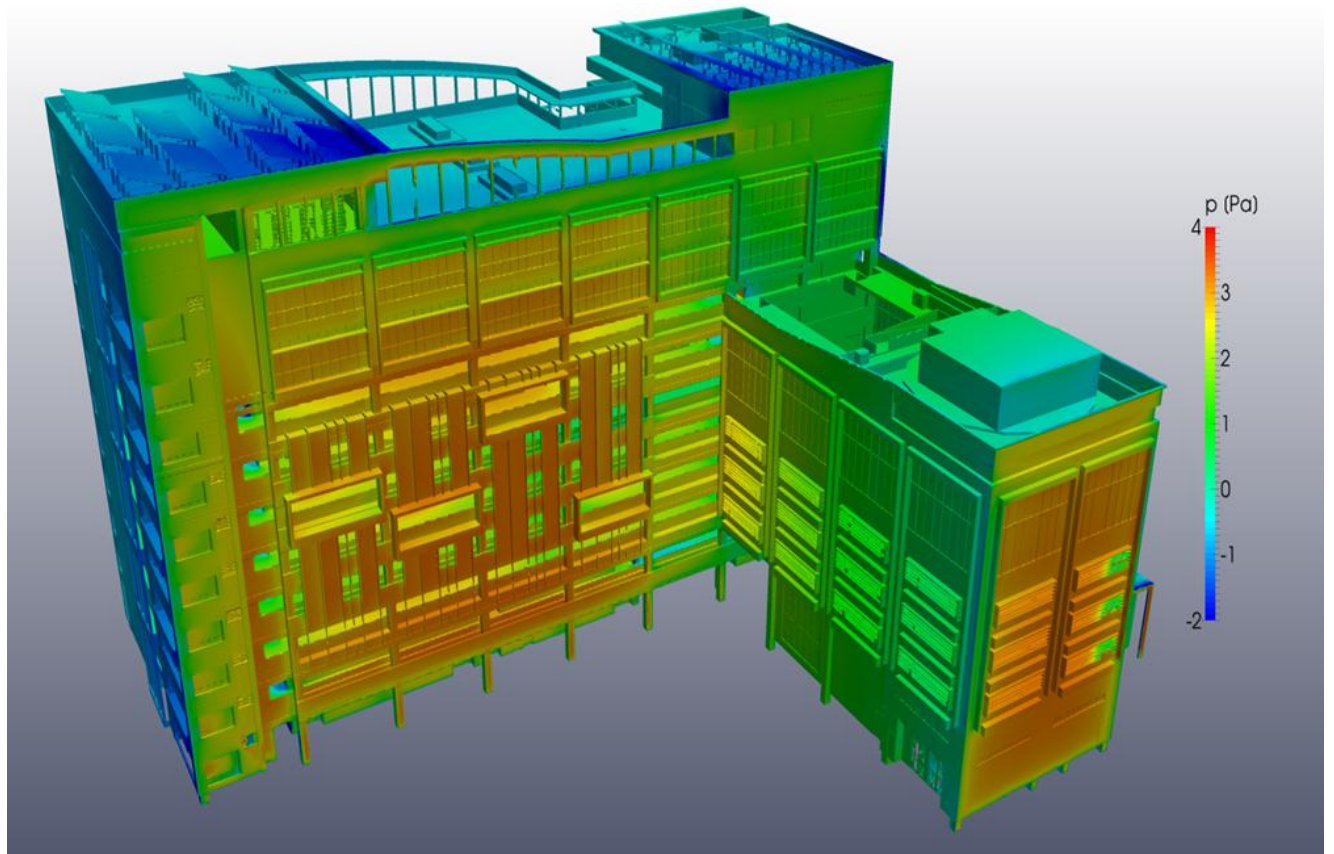


BIM Essential Guide

For Transfer of BIM into

Building Performance Analysis (BPA) Tools



BCA acknowledges the leadership provided by the BIM Steering Committee in support of the production of the BIM Essential Guides

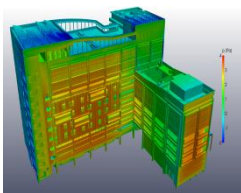
The BIM Essential Guides have been drafted by the Centre for Construction IT on behalf of BCA and the BIM Steering Committee.

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CEO's Message

Dear readers,

Under the 1st Construction Productivity Roadmap introduced in 2010, BCA had introduced Building Information Modelling (BIM) as a key enabler of productivity in Singapore's construction industry. Today in 2015, more than 60% of the larger contractors and 80% of the larger consultants have adopted BIM. Moving forward, we have drawn up the 2nd Construction Productivity Roadmap where we would like to advance beyond BIM adoption by individual firms, and leverage on BIM technology for greater integration and collaboration among all firms across the value chain.



Together with the industry, we will continue to explore the uncharted areas of BIM software integration, machine automation and process re-engineering to achieve a quantum leap in the adoption of BIM technology and methodologies that are aligned with our local practices.

We would like to encourage the industry to continue our partnership in improving and expanding the BIM Essential Guides Series, to plug the gaps as more stakeholders play a part in the input and sharing of information and benefits generated from BIM.

We would like to thank the valuable time and efforts of the BIM Managers Forum and the leadership of the BIM Steering Committee, chaired by Er Lee Chuan Seng, Emeritus Chairman, Beca Carter, that enabled the release of this document.

Dr John Keung

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Ms. Thazin Soe

Mr. Felix Batad

Mr. Chidambaram Chidambaram

Mr. Liu Ziwen

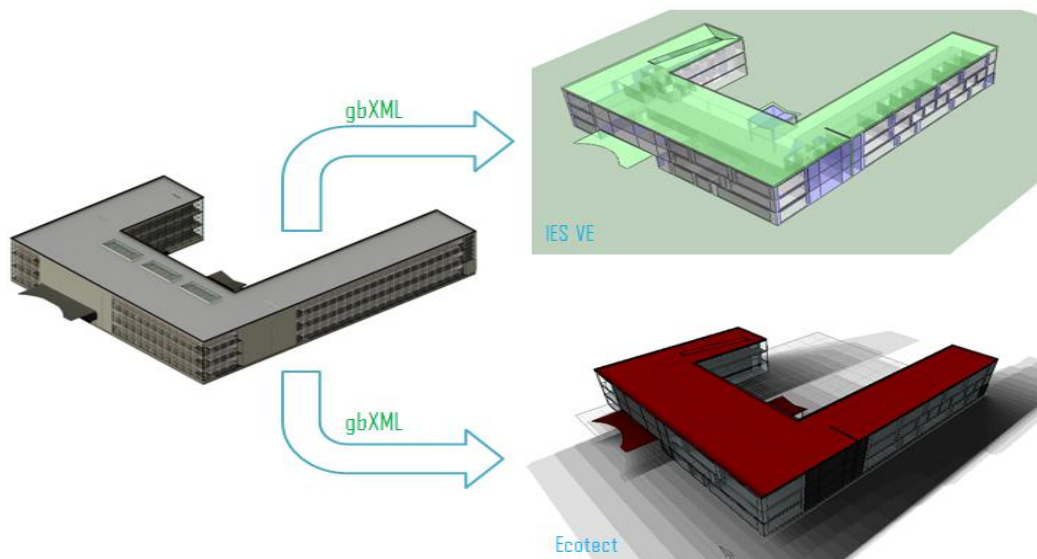
OBJECTIVES

Building information Modelling (BIM) is fast becoming a standard tool for building design and construction in Singapore. BIM can also be used for various forms of analyses, especially Building Performance Analysis (BPA). With BIM, more accurate and efficient analysis processes can be expected.

In order to achieve sustainable design goals through BIM-based BPA, it is necessary to transfer essential information, such as accurate model geometry, into different file formats and BPA software.

The objective of this Essential Guide is to demonstrate the transfer of this essential information between commonly used software and formats, i.e. from BIM Authoring tools into Trace 700, IES-VE, Carrier E20-II, Design Builder and Ecotect software, through the gbXML format. A step by step guide of the transfer of a specific BIM authoring tool can be found in the **gbXML File Export Process** chapter.

Example of transfer from BIM to BPA software



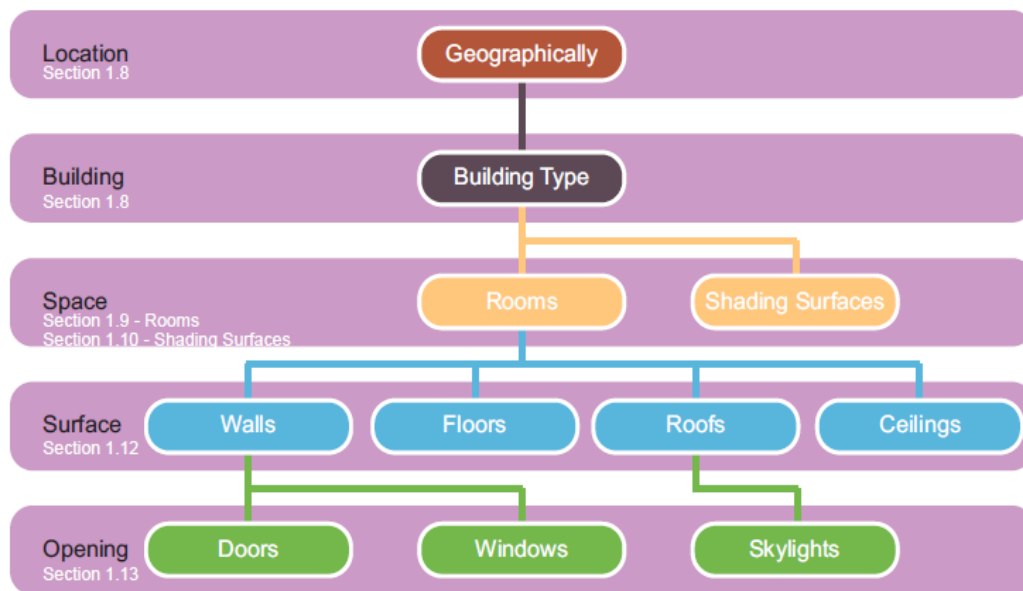
This is not an extensive document that covers all scenarios that might arise based on specific projects. Users are allowed to edit/change accordingly to suit their needs.

Common Exchange Formats

green building XML (gbXML) FORMAT

The green building XML format was developed to facilitate the transfer of information from the BIM model into BPA tools. The gbXML schema organizes information according to the following hierarchy: Location, Building, Space, Surface and Opening. It is usually used for BPA requiring enclosed volumes, such as analysis for views, daylight, thermal and acoustics.

gbXML Structure

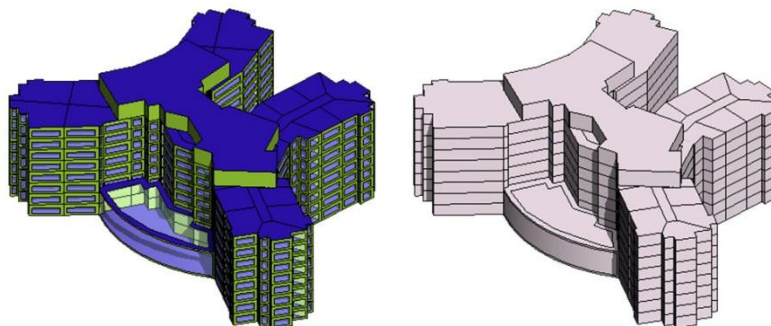


Preparing the Analytical Model

It is crucial to create an analytical model from a BIM model. The analytical model will consist of spaces found in the BIM model. One can make changes to the analytical model without modifying the BIM model. Other points to note include:

- Only significant spaces, corresponding to thermal zones, should be defined as space elements.
- Smaller space elements, such as shafts, storage spaces and mechanical spaces of minimal impact, should be grouped together.
- All space elements must be fully bounded with correct heights and dimensions, and each of their location and other properties must be specified in the analytical model.
- Openings such as windows and skylights should be defined in the analytical model, but their properties (thickness, U value, transmittance coefficient and solar heat gain coefficient) can be defined after data transfer within the BPA software.
- Analytical surfaces for floors, walls, and roofs must be bounded and connected to other elements where necessary.
- Shading surfaces that are treated as analytical surfaces of walls, floors or roofs not bounding a room can be exported as simple surfaces.

Example of an analytical model (left) generated from a BIM model (right)

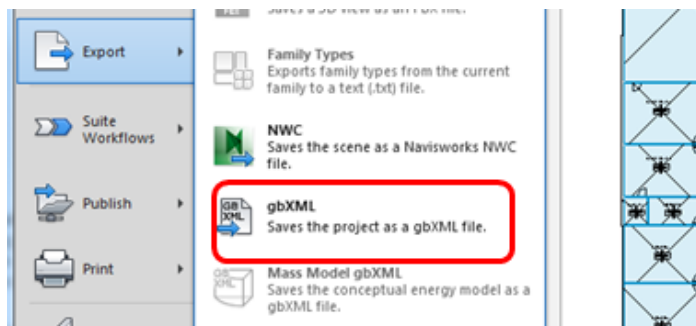


gbXML File Export Process

After all spaces have been defined in the BIM model, the geometry and space data can be exported via gbXML format and imported into the BPA software. This section describes the gbXML export process for Trace 700, IES-VE, Carrier E20-II, Design Builder and Ecotect software.

For TRane Air Conditioning Economics (TRACE) 700

Step 1: Export gbXML file from BIM authoring tool



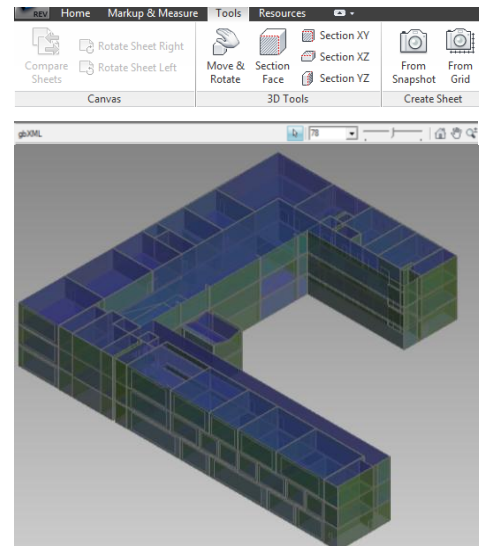
- After the BIM Model has been checked, go to File → Export → gbXML
- Set the location and the ground plane in the dialog box
- The remaining parameters can be left on the defaults, as the default parameters will be overridden in the TRACE model.
- After checking project parameters, click next, and save the gbXML file in your project folder.

Step 2: Import gbXML file into TRACE

Before importing, check the gbXML geometry using the gbXML2dwfx.exe utility and Autodesk Design Review, a 2D and 3D DWF viewer.

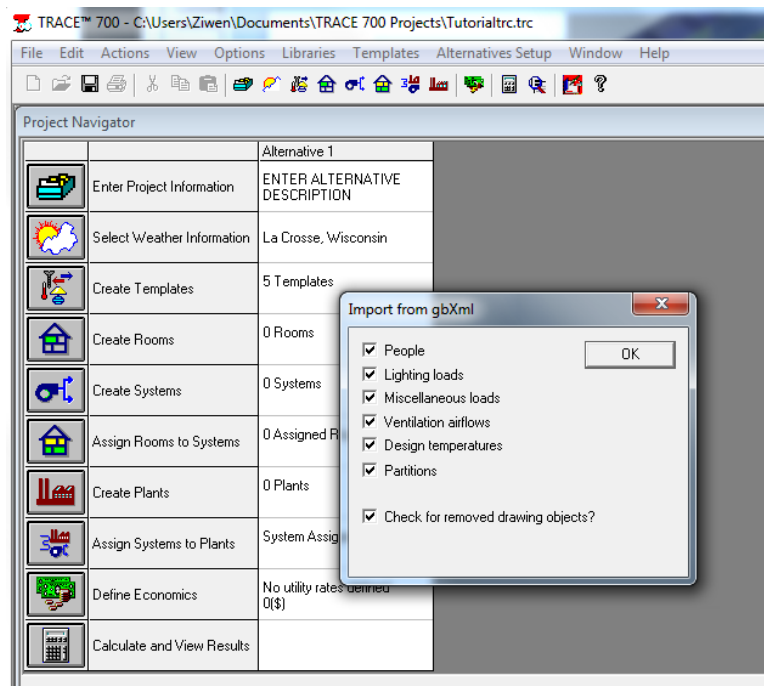
- Drag and drop the gbXML file to gbXML2dwfx.exe to generate a DWFX file, which can be viewed in Autodesk Design Review.

- Check the geometry visually to identify any major issues (gaps in the model, missing spaces, surface recognition etc).
- When the gbXML file is checked and ready to be imported, open a new TRACE Program, and select file → import gbXML. Use the dialog to select which gbXML parameters should be imported. Only select the parameters that you have defined in the BIM authoring software.
- Once imported into TRACE, the model should be thoroughly checked again.

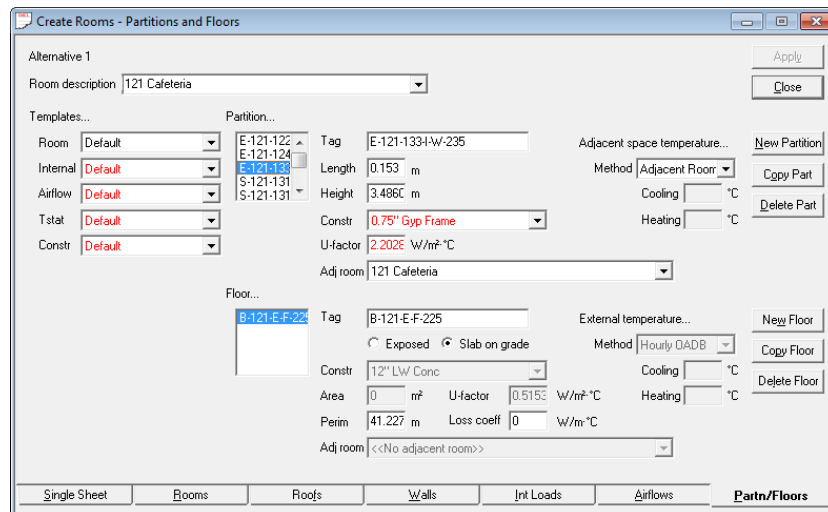


Step 3: Manual Inputs & Checking

After importing the gbXML file, check that the data was correctly imported into TRACE. In particular, check the following: Rooms, Roofs, Walls, Internal Loads, Airflows and Partitions / Floors, and make adjustments in the BIM authoring software or the TRACE file as required.



Minor geometry changes can be made manually in TRACE



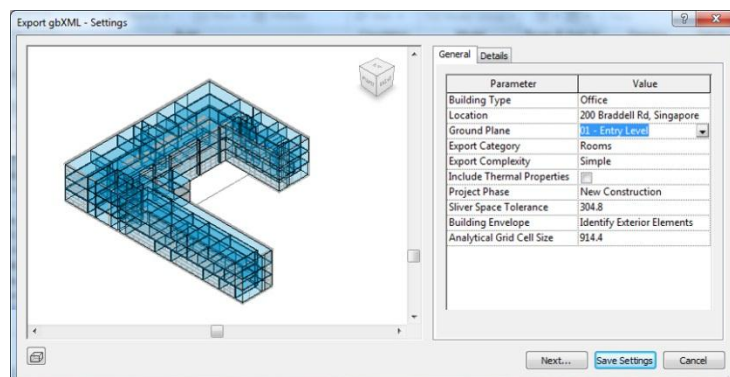
Step 4: Re-importing gbXML process

The spaces inside the BIM authoring tools should be updated so that the zoning diagram reflects the changes. Major geometry updates will require adjusting the spaces directly in the BIM model and re-importing the gbXML file into TRACE.

For IES Virtual Environment (IESVE)

Step 1: Set export settings to export gbXML file from the BIM authoring tool

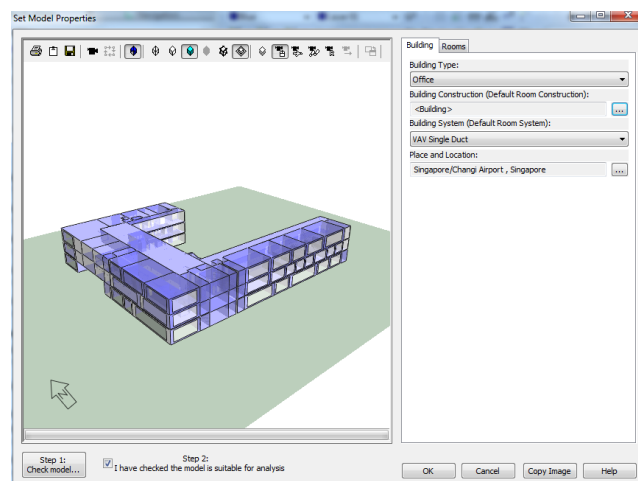
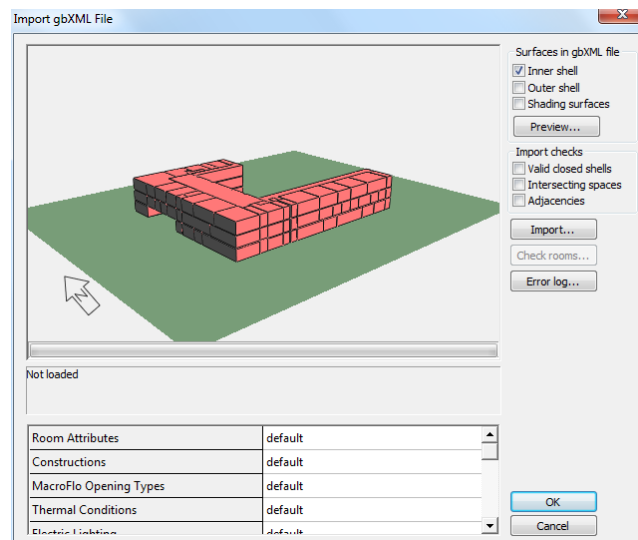
- After the model has been checked, go to File → Export → gbXML
- Set the Building Type, Location and the Ground Plane as shown below



- For Export Complexity, choose “Simple” if no shading surface has been defined. Choose “Simple with Shading Surfaces” if overhangs or fins were defined in the BIM authoring tool (by drawing in roof surfaces earlier). To reduce the IES-VE model run time, try to reduce the quantity of shading surfaces and keep the geometry as simple as possible. Shading surfaces can also be defined later in ModelIT, which is IES’s 3D building geometry tool.
- After checking project parameters, click Next, and save the gbXML file in your project folder

Step 2: Import into IESVE

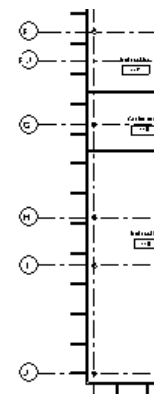
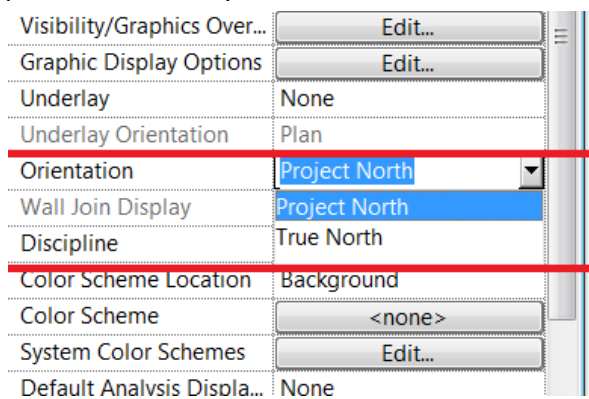
- Open a new IESVE project. Go to file → import gbXML and browse for the gbXML file. The model check window will come up.
- Check the geometry of the model in the viewer window, and select which surface type to import. The categories at the bottom of the window can be left as “default” and assigned later.
- Click okay and check each level in IESVE.
- The schedule will be imported into IESVE. It is recommended to export a .GEM geometry file from ModelIT, and import the geometry file into a new IESVE project file.



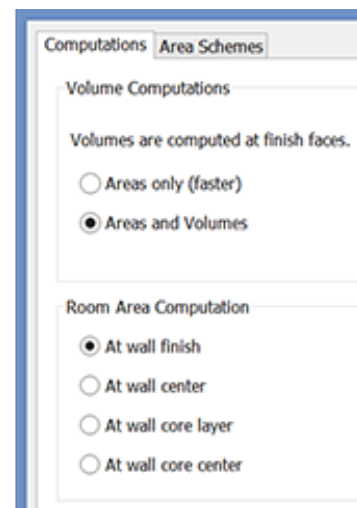
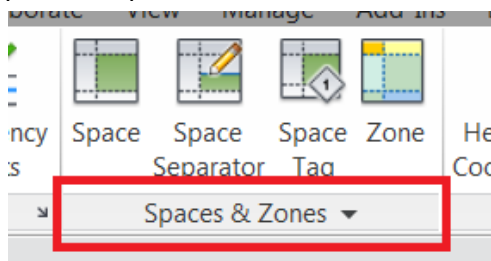
For Carrier E20-II

Step 1: Project Set-up for gbXML Exporting

- Make sure that the Architectural BIM Model is linked into the MEP BIM Model.
- Acquire the True North orientation from Manage Tab → Coordinates → Select (the linked architectural model). Change the orientation of the project on the Properties panel if necessary.

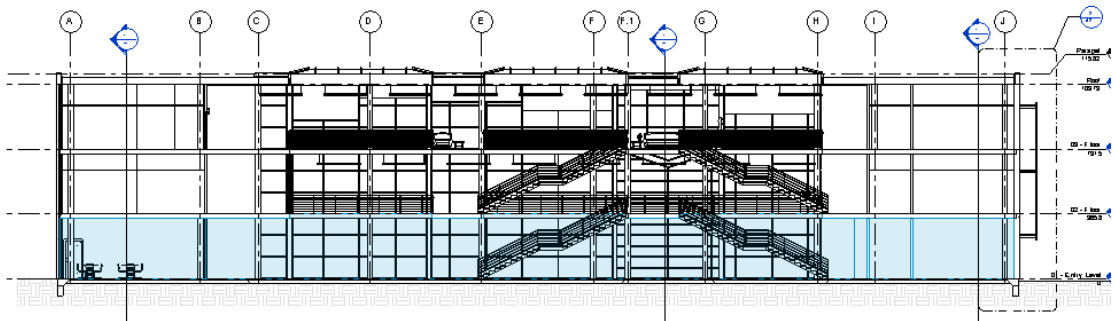


- Set the Area and Volume Computations values on the Analyze Tab → Space & Zones panel drop-down.

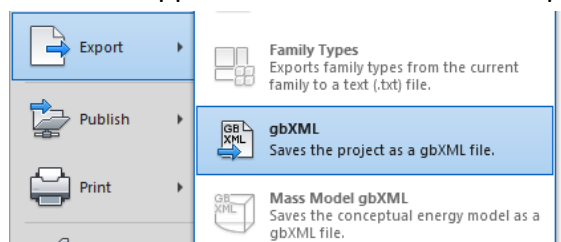


- To create spaces in all areas of the model, you can place spaces manually or automatically through Modify → Place Space tab → Spaces Panel → Place Spaces Automatically.

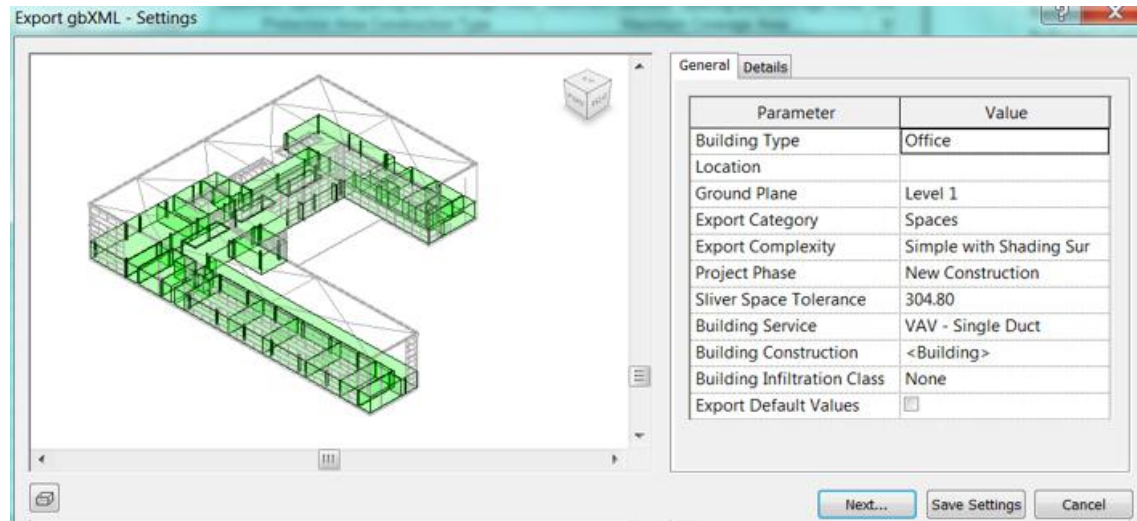
- The names and numbers from the rooms in the Architectural BIM model can be assigned to the spaces by using example like Autodesk Revit Space Naming Utility, at the Add-Ins tab → Space Naming Utility → Names and Numbers. Spaces can be named manually if the Space Naming Utility tool is not available. (Note: the utility is a free app that can be downloaded and installed through an Autodesk Subscription account)
- Verify the extents of all spaces based on the rooms of the Architectural BIM model. It is important that space extents are not overlapping, which will create inconsistencies in the data to be gathered. To verify the extents:
 - Create and open a section of a room
 - Verify the space placement by opening the View tab → Graphics panel → Visibility/Graphics → Spaces → tick Interior and Reference (if you want to display reference crosshairs)
 - Adjust Spaces if extent is not met
 - To make sure that all spaces extents are correct, go to the floor plan , go to Properties panel → Limit Offset → specify the height limit of the level that you are checking, and select all spaces within that level



- After all space extents have been verified, export the model into gbXML file.
- Go to the Application Menu and select Export → gbXML File

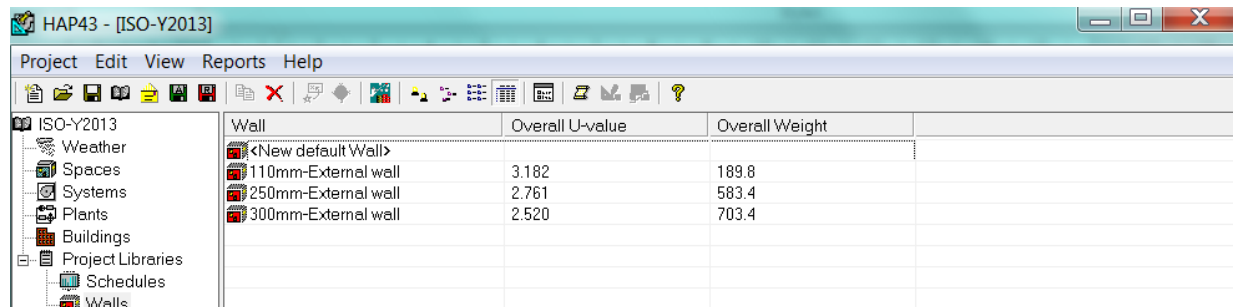


- Verify the accuracy of the gbXML file in the dialog to avoid any errors when loading the gbXML file into Carrier's Hourly Analysis Program.
- Adjust settings as shown in the figure below. Click Next when ready for export.



Step 2: Importing the gbXML file into Carrier's Hour Analysis Program

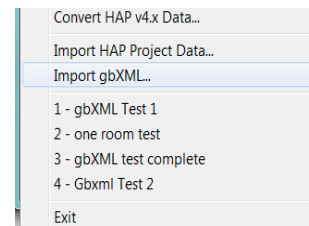
- Open the Hour Analysis Program
- Retrieve the company template for analysis



- Go to the Project Tab and click Import gbXML
- Locate and load the file
- After importing, the gbXML data will be automatically loaded to the Carrier Analysis Program for verification, as shown in the following page.



BIM Essential Guide – For Transfer of BIM Data into Building Performance Analysis (BPA)



gbXML Translation Report

Project: ISO-Y2013
Prepared By: UPC

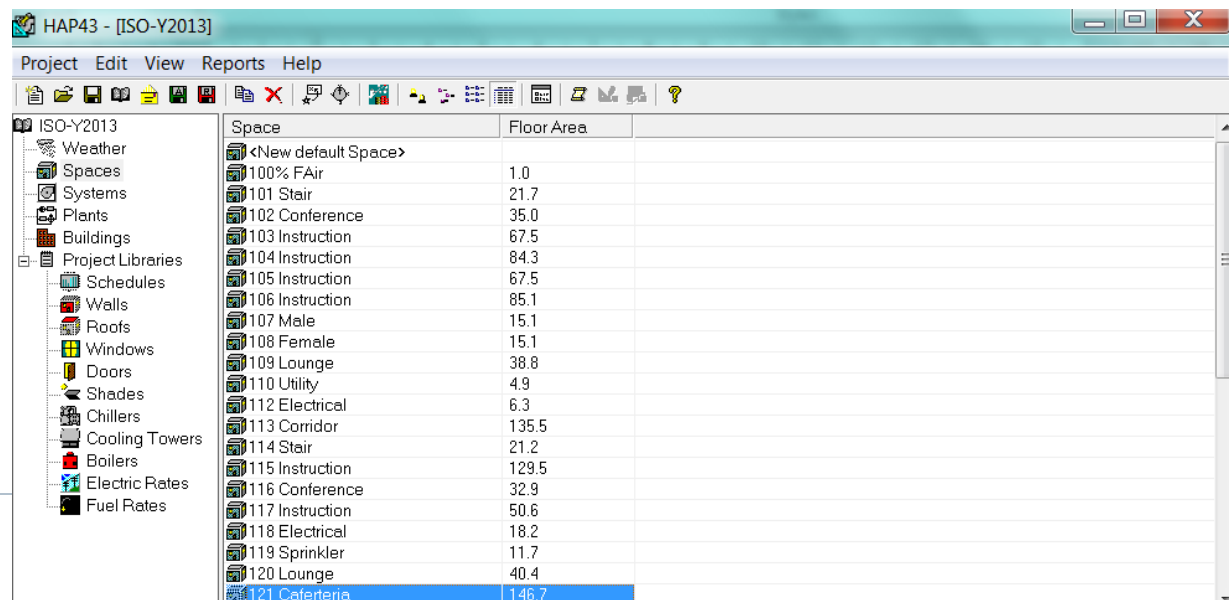
04/09/2014
12:31PM

A. Summary of Translation Results

Source gbXML File C:\Users\felixbatad\Desktop\test\Cooling Load Analysis\Arch Link
Model_Cooling Load Analysis_Test.xml
Destination Project ISO-Y2013
Number of Spaces Created 32
Total Building Floor Area 1620.6 sqm
Total Wall Area 1299.4 sqm
Total Window Area 831.0 sqm
Total Roof Area 28.9 sqm

S.No.	Space Name	Floor Area (sqm)	Gross Wall Area (sqm)	Window Area (sqm)	Gross Roof Area (sqm)
1	101 Stair	21.7	59.3	19.1	0.0
2	102 Conference	35.0	15.4	9.8	0.0
3	103 Instruction	67.5	29.7	19.5	0.0
4	104 Instruction	84.3	37.2	24.4	0.0
5	105 Instruction	67.5	29.7	19.5	0.0
6	106 Instruction	85.1	37.5	24.5	0.0
7	107 Male	15.1	22.1	0.0	0.0
8	108 Female	15.1	22.1	0.0	0.0
9	109 Lounge	38.8	1.0	0.0	0.0
10	110 Utility	4.9	0.0	0.0	0.0
11	112 Electrical	6.3	0.0	0.0	0.0
12	113 Corridor	135.5	186.5	180.0	0.0
13	114 Stair	21.2	31.3	0.0	0.0
14	115 Instruction	129.5	87.8	57.3	0.0
15	116 Conference	32.9	14.7	9.6	0.0
16	117 Instruction	50.6	25.1	14.3	0.0
17	118 Electrical	18.2	9.7	0.0	0.0
18	119 Sprinkler	11.7	25.1	0.0	0.0
19	120 Lounge	40.4	141.3	131.1	28.9
20	121 Cafeteria	146.7	125.7	58.6	0.0

- Proceed with calculations on Carrier E20-II using the data that was automatically generated from the model.



- Partition data will not be transferred together with the gbXML file during import into the Hourly Analysis Program. For calculation purposes, the data has to be extracted directly from the BIM model, as shown below, and keyed in manually to supplement missing information in the Hourly Analysis Program.

E20 EXPOSED ROOM SCHEDULE						
Level	Name	Comments	Averag	Wall Length	Excluded	Area of Partition
01 - Entry Level	Corridor	ES	3397	38062	129.31 m²	266.460
01 - Entry Level	Cafeteria	ES	3397	24269	82.45 m²	95.327
01 - Entry Level	Prep/Dish	ES	3397	3962	13.46 m²	53.080
01 - Entry Level	Conference 1	ES	3397	5905	20.06 m²	77.071
01 - Entry Level	Office	ES	3397	6261	21.27 m²	40.266

- Key in the Area Partition Data in E20-II to get the required load calculation.
- Data that is transferred automatically into the E20-II is shown below

(i) General Information on each space

Space Properties - [117 Instruction]

General | Internals | Walls, Windows, Doors | Roofs, Skylights | Infiltration | Floors | Partitions

Name: 117 Instruction

Floor Area: 50.6 m²

Avg Ceiling Height: 3.3 m

Building Weight: 341.8 kg/m²

Light Med. Heavy

OA Ventilation Requirements

Space Usage: <User-Defined>

OA Requirement 1: 0.0 L/s/person

OA Requirement 2: 0.00 L/(s-sqm)

Space usage defaults: ASHRAE Std 62-2001
Defaults can be changed via View/Preferences.

OK Cancel Help

(ii) Data for walls, windows and doors

Space Properties - [117 Instruction]

General | Internals | Walls, Windows, Doors | Roofs, Skylights | Infiltration | Floors | Partitions

Exposure	Wall Gross Area m²	Window 1 Quantity	Window 2 Quantity	Door Quantity
1 ESE	0.9	0	0	0
2 WNW	2.2	0	0	0
3 WNW	22.0	1	0	0
4 not usec				
5 not usec				
6 not usec				
7 not usec				
8 not usec				

Construction Types for Exposure: 1 (ESE)

Wall: Standard Default Wall

Window 1: (none)

Shade 1: (none)

Window 2: (none)

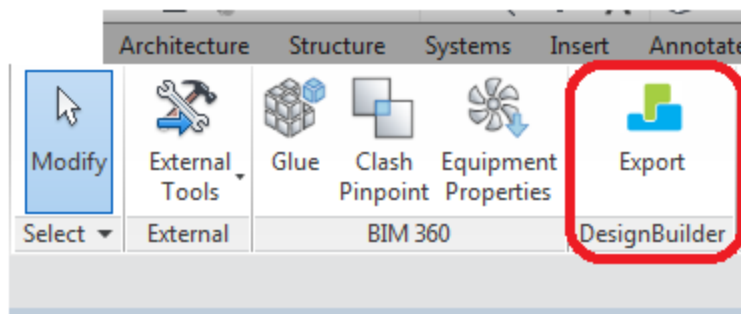
Shade 2: (none)

Door: (none)

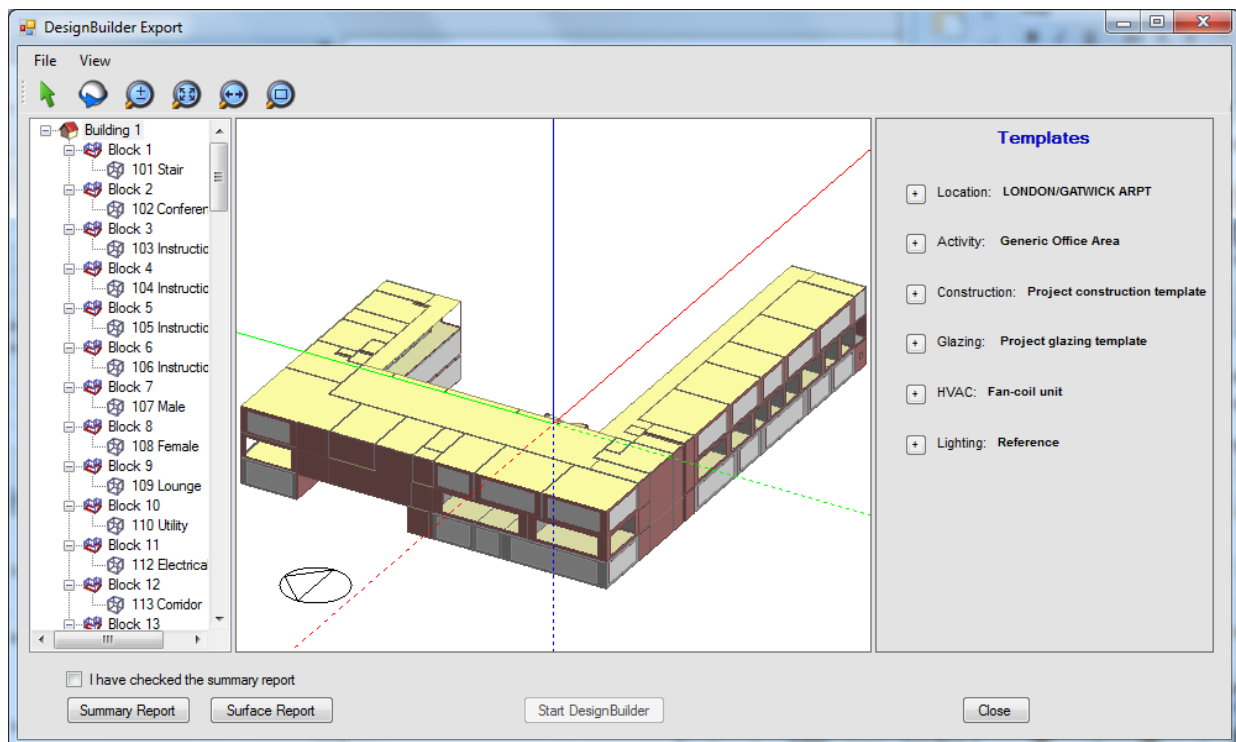
OK Cancel Help

For DesignBuilder

To facilitate the direct export of BIM model data, including certain building parameters, directly from the BIM authoring tool into the DesignBuilder software, a DesignBuilder plug-in can be added into the BIM authoring tool such as the example shown below. (Note: This plugin is only available after DesignBuilder has been installed on the same computer as the BIM authoring tool)



After checking the model within the BIM authoring tool, click on Add-Ins tab → Export button on DesignBuilder panel, and check the model again in the DesignBuilder Export dialog.

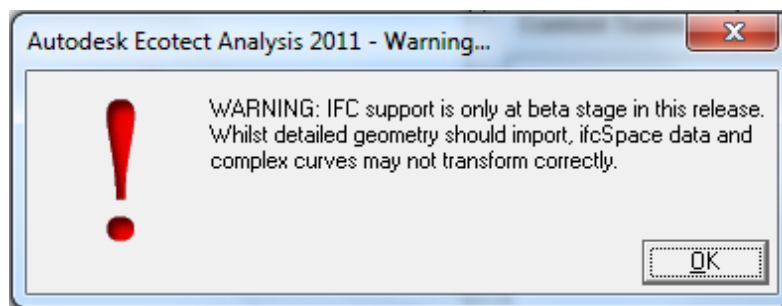


For Ecotect Analysis

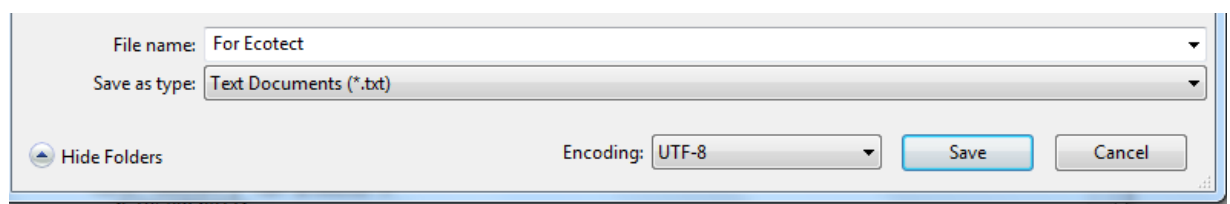
Step 1: Set export settings to export gbXML file from the BIM authoring tool (see IESVE, pg 5)

Step 2: Importing the gbXML file into Ecotect Analysis

- When importing the gbXML file into the Ecotect Analysis software, the following error message may appear



- This error message appears because the generated gbXML file is not encoded in a format that is recognized in Ecotect Analysis.
- The simplest workaround is to open the gbXML file in Windows Notepad and save the file separately as a new Text Document with the UTF- 8 Encoding.



Communicating with Project Teams

Space placement can be performed with or without the architect's involvement. If the architectural 2D data or BIM model is used as reference in the background without recognizing room-bounding elements, the zoning is independent of the reference.

If the room-bounding elements of the architectural BIM model are recognized, the architectural BIM model should specify the following rules as much as possible:

- 1) Ensure all exterior walls, floors and roof elements are room-bounding.
- 2) Ensure all ceilings are not room-bounding
- 3) Ensure all columns are not room-bounding

Also, before placing spaces, communicate with the project team and BIM Coordinator regarding model set-up. Spaces hold information related to other disciplines, and can be used for other purposes beyond zoning.

Because spaces must not overlap within the model, it is important to discuss space zoning with the whole team. If, for example, the electrical team wants to store electrical loads in spaces, it may make sense to place one space per room in the MEP model (using space bounding functions), and if necessary, create a separate model containing simplified zoning for the electrical load and energy model.

This guide is part of the BIM Essential Guide Series

BIM Essential Guide	FOR EACH BIM PROJECT		FOR EACH ORGANIZATION
	WITHIN EACH DISCIPLINE	ACROSS MULTIPLE DISCIPLINES	ALL DISCIPLINES
For Architectural Consultants	●		
For C&S Consultants	●		
For MEP Consultants	●		
For Contractor	●		
For BIM Execution Plan		●	
For BIM Adoption in an Organization			●
For Transfer of BIM Data into Building Performance Analysis (BPA)		●	
For Construction Collaboration		●	
For BIM for Design for Manufacturing and Assembly (DfMA)		●	
For Land Surveyors	●		



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bimsg.org

