# DX-Assisted Ventilation Unit Modelling Guide

## DesignBuilder v7.3

V1.1 - July 2024

# Contents

# 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.

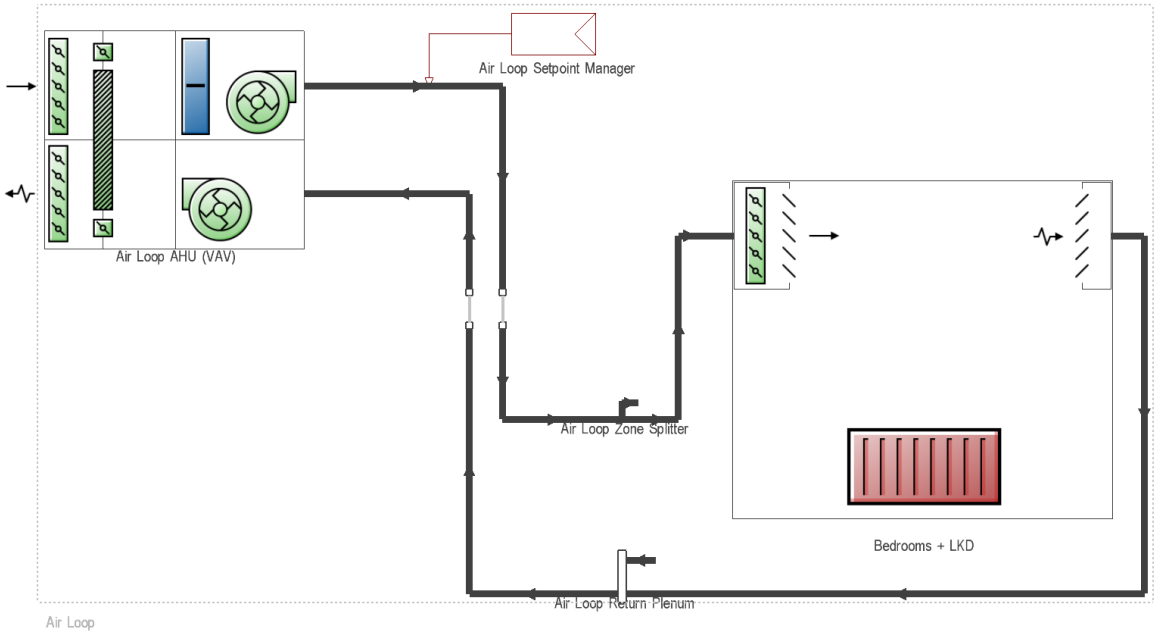


*Figure 1 HVAC System Layout*

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.

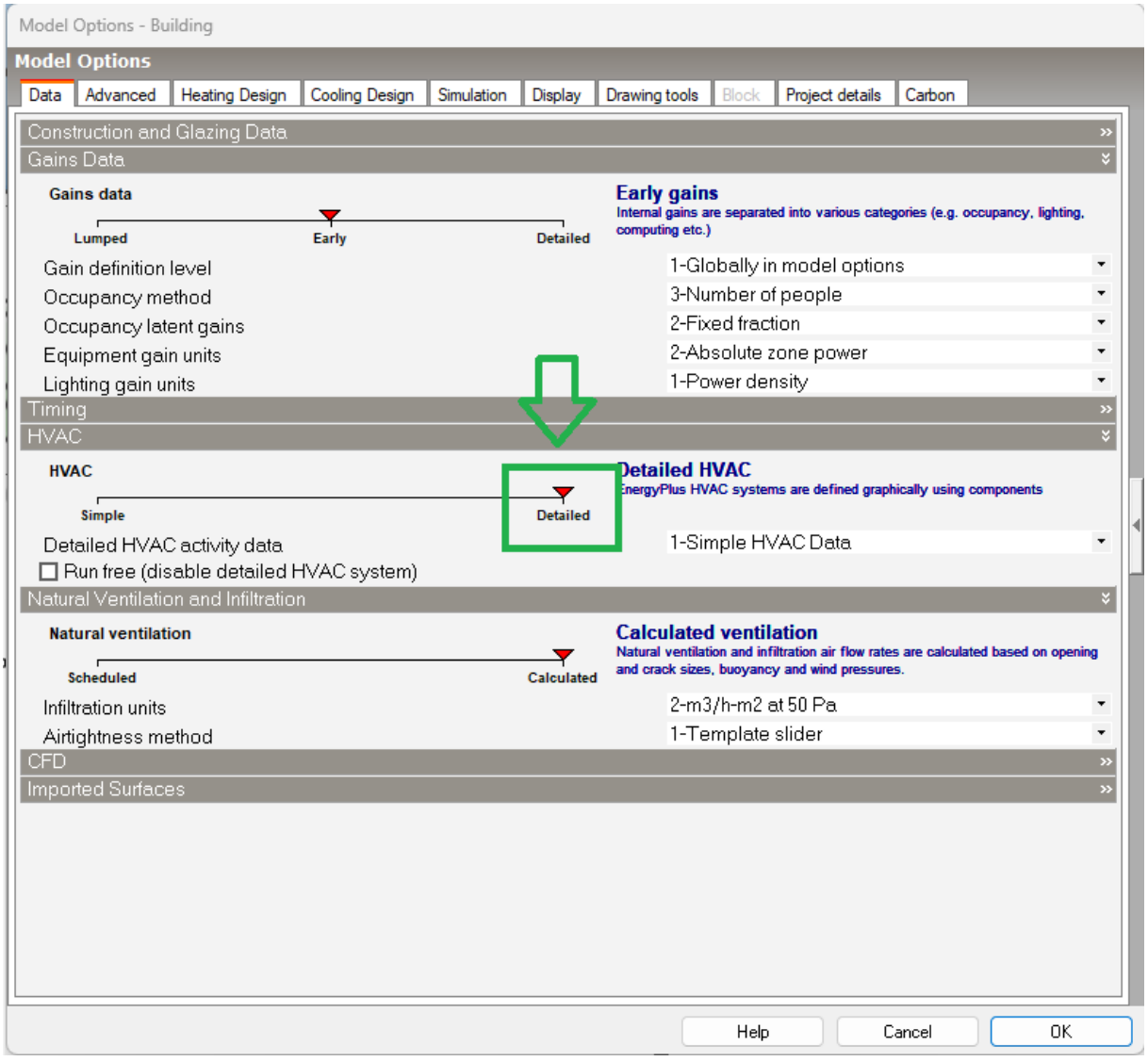


*Figure 2 Model Options*

# 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:

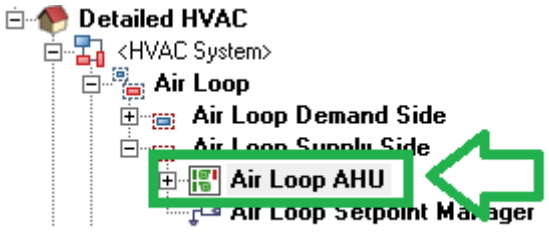


*Figure 3 Navigator Tree*

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:

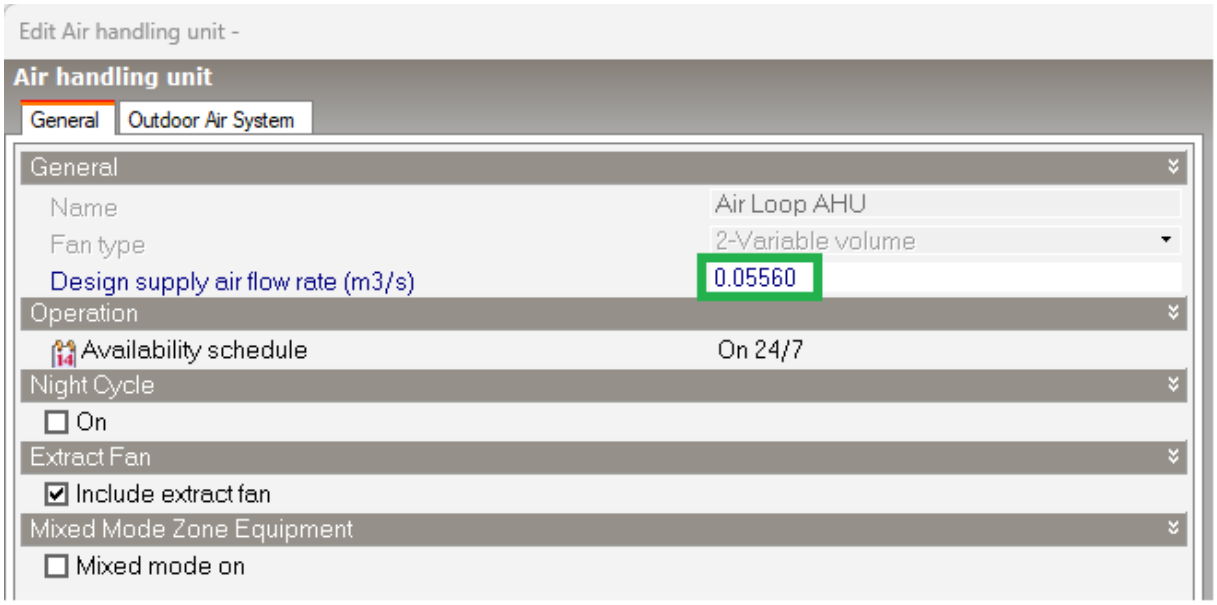


*Figure 4 Air Handling Unit Dialog*

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

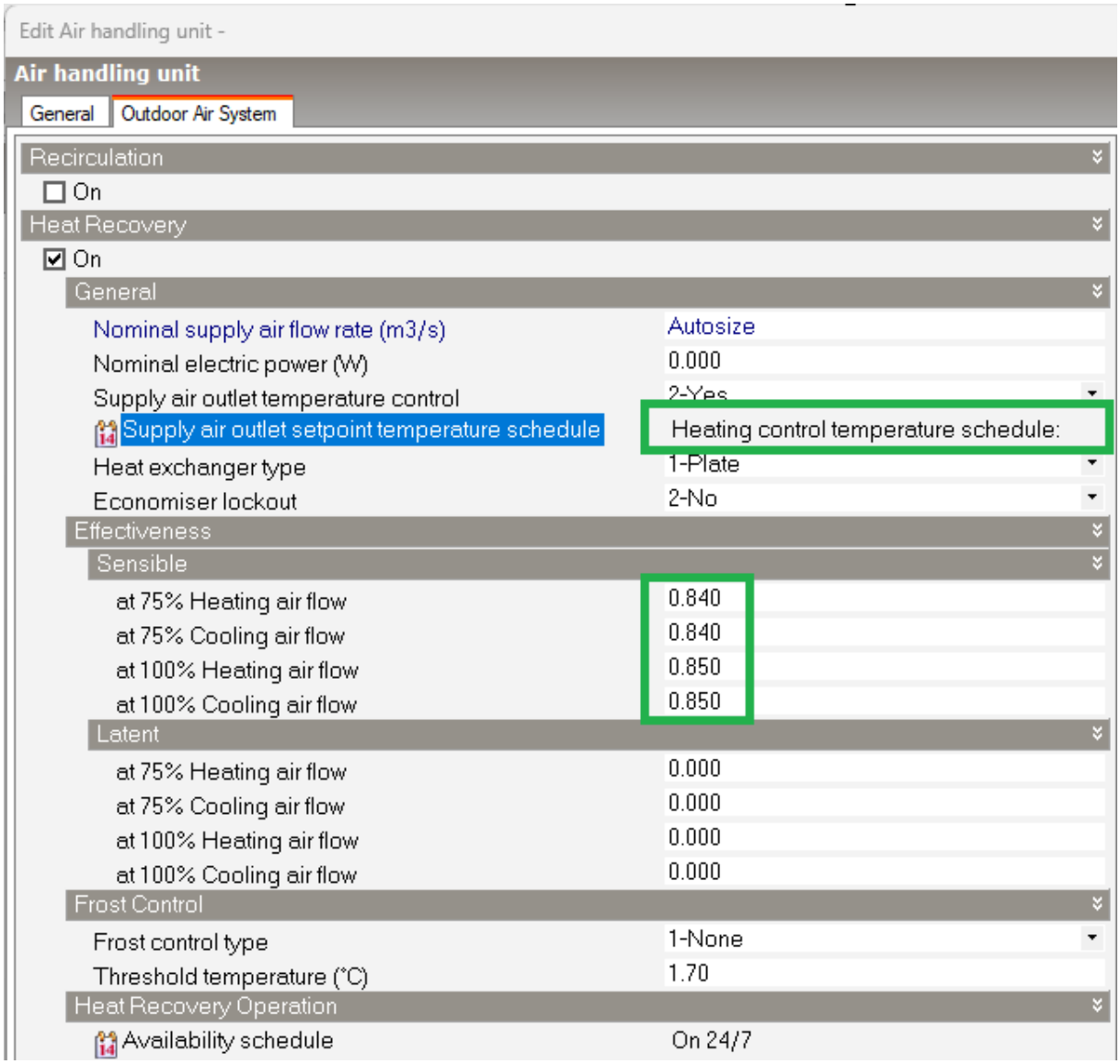


*Figure 5 Heat Recovery Specification*

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:

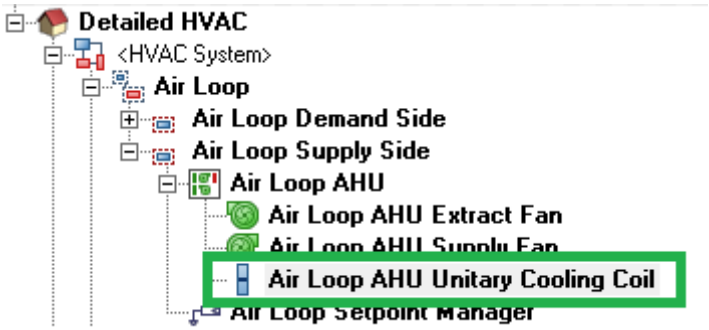


*Figure 6 Cooling Coil Navigator Location*

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

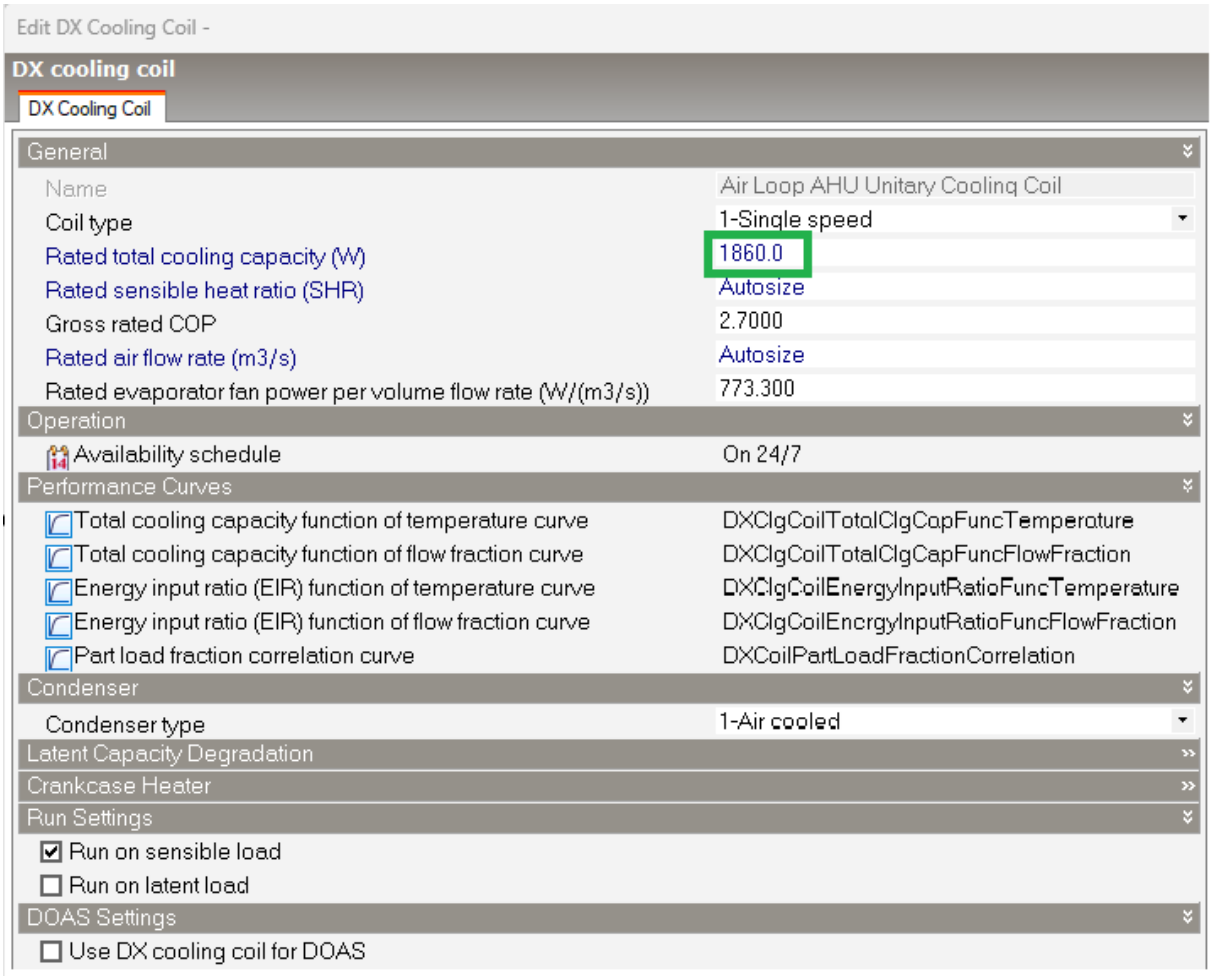


*Figure 7 Cooling Coil Specification*

## 3.3 Setpoint Manager

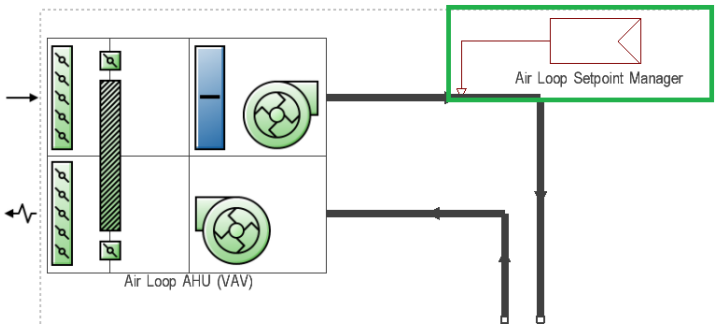


*Figure 8 Setpoint Manager*

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”.

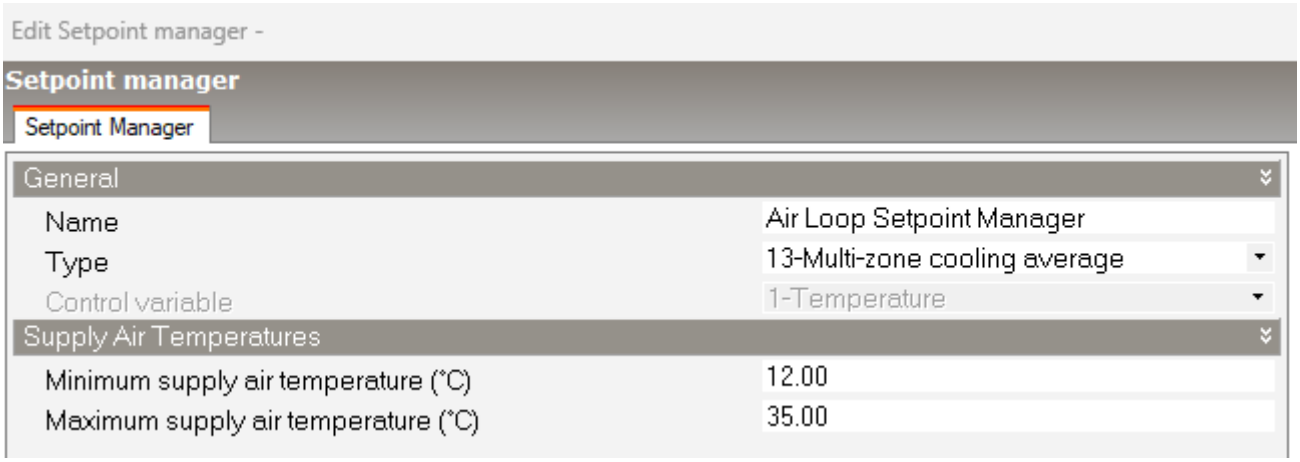


*Figure 9 Setpoint Manager Inputs*

## 3.4 Return Plenum

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

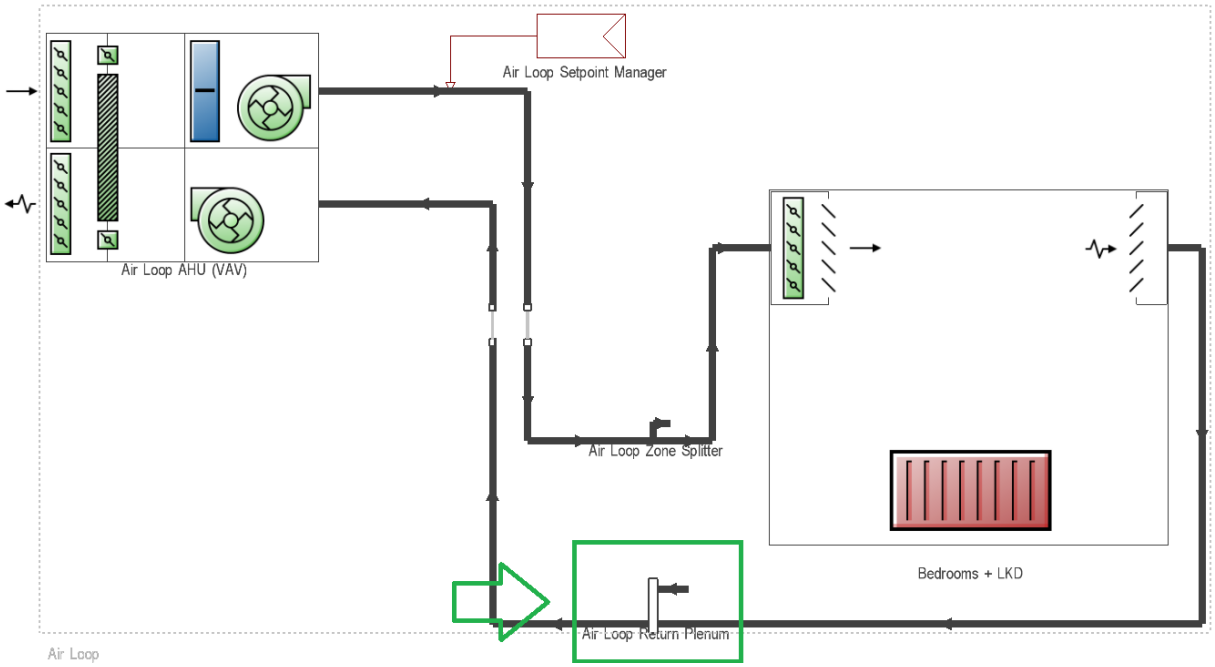


*Figure 10 Return Plenum*

The only input is the zone reference.

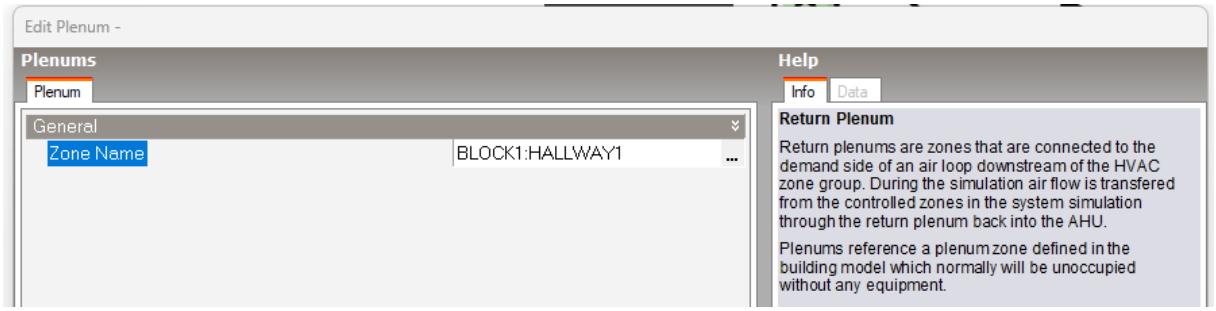


*Figure 11 Return Plenum Zone Specification*

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.

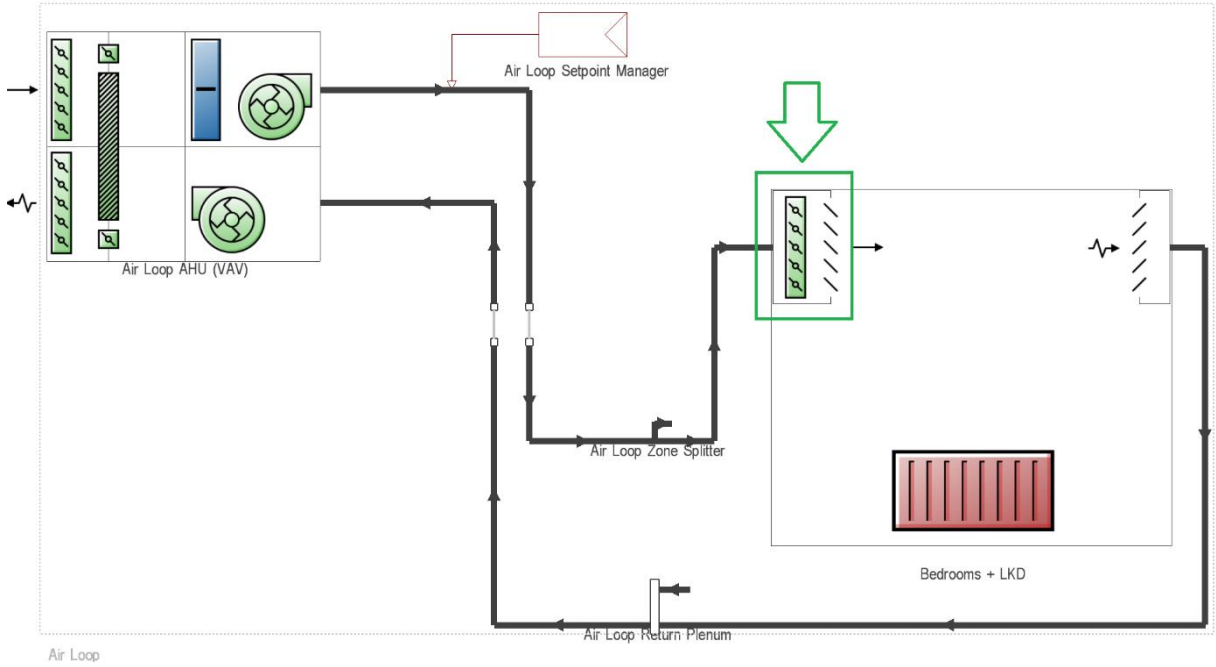


*Figure 12 VAV Terminal*

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)

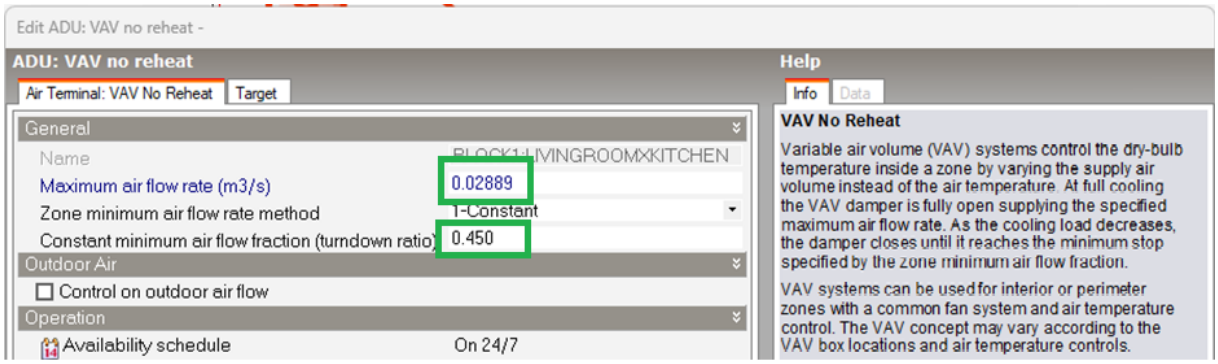


*Figure 13 VAV Terminal Inputs*

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

| Inputs | | |
|---|---|---|
| Dwelling floor area | 79 | $m^2$ |
| Number of bedrooms | 2 | - |
| AHU nominal flow | 200 | $m^3/h$ |

| Minimum whole dwelling ventilation rate | | |
|---|---|---|
| Per internal floor area | 23.7 | l/s |
| Per number of bedroooms | 25 | l/s |
| **Maximum** | 25 | **l/s** |

| Air loop nominal supply flow | 0.055556 | $m^3/s$ |
|---|---|---|

| Zone | Part F | | Terminal | |
|---|---|---|---|---|
| | | | Max | Min |
| | l/s | $m^3/s$ | $m^3/s$ | - |
| Bedroom 1 | 6 | 0.006 | **0.013333** | **0.45** |
| Bedroom 2 | 6 | 0.006 | **0.013333** | **0.45** |
| LKD | 13 | 0.013 | **0.028889** | **0.45** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | | 0 | **0** | **0** |
| | 25 | | 0.055556 | |

## Whole dwelling ventilation

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

a. Continuous supply fans.

b. 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. A minimum rate of 0.3 litres per second per $m^2$ of internal floor area (this includes all floors, e.g. for a two-storey building, add the ground-floor and first-floor areas).

b. 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[1][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 1.3.

*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)

Drag a column header here to group by that column.

| | | Air Terminal: VAV No Reheat | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | General | | | | | Outdoor Air | Operation |
| Name | Zone Group | Maximum air flow ra... | Zone minimum air fl... | Constant minimum... | Fixed minimum air fl... | Minimum air flow fr... | 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:DOUBLEBED... | Bedrooms + LKD | 0.01333 | Constant | 0.450 | 0.10000 | Min supply air flow f... | ☐ | On 24/7 |
| BLOCK1:DOUBLEBED... | 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.

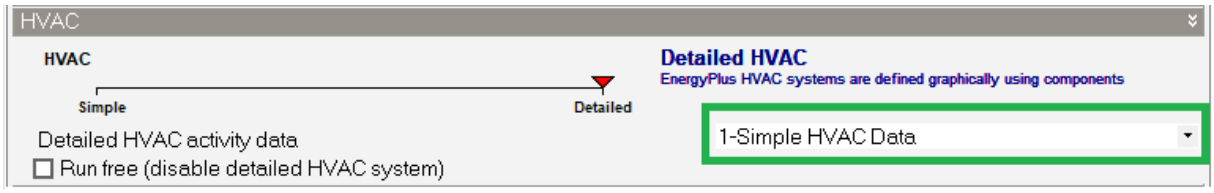


*Figure 17 HVAC Activity Data Level*

This section summarizes the relevant HVAC system setpoints.

## 4.1 Activity Tab

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

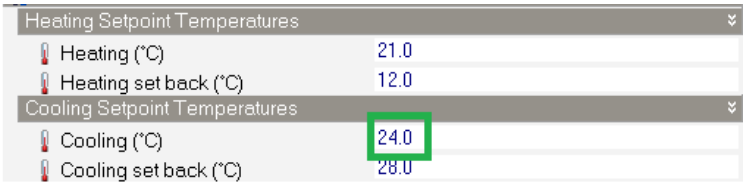


*Figure 18 Cooling Setpoint*

## 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.

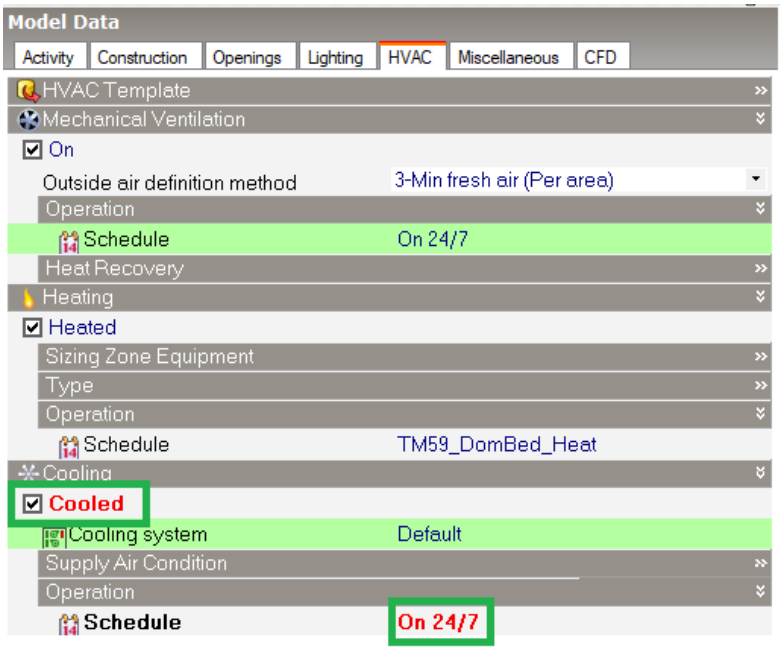


*Figure 19 HVAC Cooling Schedule*

# 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.

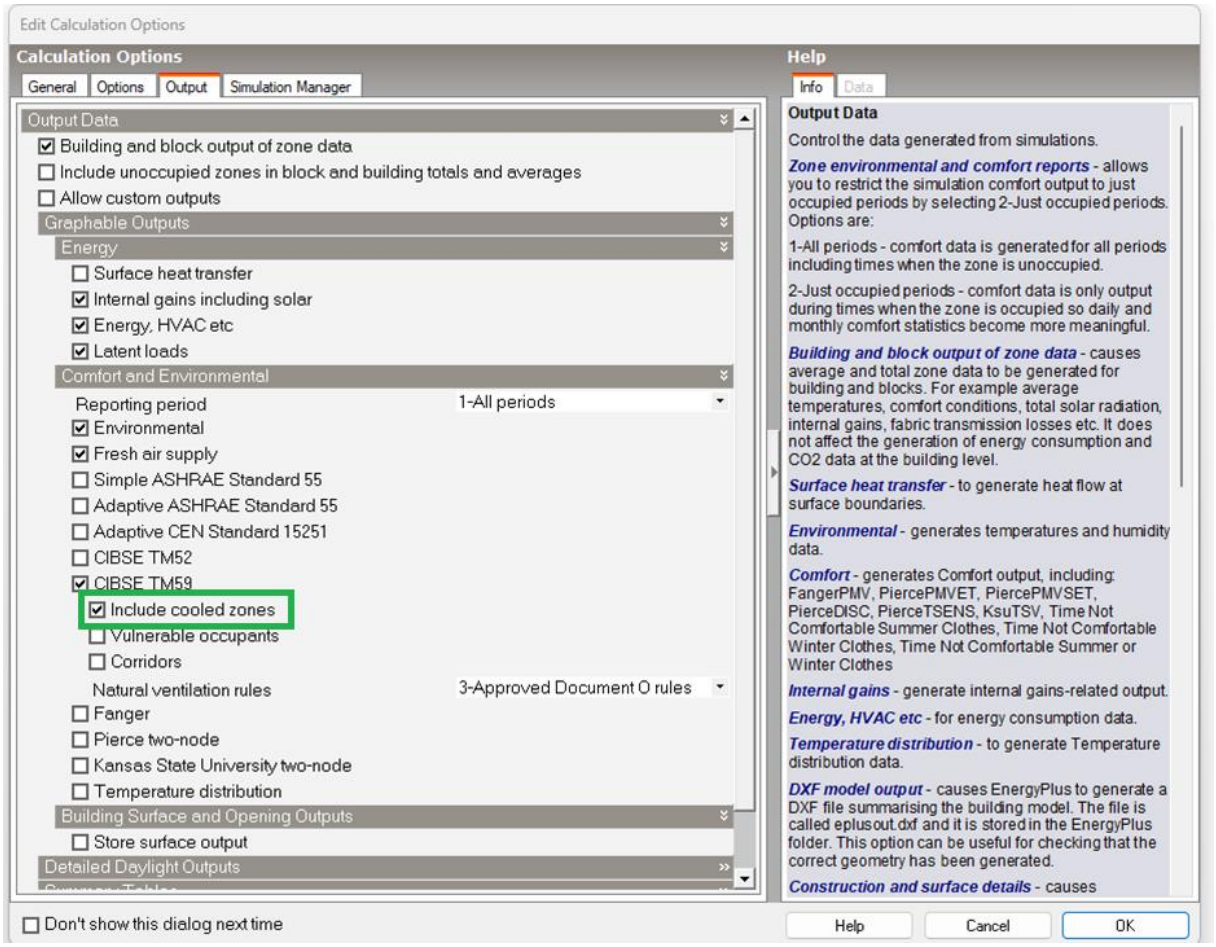


*Figure 20 TM59 Output Specification*