BIM4Ren

TRAINING

BIM2BEM

Interoperability between BIM and Building Energy Model (BEM), good practices and common barrierd

ATI - Giacomo Marani

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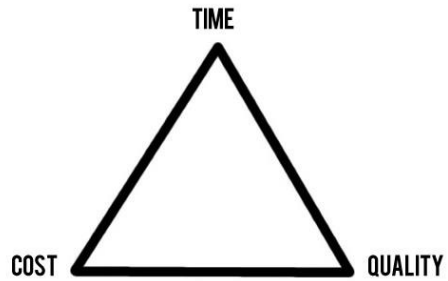
ATI | Project

CREATING A BETTER REALITY

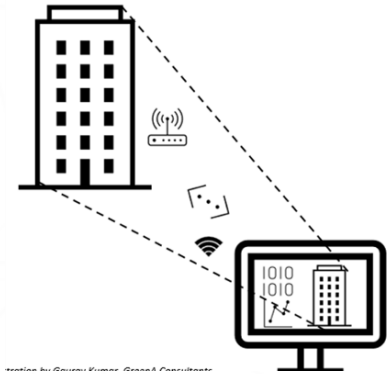
Introduction

Building Information Modeling (BIM) is increasingly being adopted around the world to improve and accelerate productivity in building design and construction, reducing errors and reducing costs. To support energy-efficient design, many BIM platforms now integrate Building Energy Modeling (BEM) at the design stage, based on building geometry, location, and weather data inputs.



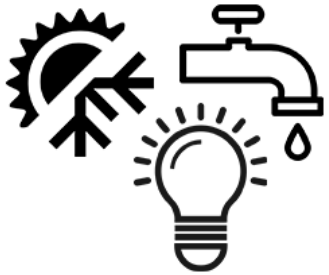
By increasing the level of information related to the energy consumption of the equipment and the actual measured performance of the building, the accuracy of the BEM within the BIM environment can be further improved.

This will help make better design decisions, as well as enable a more comprehensive "digital twin" that gives facilities operations and maintenance teams a comprehensive and unified view of all architectural and energy features.



Energy design and simulation

The tools for the energy performance of buildings can be divided into two parts:



1. Design tools: they are intended to size the optimal mechanical and electrical systems, taking into account the worst-case scenarios.

2. Simulation tools: These include dynamic simulation typically for a duration of one year. Three parameters are taken into account: the building envelope, the equipment and the control and use scenario. They are used to assess energy demand, the quality of the indoor environment, carbon dioxide emissions and the payback periods of energy saving measures.

Responsibility for energy design?

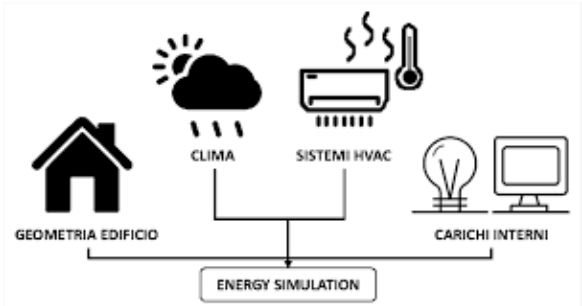
Architectural Designer

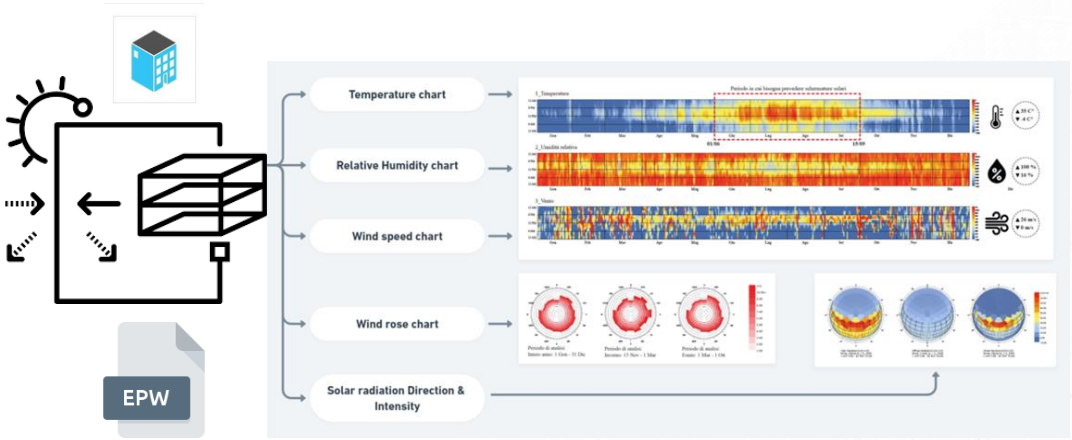
MEP Designer

Objectives of the energy analysis

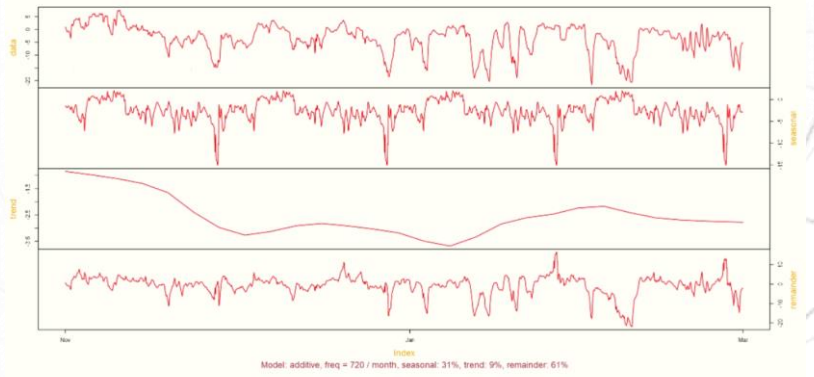
Energy workflow: standardized procedure for the preliminary analysis of the project of Climatic Context, Building, Shadow Mask, Solar Radiation, Illuminance etc.

- Determine how the context affects the building's energy consumption.





- Determine how internal loads (People, Equipment, Lights) affect the trend of the winter and summer peak load for the sizing of HVAC systems.

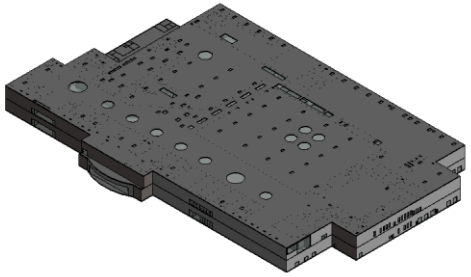


Understanding the transition process

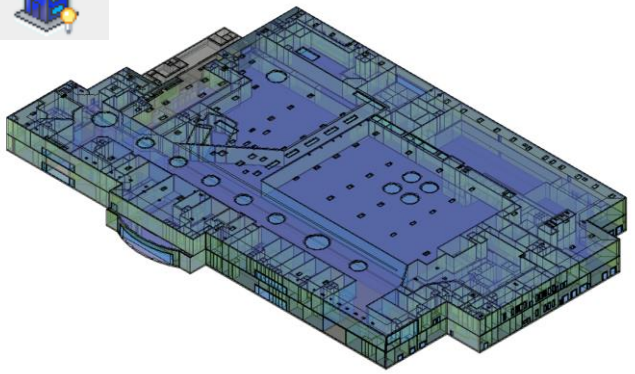
This Training was developed to help BIM project users transfer architectural models to building performance analysis software to access information on daylighting, heating and cooling loads, LEED credits, energy consumption, and comfort data for building design.

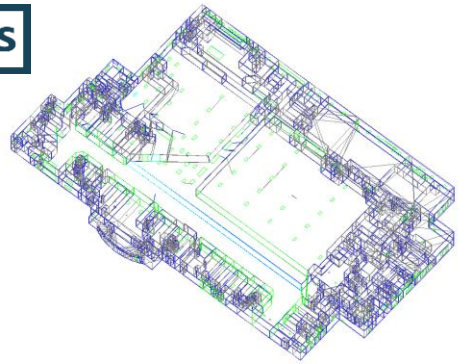
Although native BIM data provides considerable "intelligence" compared to more basic data, which consists of shapes and lines, it does not contain the volumetric/zone data required by building performance analysis tools such as IES-VE. This data must be superimposed on the native architectural model which is called the "Analytical Model" because it is the model on which the subsequent analysis is based.

Workflow for BIM2BEM Interoperability



- Realization of the 3D model in BIM environment
- Choosing the File Format for Export
- Defining the characteristics to be exported
- Analytical BIM Model Extrapolation
- Import into Energy Simulation Software
- Verification of the information received





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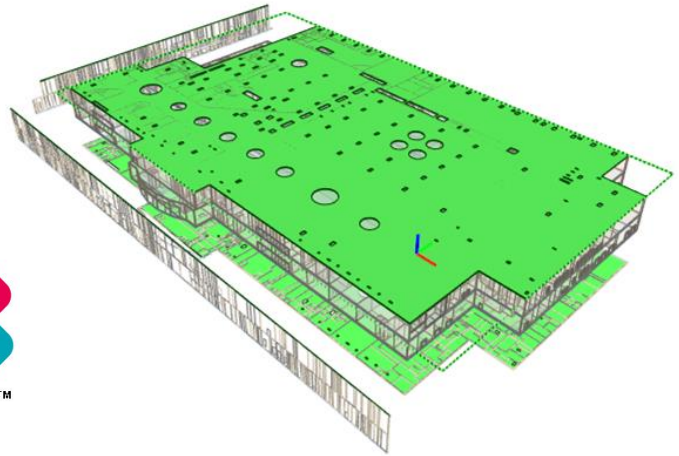
Realization of the 3D model in BIM environment

Creazione Modello 3D



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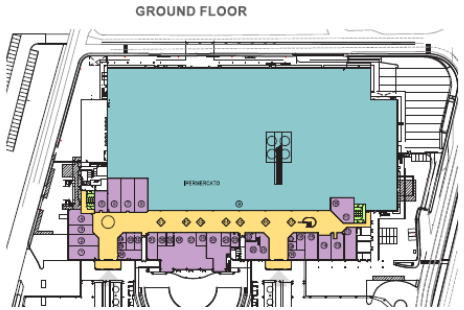
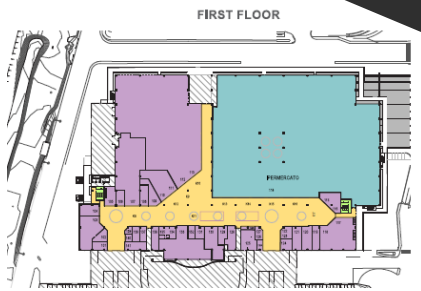
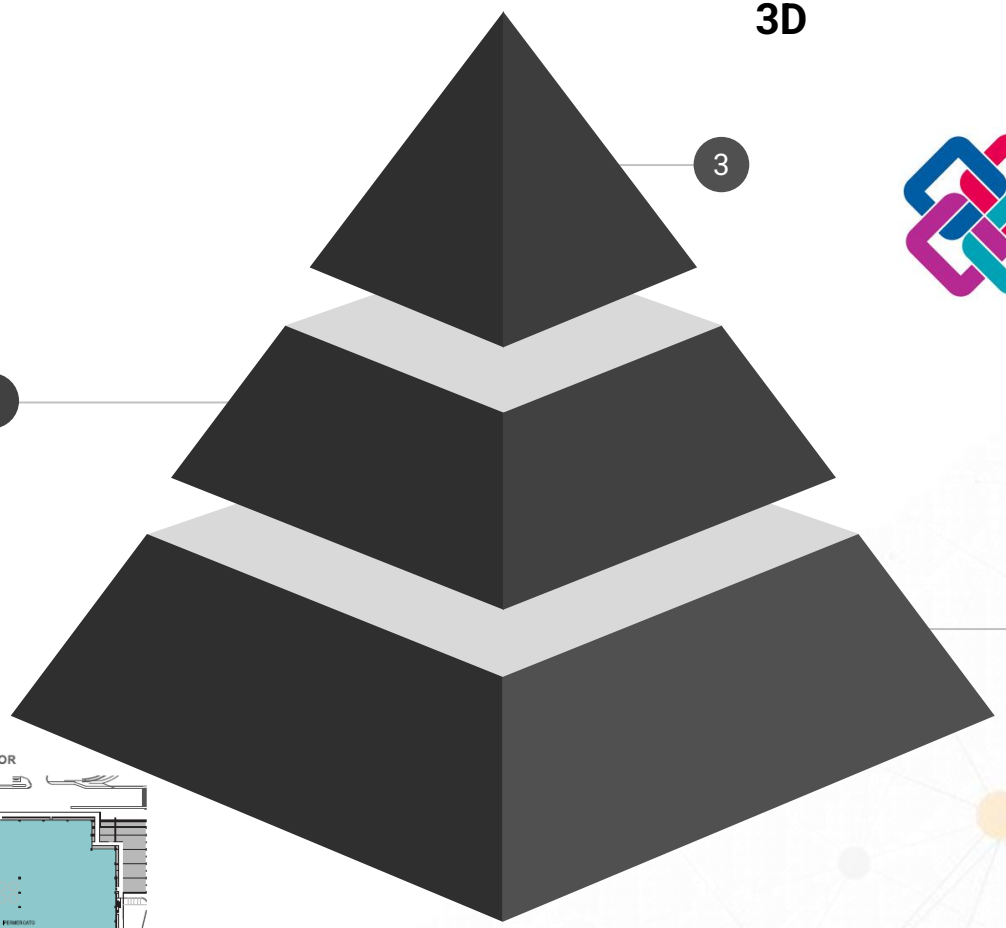
Conversione 2D

plans2bim

2







1

Inputs Data

PDF .dwg JPG

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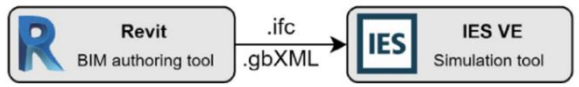
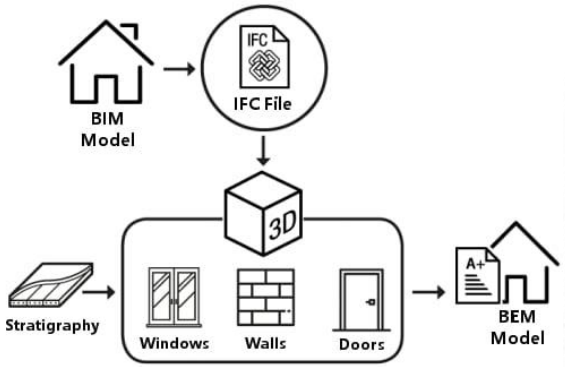
Choosing the File Format for Export

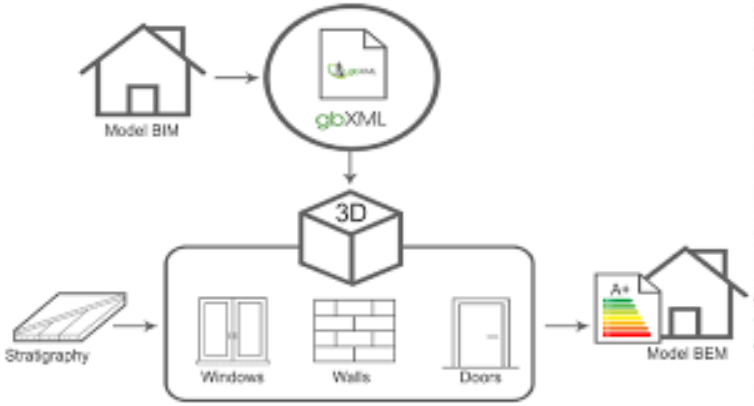
BIM software packages offer several possibilities to extract model data. One option is to generate "lists" or "schedules," and then create an output file in one of the industry-standard protocol formats:

• IFC = IFC is "the open and neutral data format for openBIM". It is an output format for sharing with different applications and groups. The limitation of this format is that it cannot be changed. Therefore, all required changes must be made to the source (i.e. within the BIM software).

• gbXML = Green Building XML. "An industry-supported scheme for sharing building information between disparate building design software tools... It allows you to share information with each other with 3D models (BIM) and analysis software."

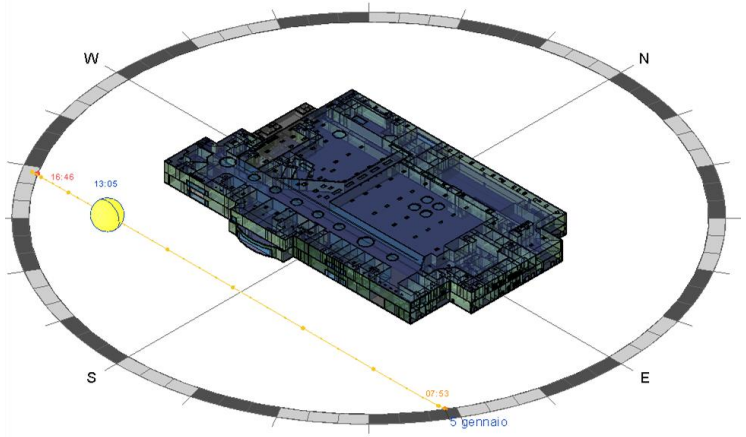


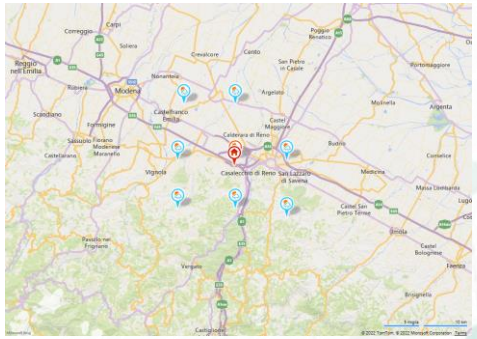


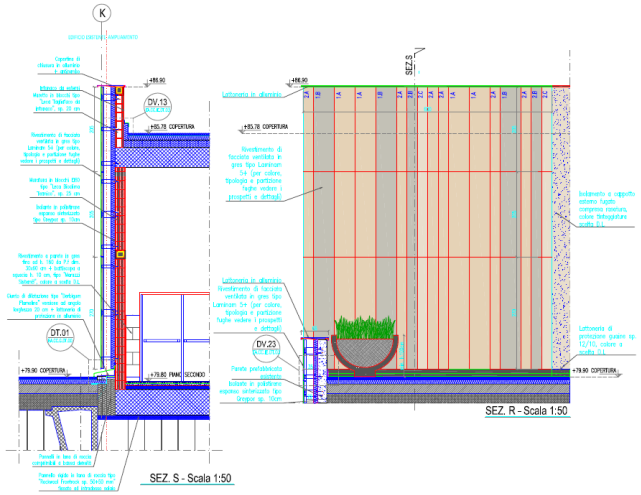


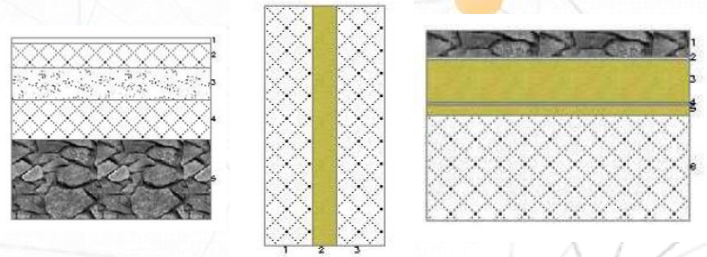
Defining the characteristics to be exported

- Features to be transmitted
  - Climate Context
  - Orientation of the building
  - Features of the casing
  - Material properties
  - Geometry
  - Internal Loads









Defining the characteristics to be exported

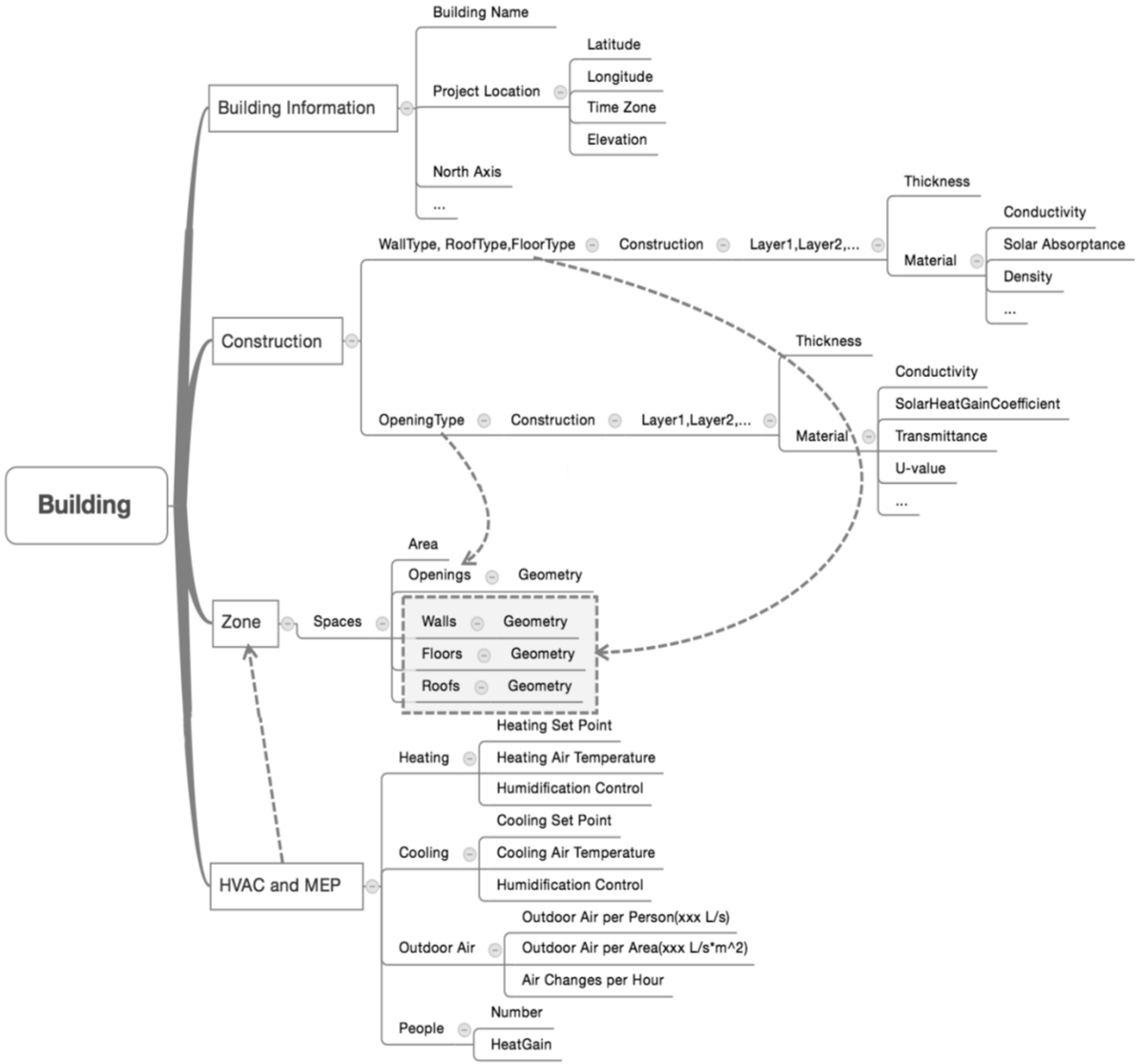


Table 1. Exchange BIM-BPS formats. Own elaboration based on Autodesk manuals and tests. Self Elaboration.

DXF	gbXML	ifcXML
Drawing Exchange Format	Green Building extensible markup language	Industry Foundation Classes
- Geometry (2d/3d) - Layers - Materials*	- Building Type - Building Location - Geometry - Orientation - Area - Volume - Openings Location and Size (windows/doors) - Lighting, Electrical and - Occupancy Loads* - Space Type* - Condition Type* - HVAC Heating and Cooling Setpoints* - Outside Air* - Materials**	- Full geometric description in 3D - Object location and relationships - Properties (or parameters) of each object. - Structural, mechanical and energy analysis applications. - IfcSpaces

* Exported when they are added to Revit MEP models.
** depends on the BPS target software (i.e. Ecotect does recognize Materials, but Revit Architecture does not export them correctly).

Analytical BIM Model Extrapolation

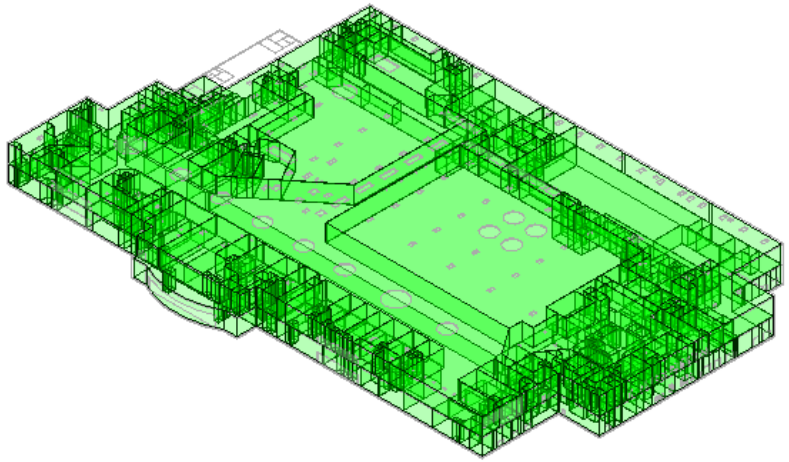
The preparation of the Revit analytical model is critical to the success of the transition process.

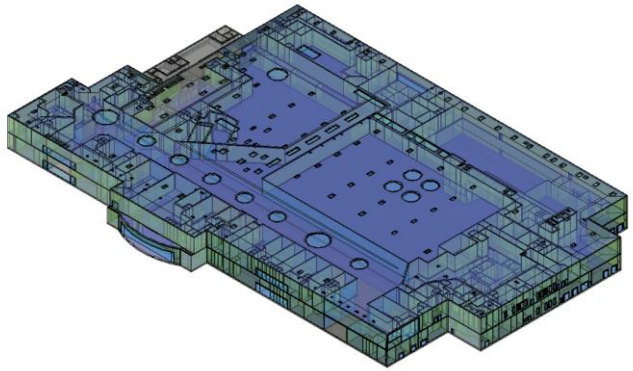
The analytical model is based on the definition of environments that overlap with the underlying Revit architectural model.

Any gbXML subsequently generated is based only on the analytical model and not on the underlying Revit architectural model.

<gbXML/>

You can usually create and make changes to the analytical model without modifying the underlying Revit model.





An effective energy analysis can only be performed if all areas of the model are defined by the room components in the building model, and the entire volume of the building model is included.

The gbXML data exported from Revit is primarily based on rooms and their bounding elements. IES' gbXML import mechanism identifies and converts these rooms into blocks and zones. Other building components such as doors, windows, and shading surfaces are also automatically created.

Spaces and Rooms

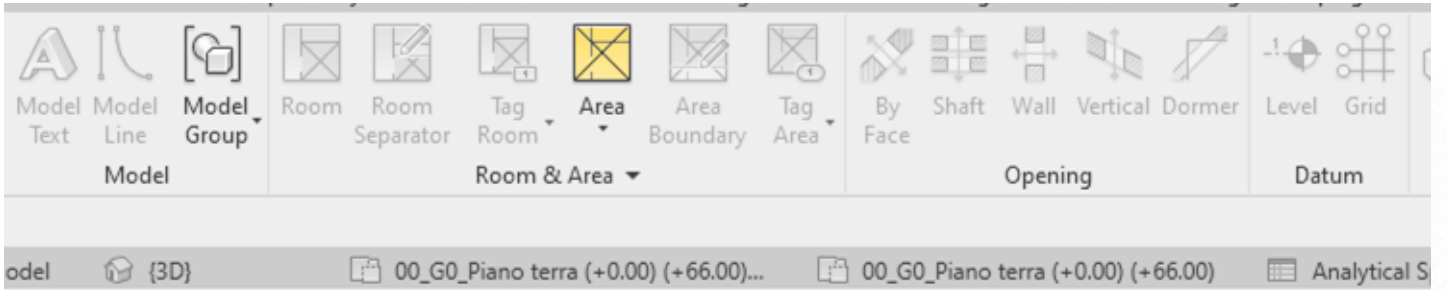
Creating Rooms: they keep information about the subdivisions of the space within the building. Rooms are used as DBs for a variety of parameters that affect the subsequent analysis of building performance, such as volumes and geometry of delimitation elements.

Definition of boundary components : The Volume of a room is defined by limit parameters and Elements that delimit the room. If the boundary elements of the room are within the range of the defined boundaries of the room, Revit uses the space defined by the boundary elements of the room when calculating the volume.

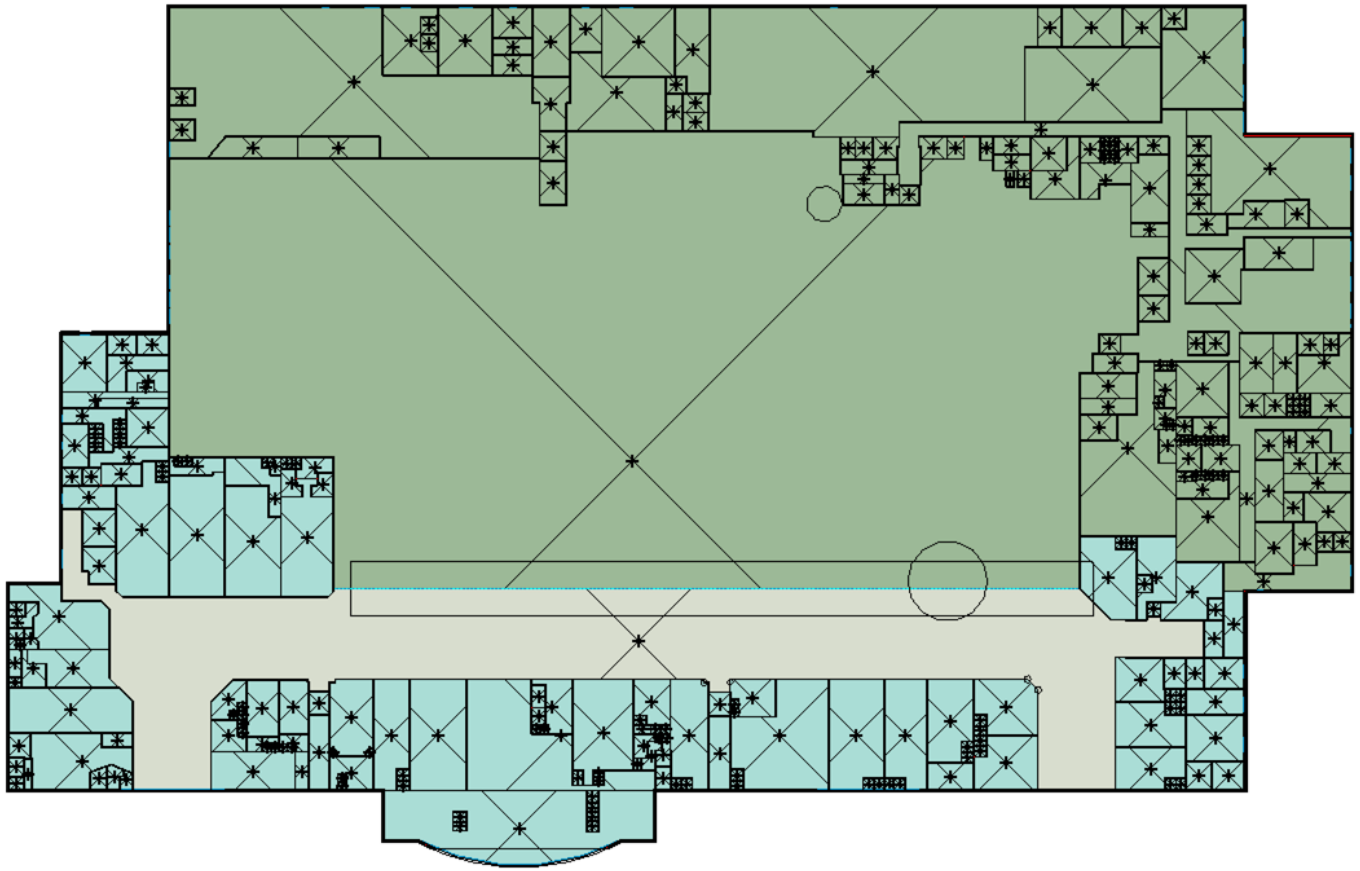
Calculation of the Zone Volume

The calculation of the volume for a space is based on its components of delimitation of the room and is calculated as the area of its base multiplied by the height of the space. In Revit, both the area and the volume are calculated based on the faces of the wall.

By default Revit does not calculate room volumes, you need to turn on "Area and Volumes".



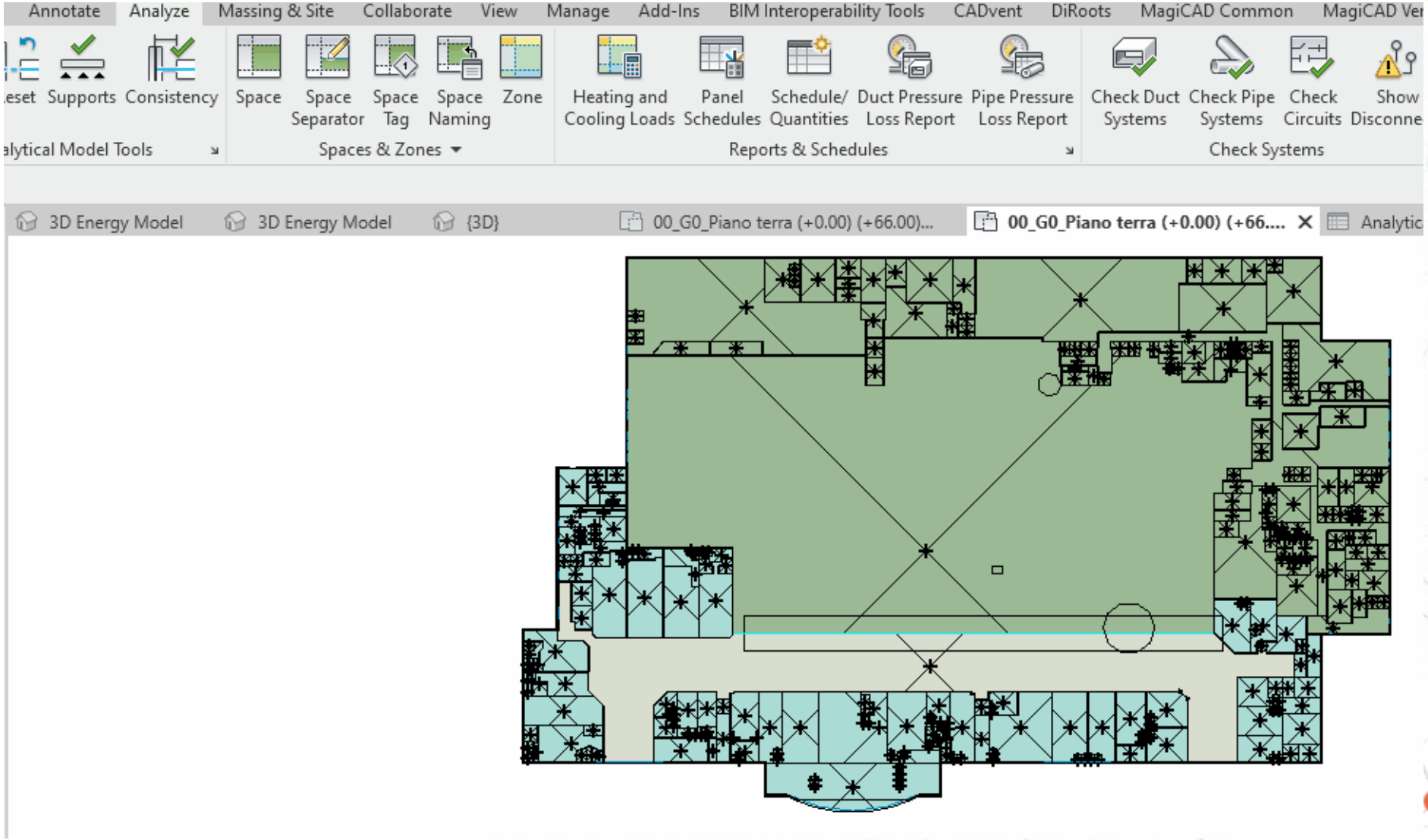
It is necessary to create a room for all occupied and unoccupied spaces. After placing the components of the room in all areas of a plant, you can export the project as a gbXML file.



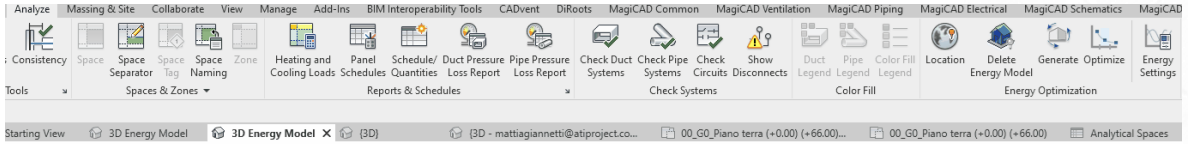
To facilitate the visualization of the rooms it is possible to activate the visibility of the rooms in plan to make the rooms and their reference lines visible.

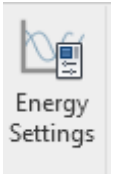
Room Creation

Once the model is populated with the rooms, creating the spaces connected to the latter is an automated process

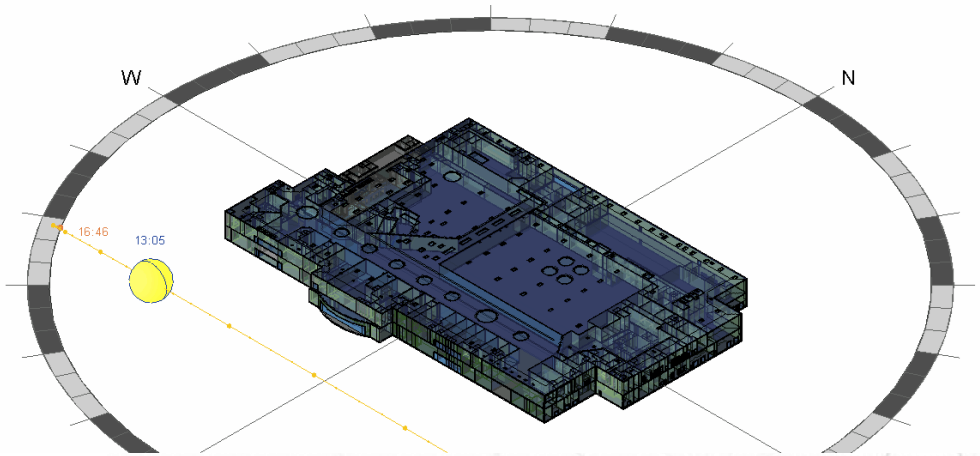


Analytical BIM Model Extrapolation



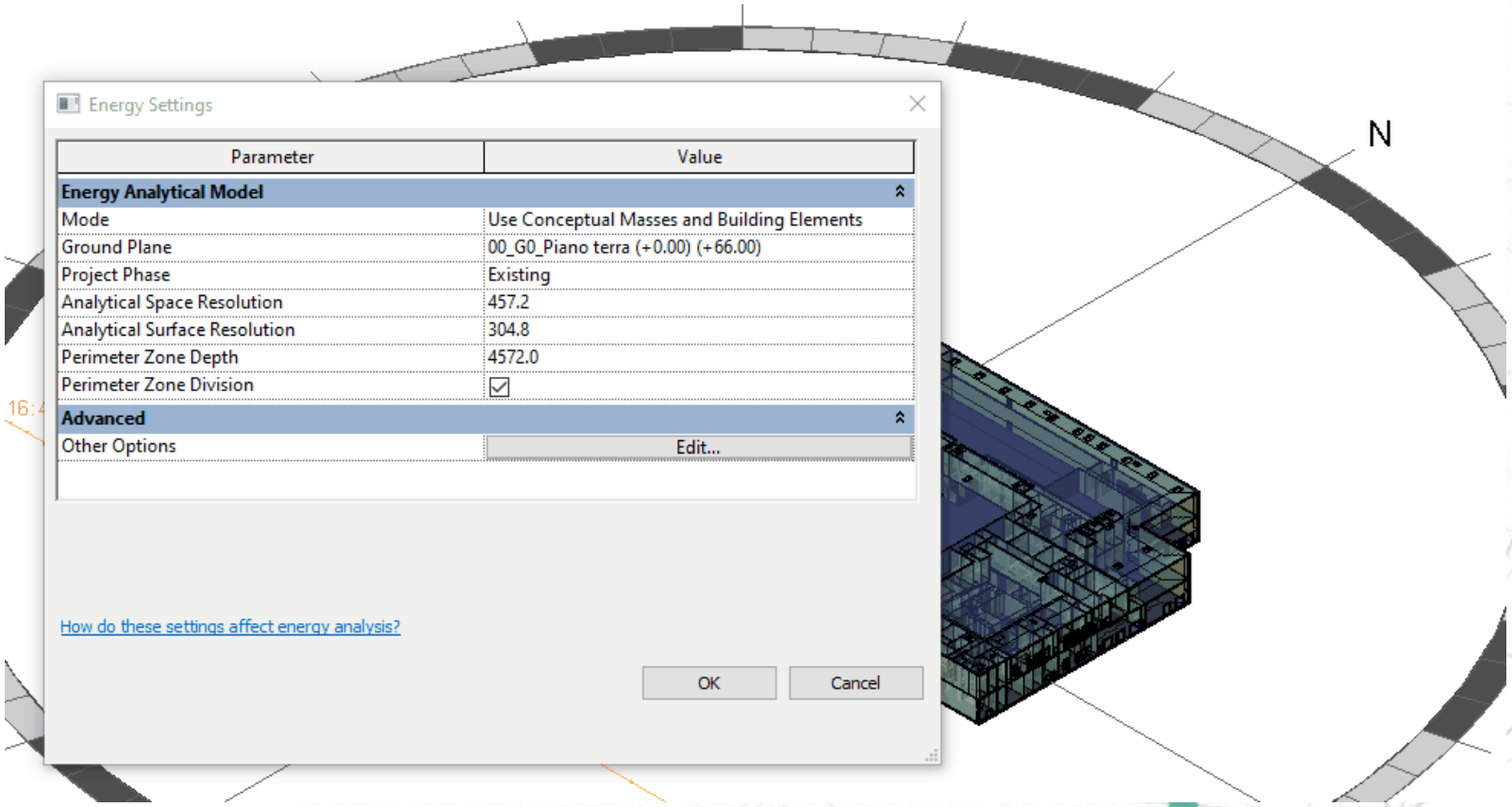


Energy analysis settings are available to help control the parameters that define the values and are subsequently exported to the gbXML file.



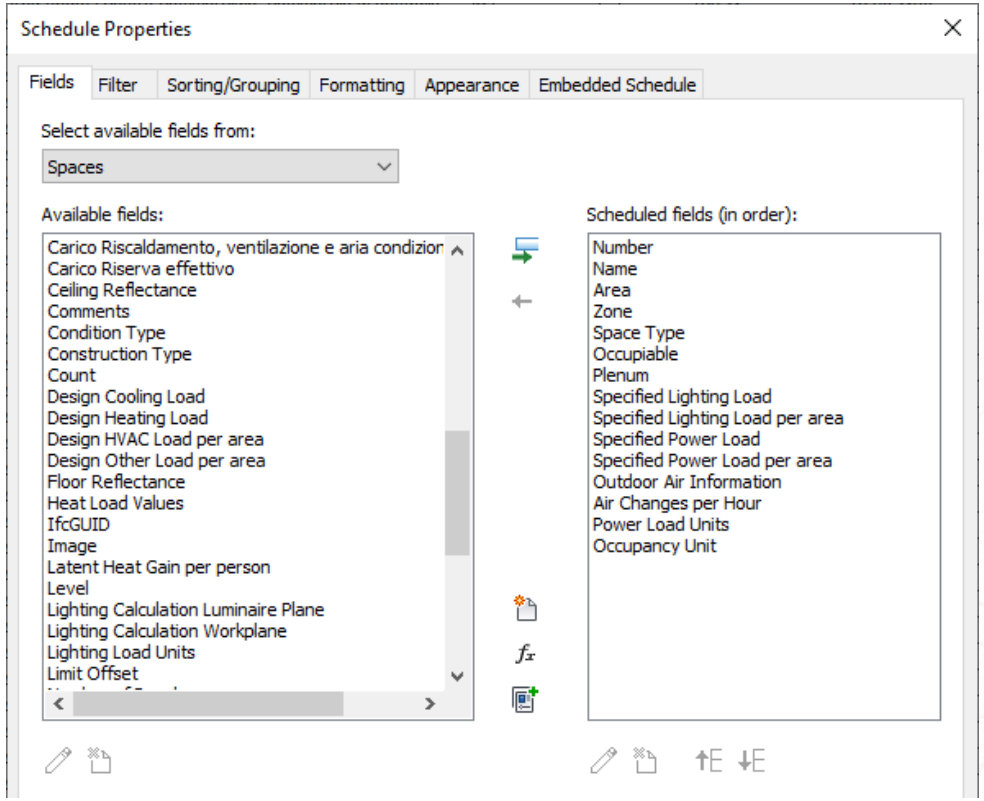
When this parameter is set to Rooms, Revit passes the Local object name and the corresponding analytic compartment number.

When set to Spaces, Revit transfers the following information for use in the analysis: object name and compartment number, occupation, lighting, equipment, and area.



Parameters Export Rooms

Creation of an schedule for checking the parameters to be assigned to the compartments

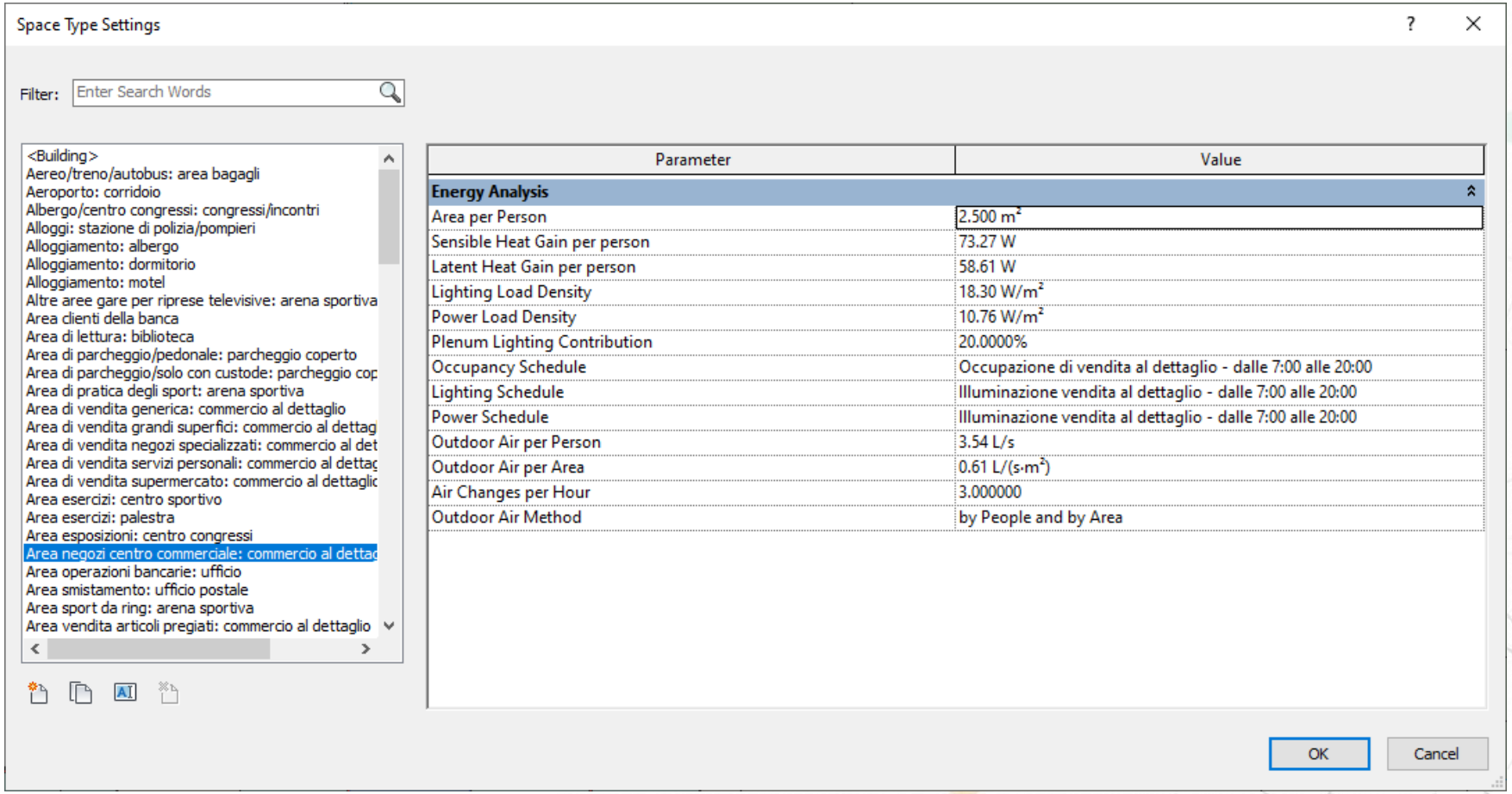


<Space Schedule>

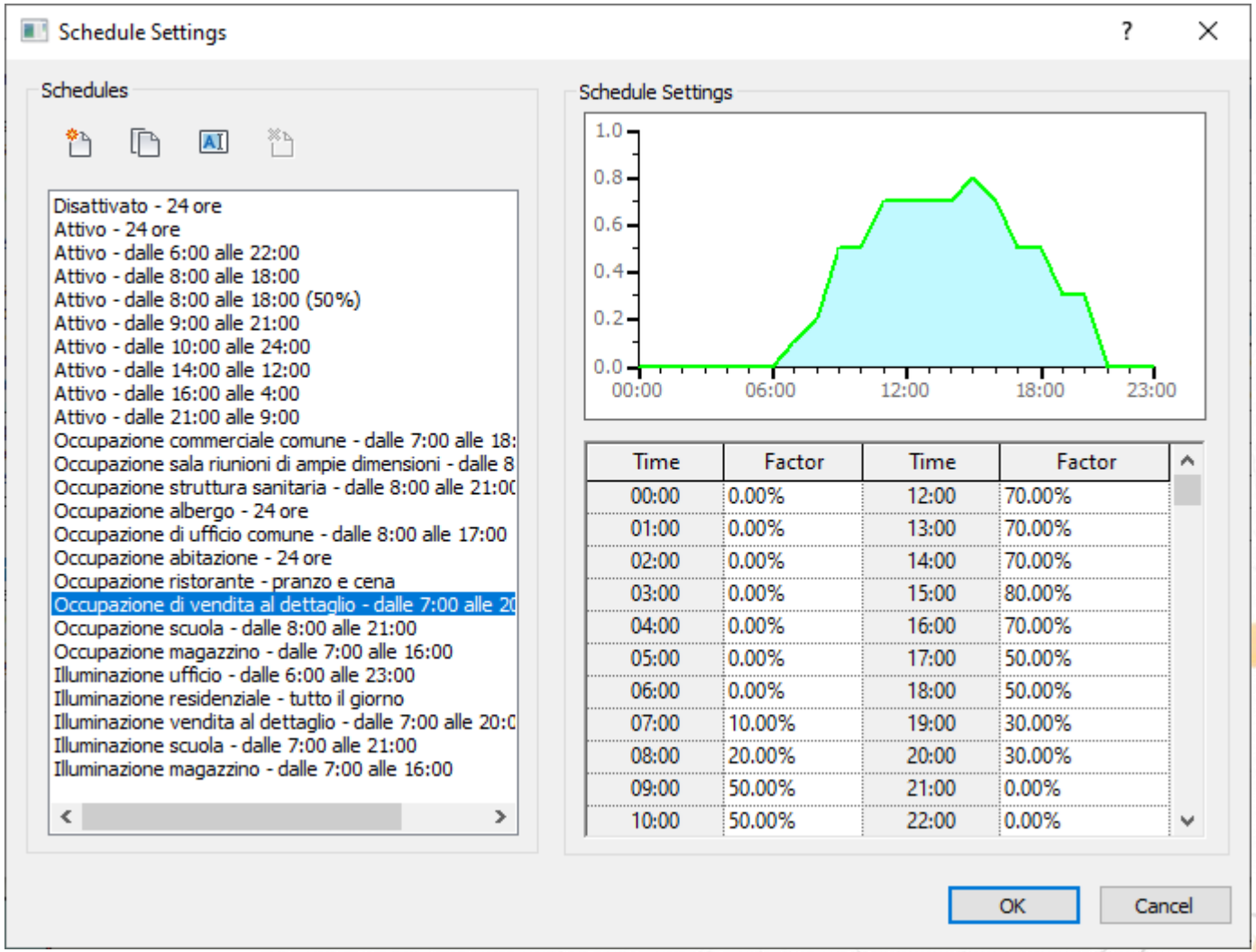
B	C	D	E	F	G	H	I	J	K	L	M	N	O
Name	Area	Zone	Space Type	Occupiable	Plenum	Specified Lighting	Specified Lighting	Specified Power Load	Specified Power L	Outdoor Air Inform	Air Changes per H	Power Load Units	Occupancy Unit
Ipermarket - First Floor	19 m²	HVAC_Zone_First_Floor	Area negozi centro commerciale: commercio al dettaglio	☑	☐	357 W	18.30 W/m²	210 W	10.76 W/m²	From Space Type	3	Power Density	By Space Type
Ipermarket - First Floor	10 m²	HVAC_Zone_First_Floor	Area negozi centro commerciale: commercio al dettaglio	☑	☐	188 W	18.30 W/m²	110 W	10.76 W/m²	From Space Type	3	Power Density	By Space Type
Ipermarket - First Floor	10 m²	HVAC_Zone_First_Floor	Area negozi centro commerciale: commercio al dettaglio	☑	☐	187 W	18.30 W/m²	110 W	10.76 W/m²	From Space Type	3	Power Density	By Space Type

Parameters Export

Define the type of intended use, through the type compartments

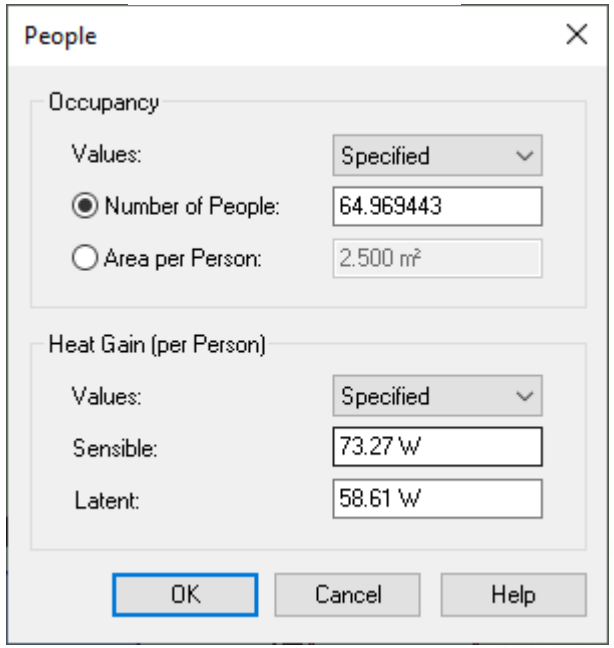


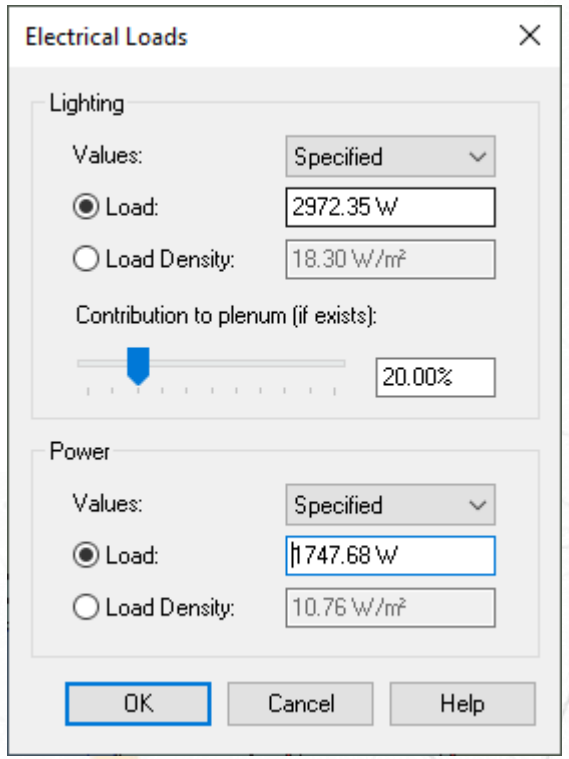
Define the occupancy schedule of the compartment. That will be used to define the internal peak loads within the energy model



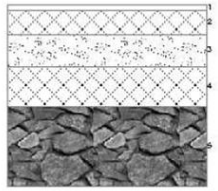
Parameters Export

It is possible to vary environment by environment the characteristics of the internal loads associated with people lights and equipment.





Export Thermal Properties of the building



You can select the specific item categories for which you want to use schema types. All categories of elements that are not overwritten with a schematic type will continue to use the default conceptual types. If Detailed Elements is enabled, schematic types and conceptual types are replaced by material-based thermal properties, where defined.

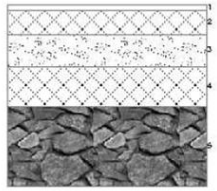
Advanced Energy Settings

Parameter	Value
Detailed Model	
Target Percentage Glazing	0%
Target Sill Height	750.0
Glazing is Shaded	☐
Shade Depth	457.2
Target Percentage Skylights	0%
Skylight Width & Depth	914.4
Building Data	
Building Type	Commercio al dettaglio
Building Operating Schedule	Default
HVAC System	Central VAV, HW Heat, Chiller 5.96 COP, Boilers 84.5 eff
Outdoor Air Information	Edit...
Room/Space Data	
Export Category	Spaces
Material Thermal Properties	
Conceptual Types	Edit...
Schematic Types	<Building>
Detailed Elements	☐

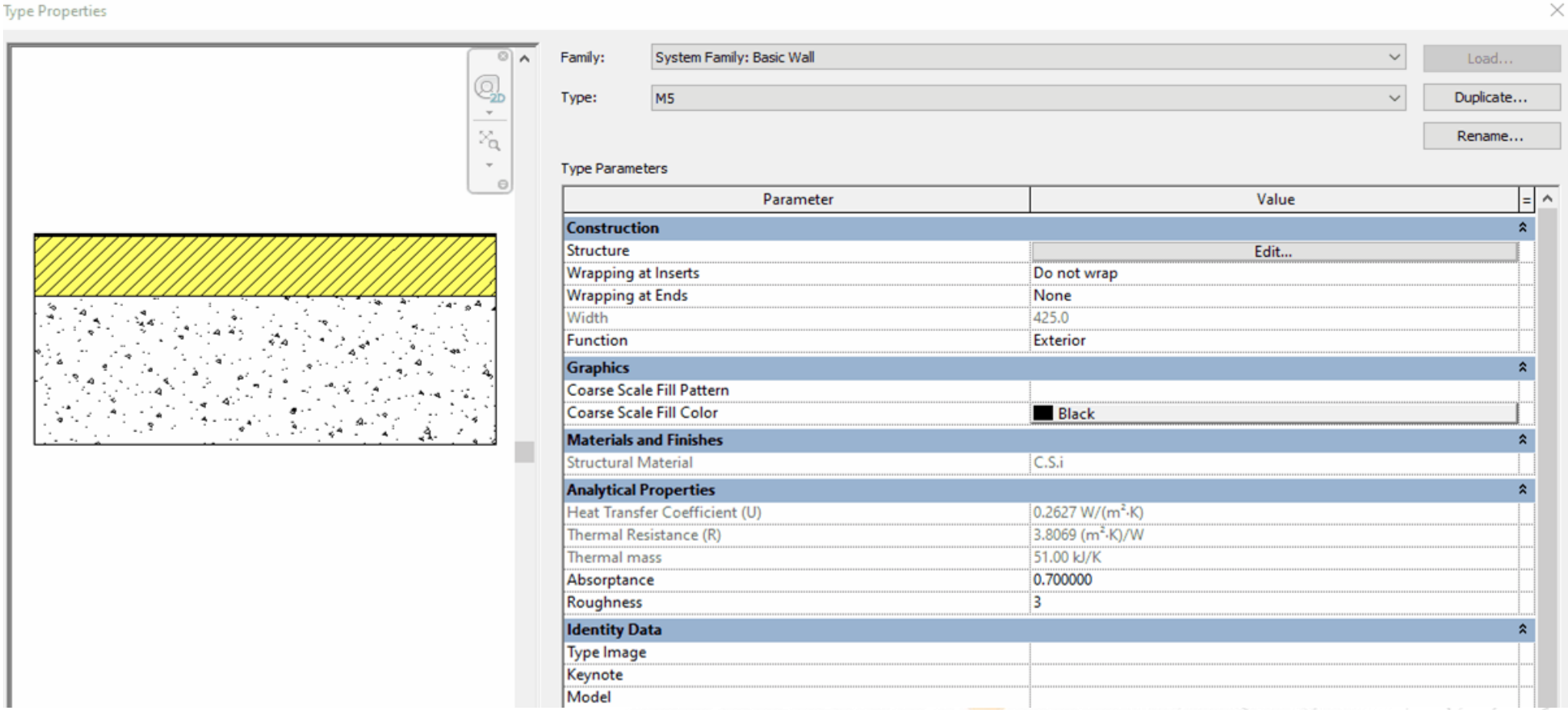
How do these settings affect energy analysis?

OK Cancel

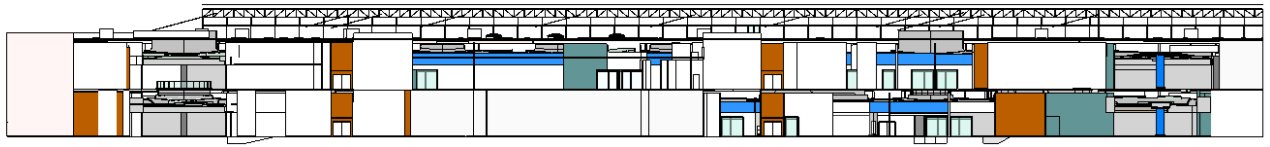
Export Thermal Properties of the building



When you want to perform energy analysis for a Revit model that contains building elements such as floors, walls, and roofs, you can use the thermal properties of the material from the detailed elements.



Top export errors



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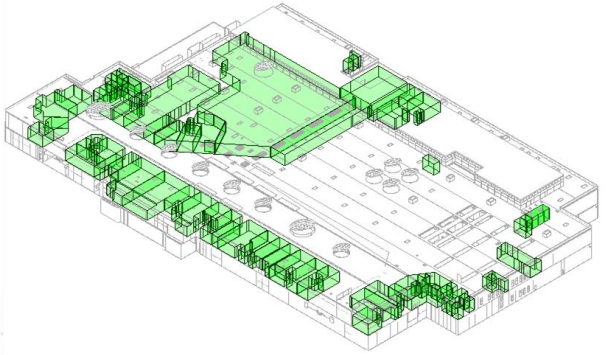
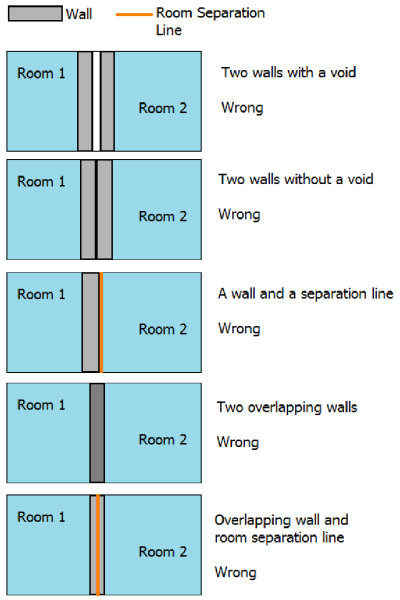
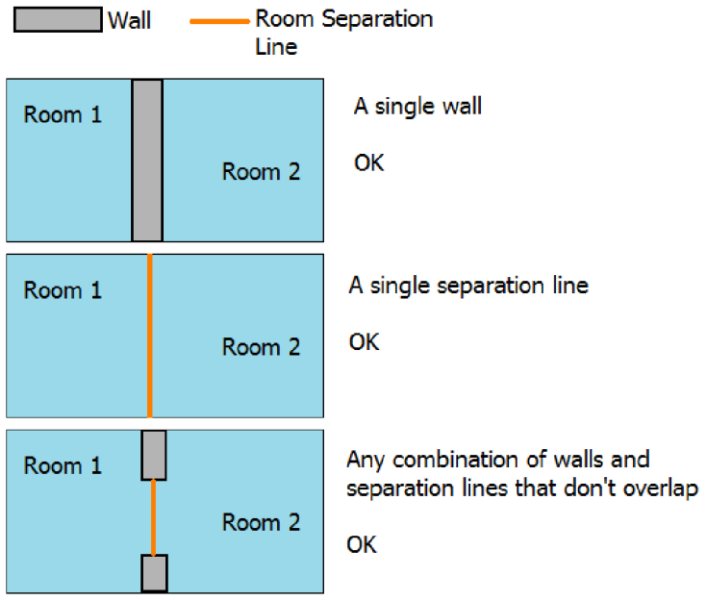
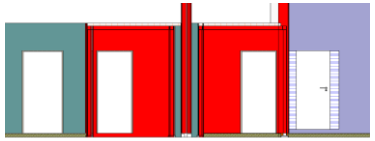
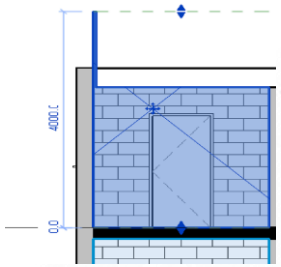
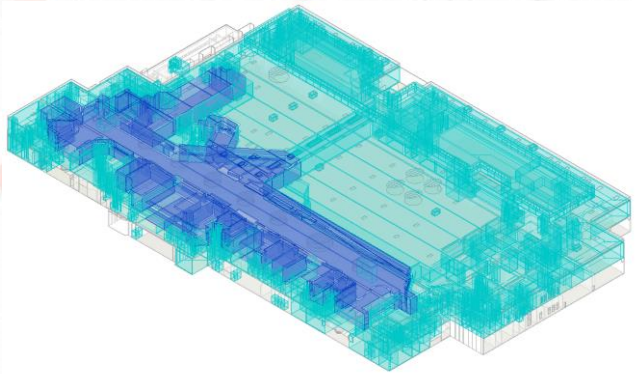




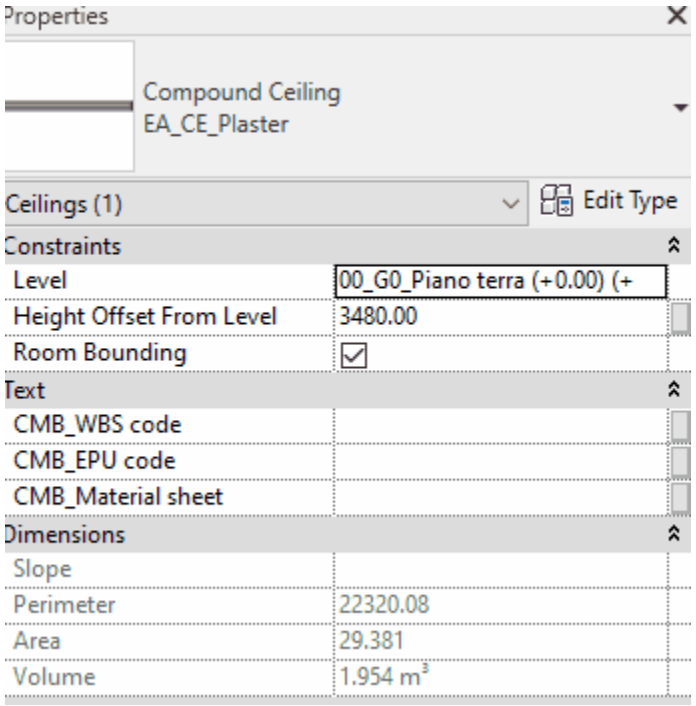


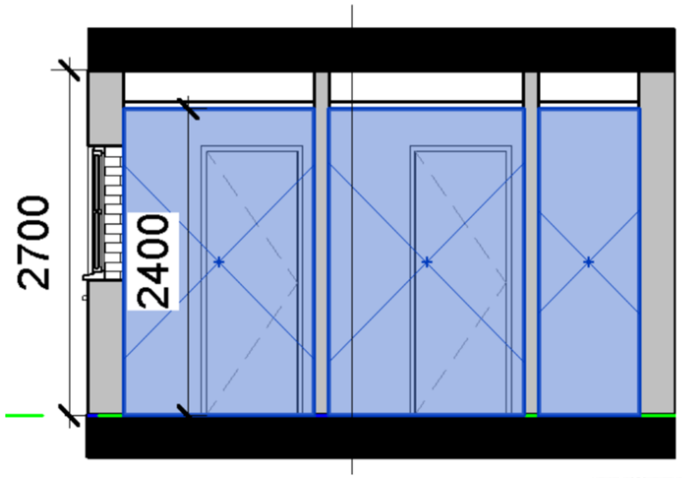


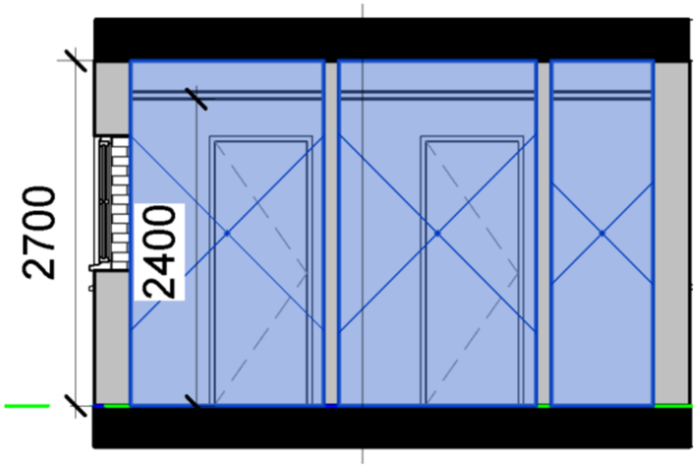




Some elements should not be included in the energy model. In Revit, you can enable/disable the Room Bounding parameter of many items.

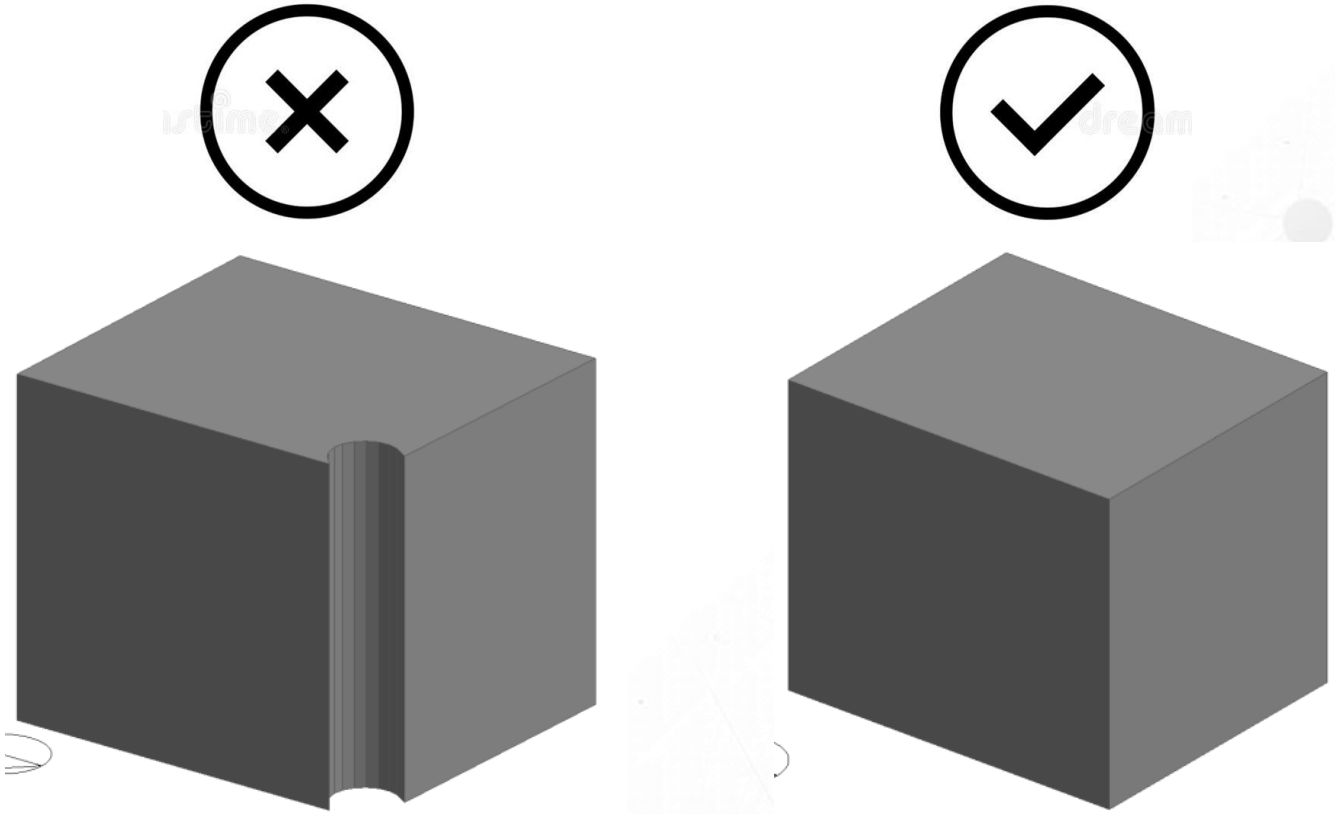




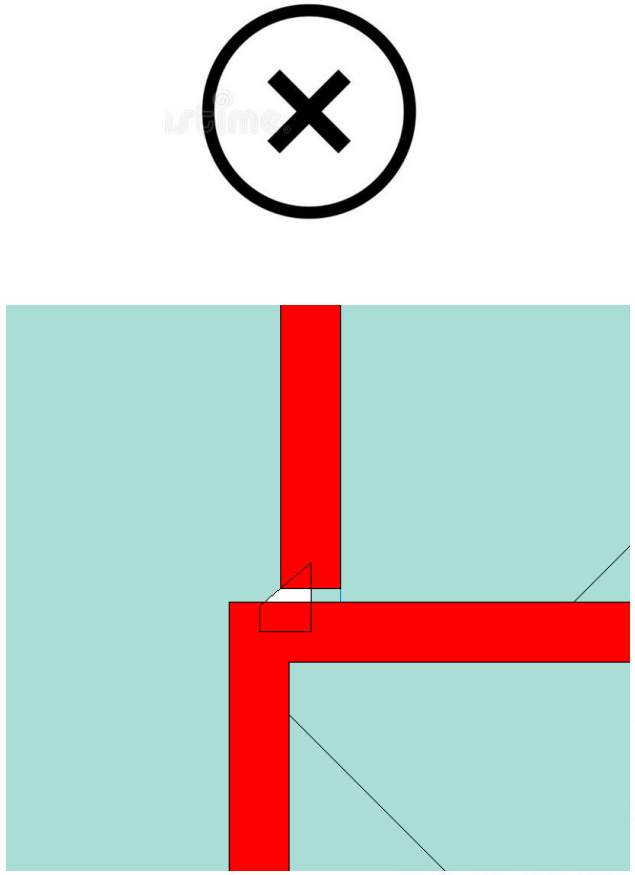


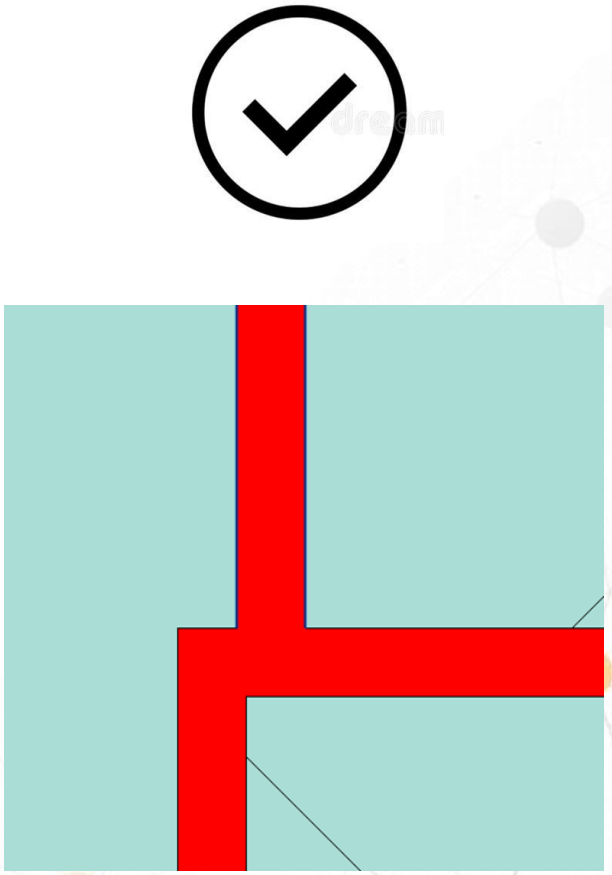
Common mistakes

Disable the delimitation of the rooms of the structural pillars to avoid problems.



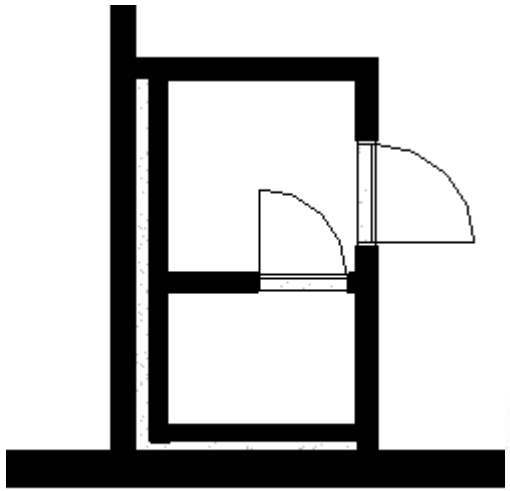
Le stanze in Revit devono avere una regione adeguatamente chiusa.

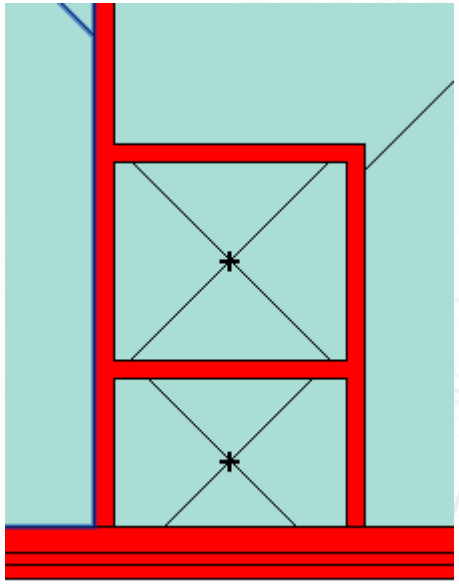




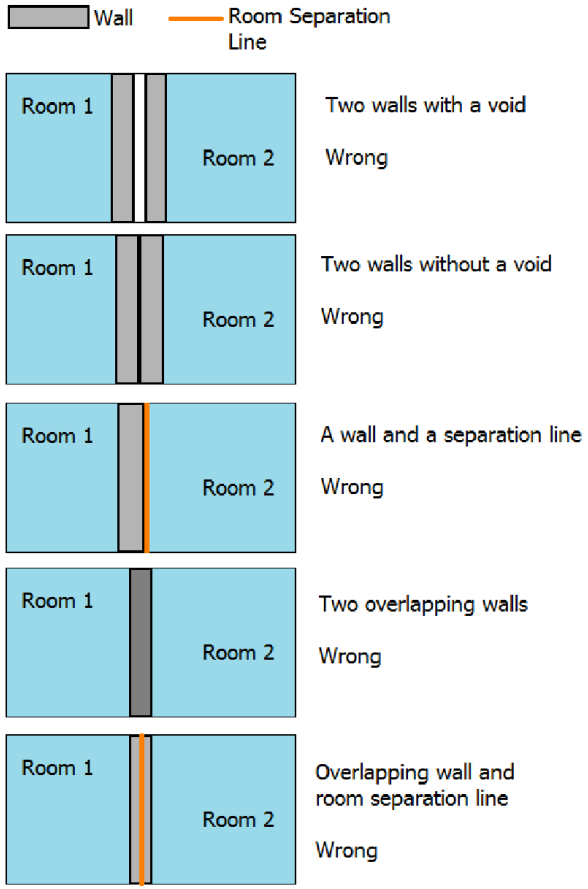
Common mistakes

Verification of technical spaces such as Cavedi and other spaces dedicated to the vertical connections of the building

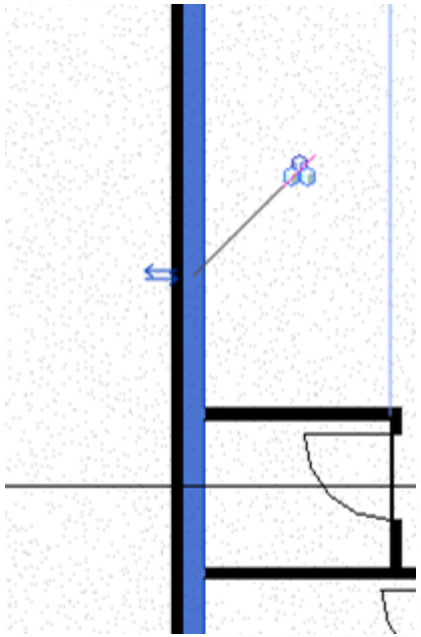


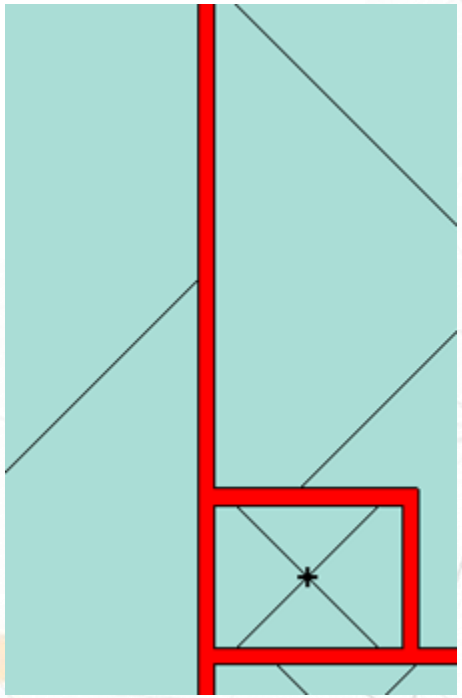


Common mistakes

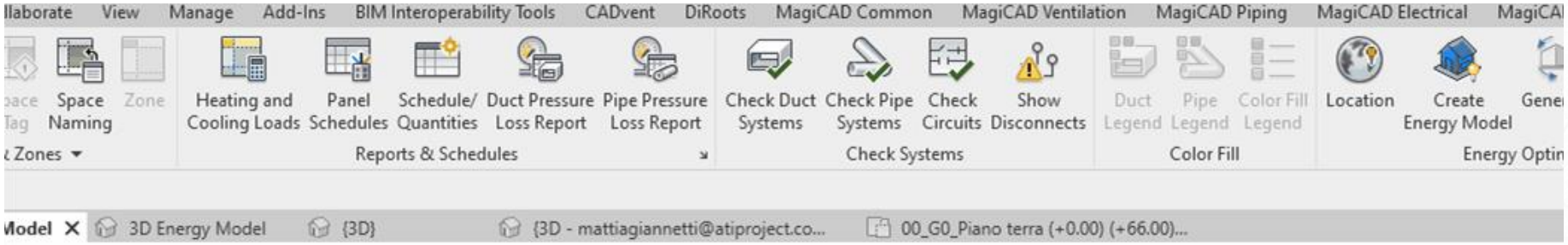


Avoid overlapping boundary multiple elements.

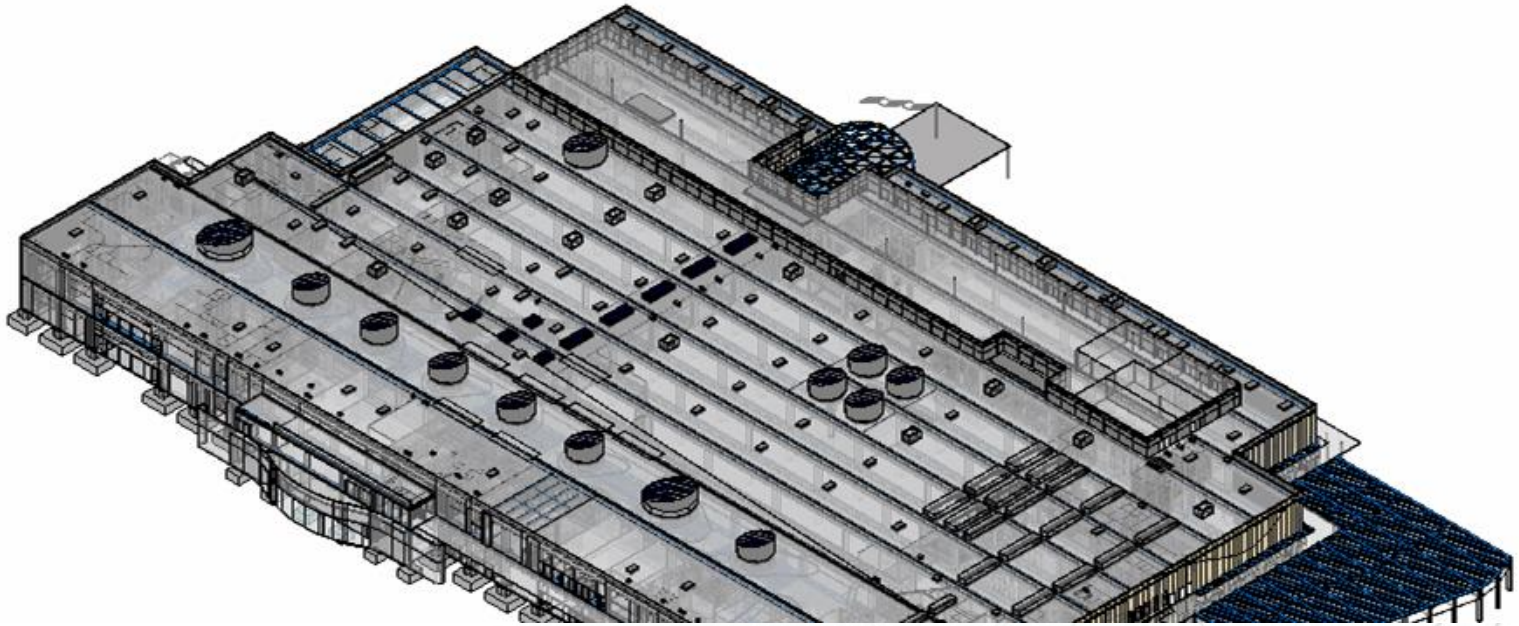




Analytical BIM Model Extrapolation

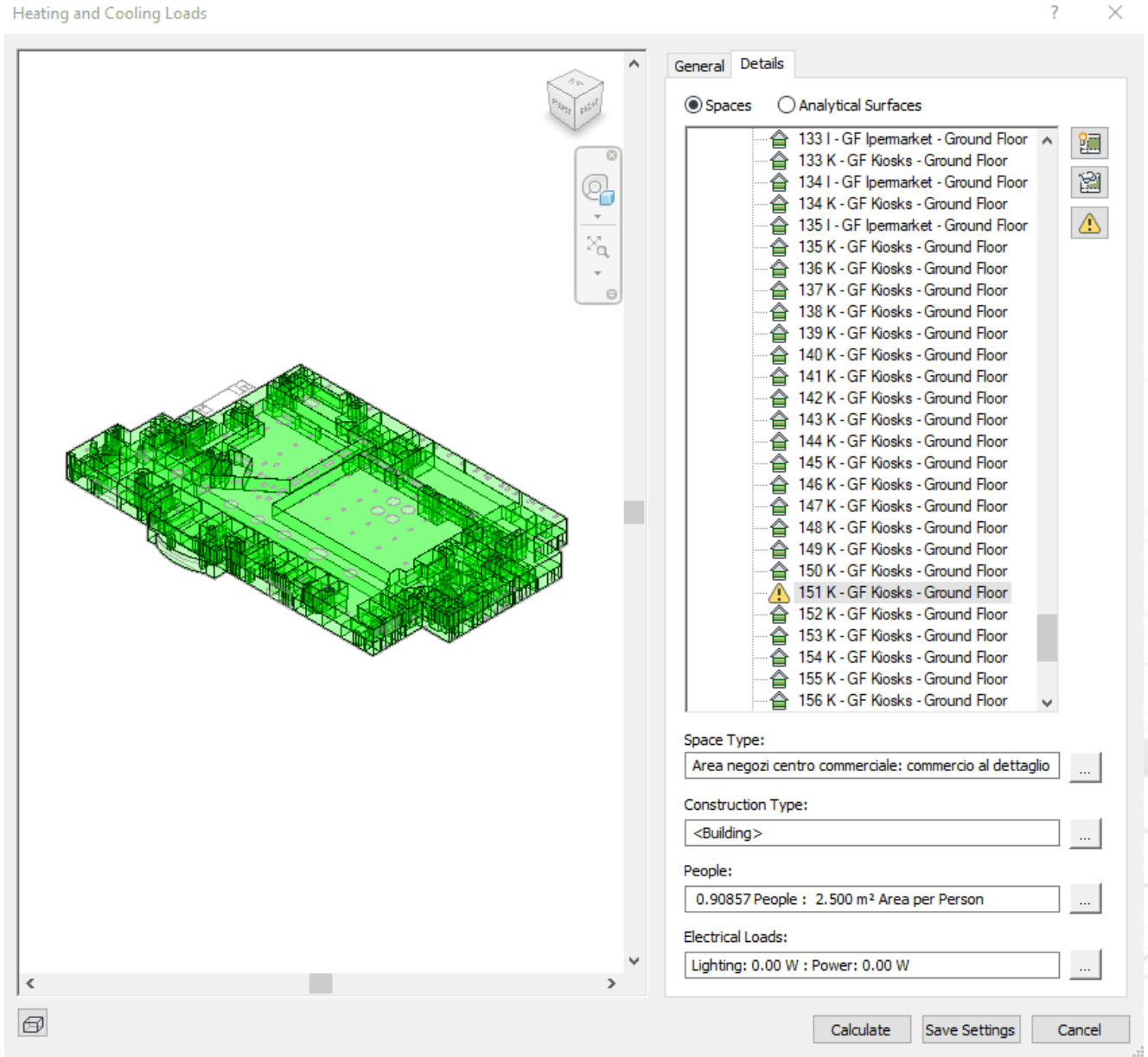


Automatic creation of a precise and complete energy model directly from an architectural model.



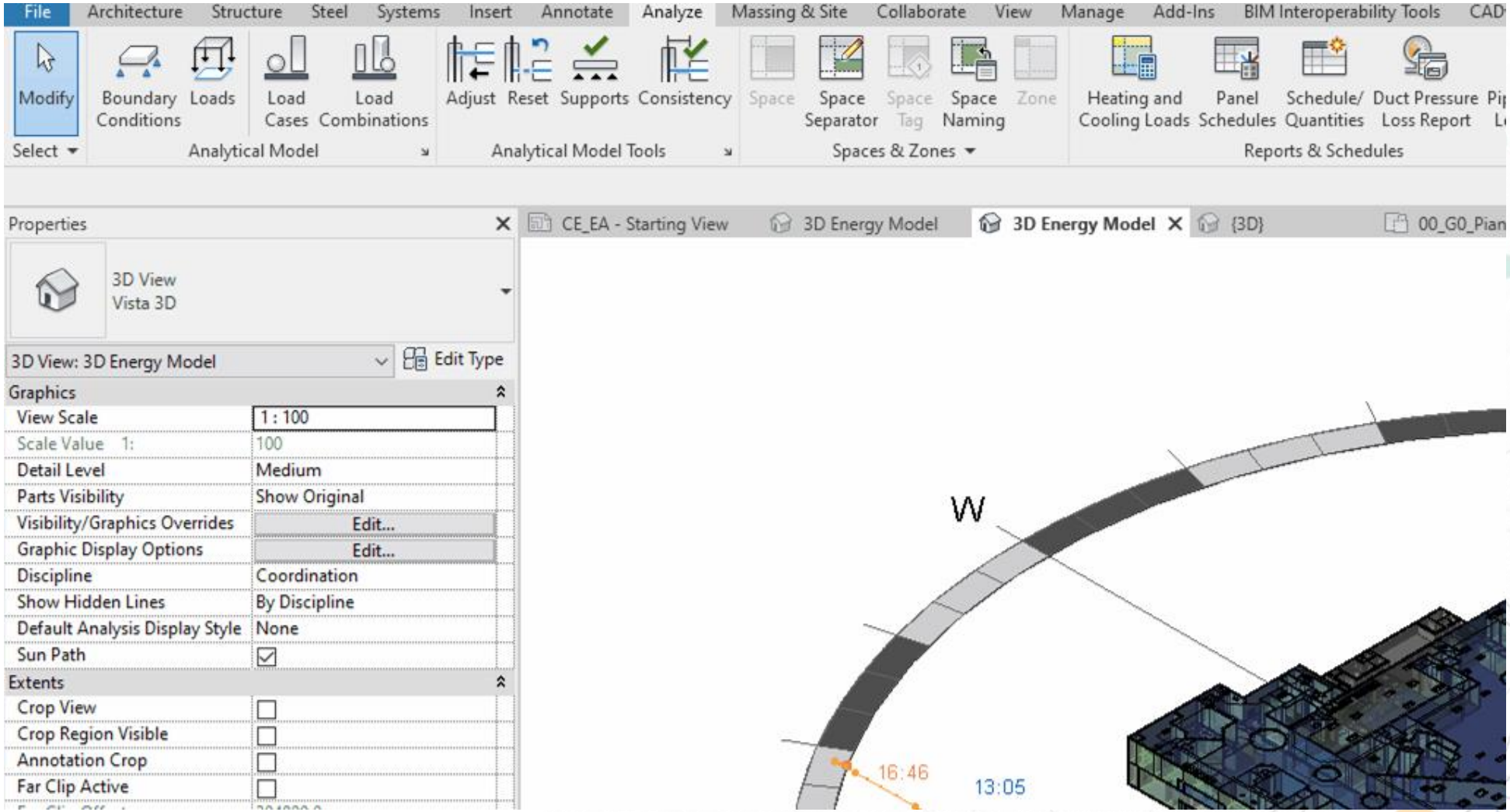
Analytical BIM Model Extrapolation

Check del modello analitico creato, con visualizzazione facilitata degli errori.



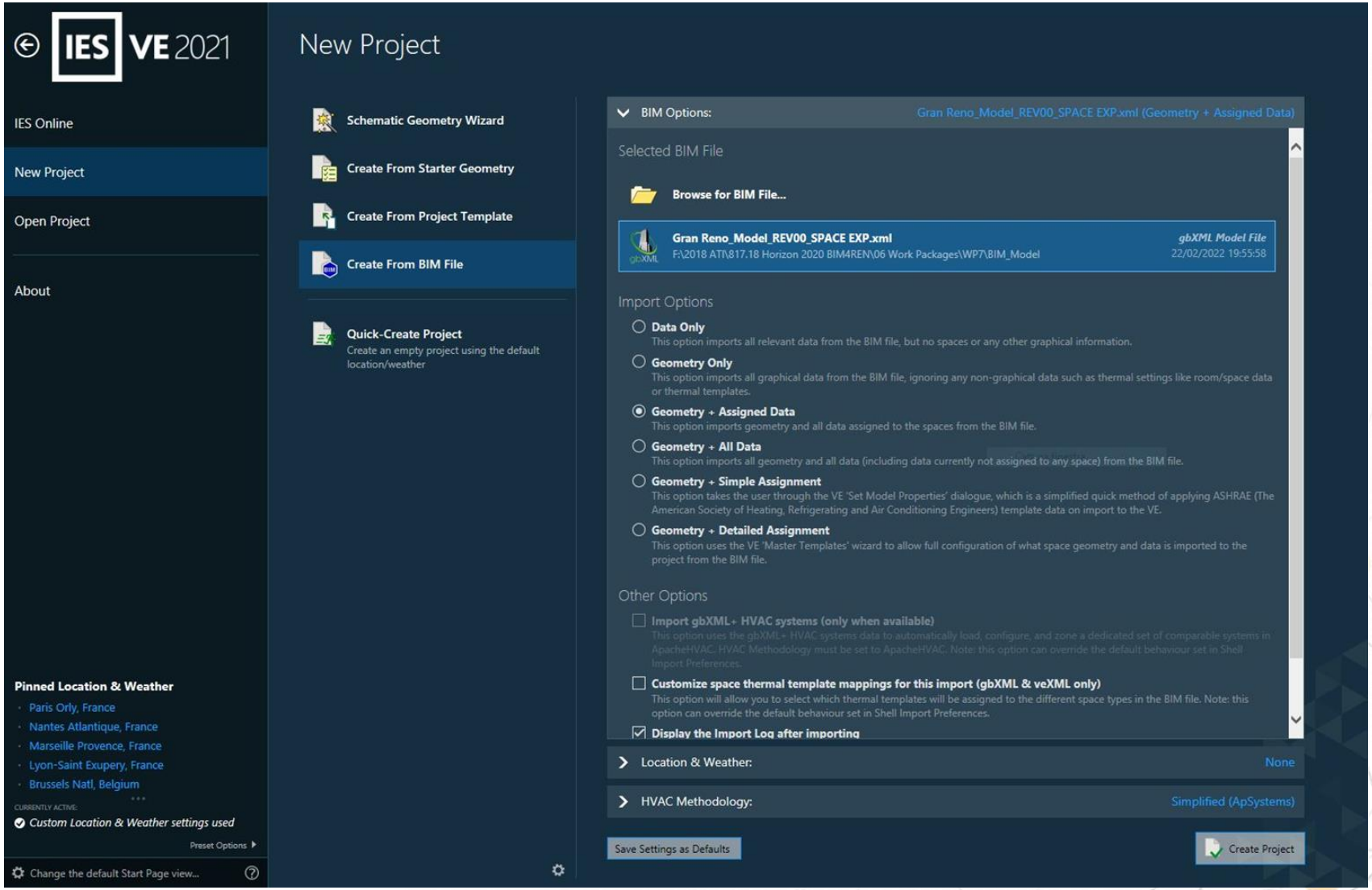
Analytical BIM Model Extrapolation

Esportazione **gbXML** tramite Energy Settings

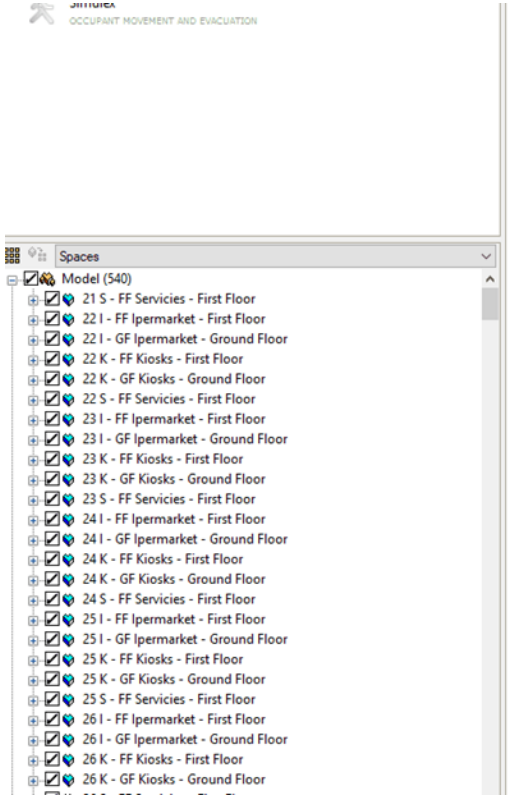


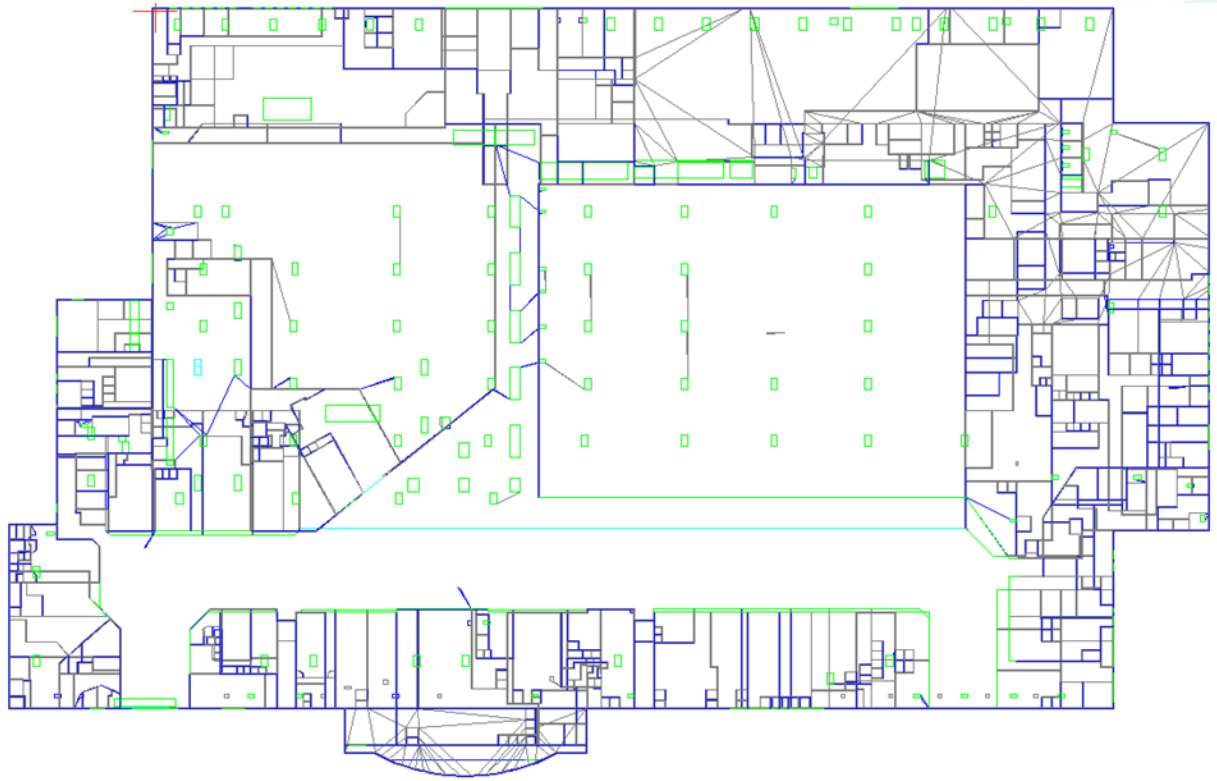
Import into Energy Simulation Software

Import **gbXML** into **BEM IES-VE** software



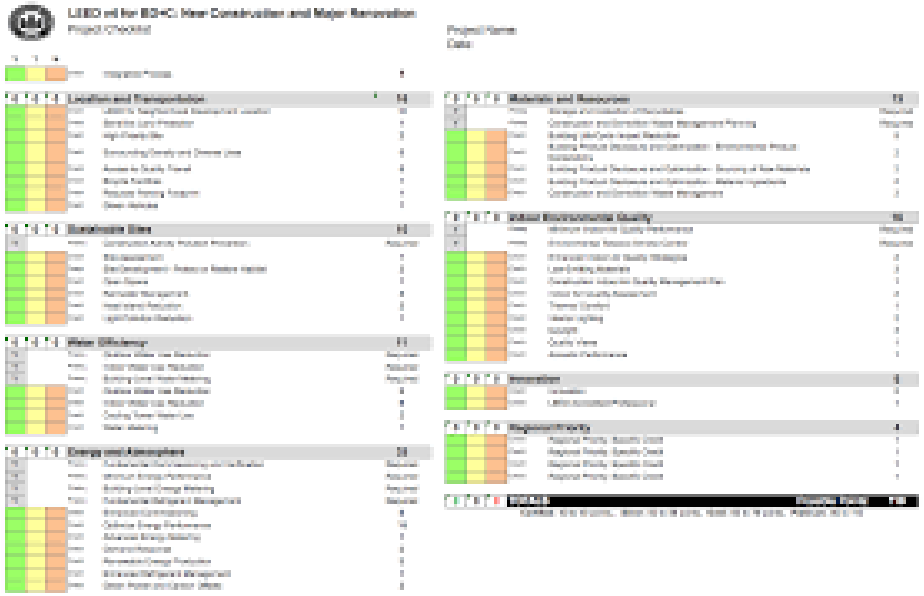
Check of the correct creation of the energy model in the BEM environment

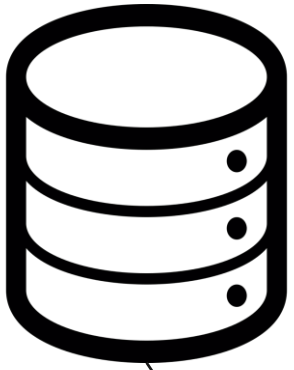




Building certification support

Performance evaluation of buildings: energy modeling can be used to measure the performance of a building against a standard reference (called "baseline") for obtaining sustainability certifications.





BIM4Ren

TRAINING

Thank you for your attention

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