

EXchange



Modeling 100% OA Constant Volume Air Systems

This article provides an overview of how to model a stand-alone constant air volume (CAV) 100% OA system in HAP. For additional details this topic is covered in more depth in [*Carrier's Advanced Modeling Techniques for HVAC Systems \(SSN 006\)*](#) training course.

In HAP this system is called a "CAV Makeup Air / DOAS" and provides tempered (conditioned) ventilation air to a region of the building, but does not provide conditioning to control the space (zone) air temperature. In other words, the MAU / DOAS is not controlled by a zone-level thermostat; rather it is controlled by a discharge air sensor located in the supply air duct (see Figure 1 on page 2). This CAV MAU / DOAS model is typically used in applications such as industrial processes, factories, warehouses, natatoriums or gymnasiums, which are supplied with tempered outdoor (ventilation) air. The space conditioning is then handled by a separate heating and/or cooling system.

Note: if instead your design is to provide preconditioned ventilation air to mix with the return air of other HVAC units such as fan coils, WSHPs or VRF units, you should configure the equipment type as Terminal Units and the ventilation type as a DOAS. This configuration, as well as others, is covered in the *Advanced Modeling Techniques for HVAC Systems* course mentioned above.

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Schematically the CAV MAU / DOAS system looks like this:

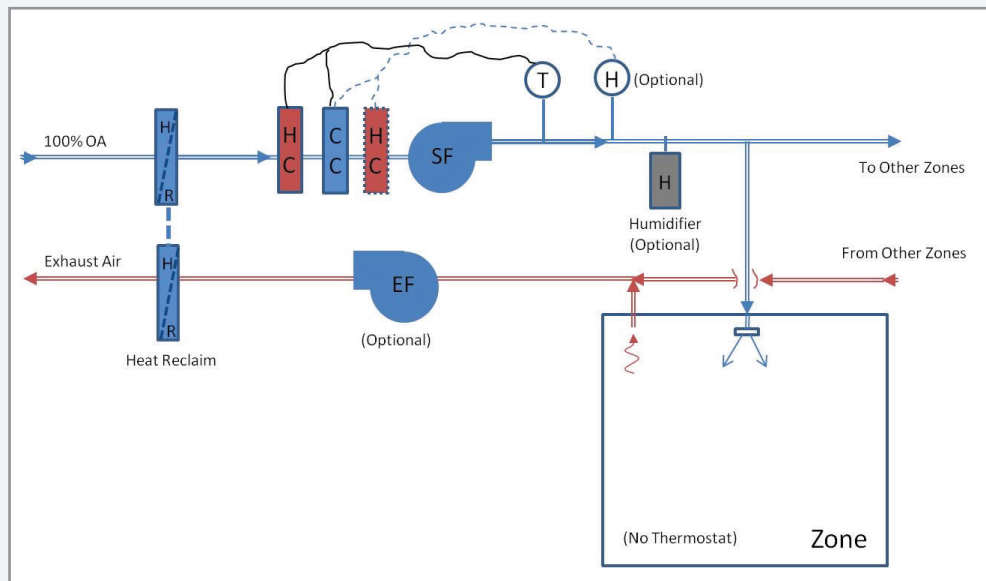


Figure 1 - System Diagram - 100% OA CAV MAU / DOAS

At the system level, the supply air is constant-volume, 100% outdoor air at all times. The heating, cooling and optional reheat coil and humidifier are energized based on supply air (duct) temperature and humidity requirements. There is no recirculation or return air. The system is a once-thru design, as illustrated in Figure 1. Optionally an exhaust fan and a ventilation (heat) reclaim device may be specified to recover heat from the building exhaust. Depending on the user's definition of the system, operation in the occupied and unoccupied periods varies as described below:

A. Occupied Period Operation

1. The supply fan runs continuously to supply 100% outside air.
2. If a cooling coil is available, the coil will operate whenever the duct temperature downstream of the unit is above the duct cooling setpoint. The air will be cooled so the duct temperature is held at the setpoint.
3. If a cooling coil is available and dehumidification control is used, the unit will control both dry-bulb temperature and relative humidity (RH) downstream of the unit. If the temperature of duct air downstream of the unit is above the duct cooling setpoint, the

cooling coil will be energized to hold the duct air at the setpoint. If the duct humidity is above the RH setpoint, the cooling coil will provide additional cooling to lower the coil dewpoint, thus condensing more moisture, and holding the duct air at the dehumidification setpoint. A heating coil will provide reheat so the duct air temperature continues to be held at duct cooling setpoint.

4. If a heating coil is available, the coil will operate whenever the duct temperature downstream of the unit is below the duct heating setpoint. The air will be heated so the duct temperature is held at the setpoint.
5. If a heating coil is available and humidification control is used, the unit will control both dry-bulb temperature and relative humidity (RH) downstream of the unit. If the temperature of duct air downstream of the unit is below the duct heating setpoint, the heating coil will be energized to hold the duct air at the setpoint. If the duct humidity is below the RH setpoint, the humidifier will add moisture to the air stream to hold the duct humidity at the setpoint.

B. Unoccupied Period Operation

1. The system is off during the unoccupied period.

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Defining the CAV MAU / DOAS System

As mentioned previously, the CAV MAU / DOAS system is the only system type in HAP that is not controlled by a zone (room) thermostat. As such, we will use a “dummy” space (zone) to configure the air system such that zone thermal loads are not quantified or used to compute the required airflow quantity. The ventilation airflow quantity is predetermined and user-defined. In this example we will model a “dummy” space with 1.0 sq. ft floor area, no walls, roof, internal loads, etc. This is because all we are attempting to do is condition a particular quantity of ventilation air.

For this “dummy” space we will assume that 5,000 cfm of make-up air is required for a particular process application. Specify the space OA ventilation to be 5,000 CFM, as shown in Figure 2.

Figure 2 - Space Input - 100% OA System

After setting up the dummy space, create the DOAS air system. Equipment type can be either Packaged RTU (DX) or one of the other types such as chilled water, depending on the actual source of cooling and heating you are using. This example will use air-cooled DX so we would select a Packaged Rooftop Unit. Set the Air System Type to “CAV – MAU / DOAS”, as shown in Figure 3.

Figure 3 - System Input - General

Under System Components tab set the Ventilation Air to Constant, Sum of Space OA airflows, as shown in Figure 4. We don’t have to choose ASHRAE Std 62 since we already know the required ventilation air that we want is 5,000 CFM in this example.

Figure 4 - System Input - Ventilation Air

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If desired select Vent Reclaim check box and enter thermal efficiency and Input kW, as appropriate, as shown in Figure 5.

Under Cooling & Heating Coils specify a room-neutral supply air temperature of 72 F for cooling and 70 F for heating along with a Combustion Natural Gas heating source, as indicated in Figure 6.

Air System Properties - [MAU_DOAS]

General | **System Components** | Zone Components | Sizing Data | Equipment

☒ Ventilation Air
☒ **Vent. Reclaim**
☒ Cooling Coil
☒ Heating Coil
☐ Humidification
☐ Dehumidification
☒ Vent. Fan
☐ Exhaust Fan

Ventilation Reclaim Data

Reclaim: ☐ Sensible Heat, ☒ **Sensible & Latent Heat**

Thermal Efficiency: 70 %

Input kW: 0.200 kW

Schedule: J F M A M J J A S O N D

OK Cancel Help

Figure 5 - System Input - Vent Reclaim

Air System Properties - [MAU_DOAS]

General | **System Components** | Zone Components | Sizing Data | Equipment

☒ Ventilation Air
☒ Vent. Reclaim
☒ **Cooling Coil**
☒ Heating Coil
☐ Humidification
☐ Dehumidification
☒ Vent. Fan
☐ Exhaust Fan

Cooling Coil

Setpoint: 72.0 °F

Coil Bypass Factor: 0.100

Cooling Source: Air-Cooled DX

Schedule: J F M A M J J A S O N D

OK Cancel Help

Air System Properties - [MAU_DOAS]

General | **System Components** | Zone Components | Sizing Data | Equipment

☒ Ventilation Air
☒ Vent. Reclaim
☒ Cooling Coil
☒ **Heating Coil**
☐ Humidification
☐ Dehumidification
☒ Vent. Fan
☐ Exhaust Fan

Heating Coil

Setpoint: 70.0 °F

Heating Source: Combustion - Natural Gas

Schedule: J F M A M J J A S O N D

OK Cancel Help

Figure 6 - System Input - Cooling & Heating Coils

Room-neutral temperature air is generally specified if the design intent is to deliver supply air at or near typical room setpoints, however in some cases the designer may wish to deliver colder or warmer air to help offset some of the space thermal loads. HAP prevents the heating coil setpoint from being set warmer than the cooling coil setpoint, this would result in the two coils fighting each other since the heating coil is in the preheat position (see Figure 1 schematic) and the warmer leaving air would impose an additional load on the cooling coil downstream. This may be avoided by setting the monthly operating schedules for the two coils such that they are not in conflict. Simply enable the cooling coil only in warmer(cooling) months and disable the heating coil during these times. Do the opposite for the heating coil, that is enable during colder (heating) months and disable heating coil during the cooling months, as shown in Figure 7.

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The figure consists of two side-by-side screenshots of the 'Air System Properties - [MAU_DOAS]' dialog box. The left screenshot shows the 'Cooling Coil' tab. The 'Cooling Coil' checkbox is checked. The 'Setpoint' is 55.0 °F, 'Coil Bypass Factor' is 0.100, and 'Cooling Source' is 'Air-Cooled DX'. The 'Schedule' is J F M A M J J A S O N D. The right screenshot shows the 'Heating Coil' tab. The 'Heating Coil' checkbox is checked. The 'Setpoint' is 110.0 °F, 'Heating Source' is 'Combustion - Natural Gas', and the 'Schedule' is J F M A M J J A S O N D. Both schedules have callouts indicating 'disabled' for months J, F, M, A, M, J and 'enabled' for months J, A, S, O, N, D.

Figure 7 - System Input – Scheduled Cooling & Heating Coils

If active humidity control is required then check both the Humidification and Dehumidification check boxes and enter the lower and upper limit of supply air relative humidity along with the humidifier type, as shown in Figure 8.

The figure consists of two side-by-side screenshots of the 'Air System Properties - [MAU_DOAS]' dialog box. The left screenshot shows the 'Humidifier Data' tab. The 'Humidification' checkbox is checked. The 'Minimum RH Setpoint' is 40 %, 'Humidifier Type' is 'Direct Steam Injection', and 'Input Power' is 0 KBTU/lb. The right screenshot shows the 'Dehumidifier Data' tab. The 'Dehumidification' checkbox is checked. The 'Maximum RH Setpoint' is 60 %.

Figure 8 - System Input - Humidification & Dehumidification

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As appropriate assign Vent and Exhaust Fan settings, as indicated in Figure 9. At the bottom of the Vent Fan screen there is a Schedule button, which defines the operating schedule for when this MAU / DOAS operates. Set this appropriately along with an assumed input for average zone temperature, in this case 75 F. The “average zone temperature” input is applicable only for the ventilation fan in a standalone MAU / DOAS system. This value is an estimate of the average temperature in the zone served by the system. Because this system is not linked to a thermostat in the zone, it does not control zone temperature. Instead the zone temperature floats and an estimate of the average zone temperature is needed in order to calculate the floating temperature.

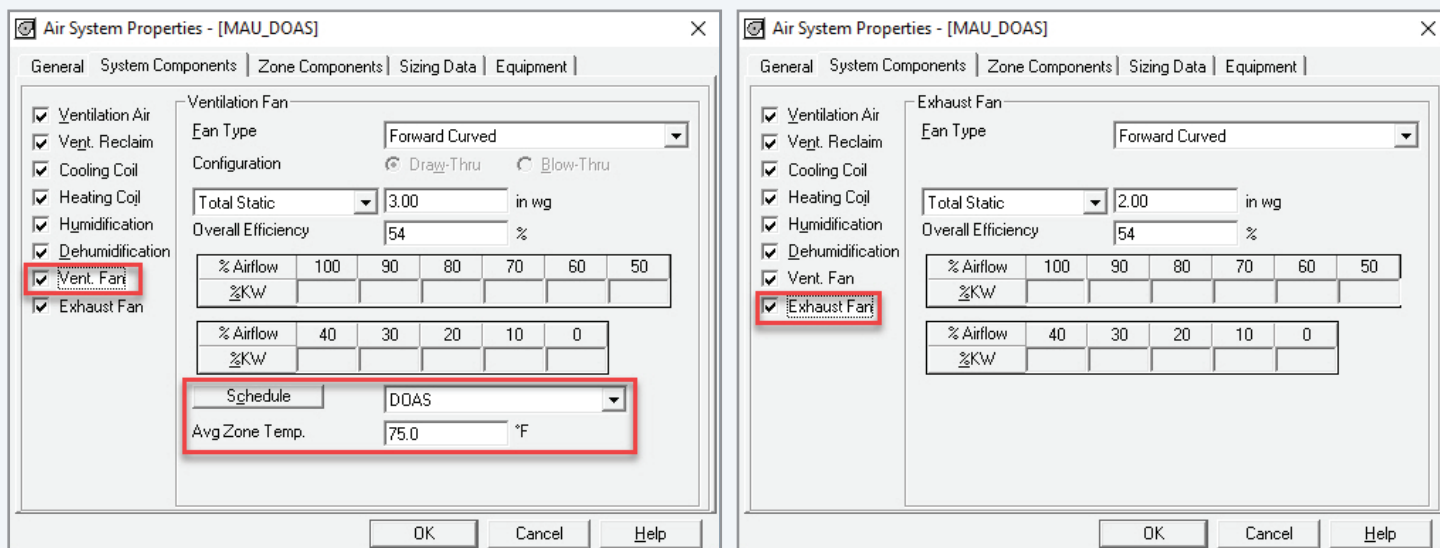


Figure 9 - System Input - Vent & Exhaust Fans

Next we must assign the “dummy” space to the system by selecting the “MAU DOAS” space and pressing the Add button which assigns it to the system. Once assigned the space appears on the right side under Zone.

Under Sizing Data tab leave this as Computer Generated.

On Equipment tab set the Vent Cooling Unit settings accordingly. Use Auto-Sizing for equipment as this will ensure the coils are automatically sized to meet the peak loads. If performing an energy simulation, instead of just computing design loads, make sure the unit efficiency (EER) is specified. Low temperature operation is defaulted to be on and we will leave that as-set. Repeat the process for the Vent Heating Unit, that is, set the sizing and heating efficiency. Press <OK> button once all system settings are complete, this saves the system.

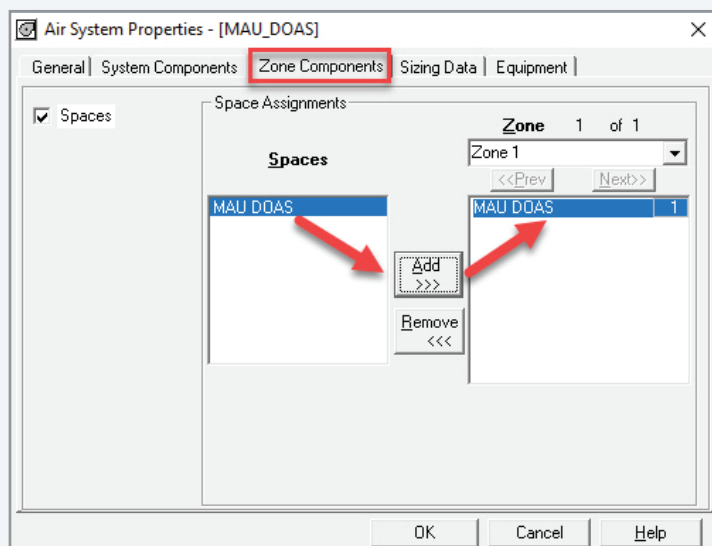


Figure 10 - System Input - Space Assignment

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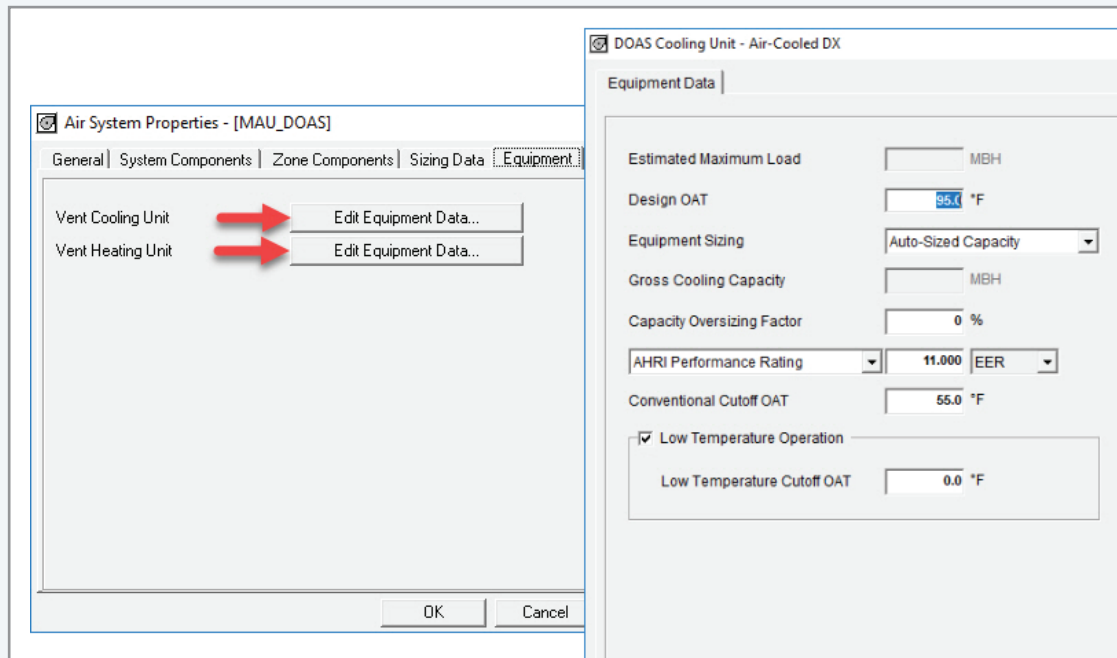


Figure 11 - System Input - Equipment Sizing Data

Save project and run design calculations to get peak coil loads. If performing an energy simulation you will need to also define a steam plant to serve the humidifier, and define a "Building" along with appropriate costs for utilities.

Right-click on the MAU_DOAS system and then select Print/View Design Results.

Run the Air System Sizing Summary report, as shown in Figure 13. This report contains the sizing requirements for all components: the pre-cooling coil (cooling coil in the MAU / DOAS), the pre-heating coil (heating coil in the MAU / DOAS), humidifier, supply fan and return fan. It may also be beneficial to run the System Psychrometrics report to see the effects of the vent reclaim device. Toggling the vent reclaim device off and re-running the report will demonstrate the sizing effects on the other system components.

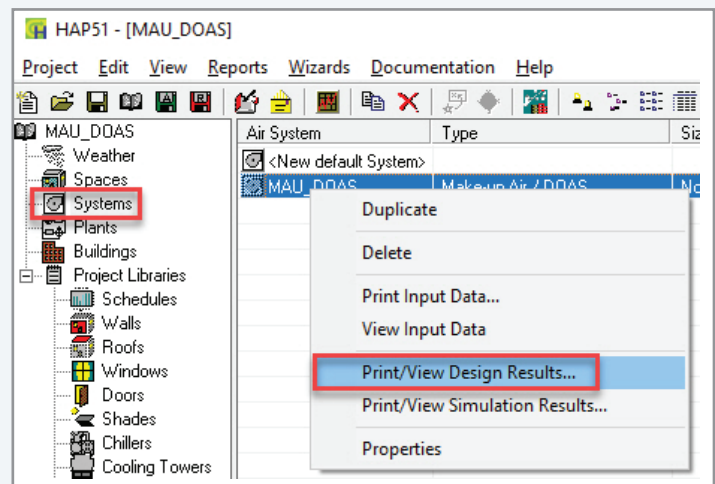


Figure 12 - System Output - Print/View Design Results

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Air System Sizing Summary for MAU_DOAS			
Project Name: MAU_DOAS Prepared by: Carrier		12/13/2017 03:51PM	
Air System Information			
Air System Name	MAU_DOAS	Number of zones	1
Equipment Class	PKG ROOF	Floor Area	1.0 ft²
Air System Type	MUA/DOAS	Location	Chicago IAP, Illinois
Sizing Calculation Information			
Calculation Months	Jan to Dec	Zone CFM Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space CFM Sizing	Individual peak space loads
Precool Coil Sizing Data			
Total coil load	10.9 Tons	Load occurs at	Jul 1500
Total coil load	130.2 MBH	OA DB / WB	91.0 / 74.0 °F
Sensible coil load	100.2 MBH	Entering DB / WB	77.3 / 66.2 °F
Coil CFM at Jul 1500	5000 CFM	Leaving DB / WB	58.3 / 57.7 °F
Max coil CFM	5000 CFM	Bypass Factor	0.100
Sensible heat ratio	0.769		
Water flow @ 10.0 °F rise	N/A		
Preheat Coil Sizing Data			
Max coil load	103.8 MBH	Load occurs at	Des Htg
Coil CFM at Des Htg	5000 CFM	Ent. DB / Lvg DB	48.2 / 67.9 °F
Max coil CFM	5000 CFM		
Water flow @ 20.0 °F drop	N/A		
Humidifier Sizing Data			
Max steam flow at Des Htg	39.12 lb/hr	Air mass flow	21958.15 lb/hr
Airflow Rate	5000 CFM	Moisture gain00178 lb/lb
Supply Fan Sizing Data			
Actual max CFM	5000 CFM	Fan motor BHP	4.11 BHP
Standard CFM	4880 CFM	Fan motor kW	3.26 kW
Actual max CFM/ft²	5000.00 CFM/ft²	Fan static	3.00 in wg
Return Fan Sizing Data			
Actual max CFM	5000 CFM	Fan motor BHP	2.74 BHP
Standard CFM	4880 CFM	Fan motor kW	2.17 kW
Actual max CFM/ft²	5000.00 CFM/ft²	Fan static	2.00 in wg
Outdoor Ventilation Air Data			
Design airflow CFM	5000 CFM	CFM/person	0.00 CFM/person
CFM/ft²	5000.00 CFM/ft²		

Figure 13 - System Output - Air System Sizing Summary

Modeling Occupant & Load Diversity in HAP

Occupants in a building often move from one area to the next, either randomly during the occupied period or in more predictable ways such as scheduled meetings, conferences or students in a school. Along with the occupants, lighting and electric equipment (computers, printers, copiers, etc) usage typically tracks people with the use of occupancy sensors or “sleep” mode on many electronics. Lights are shut-off or dimmed when people leave an area for a certain time period.

This occupant and load “diversity” should be taken into account when sizing HVAC systems or computing annual energy usage. Otherwise if we assume that design-level occupancy, lighting and electric equipment usage is at the peak design condition for all occupied hours we may significantly over-estimate the energy usage. For example, consider an office with 100 occupants. At some times of the day people are in their office while at other times some are in a meeting, which means they are not in their office. Other times people move

predictably such as children in a school moving from the classroom to the cafeteria at a predetermined time period.

Diversity in HAP can be handled by two methods. The first method is to use the Diversity Factor under Air Systems Properties > Zone Components Tab > Thermostats (see Figure 1 below). Diversity may also be modeled by utilizing fractional (hourly) schedules.

Which method to use depends on whether the occupant population is moving around the building according to a predictable schedule or whether the population moves around in an unpredictable (highly-variable or random) way.

If the movements are not predictable, (this is common), then we can make use of the Diversity Factor to size the system. If the movements are very predictable, then we can use fractional schedules and not use the Diversity Factor to design the system.

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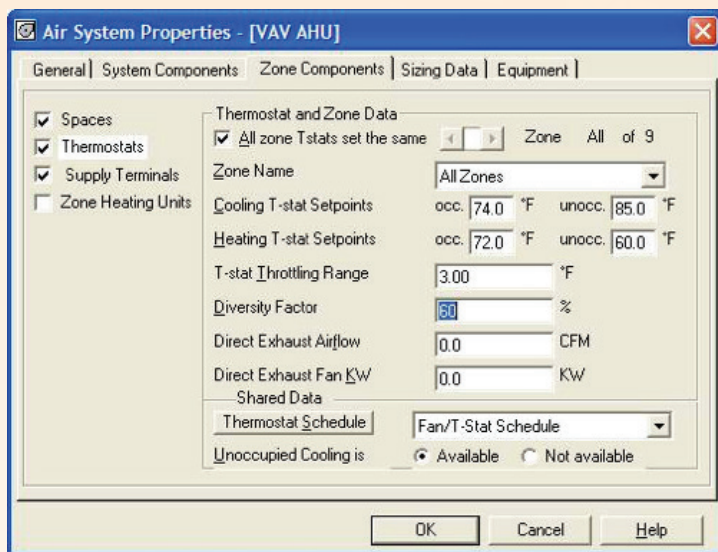


Figure 1. Diversity Factor

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Before we demonstrate the Diversity Factor let's look at a detailed, expanded definition of it; from the HAP Help system:

Zone Diversity Factor

The diversity factor is used to change lighting and occupant loads for the two stages of system design calculations. When calculating required zone airflow rates, HAP will calculate lighting and occupant loads according to the user's original space and schedule specifications. When determining cooling and heating coil loads, the program provides the option of adjusting lighting and people loads to lower levels using the diversity factor.

During coil calculations for the design cooling analysis, the occupant and lighting loads will be multiplied by the diversity factor for each zone served by the system. For example, if the occupant heat gain schedule for spaces in a zone specifies that 90% of maximum occupancy occurs for an hour, and a diversity factor of 60% is used in the air system, coil sizing will be performed using 54% occupancy (60% x 90%). Diversity factor applies to people and lights both not just people.

Diversity factors are typically applied for zones with highly variable occupancy. For example, a conference room zone varies from being densely occupied to being empty at various times of day. When calculating the required supply airflow rate for the conference room, the maximum occupancy level should be used. However, when calculating the coil loads for an HVAC system serving the entire building, it may not be necessary to use the same occupant level since the conference room occupants have moved elsewhere in the building. Considering maximum occupancy for these calculations would overestimate the total occupant load on the air system coil.

When entering diversity factors, remember that 100% means that people and lighting loads will be used as originally specified in space inputs. A 0% diversity factor means that people and lighting loads will be eliminated completely.

When you do not wish to consider diversity in coil calculations, leave the HAP default of 100% diversity factor.

We will now demonstrate the use of both methods with two examples.

Example 1 is a case where you would use the Diversity Factor. Example 2 is a case where you would not need a Diversity Factor but instead use fractional scheduling for the occupants.

Example 1: Using the Diversity Factor

- A high school building has 25 classrooms each designed for 30 occupants max. If all classrooms are at full occupancy that would be a total of 750 occupants
- However, the actual total number of occupants for the school is only 600. This is because teachers and students move around each hour. At some times during the day classrooms are fully-occupied, at other times partially occupied and may even be unoccupied. At the design stage of a project it is not possible to predict how the occupants will move around.

- All 25 classrooms are served by a common VAV/RH air system.

Solution 1

- Our design tasks include determining the peak classroom loads to size airflow and air terminals and determine the peak coincident load for the VAV AHU central cooling coil.
- When creating the classroom spaces we will specify 30 occupants per room.
- Next we create a design day schedule for the people, which is 100% from 7am to 3pm (school hours) and 0% for the other hours. See Fig 2.
- This will allow us to calculate peak loads for each classroom — accounting for the max occupancy of each room.

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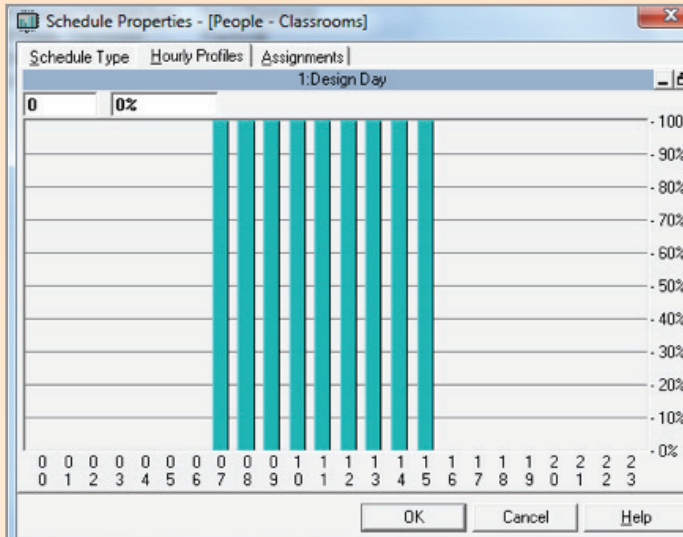


Figure 2. People Schedule – Design Day

- Next calculate the peak cooling coil load in the central AHU that serves all 25 classrooms. If you do that without considering diversity, you will be sizing the cooling coil for 750 occupants and their heat gain. But the school will not have more than 600 occupants. So, using 750 will oversize the central cooling coil equipment.

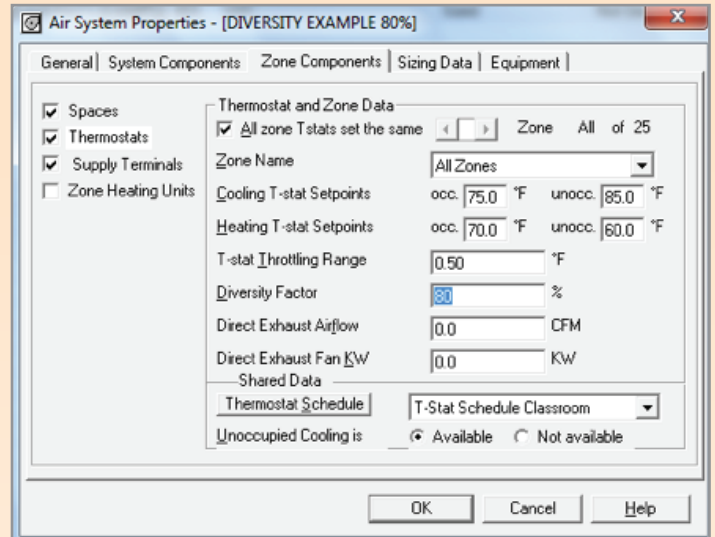


Figure 3. 80% Diversity Factor

- Therefore assign a diversity factor of $600/750 = 80\%$ to the classroom zones. That way the occupant (and lighting) heat gains are knocked down to 80% of their scheduled value for the system calculation. Your peak cooling coil load will be based on loads using 600 people in the building and will be better sized for expected conditions.

Notice the people and light loads for 100% diversity (750 people) versus 80% occupancy (600 people).

DESIGN COOLING				DESIGN COOLING			
COOLING DATA AT Aug 1500				COOLING DATA AT Aug 1500			
COOLING OA DB / WB 94.5 °F / 75.9 °F				COOLING OA DB / WB 94.5 °F / 75.9 °F			
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	4512 ft²	108142	-	Window & Skylight Solar Loads	4512 ft²	108142	-
Wall Transmission	8648 ft²	11256	-	Wall Transmission	8648 ft²	11256	-
Roof Transmission	21000 ft²	44661	-	Roof Transmission	21000 ft²	44661	-
Window Transmission	4512 ft²	25209	-	Window Transmission	4512 ft²	25209	-
Skylight Transmission	0 ft²	0	-	Skylight Transmission	0 ft²	0	-
Door Loads	0 ft²	0	-	Door Loads	0 ft²	0	-
Floor Transmission	21000 ft²	0	-	Floor Transmission	21000 ft²	0	-
Partitions	0 ft²	0	-	Partitions	0 ft²	0	-
Ceiling	0 ft²	0	-	Ceiling	0 ft²	0	-
Overhead Lighting	21735 W	58899	-	Overhead Lighting	17388 W	47119	-
Task Lighting	15750 W	47595	-	Task Lighting	12600 W	38076	-
Electric Equipment	10500 W	32508	-	Electric Equipment	10500 W	32508	-
People	750	127761	90000	People	600	102209	72000

Figure 4. System Load Summary –80% & 100% Diversity Factors

- This allows you to calculate peak loads for each room and get peak airflow requirements.

- This also allows you to get peak VAV AHU central cooling coil loads without over-sizing for the sum of all occupants, which are not present at the same time.

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Example 2: Modeling diversity with fractional schedules alone

- Consider the same school building with 25 classrooms and also a cafeteria. Each classroom is designed for 30 occupants (kids plus teachers) max, as before. The cafeteria is designed for 390 occupants max. (hourly scheduling will determine the actual number at any one time).
- The new actual total occupant count in the school are 750 (kids plus teachers) and they move around the school according to a predictable schedule between the classroom areas and the cafeteria.
- That schedule has classrooms 1-12 ($12/25 = 48\%$ of $750 = 360$) going to lunch and moving to the cafeteria from 1100-1200. Classrooms 13-25 ($13/25 = 52\%$ of $750 = 390$) taking their lunch and moving to the cafeteria from 1200-1300.
- The classrooms and the cafeteria are served by a single VAV/RH air system.

Solution 2

- Our design tasks include determining the peak classroom loads to size airflow and air terminals for the classrooms, and to determine the peak coincident cooling coil load for the VAV AHU
- When creating spaces specify 30 occupants per classroom and 390 occupants for the cafeteria.

- The design day schedule for the classrooms has 100% for 7am-3pm and 0% for the other hours. Classrooms 1-12 have 0% for 1100-1200. Classrooms have 0% for 1200-1300.
- The design day schedule for the cafeteria has 92% for 1100-1200 and 100% for 1200-1300. A nonzero lower occupancy might be used for the other school hours to indicate a small number of cafeteria workers present.

The first cafeteria period has 360 students and teachers — so $360/390 = 92\%$. The second cafeteria period has 390 students and teachers, so $390/390 = 100\%$

- This allows you to calculate peak loads for each room and get peak airflow requirements.
- This also allows you to get peak VAV AHU cooling coil loads.

So to conclude, Example 1 illustrated how to utilize a diversity factor to account for the unpredictable (random) movement of occupants in a building from one area to another during the day. Example 2 utilized fractional schedules to model diversity because in this case the movement of occupants throughout the day is predictable. Both methods result in a reduction in the required central system coils but retain the peak space/zone loads which are necessary to size zone equipment and ductwork.



Frequently Asked Questions

FAQ #1: I modeled a Ventilation Reclaim device on my air system with 70% thermal efficiency to reclaim energy from 1,500 cfm of building exhaust; however when I look at the HAP System Psychrometric Report the Ventilation Reclaim device is not recovering any heat. Why?

July DESIGN COOLING DAY, 1600							
TABLE 1: SYSTEM DATA							
Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	91.0	0.01458	1500	400	24084	41774
Ventilation Reclaim	Outlet	91.0	0.01458	1500	400	0	0
Vent - Return Mixing	Outlet	78.5	0.00954	9293	852	-	-
Preheat Coil	Outlet	78.5	0.00954	9293	852	0	-
Central Cooling Coil	Outlet	53.6	0.00821	9293	852	243781	57153
Supply Fan	Outlet	55.0	0.00821	9293	852	13778	-
Cold Supply Duct	Outlet	55.0	0.00821	9293	852	-	-
Zone Air	-	76.1	0.00857	9293	939	206188	15375
Zone Direct Exhaust	Outlet	76.1	0.00857	1500	939	-	-
Return Plenum	Outlet	76.1	0.00857	7793	939	0	-

Figure 1. System Psychrometrics Report – Ventilation Reclaim Load Zero

Answer: The first thing to verify is the setting for “Direct Exhaust” in the system under Zone Components > Thermostat as shown in Figure 2:

In this case there is 300 cfm of direct exhaust being removed directly from all five of the zones (1,500 cfm total) and this air does not flow back through the return duct and pass over the Vent Reclaim device. In HAP, “direct exhaust” implies the air is directly exhausted from the zone to outdoors. If you wish to reclaim heat from the exhaust air then do not directly exhaust the air from the zone; set this to zero and the exhaust air will pass through the return air duct and Vent Reclaim device and exchange heat with the incoming ventilation air. Removing the direct exhaust from the zones results in a Vent Reclaim load (see Figure 3 on page 14):

The screenshot shows the 'Air System Properties' window for 'ALT2 - Floor 1'. The 'Thermostat and Zone Data' tab is active. Under 'Thermostat and Zone Data', the 'All zone T stats set the same' checkbox is checked. The 'Zone Name' is set to 'All Zones'. The 'Cooling T-stat Setpoints' are 75.0 °F (occ.) and 80.0 °F (unocc.). The 'Heating T-stat Setpoints' are 70.0 °F (occ.) and 65.0 °F (unocc.). The 'T-stat Throttling Range' is 1.50 °F. The 'Diversity Factor' is 100 %. The 'Direct Exhaust Airflow' is highlighted in yellow and set to 300.0 CFM. The 'Direct Exhaust Fan kW' is 0.0 kW. Under 'Shared Data', the 'Thermostat Schedule' is set to '90.1 Office HVAC' and 'Unoccupied Cooling is' is set to 'Available'.

Figure 2. System Zone Components > Thermostat > Direct Exhaust Input

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July DESIGN COOLING DAY, 1500							
TABLE 1: SYSTEM DATA							
Component	Location	Dry-Bulb Temp (°F)	Specific Humidity (lb/lb)	Airflow (CFM)	CO2 Level (ppm)	Sensible Heat (BTU/hr)	Latent Heat (BTU/hr)
Ventilation Air	Inlet	90.4	0.01458	1275	400	5777	35242
Ventilation Reclaim	Outlet	80.4	0.01458	1275	400	13480	0
Vent - Return Mixing	Outlet	76.7	0.00943	9286	954	-	-
Preheat Coil	Outlet	76.7	0.00943	9286	954	0	-
Central Cooling Coil	Outlet	53.6	0.00826	9286	954	225894	50633
Supply Fan	Outlet	55.0	0.00826	9286	954	13769	-
Cold Supply Duct	Outlet	55.0	0.00826	9286	954	-	-
Zone Air	-	76.1	0.00861	9286	1042	206348	15375
Return Plenum	Outlet	76.1	0.00861	9286	1042	0	-

Figure 3. System Psychrometrics Report – Ventilation Reclaim Load

FAQ #2: Why does my zone cooling load peak in January and not in July or August as expected?

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (MBH)	Time of Peak Sensible Cooling Load	Zone Heating Load (MBH)	Zone Floor Area (ft²)
101-North	25.0	Jun 1700	27.8	2232.0
102-East	26.0	Jul 0900	18.5	1413.0
103-South	46.8	Oct 1400	27.8	2232.0
104-West	30.7	Jul 1700	18.5	1413.0
105-Core	53.3	Jan 1700	0.0	10588.0

Figure 1. Zone Sizing Summary Report – Jan 1700 Zone Peak Cooling Load

Answer: Generally a cooling peak load in January occurs when a zone is comprised of pure “internal” spaces without envelope loads or infiltration. In this case the only loads are internal loads from lights, people and electric equipment. Typically these loads are the same every day of the year so the loads from these internal components are constant. HAP computes design cooling loads for 288 hrs/yr, that is 24 hrs/day for all 12 months (24*12=288). When it computes the design load for January it computes for all 24 hours of design weather. Then it repeats for February then March, etc. If the loads are purely internal with no effects from outdoor ambient the load profile for all months will be exactly the same, as shown on next page in Figure 2:

(Continued on page 15)

(Continued from page 14)

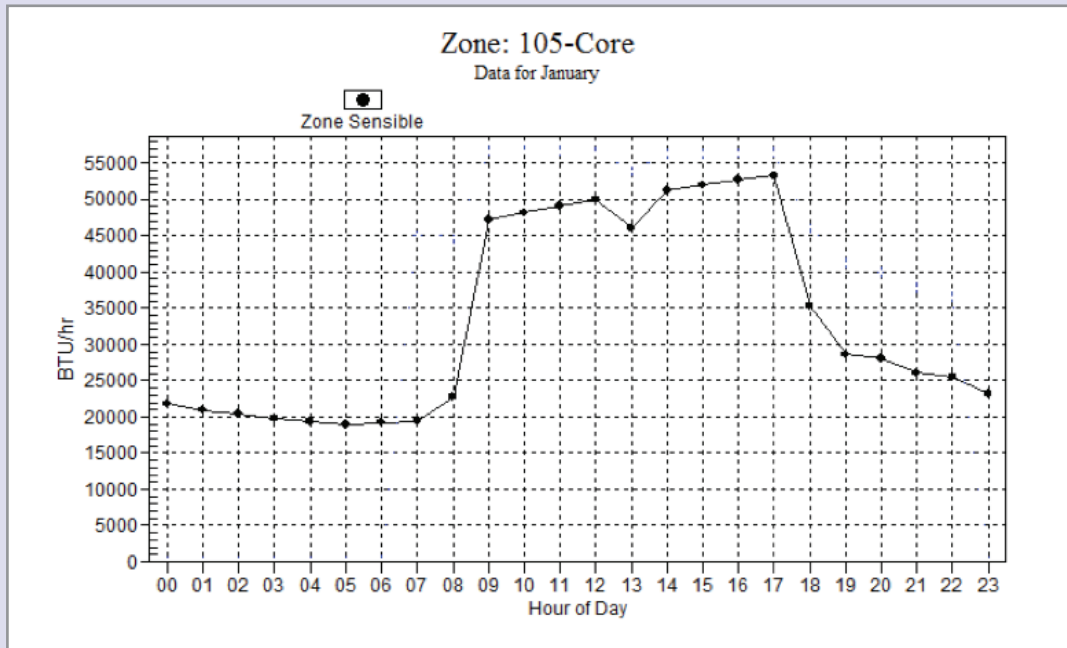


Figure 2. Zone Design Day Cooling Load Profile – January - December

The same exact load profile occurs for all 12 months. HAP computes the peak load for January – December. In this case the peak first occurs at 1700 in January. No larger load is calculated in any other month, although the same peak load occurs at 1700 in each month. As a result HAP reports the first instance of the peak load, which is January 1700.

2018 eDesign Suite Training Class Schedule







Location	Load Calculation for Commercial Buildings <i>HAP and System Design Load</i>	Energy Simulation for Commercial Buildings <i>HAP</i>	Energy Modeling for LEED® Energy & Atmosphere Credit 1 <i>HAP</i>	Advanced Modeling Techniques for HVAC Systems <i>HAP</i>	Engineering Economic Analysis <i>EEA</i>	Block Load Basic <i>Block Load</i>
Pittsburgh, PA	Jan 23	Jan 24	—	Jan 25	—	—
Cleveland, OH	Mar 6	Mar 7	—	Mar 8	—	—
Houston, TX	Mar 20	Mar 21	—	Mar 22	—	—
Philadelphia, PA	Apr 30	May 1	—	May 2	—	—

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eDesign Suite Software Current Versions (North America)

Program Name	Current Version	Functionality
 Hourly Analysis Program (HAP)	v5.10	Peak load calculation, system design, whole building energy modeling, LEED® analysis
 Building System Optimizer	v1.50	Rapid building energy modeling for schematic design
 Block Load	v4.16	Peak load calculation, system design
 Engineering Economic Analysis	v3.06	Lifecycle cost analysis
 Refrigerant Piping Design	v4.00	Refrigerant line sizing
 System Design Load	v5.10	Peak load calculation, system design



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