A BIM Components Library for Circular Energy Renovation Design

P5 Presentation

Theme: Facades & Products /Circular Building Design

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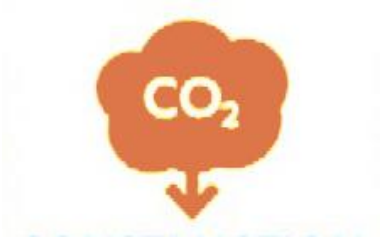
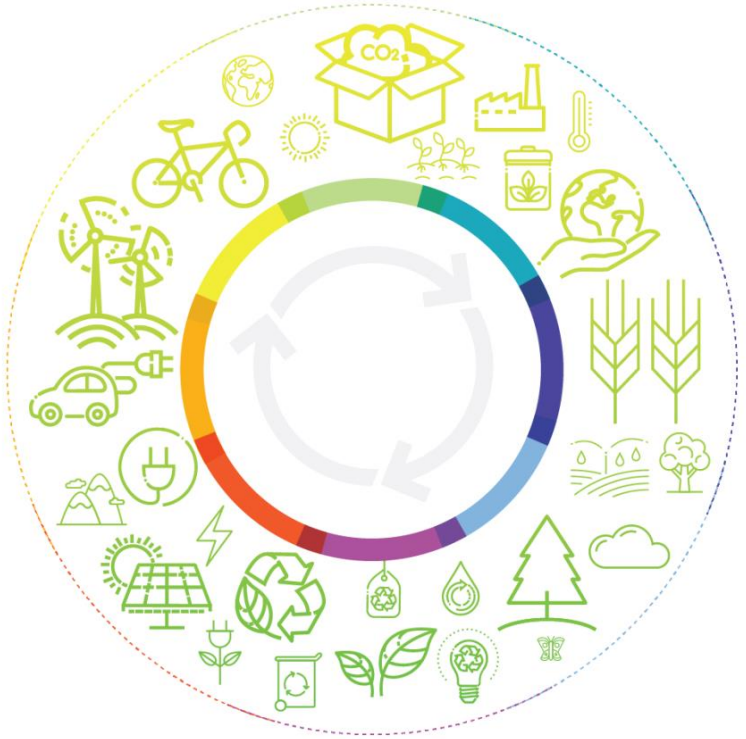
Student: Danai Moutou

1. CURRENT SITUATION
2. RESEARCH QUESTION & OBJECTIVE
3. RESEARCH
4. DESIGN STRATEGY
5. BIM LIBRARY DESIGN
6. DESIGN APPLICATION
7. CONCLUSIONS

CURRENT SITUATION

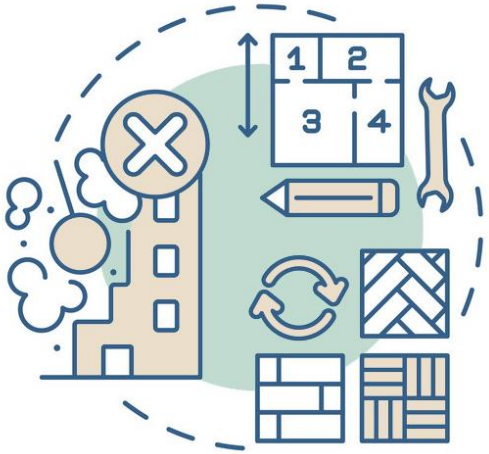


High CO2 concentration of building sector

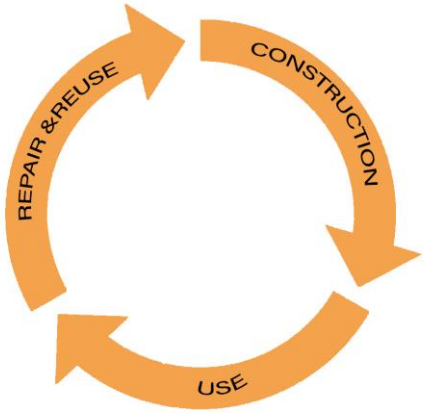


European Union Energy neutral by 2050

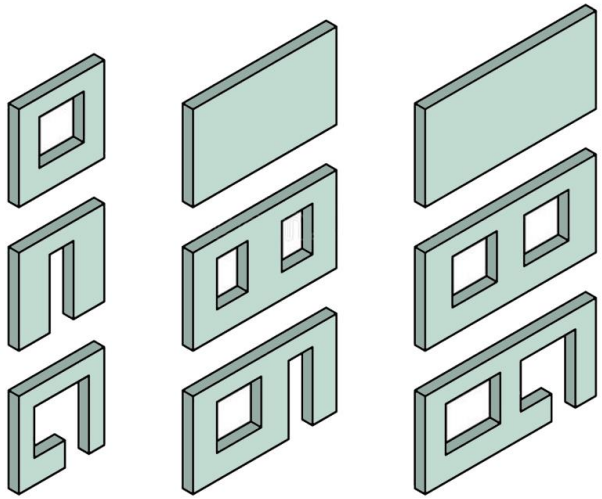
Façade energy renovation



New renovation methods



Circular solutions



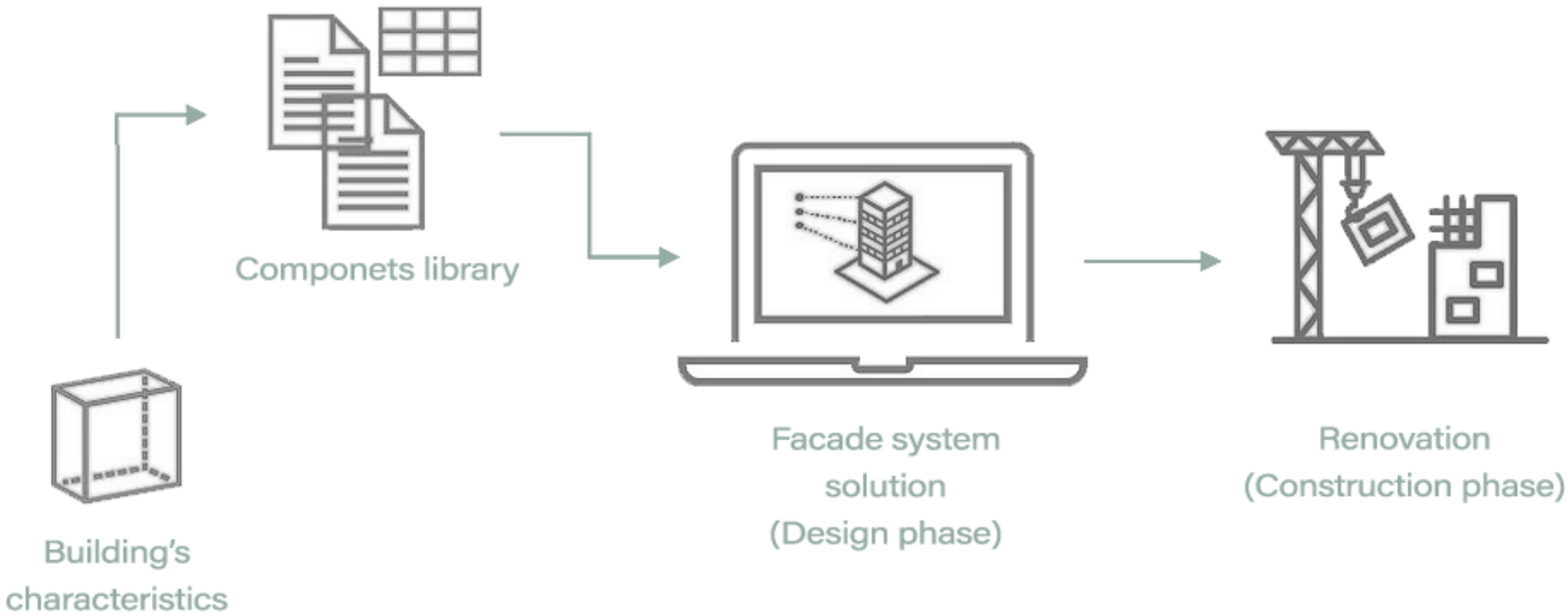
Standardized and flexible retrofitting components

BIM

BIM as a design tool

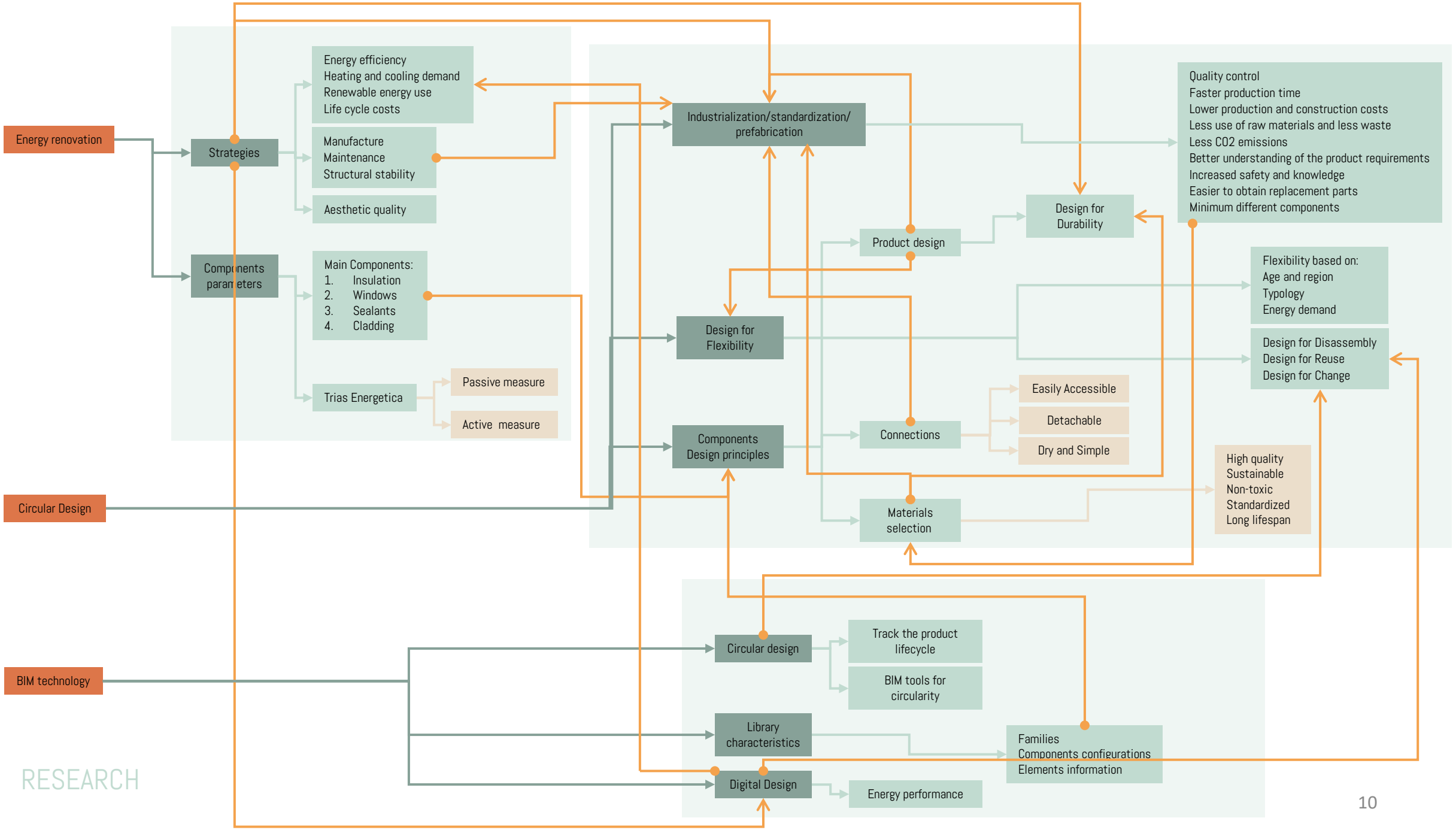
RESEARCH QUESTION & OBJECTIVE

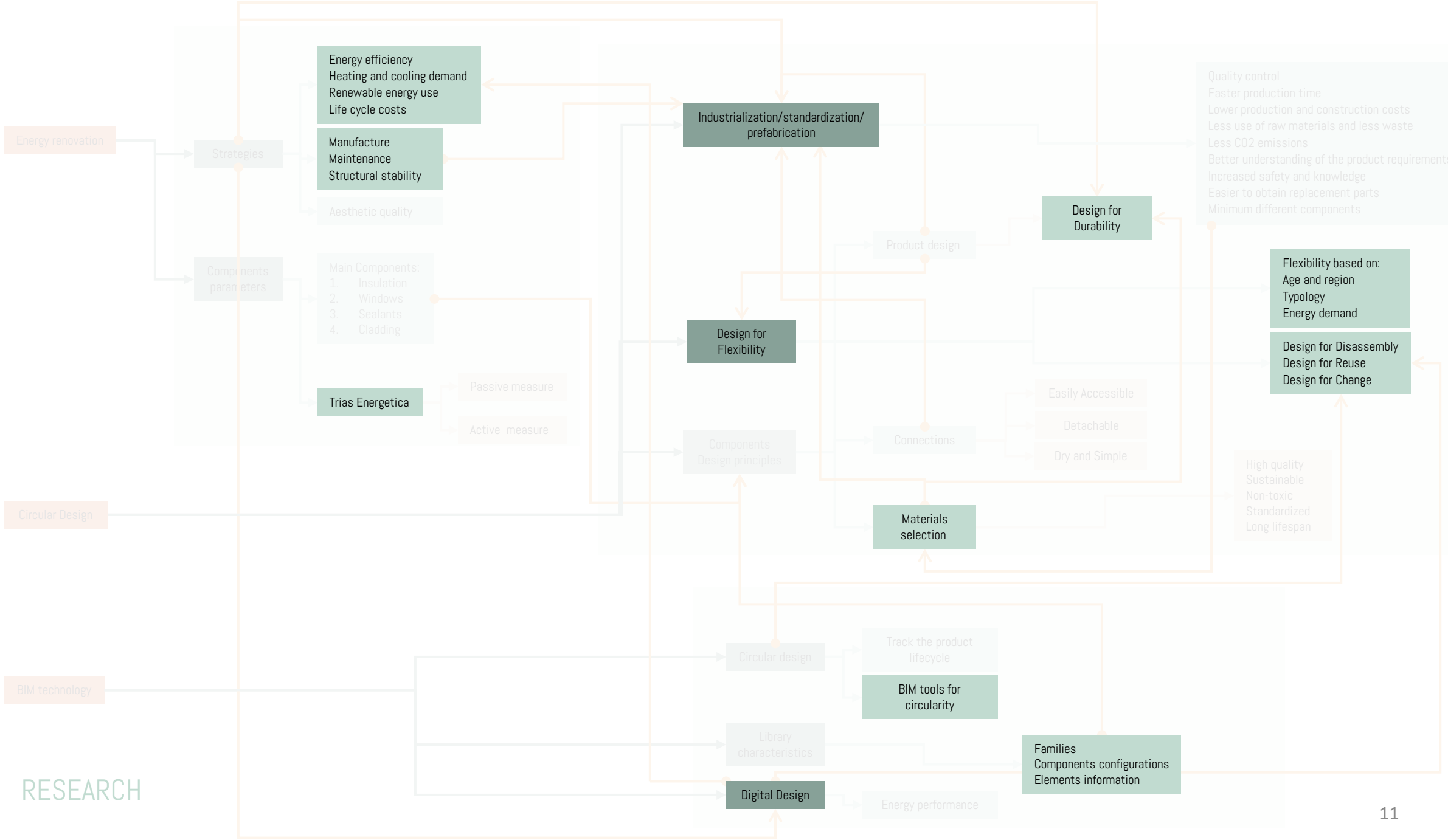
How can a **BIM components library** facilitate the design of a **circular standardized facade renovation system** that meets the **energy-saving measures,** and it is **adjustable?**



RESEARCH OBJECTIVE

RESEARCH


Energy renovation
Strategies
Energy efficiency
Heating and cooling demand
Renewable energy use
Life cycle costs
Manufacture
Maintenance
Structural stability
Aesthetic quality
Components parameters
Main Components:
1. Insulation
2. Windows
3. Sealants
4. Cladding
Trias Energetica
Passive measure
Active measure
Circular Design
BIM technology
Industrialization/standardization/ prefabrication
Design for Flexibility
Components Design principles
Product design
Connections
Materials selection
Design for Durability
Easily Accessible
Detachable
Dry and Simple
Quality control
Faster production time
Lower production and construction costs
Less use of raw materials and less waste
Less CO2 emissions
Better understanding of the product requirements
Increased safety and knowledge
Easier to obtain replacement parts
Minimum different components
Flexibility based on:
Age and region
Typology
Energy demand
Design for Disassembly
Design for Reuse
Design for Change
High quality
Sustainable
Non-toxic
Standardized
Long lifespan
Circular design
Track the product lifecycle
BIM tools for circularity
Library characteristics
Digital Design
Energy performance
Families
Components configurations
Elements information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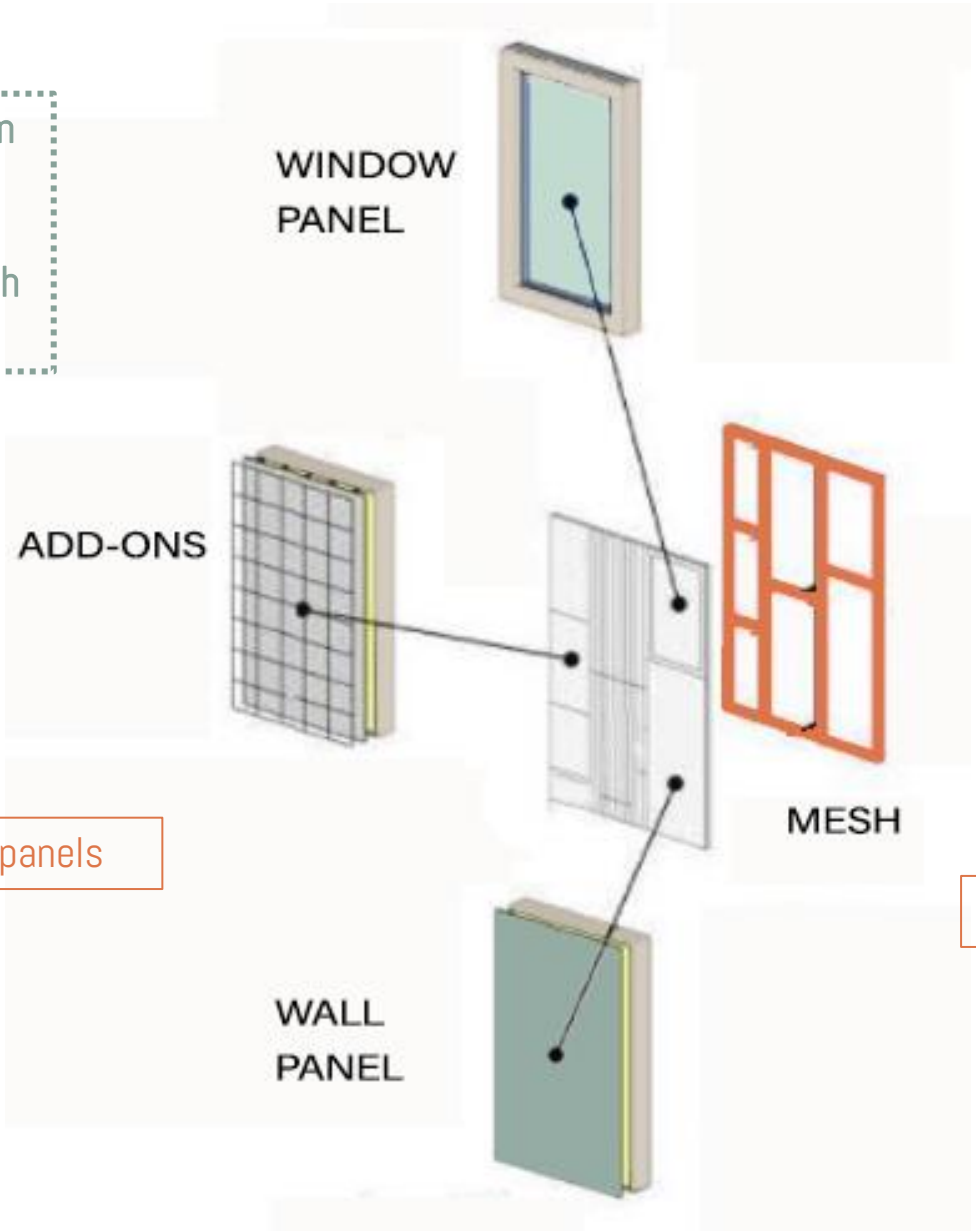
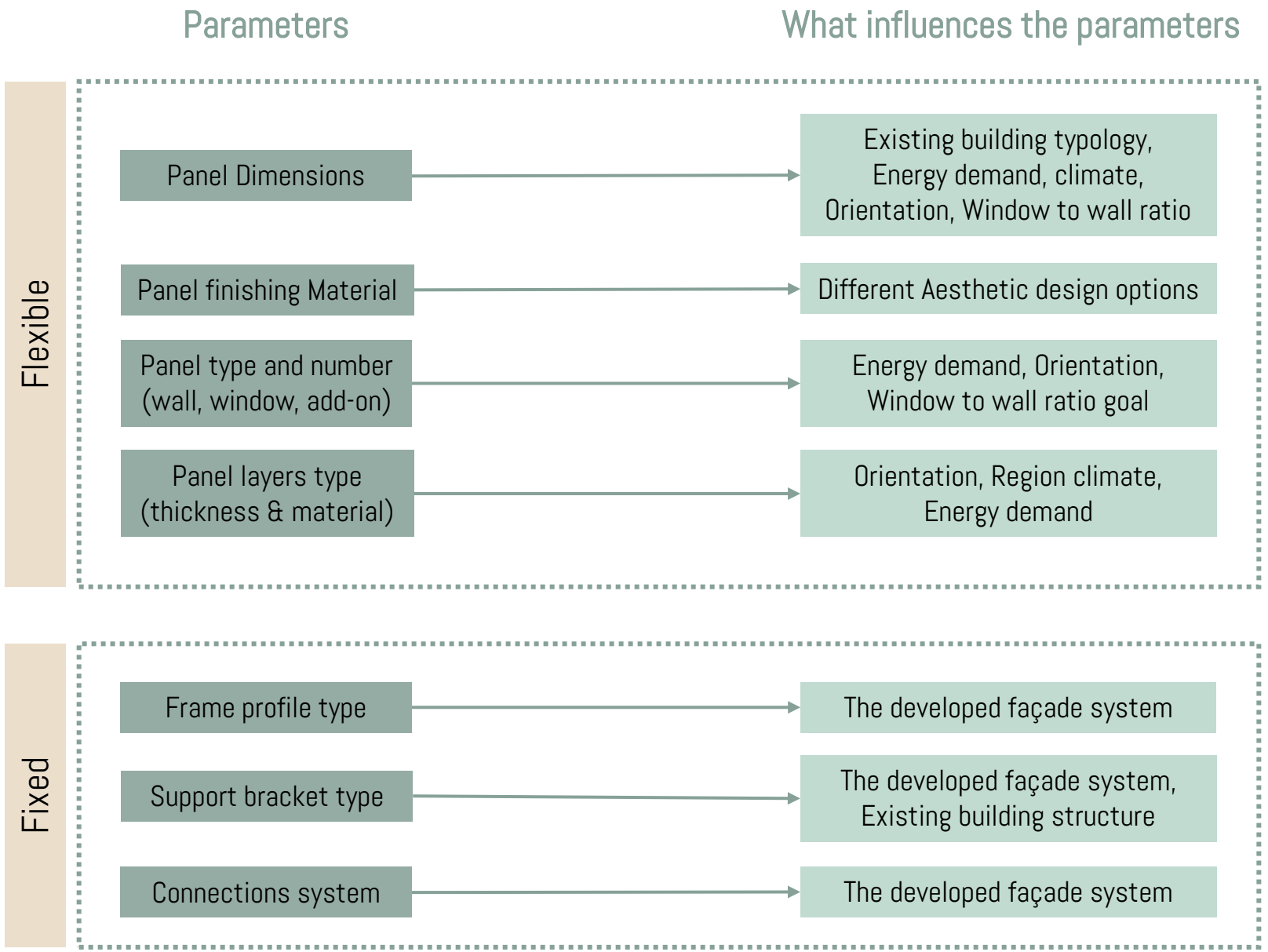
DESIGN STRATEGY

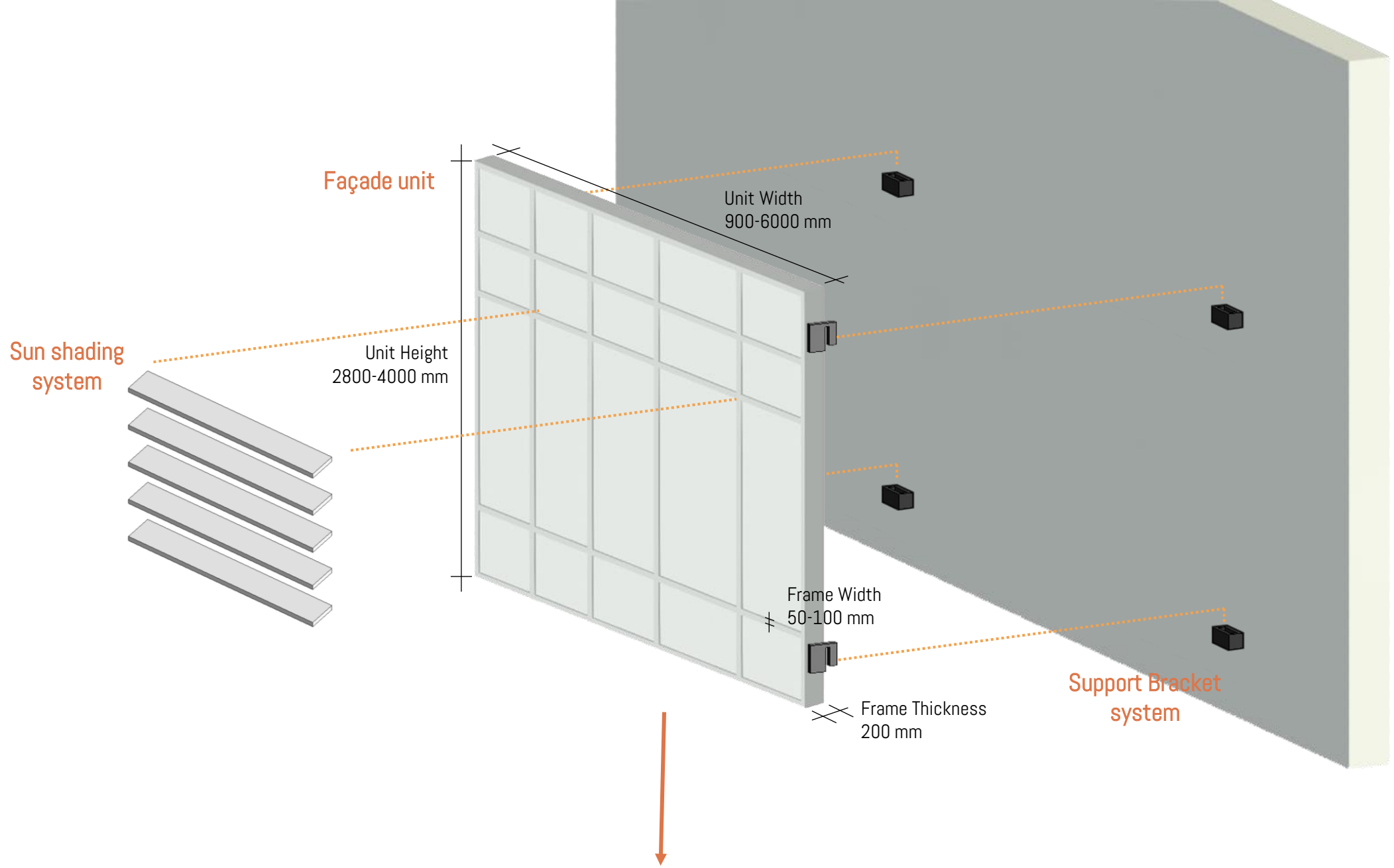
Prefabricated rainscreen façade system
with
Preassembled units with different components



Different Filling panels

Base structure

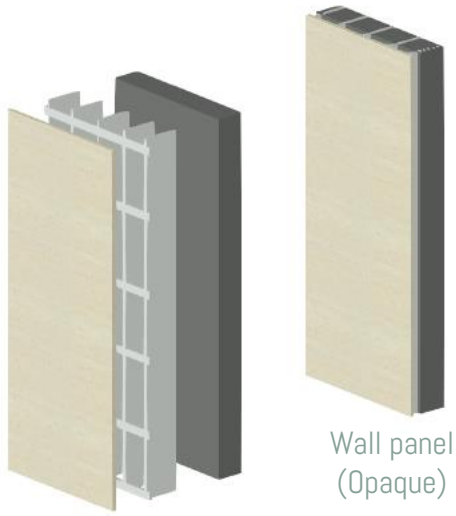

Parameters
What influences the parameters
Flexible
Panel Dimensions
Existing building typology, Energy demand, climate, Orientation, Window to wall ratio
Panel finishing Material
Different Aesthetic design options
Panel type and number (wall, window, add-on)
Energy demand, Orientation, Window to wall ratio goal
Panel layers type (thickness & material)
Orientation, Region climate, Energy demand
Fixed
Frame profile type
The developed façade system
Support bracket type
The developed façade system, Existing building structure
Connections system
The developed façade system



FAÇADE SYSTEM

Necessary

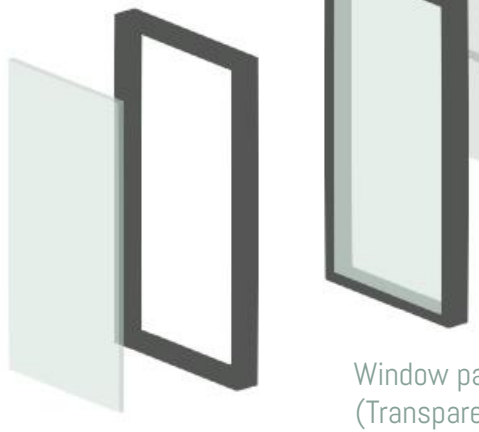
Add-ons
Active measures



Wall panel
(Opaque)

Fillings
(Panels)

Aluminium
Mesh Frame
Mullion- Transoms



Window panel
(Transparent)

PVT collector

PV panel

Solar thermal
collector

FAÇADE SYSTEM

DIFFERENT PANEL CONFIGURATIONS

Type a. Only active measure panels

Type b. Only wall panels

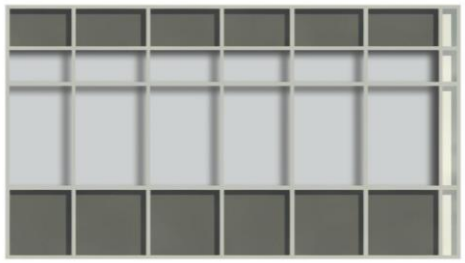
Type c. Combination of wall and active measure panels

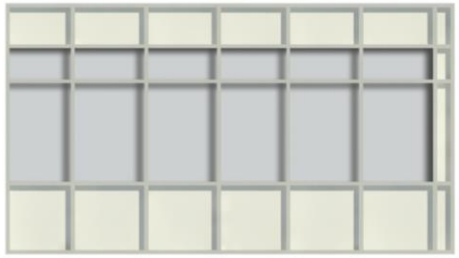
Type 1.

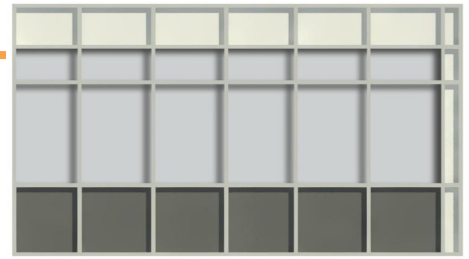
Opaque unit

Type 2.

Window to wall ratio of the existing façade

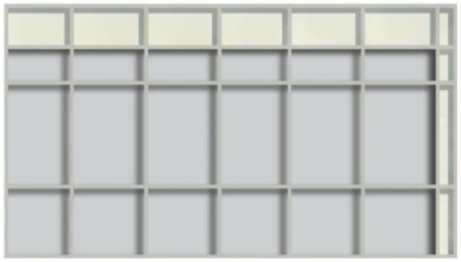






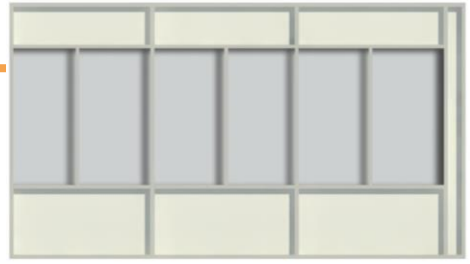
Type 3.

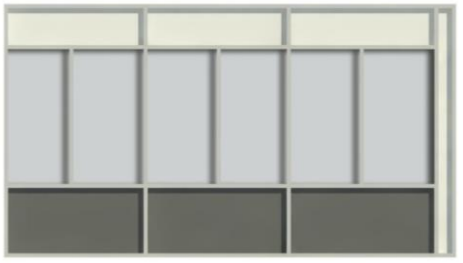
Maximize the window to wall ratio



Type 4.

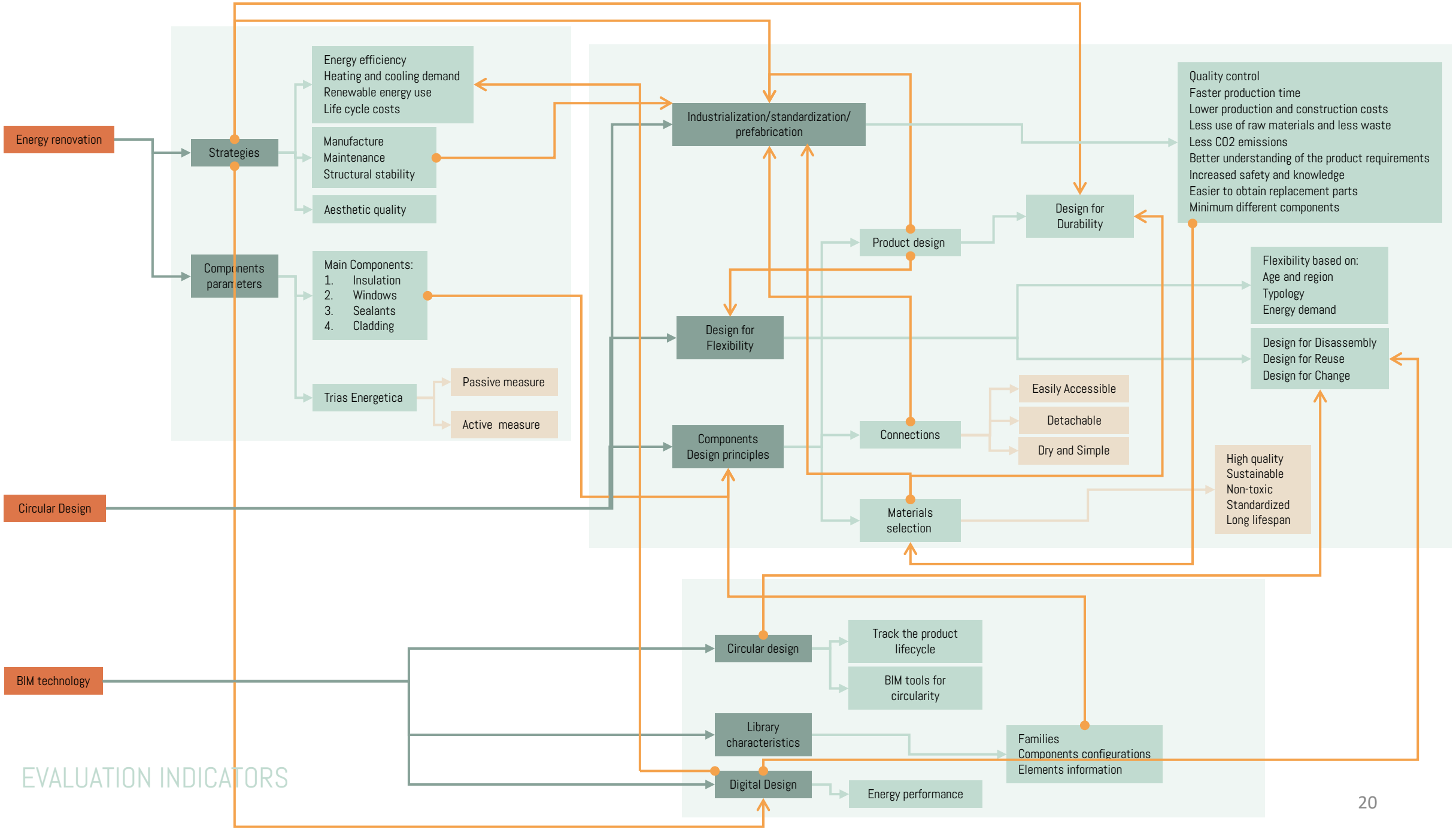
Bigger panels with more sparse mesh frame



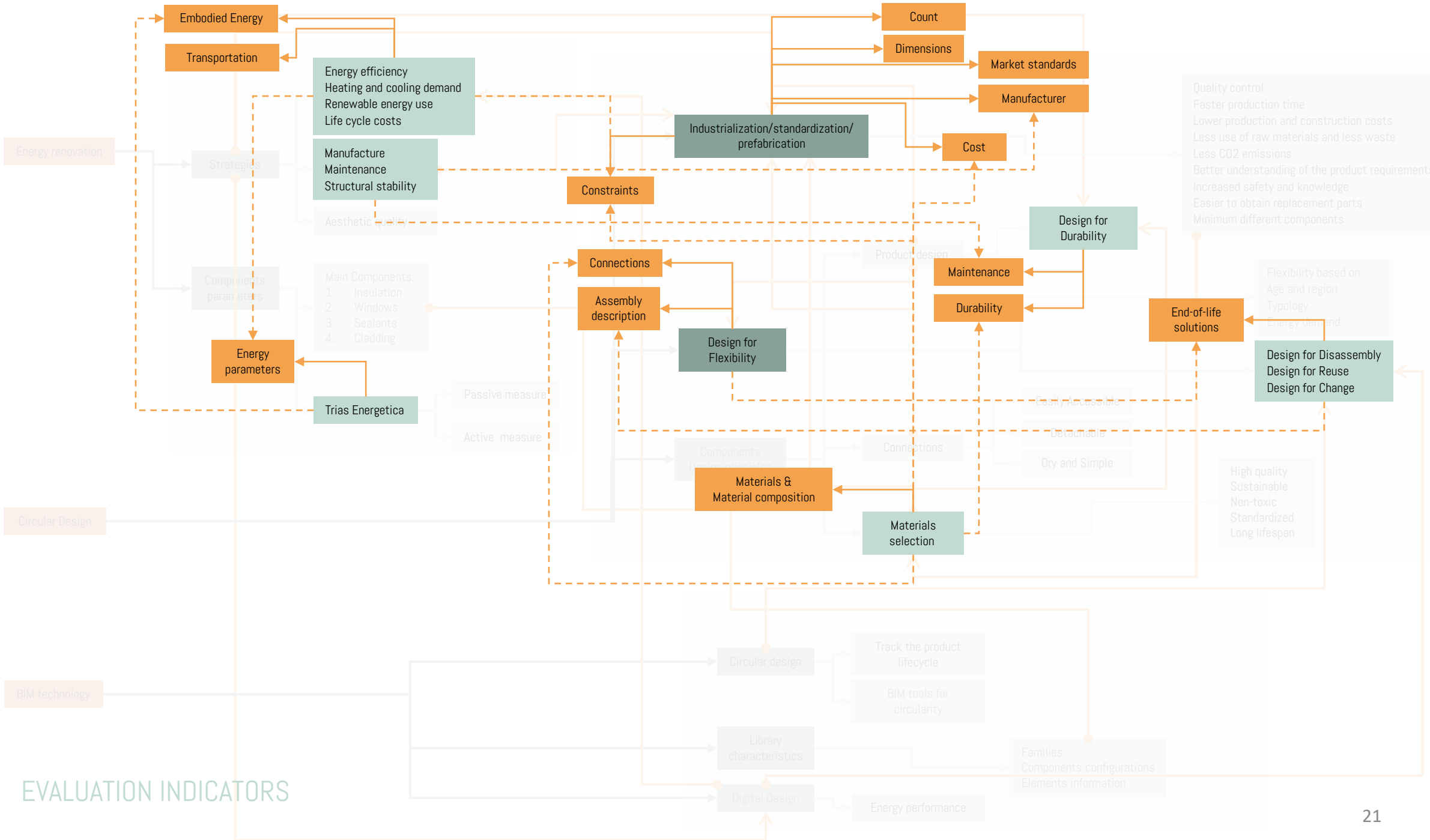


DIFFERENT PANEL CONFIGURATIONS

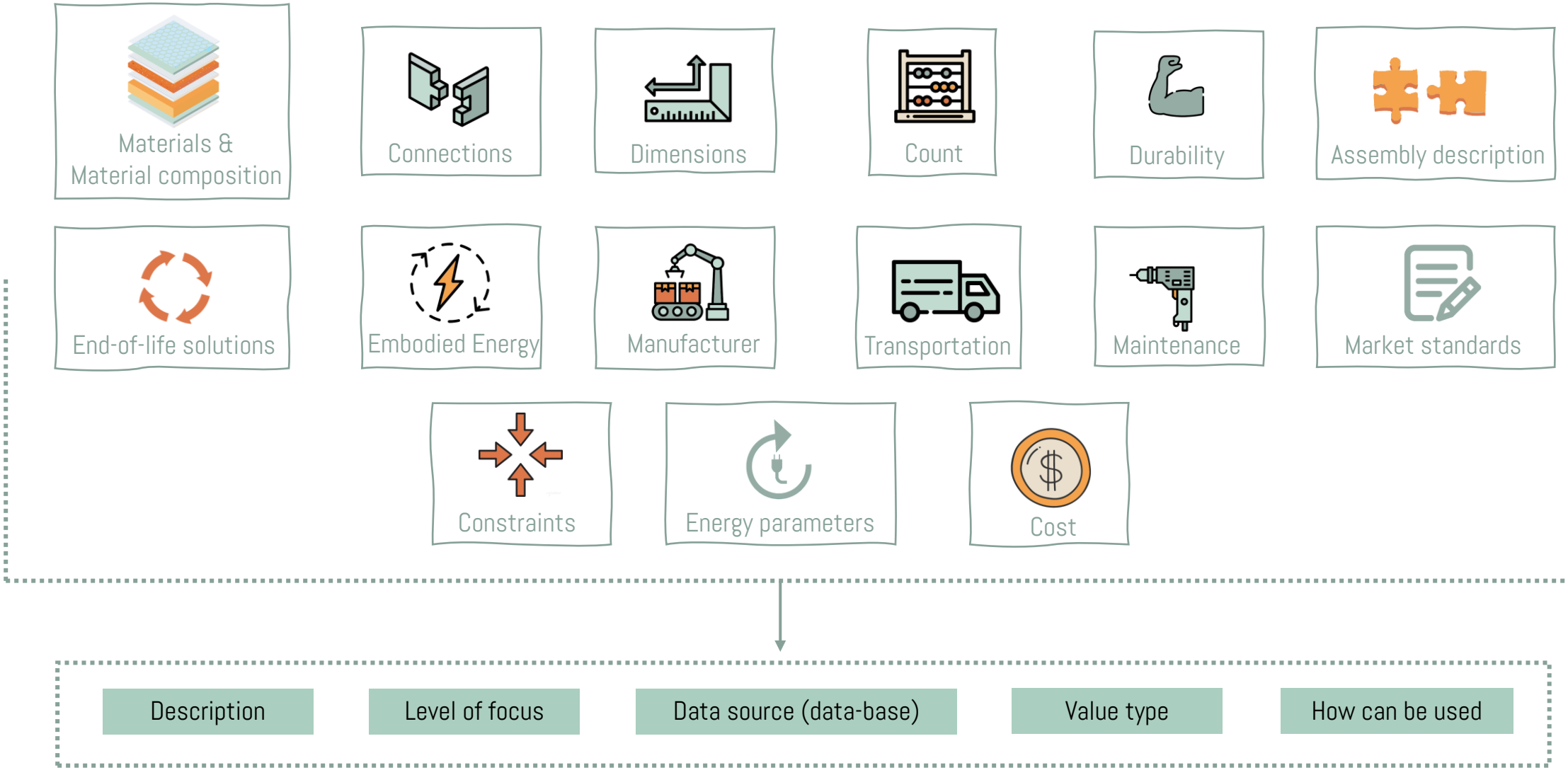
BIM LIBRARY DESIGN



EVALUATION INDICATORS



EVALUATION INDICATORS



EVALUATION INDICATORS

Parameters window

Type Parameters

Parameter	Value
Manufacturer	ALUPROF S.A.
Model	MB-86 Casement
Description	Single top-hung casement opening
Description (PL)	Okno odchylne
URL	https://aluprof.eu/
Product page URL	https://aluprof.eu/architekci/katal
Schedule No.	1
Type Image	
Keynote	
Type Comments	
Assembly Code	
Cost	30.00
Assembly Description	
Type Mark	44
OmniClass Number	23.30.20.17.21.14
OmniClass Title	Casement Windows
Code Name	
IFC Parameters	
Model Properties	
Content of the recyclate in the m	70.7%
Glazing construction	6/16/4/16/6
Opening type	Top-hung casement opening outwar
General	
Data	
Air permeability	Class 4, PN-EN 12207:2001
Resistance to wind load	Class B5/C5, PN-EN 12210:2001
Thermal insulation	0.8800 W/(m²·K)
Water resistance	Class E1950, PN-EN 12208:2001
Insert type	SI

Side window

Select ▾ Properties Clipboard

Modify | Windows

Properties

Aluprof_MB-86-Casement_E_Alu_Wind...
Top-hung Casement

Windows (1) Edit Type

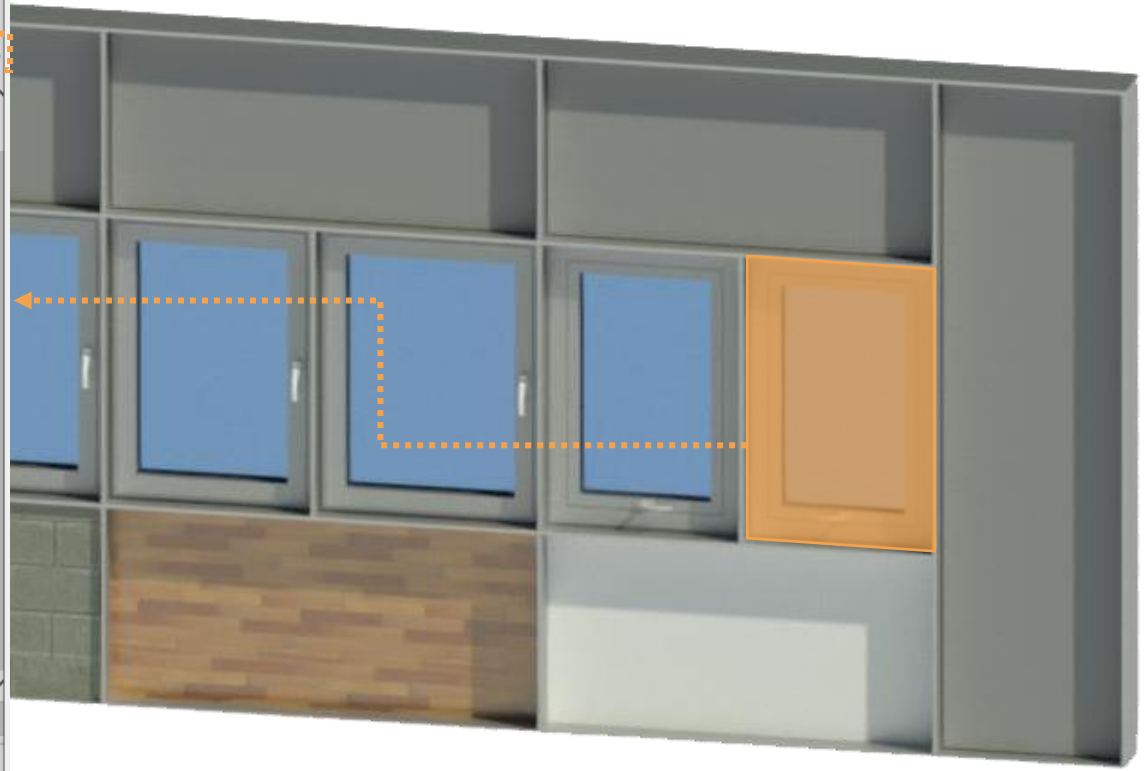
Opening angle	0.00°
Reference line...	0.0
Width	799.1
Height	1224.1
Identity Data	
Image	
Comments	glazing
Mark	12
Phasing	
Phase Created	New Constructi...
Phase Demoli...	None
Model Properties	
IsWindowOpen	☐
IsHandleVisible	☑
Handle type	
Hardware	
Other	
IsDetailVisible	☑

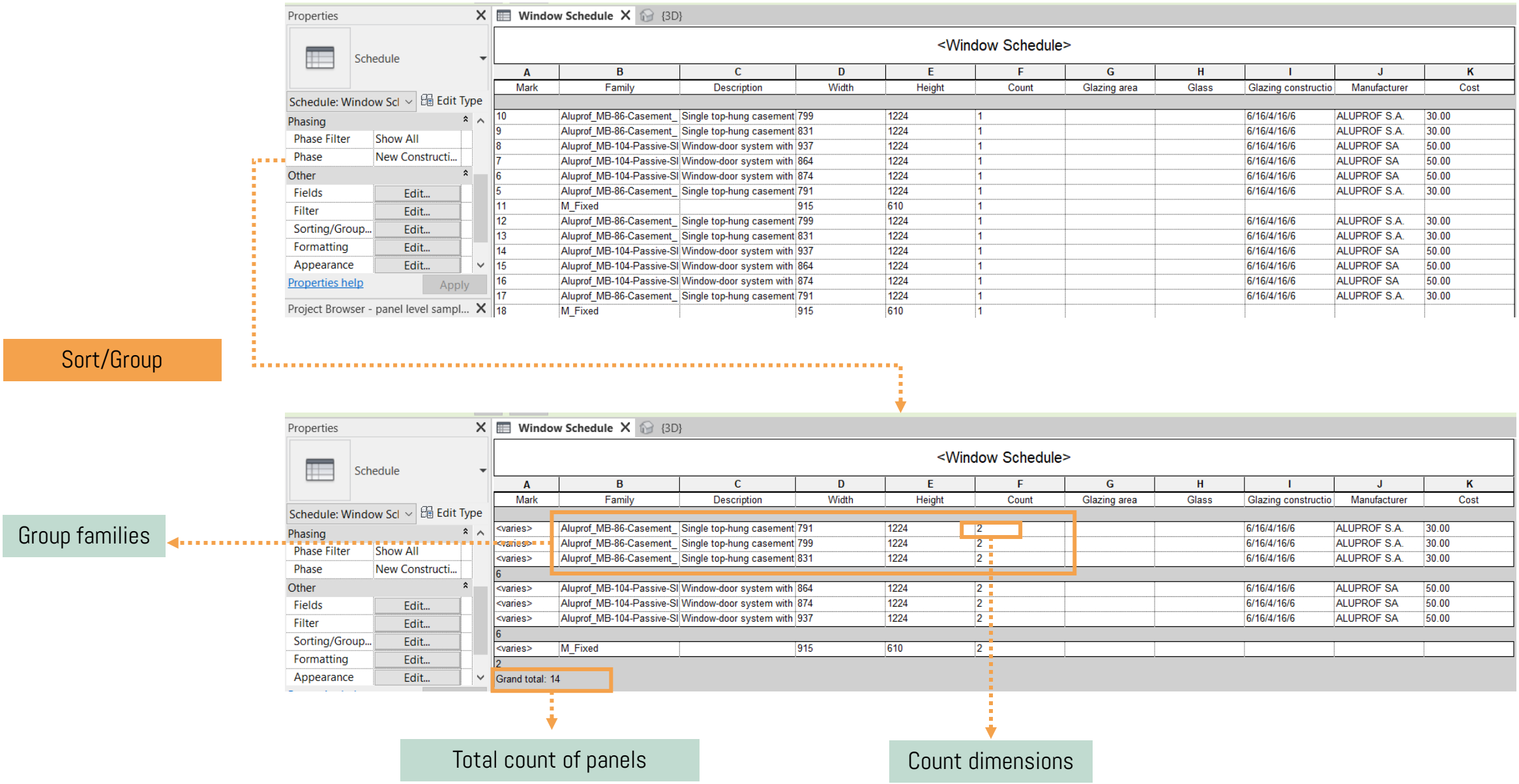
Properties help Apply

Project Browser - panel level sample f...

Views (all)

Structural Plans





A	B	C	D	E	F	G	H	I	J	K
Mark	Family	Description	Width	Height	Count	Glazing area	Glass	Glazing constructio	Manufacturer	Cost
10	Aluprof_MB-86-Casement_	Single top-hung casement	799	1224	1			6/16/4/16/6	ALUPROF S.A.	30.00
9	Aluprof_MB-86-Casement_	Single top-hung casement	831	1224	1			6/16/4/16/6	ALUPROF S.A.	30.00
8	Aluprof_MB-104-Passive-Sl	Window-door system with	937	1224	1			6/16/4/16/6	ALUPROF SA	50.00
7	Aluprof_MB-104-Passive-Sl	Window-door system with	864	1224	1			6/16/4/16/6	ALUPROF SA	50.00
6	Aluprof_MB-104-Passive-Sl	Window-door system with	874	1224	1			6/16/4/16/6	ALUPROF SA	50.00
5	Aluprof_MB-86-Casement_	Single top-hung casement	791	1224	1			6/16/4/16/6	ALUPROF S.A.	30.00
11	M_Fixed		915	610	1					
12	Aluprof_MB-86-Casement_	Single top-hung casement	799	1224	1			6/16/4/16/6	ALUPROF S.A.	30.00
13	Aluprof_MB-86-Casement_	Single top-hung casement	831	1224	1			6/16/4/16/6	ALUPROF S.A.	30.00
14	Aluprof_MB-104-Passive-Sl	Window-door system with	937	1224	1			6/16/4/16/6	ALUPROF SA	50.00
15	Aluprof_MB-104-Passive-Sl	Window-door system with	864	1224	1			6/16/4/16/6	ALUPROF SA	50.00
16	Aluprof_MB-104-Passive-Sl	Window-door system with	874	1224	1			6/16/4/16/6	ALUPROF SA	50.00
17	Aluprof_MB-86-Casement_	Single top-hung casement	791	1224	1			6/16/4/16/6	ALUPROF S.A.	30.00
18	M_Fixed		915	610	1					

A	B	C	D	E	F	G	H	I	J	K
Mark	Family	Description	Width	Height	Count	Glazing area	Glass	Glazing constructio	Manufacturer	Cost
<varies>	Aluprof_MB-86-Casement_	Single top-hung casement	791	1224	2			6/16/4/16/6	ALUPROF S.A.	30.00
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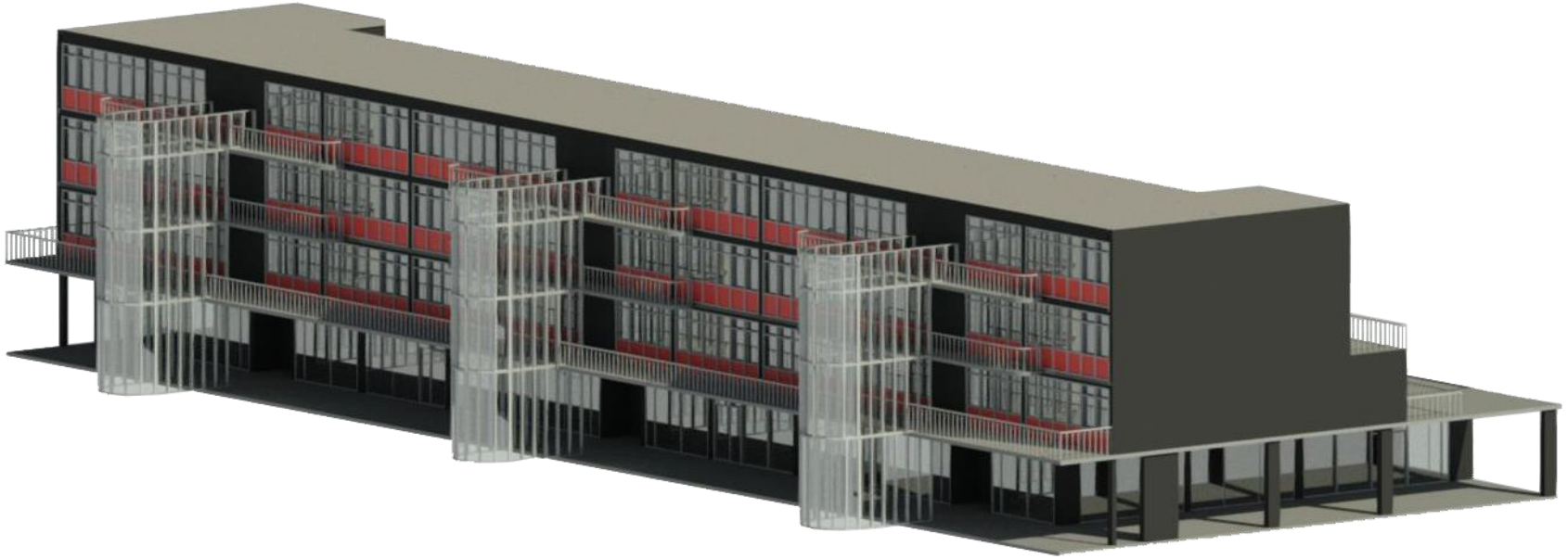
<varies>	Aluprof_MB-86-Casement_	Single top-hung casement	831	1224	2			6/16/4/16/6	ALUPROF S.A.	30.00
6										
<varies>	Aluprof_MB-104-Passive-Sl	Window-door system with	864	1224	2			6/16/4/16/6	ALUPROF SA	50.00
<varies>	Aluprof_MB-104-Passive-Sl	Window-door system with	874	1224	2			6/16/4/16/6	ALUPROF SA	50.00
<varies>	Aluprof_MB-104-Passive-Sl	Window-door system with	937	1224	2			6/16/4/16/6	ALUPROF SA	50.00
6										
<varies>	M_Fixed		915	610	2					
2										
Grand total: 14										

DESIGN APPLICATION

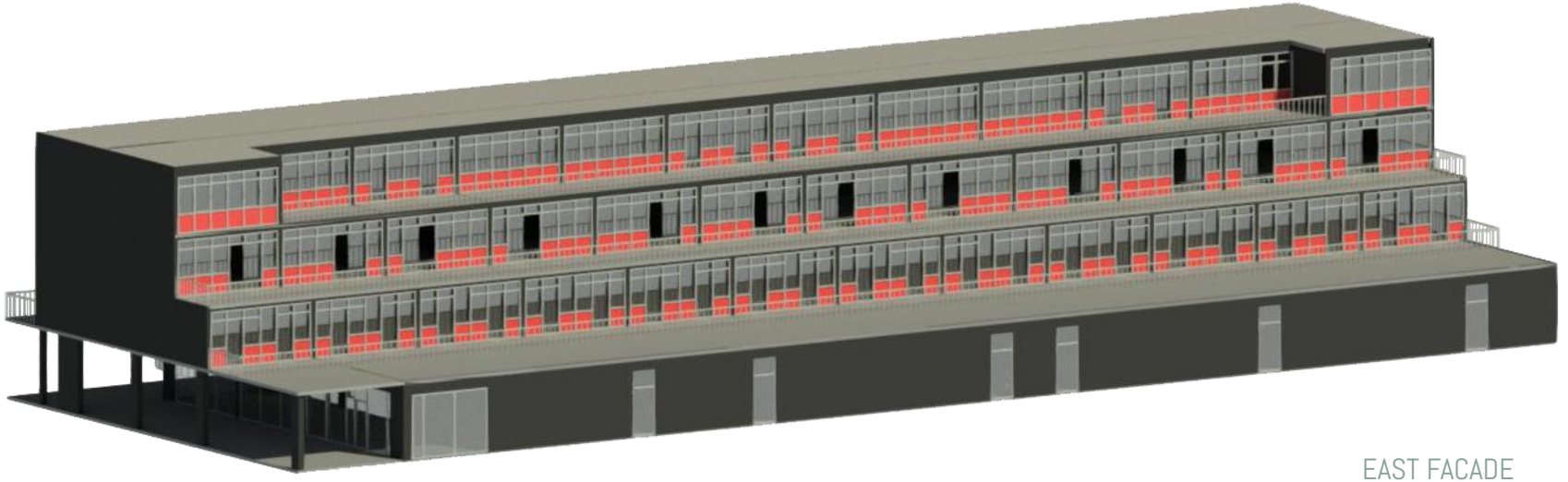
Location: Amsterdam

Construction year: 1985

Typology: Residential with Commercial Ground floor



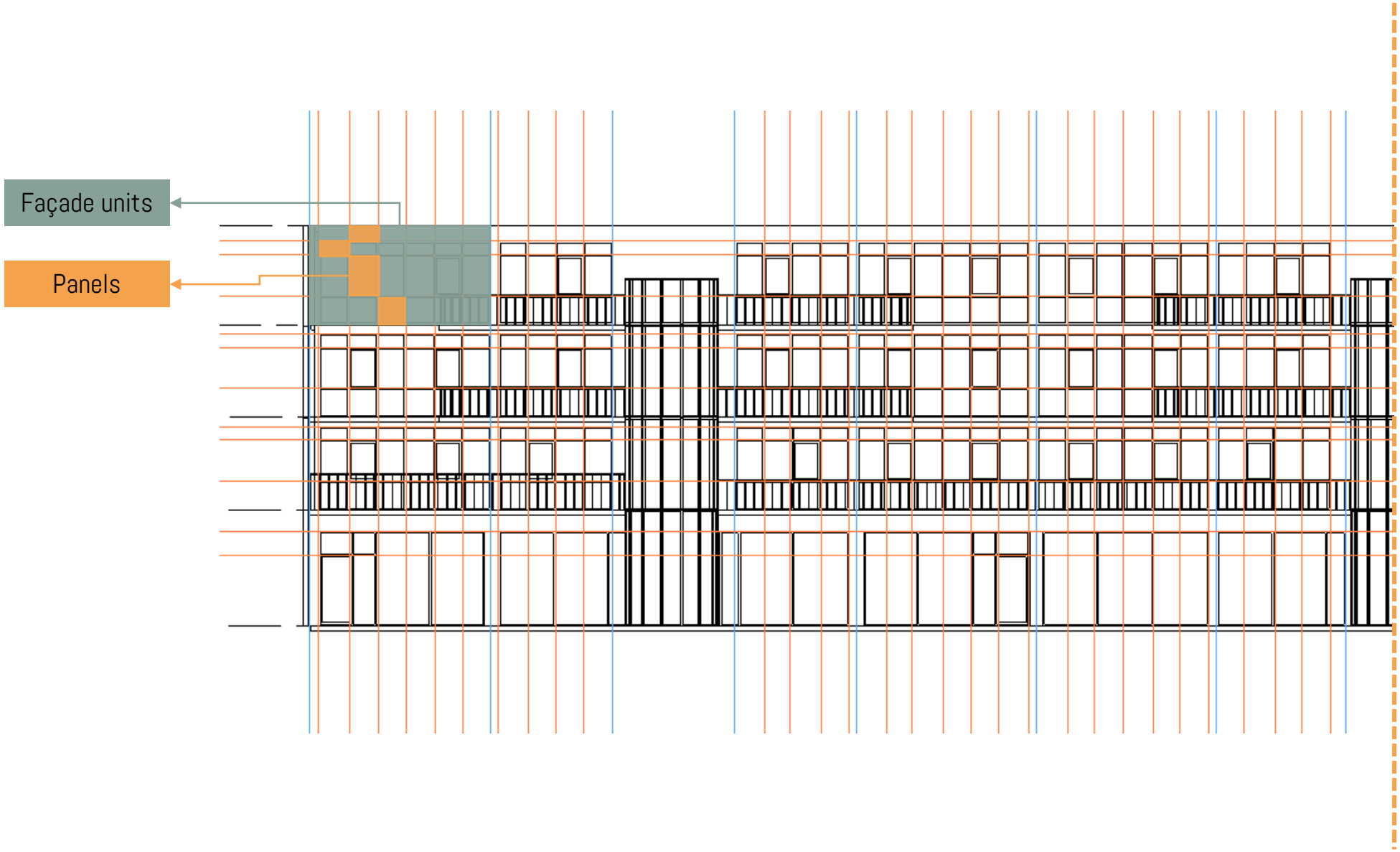
WEST FACADE



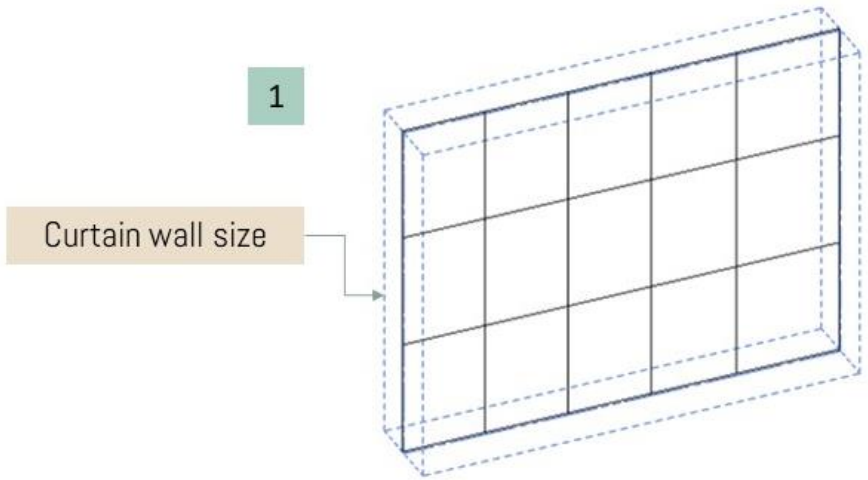
EAST FACADE

Façade units

DESIGN PROCESS _Façade Grid _Units

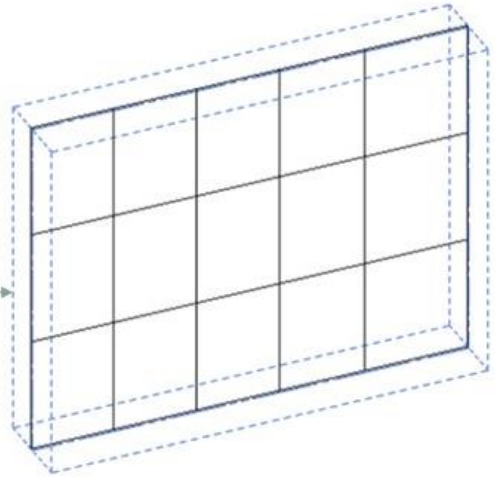


DESIGN PROCESS _Façade Grid _Panels


1
Curtain wall size

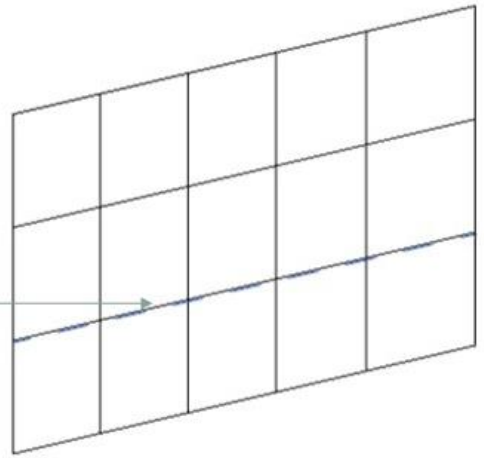
1

Curtain wall size



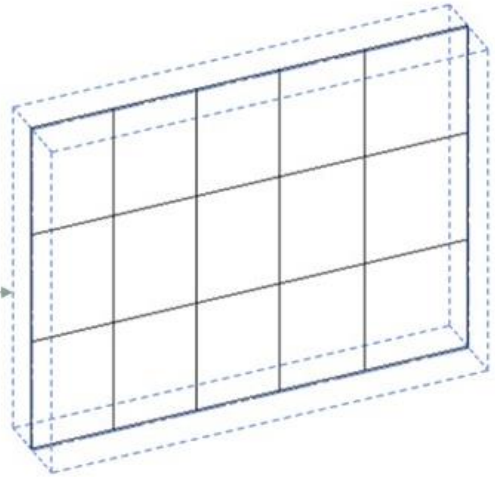
2

Curtain wall grid



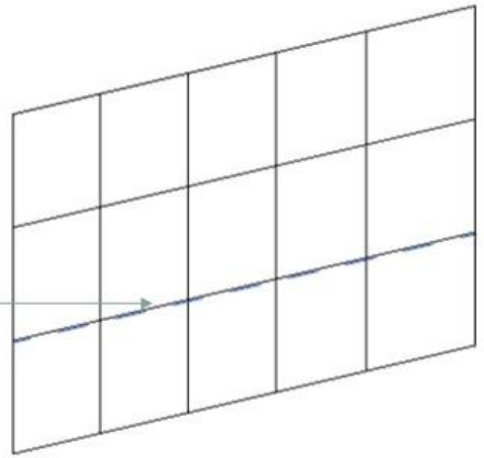
1

Curtain wall size



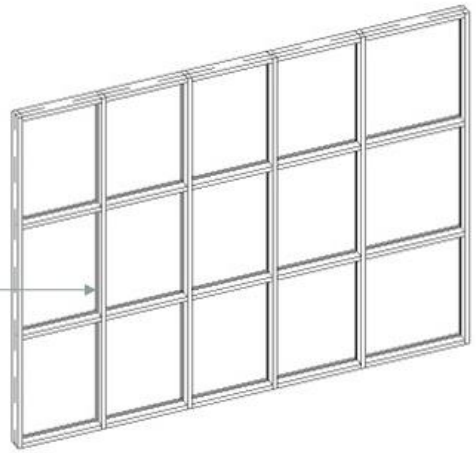
2

Curtain wall grid



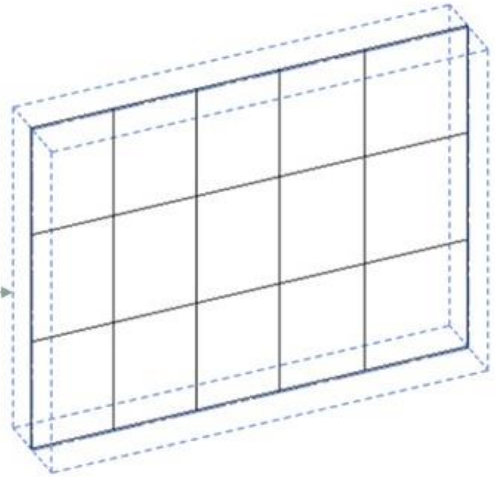
3

Curtain wall mullions



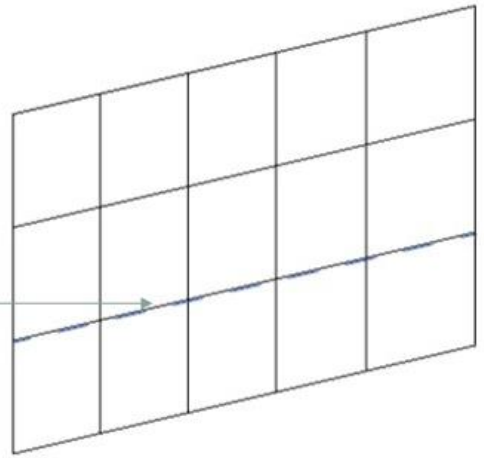
1

Curtain wall size



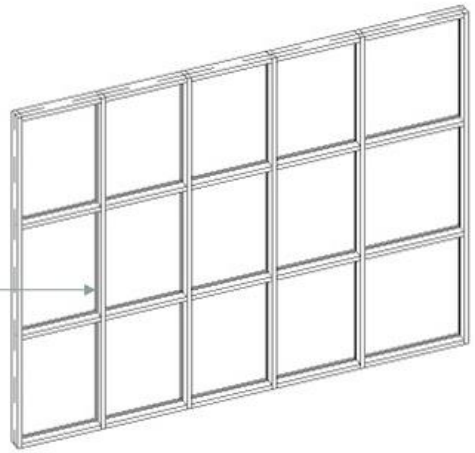
2

Curtain wall grid



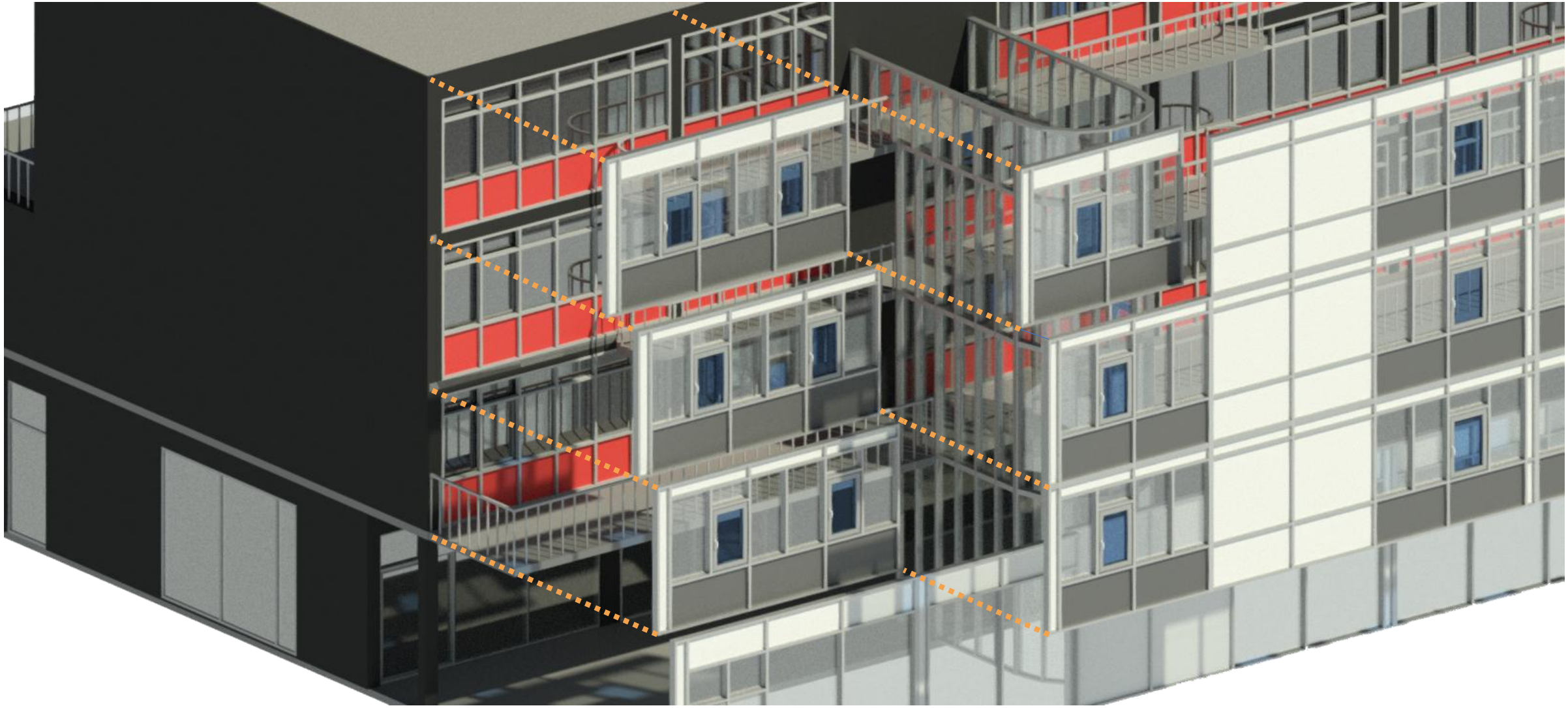
3

Curtain wall mullions

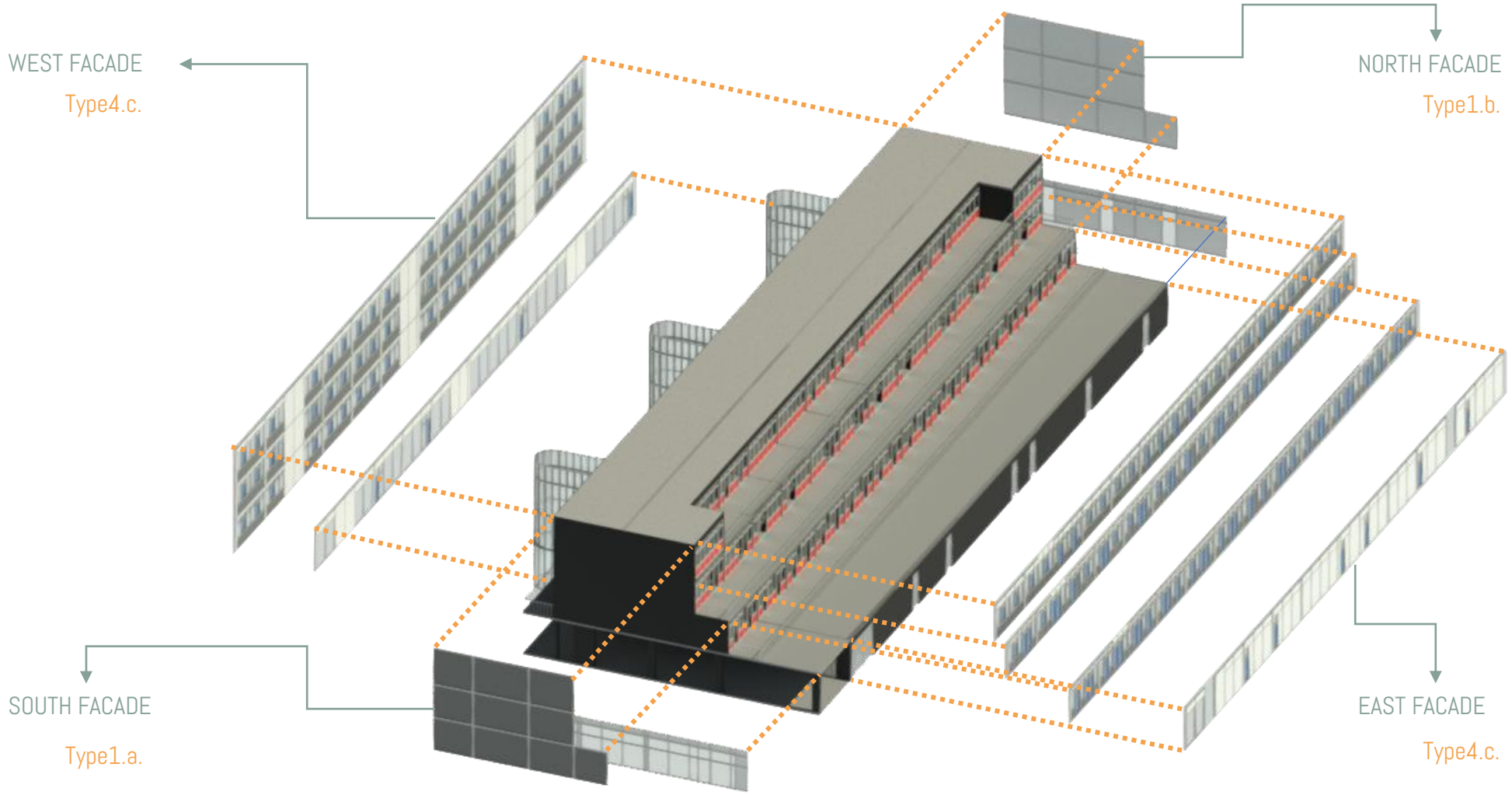


4

Curtain wall panels



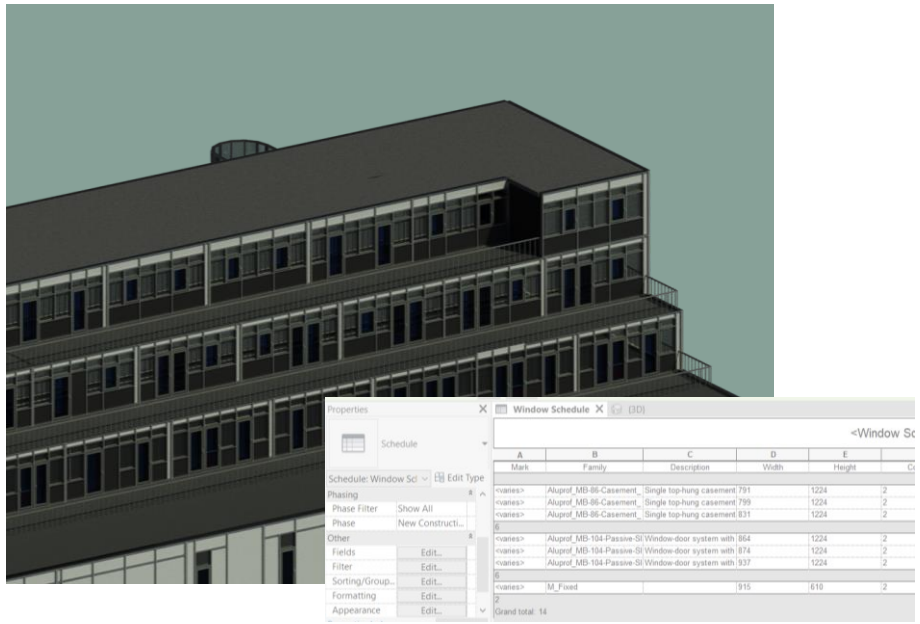
DESIGN PROCESS _Multiply façade units



DESIGN PROCESS _Complete renovation system

- CREATE SCHEDULES WITH THE INDICATORS
- COMPARE DIFFERENT DESIGN SOLUTIONS BASED ON THE INDICATORS VALUES

PROJECT FILE 1



PROJECT FILE 2

CONCLUSIONS

Answer to research question

"How can a BIM components library facilitate the design of a circular standardized facade renovation system that meets the energy-saving measures, and is adjustable?"

- Provides easy and quick accessibility to the components of the façade system.
- Groups and organizes the components' families.
- Provides information regarding the energy performance and the circularity of the components.
- Facilitates standardization by counting the different components and their different configurations.

Recommendations

- Complete the library.
- Test and apply the library to different projects.
- Create more detailed BIM components.
- Do further research regarding the energy performance and the efficiency of the system.
- Create a more efficient BIM framework for the goals of this project:
    - Improve the possibilities of evaluation indicators in schedules (easier grouping, tags).
    - Categorize and structure the BIM families, based on the indicators.
    - Allow higher flexibility in the modification possibilities of the components (layers, dimensions).
- Have energy performance analytics connected with the library.
- Create a recommendation system by setting renovation goals.
- Make the library a separate plug-in.

Thank you!