



DX-Assisted Ventilation Unit Modelling Guide

DesignBuilder v7.3



V1.1 - July 2024

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1 Introduction

As temperatures rise and climate change accelerates, the risk of overheating in buildings becomes a critical concern. Traditional passive cooling methods may no longer suffice in some cases, necessitating the adoption of more active systems like Mixed Mode or DX-assisted ventilation. Mixed mode systems can be considered where natural ventilation provides sufficient cooling and ventilation during certain times of the year. These systems switch as needed between natural ventilation and mechanical cooling. In contrast, DX-assisted ventilation is a mechanical-only system that supplies outdoor air to the building. When the outdoor air is not cool enough, the DX cooling coil provides supplementary cooling.

This guide describes how to model a DX-assisted ventilation system with heat recovery using DesignBuilder's Detailed HVAC tools.

DesignBuilder offers two HVAC system specification options:

- 1) Simple HVAC
- 2) **Detailed HVAC**

To model DX-assisted ventilation units, it is necessary to use the “component by component” modelling approach enabled by Detailed HVAC.

The HVAC layout schematic for a DX-assisted ventilation unit system is shown below.

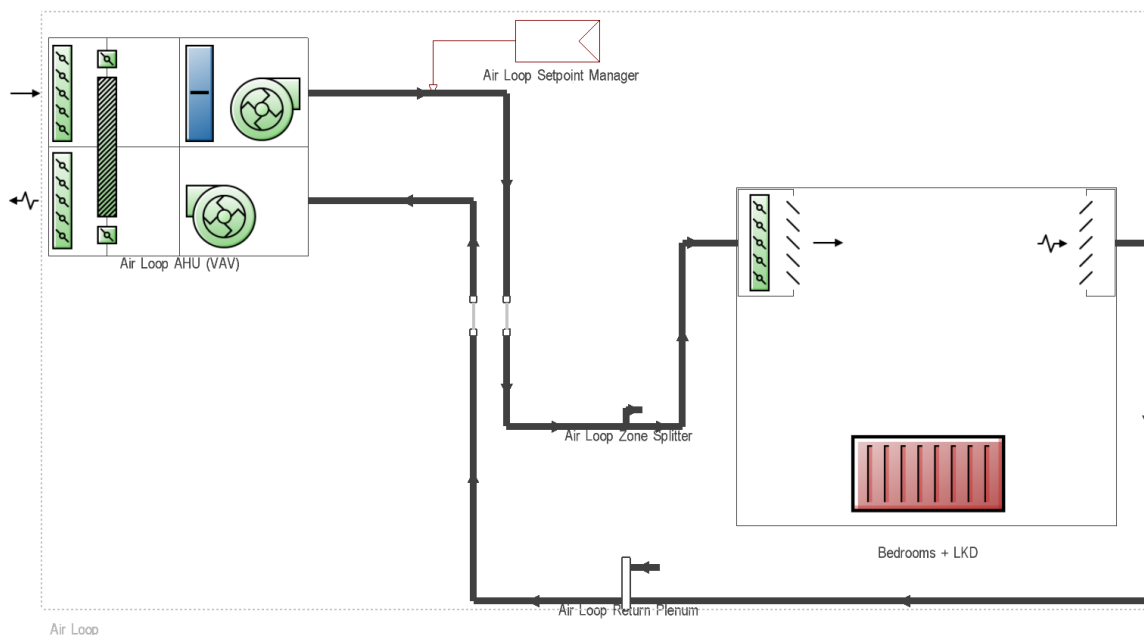


Figure 1 HVAC System Layout

This guide provides a step-by-step tutorial showing how to specify the required model data inputs.

2 Model Options

The “HVAC level detail” can be changed in “Model Options”. You should use the “Detailed” HVAC option as shown below.

The “Detailed HVAC Activity Data” should be left as “1-Simple HVAC Data”.

Note that an [HVAC module](#) license is required to access Detailed HVAC.

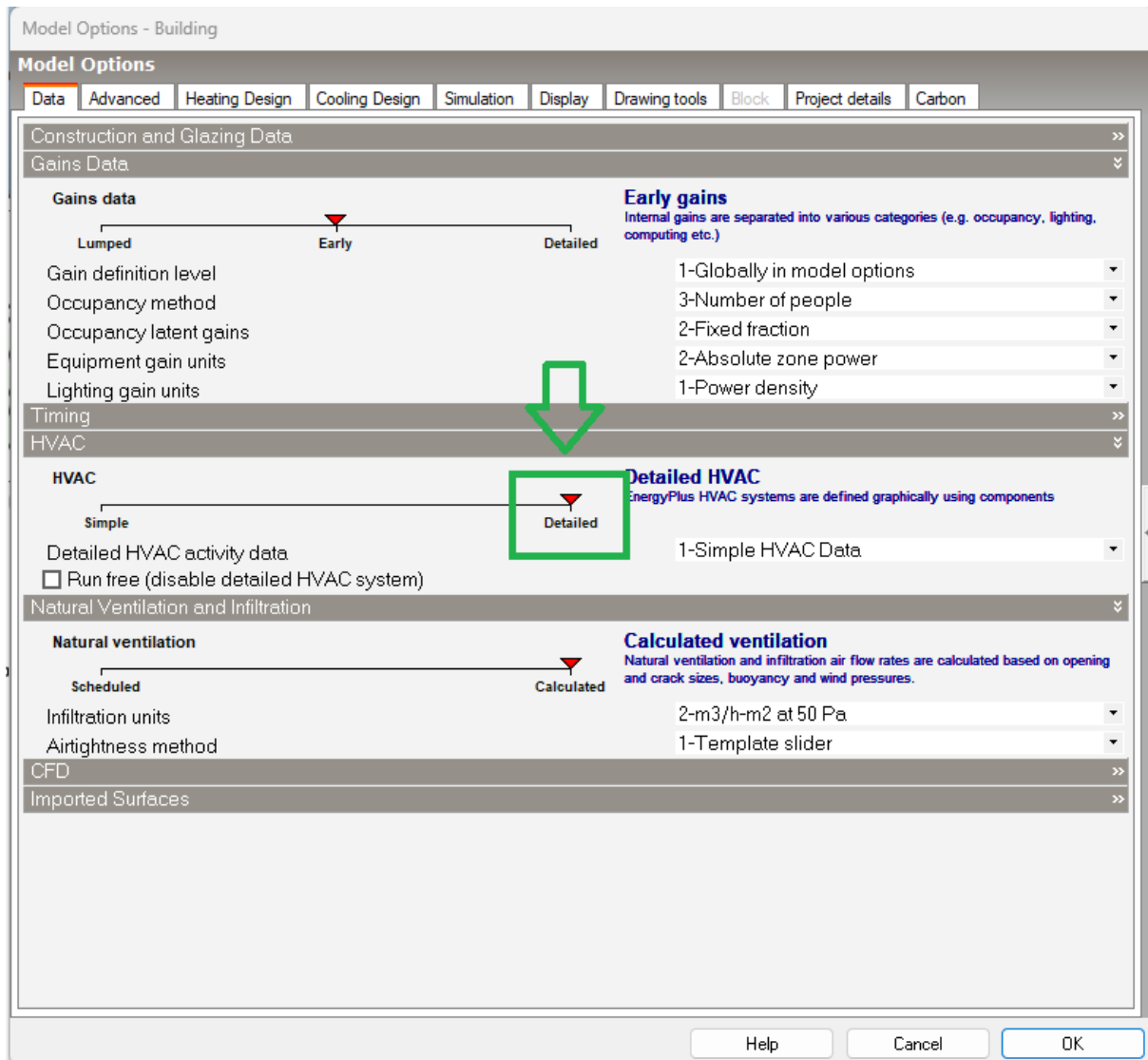


Figure 2 Model Options

3 HVAC System Layout

The MVHR ventilation system is built using the “Generic” VAV Air Loop with the following components:

- Heat Recovery Heat Exchanger
- DX Cooling Coil to provide active cooling
- Setpoint Manager
- Return plenum

3.1 Air Handling Unit

The AHU can be accessed via the model layout or the navigator tree:

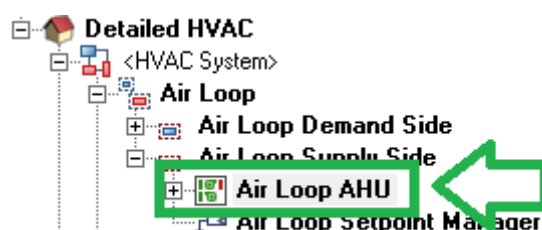


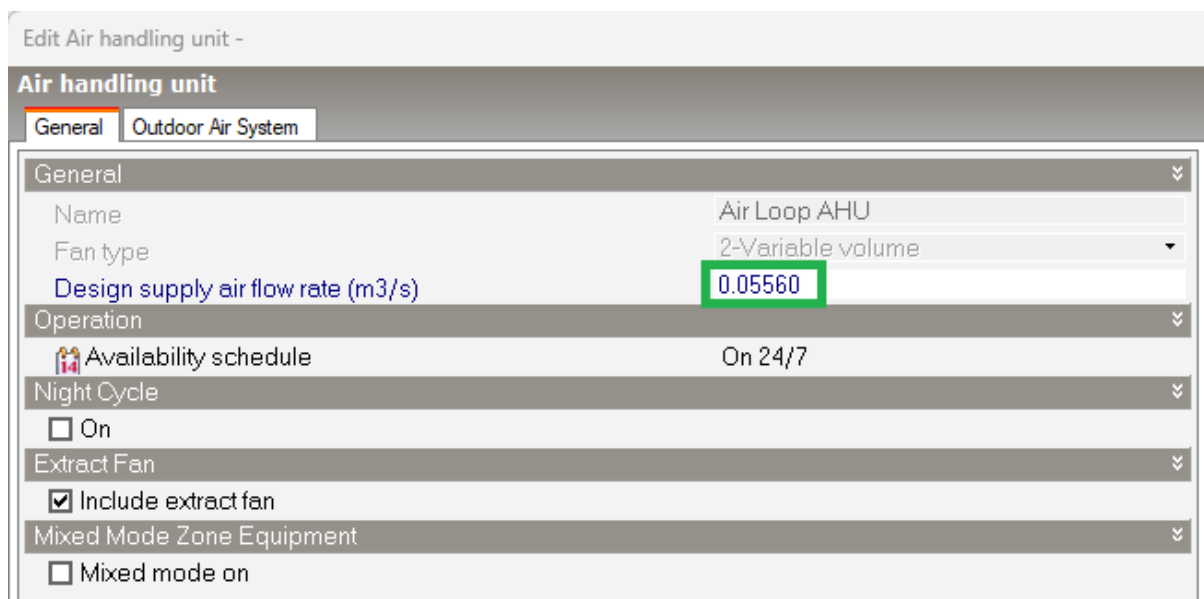
Figure 3 Navigator Tree

Generic air system attributes are defined at two levels:

1. Air Loop level – sizing parameters, this specification is less important for our case as most inputs will be hard-set
2. **Air Loop AHU level – general unit specification**

The Air Handling Unit dialog includes two tabs, “General” and “Outdoor Air System” as shown in the screenshots below.

The unit “Design supply air flow rate” is defined in the “General” tab:



Edit Air handling unit -

Air handling unit

General Outdoor Air System

General

Name Air Loop AHU

Fan type 2-Variable volume

Design supply air flow rate (m3/s) 0.05560

Operation

Availability schedule On 24/7

Night Cycle

☐ On

Extract Fan

☒ Include extract fan

Mixed Mode Zone Equipment

☐ Mixed mode on

Figure 4 Air Handling Unit Dialog

Heat Recovery specification is set up on the “Outdoor Air System” tab:

Edit Air handling unit -

Air handling unit

General Outdoor Air System

Recirculation

☐ On

Heat Recovery

☒ On

General

Nominal supply air flow rate (m3/s) Autosize

Nominal electric power (W) 0.000

Supply air outlet temperature control 2-Yes

 Supply air outlet setpoint temperature schedule Heating control temperature schedule:

Heat exchanger type 1-Plate

Economiser lockout 2-No

Effectiveness

Sensible

at 75% Heating air flow	0.840
at 75% Cooling air flow	0.840
at 100% Heating air flow	0.850
at 100% Cooling air flow	0.850

Latent

at 75% Heating air flow	0.000
at 75% Cooling air flow	0.000
at 100% Heating air flow	0.000
at 100% Cooling air flow	0.000

Frost Control

Frost control type 1-None

Threshold temperature (°C) 1.70

Heat Recovery Operation

 Availability schedule On 24/7

Figure 5 Heat Recovery Specification

The “Supply air outlet setpoint temperature schedule” can be adjusted to control the passive heat recovery setpoint.

3.2 DX Cooling Coil

The “AHU” sub-components can be accessed via the model layout or the navigator tree:

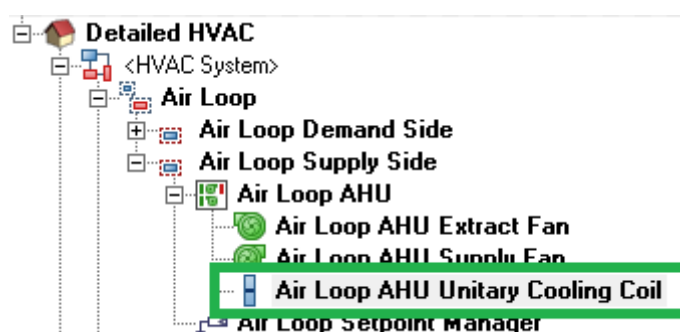


Figure 6 Cooling Coil Navigator Location

The coil capacity needs to be adjusted per the manufacturer’s specifications:

Edit DX Cooling Coil -

DX cooling coil

DX Cooling Coil

General

Name	Air Loop AHU Unitary Cooling Coil
Coil type	1-Single speed
Rated total cooling capacity (W)	1860.0
Rated sensible heat ratio (SHR)	Autosize
Gross rated COP	2.7000
Rated air flow rate (m3/s)	Autosize
Rated evaporator fan power per volume flow rate (W/(m3/s))	773.300

Operation

Availability schedule	On 24/7
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Performance Curves

☒ Total cooling capacity function of temperature curve	DXClgCoilTotalClgCapFuncTemperature
☒ Total cooling capacity function of flow fraction curve	DXClgCoilTotalClgCapFuncFlowFraction
☒ Energy input ratio (EIR) function of temperature curve	DXClgCoilEnergyInputRatioFuncTemperature
☒ Energy input ratio (EIR) function of flow fraction curve	DXClgCoilEnergyInputRatioFuncFlowFraction
☒ Part load fraction correlation curve	DXCoilPartLoadFractionCorrelation

Condenser

Condenser type	1-Air cooled
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Latent Capacity Degradation

Crankcase Heater

Run Settings

☒ Run on sensible load
☐ Run on latent load

DOAS Settings

☐ Use DX cooling coil for DOAS

Figure 7 Cooling Coil Specification

3.3 Setpoint Manager

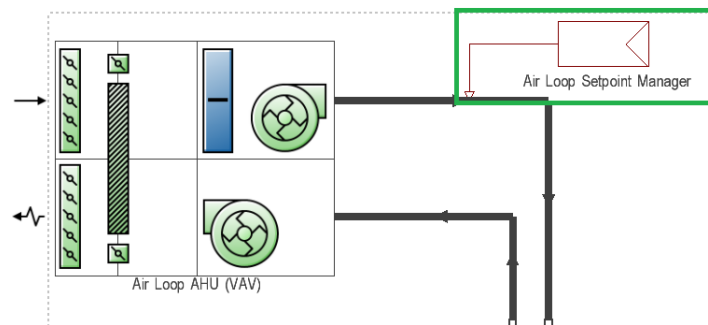


Figure 8 Setpoint Manager

The Air loop setpoint manager controls the unit supply air temperature.

The “multi-zone” control considers the setpoint temperature in all connected zones.

For cases with a single thermostat control, change the Setpoint Manager Type to “Single zone cooling”.

Edit Setpoint manager -

Setpoint manager

Setpoint Manager

General	
Name	Air Loop Setpoint Manager
Type	13-Multi-zone cooling average
Control variable	1-Temperature
Supply Air Temperatures	
Minimum supply air temperature (°C)	12.00
Maximum supply air temperature (°C)	35.00

Figure 9 Setpoint Manager Inputs

3.4 Return Plenum

To account for the return air being transferred through common spaces, DesignBuilder includes the “Return Plenum” component.

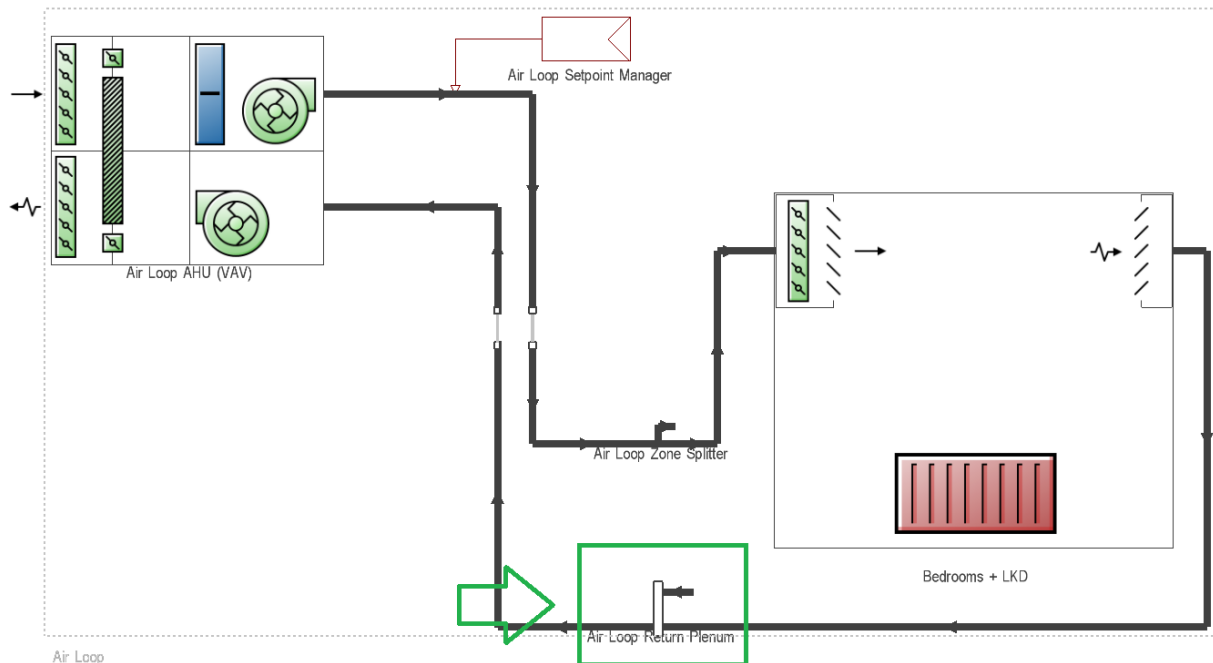


Figure 10 Return Plenum

The only input is the zone reference.

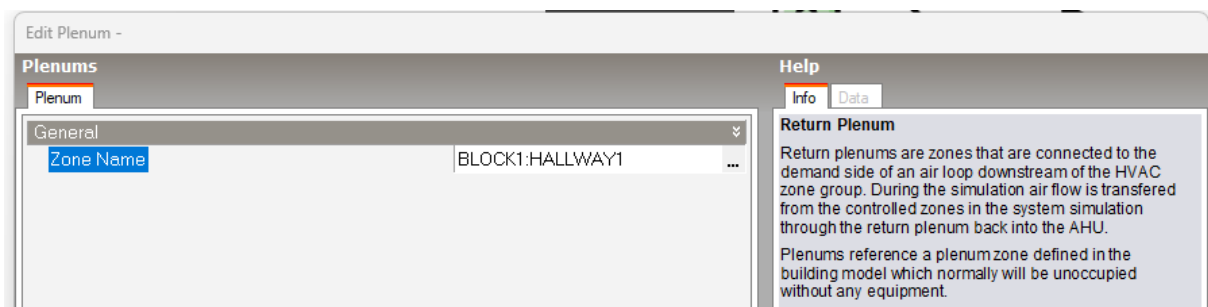


Figure 11 Return Plenum Zone Specification

The simulation engine allows only a single return plenum zone, usually the hallway/corridor is the most common choice.

Note that the plenum zone cannot be included in any HVAC zone group.

If the return plenum isn't present, replace the component with an air “Mixer” component.

3.5 Zone Air Terminal

The zone supply element is represented by the VAV:NoReheat air terminal.

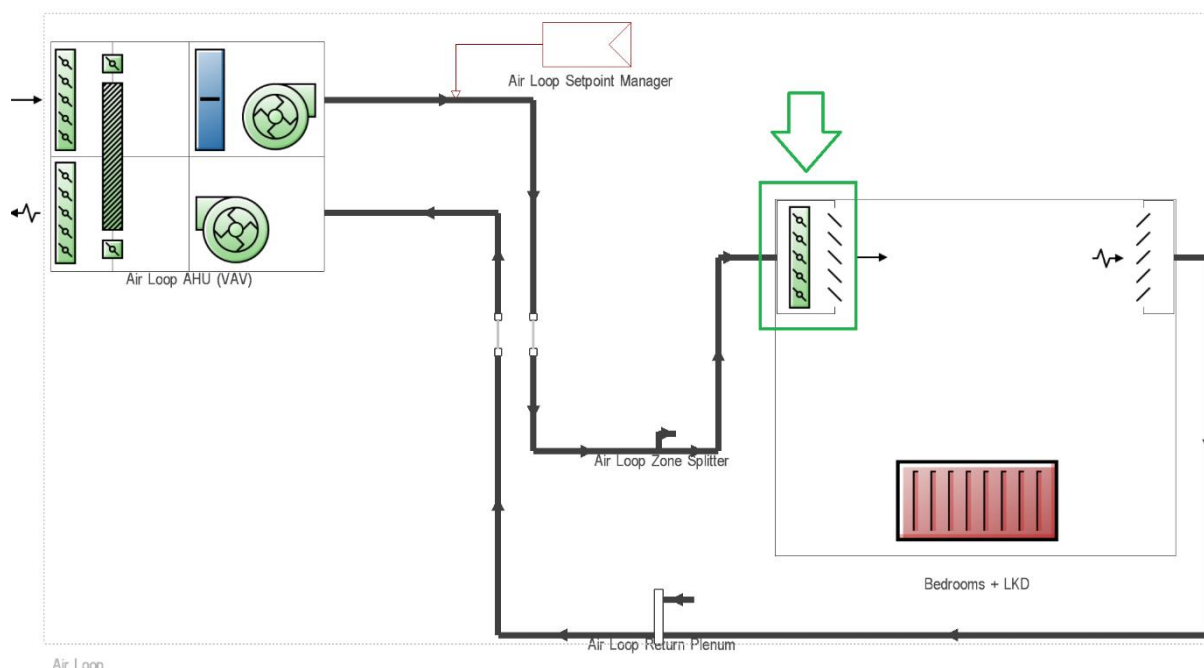


Figure 12 VAV Terminal

The main air terminal inputs are:

1. Maximum airflow rate – the “boost” ventilation rate
2. Constant minimum airflow fraction – the “base” flow rate (following the Part F)



Figure 13 VAV Terminal Inputs

The accompanying files include the “Airflow calculations.xlsx” spreadsheet to calculate the input values.

[illegible]

Whole dwelling ventilation

1.23 Supply air for the dwelling should be delivered through one of the following means.

- Continuous supply fans.
- Background ventilators.

1.24 The minimum whole dwelling ventilation rate for the supply of air to the habitable rooms in a dwelling should meet both of the following conditions.

- A minimum rate of 0.3 litres per second per m² of internal floor area (this includes all floors, e.g. for a two-storey building, add the ground-floor and first-floor areas).
- A minimum rate determined by the number of bedrooms, as specified in Table 1.3.

Table 1.3 Minimum whole dwelling ventilation rates determined by the number of bedrooms

Number of bedrooms ⁽²⁾	Minimum ventilation rate by number of bedrooms [l/s]
1	19
2	25
3	31
4	37
5	43

NOTES:

1. If the dwelling only has one habitable room, a minimum ventilation rate of 13l/s should be used.
2. For each additional bedroom, add 6l/s to the values in Table 13.

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Figure 14 Airflow Calculation

Note that the “Model Data Grid View” (MDGV) feature allows the terminal characteristics to be entered in table mode.



Figure 15 Model Data Grid View Toolbar Location

The required “ADU: VAV no reheat” Layout can be found on the MDGV “HVAC” tab.

Search (Ctrl+F)		Air Terminal: VAV No Reheat						
Drag a column header here to group by that column.								
		General					Outdoor Air	Operation
Name	Zone Group	Maximum air flow rate	Zone minimum air flow	Constant minimum...	Fixed minimum air flow...	Minimum air flow f...	Control on outdoor...	Availability schedule
BLOCK1:LIVINGROO...	Bedrooms + LKD	0.02889	Constant	0.450	0.10000	Min supply air flow f...	☐	On 24/7
BLOCK1:DOUBLED...	Bedrooms + LKD	0.01333	Constant	0.450	0.10000	Min supply air flow f...	☐	On 24/7
BLOCK1:DOUBLED...	Bedrooms + LKD	0.01333	Constant	0.450	0.10000	Min supply air flow f...	☐	On 24/7

Figure 16 Model Data Grid View VAV Inputs

4 Model Data

In the “Simple HVAC Data” mode, HVAC components are controlled using the Model data inputs on the Activity and HVAC tabs.

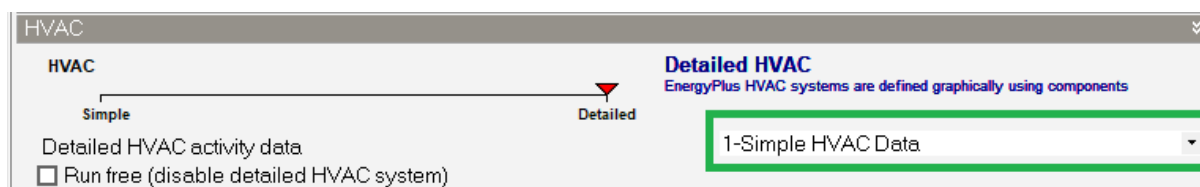


Figure 17 HVAC Activity Data Level

This section summarizes the relevant HVAC system setpoints.

4.1 Activity Tab

“Active cooling” is controlled by the zone thermostat setting.

Heating Setpoint Temperatures	
Heating (°C)	21.0
Heating set back (°C)	12.0
Cooling Setpoint Temperatures	
Cooling (°C)	24.0
Cooling set back (°C)	28.0

Figure 18 Cooling Setpoint

4.2 HVAC Tab

“Cooling” needs to be activated in zones with air terminals (for “Multizone” control).

To apply “constant” setpoint request, use the “On 24/7” schedule as shown below.

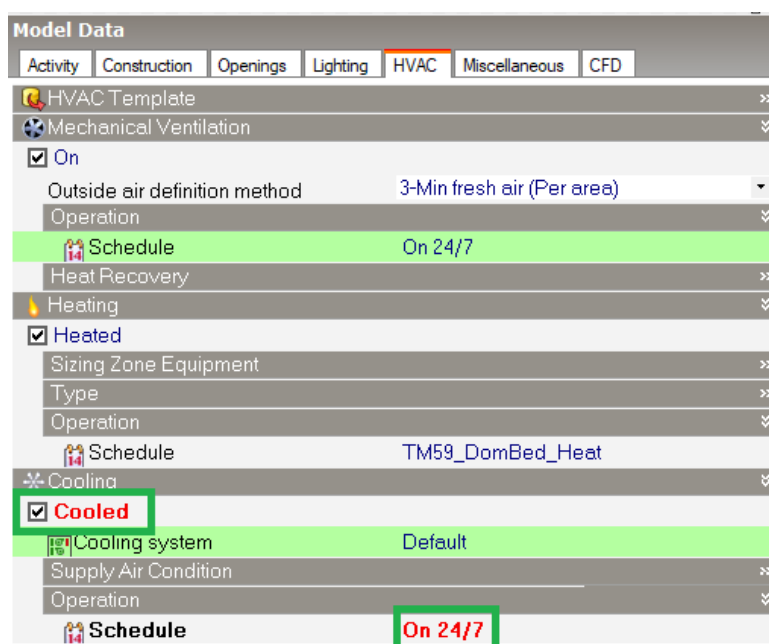


Figure 19 HVAC Cooling Schedule

5 TM59 Calculation Options

When generating TM59 outputs for overheating assessments, DesignBuilder includes a “safe check” to avoid accidentally leaving the cooling system on.

To disable excluding cooled zones from the results, select the “Include cooled zones” checkbox.

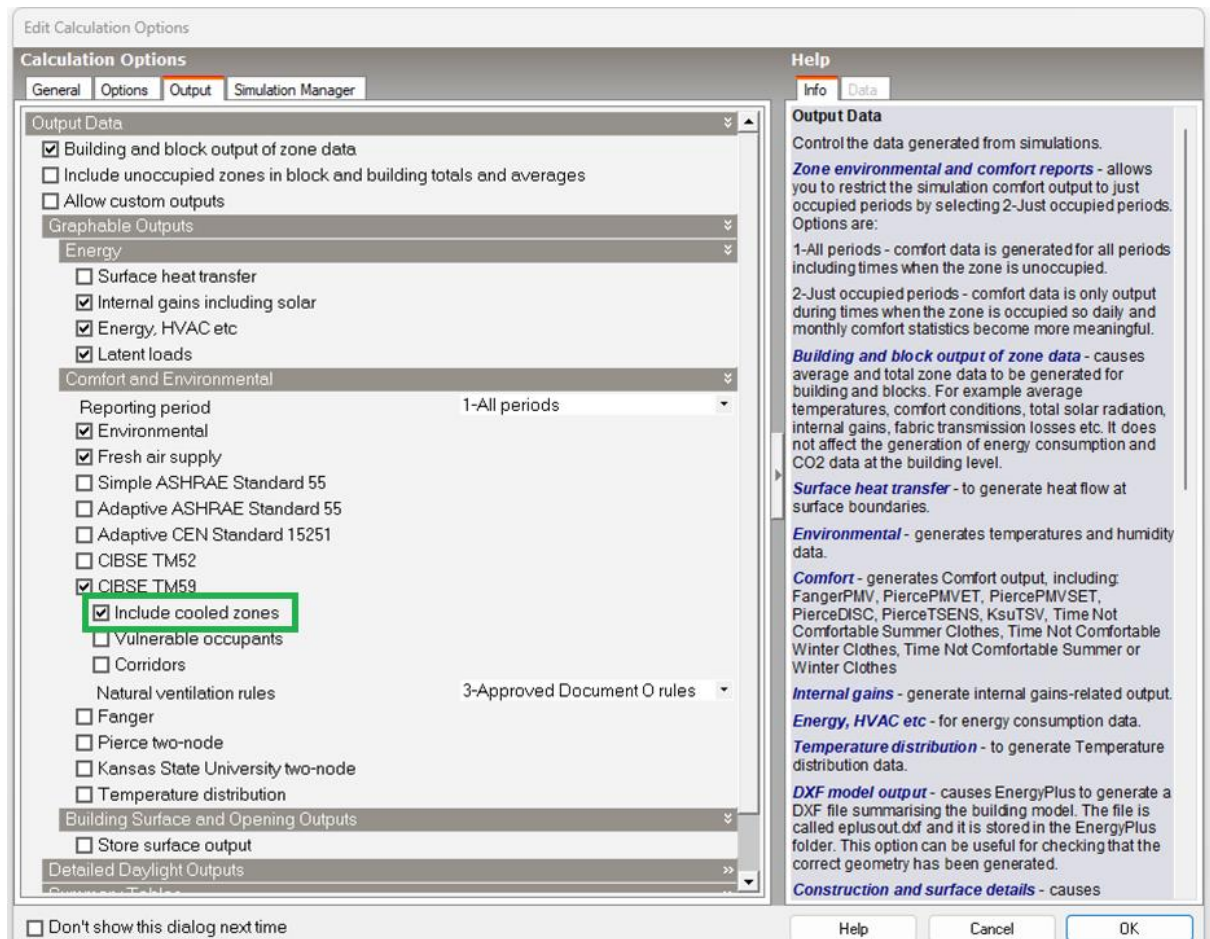


Figure 20 TM59 Output Specification