

6.6 HVAC Zone Level Systems

This group of building descriptors relate to HVAC systems at the zone level. For purposes that have a baseline building there is not a one-to-one relationship between HVAC components in the proposed design and the baseline building since the baseline building system is determined from building type, size, and heating source. Appendix A shows the applicability of each building descriptor for eight baseline building systems.

6.6.1 Space Temperature Control

Space Thermostat Throttling Range

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	The number of degrees that the room temperature must change to cause the HVAC system to go from no heating or cooling (i.e., space temperatures floating) to full heating or cooling.
<i>Units</i>	Degrees Fahrenheit (°F)
<i>Input Restrictions</i>	The prescribed value is 2°F. No input is needed and the prescribed value may not be overridden.
<i>Baseline Rules</i>	Same as the proposed design

Space Temperature Schedule

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	An hourly space thermostat schedule
<i>Units</i>	Data structure: temperature schedule
<i>Input Restrictions</i>	The schedules specified in Appendix B, Table 7 and detailed in Appendix C shall be used as a default. When the default temperature schedule is overridden, the user must provide justification for use of nonstandard space temperature schedule assumptions.
<i>Baseline Rules</i>	Schedules in the baseline building shall be identical to the proposed design.

6.6.2 Terminal Device Data

Terminal Type

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	<p>A terminal unit includes any device serving a zone (or group of zones collected in a thermal block) that has the ability to reheat or recool in response to the zone thermostat. This includes:</p> <ul style="list-style-type: none"> • None (the case for single zone units) • VAV box • Series Fan-Powered VAV box • Parallel Fan-Powered VAV box • Induction-type VAV box • Dual-duct mixing box (constant volume and VAV) • Two and three duct mixing dampers (multi-zone systems) • Reheat coil (constant volume systems) • Perimeter induction units
<i>Units</i>	List (see above)
<i>Input Restrictions</i>	As designed
<i>Baseline Rules</i>	Table 6.6.2-1 [1] specifies the HVAC terminal device for each of the baseline building systems. See Figure 6.1.2-1 [2] for a summary of the HVAC mapping.

Table 6.6.2-1: "Baseline Building HVAC Terminal Devices"

Baseline building System	Terminal Type
System 1 – PTAC	None
System 2 – PTHP	None
System 3 – PSZ-AC	None
System 4 – PSZ-HP	None

System 5 – Packaged VAV with Reheat	VAV Box
System 6 – Packaged VAV with PFP boxes	Parallel Fan-Powered VAV Box
System 7 – VAV with Reheat	VAV Box
System 8 – VAV with PFP boxes	Parallel Fan-Powered VAV Box

6.6.3 Terminal Heating

This group of building descriptors applies to proposed design systems that have reheat coils at the zone level. The building descriptors are applicable for baseline building systems 5 through 8.

Terminal Heat Type

Applicability	Systems that have reheat coils at the zone level
Definition	The heating source for the terminal unit. This includes: <ul style="list-style-type: none">• Electric resistance• Gas furnace• Oil furnace• Hot water• Steam
Units	List (see above)
Input Restrictions	As designed.
Baseline Rules	Table 6.6.3-1 [3] shows the terminal heat type for each baseline building system.

Table 6.6.3-1: "Baseline Building Terminal Heat Type"

Baseline building System	Terminal Heat Type
System 1 – PTAC	None
System 2 – PTHP	None
System 3 – PSZ-AC	None
System 4 – PSZ-HP	None
System 5 – Packaged VAV with Reheat	Hot Water
System 6 – Packaged VAV with PFP boxes	Electric Resistance
System 7 – VAV with Reheat	Hot Water
System 8 – VAV with PFP boxes	Electric Resistance

Terminal Heat Capacity

Applicability	Systems that have reheat coils at the zone level
Definition	The heating capacity of the terminal heating source
Units	Btu/h
Input Restrictions	As designed. However, if the unmet load hours exceed 300, the energy analyst and design team may have to increase the size of the equipment so that the unmet load hours are less than 300. See Figure 6.1.2-1 [2] and Figure 6.7.2-1 [4].
Baseline Rules	The software shall automatically size the terminal heating capacity to be 25% greater than the design loads. However, the equipment may need to be reduced in size such that the unmet load hours of the proposed design does not exceed the baseline building by more than 50. See Figure 6.7.2-1 [4].

Reheat Delta T

Applicability	Systems that have reheat coils at the zone level
Definition	This is an alternate method to enter the terminal heat capacity. It can be calculated as follows:

(6.6.3-1)

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where

<i>TeX Embedding failed!</i> T_{reheat}	heat rise across the terminal unit heating coil (°F)
T_{reheat}	heating air temperature at design (°F)
$T_{\text{cool_supply}}$	supply air temperature at the heating coil (°F)
Q_{coil}	heating coil load (Btu/h)

	CFM	airflow (cfm)
<i>Units</i>	Degrees Fahrenheit (°F)	
<i>Input Restrictions</i>	As designed, but may need to be increased if unmet load hours are greater than 300	
<i>Baseline Rules</i>	Method not used for baseline building. See Heat Capacity above.	

6.6.4 Baseboard Heat

Baseboard Capacity

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	The total heating capacity of the baseboard unit(s)
<i>Units</i>	Btu/h
<i>Input Restrictions</i>	As designed
<i>Baseline Rules</i>	Not applicable to the baseline building

Baseboard Heat Control

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	Defines the control scheme of base board heating as either: Reset by outdoor air temperature; or Controlled by a space thermostat
<i>Units</i>	List (see above)
<i>Input Restrictions</i>	As designed
<i>Baseline Rules</i>	Not applicable for the baseline building.

6.6.5 Zone Level Air Flow

VAV Air Flow

This group of building descriptors applies to proposed design systems that vary the volume of air at the zone level. The building descriptors are applicable for baseline building systems 5 through 8.

Design Airflow

<i>Applicability</i>	Systems that vary the volume of air at the zone level
<i>Definition</i>	The air delivery rate at design conditions
<i>Units</i>	cfm
<i>Input Restrictions</i>	As designed. If the unmet load hours in the proposed design are greater than 300, the building descriptor may need to be modified to meet the criterion.
<i>Baseline Rules</i>	For systems 5 through 8, the software shall automatically size the airflow to meet the baseline building loads based on a supply-air-to-room-air temperature difference of 20°F or the required ventilation air or makeup air, whichever is greater

Terminal Minimum Stop

<i>Applicability</i>	Systems that vary the volume of air at the zone level
<i>Definition</i>	The minimum airflow that will be delivered by a terminal unit before reheating occurs
<i>Units</i>	Unitless fraction airflow (cfm) or specific airflow (cfm/ft²)
<i>Input Restrictions</i>	This input must be greater than or equal to the outside air ventilation rate.
<i>Baseline Rules</i>	For systems 5 through 8, set the minimum airflow to be the greater of 0.4 cfm/ft² of conditioned floor area or the outside air ventilation rate.

Fan Powered Boxes

Fan Powered Box Type

<i>Applicability</i>	HVAC zones that have fan powered boxes
<i>Definition</i>	Defines the type of fan-powered induction box. This is either: <ul style="list-style-type: none"> • Series; or • Parallel
<i>Units</i>	List (see above)
<i>Input Restrictions</i>	As designed

Baseline Rules Applicable for baseline building systems 6 and 8 and the fan powered box type is parallel.

Fan Power

Applicability HVAC zones that have fan powered boxes

Definition The rated power input of the fan in a fan-powered box.

Units W or W/cfm

Input Restrictions As designed

Baseline Rules For baseline building systems 6 and 8, power is prescribed at 0.35 W/cfm.

Fan Power Box Induced Air Zone

Applicability HVAC zones that have fan powered boxes

Definition Zone from which a series or parallel fan-powered box draws its air

Units List (of zones)

Input Restrictions As designed

Baseline Rules If the proposed design has a plenum, then induced air will be drawn from that plenum. If the proposed design does not have a plenum, then induced air will be drawn from the space.

Parallel PIU Induction Ratio

Applicability HVAC zones that have fan powered boxes

Definition The ratio of induction-side airflow of a fan-powered box at design heating conditions to the primary airflow

Units Ratio

Input Restrictions As designed

Baseline Rules 50%

Parallel Fan Box Thermostat Setpoint

Applicability HVAC zones that have parallel fan powered boxes

Definition The temperature difference above the heating setpoint at which the parallel fan is turned on

Units Degrees Fahrenheit (°F)

Input Restrictions 2°F above the heating setpoint schedule

Baseline Rules 2°F above the heating setpoint schedule

Zone Exhaust

This group of building descriptors describes the rate of exhaust and the schedule or control for this exhaust. An exhaust system can serve one thermal block or multiple thermal blocks. Energy is summed for the exhaust system level, not the thermal block level.

Exhaust Fan Name

Applicability All HVAC zones

Definition A reference to an exhaust fan system that serves the thermal block

Units Text or other unique reference to an exhaust fan system defined in the secondary systems section.

Input Restrictions As designed

Baseline Rules Same as the proposed design

Exhaust Air Flow Rate

Applicability All HVAC zones

Definition Rate of exhaust from a thermal block

Units cfm

Input Restrictions As designed

Baseline Rules Same as the proposed design

Exhaust Fan Schedule

Applicability All HVAC zones

Definition Schedule indicating the pattern of use for exhaust air from the thermal block. This input should consider the position of fume hood sash opening. For toilets and other exhaust applications, the schedule may coincide with the operation of the exhaust fan system.

Units Data structure: schedule, fraction

Input Restrictions As designed

Baseline Rules Same as the proposed design

Outdoor Air Ventilation

Ventilation Source

Applicability All HVAC zones

Definition The source of ventilation for an HVAC system. The choices are:

- Natural (by operable openings)

- Natural (by operable openings)
- Mechanical (by fan)

<i>Units</i>	List: natural or mechanical
<i>Input Restrictions</i>	For residential units and hotel/motel guest rooms, as designed. For all other occupancies, set to mechanical.
<i>Baseline Rules</i>	For residential units, set to natural, for all other occupancies, set equal to the value for the proposed design (mechanical).

Design Ventilation Rate

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	The quantity of ventilation air that is provided to the space for the specified thermal block at maximum occupancy
<i>Units</i>	cfm or cfm/occupant
<i>Input Restrictions</i>	For the purpose of tax deduction calculations, the California ACM values from Table 4 of Appendix B shall be used. For green building ratings and Design to Earn ENERGY STAR, the COMNET values from Table 4 of Appendix B shall be used as a default. Other values may be used with appropriate documentation.
<i>Baseline Rules</i>	Same as the proposed design

Minimum Ventilation Rate

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	The minimum quantity of ventilation air that must provided to the space when the HVAC system is operating
<i>Units</i>	cfm or cfm/ft ²
<i>Input Restrictions</i>	As designed
<i>Baseline Rules</i>	Same as the proposed design

Ventilation Control Method

<i>Applicability</i>	All HVAC zones
<i>Definition</i>	<p>The method used to determine outside air ventilation needed for each hour in the simulation. This information is reported to the system serving the zone. The method of controlling outside air at the system level in response to this information is discussed under secondary systems. Options at the zone level are:</p> <ul style="list-style-type: none"> • Occupant sensors: When the space is occupied, the outside air requirement is equal to the <i>design ventilation rate</i>, otherwise, the outside air requirement is the <i>minimum ventilation rate</i>. • CO₂ sensors in the space: The outside air is determined to maintain a maximum CO₂ concentration in the space. This may be approximated by multiplying the ventilation rate per occupant times the number of occupants for that hour. • Turnstiles to determine the number of occupants in the space (appropriate for theatres, etc.): The outside air requirement is modulated based on the number of occupants in the space, based on the turnstile counts. • Fixed ventilation rate. Outside air is delivered to the zone at a constant rate and is equal to the design ventilation rate (see above).
<i>Units</i>	List (see above)
<i>Input Restrictions</i>	As designed
<i>Baseline Rules</i>	<p>For the federal tax credit, if the design occupancy is greater than 100 persons per 1,000 ft² and the system design outside air flow rate is greater than 3,000 cfm, set control method to <i>CO₂ sensors in the space</i>, otherwise set to <i>fixed ventilation rate</i>.</p> <p>For green building incentive programs, set to <i>CO₂ sensors in the space</i> if the design occupancy is greater than 40 people per 1,000 ft² and the system design outdoor air flow rate is greater than 1,200 cfm, otherwise set to <i>fixed ventilation rate</i>.</p>

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Links:

- [1] <http://www.comnet.org/mgp/content/662-terminal-device-data#baseline-building-HVAC-terminal-devices>
- [2] <http://www.comnet.org/mgp/content/hvac-system-map#hvac-mapping>
- [3] <http://www.comnet.org/mgp/content/663-terminal-heating#baseline-building-terminal-heat-type>
- [4] <http://www.comnet.org/mgp/content/system-controls#sat-cooling-setpoint-reset-based-on-outdoor-air-temperature-oat-for-dry-b-and-marine-c-climates>