VAV Diffusers: The Solution to Some Issues but the Cause of Others?

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Background

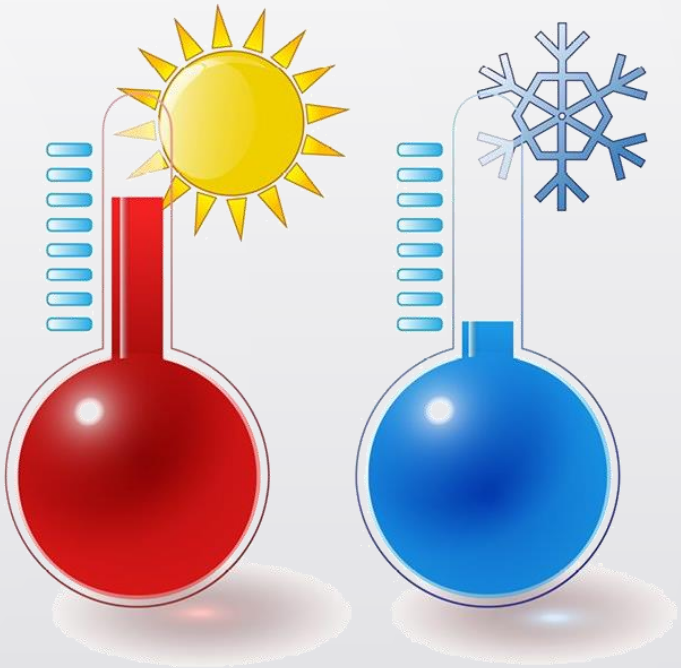
- Over-cooling in summer/over-heating in winter impacts occupant comfort
- There are several solutions for this issue. These include:
  - Rebalancing the system
  - Adding Terminal Units for those spaces
  - Adding a VAV Diffuser
    - **Nailor is currently in the process of adding a VAV diffuser to its portfolio**
- The use of a VAV Diffuser requires:
  - Understanding of the design
  - How they work
  - Limitations
  - System considerations associated with the product

VAV Diffusers Overview

- The Nailor UNI VAV Diffuser enables control of airflow into a room with a connected thermostat
- The diffuser includes:
  - Actuator
  - Linkage
  - Plate damper
  - Diffuser
- Ductwork from the AHU is connected to the diffuser in the same way it connects to a standard diffuser
- Associated thermostat is in the space and is wired to the UNI VAV controller
- The diffuser controls provide ability to link several diffusers to be controlled by a single thermostat

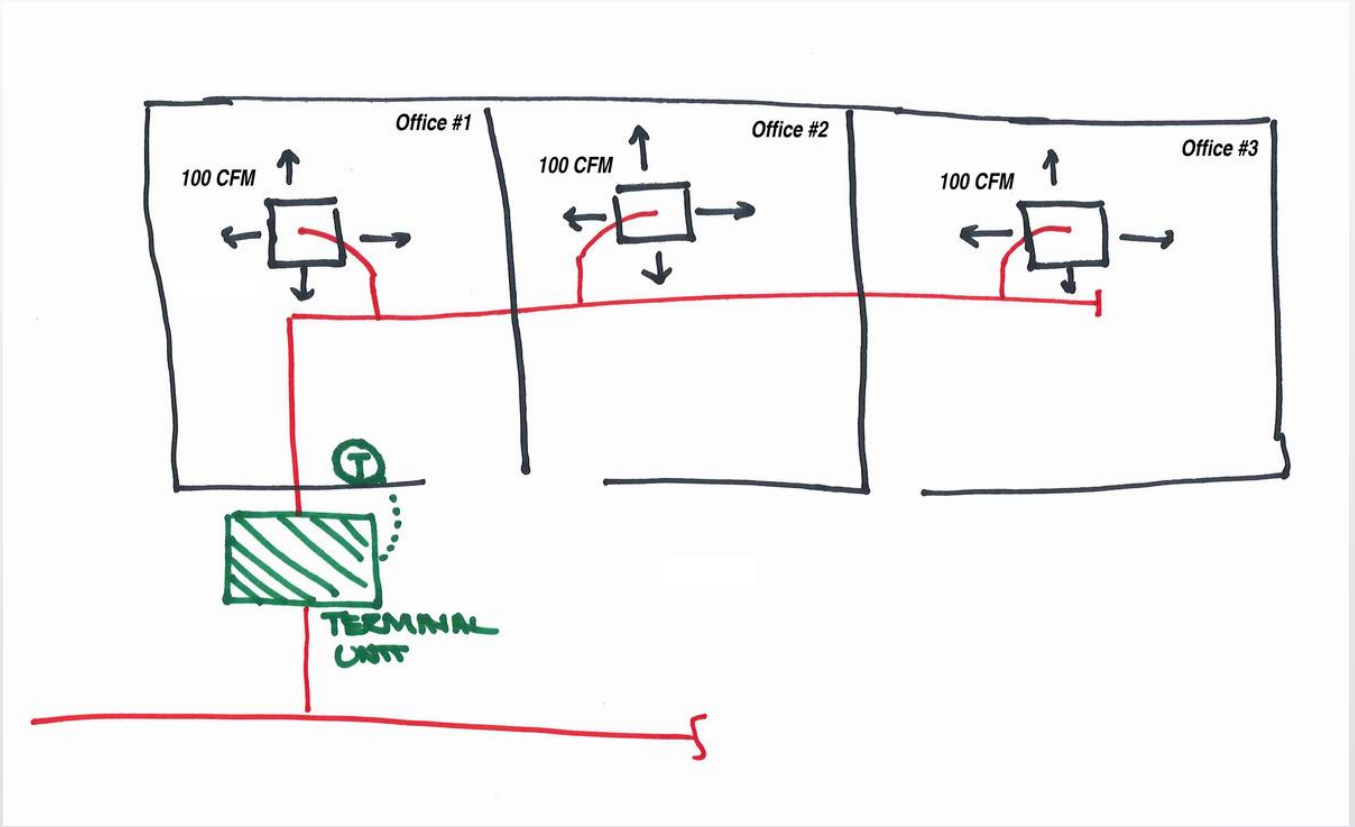
VAV Diffusers Operation

- **IF** room temperature is below thermostat setting during cooling,
- **THEN** an actuator in the diffuser will close an integral damper to reduce the airflow.
  - This will result in less overcooling of the space.
- The diffuser would work in opposite direction during heating
  - **IF** room temperature is below the thermostat set point
  - **THEN** the damper opens to increase heating
- These devices are pressure dependent
  - The airflow control is dependent on the pressure supplied to them
  - They do not affect the overall control of the system.
- When the UNI VAV is added to an existing VAV or constant volume system controlled by a thermostat in another zone there are some limitations.

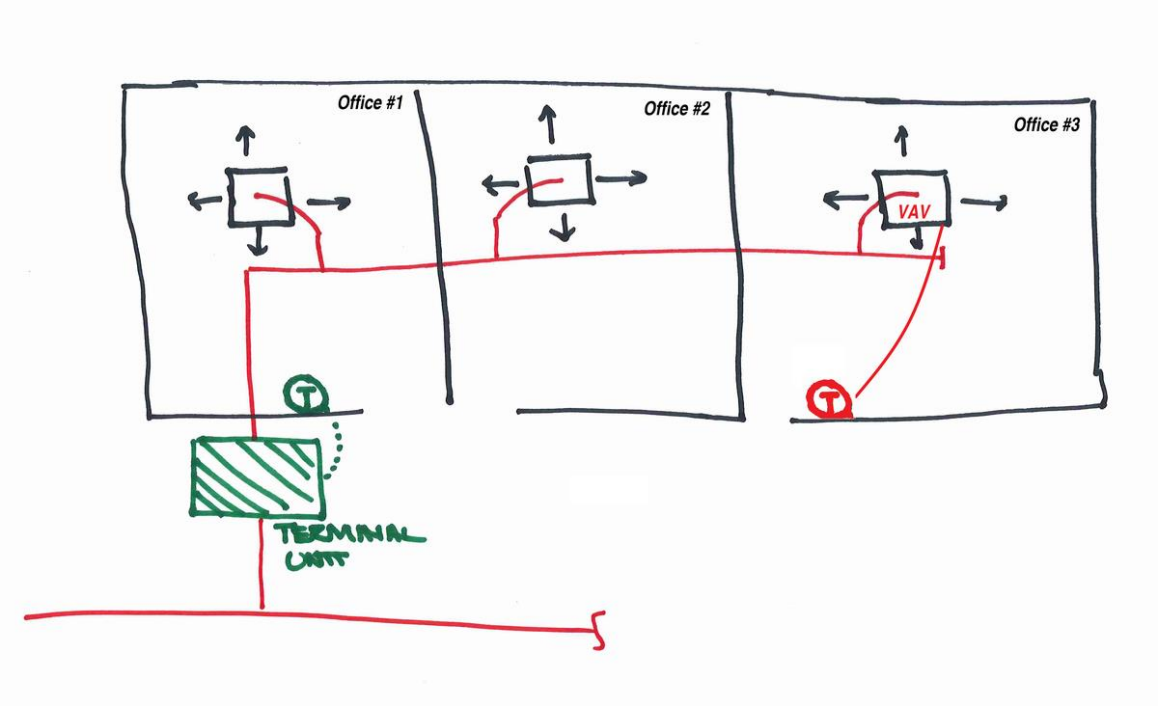


Application Example

- Zone is served by a terminal unit
  - controlled by a thermostat in Office #1.
- Occupant in Office #3 complains of being too cold in summer/hot in winter.
- One option to solve problem:
  - Move thermostat serving terminal unit to Office #3.
- The deciding factor for this solution would probably be office politics.
  - Which occupant is more powerful?
    - **IF** it is Office #3's occupant
    - **THEN** this is an acceptable solution.
    - If not, this probably wouldn't fly. In this case, installing a VAV diffuser would be an option.



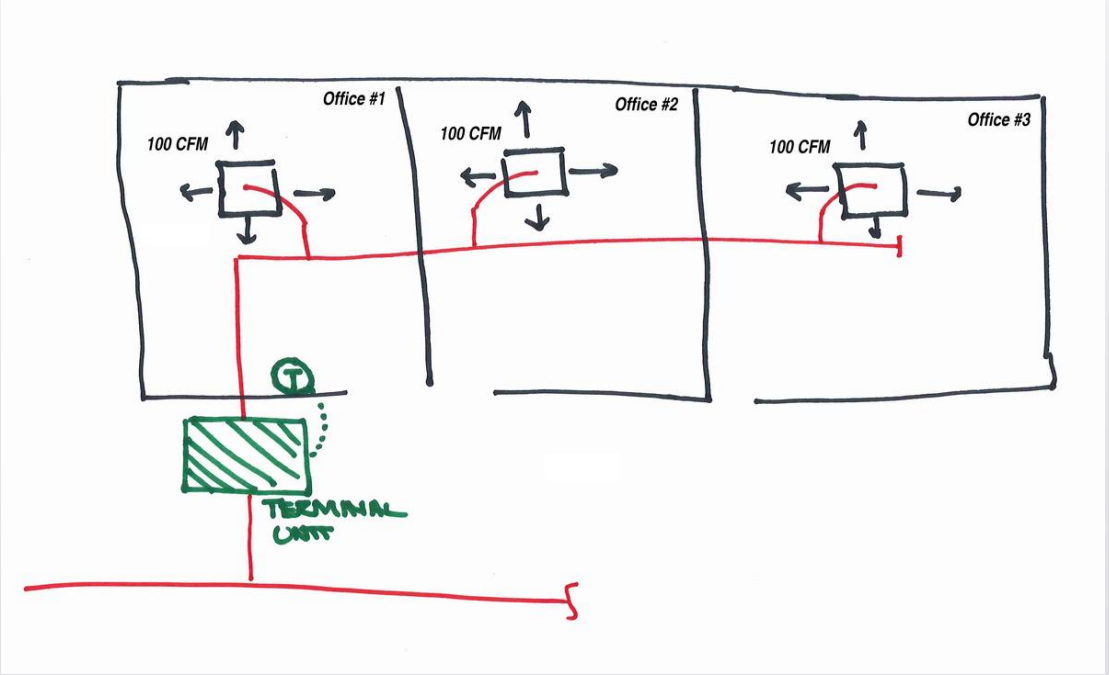
Continued Application Example



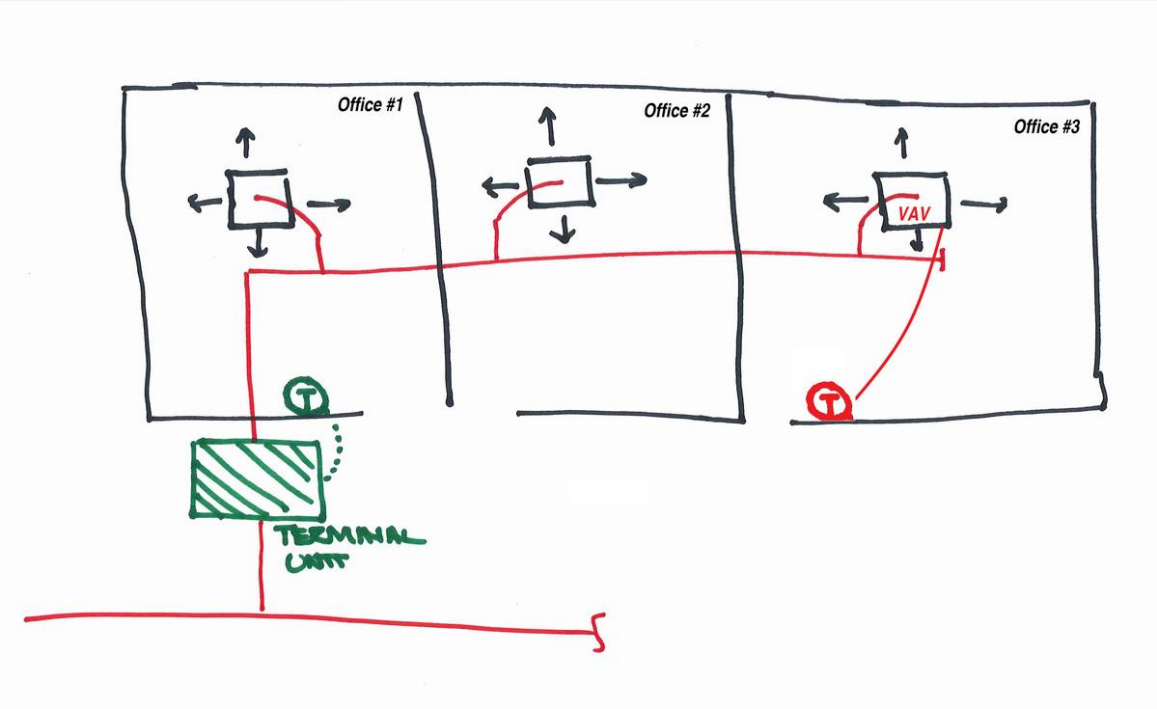
- Assume diffuser supplies 100 CFM
- **IF** 100 CFM supplied to Office #3 causes temperature to fall below the VAV diffuser thermostat set point
- **THEN** diffuser damper will close to reduce airflow.
  - As a result, the reduction in airflow to Office #3 diverts to Offices 1&2.
  - Increased airflow could cause Office #1 to be over-cooled,
    - Resulting in the damper on the Terminal Unit closing to achieve 100 CFM in Office #1 once again.
- VAV diffuser is pressure dependent
  - Closing Terminal Unit damper will cause lower pressure and airflow through diffuser.
  - Lower airflow could affect the space temperature in Office #3 and cause the damper to open to increase airflow.
  - Equilibrium will eventually result between Terminal Unit and VAV diffuser to satisfy both room temperature set-points.

Continued Application Example

Situation	Office #1 (CFM)	Office #2 (CFM)	Office #3 (CFM)
Starting Point	100	100	100
Office 3 is over cooled so the UNI VAV damper closes	105	105	90
Office 1 becomes overcooled so the Terminal Unit Damper closes	100	100	80
Office 3 now is undercooled so the UNI VAV damper opens	95	95	90
ETC, units Equilibrium is achieved	100	100	90



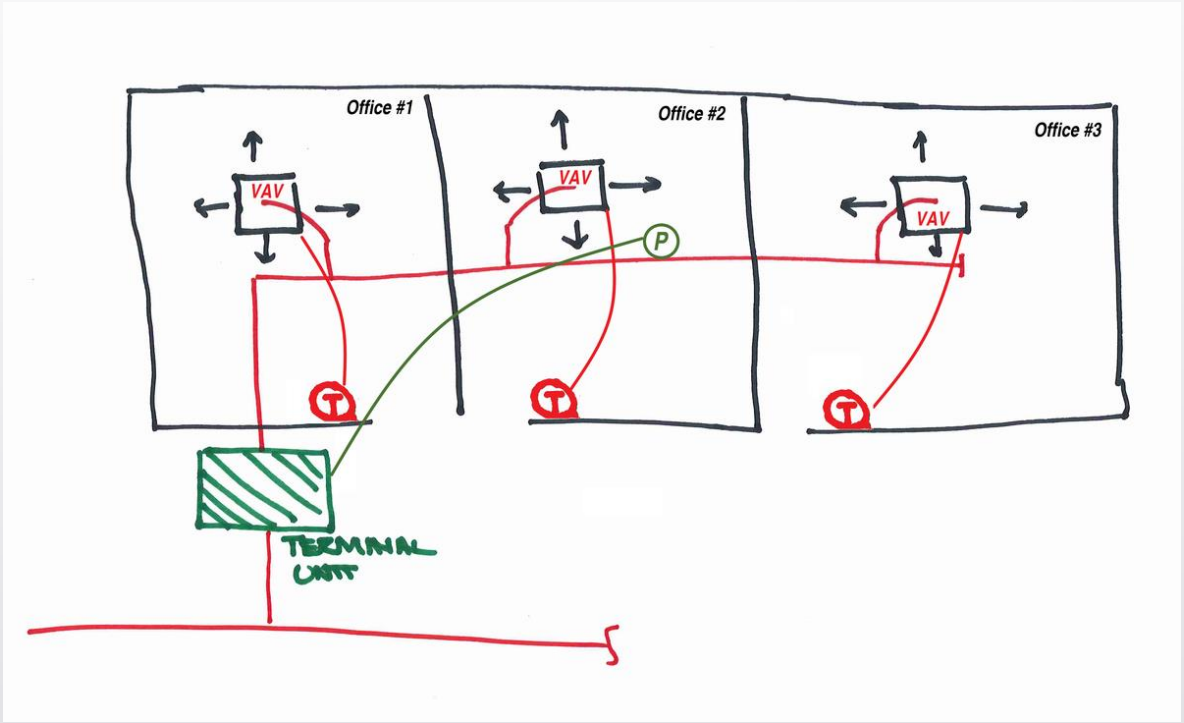
Limitations Example



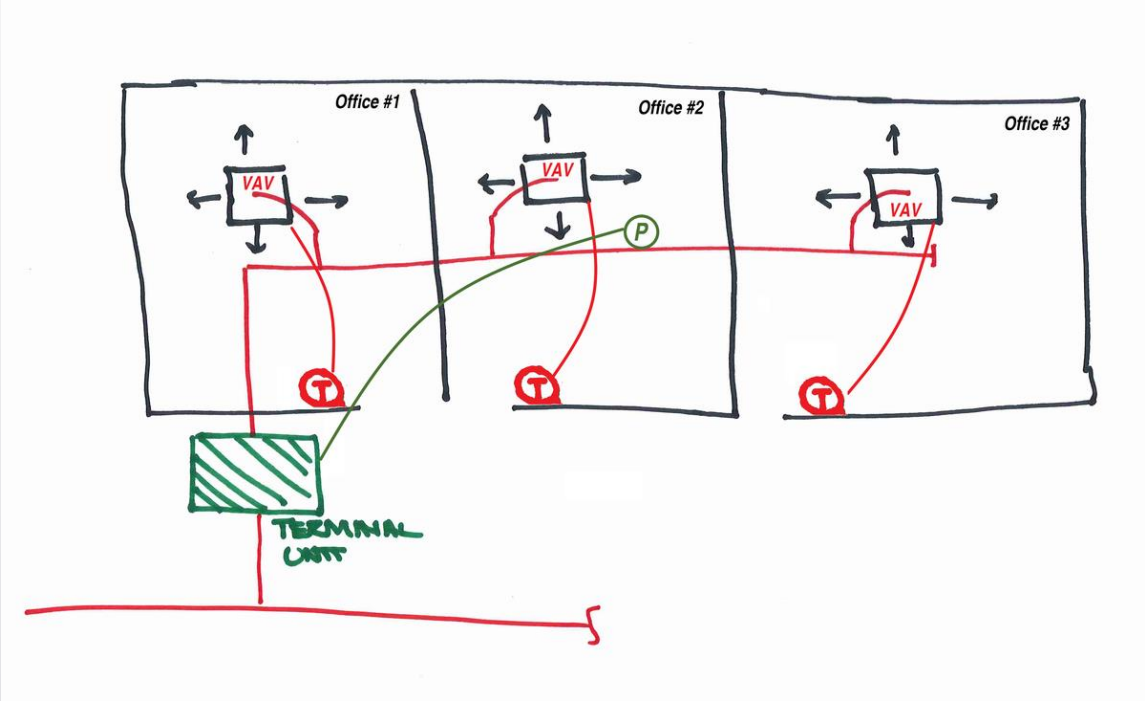
- During the cooling mode, Office #3 experiences temperatures above the set-point
  - The damper in the diffuser will open to allow more airflow.
  - Once damper is completely open, diffuser will not supply additional air.
  - Maximum airflow to room would be the original 100 CFM.
  - A VAV diffuser will only help reduce overcooling in cooling mode/ overheating in heating mode.
    - It cannot increase cooling or heating.
- In this example, one diffuser in system replaced with VAV diffuser.
  - With just one diffuser, system will have to find equilibrium when either VAV Diffuser or terminal unit change airflow settings
  - Addition of a VAV diffuser to every office could result in continuous "hunting" by the different dampers, resulting in a chaotic system.
  - One solution to this problem would be to change the operation of the terminal unit to be constant pressure.

VAV Controls

- To measure and control airflow, Terminal units include:
  - Flow sensor
    - Measures the total pressure and static pressure to determine the velocity pressure of the duct
  - Controller/actuator
    - Uses flow sensor information to calculate the airflow
    - Modulates the damper to satisfy the set-point in the space.
  - Damper
- Another way to control airflow to a zone is to monitor the pressure in the downstream ductwork and modulate the damper to maintain a constant pressure.
  - If the design included VAV diffusers in every office, maintaining constant pressure in the supply duct downstream of the terminal unit.



VAV Controls Continued



- Scenario: If all three VAV diffusers were wide open each office would supply 100 CFM.
  - If Office #2 became over cooled, VAV diffuser damper would close.
    - This would increase the pressure in the Terminal Unit ductwork.
    - In response, the terminal unit damper would close (reduce airflow) to maintain the constant pressure in the ductwork.
  - If one of the zones could not meet the set-point with the maximum 100 CFM, the pressure set point could be increased so that all diffusers supplied more CFM.
    - The individual dampers in the VAV diffusers would then ensure their respective zones would not be overcooled/overheated.

Constant Volume Systems

- All examples above have assumed a variable volume system (VAV).
- These diffusers can work with constant volume systems, such as a DX rooftop unit.
  - These units are either on/off controls and deliver constant airflow when they're on.
  - DX cooling coils deliver a constant amount of cooling and rely on this airflow to operate.
- Using multiple VAV diffusers with a constant volume system could restrict the airflow through the coil causing it to freeze.
  - To combat this issue, excess pressure in ductwork must have a method to release using a dedicated bypass damper in ductwork or a bypass relief collar on diffuser.

Considerations

- Adding VAV Diffusers can be a simple fix when an occupant isn't comfortable.
- However, the information above must be considered to ensure comfort is maintained.

Contact the Experts

- Learn more about Nailor Industries, Inc. entire air handling/ air distribution line by going to https://nailor.com/
- Contact the Technical Air Systems' Sales Engineering Team at 973-285-0333 or by email at solutions@technicalair.com

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