Revit Integration with IES VE

How to Create Revit Models for Successful Transfer to IES VE

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1 INTRODUCTION

This guide is for Autodesk Revit modellers to facilitate a successful transfer process to IES Virtual Environment. Autodesk Revit is primarily known for being a design coordination software and the Virtual Environment or VE as a whole building performance tool.

The key to leveraging as much as possible from the building design is considering the connection between the two software's as early as possible in the design process. This should be discussed as part of the BIM execution plan (Building Information Modelling) before the project commences to make sure the design team is aware of what is required to make the process successful.

Linking the two software tools allows for a more integrated design development that will facilitate faster decision making on important design aspects such as energy and carbon. These are important to consider as earlier as possible to ultimately reduce the operational costs of assets and ultimately reduce their impact on the environment.

When creating an analytical model there is only a low level of detail that is actually required graphically as the majority of information within these models is non-graphical data. The essential model geometry/graphical data required can be encapsulated simply as the walls, floors, ceilings and roofs. To add to this there are three possible opening types attached to these; windows, doors and holes (openings for spatial zoning in a model).

This lends itself to being introduced at stage two concept design/LOD100/200 or stage three/LOD300 design phase when the models are at a low level of detail making the process simpler and the gains much greater.

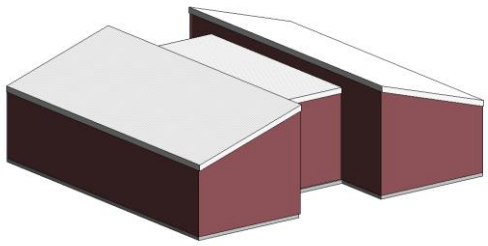
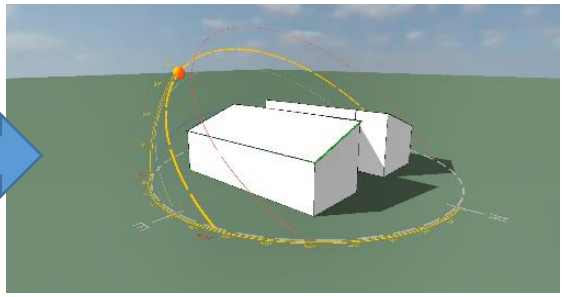
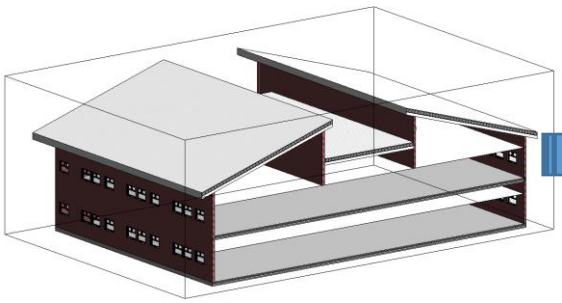
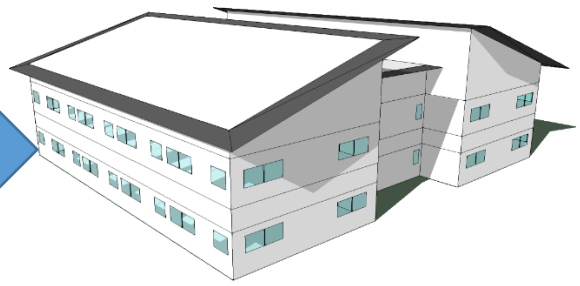
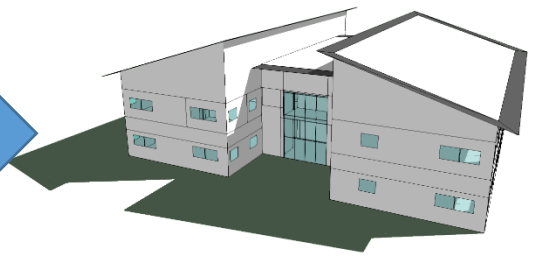
NB: This guide is written for modellers with a basic level of knowledge using Autodesk Revit.

2 DEVELOPING THE REVIT MODEL

It is best practice when creating a BIM model for export via gbXML/IFC (See section 12: File Types for more information) to develop the model geometry in a particular order.

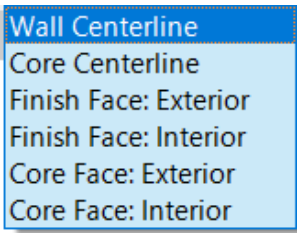
1. Start with the external shell boundary wall
2. Add in the floor Levels/Ceiling Voids/Roofs
3. Then add in core areas
4. From there add in all other internal partitions
5. Finally incorporate any openings as required

At each stage test the model to check that the boundaries are fully enclosed by placing a room or space volume into the model (see rooms & spaces section for further information). You can even export the model to test it at this point as shown in the images below. When developing the model it is best practice to have only a single external boundary wall type, a single internal type partition if possible and a single floor slab/ceiling/roof type set with 'Room Bounding' ticked on. Please refer to section **'Element properties'** for more information.

Revit Model	Revit Model Transfered to the VE
	
	
	

3 DRAWING REVIT WALLS

Within Revit there are six different options to choose from when drawing your walls.



Each option changes the floor area/volume of the spaces in a slightly different manner and should be accounted for depending on what analysis type is intended once within the Virtual Environment. The key point to note is that the area/volume value that is in Revit properties, this value will be replicated within the VE.

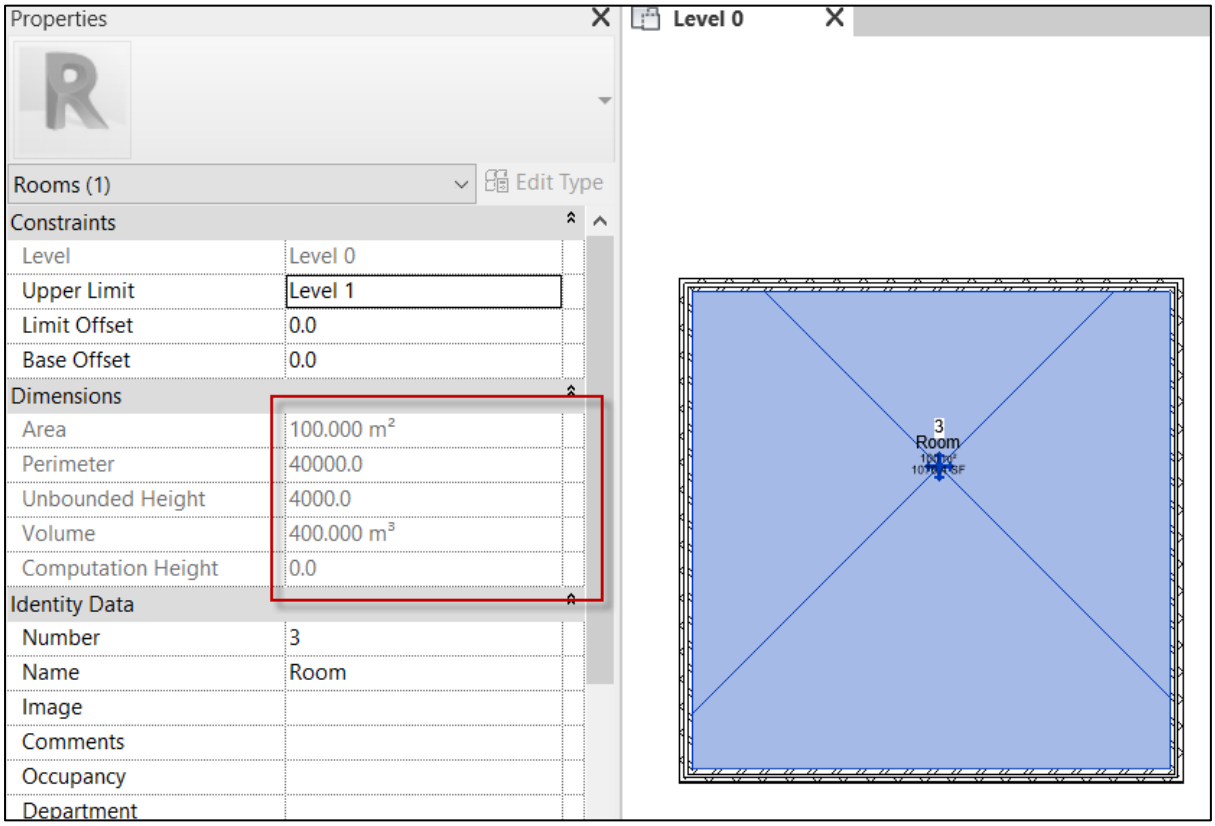


Image from Autodesk Revit: Properties dialogue – Dimensions

4 ELEMENT PROPERTIES

Within Revit there is a setting for elements such as walls to be defined as 'room bounding'. Elements with this setting will affect the room volumes and geometry quality when exported via the format of choice, whether it is gbXML or IFC.

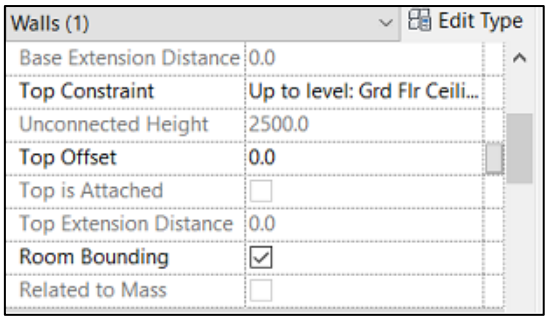
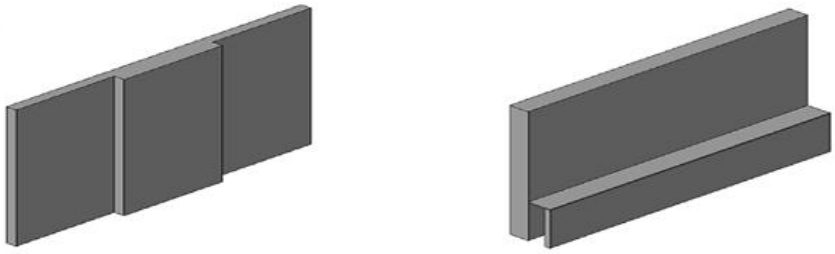


Image from Autodesk Revit: Properties dialogue – Room Bounding option

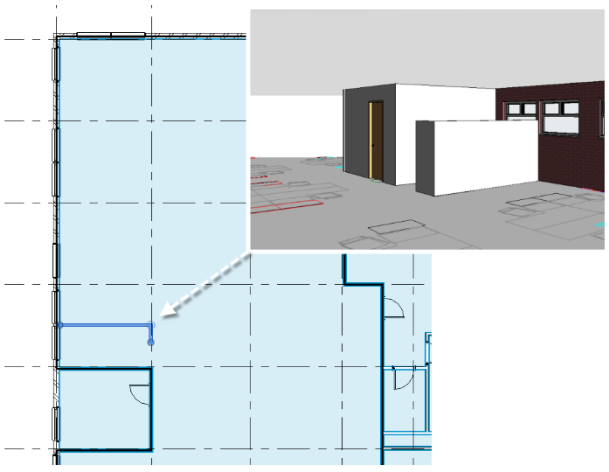
It is good practice at the outset of the model creation to choose which elements are going to be set as the primary 'room bounding elements', i.e. one floor/ceiling/roof element and one internal/external wall element. All other elements placed within the model can be included to show design intent but have this setting unticked to avoid them interfering with the gbXML or IFC file exported from the BIM model.

An example might be internal partitions creating cubicles in a restroom/toilet – setting these to non-room-bounding greatly simplifies the room geometry. In the examples below the wall has been detailed out and is thicker in the middle. This detail would either need to be modelled as two separate walls with only the primary wall set with 'room bounding 'on or with the detail removed. In the other example the low sill can be left in the BIM model for design intent but again the 'room bounding' unticked within the element properties.



Images from Autodesk Revit: Wall of varying thickness (left) and wall with lower sill (right)

Another example illustrated in the image on the right is the scenario of a half-height partition denoting a printer bay. In an energy model this area could be absorbed into the main space. From an architectural perspective it would need to remain to show design intent. The solution is to follow the methodology above and place the partition into the Revit model but untick the 'Room Bounding' option within the properties dialogue.



5 MODELLING TIPS & COMMON ISSUES

Room/Space Separation Lines

Room/Space separation lines should only be used to divide open plan spaces. They should never be run along the same line as another solid partition or used to close off an area of a model to solve an issue with the Room/Space placement tool. This results in a poorly defined gbXML with additional shading surfaces being included where they are not wanted (see images below).

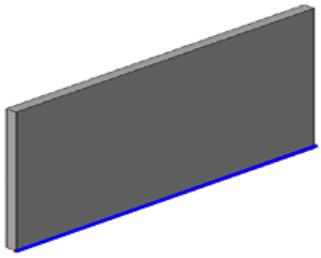
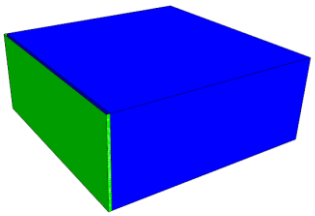
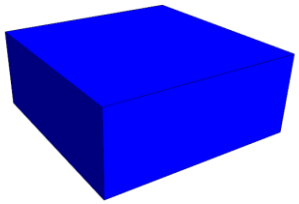
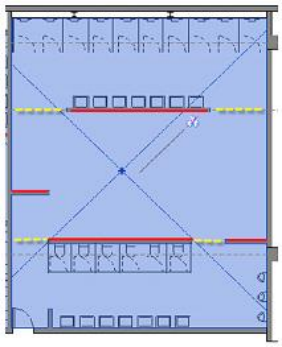
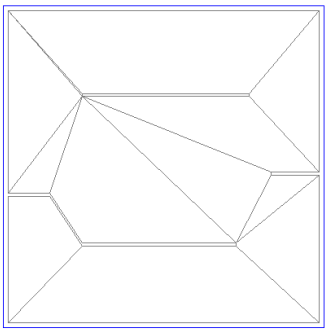
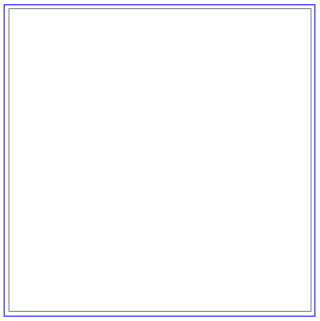
		

Image from Autodesk Revit: Wall with room separation line running along it	Image from IES Virtual Environment: Additional shading surfaces (green) as a result of the boundary conflict.	Image from IES Virtual Environment: successful gbXML import.

Partitions Protruding into the Centre of a Room or Sit in the Middle of a Room

Where walls in a model protrude into the centre of a room or sit in the middle (walls highlighted in red below), the decision needing made is either set to 'non-room bounding' or to add in room separation lines to create separate spaces as indicated in the images below left(yellow dotted lines). In the example below all the walls highlighted in red had the 'room bounding' option unticked in their element properties. It should be noted that structural columns cause similar unwanted outcomes and should be addressed in a similar manner when building up the Revit model.

		
Images from Autodesk Revit: Plan view highlighting walls protruding into a room (left) and partitions in the centre of a room	Image from IES Virtual Environment: Resultant poorly defined gbXML. Unnecessary additional surfaces may cause simulation speed issues and over-complicated surface-level results (e.g. temperature).	Image from IES Virtual Environment: successful gbXML import with 'room bounding' option unticked.

If you plan iterative work flows (e.g. import design changes into existing VE models) or plan to export a VE loads calculation back to a gbXML file, it is crucial to use unique room names. Revit generates a new unique room ID each time a gbXML file is exported. To allow the analytical model to be easily updated

from the main Revit model after each design iteration, unique room names / numbers are required to facilitate the process. This is a basic requirement of energy modelling to allow design teams to make sense of simulation results. (See examples below)

L00: Meeting Room	L00: Kitchen	L01: Male WC
L00: Board Room	L00: Shower Room	L01: Access WC
L00: Meeting Room	L00: Server Room	L01: Circulation

Image from Autodesk Revit – Spaces Schedule highlighting unique room/space naming.

6 ROOMS AND SPACES

Within the Revit model you must make sure to have a room or space assigned to all areas within the building envelope. This includes lifts, stairwells, risers and floor/ceiling voids (if required dependent on design stage/analysis), ensuring there are no air gaps within the model. Not adhering to this will result in external air gaps to internal areas of the building model and rooms missing from the model leading to inaccurate results.

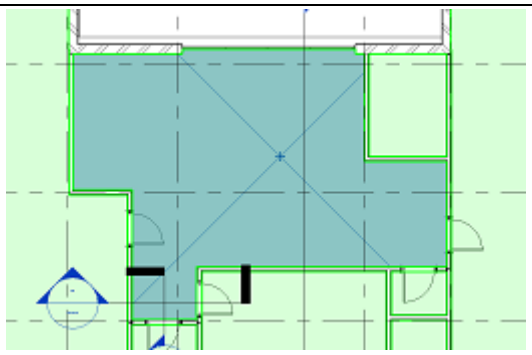


Image from Autodesk Revit – Space Flooding the area to its boundaries as required.

When placing a room or space into your model, if you are presented with the warning below, then the boundary of that area in the model will need to be addressed for gaps. You should be achieving the space fill flooding the whole area to its boundaries. (Example image above).

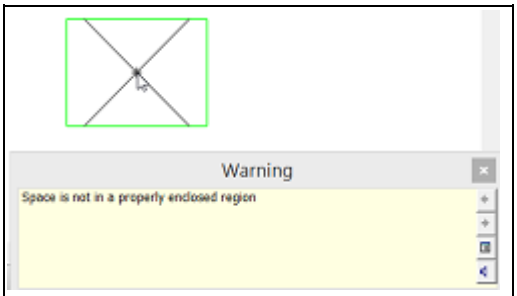
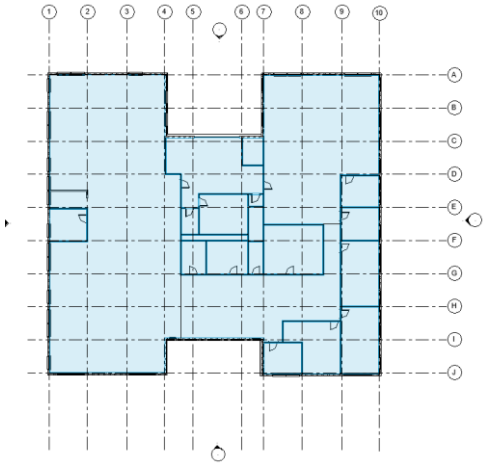
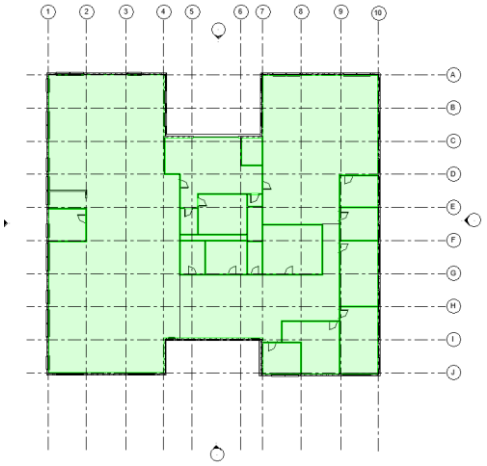


Image from Autodesk Revit – Error placing the Room or Space into the model.

Once your model is complete you should have a floor plan similar to the images below depending on whether you are choosing to export rooms or space.

Revit Model With ***Rooms*** Placed	Revit Model With ***Spaces*** Placed
	

7 THE DIFFERENCE BETWEEN ROOMS & SPACES

With regards to geometry there is no difference between Revit Rooms and Revit Spaces. The only difference between the two element types is the additional non-graphical data that can be exported along with 'SPACE' data. The table below compares the data that can be exported with each option.

Revit Room Data	Revit Space Data
Building Location	Building Location
Building Type	Building Type
Building Constructions/Fabric	Building Constructions/Fabric
Room Names	Room Names
	Room Type – Occupied/Plenum
	Occupancy – Heat Gain/Person
	Electrical – Lighting & Power Loads
	Zone Data – Heating & Cooling Set Points

8 Ceiling Voids & Utilising Floor Levels

8.1 Ceiling Voids:

In addition to the section regarding 'Rooms and Spaces', the volumes of ceiling voids also need to be considered. It is common these volumes are missed when exporting from the main Revit design model resulting in large gaps between floor levels within the energy models. This in turn will result in incorrect results when simulating your building.

A design team agreement should be reached at the outset of the project noting the responsibility of who will account for these and when they will be taken into account. For early stage analysis these could be omitted exporting the room volumes tied to floor to floor heights (NB: any ceiling elements should have room bounding unticked to achieve a clean gbXML in this manner – See Section 9 Utilising Floor Levels for more information).

For a more detailed stage analysis there are two options.

1. Export the ceiling voids included within the Revit gbXML model creating levels for the ceiling voids and tie the rooms or spaces to the correct levels.

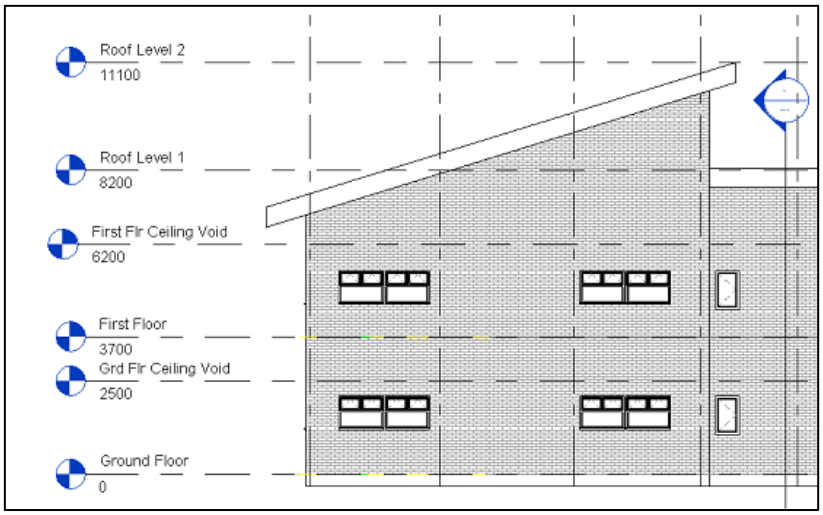


Image from Autodesk Revit: using levels to set up room/space volumes for export – elevation view.

Or

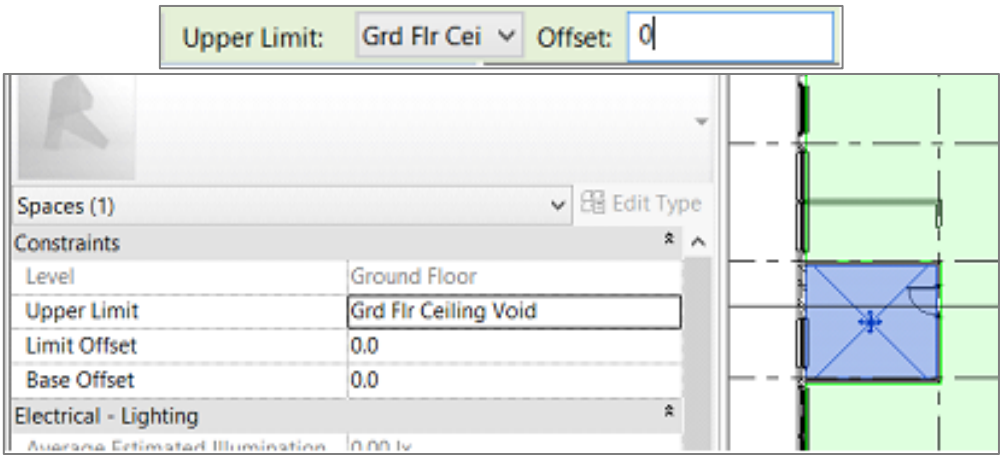
2. The same floor to floor volumes are exported as at concept stage with the ceiling voids being added into the geometry to create them within the VE using the 'ceiling voids' tool, or other modelling tools within the 'ModelIT' applications.

If these volumes are to be exported from the Revit model, then a room/space must be placed for these like any other volume within your Revit model.

8.2 Utilising Floor Levels

It is good practice to tie room/space volumes to levels within your Revit model. At the outset of the project the inclusion of these should be considered and levels created to accommodate the modelling. This ensures a good clean gbXML is exported from Revit with no room/space volumes overlapping and any future updates to levels adjusts volumes automatically.

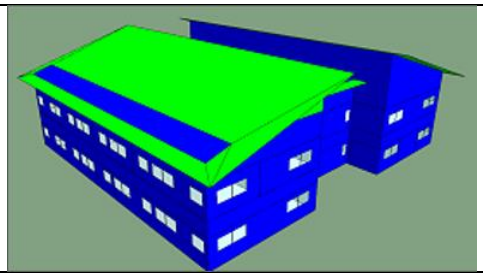
It is best practice not to use the offset function when placing rooms / spaces within Revit, except when placing roof level volumes (see below for Roof Level rooms/spaces). As mentioned above, if you are using the levels with no offset it ensures that volumes are not overlapping and are clearly defined. Place the room / space within the floor level in question, set the upper limit to the next level above and set the offset to zero.



Images from Autodesk Revit: Space placement Constraints and settings

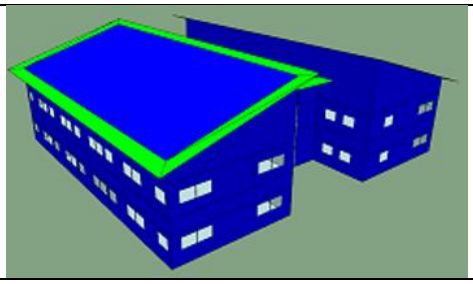
8.3 Roof Level Rooms/Spaces

Another common issue is where the gbXML is poorly defined for roof levels. When imported into the VE an additional 'shade surface' has been added to the model where it is not required. This can occur where there are pitched or flat roofs. (See image below) The impact of this is incorrect results from analysis performed as this shade surface is altering where the external boundary begins and is also blocking sunlight that would normally be received by the roof surface.



Images from the Virtual Environment: Rendered view with model volumes incorrectly imported from a poorly defined gbXML.

To resolve this issue new level need to be created above the roof construction in the Revit model to tie the rooms/spaces too or the offset function utilised for the roof level volumes within the model. All other volumes should be tied to levels in the model as mentioned previously to avoid overlapping. The image below shows the outcome that should be achieved.



Images from the Virtual Environment: Rendered view with model volumes correctly defined and imported from the gbXML.

Using sections and turning 'Room/Space' fill on is a good way to interrogate if volumes placed in the model are to the levels required as shown in the image below.

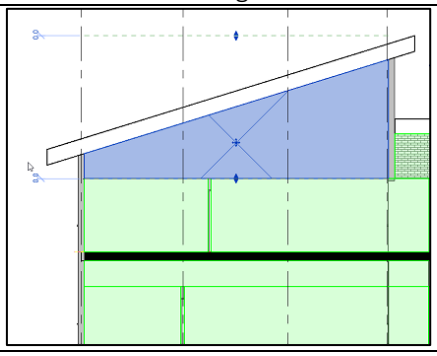


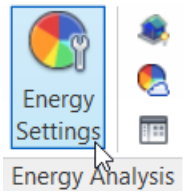
Image from Autodesk Revit: using levels to set up room/space volumes for export – section view of space volumes.

9 CEILINGS CONSTRUCTIONS WITHIN THE REVIT MODEL

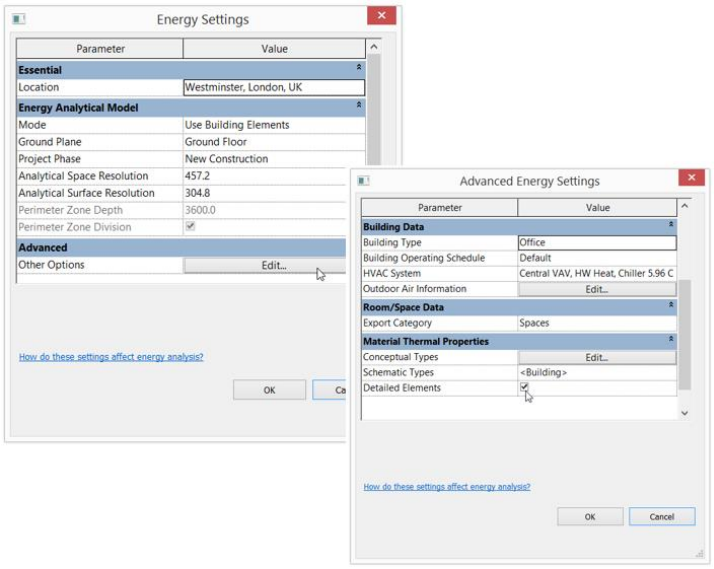
If ceiling voids are to be included in the Revit model then the best option is to utilise the generic ceiling type as compound ceilings can be a potential source of a poorly defined gbXML that is then imported into the VE.

10 TAGGING CONSTRUCTIONS WITHIN REVIT

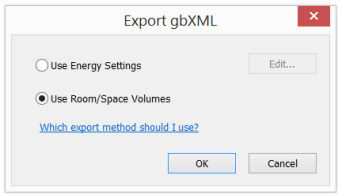
You can create or tag constructions within Revit so that they already set up when imported into the VE. The constructions can be define by their name/type only with the thermal properties left at default and edited easily on a globally scale within the VE. Once the constructions within the Revit model are created follow the steps below to achieve this.



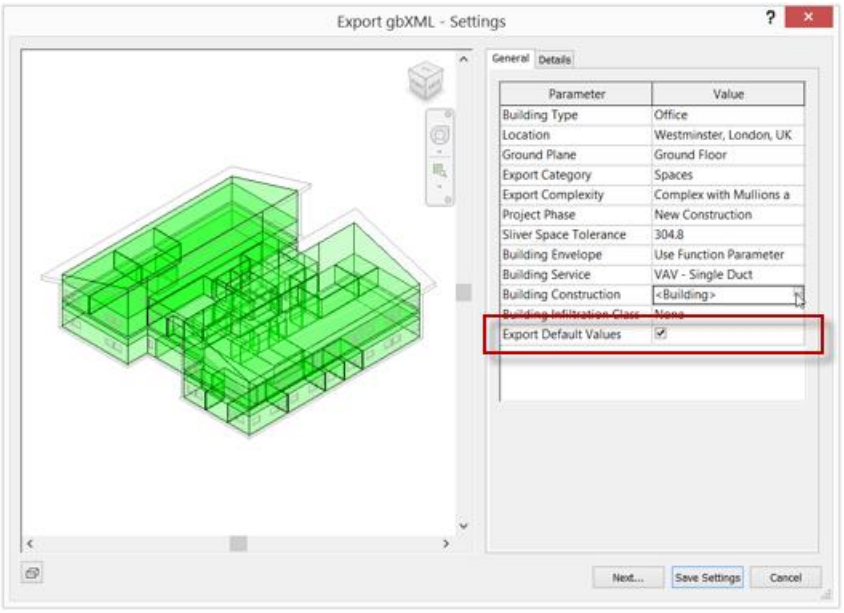
- Go to 'Analyze' Tab > Energy Analysis
- Click 'Energy Settings'
- Select Advanced > Other Options
- In the Material Thermal Properties Tick Detailed Elements



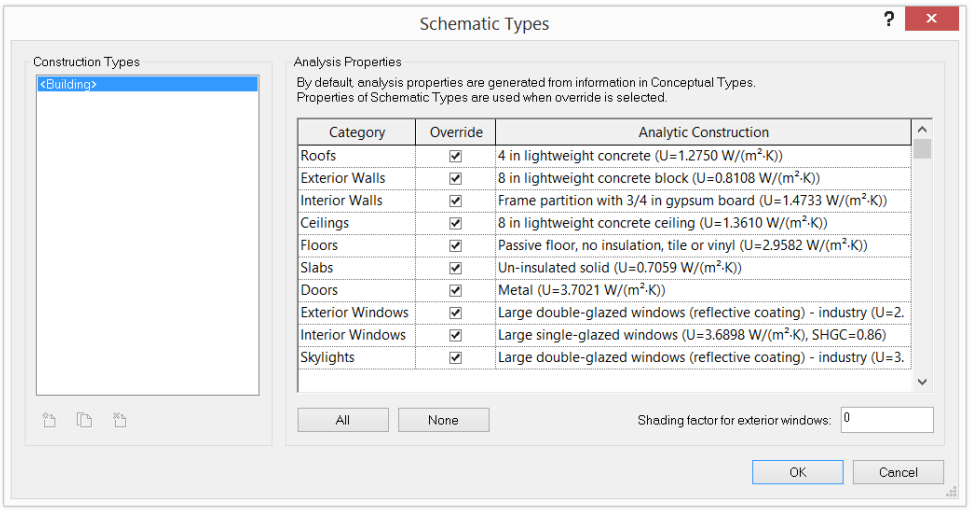
- Then go to File > Export gbXML
- Select 'Use Room/Space Volumes



- Make sure Export Default Values is ticked
- Open up Building Constructions



- Once in Building Constructions make sure the Override is Ticked for all constructions



With the options above set constructions specified in the Revit model will transfer across to the VE analytical model.

11 COORDINATE SYSTEM WITHIN REVIT

If, after import into the VE, windows are missing or your geometry appears to be warped, then resetting the coordinates in your Revit model and exporting again will resolve the issue. This particular issue is due to the two software's having different coordinate systems. Go to "Manage> Coordinates> Specify Coordinates at Point" and click within the model space. The following dialogue box below will appear allowing the adjustments required.

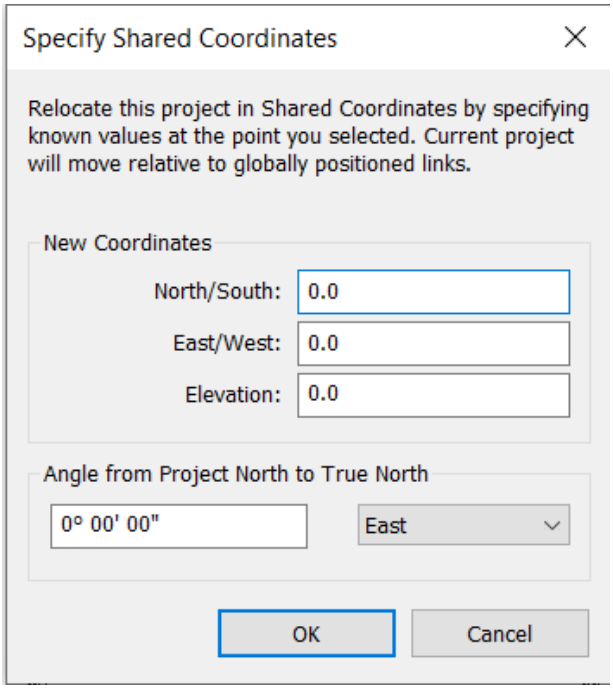


Image from Autodesk Revit: Specify Coordinates Dialogue Box

12 File Types

There are two exchange file types that can be utilised to transfer data between Revit and the VE.

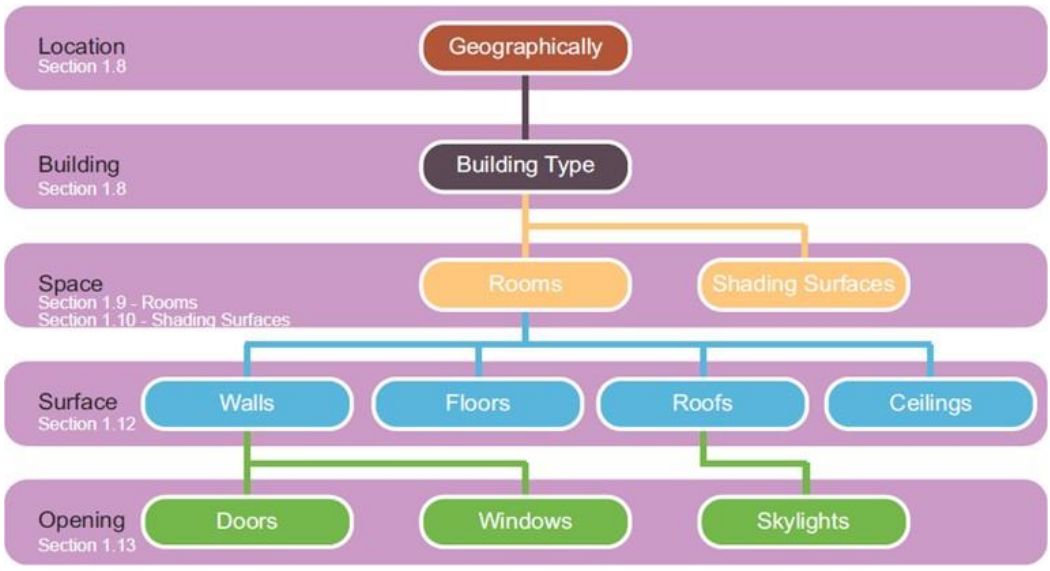
- gbXML schema
- IFC schema:

Green Building XML schema, referred to as “gbXML”, was developed to facilitate the transfer of information from building information models to performance (predominantly energy) analysis tools.

Industry Foundation Class, referred to “IFC”, is a more recent exchange format developed as an agnostic file type to exchange information between multiple hardware devices and software platforms.

IES recommends using the gbXML exchange file format as it has been developed specifically for the exchange with performance analysis tools and more importantly provides a more accurate model at this time.

A gbXML file organises information according to the following hierarchy: Location, Building, Space, Surface and Opening.



IES