



## Assigning profiles to an e-stack R-Series

This document provides a comprehensive step-by-step guide to assigning opening profiles for an R-series to an existing IES VE model. Should you have any questions please contact **Joe Clawley** at [joe.clawley@breathingbuildings.com](mailto:joe.clawley@breathingbuildings.com), or call the office on **01223 450 060**.

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## Modelling natural hybrid ventilation in IES VE

One of the big advantages of the e-stack system over other natural ventilation systems is that in the winter, we do not bring in air via opening windows, as this requires a potentially large amount of preheating energy. This would of course make for a less energy efficient and environmentally friendly solution to keeping temperatures and CO2 levels comfortable.

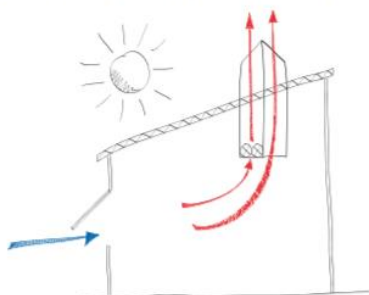
Instead we operate in 'mixing mode' where we bring air at high-level and mix it with the warm room air to create a tempered air stream which is comfortable for occupants. However, as IES VE does not take into account the thermal comfort in the context of cold draughts, this major advantage does not need to be modelled.

IES VE models a room with a 'bulk air temperature', which means the requirement to preheat the incoming air (and associated energy consumption) of other conventional natural ventilation systems is not included in the IES model. It is however worth noting that in a real-world situation **our** systems would have you covered to comply with the new BB101 regulations.

### Summer Mode

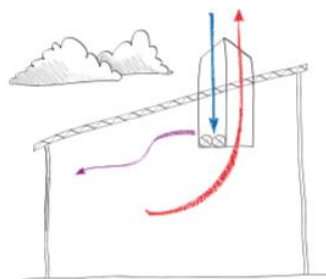
When it is warm outside the system operates in upflow displacement mode, using the stack effect to achieve high air flow rates and keep the room at a pleasant temperature.

Fan boost and night cooling modes offer greater thermal comfort in exceptional summer conditions.



### Winter Mode

When the outside temperature becomes too low to bring directly onto the occupants the R Series unit operates as inflow and outflow. The fans in the unit pre-mix the incoming air with air from within the room, preventing the need for wasteful pre-heating.



The e-stack system is not a heat exchanger, and therefore cannot be modelled as a mechanical system with heat recovery. The system saves energy by bringing air into the space and mixing it with the room air to reduce cold draughts.

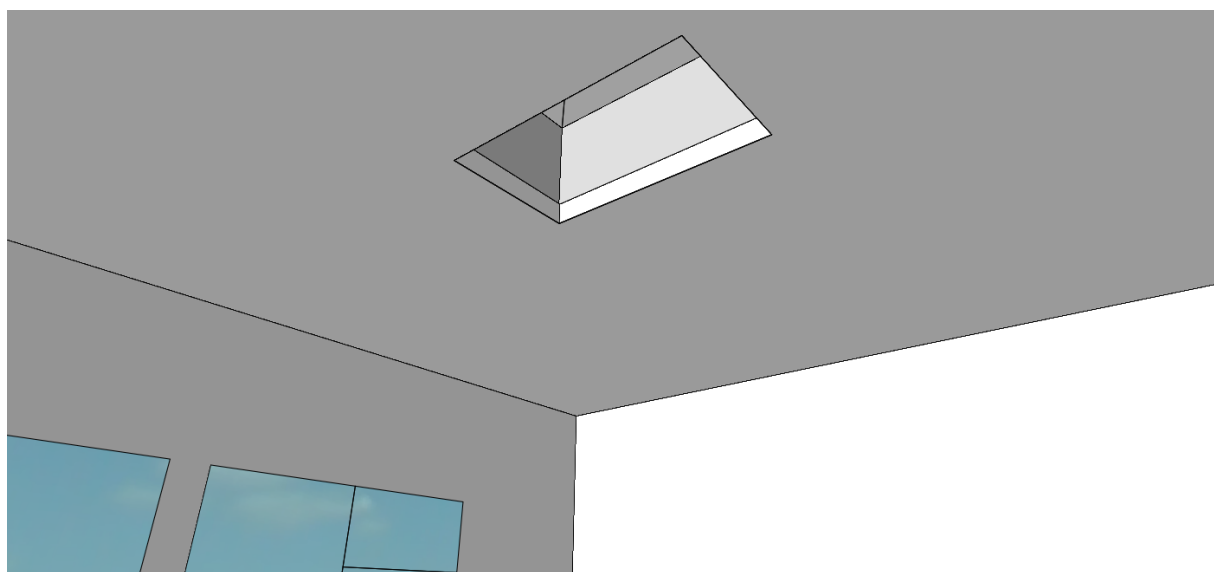
This document explains in detail how to set up our R-Series unit in IES VE, specialist engineers are available for further explanation, feel free to contact us anytime.

## Download, unzip and attach the e-stack R-Series geometry file

Start by creating the model of your room or building within the VE. Once you have your building set up, with the necessary construction properties applied, you are ready to add an e-stack system.

<http://www.breathingbuildings.com/wp-content/uploads/2017/04/Adding-an-e-stack-unit-to-a-model.pdf>



Follow the above link to our dedicated guidance, download '*Importing & Installing the E-Stack Geometry Files*', then follow the instructions to attach the R-Series to your model as shown in the image below.



## Modelling functionality of the R-Series in IES VE

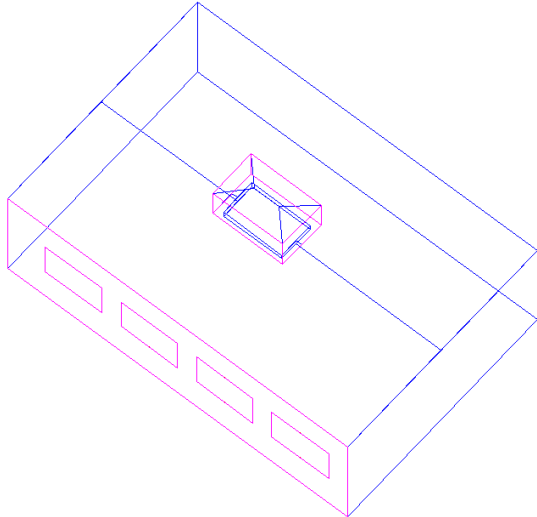
The functional control of an e-stack R-Series system takes into account: modulating damper control, window opening, fan operation, temperature sensing, CO2 sensing, and timed functions. The complexity of this system can be difficult to model in any dynamic simulation software.

We have therefore created all the profiles necessary and included them in the cabinet file in the R-Series folder. The geometry file contains an easily importable R-Series unit which can be copied as many times as required.

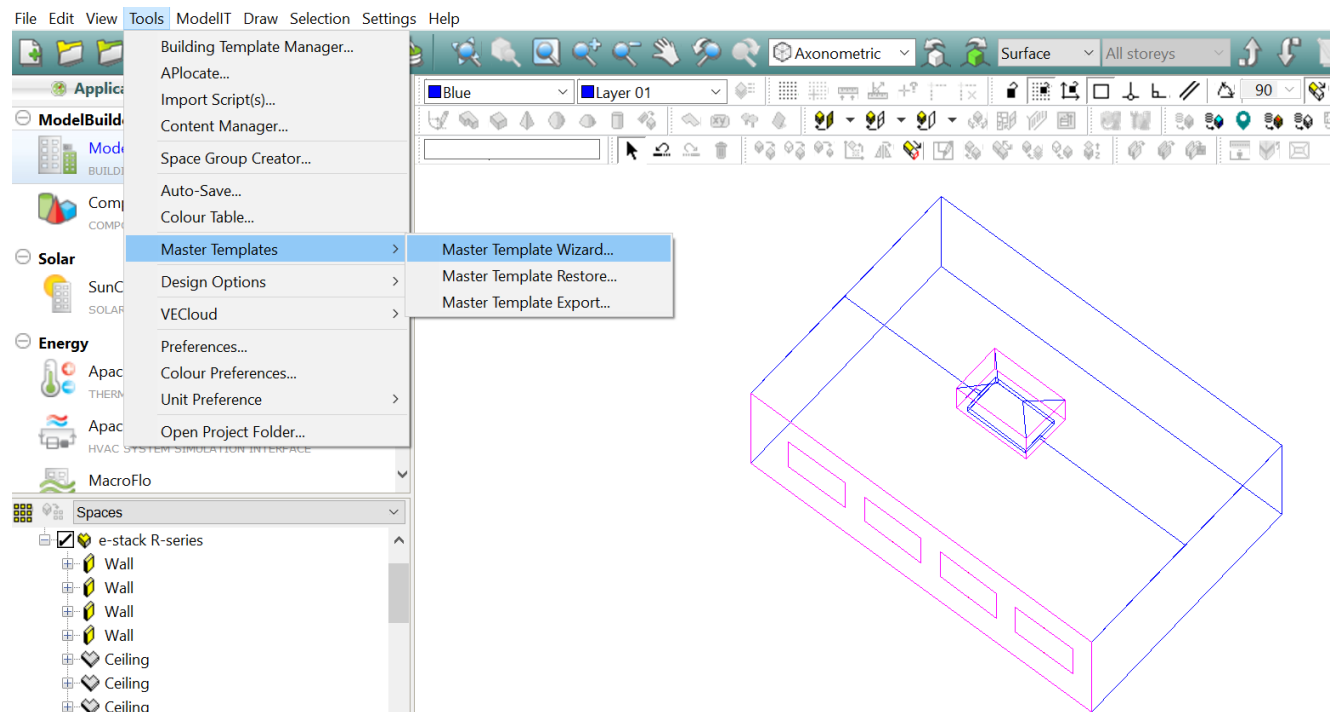
Name	Type	Size
 BB R-Series [VE2017]	Cabinet File	20 KB
 BB R-Series.gem	GEM File	2 KB

## Importing R-Series profiles into your project

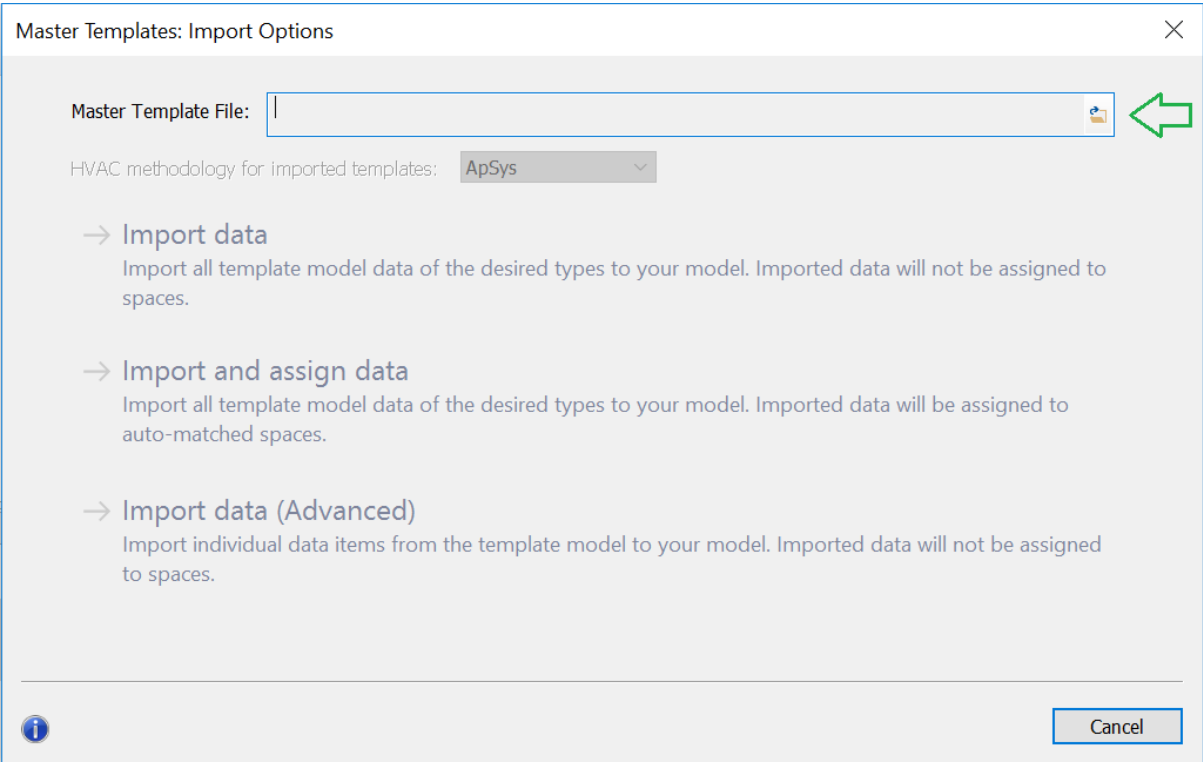
Once the geometry file has been imported into your project, you'll be in a comparable situation as shown below, with the R-Series attached to the roof of the required room:



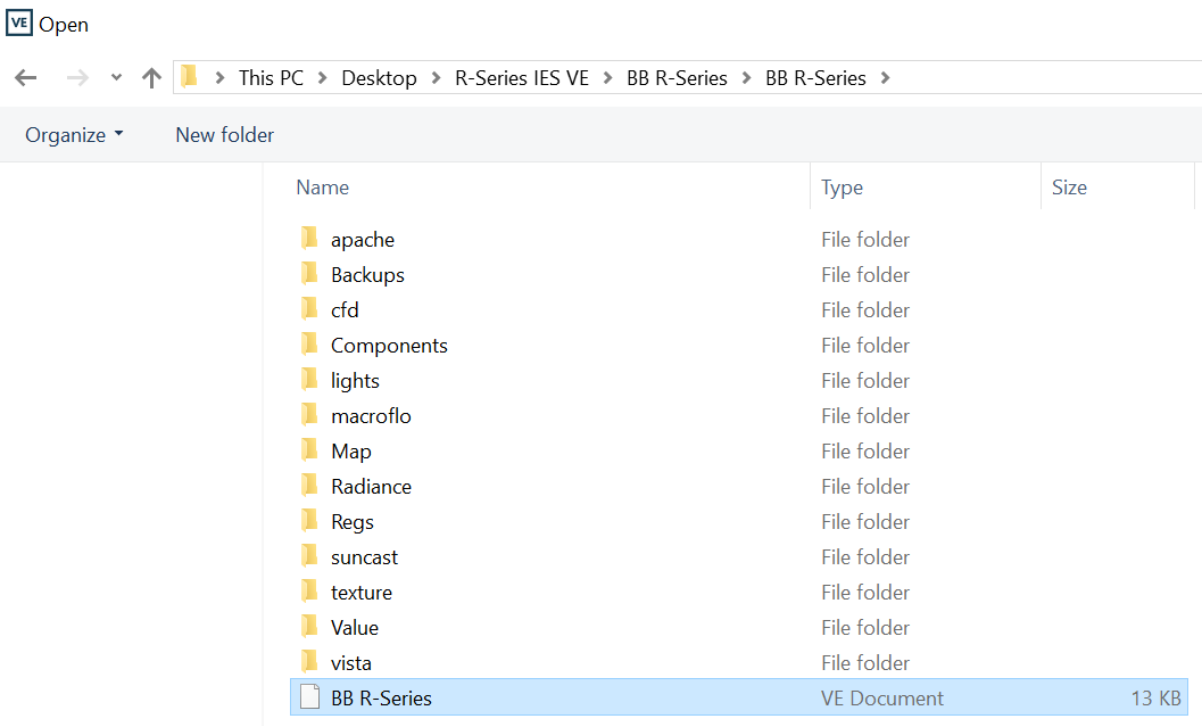
Next you will need to import the profiles from the '**BB R-Series [VE2017]**' cabinet file using the 'master template' Wizard' option as shown below:



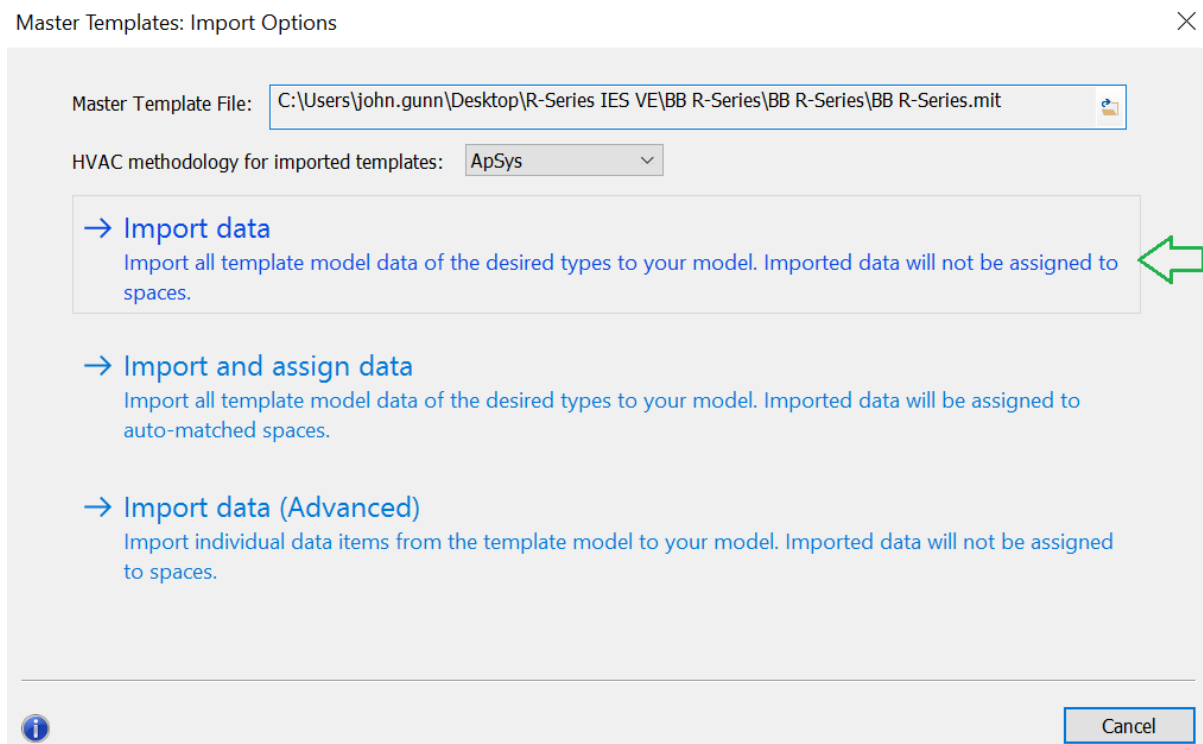
Click the 'find folder' button:



Find the **BB R-Series** folder in the location it was saved after being downloaded from our website, and select the VE Document entitled '**BB R-Series**':



Click the 'Import data' button:



Select the 'MacroFlo Openings Templates' and 'Apache Profiles' options as shown below:

Master Templates: Extra Import Options ✕


Select all template imports ☐

<input type="checkbox"/> Room Attributes Templates	<input type="checkbox"/> Thermal Conditions Templates
<input type="checkbox"/> Constructions Templates	<input type="checkbox"/> Electric Lighting Templates
<input checked="" type="checkbox"/> MacroFlo Openings Templates	<input type="checkbox"/> Radiance Surfaces Templates

Select all data imports ☐


<input checked="" type="checkbox"/> Apache Profiles	<input type="checkbox"/> Air Exchanges
<input type="checkbox"/> Constructions	<input type="checkbox"/> CostPlan Projects
<input type="checkbox"/> MacroFlo Openings	<input type="checkbox"/> EnviroImpact Projects
<input type="checkbox"/> Radiance Surfaces	<input type="checkbox"/> PVS Generator
<input type="checkbox"/> Apache Systems	<input type="checkbox"/> Wind Generator
<input type="checkbox"/> HVAC Networks	<input type="checkbox"/> CHP Generator
<input type="checkbox"/> Room Groupings	<input type="checkbox"/> Components

< >

 < Back Next > Cancel


Click 'next', and then 'Start':

Master Templates ✕

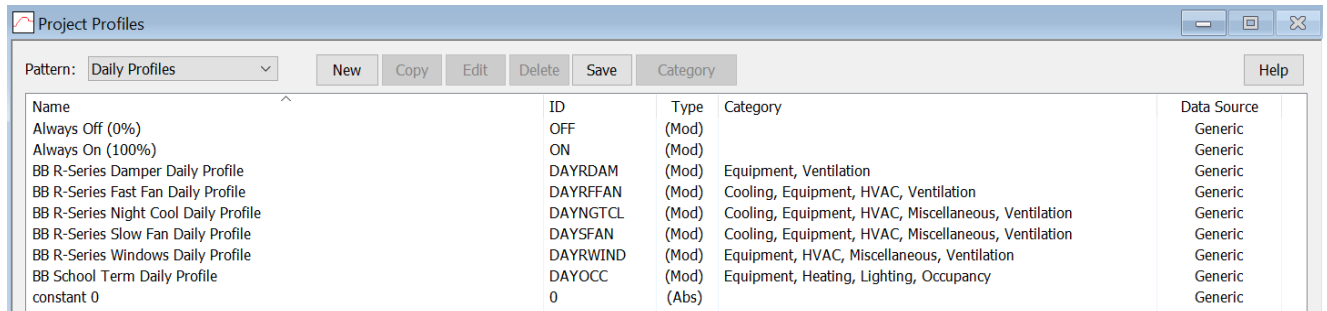
 Click Start to apply changes below

Summary:

- Create restore point
- Import Apache Profiles
- Import MacroFlo Openings
- Import MacroFlo Openings Templates

 < Back Start Cancel

Your IES VE file will now contain the Breathing Buildings R-Series profiles required to control the unit. The profiles have been prefixed with 'BB R-Series' to make them easy to identify and group within the Profiles Database:



Name	ID	Type	Category	Data Source
Always Off (0%)	OFF	(Mod)		Generic
Always On (100%)	ON	(Mod)		Generic
BB R-Series Damper Daily Profile	DAYRDAM	(Mod)	Equipment, Ventilation	Generic
BB R-Series Fast Fan Daily Profile	DAYRFFAN	(Mod)	Cooling, Equipment, HVAC, Ventilation	Generic
BB R-Series Night Cool Daily Profile	DAYNGTCL	(Mod)	Cooling, Equipment, HVAC, Miscellaneous, Ventilation	Generic
BB R-Series Slow Fan Daily Profile	DAYSFAN	(Mod)	Cooling, Equipment, HVAC, Miscellaneous, Ventilation	Generic
BB R-Series Windows Daily Profile	DAYRWIND	(Mod)	Equipment, HVAC, Miscellaneous, Ventilation	Generic
BB School Term Daily Profile	DAYOCC	(Mod)	Equipment, Heating, Lighting, Occupancy	Generic
constant 0	0	(Abs)		Generic

The profiles included are daily, weekly and annual profiles culminating in:

**BB R-Series Damper Annual Profile** – Damper control of the actual R-Series unit in your project

**BB R-Series Fast Fan Annual Profile** – Auxiliary ventilation control

**BB R-Series Night Cool Annual Profile** – Auxiliary ventilation control

**BB R-Series Slow Fan Annual Profile** – Auxiliary ventilation control

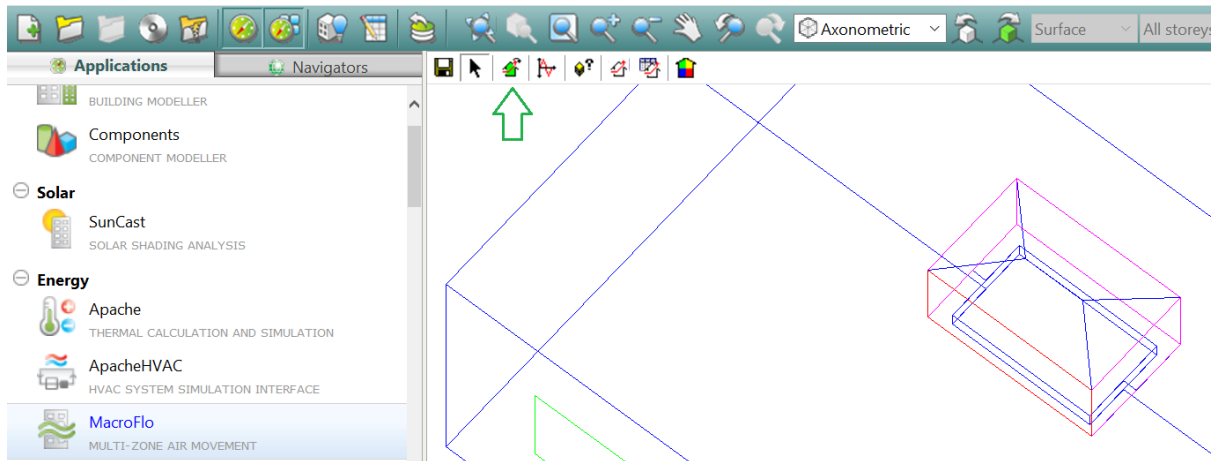
**BB R-Series Windows Annual Profile** – Window opening profiles as controlled by the unit

**BB R-Series School Term Annual Profile** – UK school term times

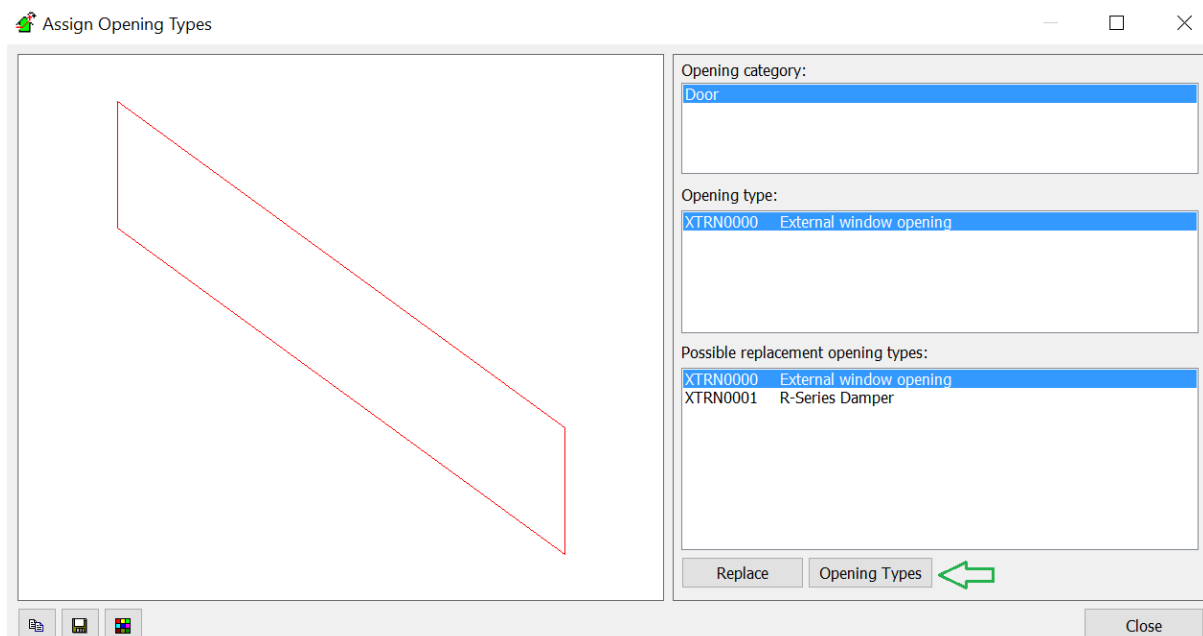


## BB R-Series Damper Annual Profile setup

Through the MacroFlo tab select an opening door of the R-Series unit and click the '*edit selection set opening types*' button as shown below:



The R-Series Damper opening type profile will have already been assigned, but should you find an additional opening type such as 'External window opening' then delete this by clicking the '*Opening Types*' button:



And removing the additional opening profile as shown below:

MacroFlo Opening Types - BB Generic Classroom

MacroFlo Opening Types

Reference ID	Description
XTRN0000	External window opening
XTRN0001	R-Series Damper

Reference ID: XTRN0000

Description: External window opening

Exposure Type: 05. semi-exposed wall

Opening Category: Custom / sharp edge orifice

Openable Area %: 0

Equivalent orifice area: 0 % of gross

Crack Flow Coefficient: 0.150  $l/(s \cdot m \cdot Pa^{0.6})$

Crack Length: 0 % of opening perimeter

Opening threshold: 0.00 °C

Degree of Opening (Modulating Profile): off continuously

Add Remove

You will be asked to confirm this choice:

Delete Opening Type From Project Database?

WARNING - removing this opening type could cause problems if it is referenced in the current project !

Are you sure that you wish to delete the selected opening type from the project database?

Please confirm that you wish to remove the referenced opening type from your Virtual Environment project.

☒ Yes, I want to delete the opening type shown below !

External window opening

Reference ID: XTRN0000

Delete Cancel

The R-Series unit should now be set with the opening profile shown below:

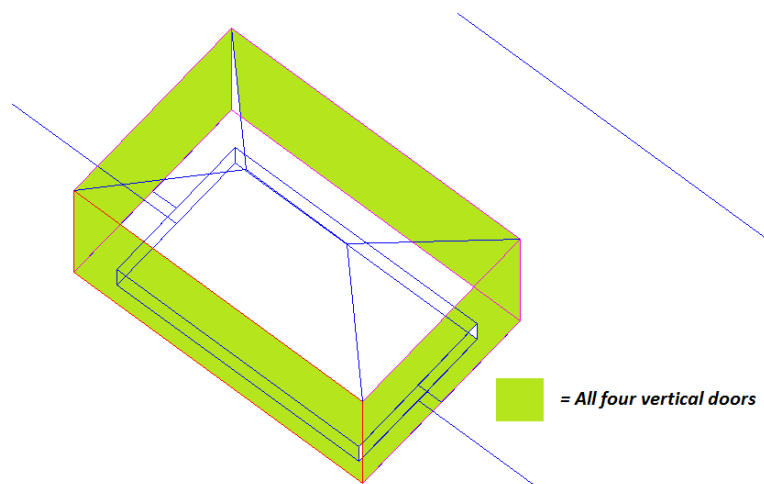
MacroFlo Opening Types - BB Generic Classroom

MacroFlo Opening Types

Reference ID	Description	Exposure Type	Opening Category	Openable Area %	Equivalent orifice area	Crack Flow Coefficient	Crack Length	Opening threshold	Degree of Opening (Modulating Profile)
XTRN0001	R-Series Damper	05. semi-exposed wall	Custom / sharp edge orifice	16	16 % of gross	0.150 $l/(s \cdot m \cdot Pa^{0.6})$	0 % of opening perimeter	0.00 °C	BB R-Series Damper Annual...

Add Remove

Ensure all four vertical doors on the R-Series have the '**BB R-Series Damper Annual**' opening type assigned.



You now have the Macroflo opening profiles set up correctly. This will enable the roof vent to open and close automatically, depending on internal and external conditions, replicating the real-life operation of our R-Series system.

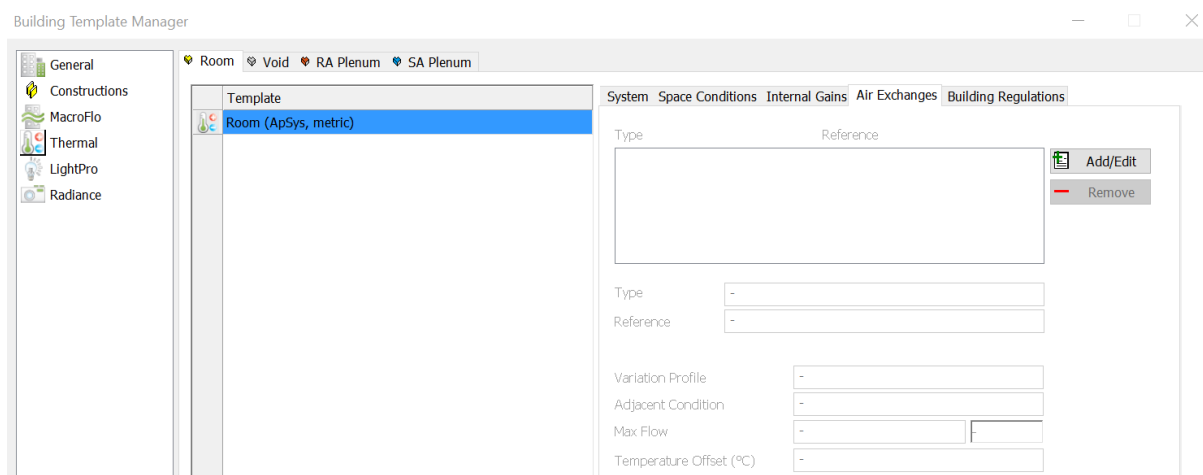
## BB R-Series Auxiliary Ventilation Annual Profile setup

Breathing Buildings' e-stack systems are hybrid natural ventilation systems, which include low-powered fans, primarily there to enable mixing ventilation in colder weather - Breathing Buildings' energy saving method for mitigating cold draughts whilst ensuring occupancy comfort.

Since these low-powered fans are present, it makes sense to utilise them, wherever possible, to assist the predominantly natural ventilation airflow in warmer weather - i.e. summer mode.

In summer mode, we are able to run the fans to assist the natural ventilation airflow. This fan assistance should be represented within IES as an auxiliary ventilation within the room.

The fans in the unit are modelled in IES as auxiliary ventilation within the room, added through the '*building templates manager*' '*Air Exchanges*' tab as shown below:



Click the '*Add/Edit*' button, and set up a new air exchange, specifying '*auxiliary ventilation*'. And referencing as '*BB R-Series ...*' for Slow Fan, Fast Fan and Night Cool. The variation profile will be that of the respective type of fan, and adjacent condition will be modelled as external air temperature. Remember to tick the '*Add to Template*' option!

Air Exchanges ✕

Type	Exchange Reference	Max Flow	Unit		Variation Profile	Adjacent Condition	Temperature Profile	Temperature Offset (°C)	Add To Template
Infiltration	Infiltration	0.250	ach		on continuously	External Air	-	-	
Auxiliary Ventilation	BB R-Series Fast Fan	150.000	l/s		BB R-Series Fast Fan	External Air	-	-	✓

✚ Add Air Exchange
✚ Remove Air Exchange
Select All
Deselect All

Type: Auxiliary ventilation  
 Reference: BB R-Series Fast Fan  
 Max Flow: 150.0000 l/s

Variation Profile: BB R-Series Fast Fan Annual Profile  
 Adjacent Condition: External Air

OK
Cancel

Below is a completed version of all auxiliary ventilation modules required:

Type	Exchange Reference	Max Flow	Unit		Variation Profile	Adjacent Condition
Infiltration	Infiltration	0.250	ach		on continuously	External Air
Auxiliary Ventilation	BB R-Series Fast Fan	150.000	l/s		BB R-Series Fast Fan	External Air
Auxiliary Ventilation	BB R-Series Slow Fan	100.000	l/s		BB R-Series Slow Fan	External Air
Auxiliary Ventilation	BB R-Series Night Cool	220.000	l/s		BB R-Series Night	External Air

By allowing for the Infiltration you can avoid CO2 being trapped in the room during unoccupied hours, this is a more realistic model of the building and we recommend 0.25 ach as is the default for IES VE.

All air exchanges through the unit have now been set up:

Building Template Manager — □

- General
- Constructions
- MacroFlo
- Thermal
- LightPro
- Radiance

Room Void RA Plenum SA Plenum

Template

Room (ApSys, metric)

System Space Conditions Internal Gains Air Exchanges Building Regulations

Type	Reference
Auxiliary Ventilation	BB R-Series Fast Fan
Auxiliary Ventilation	BB R-Series Slow Fan
Infiltration	Infiltration
Auxiliary Ventilation	Auxiliary ventilation

Add/Edit
Remove

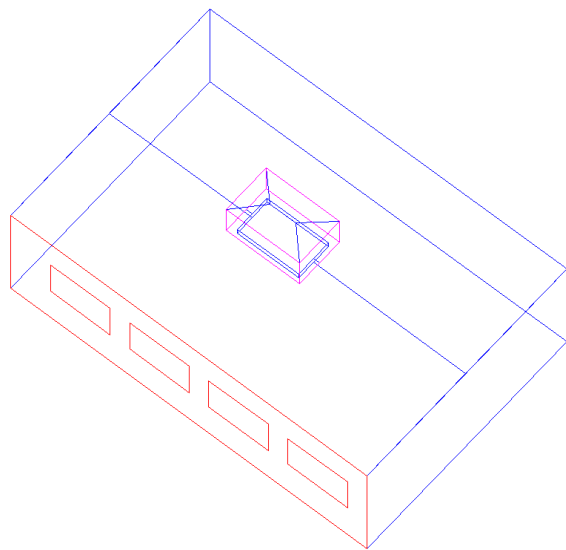
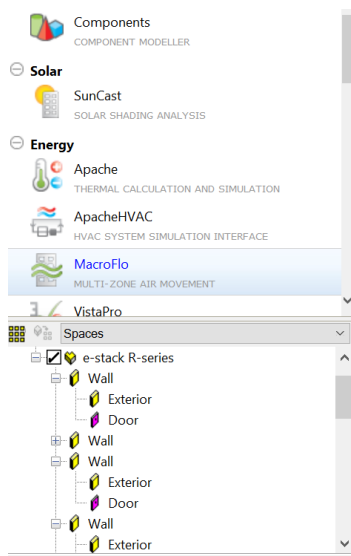
Click 'save' and 'OK'.

## BB R-Series Windows Annual Profile setup

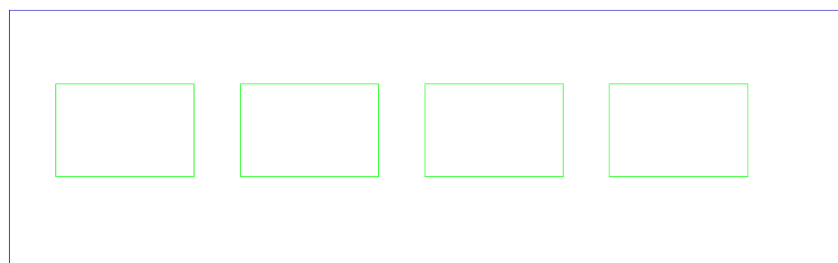
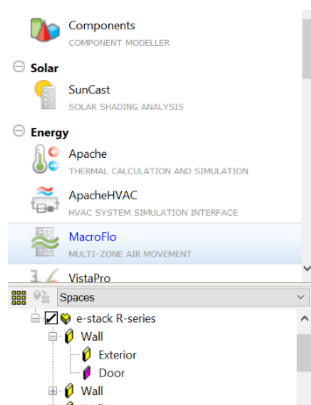
The e-stack system is designed to perform optimally when working in conjunction with openable windows at low-level. In a real building, the opening and closing of these windows would be done by the room occupants. When simulating the building, however, we need to set the window opening profiles in line with the internal and external conditions.

The profiles you need are all included in the CAB file you downloaded and imported into your IES. You simply need to assign them to the windows in your building.

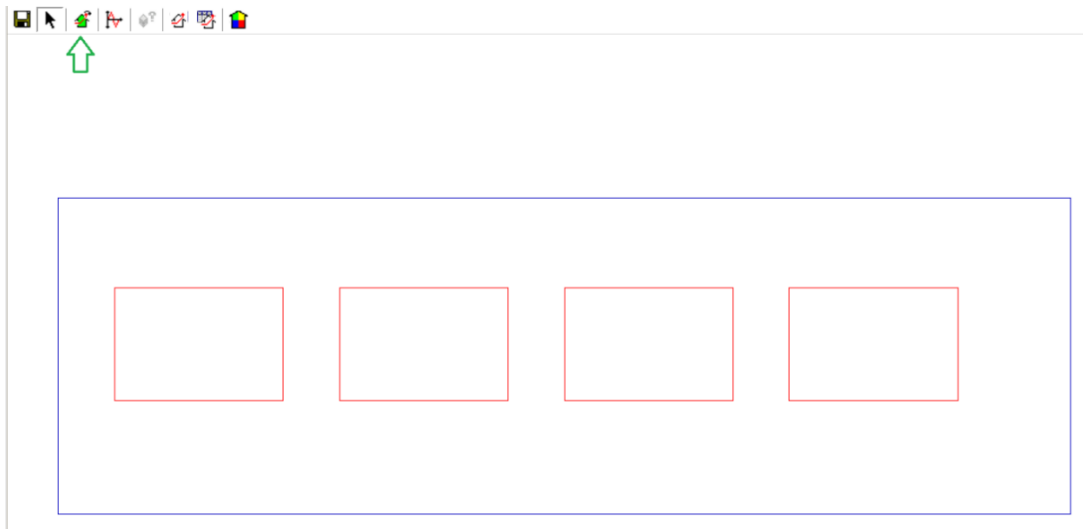
In the 'MacroFlo' tab select the wall which contains the openable windows as shown below:



The double click the wall to come down to its level:



Select the openable windows and click the *'Edit selection set opening profiles'* button as shown below:



Choose your windows opening percentage (in this case 15%), this will vary depending on the type of windows used for your project. Then set the profile to ***'BB R-Series Windows Annual'*** as shown below:

MacroFlo Opening Types - BB Generic Classroom

MacroFlo Opening Types

Reference ID	Description
XTRN0001	R-Series Window

Reference ID: XTRN0001

Description: R-Series Window

Exposure Type: 05. semi-exposed wall

Opening Category: Custom / sharp edge orifice

Openable Area %: 15

Equivalent orifice area: 15 % of gross

Crack Flow Coefficient: 0.150  $l/(s \cdot m \cdot Pa^{0.6})$

Crack Length: 0 % of opening perimeter

Opening threshold: 0.00 °C

Degree of Opening (Modulating Profile): BB R-Series Windows Annu...

Add Remove

☒ Include effects of wind turbulence?

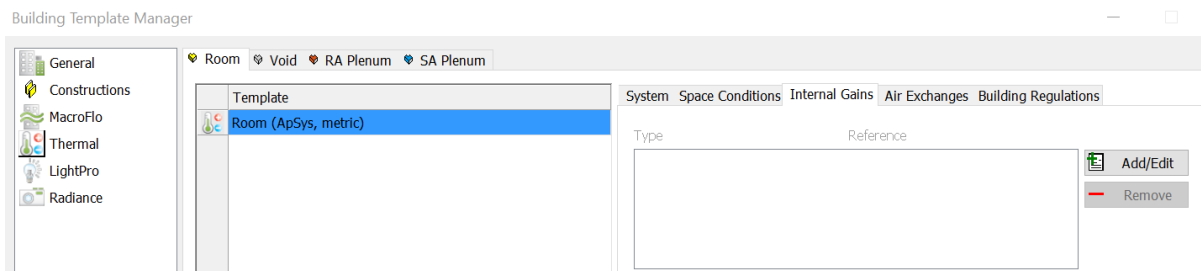
OK Cancel Save

Click 'Save' and 'OK'

## BB R-Series School Term Annual Profile setup

The profiles set up so far have been synced for the UK school term as defined in BB101, and therefore require the occupancy to be either set up the same, or the annual profiles need to be adapted to suit the usage of the building.

To set usage of the building up as per the BB101 term times go to the '*building template manager*' and select the '*internal gains*' tab as shown below:



Set the internal gains (usually occupants, computers, lighting) up as shown below (remember to use the '**BB School Term Annual Profile**' for all):

Internal Gains

Type	Gain Reference	Maximum Sensible	Occupancy	Max Power Co	Radiant	Meter	Variation Profile	Dimming	Add To Temp
People	People	70.000 W/person	32.000 people	-	-	-	BB School Term Annual	-	✓
Fluorescent Lighting	Fluorescent Lighting	8.000 W/m²	-	8.000 W/m²	0.45	Electricity: Meter	BB School Term Annual	on contin	✓
Computers	Computers	300.000 Watts	-	300.000 Watts	0.22	Electricity: Meter	BB School Term Annual	-	✓

+ Add Internal Gain   - Remove Internal Gain   Select All   Deselect All

Type: People   Reference: People

Occupancy units: People

Variation Profile: BB School Term Annual Profile

Maximum Sensible Gain (W/P): 70.000

Maximum Latent Gain (W/P): 60.000

Number of people: 32.000

Diversity factor: 1

% of convective gain to RA plenum: 0.00 %

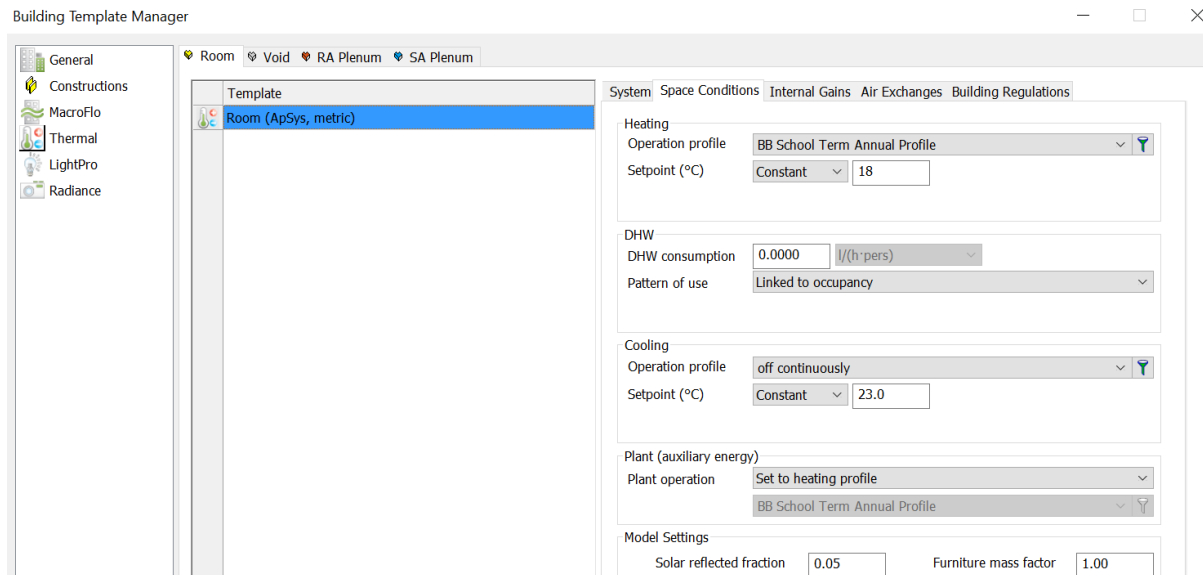
☒ Allow profile to saturate for loads analysis?

Click 'OK' and save the changes to the building template manager.



## Heating and Cooling defaults within the building

IES VE will automatically set your room up to have a continuous heating set at 19 degrees, and cooling set at 23 degrees. This is not realistic, so change these in the '*Space Conditions*' tab of the building template manager as shown below:



Note that the heating is set to the '**BB School Term Annual Profile**', and the cooling is off entirely. These can obviously change depending on your project, but this is a good default should you be currently uncertain of the heating and cooling strategies.