https://nailor.com/products/terminal-units
- Contact the Technical Air Systems' Sales Engineering Team at 973-285-0333 or by email at solutions@technicalair.com

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