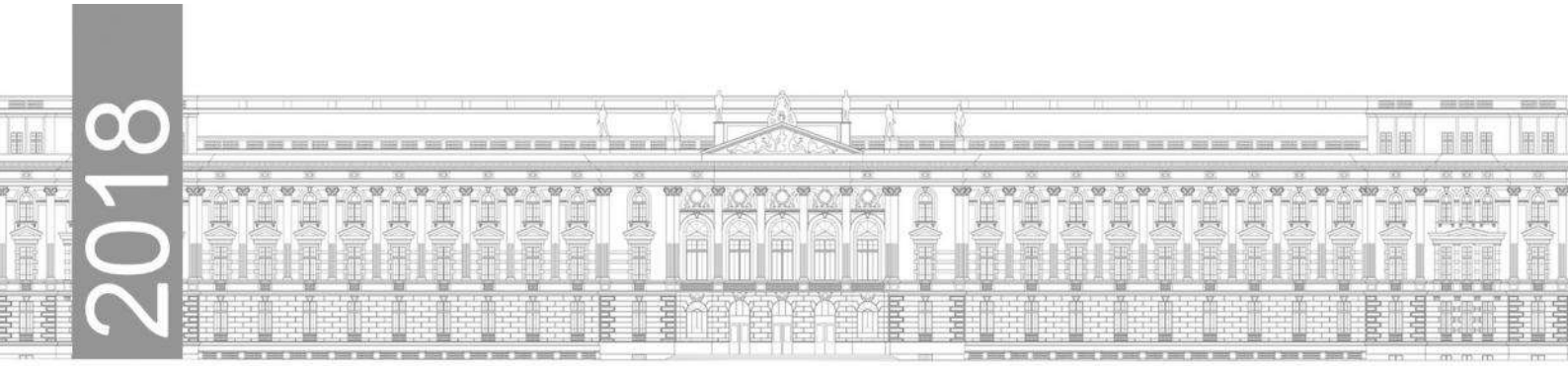

ADAPTIVE FACADES 2018

BELGRADE

BOOKLET

Adaptive Facades Training School 2018
"Retrofitting Facades for Energy Performance Improvement"

3th to 7th of September 2018
University of Belgrade, Faculty of Architecture, Belgrade, Serbia

Edited by
Professor Dr. Aleksandra Krstić-Furundžić
Ass. Professor Dr. Budimir Sudimac

Organised and sponsored by

cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

European COST Action TU1403
Adaptive Facades Network

UNIVERSITY OF BELGRADE
FACULTY OF
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Technical Assistance
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Research within the Workshop can be useful for research in the field of architectural design and energy efficiency of buildings, as well as contribute to further research within national scientific projects, such as TR36035 and III43007.

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Table of contents

Case Study: Office building

▶ Ahmed Felimban, Ali Aghazadeh Ardebili, Martina Di Bugno, Magdalena Patrus, Nevena Lukic

PROJECT DEVELOPMENT PROCESS

Location

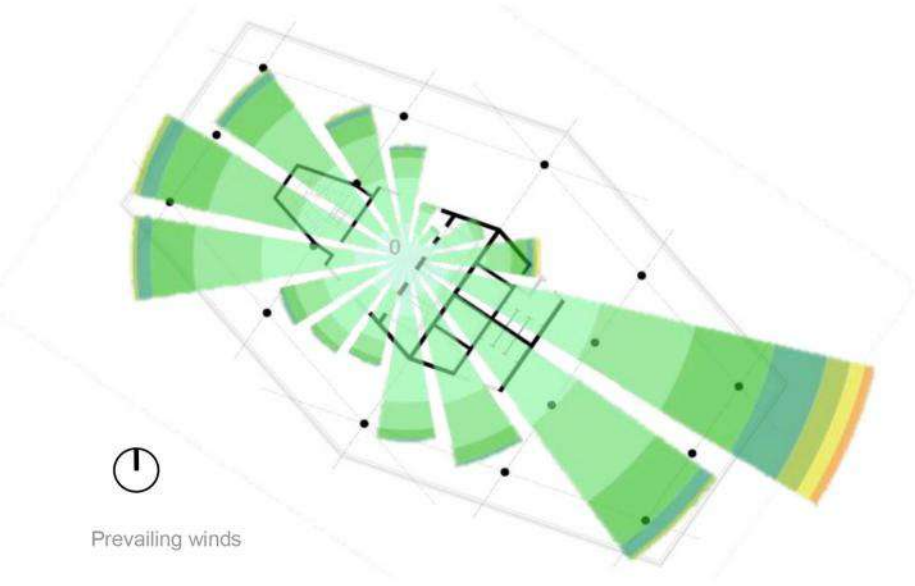
- High-rise commercial unit located in central Belgrade
- Semi-dense urban environment
- The talles building in the city

Limitations and decisions

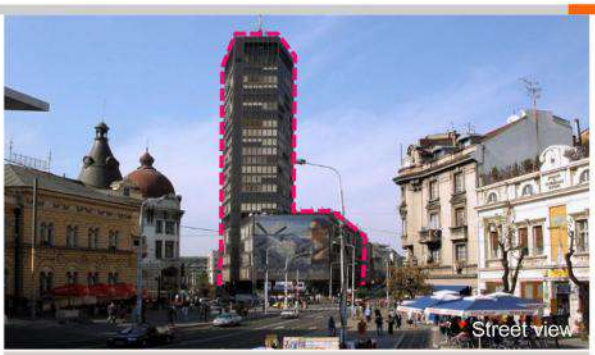
- Maintain the form
- Sustain the uniformity
- Maintain the materiality (dark colours to follow the initial architectural concept of *a black building in the 'White City'*)
- Maintain the prominence of the building on the city's skyline
- Sustain and highlight the hisorical value fo the building
- Holistic approach to accommodate and address the existing conditions

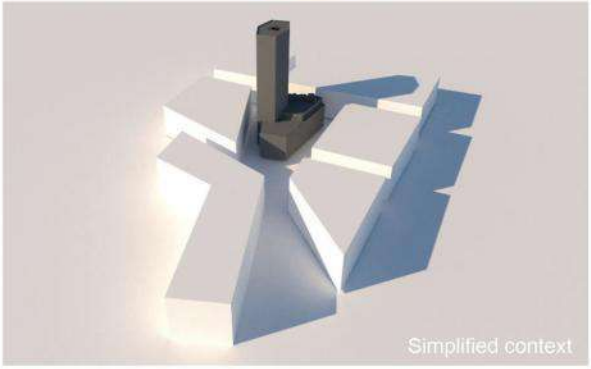
Façade concept

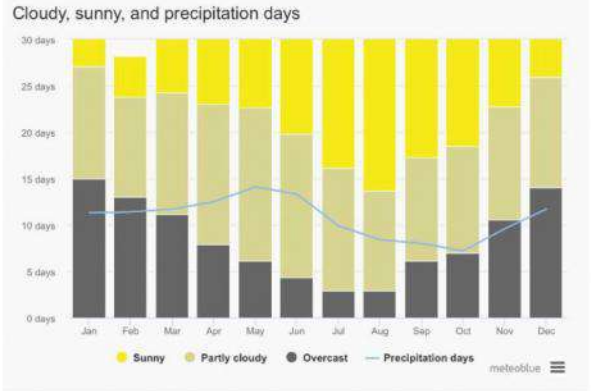
- Address the prevailing winds → E-W axis orientation optimal for natural ventilation
- Maximize solar gains in the winter
- Control glare
- Solar control on southern-oriented facades
- Heat loss prevention
- Improved insulation inside the cladding panels

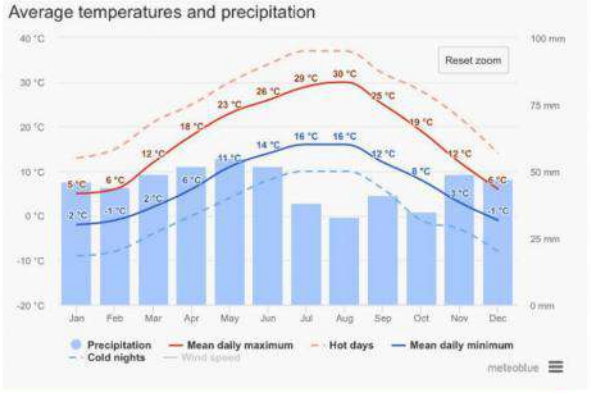


Prevailing winds









Option 1: improving the fabric of the existing facade

- Maintained form & structure of the building
- Cost-effective solution
- Minimized costruction waste
- Less controvertial solution
- Minimal potential for operational issues

Improved energy efficiency

Option 2: new facade fabric with kinetic shading

- Innovative & trendy solution
- More cost-imposed
- Construction waste generation
- Potential for better solar control in summer
- Operational & installation issues
- Uncertainty of the performance

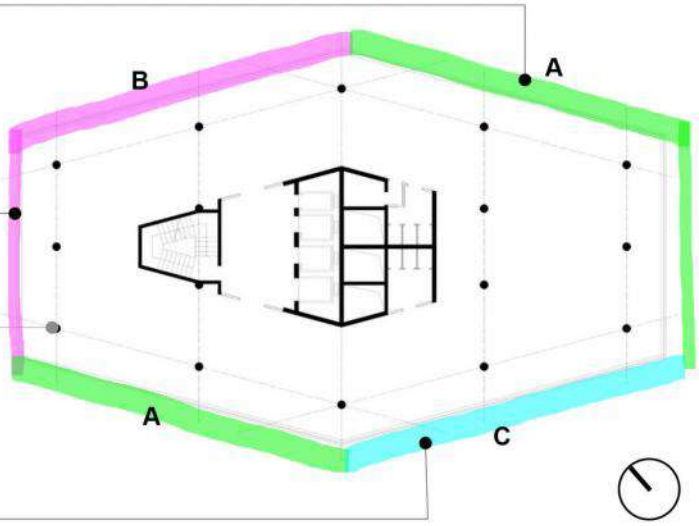
Façade adaptability

Double skin facade with low iron glazing to maximize transparency and boost natural ventilation

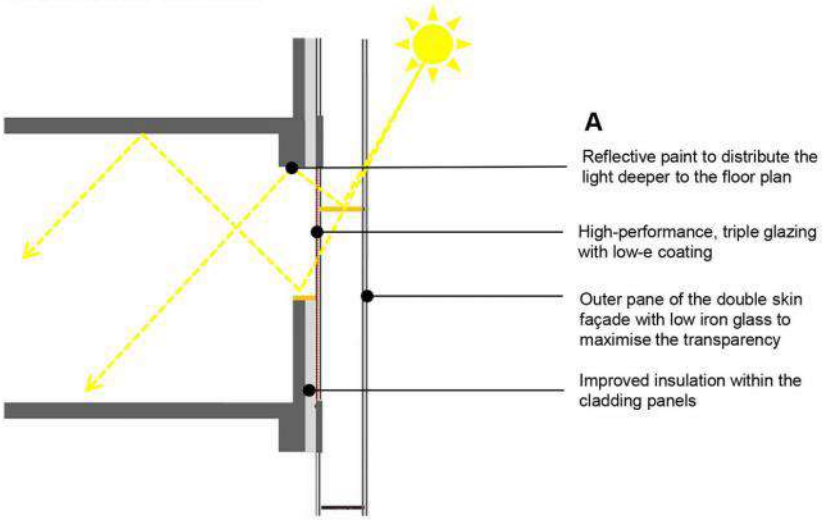
Triple glazing with low-e coating on #5 to minimize heat loss

Exposed concrete columns to store heat

Triple glazing with low-e coating on #5 and ceramic frit for solar control



Technical details



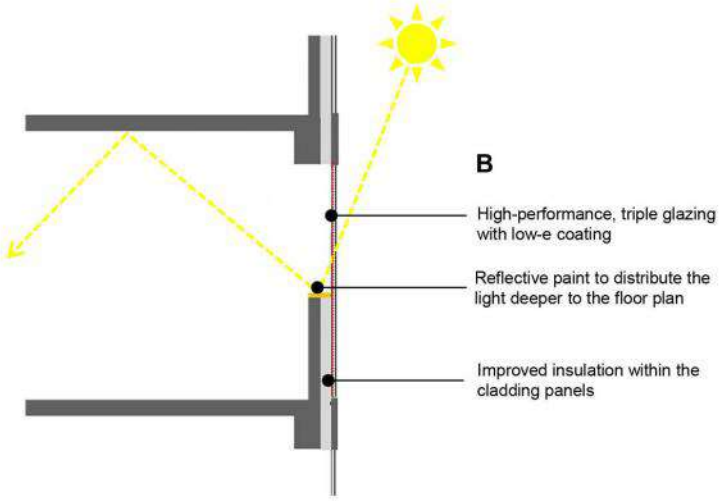
A

Reflective paint to distribute the light deeper to the floor plan

High-performance, triple glazing with low-e coating

Outer pane of the double skin façade with low iron glass to maximise the transparency

Improved insulation within the cladding panels

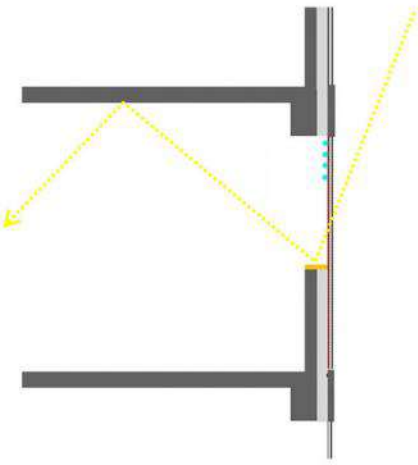


B

High-performance, triple glazing with low-e coating

Reflective paint to distribute the light deeper to the floor plan

Improved insulation within the cladding panels



C

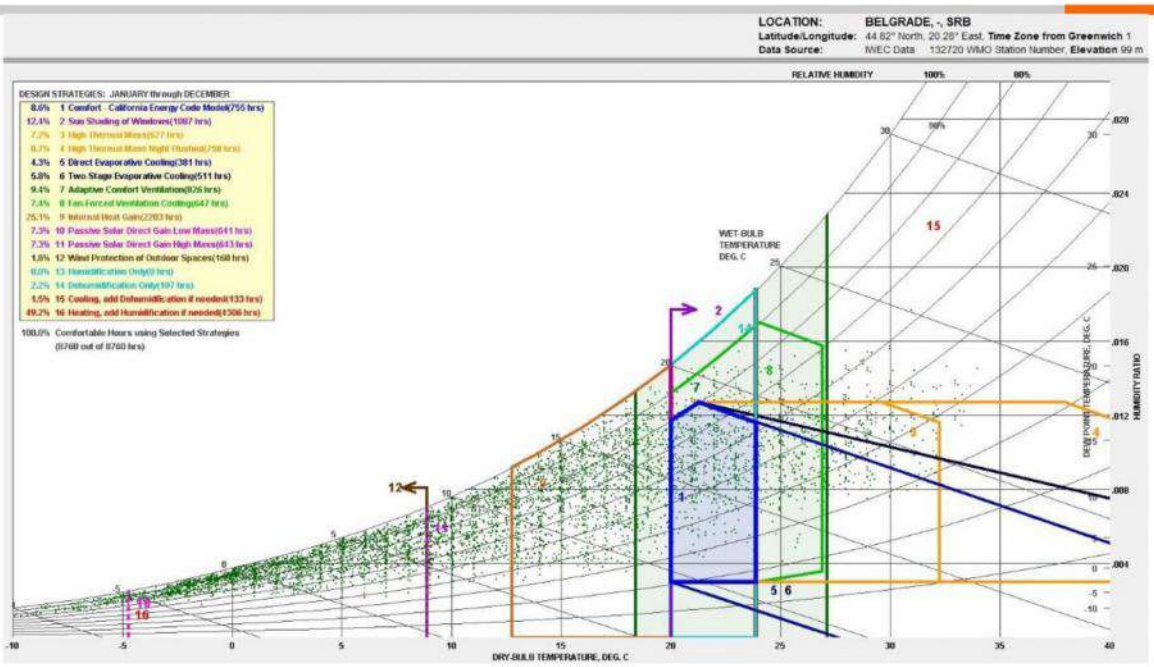
Ceramic frit for solar control

High-performance, triple glazing with low-e coating

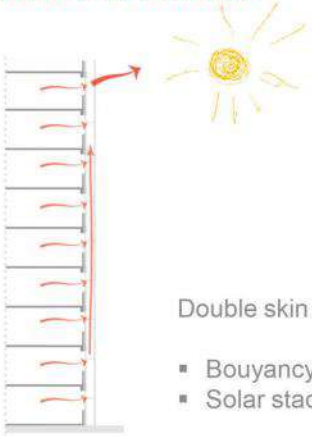
Reflective paint to distribute the light deeper to the floor plan

Improved insulation within the cladding panels

- Psychometric analysis to investigater optimal indoor environmental conditions:



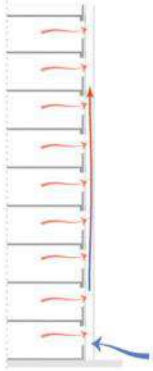
Summer behaviour



Double skin facade:

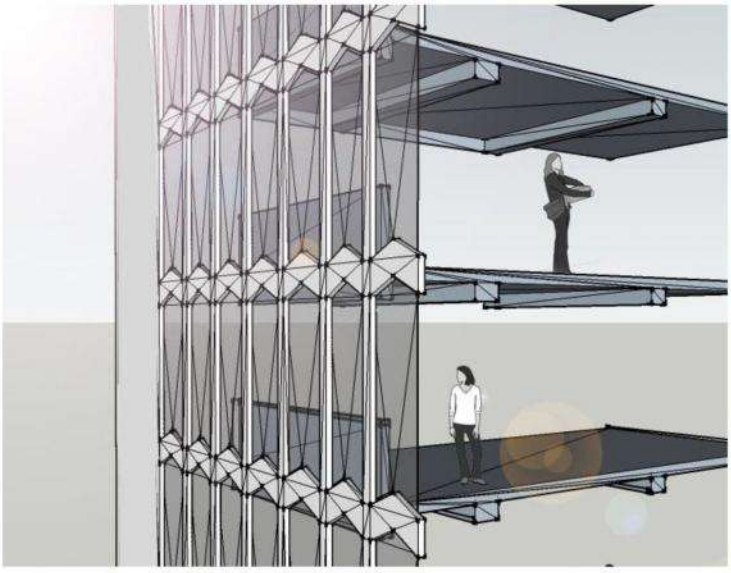
- Bouyancy driven cooling
- Solar stack extract

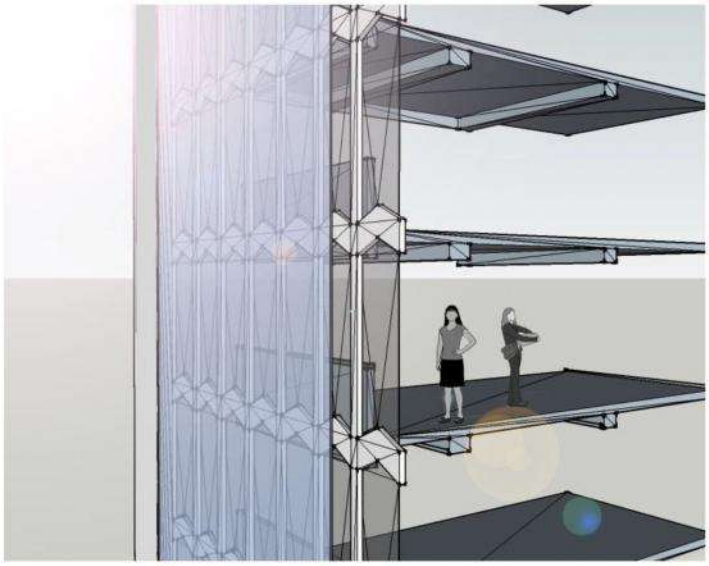
Winter behaviour



Double skin facade:

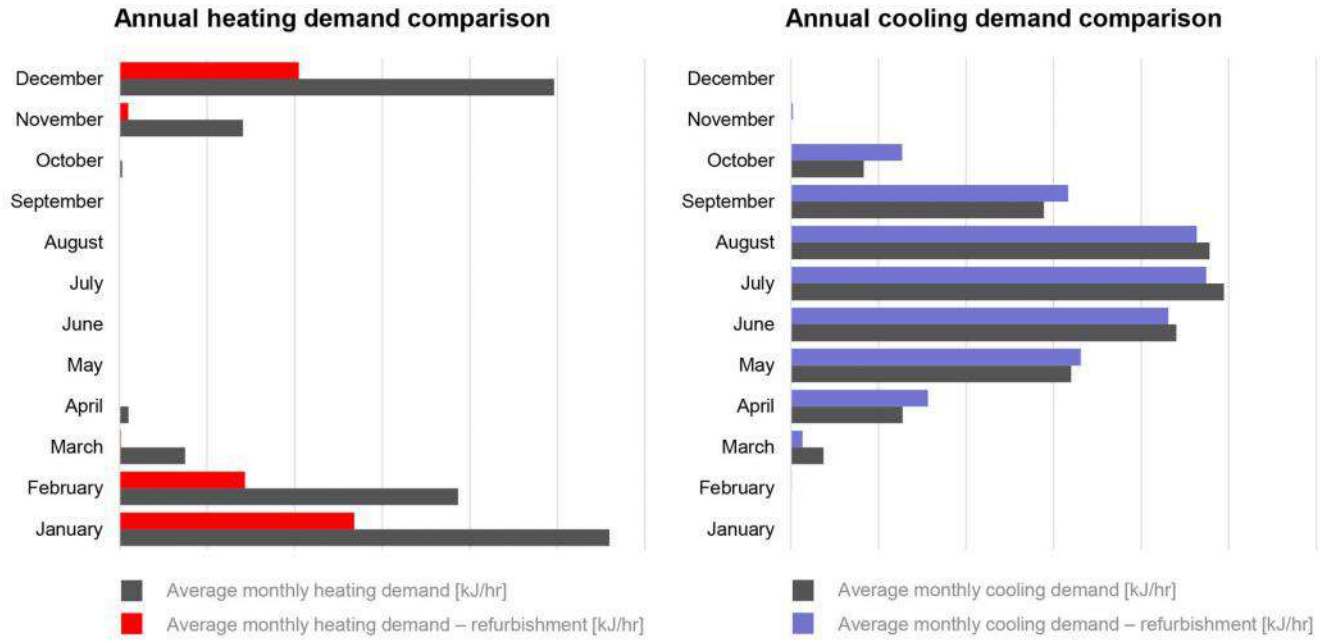
- Pre-heated ventilation, bouyancy driven
- Thermal buffer





Simulations and results

The simple simulation was based on the office space conditions, including standard loads and 100% occupancy scheduled between 8am and 6pm between Monday to Friday and 0% occupany during the weekends.

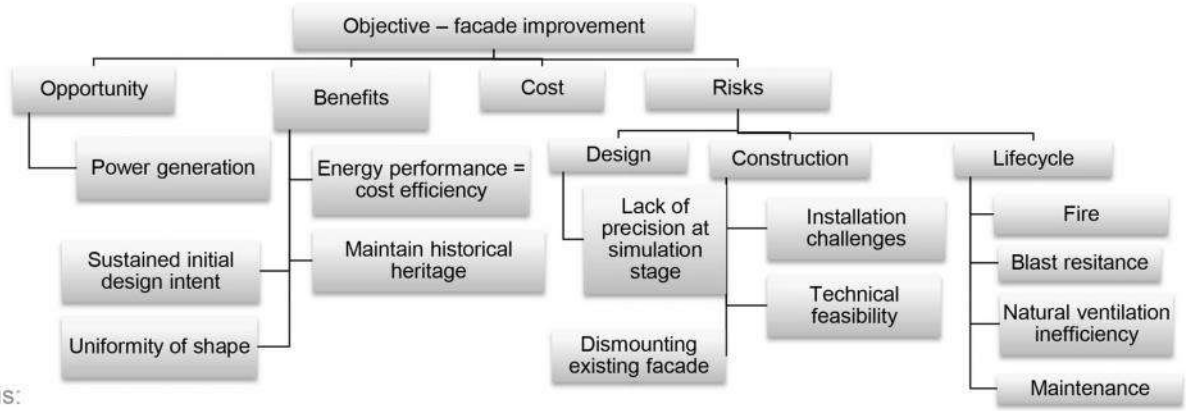


Basic fabric improvement of the existing facade (excluding the proposed double skin facade) results in:

- Heating dempand improved by 67%
- Cooling demand lowered by 2%

Additional computational fluid dynamics simulations are necceessary to asses the performance of the proposed double skin facade on the south-west and north-east faces. Nevrtherless, it is assumed that cooling loads shall be offset by up to 70% due to the natural ventilation.

Conclusion



- Whole life carbon analysis: