



Assigning profiles to an e-stack S1500

This document provides a comprehensive step-by-step guide to assigning opening profiles for an S1500 e-stack to an existing IES VE model. Should you have any questions please contact **Joe Clawley** at joe.clawley@breathingbuildings.com, or call the office on **01223 450 060**.

Table of Contents

Table of Contents.....	1
Modelling natural hybrid ventilation in IES VE	2
Download, unzip and attach the e-stack S1500 geometry file	3
Modelling functionality of the S1500 in IES VE.....	3
Importing S1500 profiles into your project	4
BB S1500 Damper Annual Profile setup.....	8
BB S1500 Auxiliary Ventilation Annual Profile setup.....	11
BB S1500 Windows Annual Profile setup	13
BB S1500 School Term Annual Profile setup.....	15
Heating and Cooling defaults within the building	16



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.

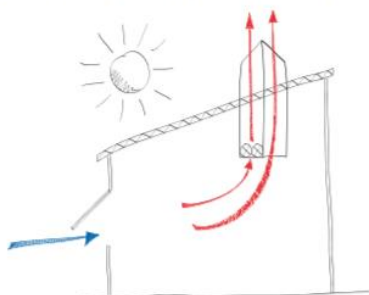
Instead we operate in 'mixing mode' where we bring air at high-level and mix it with the warm room air to create a tempered air stream which is comfortable for occupants. However, as IES VE does not take into account the thermal comfort in the context of cold draughts, this major advantage does not need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

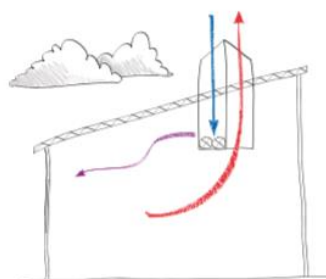
When it is warm outside the system operates in upflow displacement mode, using the stack effect to achieve high air flow rates and keep the room at a pleasant temperature.

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.

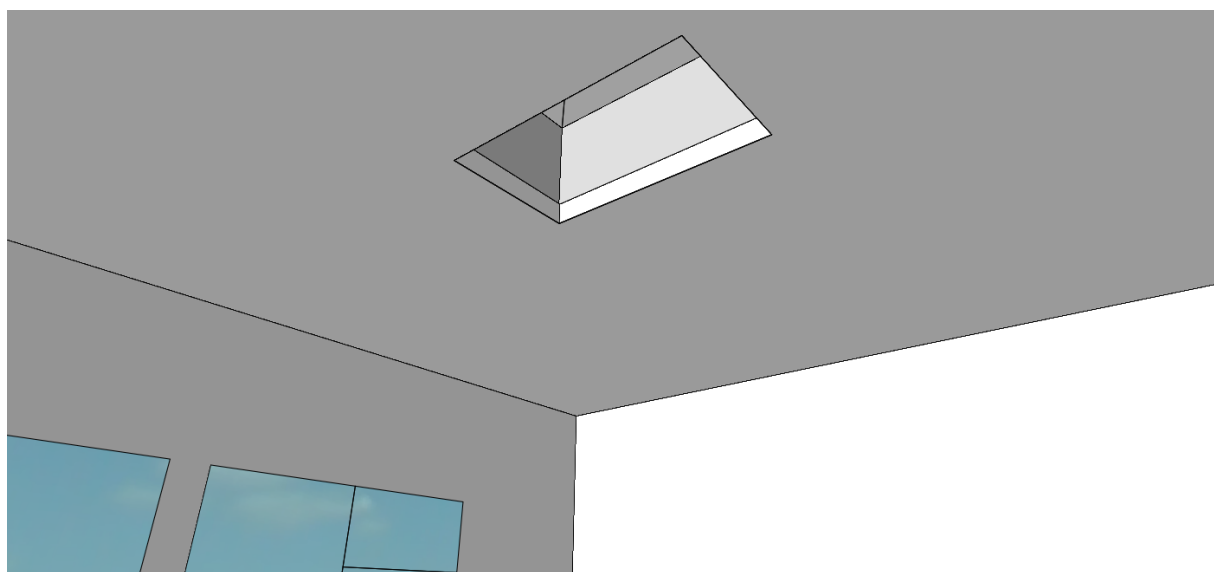
This document explains in detail how to set up our S1500 unit in IES VE, specialist engineers are available for further explanation, feel free to contact us anytime.

Download, unzip and attach the e-stack S1500 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 S1500 to your model as shown in the image below.



Modelling functionality of the S1500 in IES VE

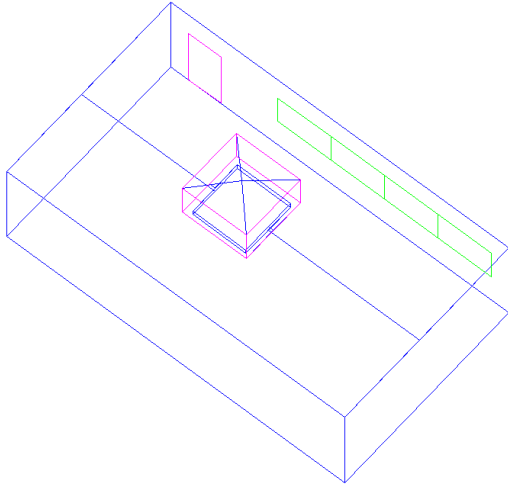
The functional control of an e-stack S1500 system takes into account: modulating damper control, window opening, fan operation, temperature sensing, CO2 sensing, and timed functions. The complexity of this system can be difficult to model in any dynamic simulation software.

We have therefore created all the profiles necessary and included them in the cabinet file in the S1500 folder. The geometry file contains an easily importable S1500 unit which can be copied as many times as required.

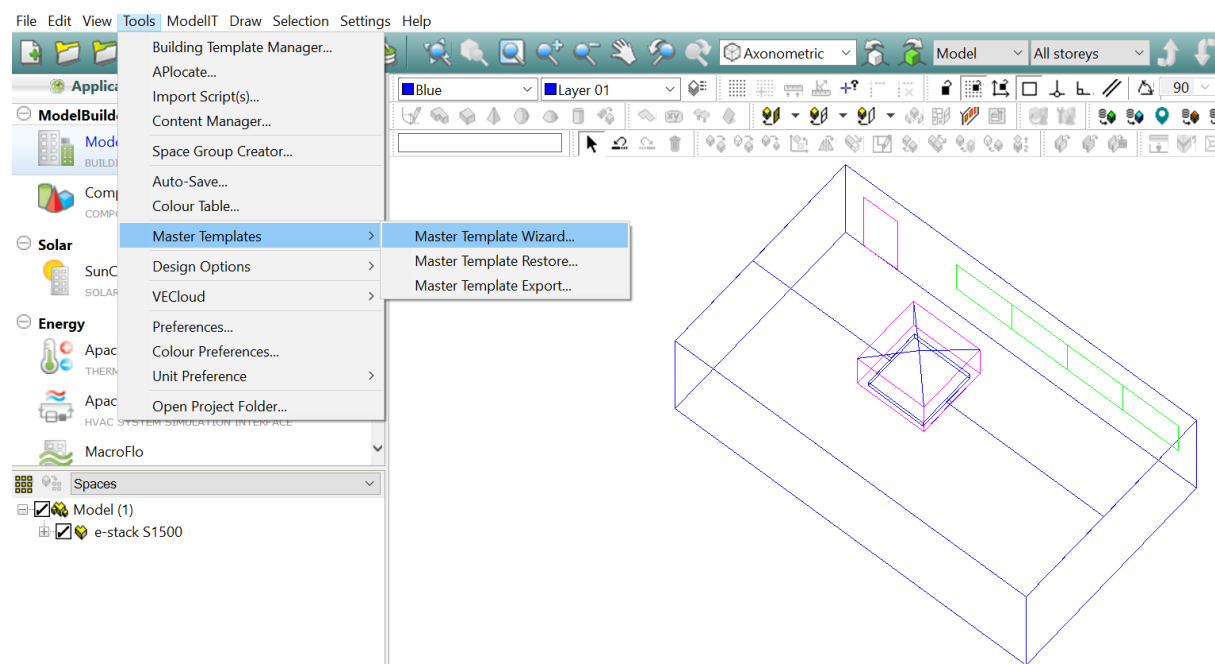
Name	Type	Size
 BB S1500 [VE2017]	Cabinet File	19 KB
 BB S1500.gem	GEM File	2 KB

Importing S1500 profiles into your project

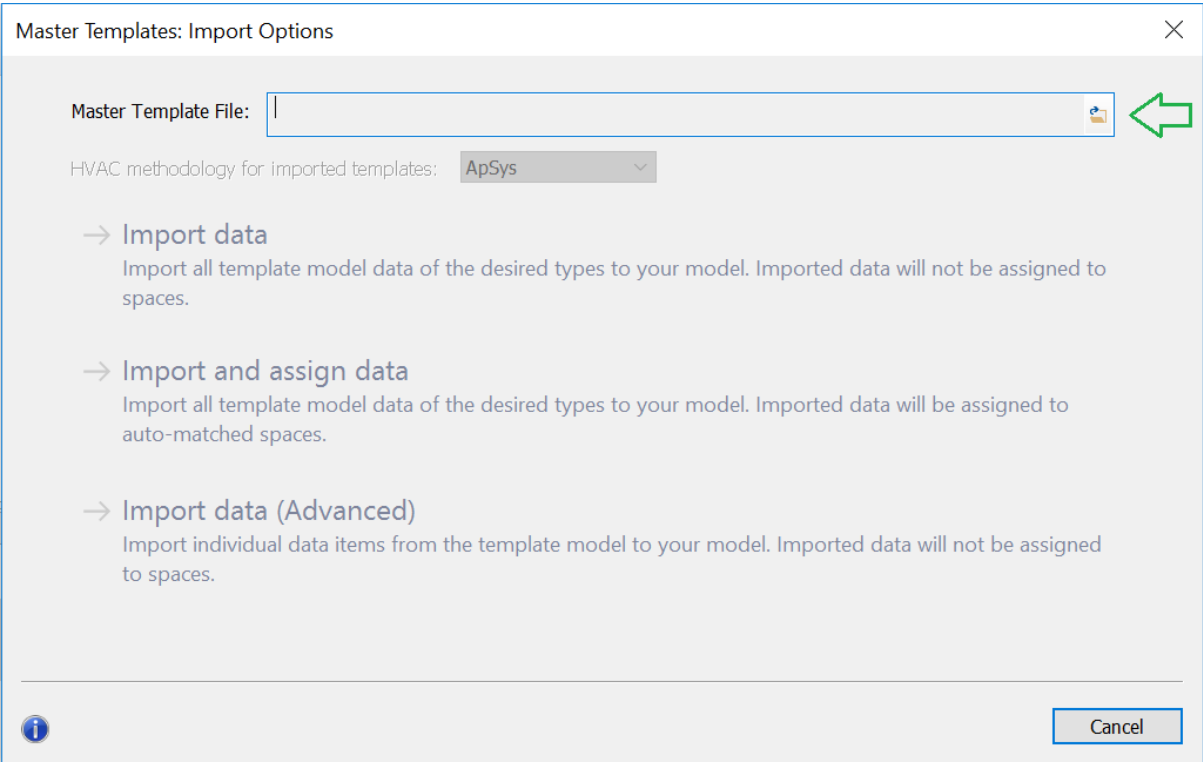
Once the geometry file has been imported into your project, you'll be in a comparable situation as shown below, with the S1500 attached to the roof of the required room:



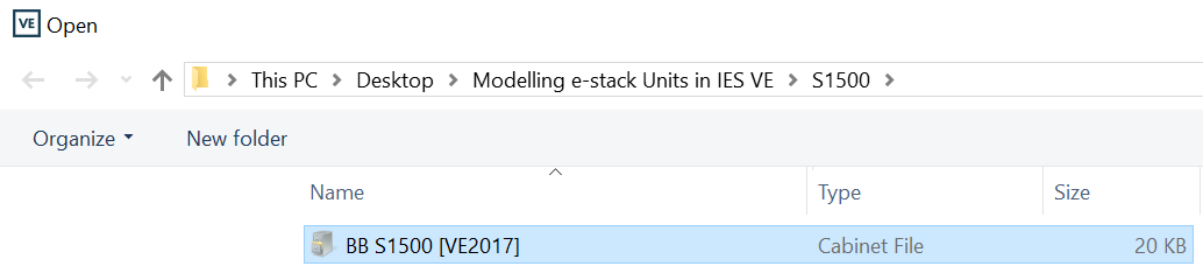
Next you will need to import the profiles from the '**BB S1500 [VE2017]**' cabinet file using the '*master template Wizard*' option as shown below:



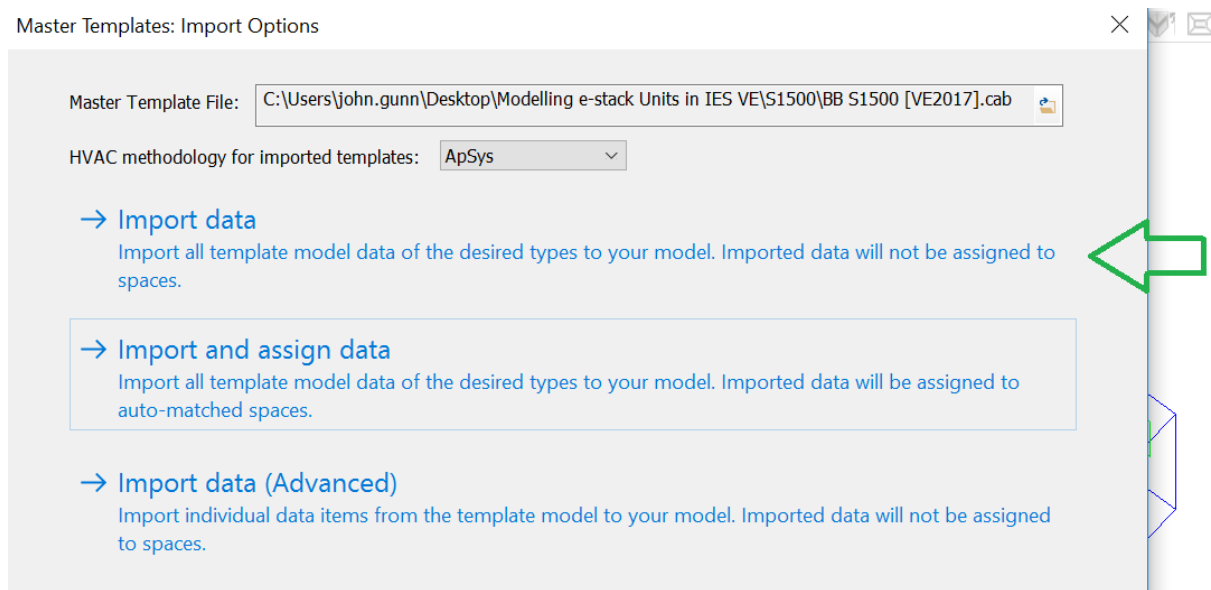
Click the 'find folder' button:



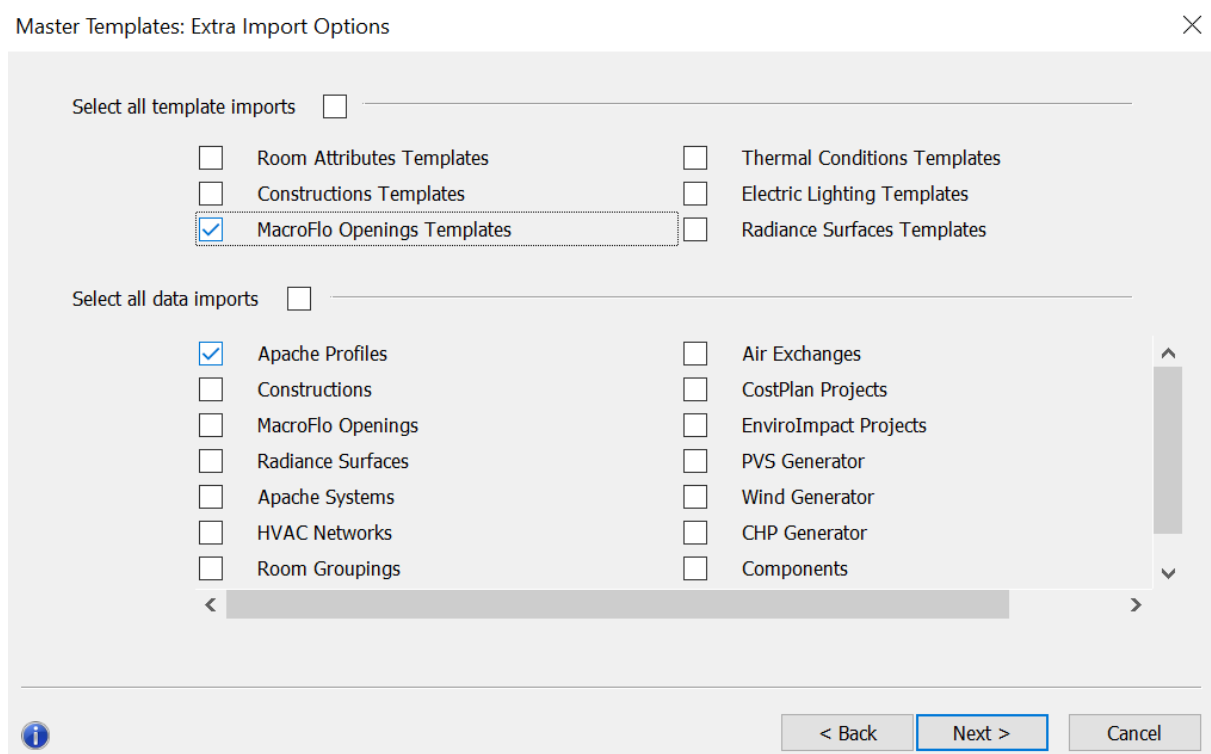
Find the **BB S1500** folder in the location it was saved after being downloaded from our website, and select the VE Document entitled '**BB S1500**':



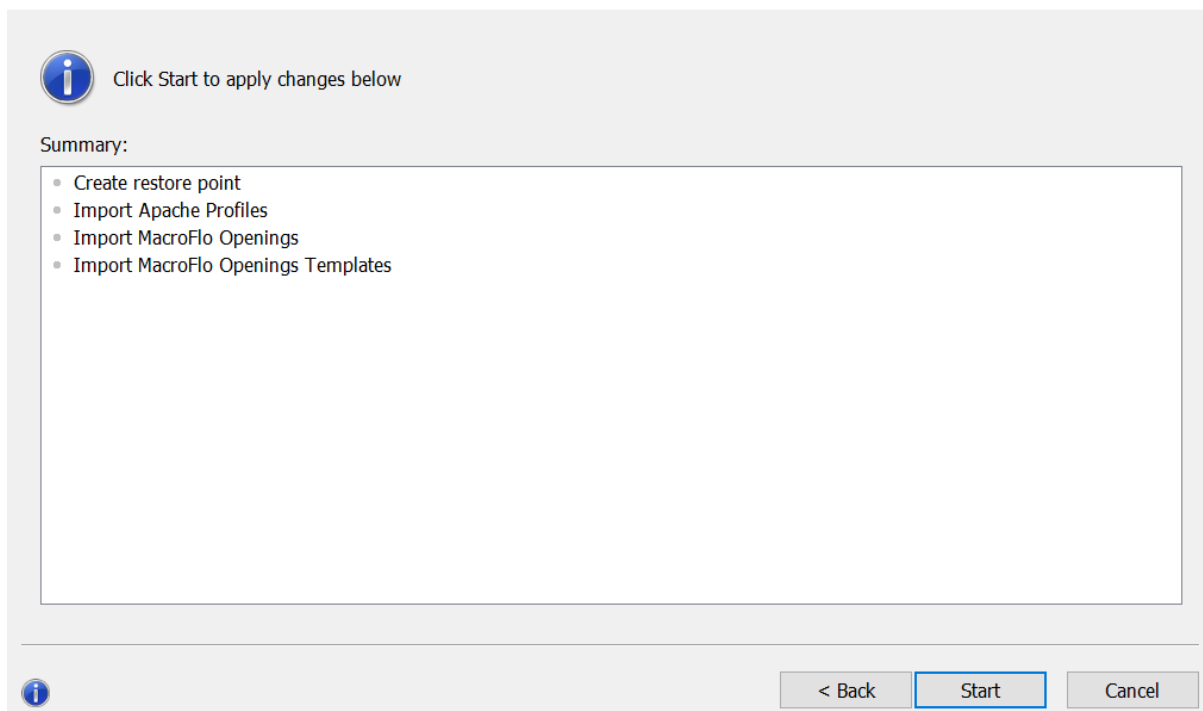
Click the 'Import data' button:



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



Click 'next', and then 'Start':



Your IES VE file will now contain the Breathing Buildings S1500 profiles required to control the unit. The profiles have been prefixed with 'BB S1500' to make them easy to identify and group within the Profiles Database:

Project Profiles					
Pattern: Daily Profiles					
New Copy Edit Delete Save Category Help					
Name	ID	Type	Category	Data Source	
Always Off (0%)	OFF	(Mod)		Generic	
Always On (100%)	ON	(Mod)		Generic	
BB S1500 Damper Daily Profile	DAYRDAM	(Mod)	Equipment, Ventilation	Generic	
BB S1500 Fast Fan Daily Profile	DAYRFFAN	(Mod)	Cooling, Equipment, HVAC, Ventilation	Generic	
BB S1500 Night Cool Daily Profile	DAYNGTCL	(Mod)	Cooling, Equipment, HVAC, Miscellaneous, Ventilation	Generic	
BB S1500 Slow Fan Daily Profile	DAYSFAN	(Mod)	Cooling, Equipment, HVAC, Miscellaneous, Ventilation	Generic	
BB S1500 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 S1500 Damper Annual Profile – Damper control of the actual S1500 unit in your project

BB S1500 Fast Fan Annual Profile – Auxiliary ventilation control

BB S1500 Night Cool Annual Profile – Auxiliary ventilation control

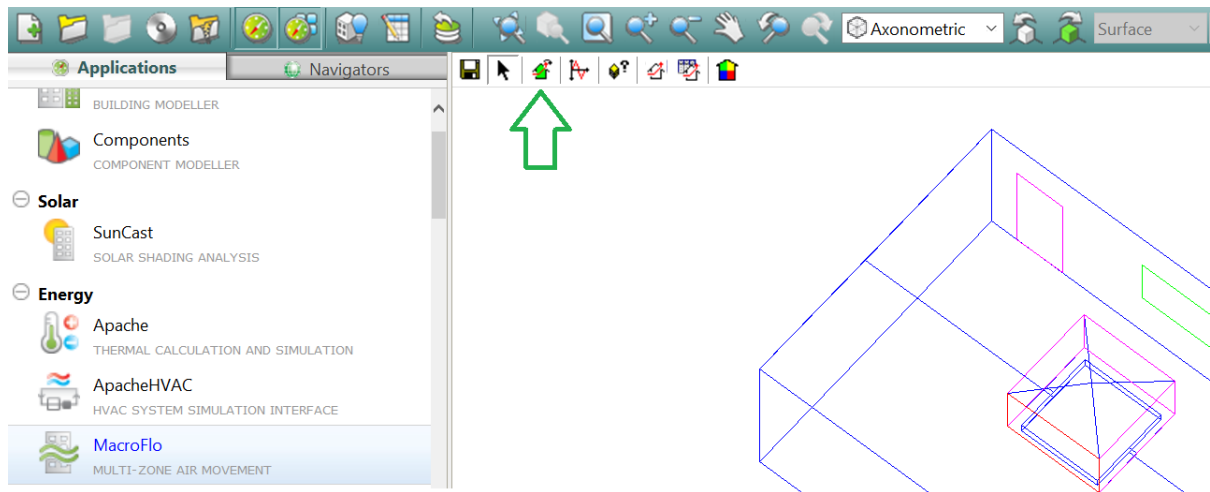
BB S1500 Slow Fan Annual Profile – Auxiliary ventilation control

BB S1500 Windows Annual Profile – Window opening profiles as controlled by the unit

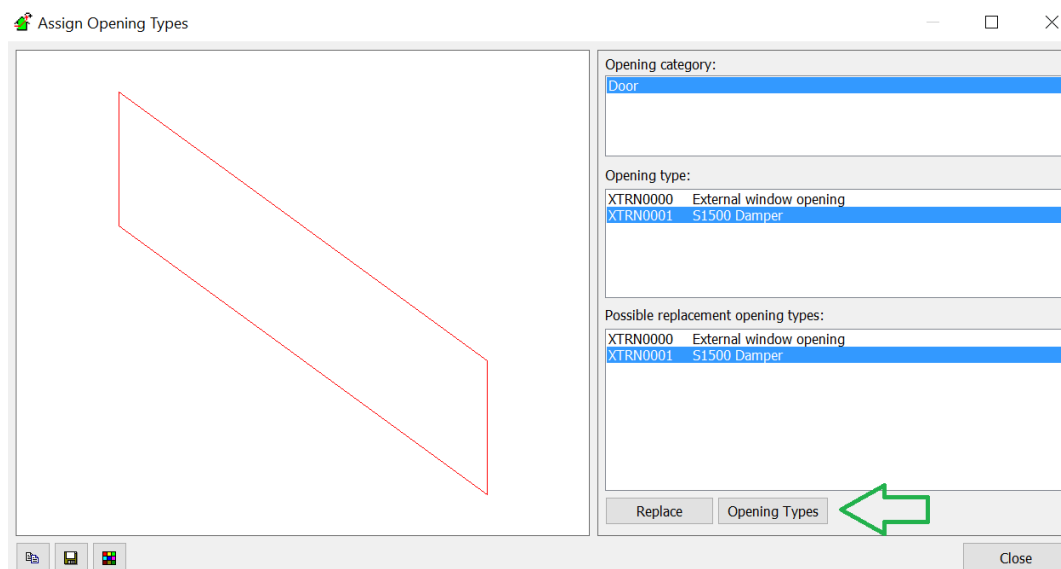
BB S1500 School Term Annual Profile – UK school term times

BB S1500 Damper Annual Profile setup

Through the MacroFlo tab select an opening door of the S1500 unit and click the '*edit selection set opening types*' button as shown below:



The S1500 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 S1500 [VE2017] ✕

MacroFlo Opening Types

XTRN0000	External window opening
XTRN0001	S1500 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: 0.000 % 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



☒ Include effects of wind turbulence?

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



% of gross

$\cdot Pa^{0.6})$

opening perimeter

The S1500 unit should now be set with the opening profile shown below:

MacroFlo Opening Types - BB S1500 [VE2017]

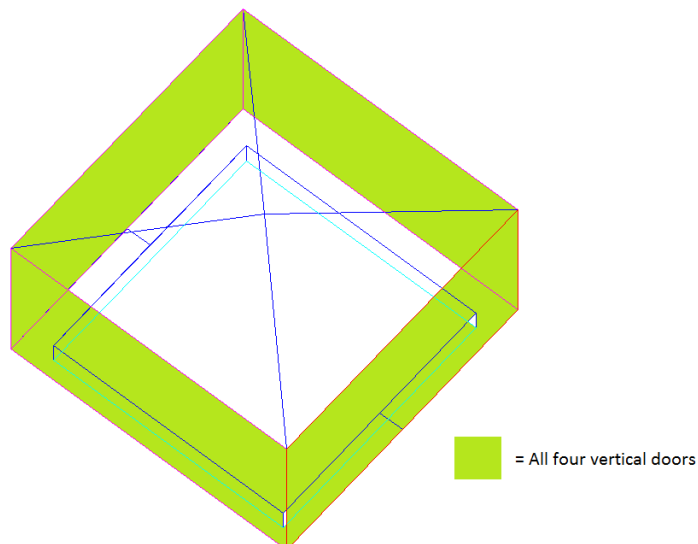
MacroFlo Opening Types

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	S1500 Damper	05. semi-exposed wall	Custom / sharp edge orifice	17	17.000 % of gross	0.150 $l/(s \cdot m \cdot Pa^{0.6})$	0 % of opening perimeter	0.00 °C	BB S1500 Damper Annual P...

Buttons: Add, Remove, OK, Cancel, Save

☒ Include effects of wind turbulence?

Ensure all four vertical doors on the S1500 have the '**BB S1500 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 S1500 system.

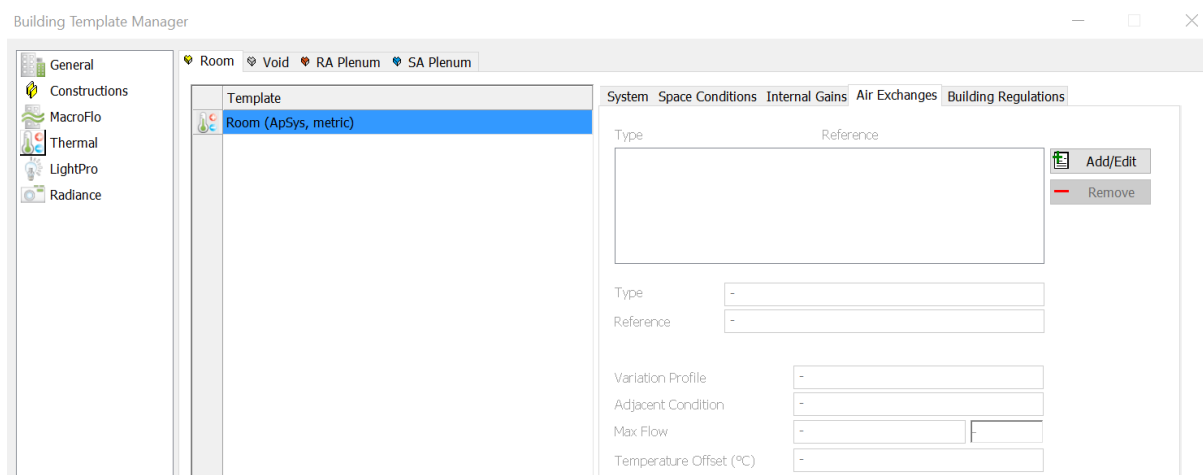
BB S1500 Auxiliary Ventilation Annual Profile setup

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.

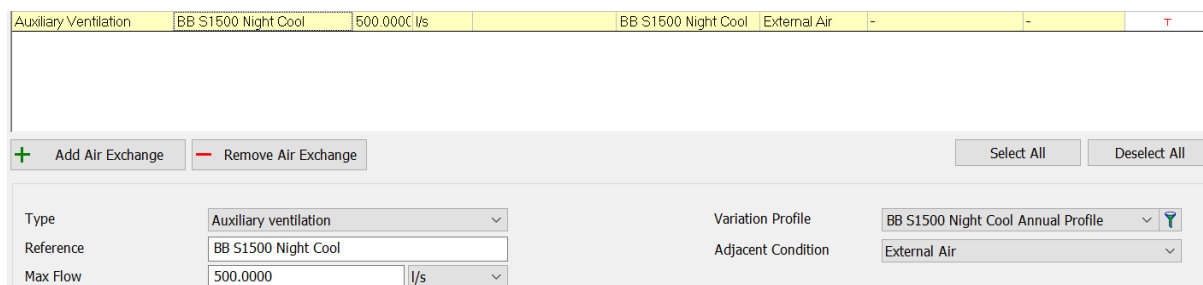
Since these low-powered fans are present, it makes sense to utilise them, wherever possible, to assist the predominantly natural ventilation airflow in warmer weather - i.e. summer mode.

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 S1500 ...*' 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!

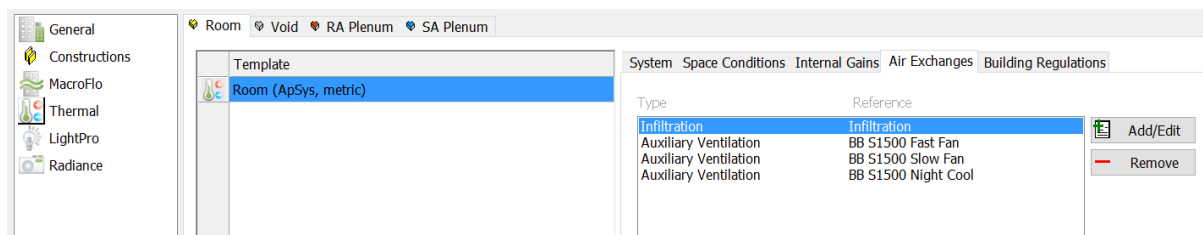


Below is a completed version of all auxiliary ventilation modules required:

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	-	-	T
Auxiliary Ventilation	BB S1500 Fast Fan	230.000C	l/s		BB S1500 Fast Fan	External Air	-	-	T
Auxiliary Ventilation	BB S1500 Slow Fan	170.000C	l/s		BB S1500 Slow Fan	External Air	-	-	T
Auxiliary Ventilation	BB S1500 Night Cool	500.000C	l/s		BB S1500 Night Cool	External Air	-	-	T

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:



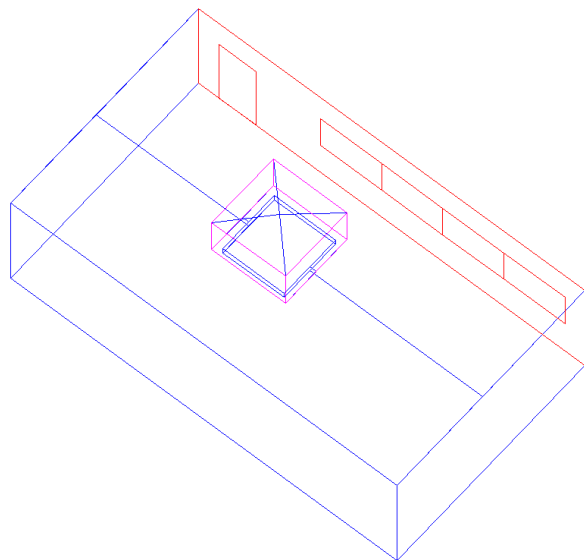
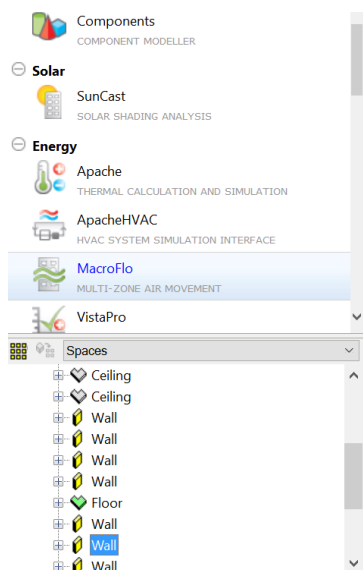
Click 'save' and 'OK'.

BB S1500 Windows Annual Profile setup

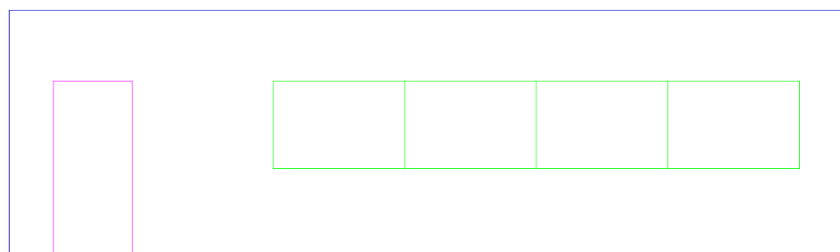
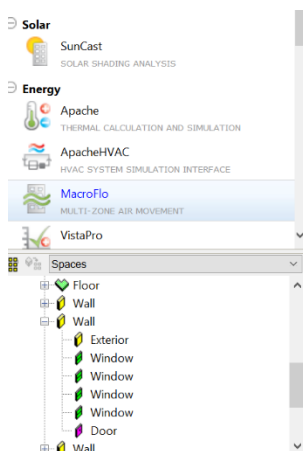
The e-stack system is designed to perform optimally when working in conjunction with openable windows at low-level. In a real building, the opening and closing of these windows would be done by the room occupants. When simulating the building, however, we need to set the window opening profiles in line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

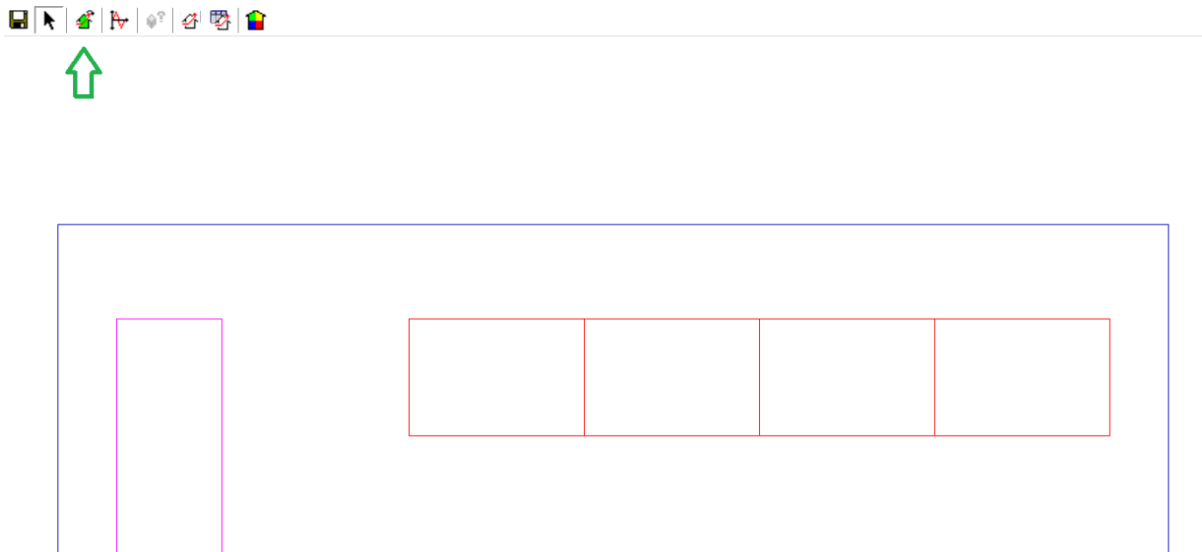
In the 'MacroFlo' tab select the wall which contains the openable windows as shown below:



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 S1500 Windows Annual**' as shown below:

MacroFlo Opening Types - S1500 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 %: 15.00

Equivalent orifice area: 15.000 % 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 S1500 Windows Annual ...

Add Remove

☒ Include effects of wind turbulence?

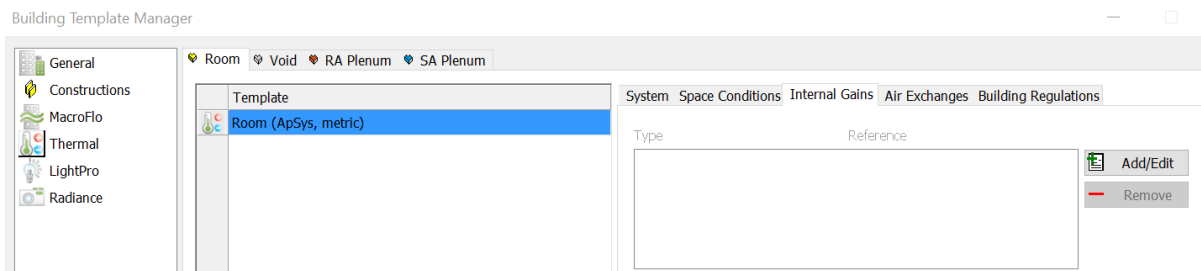
OK Cancel Save

Click 'Save' and 'OK'

BB S1500 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

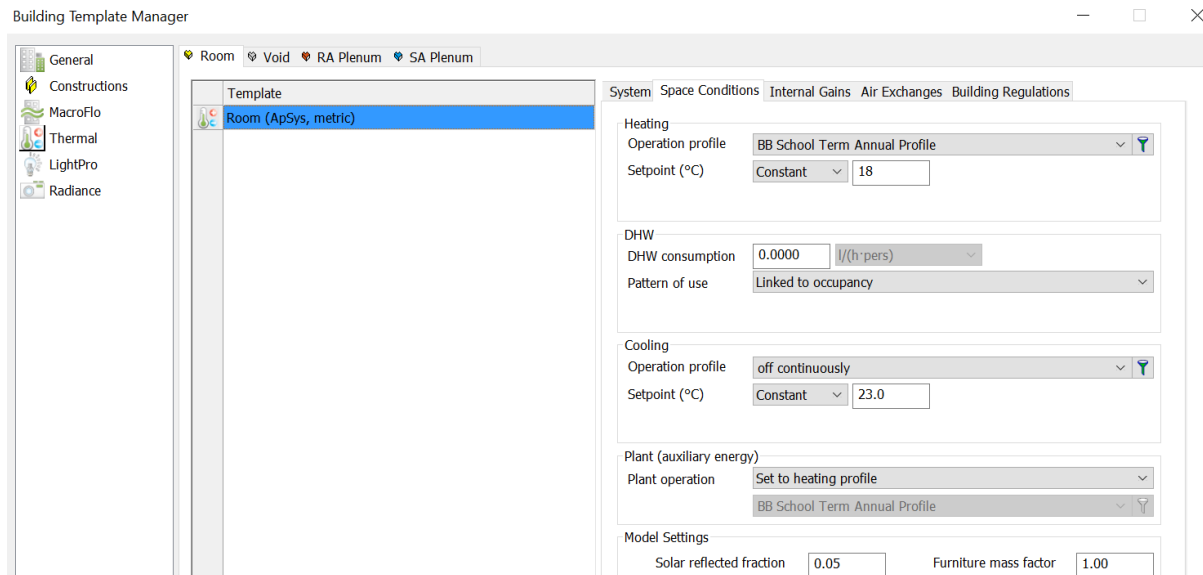
% of convective gain to RA plenum: 0.00 %

☒ 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.