TIMEPAC Academy

Session 3

How to use the 3D models and the EPC in order to analyse energy savings

Presenter: Alice Gorrino (Edilclima srl)

5 March 2024

Objective of the presentation

To show a procedure for generating the Energy Performance Certificate (EPC) through the use of a BIM approach coupled with an Italian EPC generation tool

- Pointing out some tips and tricks for performing the architectural BIM model to better interconnect BIM with EPC tool
- Focusing on the 3D model of the building envelope
- Listing the information needed for the energy performance and showing how to complete the BIM architectural model for creating the model for EPC generation

Content of the presentation

- Workflow of the calculation procedure
- Case study
  - Building data from architectural model
  - How to prepare the architectural BIM model
  - Importing the .ifc file into the EPC generation tool
  - Adding information on the EPC generation tool

Workflow and softwares used

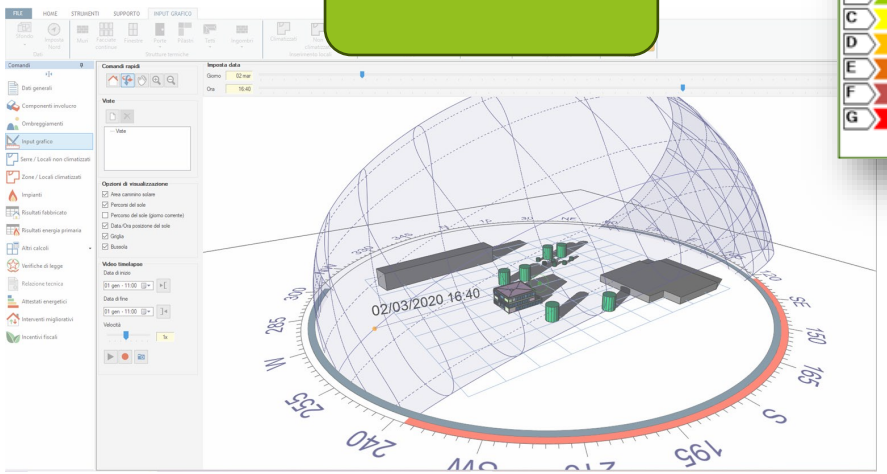
- Geometrical information
- Opaque and transparent dimension and orientation
- Thermal characterization of the opaque envelope
- Spaces

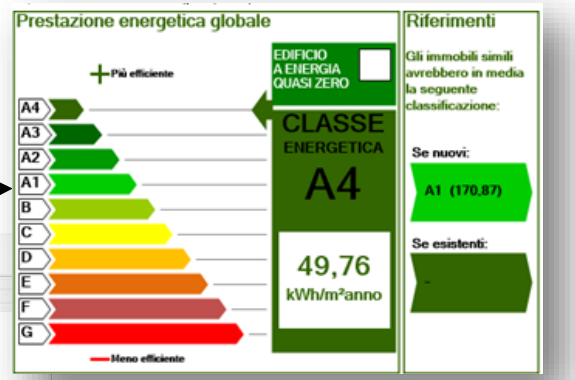
- Climatic data
- Thermal and solar characterization of the envelope (opaque, transparent, thermal bridges)
- Shading objects
- Input data for internal heat gains and ventilation flow rate
- HVAC technical systems
- Legislative framework

Archicad

.ifc

EC700



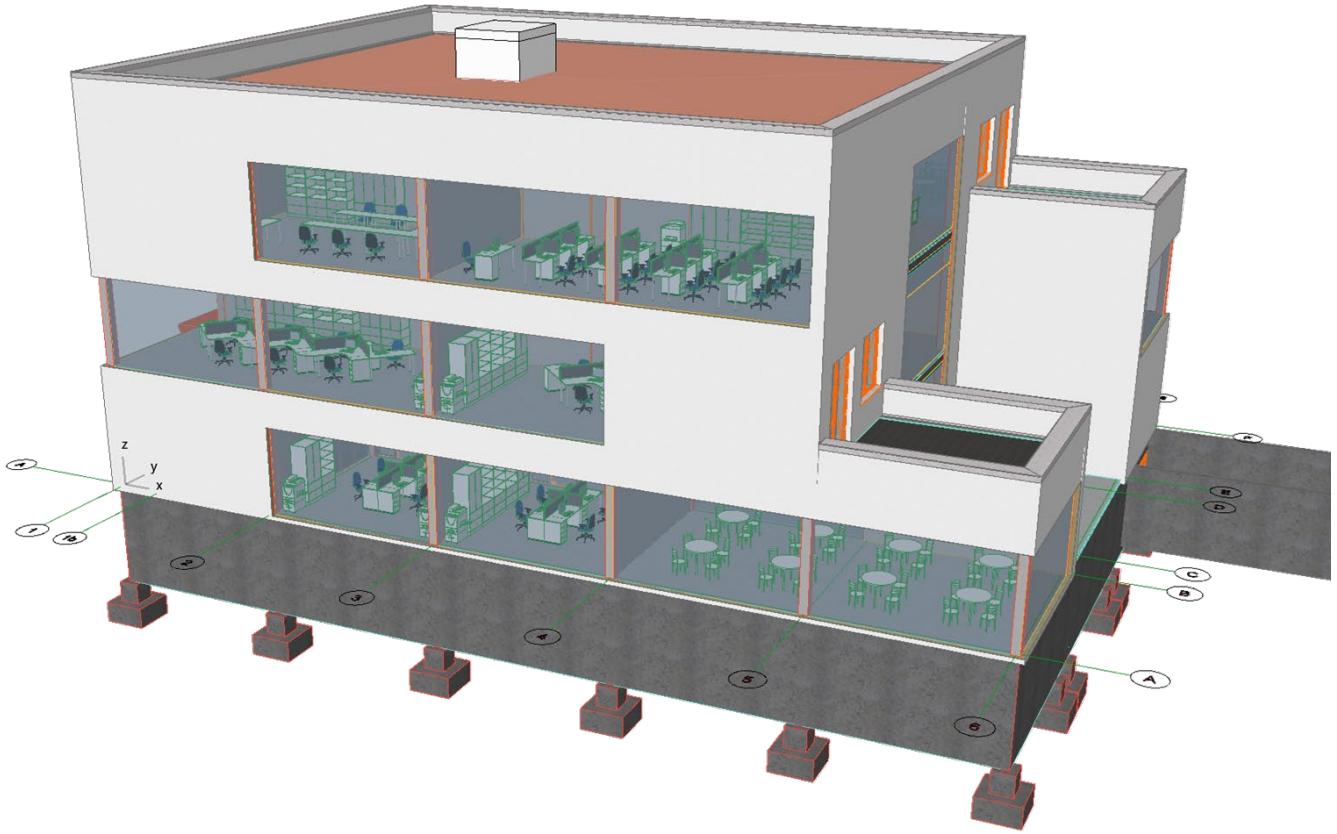


Case study - description

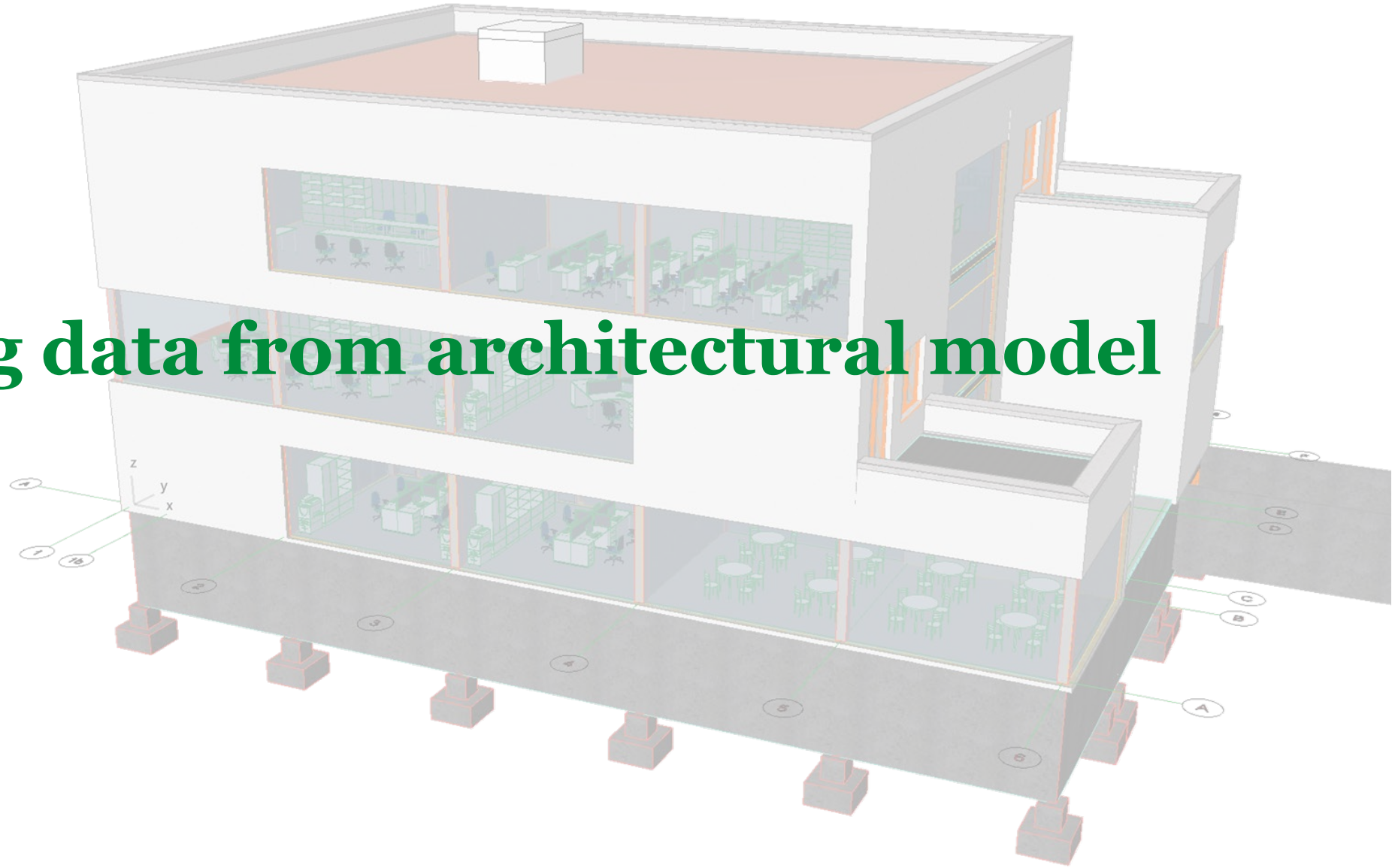
Building type: office building
Location: Rome
Conditioned net floor area: 1400 m^2

Software for architectural modeling: Archicad, Graphisoft

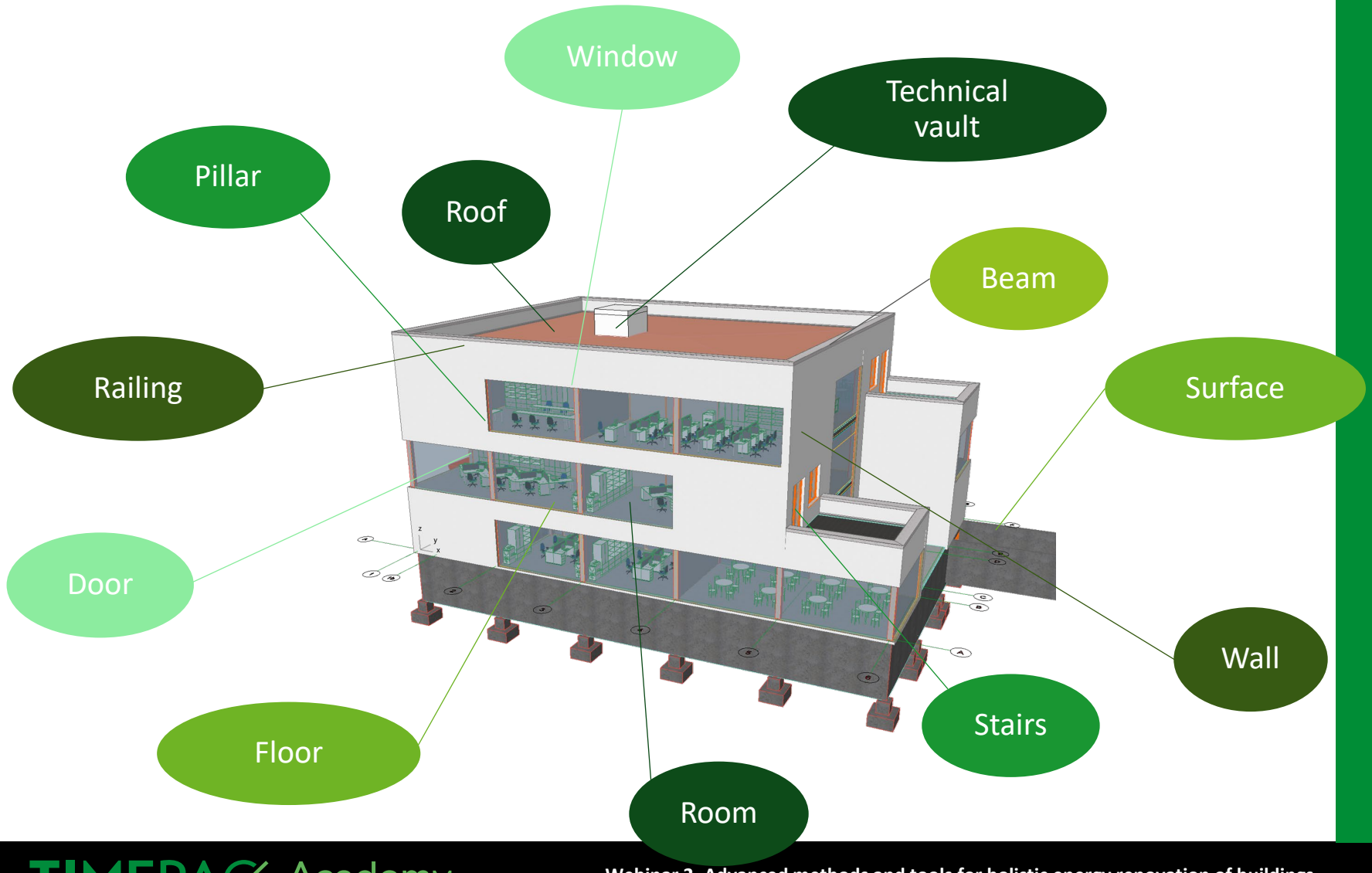
Software used for the EPC generation: EC700, Edilclima srl



Building data from architectural model



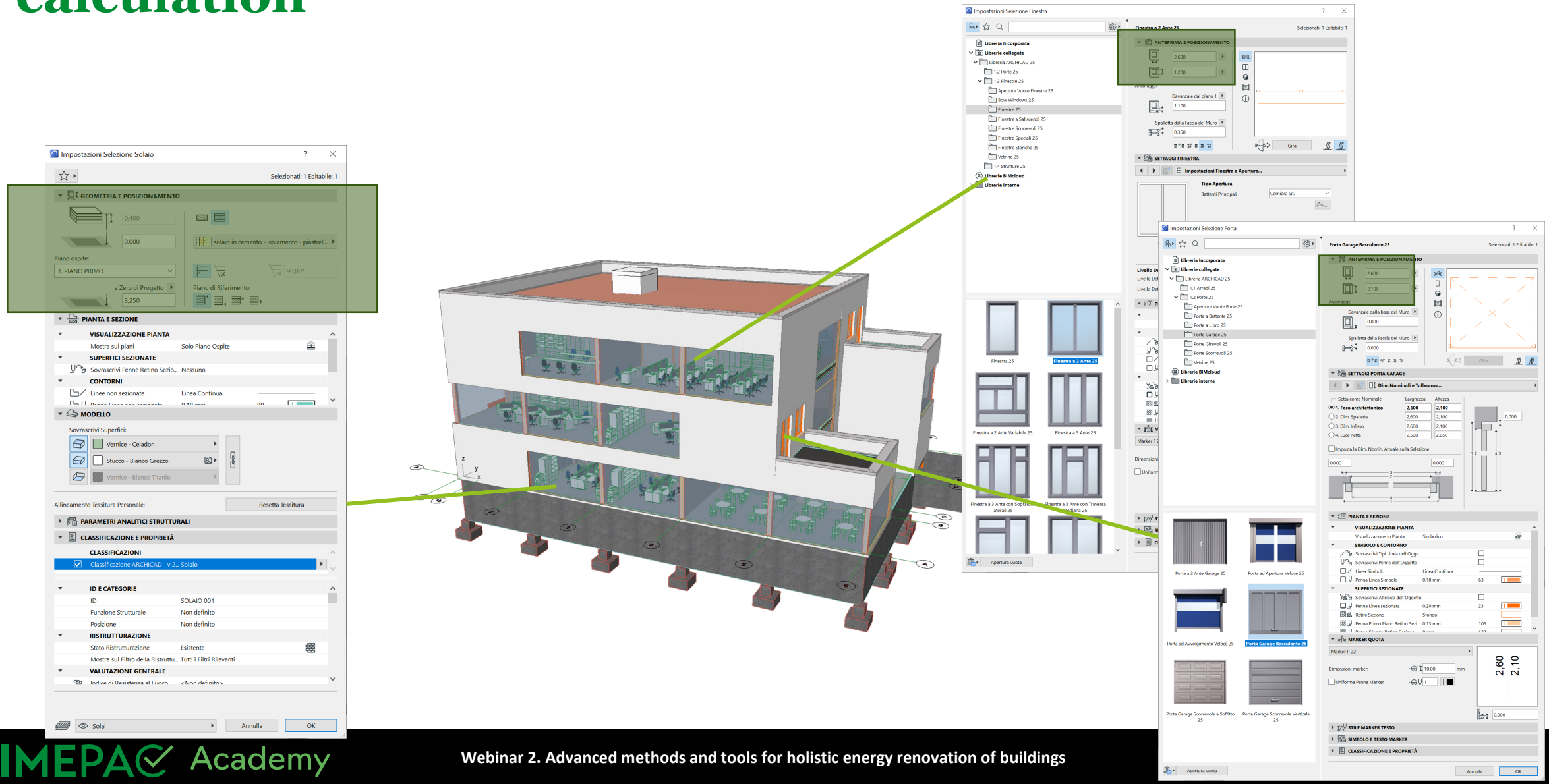
Architectural BIM model for energy performance calculation



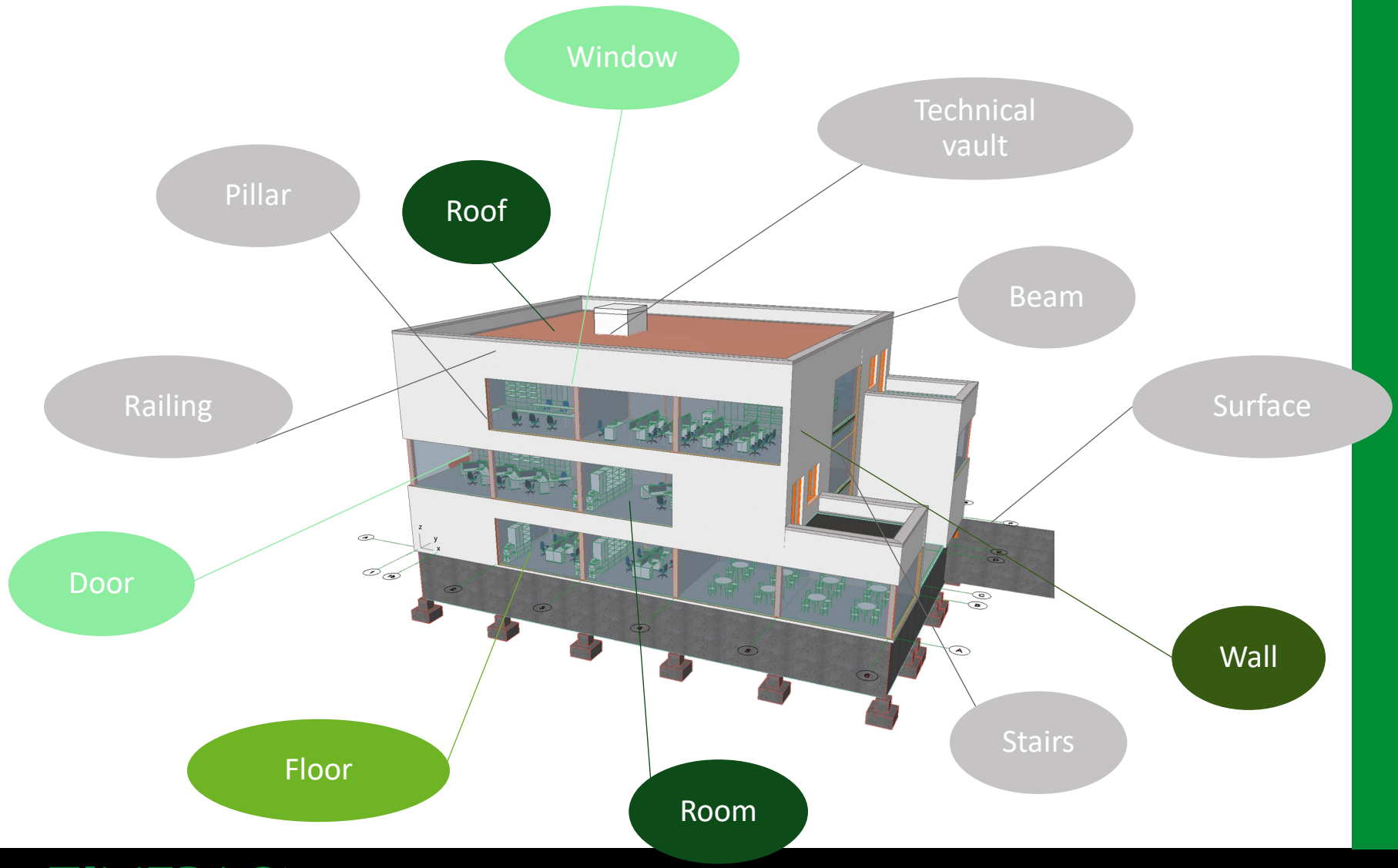
The architectural model contains a vast amount of data, including elements that are not necessary for energy evaluation.

The product receiving the IFC file should be able to choose which objects are of interest for the specific evaluation and which ones should not be considered.

Architectural BIM model for energy performance calculation



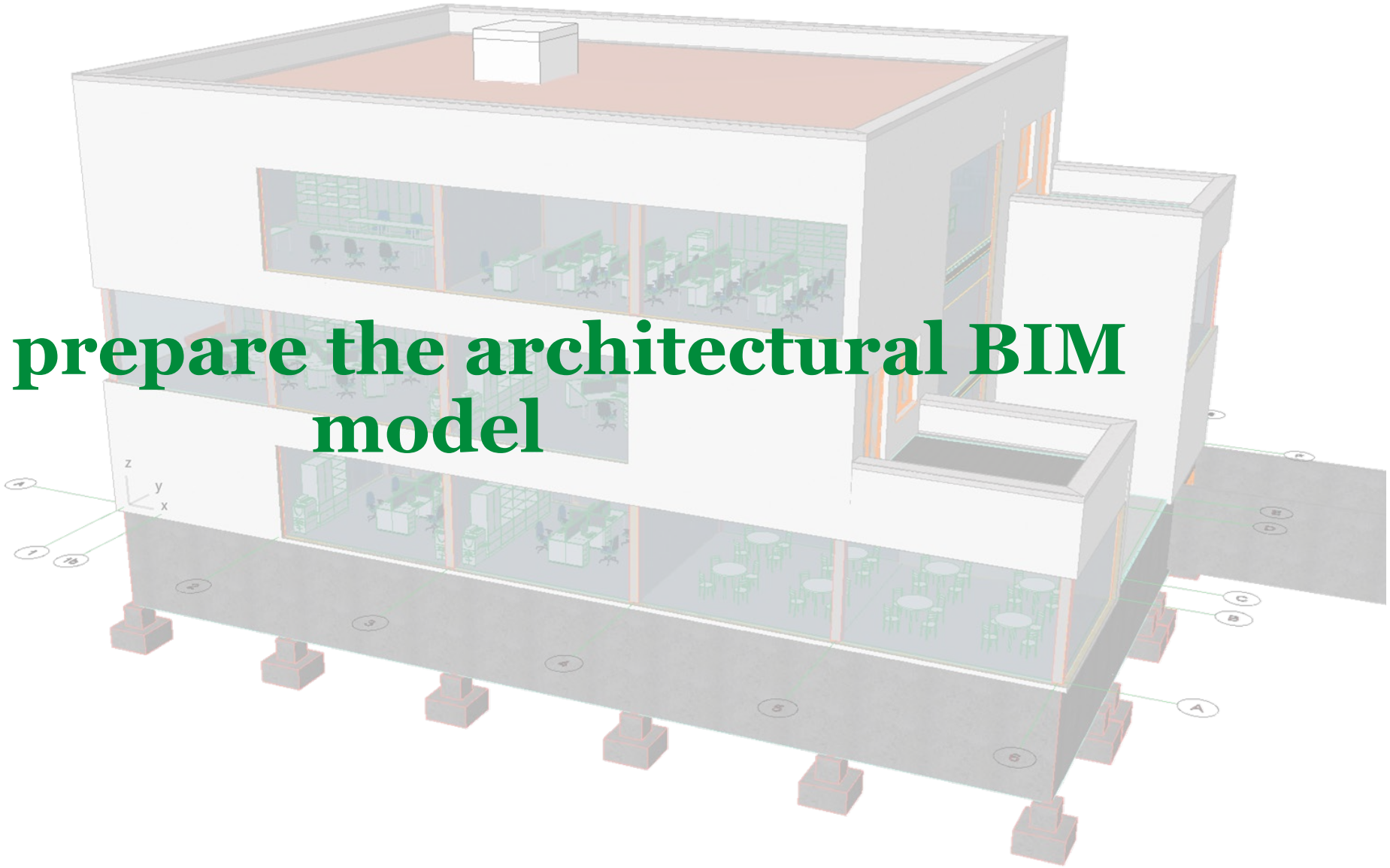
Architectural BIM model for energy performance calculation



During the import process of an IFC into energy evaluation software, it is necessary to exclude certain elements that, despite being present in the architectural model, should not be the subject of analysis.

For the imported elements, only the information necessary for specific evaluations should be acquired.

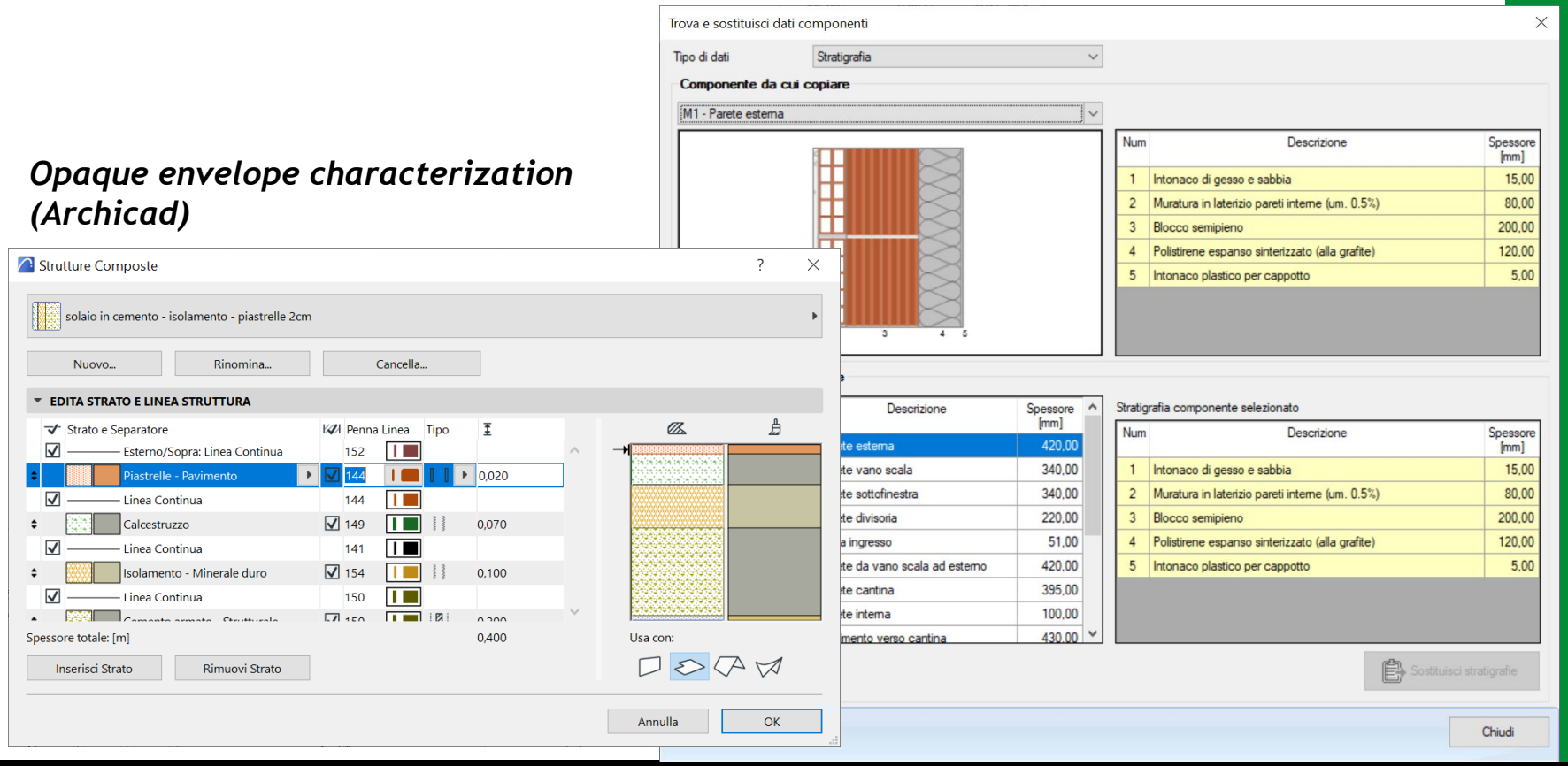
How to prepare the architectural BIM model



How to prepare the architectural BIM model – Opaque envelope characterization

Modification/characterization of the EC700 stratigraphy for opaque elements that were not correctly handled in the architectural modeling software

Opaque envelope characterization (Archicad)

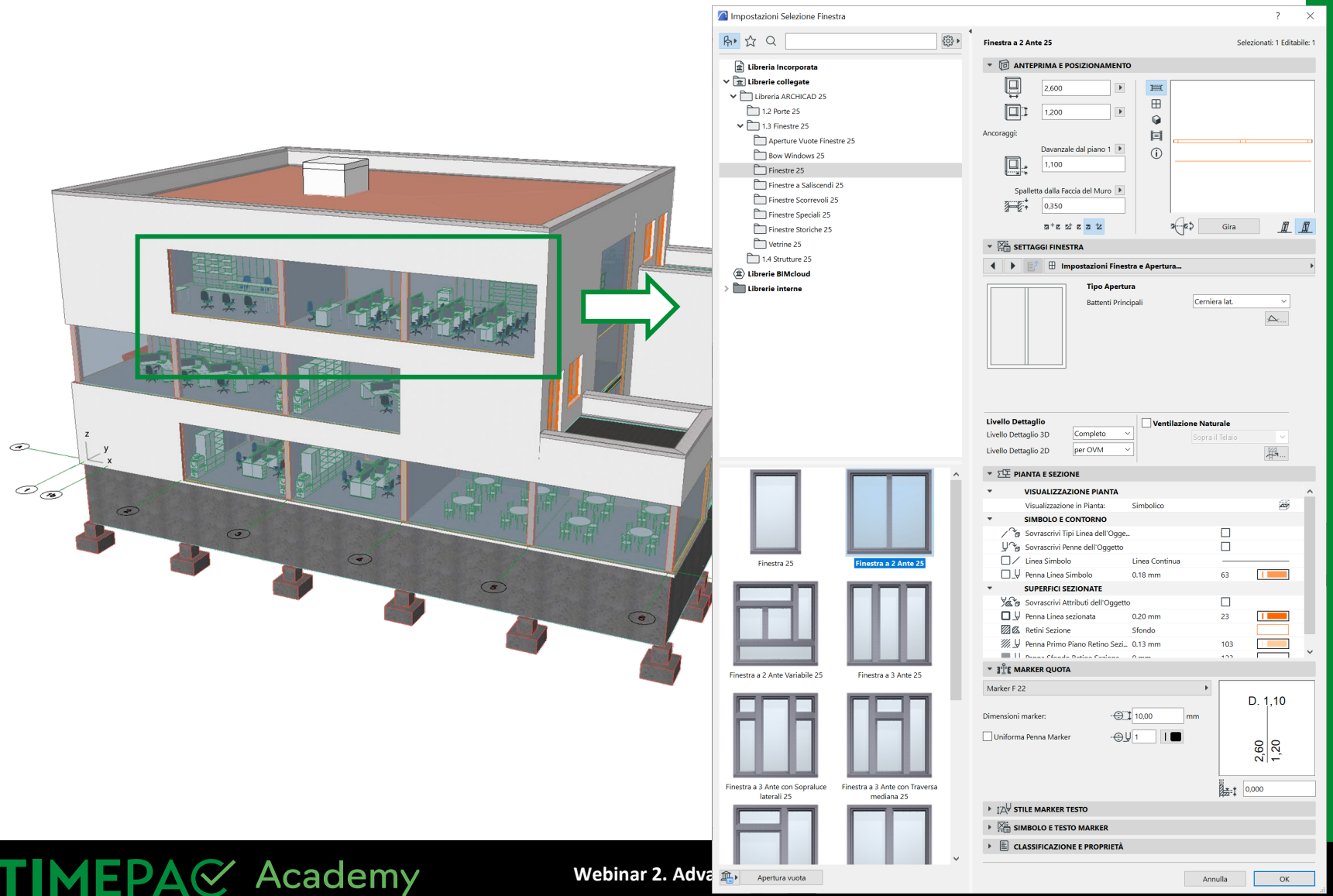


The creation of the opaque and transparent envelope is the first operation to be performed in architectural model creation software.

If possible, the layers of the envelope components should be characterized in the architectural model.

Otherwise, this characterization can be done with specific EPC generation tools.

How to prepare the architectural BIM model – transparent envelope characterization



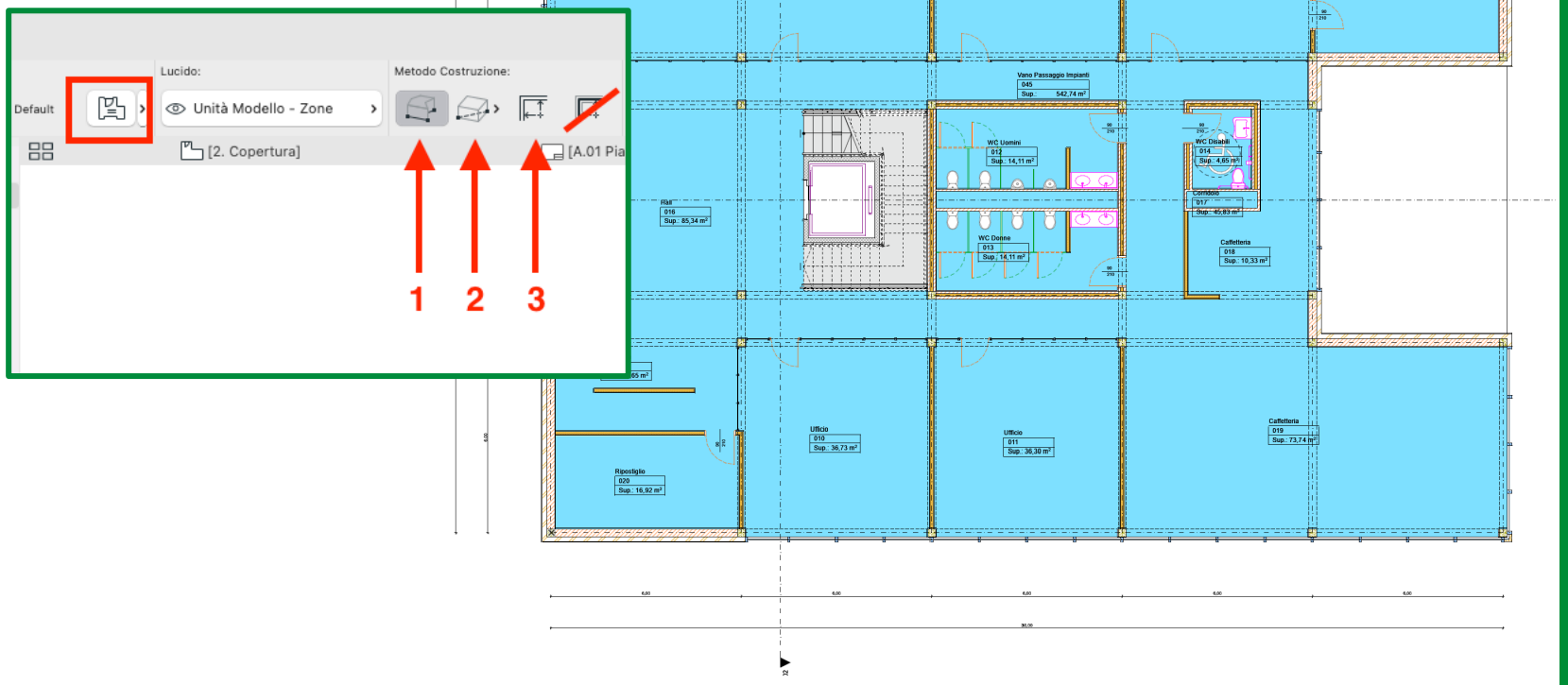
It is necessary to model the windows on the opaque envelope created before. Otherwise, double surfaces may be counted, as both the opaque and transparent parts will be included at the same position.

Additionally, elements like roller shutter boxes should not be included in the window modelling.

Despite being part of the window component, these elements need to be distinguished for energy evaluation purposes and should be modeled as separate elements.

How to prepare the architectural BIM model – creation of the spaces

Include in the model the IfcSpace
Avoid totaly or partial overlapsof spaces!



IfcSpace need to be included. These elements are used to identify each individual environment and define certain characteristics that will later be used for subsequent evaluations.

The **information** extracted from these elements via IFC will **pertain to surfaces and volumes.**

All other discipline-specific details, will be added to these entities downstream of the import (e.g. occupant profile, ventilation air flow etc.). It is crucial that **spaces do not intersect** with each other either horizontally or vertically, as overlaps will result in additional and inaccurate quantities of surfaces and volumes.

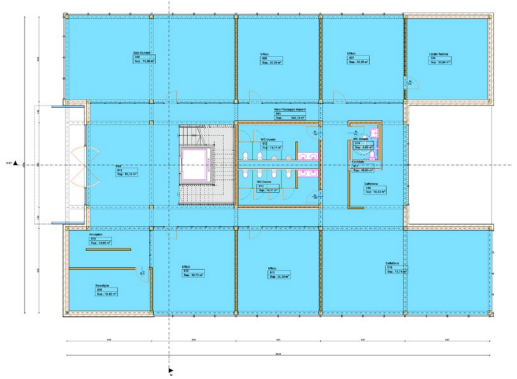
How to prepare the architectural BIM model – creation of the spaces

Perform an accurate offset!

It is important to check that the boundaries of the spaces touch all the enclosing surfaces both **laterally and superiorly**.

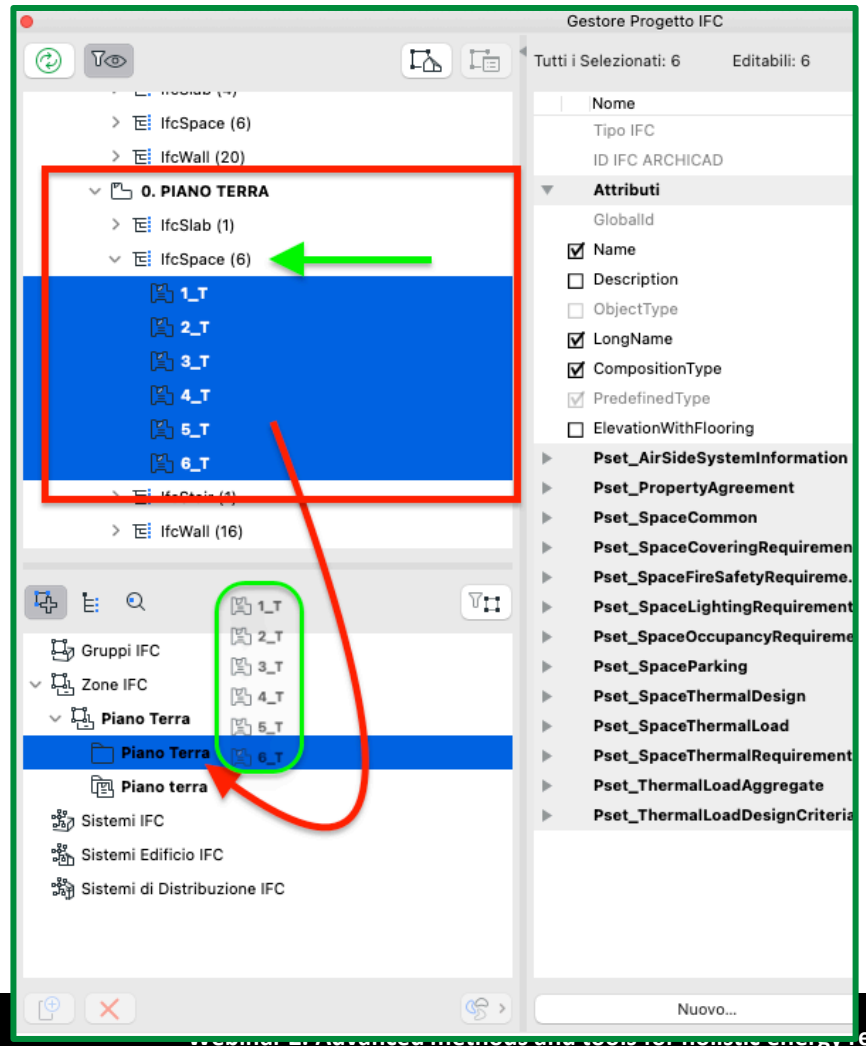
It often happens that the **upper offset of the rooms is not properly checked**, and if the room does not extend to the element that encloses it from above, this will result in **the loss of that thermal surface**.

How to prepare the architectural BIM model – creation of the thermal zones



Grouping the spaces for the creation of thermal zones, for energy calculation purposes

Exporting the Ifc file



The spaces, (blue in figure), must be associated with a reference **thermal zone**.

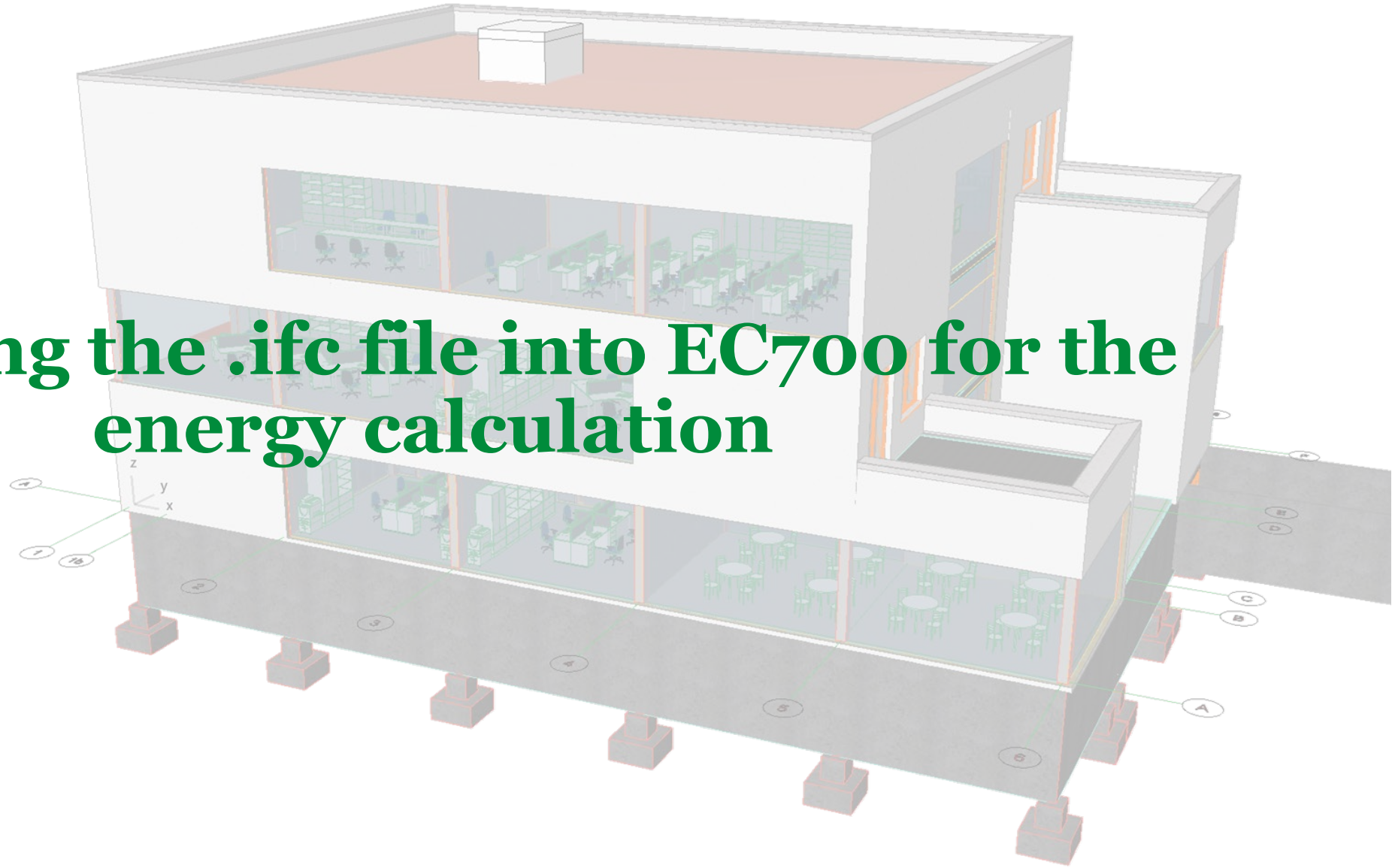
Each architectural modeling software performs this operation in its own way.

For example, **Archicad** allows these groupings to be done after the modeling phase, **when exporting the IFC file**.

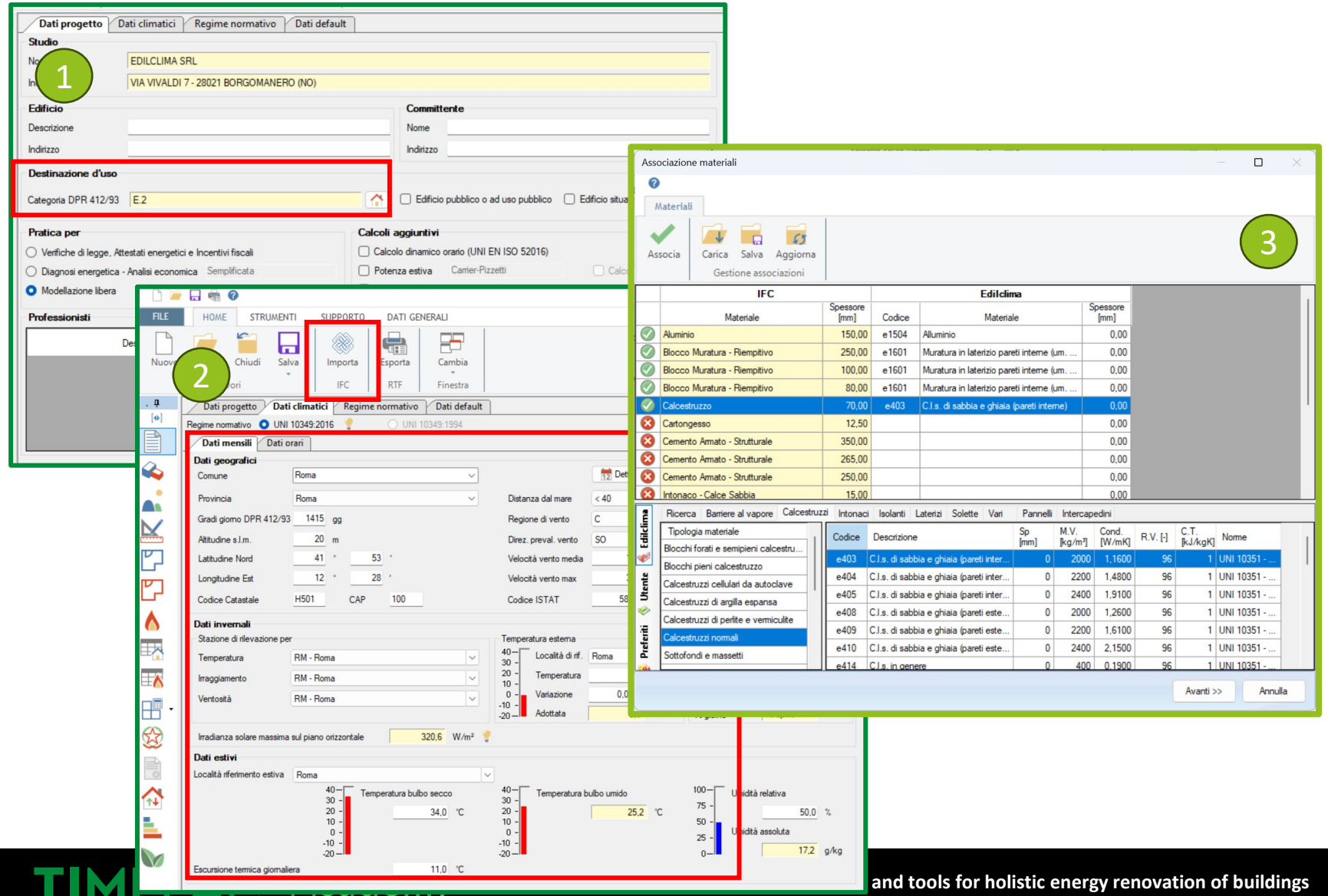
These steps may also not be executed in the architectural modeling software.

In this case, they should be **performed during the IFC import phase in EC700**, as this information is necessary for the subsequent energy assessment.

Importing the .ifc file into EC700 for the energy calculation



Importing the .ifc file into EC700 for the energy calculation



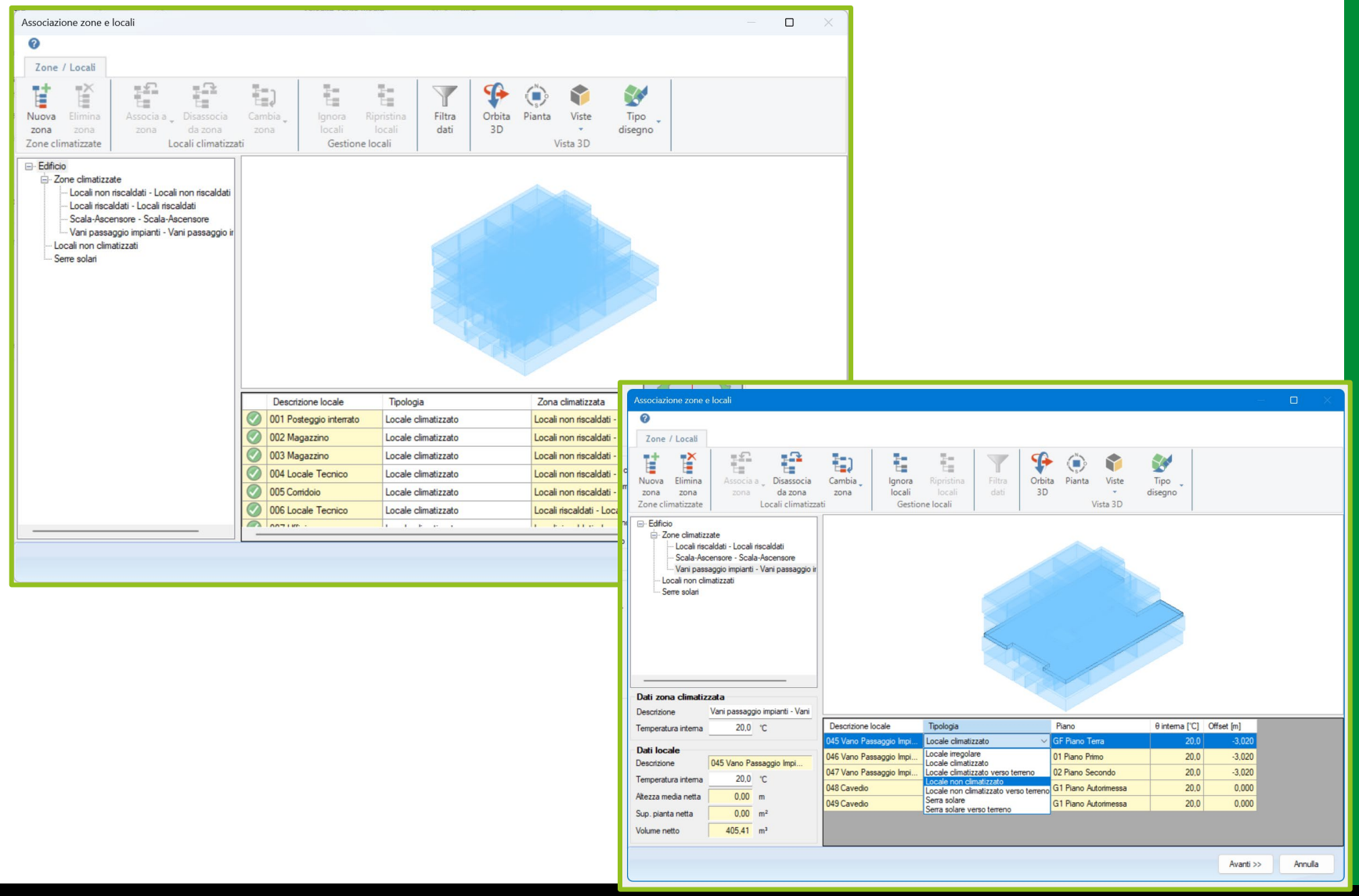
The import phase is activated after entering the building typology and the climatic data.

During the importation phase, it is requested to add the information that are not yet contained in the .ifc.

In the first dialogue window, you are prompted to associate each material found in the architectural BIM model with a material present in the archives provided by the EC700 tool.

In the next release of EC700 this will be done semi-authomatically!

Importing the .ifc file into EC700 for the energy calculation



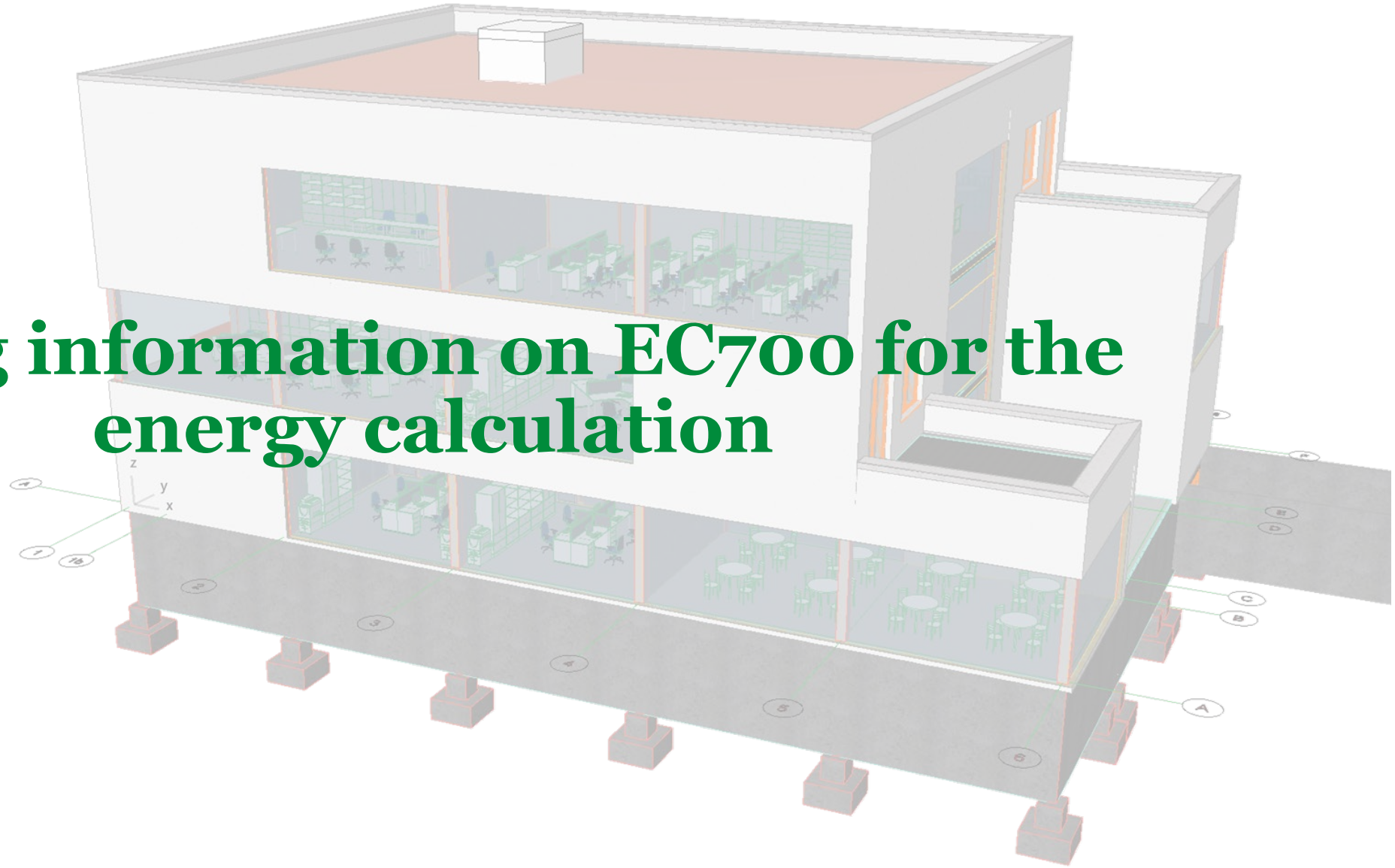
After the material association, you should perform the **thermal zone** association.

In this example, zoning associations had already been done, so it was not necessary to perform them again.

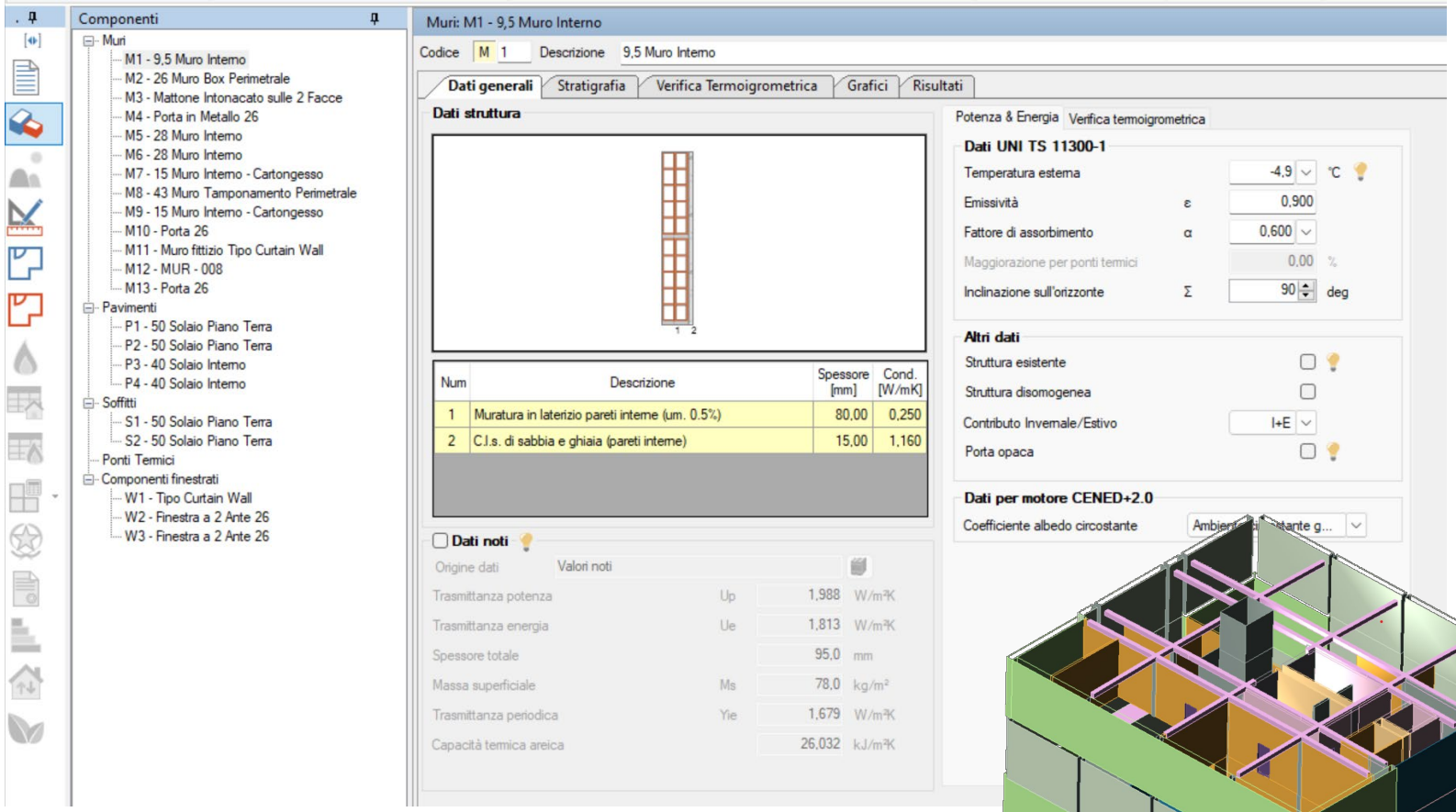
However, there is still the option to **modify the existing associations** or move rooms from one category to another.

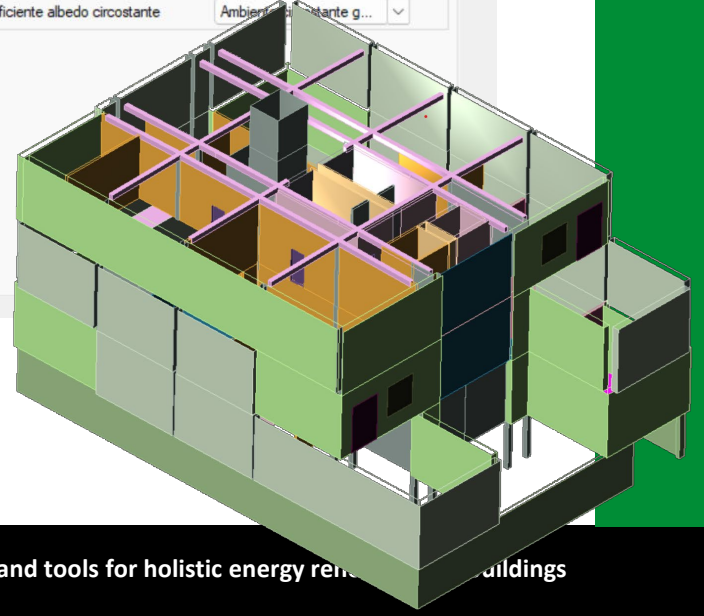
In .ifc file there is no information about the **unheated zones**. Therefore, these rooms are manually identified.

Adding information on EC700 for the energy calculation



Adding information on EC700 for the energy calculation

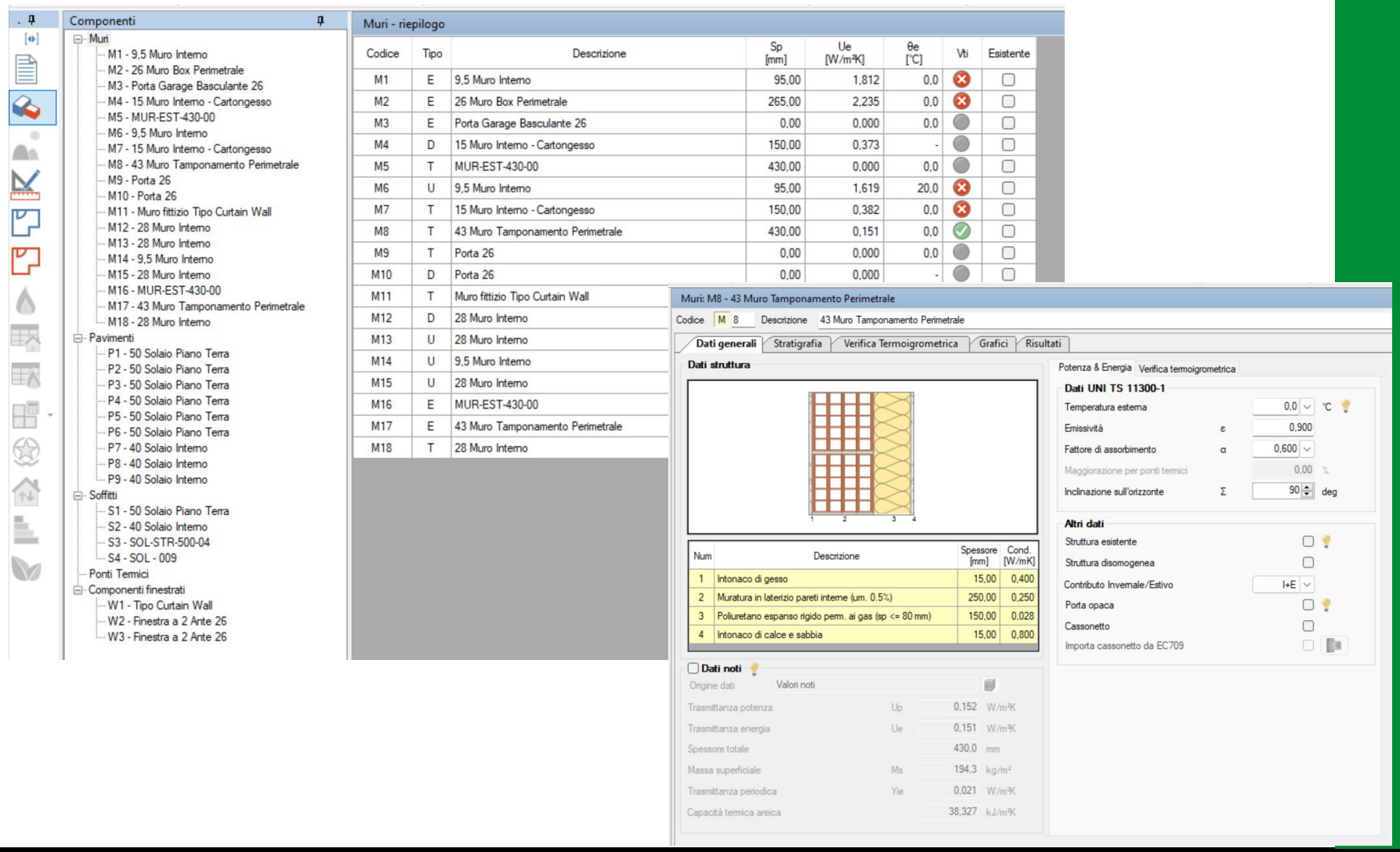




The first phase of the building modeling after the .ifc import phase consists of the opaque envelope modeling.

All materials that have not been yet associated, may be inserted, together with all properties affecting the energy calculation.

Adding information on EC700 for the energy calculation

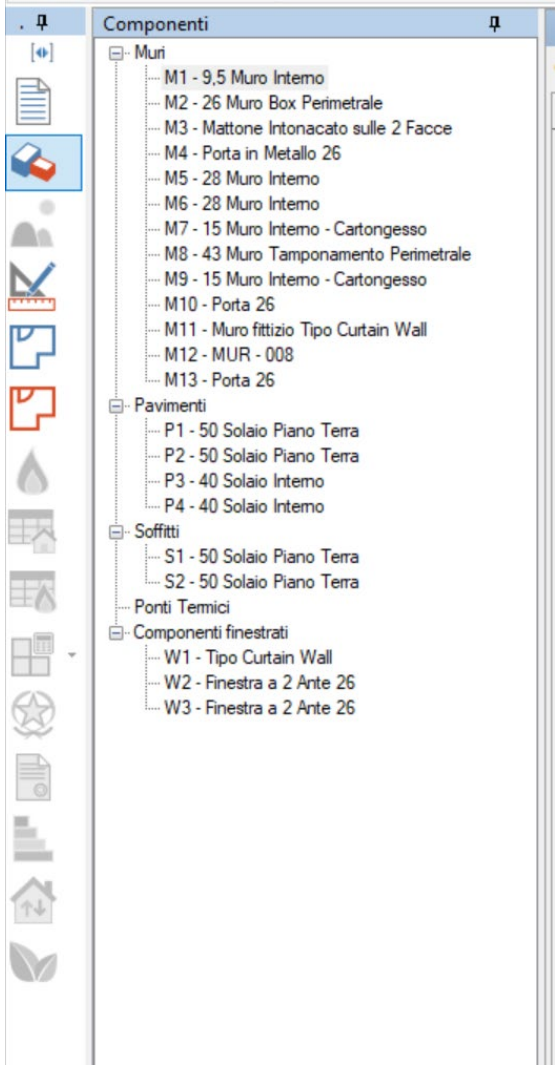


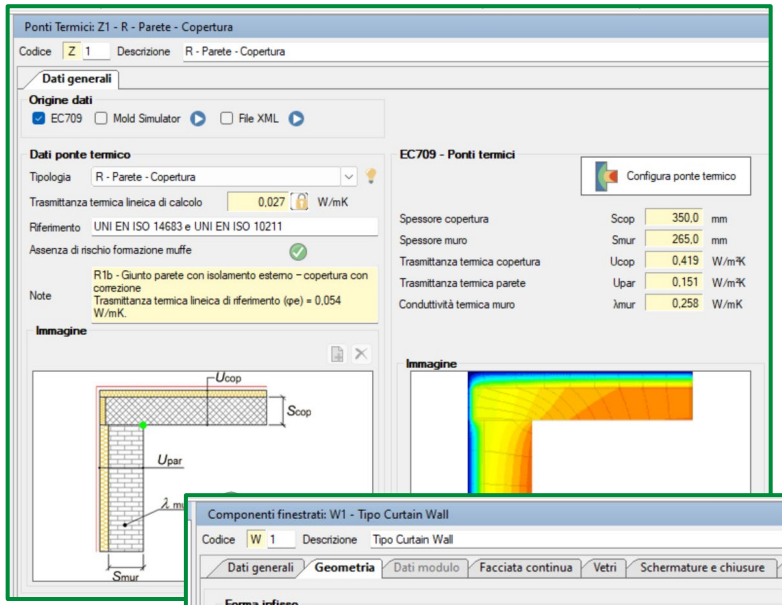
Here is the overview of the envelope components that have been imported into EC700 with a focus on the opaque envelope.

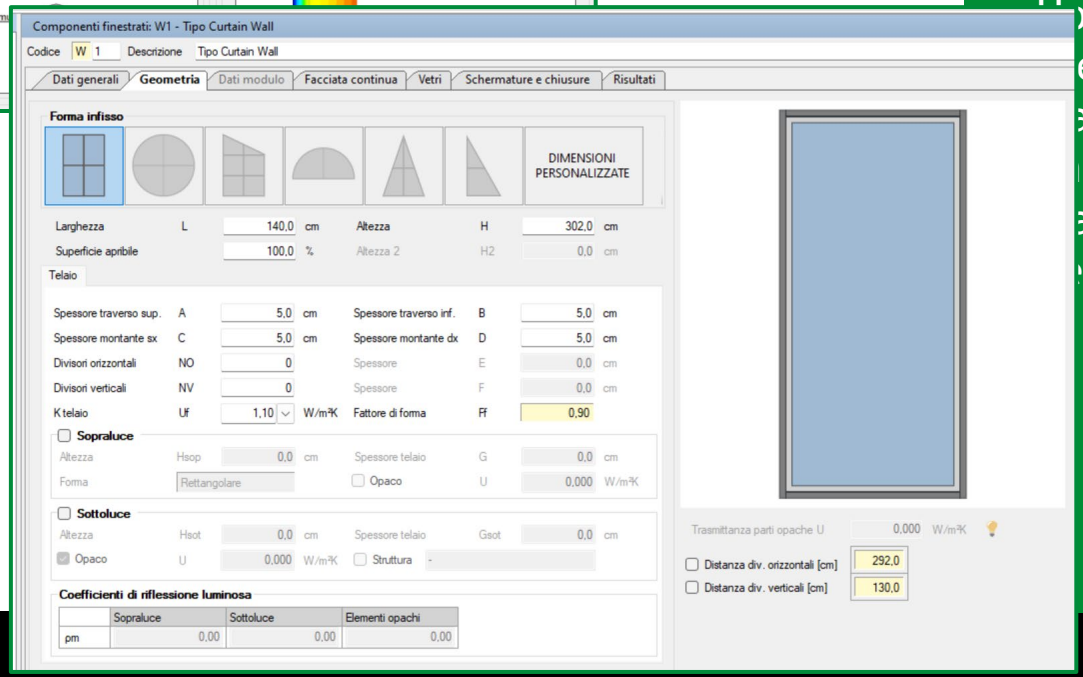
Not all the layers of the components have been recognised (and the corresponding thermal properties e.g. U-values are not yet calculated).

Therefore, it is necessary to model each envelope element together with its specific stratigraphy.

Adding information on EC700 for the energy calculation





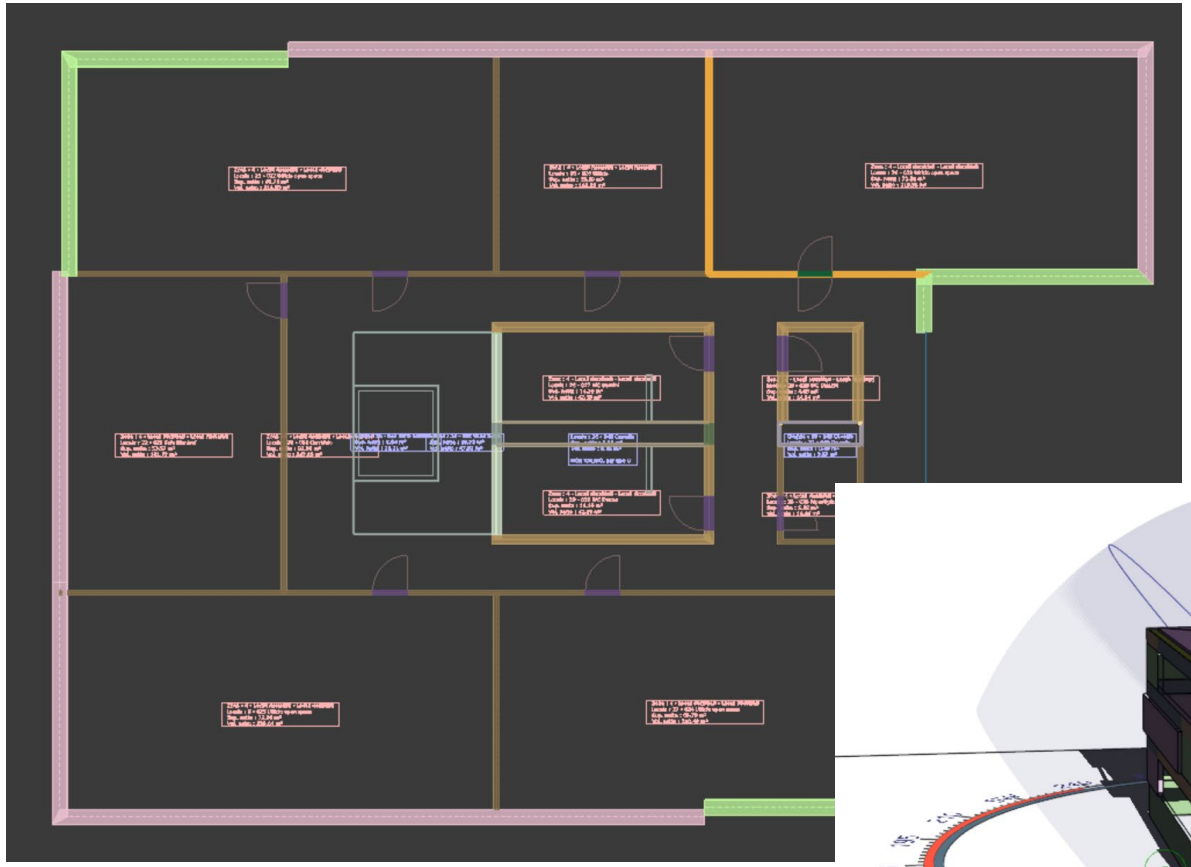


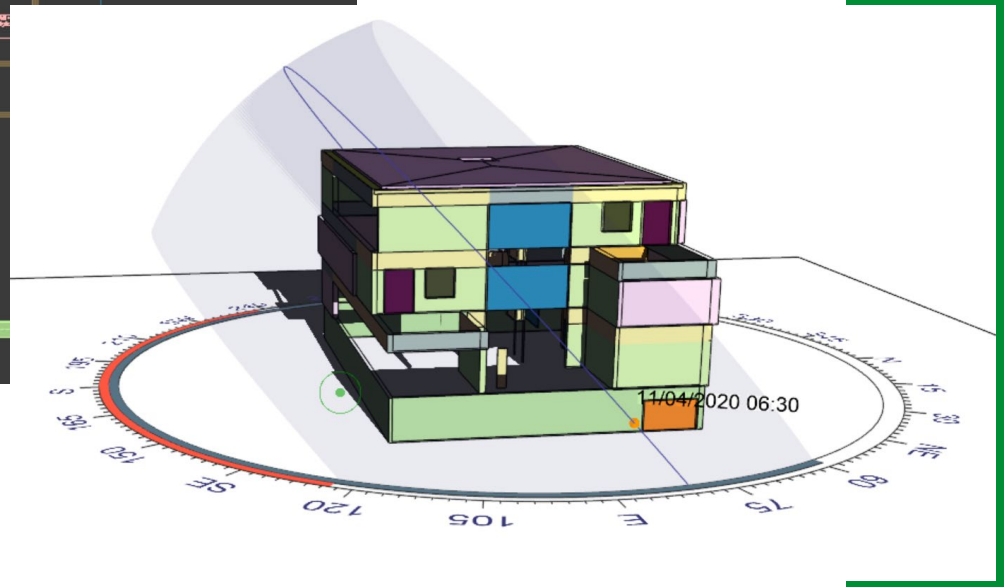
Thermal bridges must be created and associated to the specific part of the thermal building envelope.

As regards windows, they are partially pre-compiled with their geometrical characterization.

...owever, the geometrical and ...ermal properties of the ...ame as well as the thermal ...d solar properties of the ...ass part of the window must ... manually compiled.

Adding information on EC700 for the energy calculation

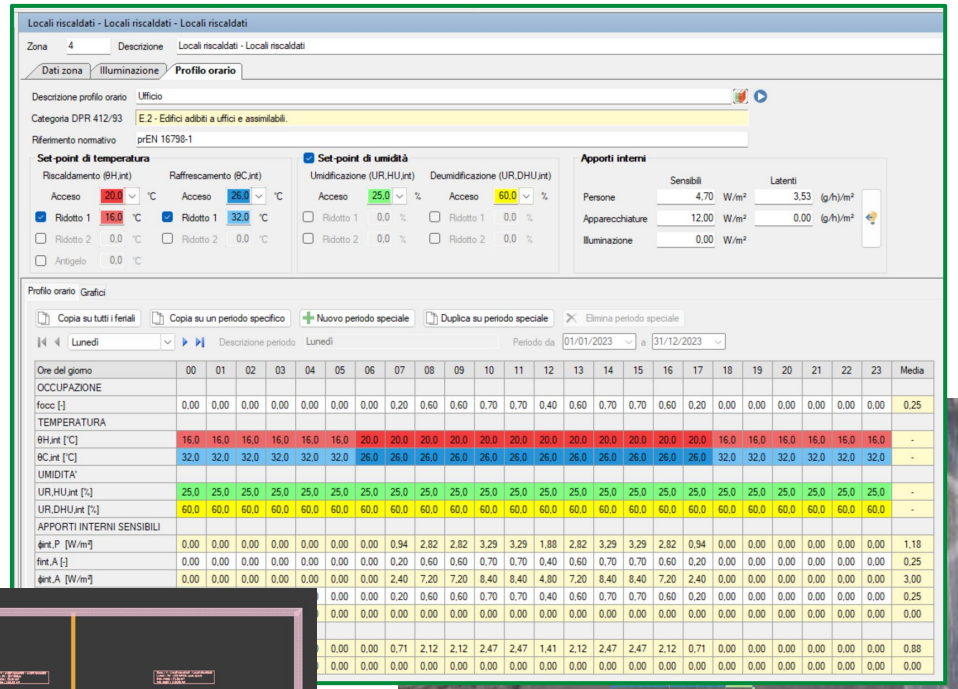


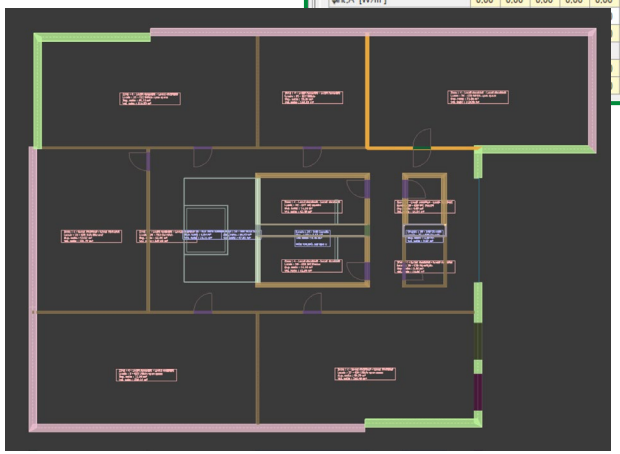


The drawing of the building is automatically performed.

However, it is important to check if the zones are correctly modelled, as well as the opaque and transparent envelopes.

Adding information on EC700 for the energy calculation





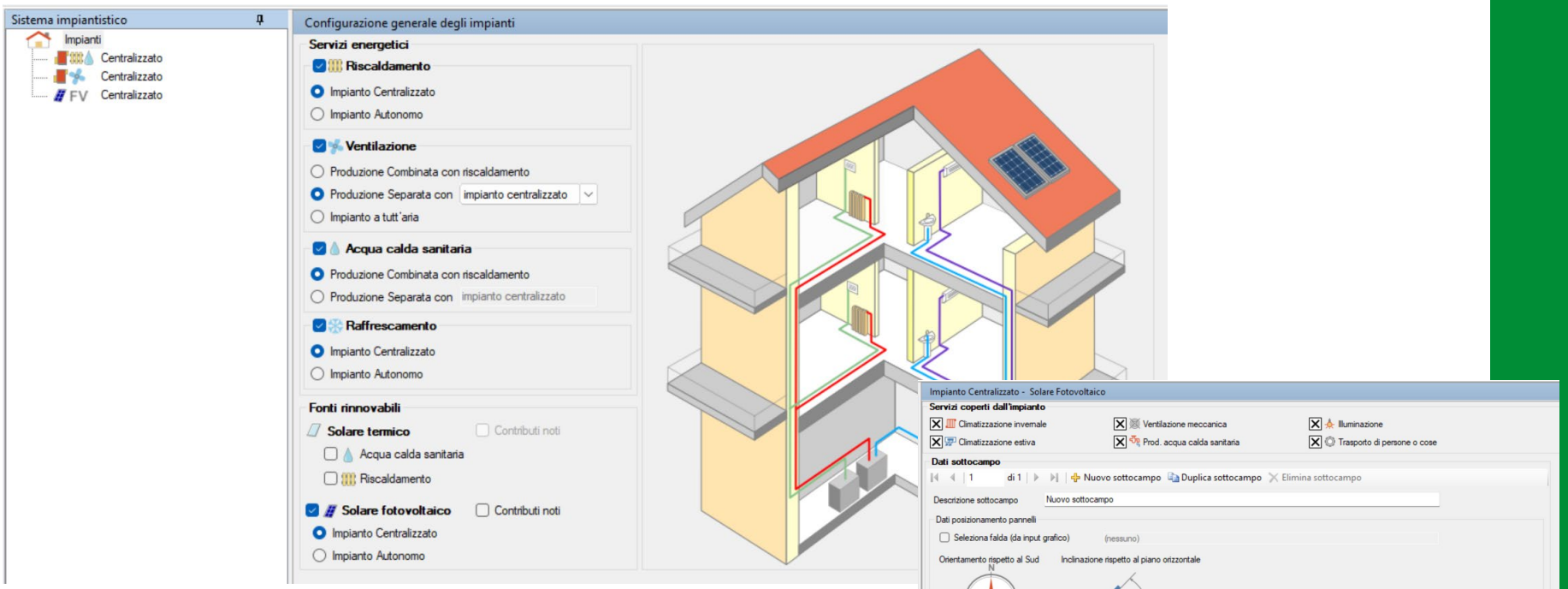
The drawing should be also implemented with the following elements:

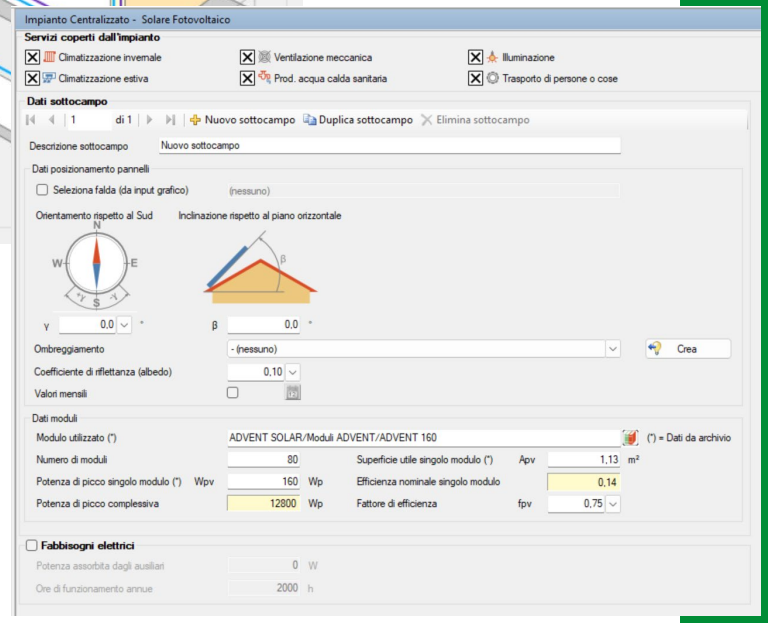
- **Thermal bridges** both horizontal and vertical, created manually in the building components' section.

Shading objects (balconies, nearby buildings, trees) **In the new EC700 release, we will learn to import some shading object automatically!**

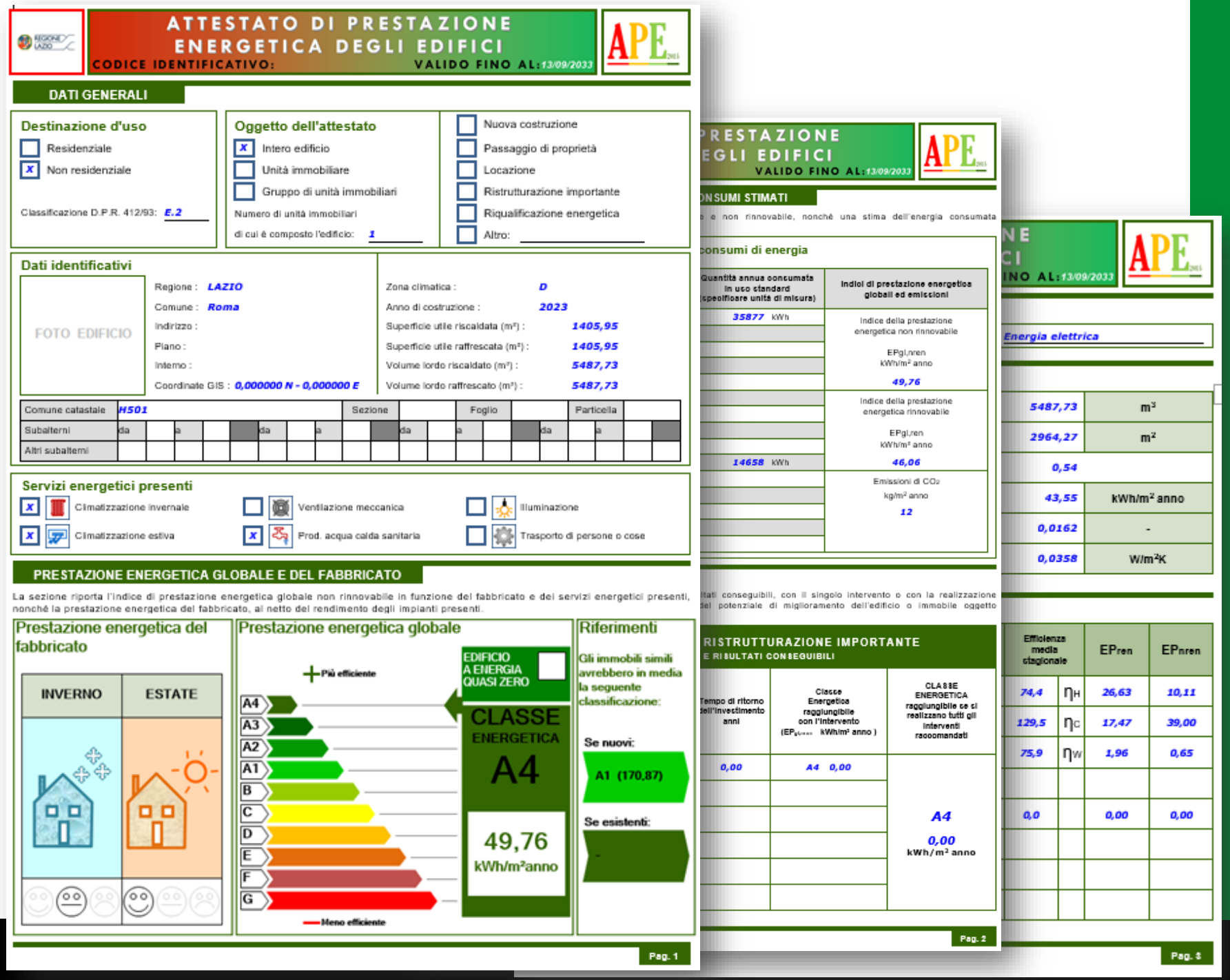
Data associated to each thermal zone (e.g. user profiles, air flow rate, set point temperature etc.)

Adding information on EC700 for the energy calculation





Finally, HVAC systems must be added, together with the renewable energy sources plants.



ATTESTATO DI PRESTAZIONE ENERGETICA DEGLI EDIFICI

CODICE IDENTIFICATIVO: VALIDO FINO AL: 13/09/2033

APE

DATI GENERALI

Destinazione d'uso
- [ ] Residenziale
- [x] Non residenziale

Classificazione D.P.R. 412/93: E.2

Oggetto dell'attestato
- [x] Intero edificio
- [ ] Unità immobiliare
- [ ] Gruppo di unità immobiliari

Numero di unità immobiliari di cui è composto l'edificio: 1

- [ ] Nuova costruzione
- [ ] Passaggio di proprietà
- [ ] Locazione
- [ ] Ristrutturazione importante
- [ ] Riqualificazione energetica
- [ ] Altro:

Dati identificativi

FOTO EDIFICIO

Regione: LAZIO
Comune: Roma
Indirizzo:
Piano:
Interno:
Coordinate GIS: 0,000000 N - 0,000000 E

Zona climatica: D
Anno di costruzione: 2023
Superficie utile riscaldata (m²): 1405,95
Superficie utile raffrescata (m²): 1405,95
Volume lordo riscaldato (m³): 5487,73
Volume lordo raffrescato (m³): 5487,73

Comune catastale	H501	Sezione		Foglio		Particella	
Subalterni	da a	da a	da a	da a			
Altri subalterni							

Servizi energetici presenti
- [x] Climatizzazione invernale
- [ ] Ventilazione meccanica
- [ ] Illuminazione
- [x] Climatizzazione estiva
- [x] Prod. acqua calda sanitaria
- [ ] Trasporto di persone o cose

PRESTAZIONE ENERGETICA GLOBALE E DEL FABBRICATO

La sezione riporta l'indice di prestazione energetica globale non rinnovabile in funzione del fabbricato e dei servizi energetici presenti, nonché la prestazione energetica del fabbricato, al netto del rendimento degli impianti presenti.

Prestazione energetica del fabbricato

INVERNO | ESTATE

Prestazione energetica globale

Più efficiente

A4
A3
A2
A1
B
C
D
E
F
G

Meno efficiente

EDIFICIO A ENERGIA QUASI ZERO

CLASSE ENERGETICA
A4

49,76
kWh/m²anno

Riferimenti

Gli immobili simili avrebbero in media la seguente classificazione:

Se nuovi: A1 (170,87)

Se esistenti: -

Pag. 1

PRESTAZIONE ENERGETICA DEGLI EDIFICI
VALIDO FINO AL: 13/09/2033

CONSUMI STIMATI

e non rinnovabile, nonché una stima dell'energia consumata

consumi di energia

Quantità annua consumata in uso standard (specificare unità di misura)	Indici di prestazione energetica globali ed emissioni
35877 kWh	Indice della prestazione energetica non rinnovabile EPgl,nren kWh/m² anno 49,76
	Indice della prestazione energetica rinnovabile EPgl,ren kWh/m² anno
14658 kWh	46,06
	Emissioni di CO_2 kg/m² anno 12

...tati conseguibili, con il singolo intervento o con la realizzazione ...del potenziale di miglioramento dell'edificio o immobile oggetto

RISTRUTTURAZIONE IMPORTANTE
E RISULTATI CONSEGUIBILI

Tempo di ritorno dell'investimento anni	Classe Energetica raggiungibile con l'intervento ($EP_{gl,ren}$ kWh/m² anno)	CLASSE ENERGETICA raggiungibile se si realizzano tutti gli interventi raccomandati
0,00	A4 0,00	A4 0,00 kWh/m² anno

Pag. 2

Energia elettrica

5487,73	m³
2964,27	m²
0,54	
43,55	kWh/m² anno
0,0162	-
0,0358	W/m²K

Efficienza media stagionale		EPren	EPnren
74,4	η_H	26,63	10,11
129,5	η_C	17,47	39,00
75,9	η_W	1,96	0,65
0,0		0,00	0,00

Pag. 3

EPC generation through EC700

Take aways

BIM authoring tools play a significant role in facilitating the creation of accurate and detailed geometric models of buildings.

The geometrical information within these models is essential for various analyses and assessments, including energy performance assessment.

It is important to properly create the BIM architectural model, otherwise some mistakes may occur in the energy performance assessment

TIMEPAC The new EPC for Europe

If you would like more information, please visit www.timepac.eu or contact us at

a.gorrino@edilclima.it

Thanks for your attention!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033819