



PROJECT: ECOLOGICAL AND INNOVATIVE TECHNOLOGIES FOR RECOVERING  
INDUSTRIAL AREAS FROM LCA AND ENERGY EFFICIENCY POINT OF VIEW  
2020-1-RO01-KA203-080223

# *BUILDING ENERGY ASSESSMENT IN BIM*



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Universitatea  
Transilvania  
din Braşov

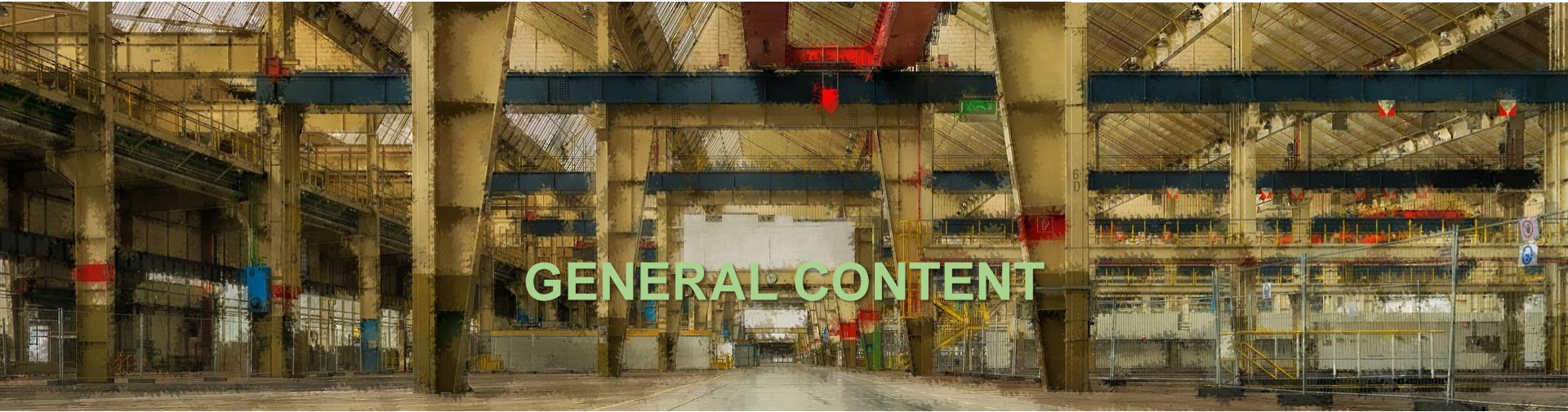


ROMANIA  
GREEN  
BUILDING  
COUNCIL



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Erasmus+ Programme  
of the European Union





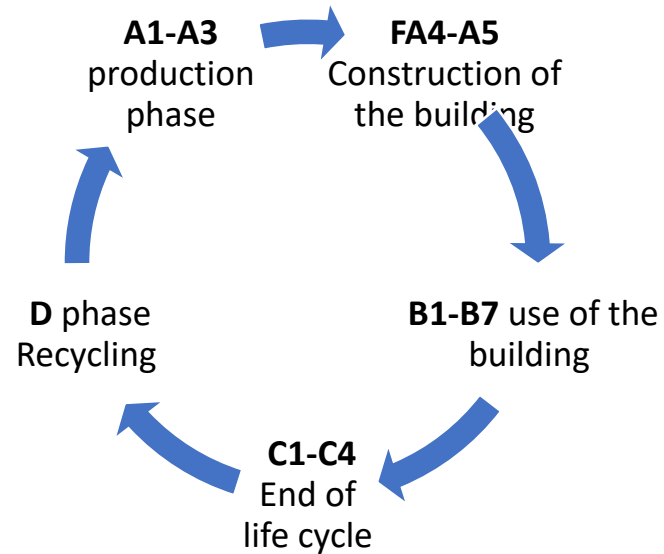
## GENERAL CONTENT

1. Model the building in ArchiCAD
2. Add internal zones of rooms
3. Create thermal blocks
4. Estimating energy efficiency



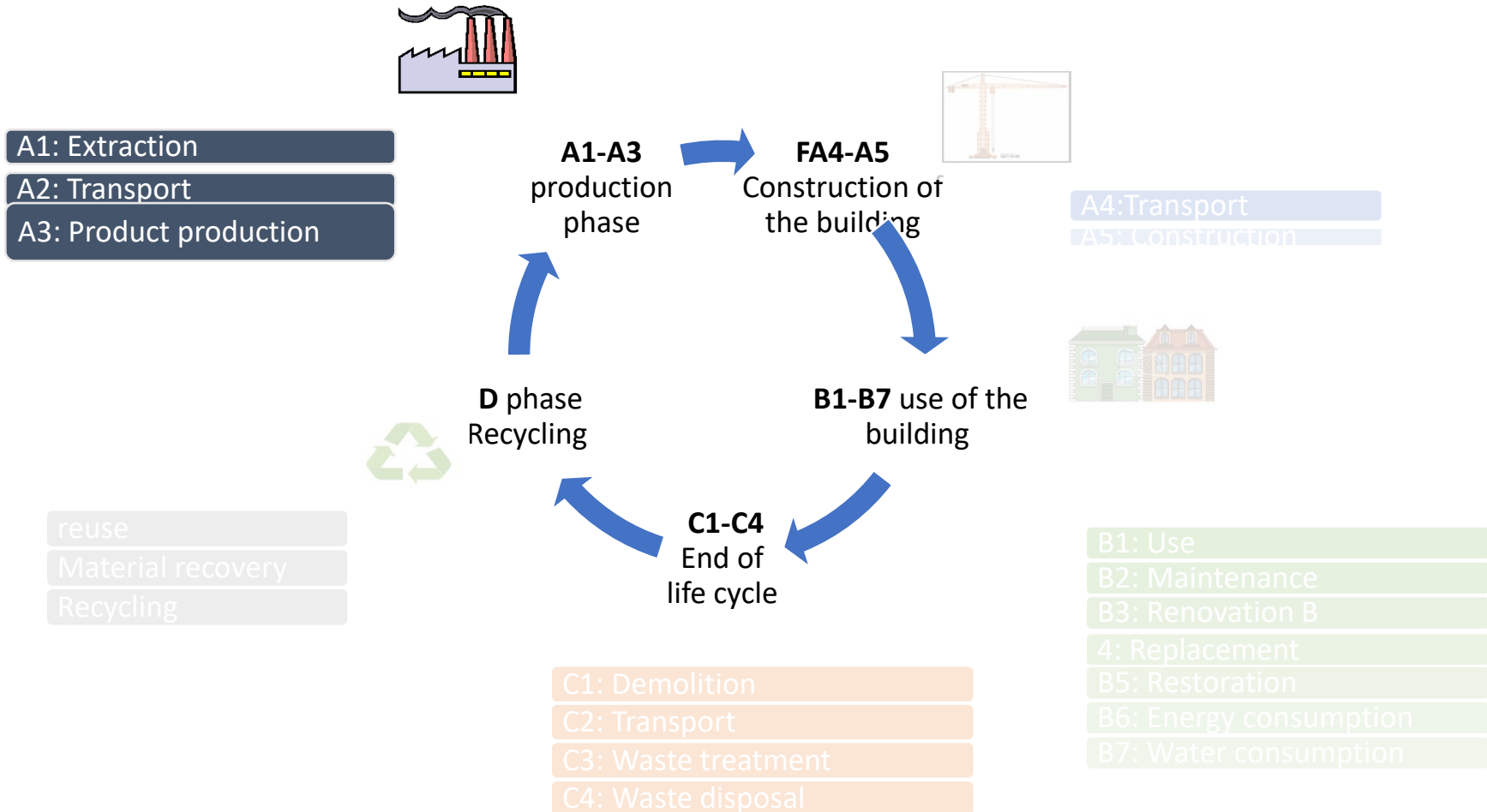


## LIFE CYCLE ASSESSMENT (LCA)



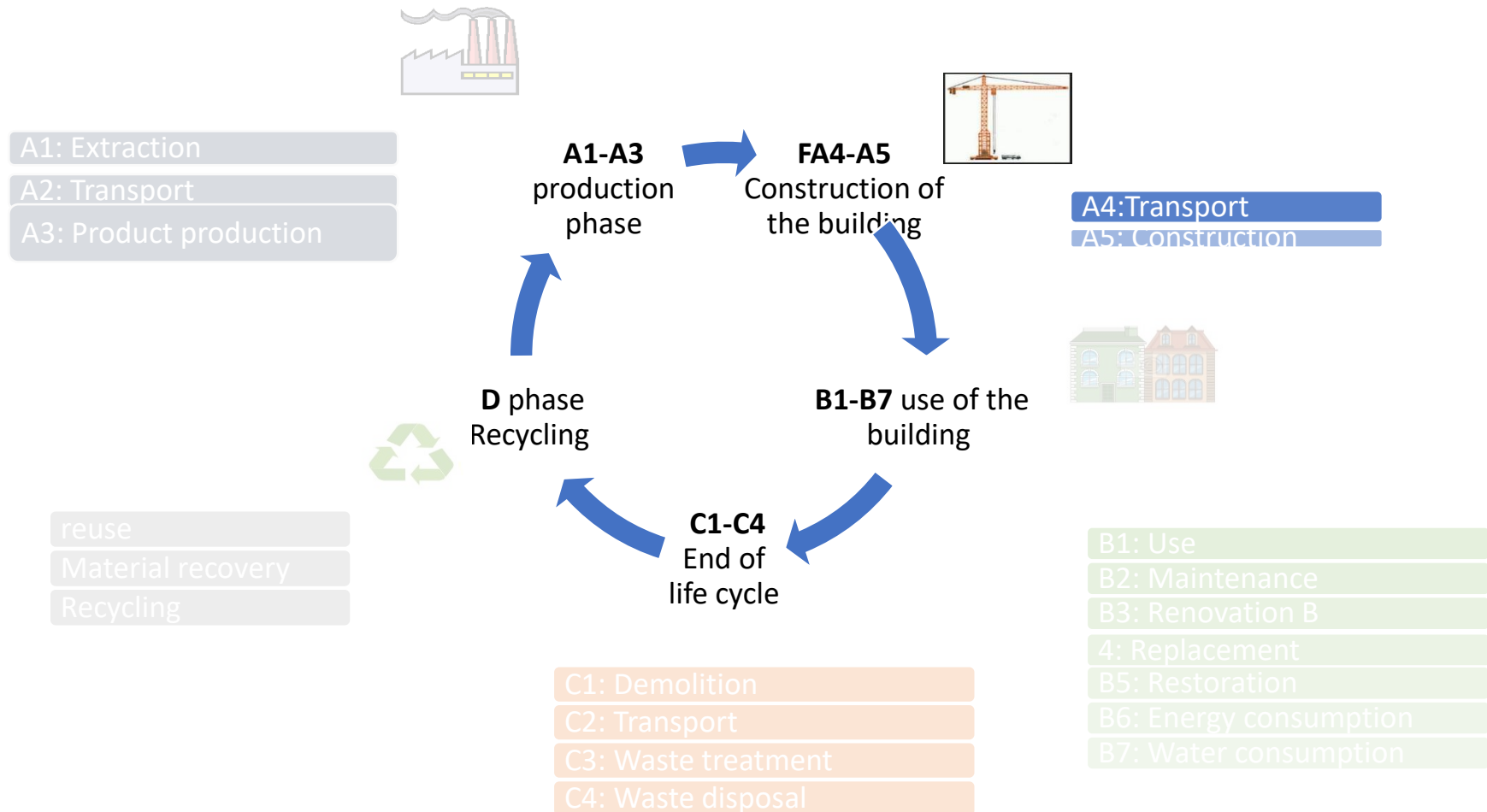


# Life Cycle of the building according to standard EN15978

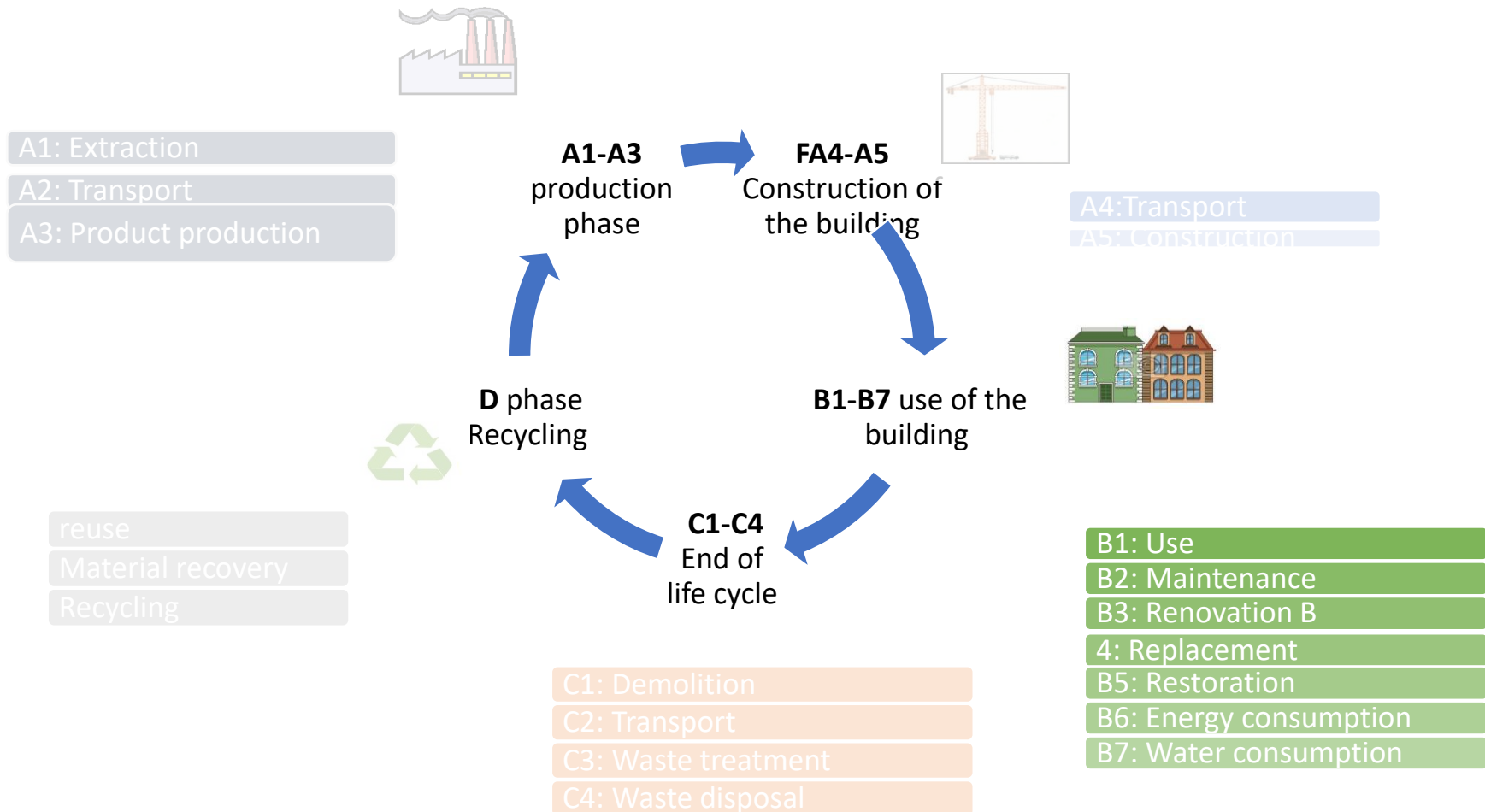




## Life Cycle of the building according to standard EN15978



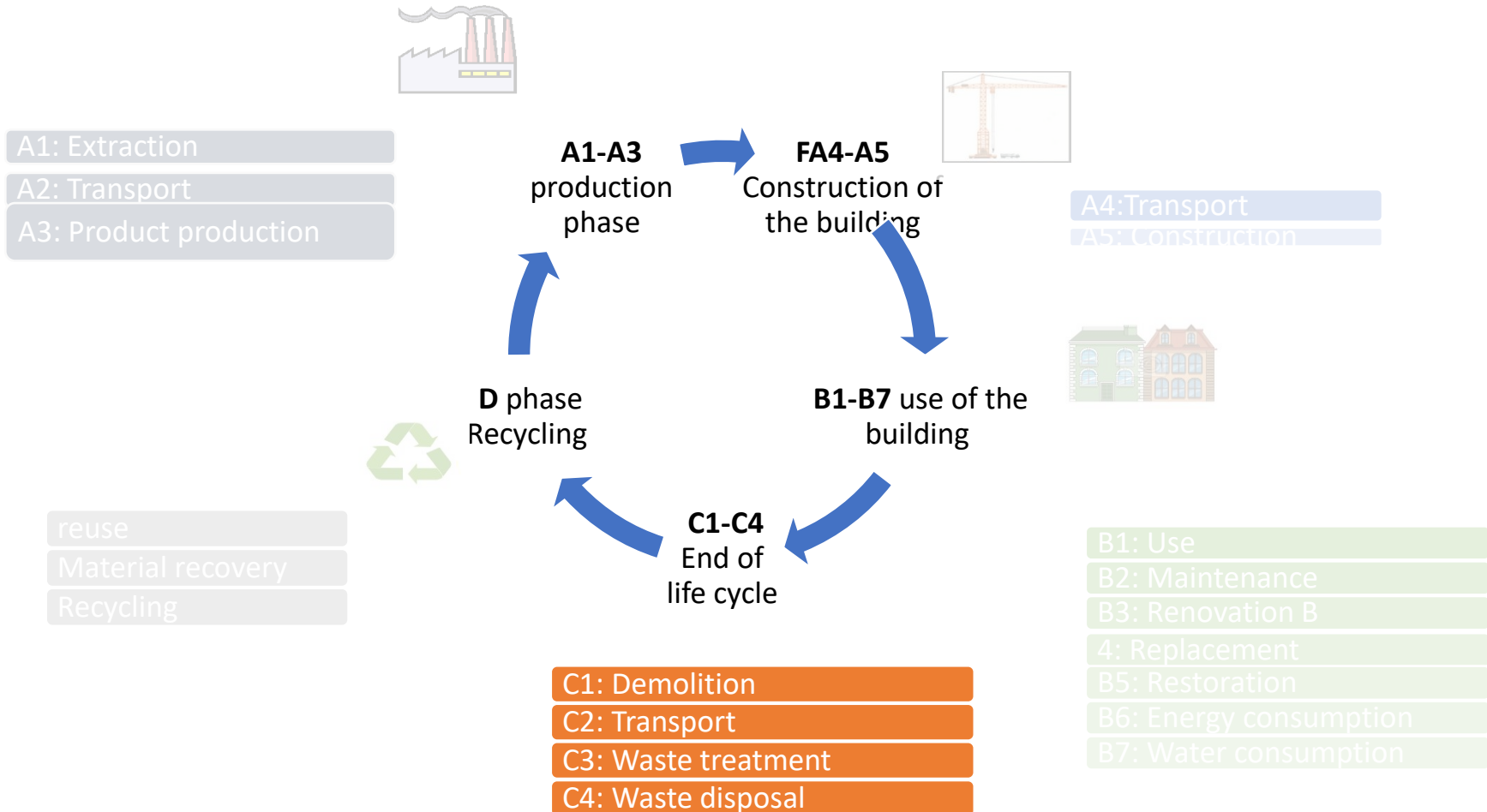
# Life Cycle of the building according to standard EN15978





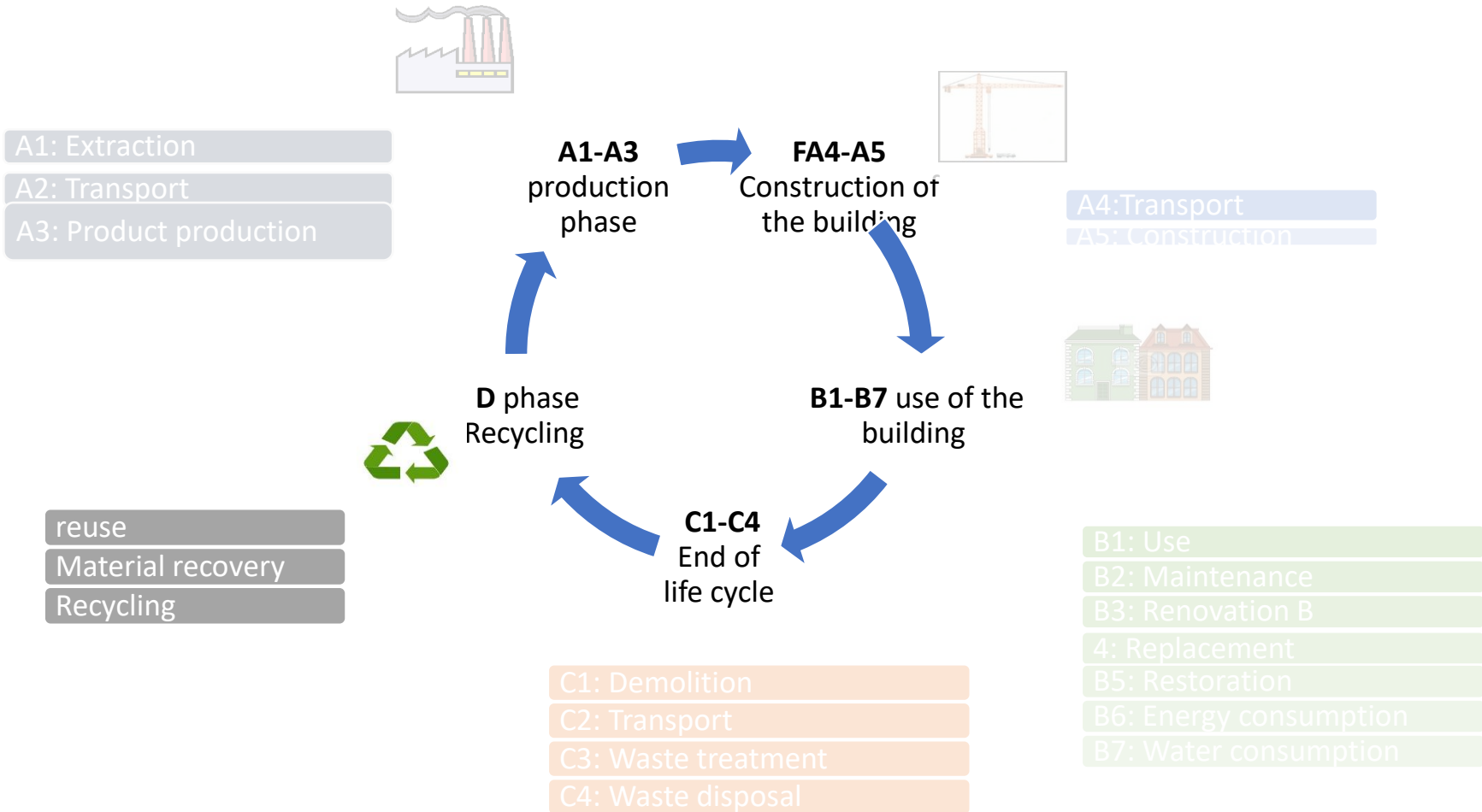


# Life Cycle of the building according to standard EN15978





# Life Cycle of the building according to standard EN15978





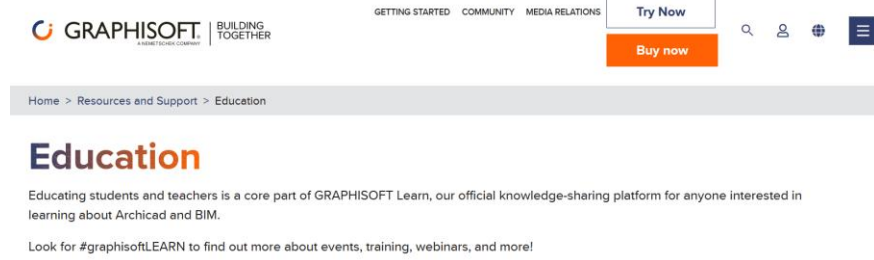


Download and install Graphisoft Archicad

Information about Archicad:



Get your free educational licence here:







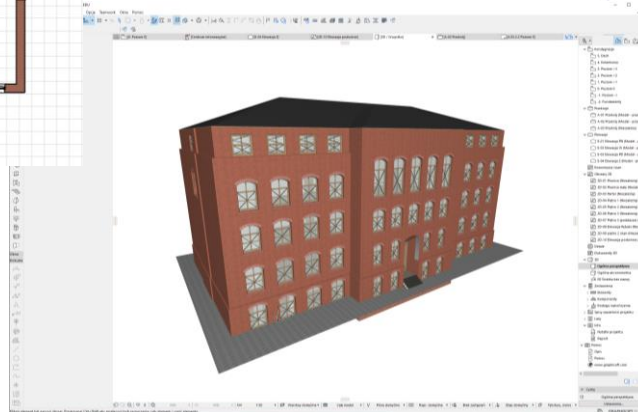
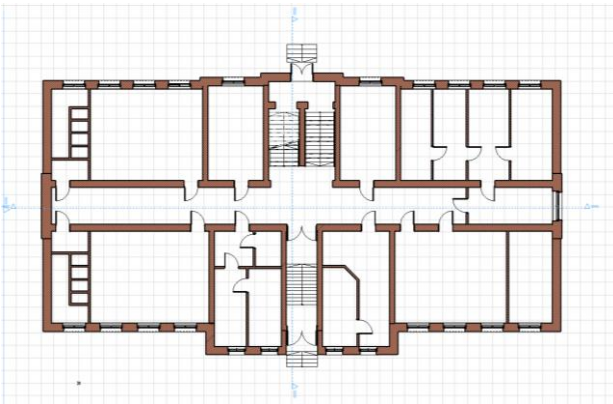
Open Graphisoft Archicad







# 1. Model the building in Archicad



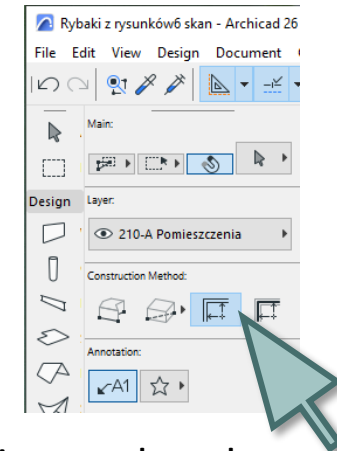
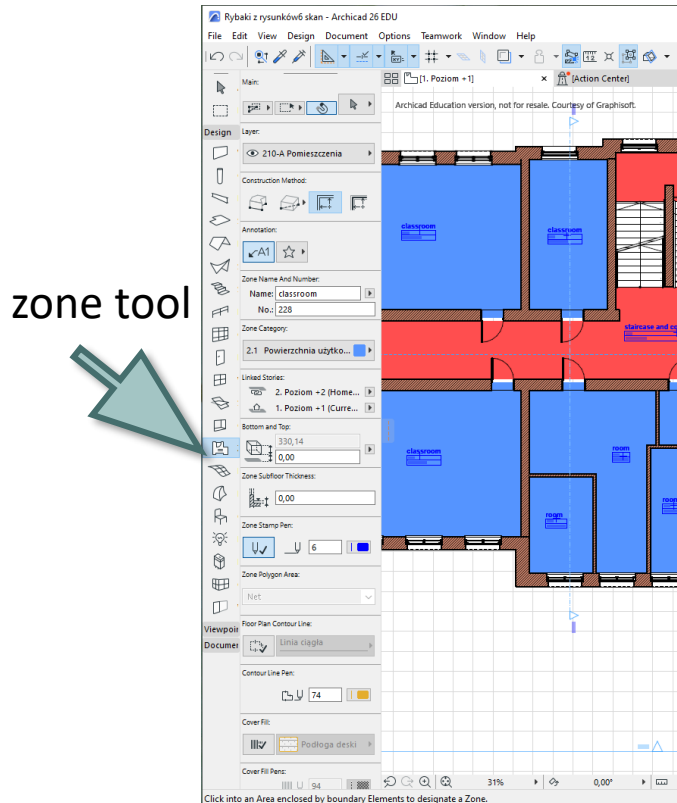






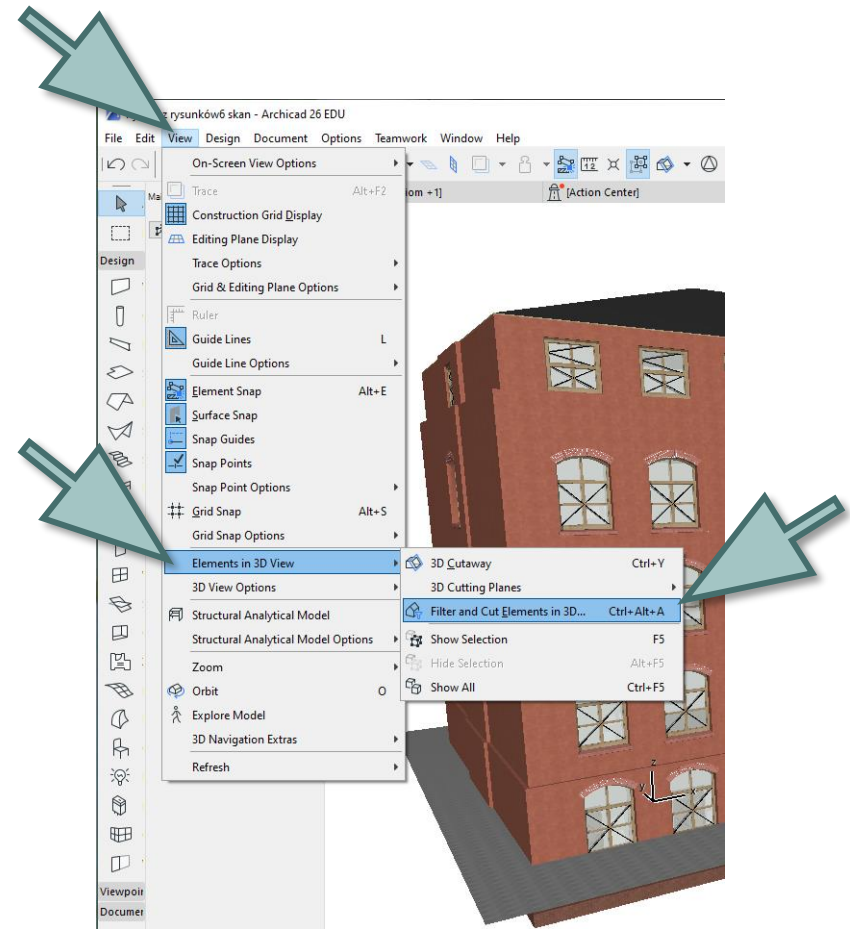


use the **zone tool** to create a zone in each conditioned space in the building by using only the **inner edge of the zone structure**.



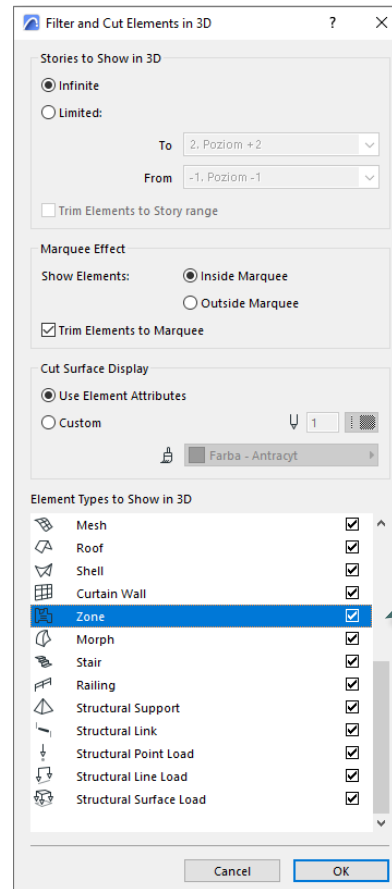
internal tool  
edge of the construction of zones

When inserting zones on a plan view check that they are completely surrounded by zone boundaries.



- open the **3D View** tab
- right click on it
- open the "Filtering and Sections window elements in 3D"

## select visible zones



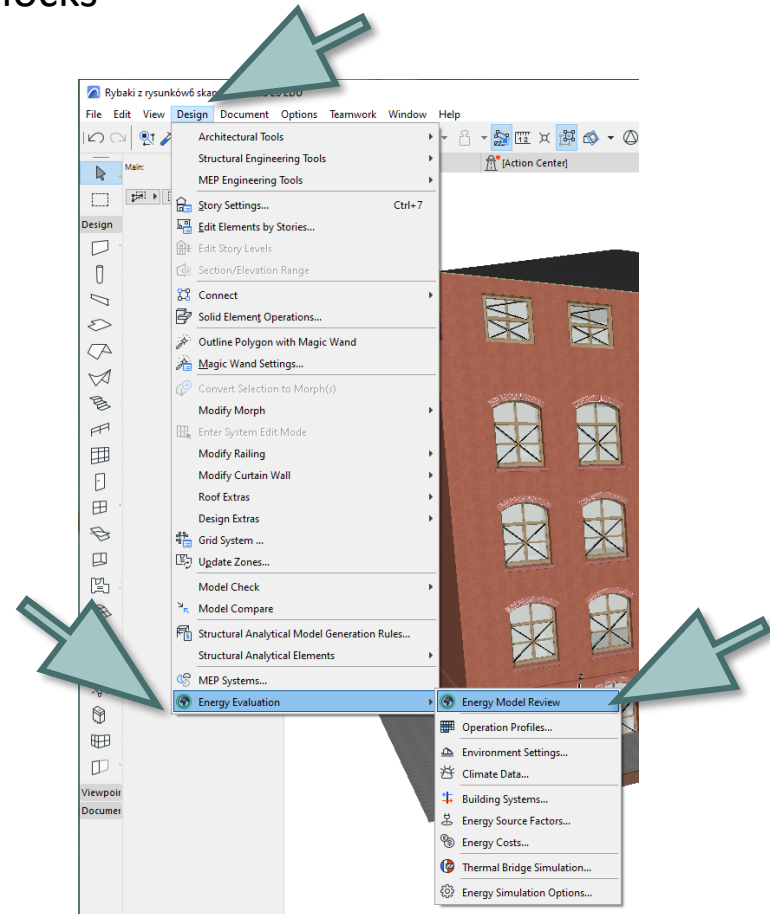
A wide-angle photograph of a large, empty industrial building interior. The space is filled with a complex network of steel beams, pipes, and structural supports. The floor is concrete and shows signs of wear. The lighting is natural, coming from high windows, creating a bright but somewhat overcast atmosphere. A white text box is overlaid on the left side of the image.

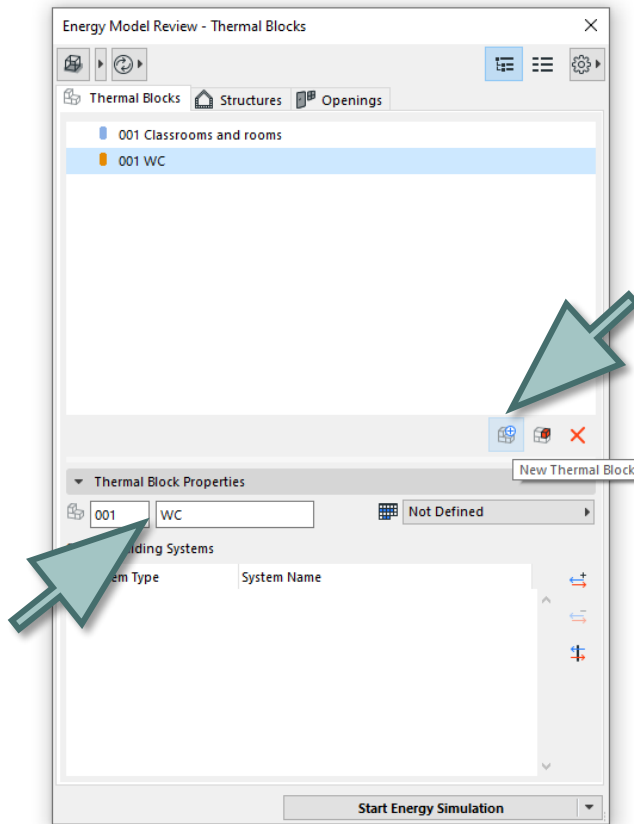
## 2. Create thermal blocks



For **Energy Assessment purposes**, these Zones should be grouped into thermal blocks using the Thermal Blocks option in the Energy Model Overview palette

- open the **Project tab**
- energy evaluation
- review of the energy model

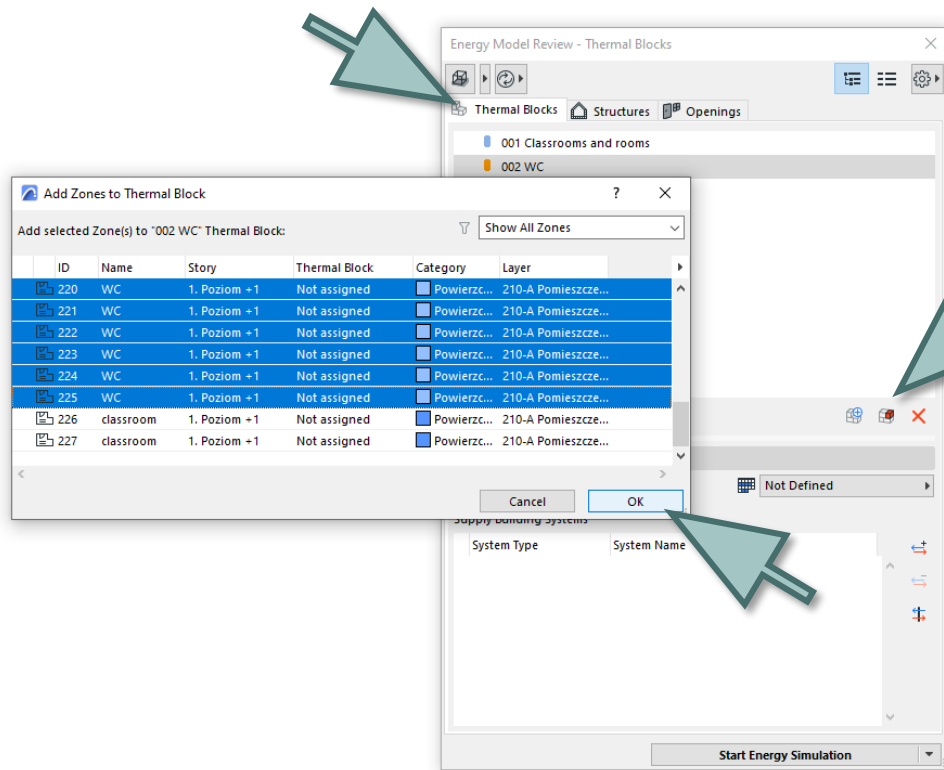




Create a thermal block

- use the **New thermal block** button

- the name and ID can be entered in the list



Assigning a Zone to a thermal block:

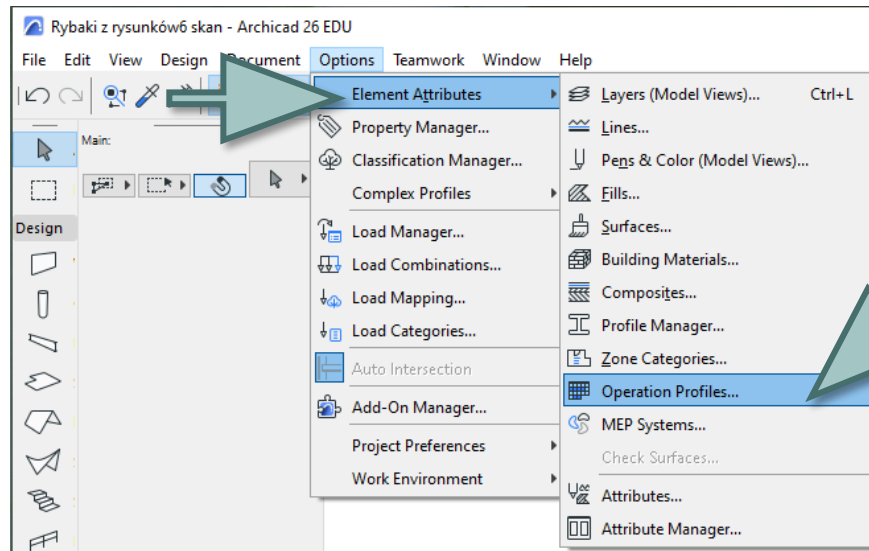
- use the **Add Zones to thermal blocks** option (in list view)

**Note:** The zones do not have to be adjacent to each other to be combined into one thermal block.

## 2.1. Thermal blocks – user profile

Setting properties of thermal blocks:

- use the command **Options> Element Attributes> Usage Profiles**





A separate user profile can be assigned to each thermal block.

- select available profiles or create your own
- define a daily schedule with the following data, by hour, for a full year (8760 hours in total)
- determine the heat output
- demand for hot water
- enter the moisture demand

**Operation Profiles**

**AVAILABLE OPERATION PROFILES**

- Audytoria/sale wykładowe
- Biblioteki (czytelnie)
- Biblioteki (księgozbiory otwarte)
- Biblioteki (księgozbiory zamknięte i magazyny)
- Biura otwarte
- Biura zamknięte

Buttons: New..., Rename..., Delete

**Occupancy Data**

Occupancy type: Non residential

Human heat gain: 100,00 W per capita

Service hot-water load: 60,00 l/day per capita

Humidity Load: 10,00 g/day, m<sup>2</sup>

Note: Define "Audytoria/sale wykładowe" profile's daily schedules and drag them in the order of precedence.

Daily Schedules	Recurrence	Date Range	In use [hours]
↕ dzień dydaktyczny	Mon. Tue. W...	02.02 - 15.06	2304
↕ dzień dydaktyczny	Mon. Tue. W...	01.10 - 20.12	1416
↕ dzień wolny	Sat. Sun.	All Year	2496

Buttons: Add, Remove, Edit Daily Schedules..., Uncovered: 2544

Buttons: Cancel, OK



Set the required indoor temperature range:

Click: edit daily schedules

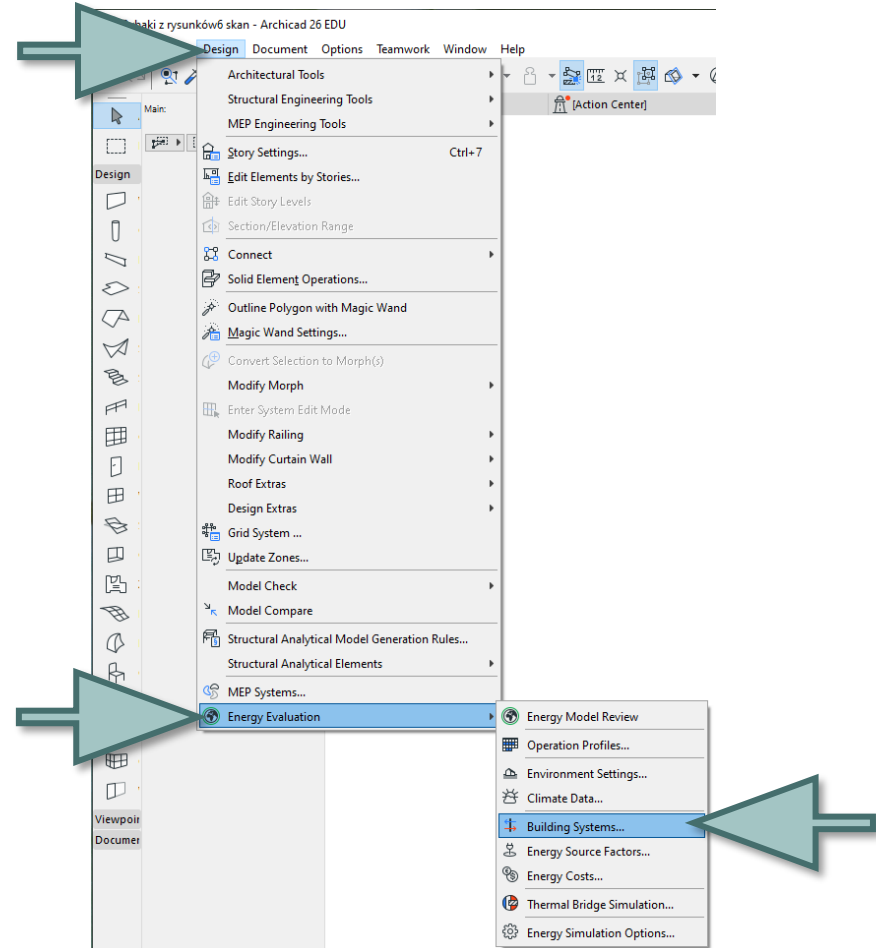
The screenshot displays two overlapping software windows. The background window is titled 'Operation Profiles' and lists various profiles such as 'Audytoria/sale wykładowe', 'Biblioteki (czytelnie)', and 'Biura otwarte'. The foreground window is titled 'Daily Profile Editor' and is focused on editing the 'dzień dydaktyczny' profile. It features a graph showing internal temperature (°C) and internal heat gain (W/h³) over a 24-hour period. The temperature graph shows a minimum of 12,00 °C. The heat gain graph shows a peak of 1,00 W/h³. The 'Internal temperature' section has a 'Minimum' field set to 12,00 °C. The 'Internal heat gain' section has an 'Equipment' field set to 1,00 W/m². A green arrow points to the 'Minimum' temperature field, and another green arrow points to the 'Edit Daily Schedules...' button in the 'Operation Profiles' window.

set the appropriate temperature

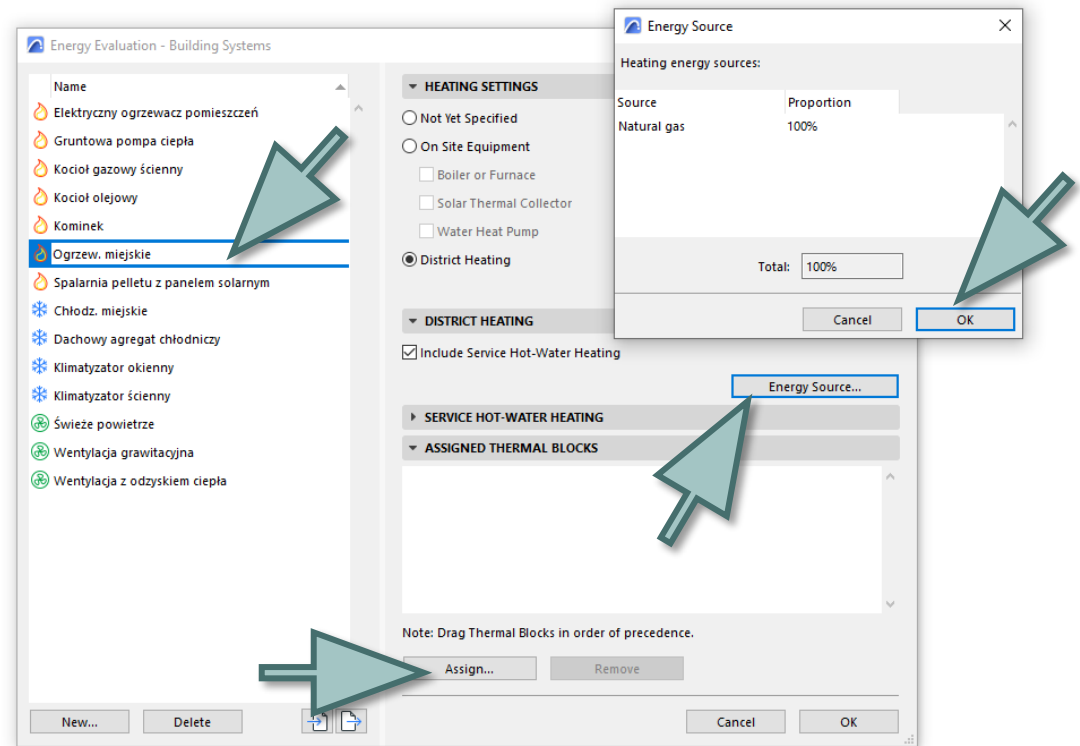
## 2.2. Thermal blocks - Installations in the building

open a dialog with **Project> Energy Assessment> Installations in the building**

Use this dialog to configure the building installation settings that will provide comfortable indoor conditions (as set in the User Profile window) for the building model thermal blocks.



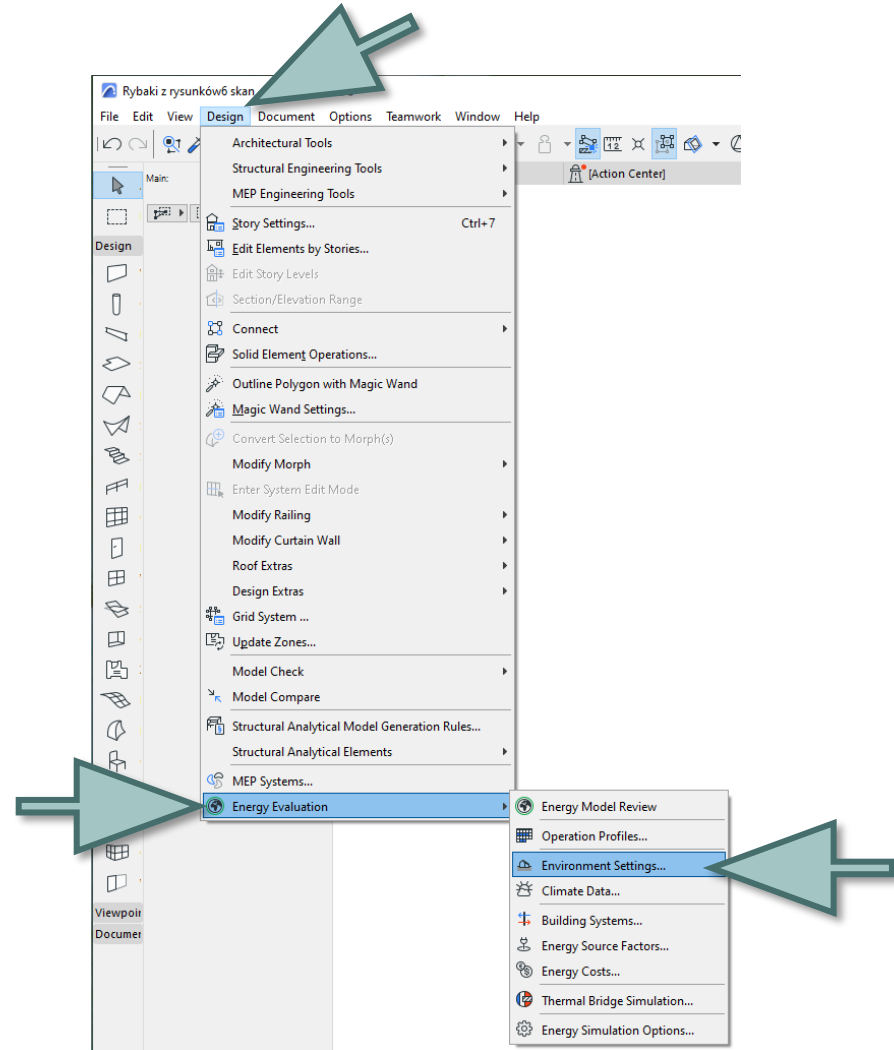
In the **Installation** dialog box all installations are shown on the left and options corresponding to each of them on the right. The content of the options for building installation on the right will change depending on the selected system configuration. Use the Building installations dialog box to edit the properties of the existing Building installations, create new ones and assign them to thermal blocks.





## 2.3. Thermal blocks - Environmental parameters

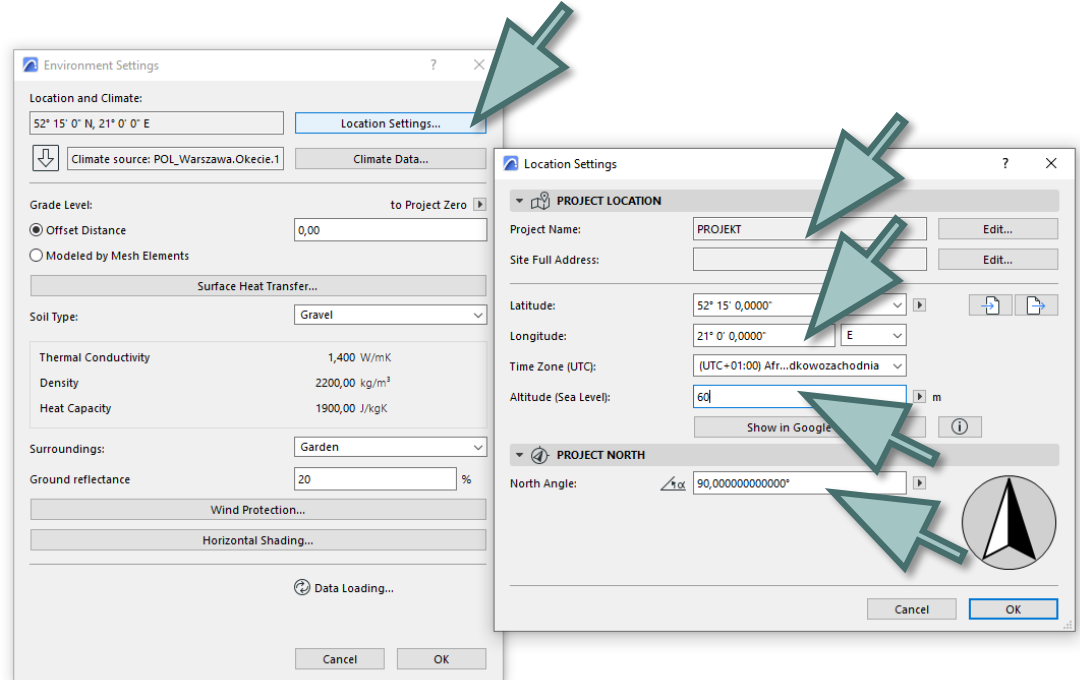
open the **Project > Energy Estimation > Environment Parameters** dialog.



## Location setting

The energy estimate takes the geographic location of the building into account when retrieving climate data from the StruSoft climate server.

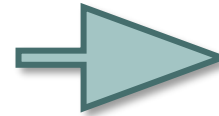
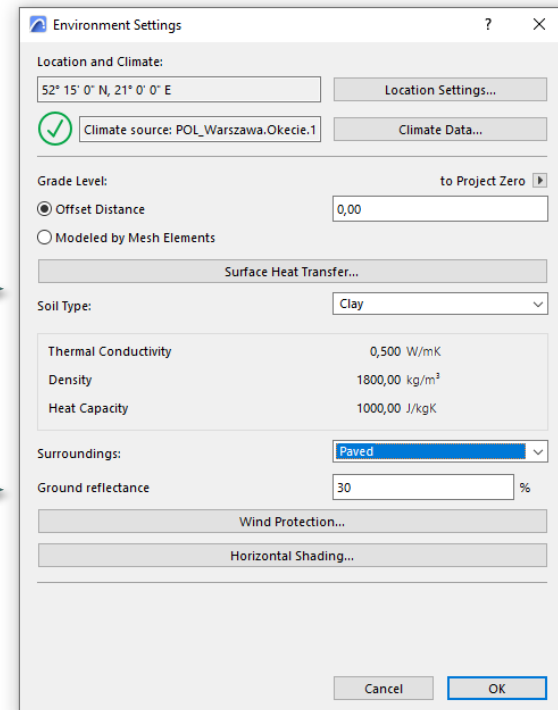
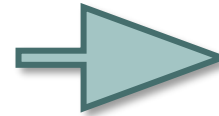
- click on location settings
- provide the address of the investment
- enter the width and longitude
- enter your time zone
- enter elevation above sea level





## Soil type

Select: options from the window, which best suits soil type at the site buildings.



## Surroundings

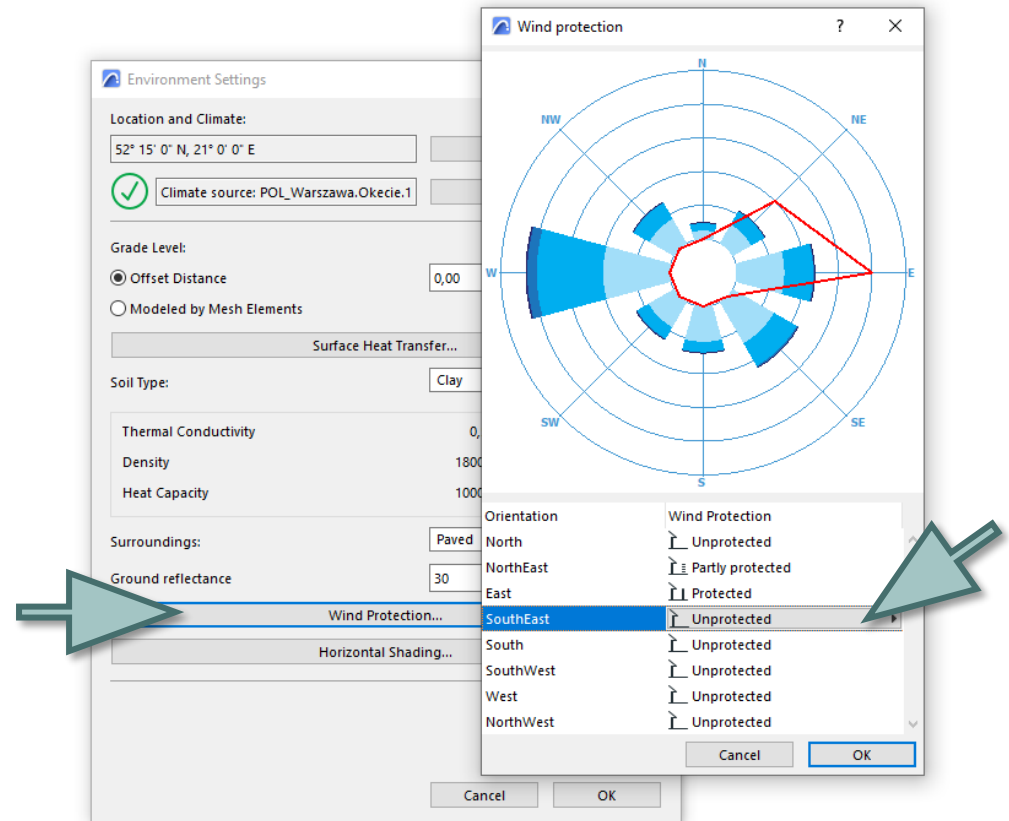
choose an environment that best describes the conditions for a given building location: Water, Garden, Paved or your own.





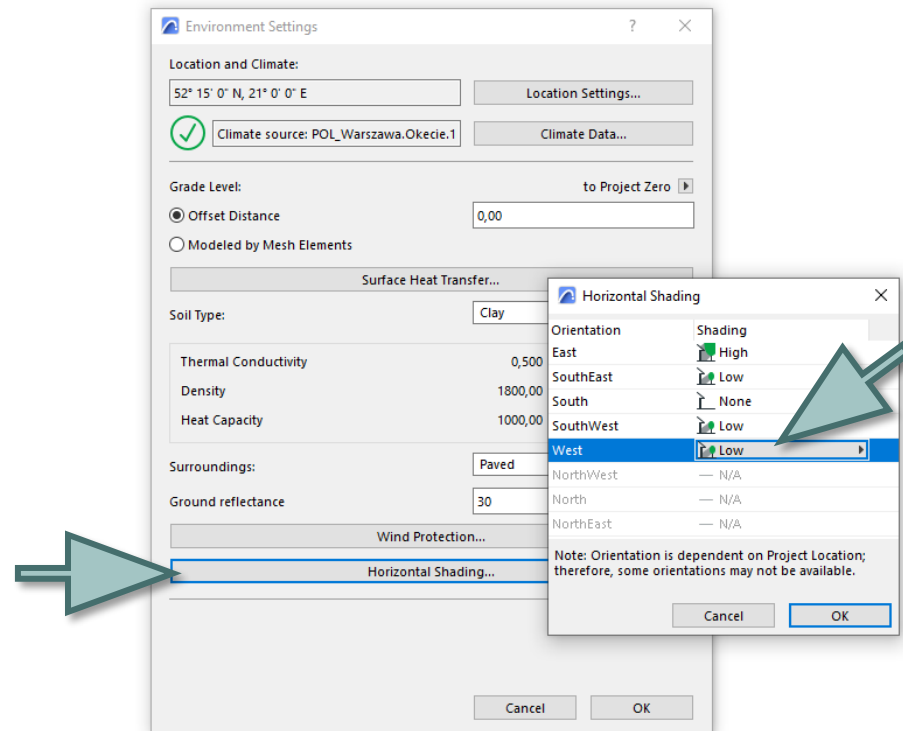
## Wind exposure

select the appropriate Wind Exposure Level for each orientation of the building. Shrouded, Partially Shrouded, or Unprotected. For each orientation, a point will be inserted on the graph that represents Wind exposure (the further the point is, the higher the exposure factor) and the points are connected by a red line.



## Horizontal shading

Model-Driven Solar Analysis in ARCHICAD's Energy Estimation only works on the translucent parts of the building envelope. However, it does not automatically determine the extent to which shadows are cast by external objects onto the opaque parts of a building. Using the Horizontal shading button, activate a separate dialog with a list of sunny sides of the building (the Orientation list may differ depending on the project location).





## Climatic data

- click Download from **Strusoft Server**. All meteorological data on the StruSoft website is generated from data collected by NCEP facilities obtained from the NOAA-CIRES meteorological research center in Boulder, Colorado (USA) at <http://www.cdc.noaa.gov/>.
- click on a data type to view the table: Air Temperature, Relative Humidity, Sunshine or Wind Speed.

The screenshot shows the 'Environment Settings' window with the 'Climate Data...' button highlighted. The 'Climate Data' dialog box is open, showing the 'Download from Strusoft Climate Server' option selected. The 'Climate Type' is set to 'Moist (A)' and the 'Climate Zone Identifier' is '5A'. The 'Data Type' is set to 'Air temperature'. A graph displays the air temperature data for a year, with a maximum of 36.28°C, an average of 13.23°C, and a minimum of -9.81°C.

Month	Temperature (°C)
Jan	~5
Feb	~5
Mar	~10
Apr	~15
May	~20
Jun	~25
Jul	~30
Aug	~25
Sep	~20
Oct	~15
Nov	~10
Dec	~5

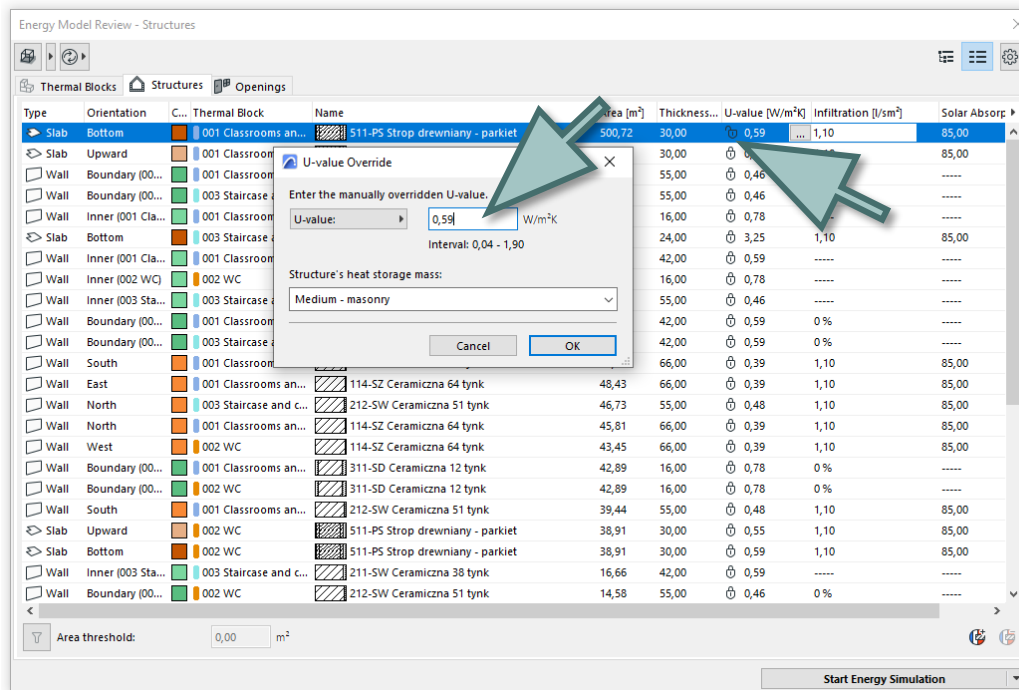


## 2.4. Thermal blocks - Structure property settings

### U-factor calculator

The U refers to the heat transfer coefficient of the selected structure.

The layers that make up the selected structure in the U-value calculator are listed along with their specific properties (thickness, thermal conductivity, density and heat capacity). To be able to modify them:

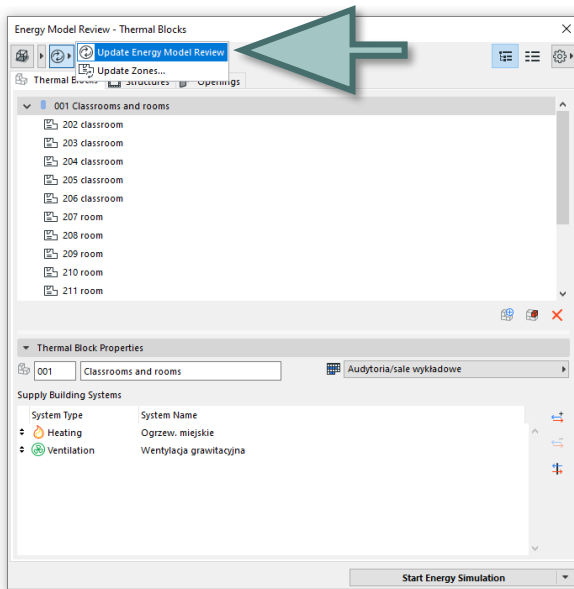


click the ellipsis button in the U-factor column - when the padlock icon is closed (red) - to bring up the U-factor calculator dialog.



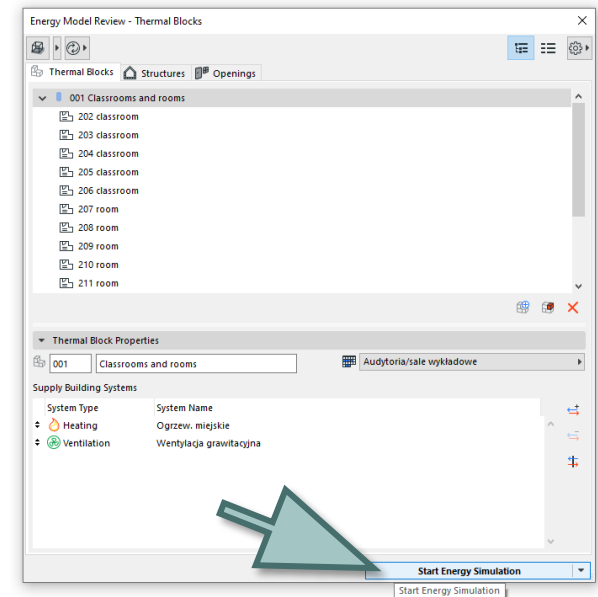
Before starting the energy simulation of the energy balance

click the **Update energy model** button



Now we can start the  
simulation  
energy balance

click the button **Start  
energy balance simulation**





The built-in, certified VIP-Core module performs a dynamic energy simulation that calculates the hourly energy balance in the building and generates the report on the energy balance in the building. The report contains information on, inter alia, energy efficiency of structures in the project, the annual energy consumption, energy balance and the level of carbon dioxide emissions.



**Oszacowanie wydajności energetycznej**  
[Project Number] PROJEKT

**Key Values**

General Project Data		Heat Transfer Coefficients		U value
Project Name:	PROJEKT	Building Shell Average:		0,84
City Location:	52° 15' 0" N	Floors:	-	
Latitude:	21° 0' 0" E	External:	0,34 - 3,25	
Longitude:	80,00	Underground:	-	
Altitude:	80,00 m	Openings:	3,03 - 3,04	
Climate Data Source:	Staszek server	<b>Specific Annual Values</b>		
Evaluation Date:	07.12.2022 15:01	Net Heating Energy:	62,52 kWh/m <sup>2</sup>	
<b>Building Geometry Data</b>		Net Cooling Energy:	0,00 kWh/m <sup>2</sup>	
Gross Floor Area:	868,8 m <sup>2</sup>	Total Net Energy:	62,52 kWh/m <sup>2</sup>	
Treated Floor Area:	705,0 m <sup>2</sup>	Energy Consumption:	244,21 kWh/m <sup>2</sup>	
External Envelope Area:	1637,1 m <sup>2</sup>	Fuel Consumption:	244,21 kWh/m <sup>2</sup>	
Ventilated Volume:	2388,57 m <sup>3</sup>	Primary Energy:	277,84 kWh/m <sup>2</sup>	
Glazing Ratio:	4 %	Fuel Cost:	-	
<b>Building Shell Performance Data</b>		CO <sub>2</sub> Emission:	3,96 kg/m <sup>2</sup>	
Infiltration at 50Pa:	3,55 ACH	Degree Days Heating (HDD):	4115,82	
		Cooling (CDD):	1236,82	

**Energy Consumption by Sources**

Source Type	Energy		Primary	Cost	CO <sub>2</sub> Emission
	Source Name	Quantity			
Secondary	Electricity	12	38	-	2789
	District Heating	157	157	-	0
<b>Total:</b>		<b>170</b>	<b>195</b>	<b>Not Applicable</b>	<b>2789</b>

Energy Quantity and Primary Energy donut charts are also displayed.





We conducted the simulation to the 3rd floor of the building

**Oszacowanie wydajności energetycznej**  
[Project Number] PROJEKT

**Key Values**

General Project Data		Heat Transfer Coefficients	
Project Name:	PROJEKT	Building Shell Average:	0,94 [W/m <sup>2</sup> K]
City Location:	52° 15' 0" N 21° 0' 0" E	Floors:	~
Latitude:	52° 15' 0" N	External:	0,34 - 3,25
Longitude:	21° 0' 0" E	Underground:	~
Altitude:	80,00 m	Openings:	3,03 - 3,04
Climate Data Source:	Stausoft server	<b>Specific Annual Values</b>	
Evaluation Date:	07.12.2022 15:01	Net Heating Energ:	62,52 kWh/m <sup>2</sup> a
<b>Building Geometry Data</b>		Net Cooling Energ:	0,00 kWh/m <sup>2</sup> a
Gross Floor Area:	868,8 m <sup>2</sup>	Total Net Energ:	62,52 kWh/m <sup>2</sup> a
Treated Floor Area:	703,0 m <sup>2</sup>	Energy Consumption:	241,21 kWh/m <sup>2</sup> a
External Envelope Area:	1657,1 m <sup>2</sup>	Fuel Consumption:	241,21 kWh/m <sup>2</sup> a
Ventilated Volume:	2308,57 m <sup>3</sup>	Primary Energy:	277,84 kWh/m <sup>2</sup> a
Glazing Ratio:	4 %	Fuel Cost:	~ PLN/m <sup>2</sup> a
<b>Building Shell Performance Data</b>		CO2 Emission:	3,96 kg/m <sup>2</sup> a
Infiltration at 50Pa:	3,55 ACH	Degree Days	
		Heating (HDD):	4115,82
		Cooling (CDD):	1238,82

**Energy Consumption by Sources**

Source Type	Source Name	Quantity MWh/a	Primary MWh/a	Cost PLN/a	CO2 Emission kg/a
Secondary	Electricity	12	38	~	2789
	District Heating	157	157	~	0
<b>Total:</b>		<b>170</b>	<b>195</b>	Not Applicable	<b>2789</b>

**Energy Quantity** (Donut chart): Electricity 7%, District Heating 93%

**Primary Energy** (Donut chart): Electricity 19%, District Heating 81%

Buttons: Close, Save as PDF...

We can save the simulation results to PDF



# ECOLOGICAL AND INNOVATIVE TECHNOLOGIES FOR RECOVERING INDUSTRIAL AREAS FROM LCA AND ENERGY EFFICIENCY POINT OF VIEW 2020-1-RO01-KA203-080223

## CONTACT

[www.recoverind.eu](http://www.recoverind.eu)

