

### Assigning profiles to a Breathing Buildings NVHR Unit (NVHR900 & NVHR1100)

This document provides a comprehensive step-by-step guide to assigning operating profiles for an NVHR unit to an existing IES VE model. Should you have any questions please contact **Joe Clawley or Matthew Waterson** at <u>joe.clawley@breathingbuildings.com</u> / <u>matthew.waterson@breathingbuildings.com</u>, or call the office on **01223 450 060**.

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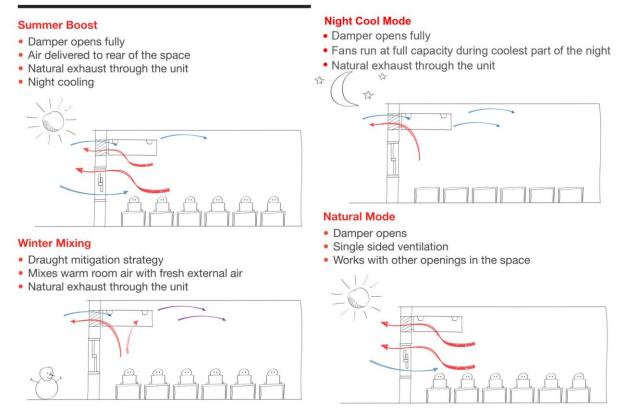
# Modelling natural/hybrid ventilation in IES VE

One of the big advantages of the Breathing Buildings systems over other natural/hybrid 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.

#### **Air Flow Strategies**



The NVHR 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 an NVHR unit in IES VE. The NVHR1100 has been used as an example in this document, but the same principles apply to the NVHR900.

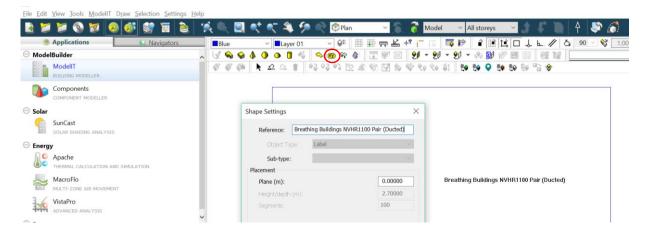
## Adding the NVHR to your Model

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 NVHR system.

Because the unit only requires access to the façade via a louvre, no external geometry file need be imported, unlike adding the E-stack units which require the roof terminal geometry to be added to the model. The louvre can be added by creating a door of the correct dimensions (NVHR900: 900mm(W) x 300mm(H) | NVHR1100: 1078mm(W)x329mm(H)) in ModelIT. This door will later be assigned an opening profile.

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		Add 😵 🕺 🔁 😫 🕯 🚱 🚱 🖀 🖄 🖓 🖓	door
BUILDING MODELLER			

If there are other louvres added to rooms without NVHR units and you wish to make it clear which rooms have NVHR profiles applied and which do not, labels could be added in ModelIT.

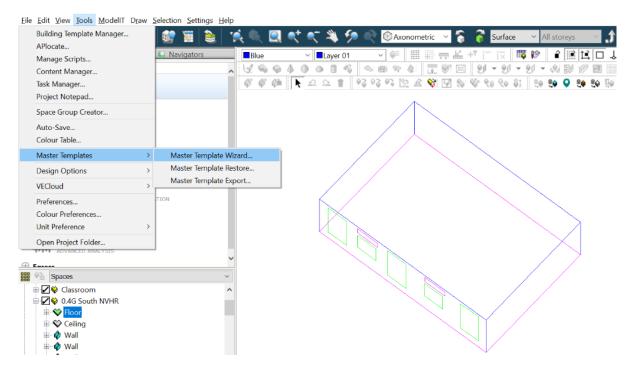


### Modelling functionality of the NVHR in IES VE

The functional control of an NVHR 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 folder.

### Importing NVHR profiles into your project

Once the rooms are set up and the NVHR louvres (represented by doors in IES) are added, the profiles, air exchanges and MacroFlo openings should be imported into the model using the 'Master Template Wizard' found in the 'Tools' menu.



#### Click the 'find folder' button:

Master Templates: Import Options	$\times$
Master Template File: HVAC methodology for imported templates: ApSys	
ightarrow Import data Import all template model data of the desired types to your model. Imported data will not be assigned to spaces.	
ightarrow Import and assign data Import all template model data of the desired types to your model. Imported data will be assigned to auto-matched spaces.	
ightarrow Import data (Advanced) Import individual data items from the template model to your model. Imported data will not be assigned to spaces.	
() Cancel	

Find the relevant unit folder, in this case the **NVHR1100** folder in the location it was saved after being downloaded from our website, and select the .cab file entitled '**NVHR1100** Profiles':

Organize   New folder				* • •		?
🍤 This PC	^	Name	Date modified	I	Туре	
🔚 Desktop		NVHR1100 Profiles 20.11.2018 [VE2018]	27/11/2018 1	1:39	cab Ar	chive
📔 Documents						
📜 Downloads						
🐌 Music						
🔚 Pictures						
🔚 Videos						
US (C:)						
🥪 Breathing Buildings Data (N:)						
👽 Archived Company Data (O:)						
🗳 Network						
😓 BB-E7470-01						
🤜 BB-OPT3010-01						
🤜 BB-T430I-01						
🤜 BB-T440S-01						
	~ <	c la				>
File name: NVHR	1100	Profiles 20.11.2018 [VE2018] ~	Template Files	(*.tpl;*.cab	;*.mit)	~
		(	Open		Cancel	

### Click the 'Import data' button:

Master Templates: Import Options			$\times$
Master Template File: [File path] HVAC methodology for imported templates: ApSys ✓ → Import data Import all template model data of the desired types to your model. Imported data will not spaces.	be assigi	shed to	
→ Import and assign data Import all template model data of the desired types to your model. Imported data will be a auto-matched spaces.	assigned	to	
→ Import data (Advanced) Import individual data items from the template model to your model. This can include space non-thermal): you may import each space's data and/or geometry, and you may replace ex spaces or add new spaces.			
0		Canc	el

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

Master Templates: Extra	Import Options		— D	×
Select all template	imports			
	Room Attributes Templates Constructions Templates MacroFlo Openings Templates		Thermal Conditions Templates Electric Lighting Templates Radiance Surfaces Templates	
Select all data impo	orts			_
	Apache Profiles	$\checkmark$	Air Exchanges	
	Constructions		CostPlan Projects	
	MacroFlo Openings		EnviroImpact Projects	
	Radiance Surfaces		PVS Generator	
	Apache Systems		Wind Generator	
	HVAC Networks		CHP Generator	
	Room Groupings		Components	
	Internal Gains			
0			< Back Next > C	ancel

#### Click 'next', and then 'Start':

Master Templates		_		×
Click Start to apply changes below				
<ul> <li>Create restore point</li> <li>Import Apache Profiles</li> <li>Import MacroFlo Openings</li> <li>Import Air Exchanges</li> <li>Import MacroFlo Openings Templates</li> </ul>				
0	< Back	Start	Cance	el

Your IES VE file will now contain the Breathing Buildings NVHR profiles required to control the unit. The profiles have been prefixed, in this case with 'BB NVHR1100' for the NVHR1100 unit, to make them easy to identify and group within the Profiles Database:

Project Profiles												3 Σ
Pattern: Daily Profiles ~	New	Сору	Edit	Delete	Save	Category	Reload					Help
Name		^					ID	Type	Category	Data Source	Delete Prevented?	1
Always Off (0%)							OFF	(Mod)		Generic	referenced by weekly profile: OFF	- 1
lways On (100%)							ON	(Mod)		Generic	referenced by weekly profile: ON	
8 NVHR1100 Damper Daily Profile							BBNV0000	(Mod)	Equipment, Ventila	Generic	referenced by weekly profile: BBNV0000	
B NVHR1100 Windows Daily Profile							BBNV0001	(Mod)	Equipment, HVAC,	Generic	referenced by weekly profile: BBNV0001	
B NVHR1100(Ducted) Fan Daily Profile							BBNV0002	(Mod)		Generic	referenced by weekly profile: WEEK0025	
B NVHR1100(Grilled) Fan Daily Profile							DAY_0025	(Mod)		Generic	referenced by weekly profile: BBNV0002	

The profiles included are daily and weekly profiles culminating in:

Damper Profile – Damper control of the NVHR units in your project

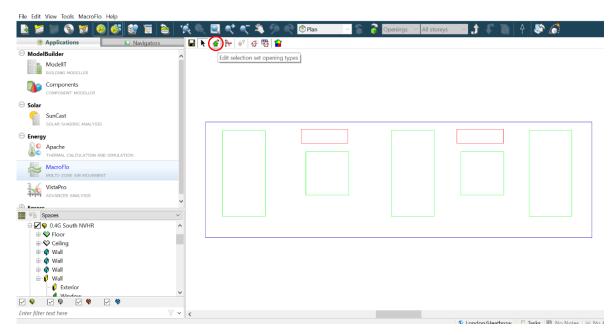
Fan Profile (this accounts for all fan operations) – Auxiliary ventilation control

**Windows Profile** – Window opening profiles (assumed to be useable 9:00-16:00 but these hours can be easily edited to suit the occupied hours of your building)

School Term weekly Profile – Typical classroom occupancy 9:00-16:00 with lunch break 12:00-13:00

## BB NVHR Damper Profile setup

Through the MacroFlo tab select the louvres/doors of the NVHR units and click the '*Edit selection set opening types*' button as shown below:



Select the 'NVHR1100 Damper' opening type and click replace.

省 Assign Opening Types		×
Assign Opening Types   Opening category:     Door     Opening type:     XTRN0000   External window - Closed     XTRN0005     NVHR1100   Damper - Mushroom     XTRN0001   Copening type:   XTRN0005     NVHR1100   Dessible replacement opening types:   XTRN0001   XTRN0001   BB R Series Damper - Mushroom   XTRN0002 BB R Series Damper - Penthouse XTRN0003 BB R Series Damper - Penthouse XTRN0003 BB R Series Damper - Mushroom XTRN003 BB R Series Damper - Mushroom XTRN003 BB R Series Damper - Mushroom XTRN004 Comparison Statematic Series Damper - Mushroom XTRN005 BB R Series Damper - Mushroom XTRN005 BB R Series Damper - Mushroom XTRN005 BB R Series Damper - Mushroom Statematic Series Damper -		×
XTRN0004 Sample NVHR Window XTRN0005 NVHR1100 Damper XTRN0006 Opening Window (NVHR1100) Replace Opening Types		
	Clos	e

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

### BB NVHR Windows Profile setup

The NVHR systems are designed to perform optimally when working in conjunction with openable windows. 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 model. You simply need to assign them to the windows in your building by selecting the '*BB NVHR1100 Window Profile*' in the '*Degree of Opening*' area of '*MacroFlo Opening Types*' as detailed below. Please ensure the hours for when windows can be used are altered accordingly in the highlighted window profile below (currently assumed to be 9am to 4pm).

🕂 MacroFlo Op	pening Types					$\times$
MacroFlo Opening	Types					
XTRN0000 XTRN0001	External window opening Sample NVHR Window	Reference ID	XTRN0001			
XTRN0002	NVHR1100 Damper	Description	Sample NVHR	Window		
		Exposure Type	05. semi-expos	sed wall		× <u>⇒</u>
		Opening Category	Custom / sharp	p edge orific	æ	
		Openable A	rea %	50		
		Equivalent c	rifice area	50.0	000 % of gross	
		Crack Flow Coeffic	ent	0.150	l/(s·m·Pa^0.6)	
		Crack Length		0	% of opening perimet	er
		Opening threshold		0.00	°C	
		Degree of Opening (Modulating Profile		BB NVHR11	100 Window Profile 🗡	7
Add	Remove					
✓ Include effects	of wind turbulence?		C	Ж	Cancel Save	9

Click 'Save' and 'OK'

## BB NVHR Auxiliary Ventilation Profile setup

Breathing Buildings' NVHR systems are hybrid natural ventilation systems, which include low-powered fans, to enable mixing ventilation in colder weather (Breathing Buildings' energy saving method for mitigating cold draughts in winter whilst ensuring occupancy comfort) and boost ventilation in summer.

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:

eneral	Room Void RA Plenum SA Plenum		
onstructions	Template	System Space Conditions I	nternal Gains Air Exchanges Building Regulations
acroFlo	Room (ApSys, metric)	Type	Reference
hermal ghtPro		· // -	Add/Edit
adiance			Remove
		Type -	
		Reference -	
		Variation Profile	-
		Adjacent Condition	-
		Max Flow	-
		Temperature Offset (°C)	-

Click the '*Add/Edit*' button and add the appropriate 'NVHR Fan' profile to the template. Fan Profiles for NVHR singles, pairs and triples will have been imported into your model using the master template wizard. If more than three units are required for a given space, a new air exchange can be created with the maximum flowrate for the single unit being multiplied by the number of units required, or alternatively multiple air exchanges can be added (e.g. 4 units in a space could be modelled as two pairs). *Note: these profiles are applied on a room level rather than per NVHR unit/door applied to the room*.

ation ∨HR1100(Grilled) Fan - Single <mark>∨HR1100(Grilled) Fan - Pair</mark>	0.250	ach	on continuously	External Air			
	330.0000	l/e			-	-	1
VHR1100(Grilled) Fan - Pair		85	BB	External Air	-	-	
	660.0000	Vs	BB	External Air	-	-	
VHR1100(Grilled) Fan - Triple	990.0000	l/s	BB	External Air	-	-	$\sim$
VHR1100(Ducted) Fan - Single	310.0000	l/s	BB	External Air	-	-	
VHR1100(Ducted) Fan - Pair	620.0000	Vs	BB	External Air	-	-	
VHR1100(Ducted) Fan - Triple	930.0000	l/s	BB	External Air	-	-	
<ul> <li>Remove Air Exchange</li> </ul>					Selec	πΑΙΙ	Deselect A
Auxiliary ventilation	8	·	Variation Profile	BB NVHF	۱100(Grilled؟	l) Fan Profile	~ 7
BB NVHR1100(Grilled) Fan - Pair		7	Adjacent Condition	External	Air		$\sim$
660.0000 I/s	~	·					
	VHR1100(Ducted) Fan - Pair VHR1100(Ducted) Fan - Triple Remove Air Exchange Auxiliary ventilation BB NVHR1100(Grilled) Fan - Pair	VHR1100(Ducted) Fan - Pair         620.0000           VHR1100(Ducted) Fan - Triple         930.0000           - Remove Air Exchange         930.0000           Auxiliary ventilation         930.0000           BB NVHR1100(Grilled) Fan - Pair         930.0000	VHR1100(Ducted) Fan - Pair         620.000(l/s           VHR1100(Ducted) Fan - Triple         930.0000(l/s           - Remove Air Exchange         980.0000(l/s           Auxiliary ventilation         V           BB NVHR1100(Grilled) Fan - Pair         980.000(l/s	VHR1100(Ducted) Fan - Pair         620 0000 (J/s         BB           VHR1100(Ducted) Fan - Triple         930 0000 (J/s         BB           - Remove Air Exchange	VHR1100(Ducted) Fan - Pair     620.000C Ws     BB     External Air       VHR1100(Ducted) Fan - Triple     930.000C Ws     BB     External Air	VHR1100(Ducted) Fan - Pair         620.000C (//s         BB         External Air         -           VHR1100(Ducted) Fan - Triple         930.000C (//s         BB         External Air         -           - Remove Air Exchange         Select         Select         Select         Auxiliary ventilation         Variation Profile         BB NVHR1100(Grilled) Fan - Pair         Adjacent Condition         External Air	VHR1100(Ducted) Fan - Pair       620.000C l/s       BB       External Air       -         VHR1100(Ducted) Fan - Triple       930.000C l/s       BB       External Air       -         - Remove Air Exchange       Select All         Auxiliary ventilation       Variation Profile       BB NVHR1100(Grilled) Fan Profile         BB NVHR1100(Grilled) Fan - Pair       Adjacent Condition       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 have now been set up (the example below is for a typical classroom):

iilding Template Man General	Room      Void      RA Plenum      SA Plenum			
Constructions	Template		Internal Gains Air Exchanges	
MacroFlo	ြင့် Room (ApSys, metric)	Туре	Reference	
LightPro		Infiltration Auxiliary Ventilation	Infiltration BB NVHR1100(Grilled) Fan - Pair	🔁 Add/Edit
Radiance				- Remove
		Type Infilt	ration	
		Reference Infilt	ration	
		Variation Profile	on continuously	
		Adjacent Condition	External Air	
		Max Flow	0.250 ach	

Click 'save' and 'OK'.

### Heating and Cooling defaults within the building

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

Note that the units will operate in night cool mode in the height of summer, if the heating profile is still on during these months and is set to a temperature higher than 16°C then this will interfere with the effectiveness of the night cool.