



The Tenth International Conference

# Engineering Computational Technology 2018

4-6 September 2018 | Sitges, Barcelona, Spain

# Analysis and development of an adaptive façade system integrated on a multi-storey office building

A. Couvelas, M. Matheou, M.C. Phocas

The above research is conducted under the European program MSCA Rise project OptArch.  
Work Package 5: Bioclimatic building design improved through performance optimization.



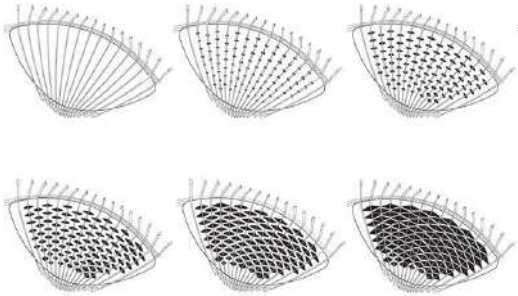
Adaptive shading  
systems

**adapt to**

functional  
environmental

- . Thermal
- . Lighting
- . Acoustic
- . Visual comfort
- . Economics (energy savings)
- . Durability
- . Aesthetic effects

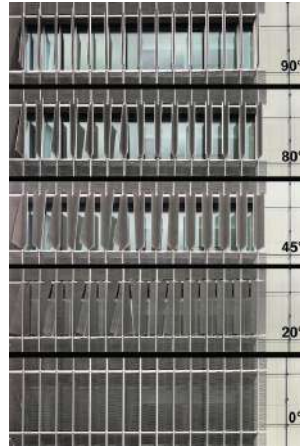
high efficiency buildings  
with improved energy performance and sustainability



Kiefer Technic Showroom, Austria



Garden by the Bay, Singapore



Q1 Headquarters Building, Germany

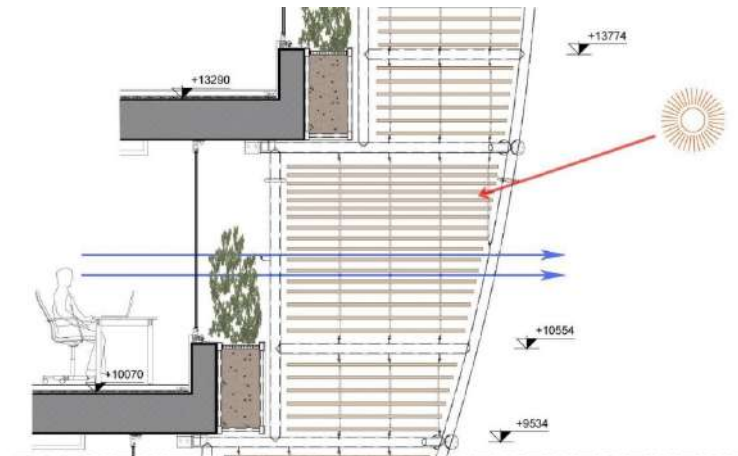


Al-Bahar Tower, Abu Dhabi



**Building use:** Offices and Retail store  
**Occupancy schedule:** 9:00 – 19:00 (weekdays)  
**Average number of occupants:** 120  
**Occupants' profile:** Employees  
**Case study area:** 150 m<sup>2</sup>

case study



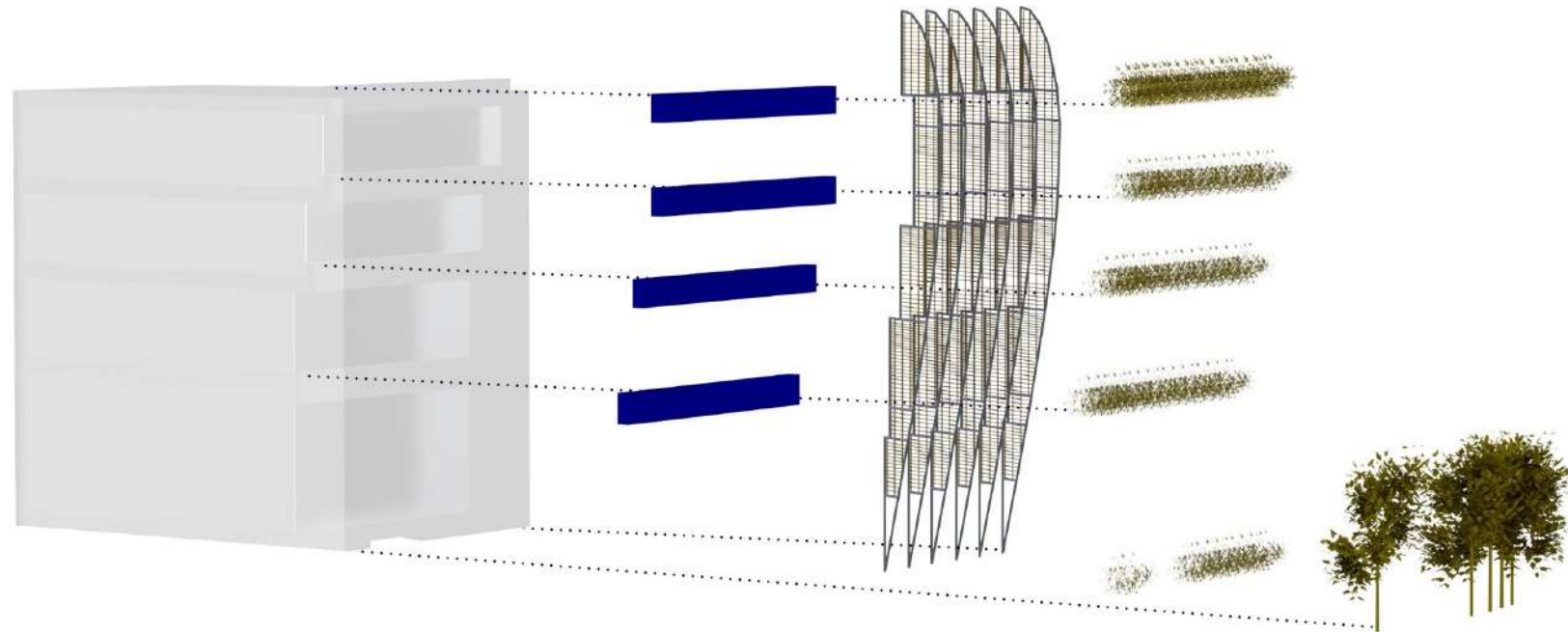
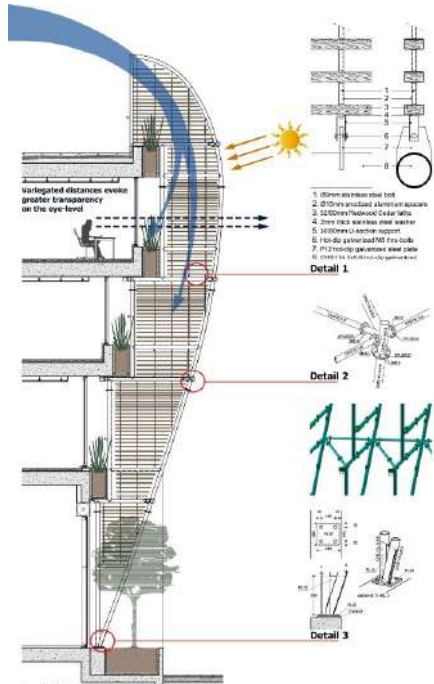
**BARE STRUCTURE**

**+ PLANTERS**

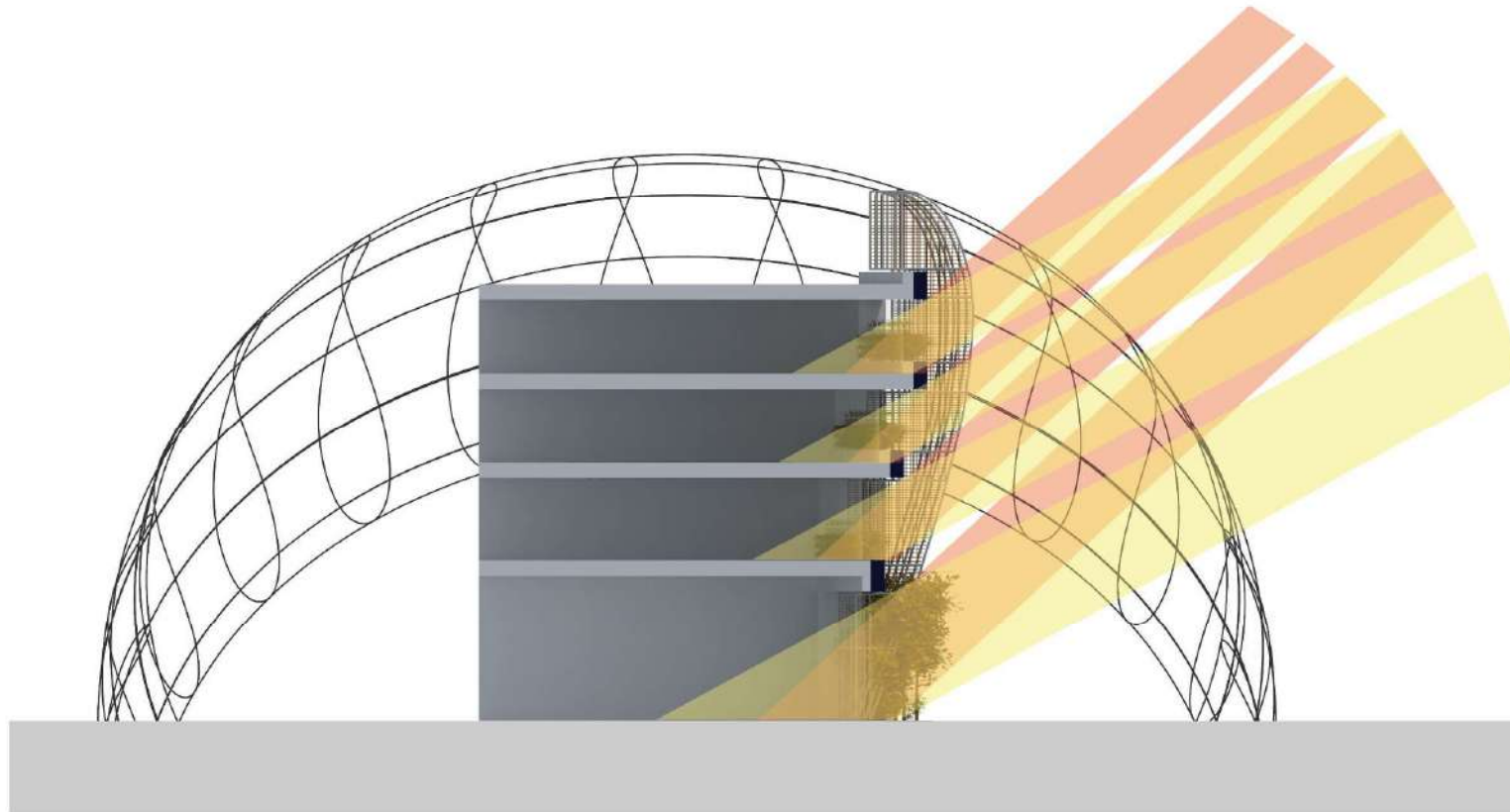
**+ SHADES**

**+ SHRUBS**

**+ TREES**







**Bare structure 21/09 16:00**

FL04 2.95m

FL03 2.15m

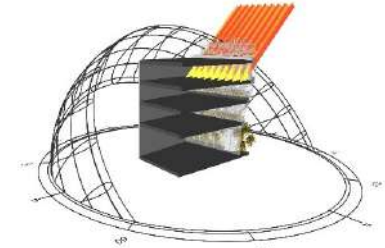
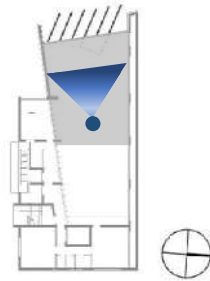
FL02 2.90m

FL01 6.90m

21/06 16:00

21/09 16:00





## FLO4

21/06 1600

21/07 1600

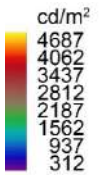
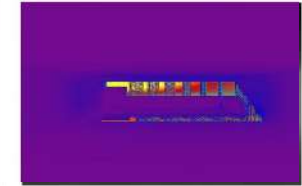
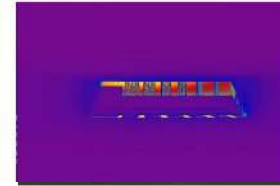
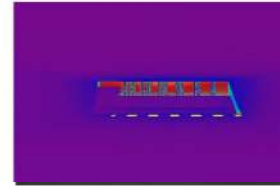
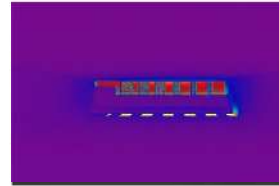
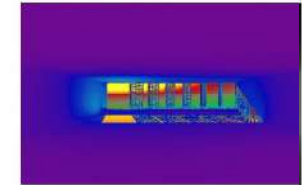
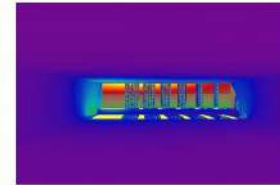
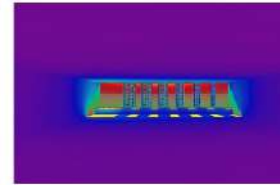
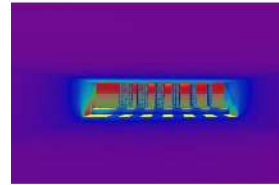
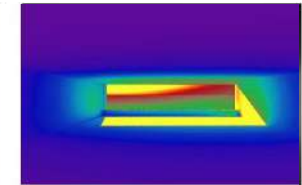
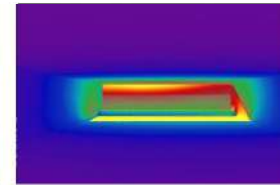
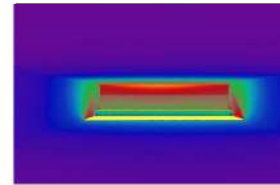
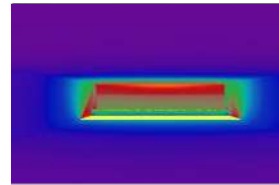
21/08 1600

21/09 1600

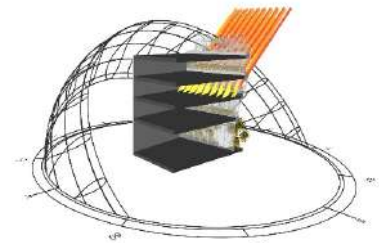
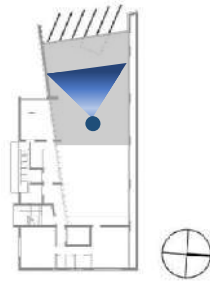
BARE STRUCTURE

+ SHADING SYSTEM  
+ FAÇADE PLANTERS

+ TREES, SHRUBS  
+ SHADING SYSTEM  
+ FAÇADE PLANTERS



Illuminance rendering of the 4<sup>th</sup> floor



### FLO3

21/06 1600

21/07 1600

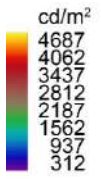
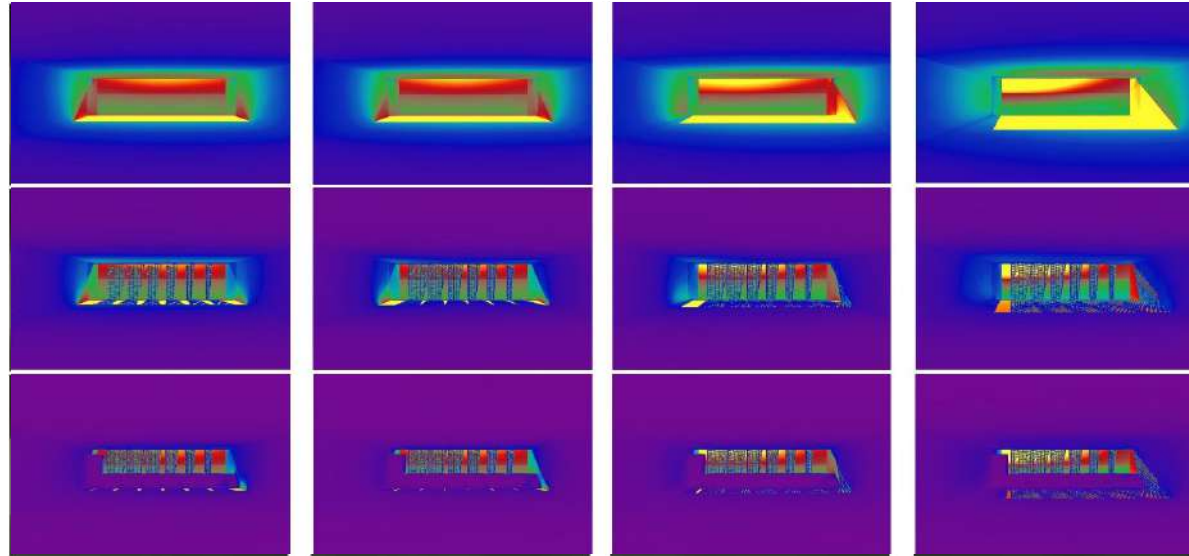
21/08 1600

21/09 1600

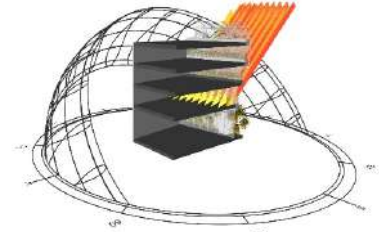
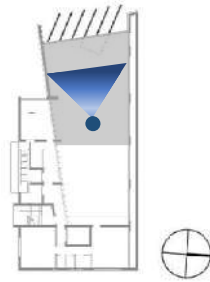
BARE STRUCTURE

+ SHADING SYSTEM  
 + FAÇADE PLANTERS

+ TREES, SHRUBS  
 + SHADING SYSTEM  
 + FAÇADE PLANTERS



Irradiance rendering of the 3<sup>rd</sup> floor



## FLO2

21/06 1600

21/07 1600

21/08 1600

21/09 1600

BARE STRUCTURE

+ SHADING SYSTEM  
+ FAÇADE PLANTERS

+ TREES, SHRUBS  
+ SHADING SYSTEM  
+ FAÇADE PLANTERS

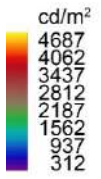
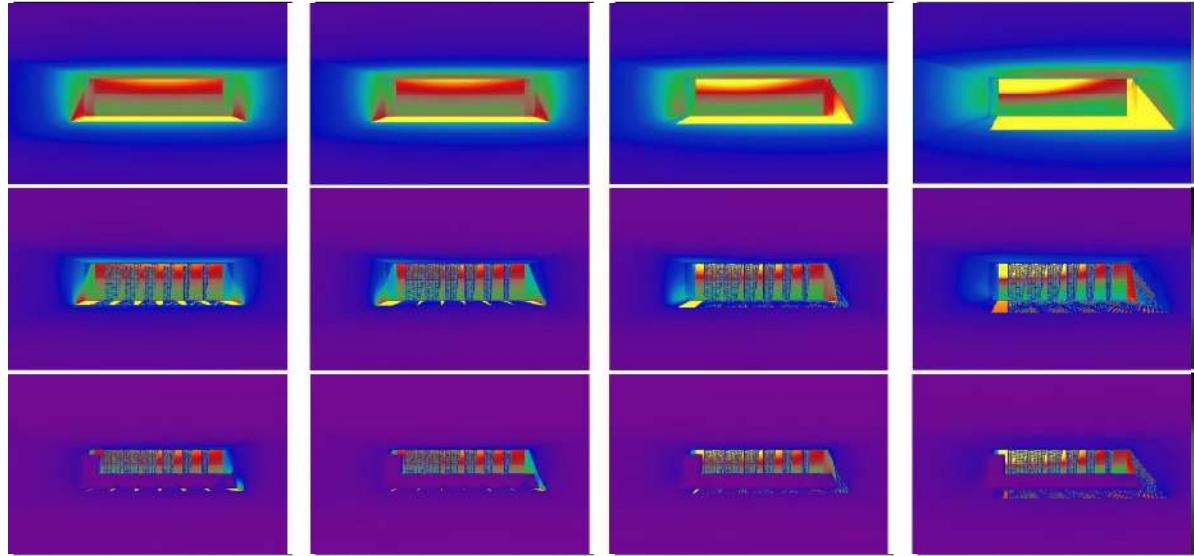
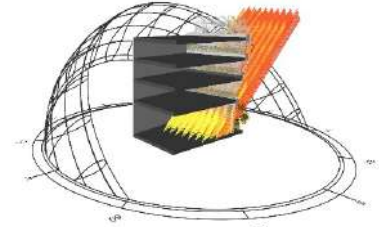
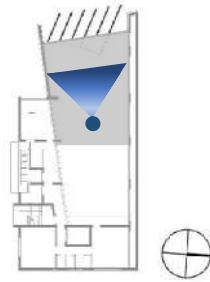


Figure 10. Irradiance rendering of the 2<sup>nd</sup> floor



## FLO1

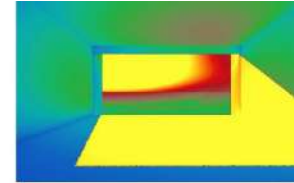
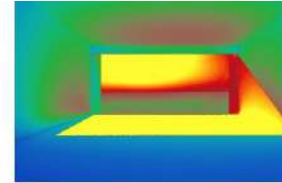
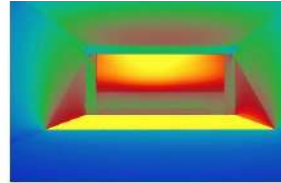
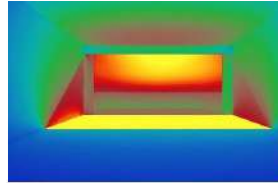
21/06 1600

21/07 1600

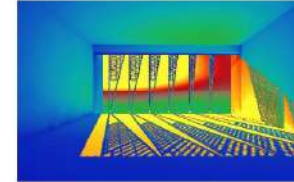
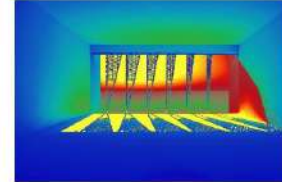
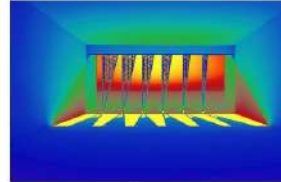
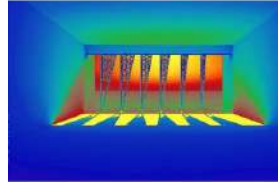
21/08 1600

21/09 1600

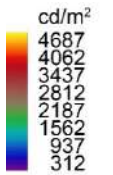
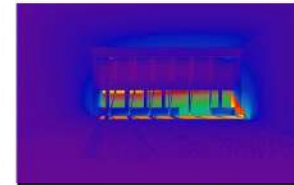
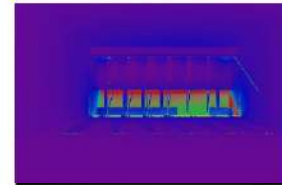
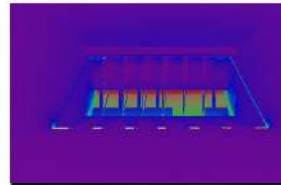
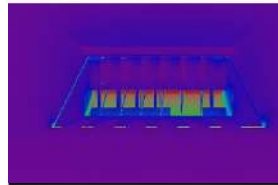
BARE STRUCTURE



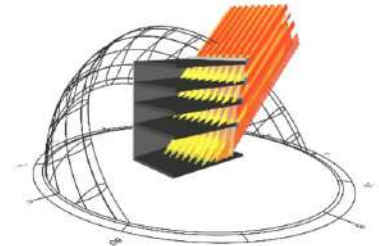
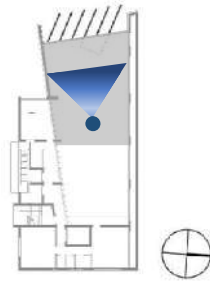
+ SHADING SYSTEM  
+ FAÇADE PLANTERS



+ TREES, SHRUBS  
+ SHADING SYSTEM  
+ FAÇADE PLANTERS



Irradiance rendering of the 1<sup>st</sup> floor



## BARE STRUCTURE

21/06 1600

21/07 1600

21/08 1600

21/09 1600

FL04

FL03

FL02

FL01

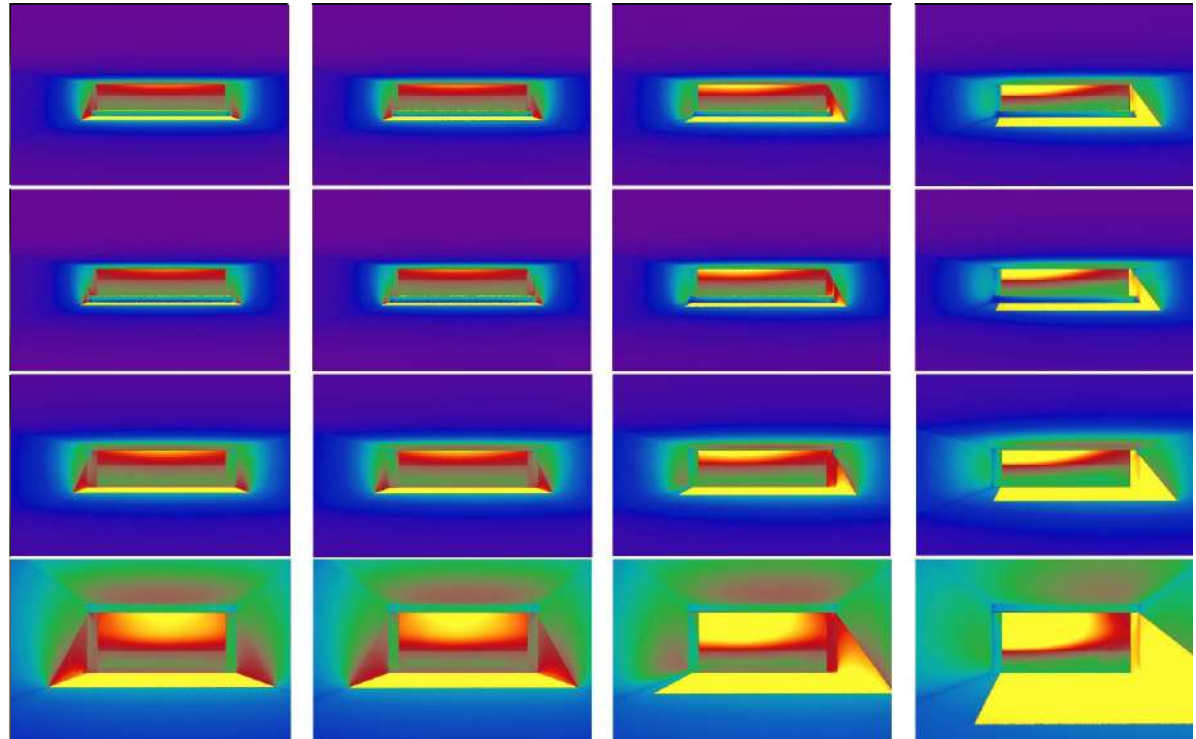
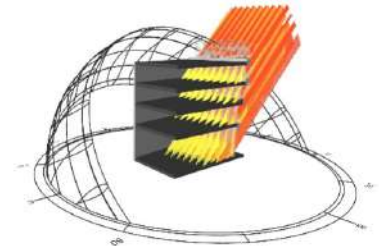
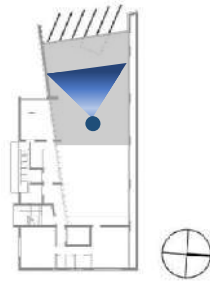


Illustration of the light intensity rendering of the Bare Structure





## + SHADING + FAÇADE PLANTERS

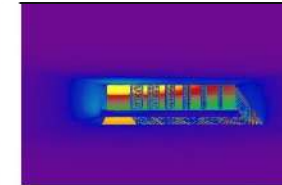
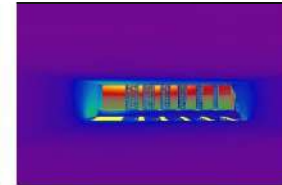
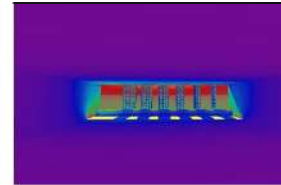
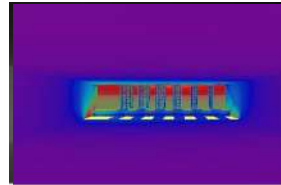
21/06 1600

21/07 1600

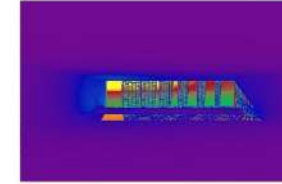
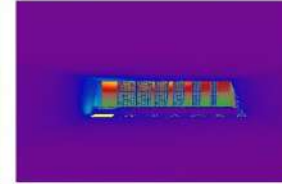
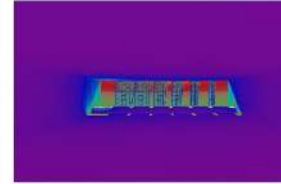
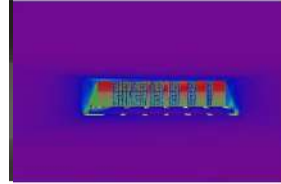
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21/09 1600

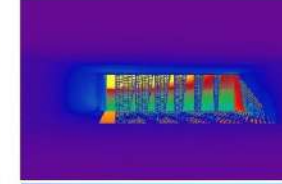
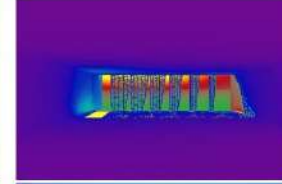
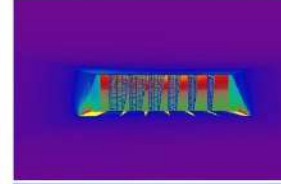
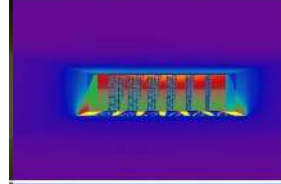
FL04



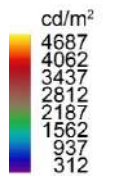
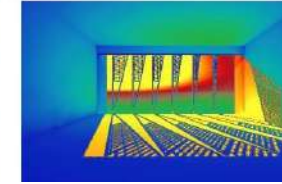
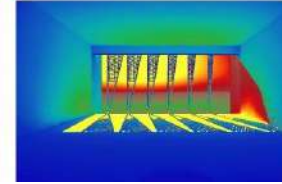
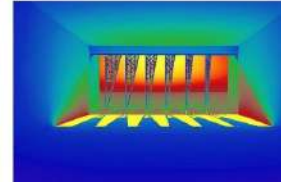
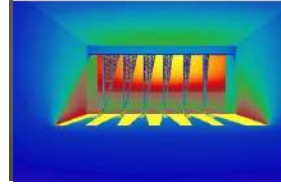
FL03



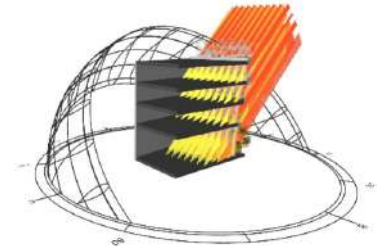
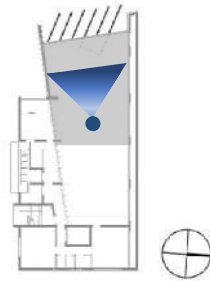
FL02



FL01



Illuminance rendering of Shading and Façade planters



**+ TREES, SHRUBS  
+ SHADING + FAÇADE PLANTERS**

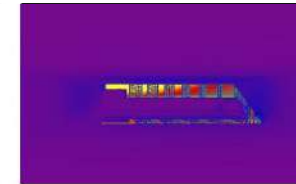
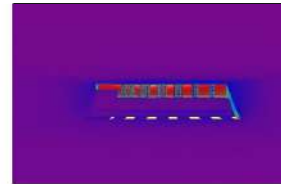
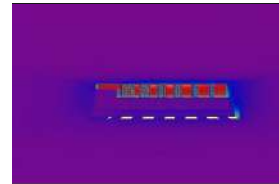
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21/07 1600

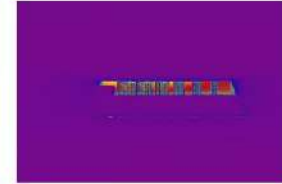
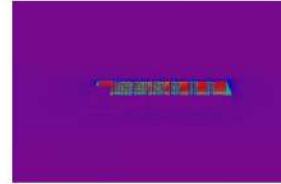
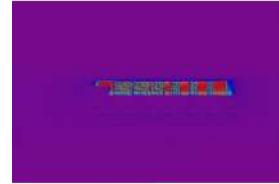
21/08 1600

21/09 1600

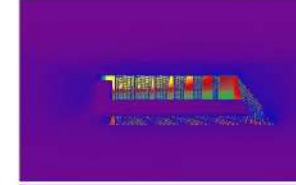
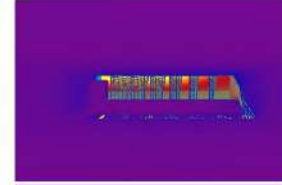
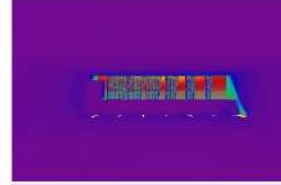
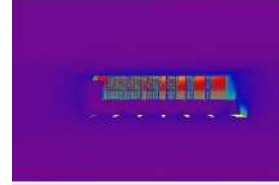
FL04



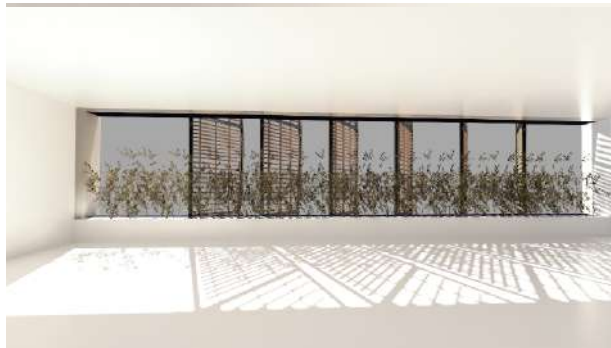
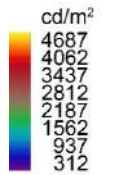
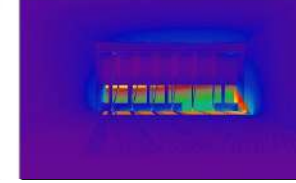
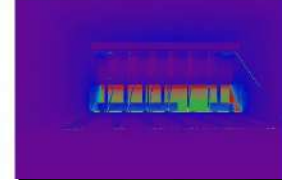
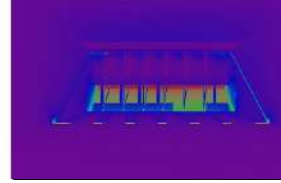
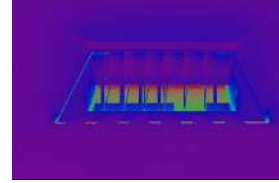
FL03



FL02

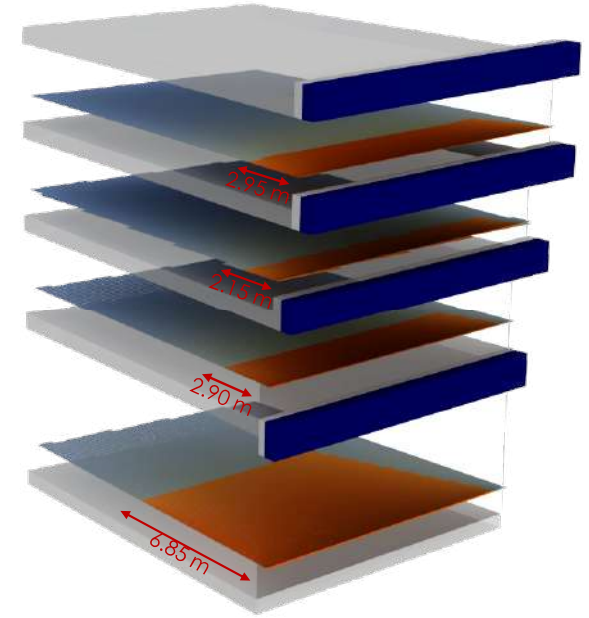
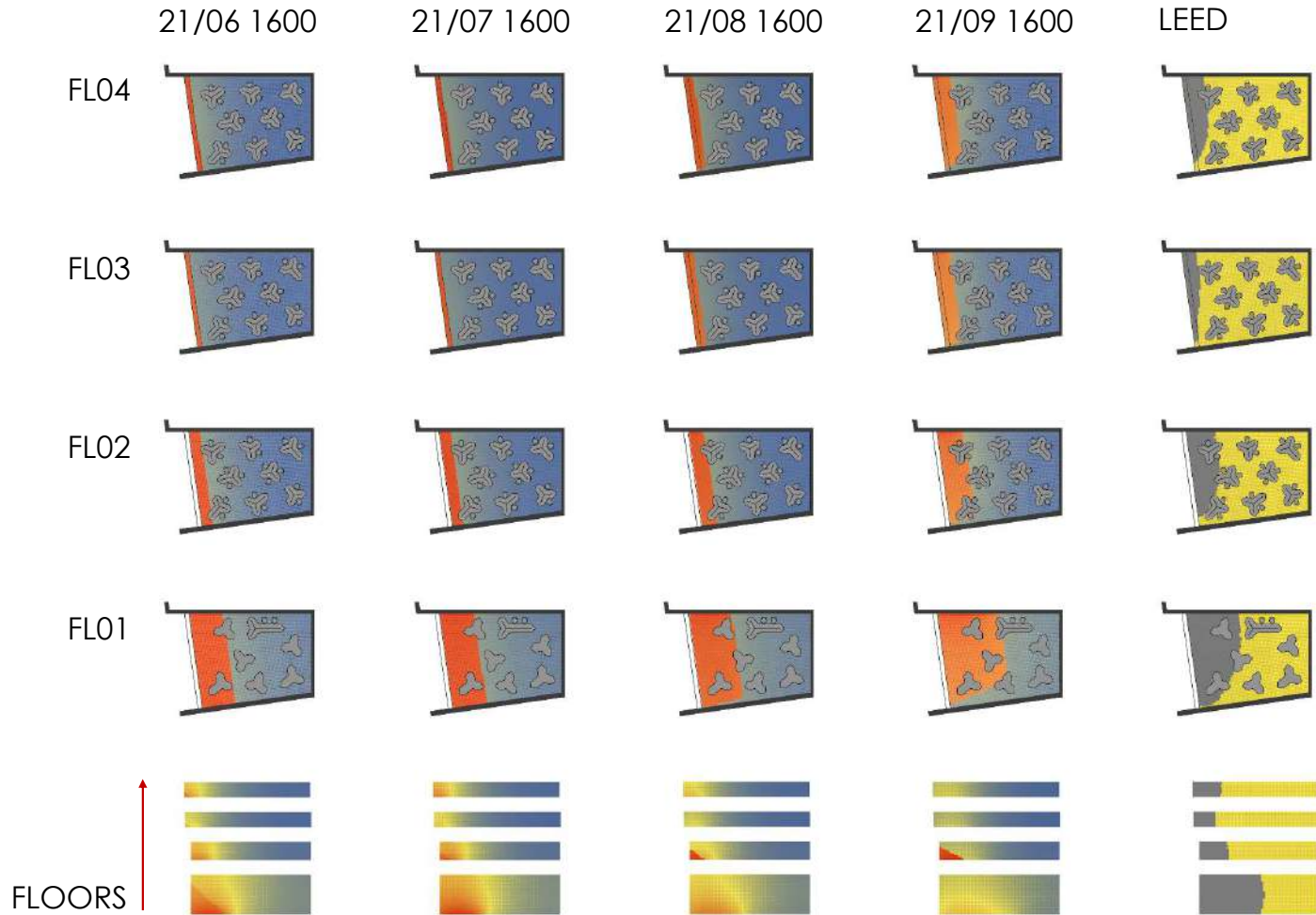


FL01



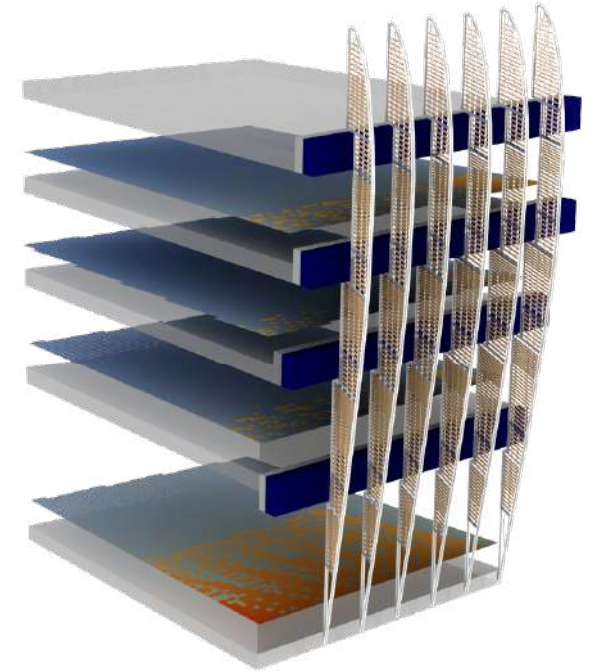
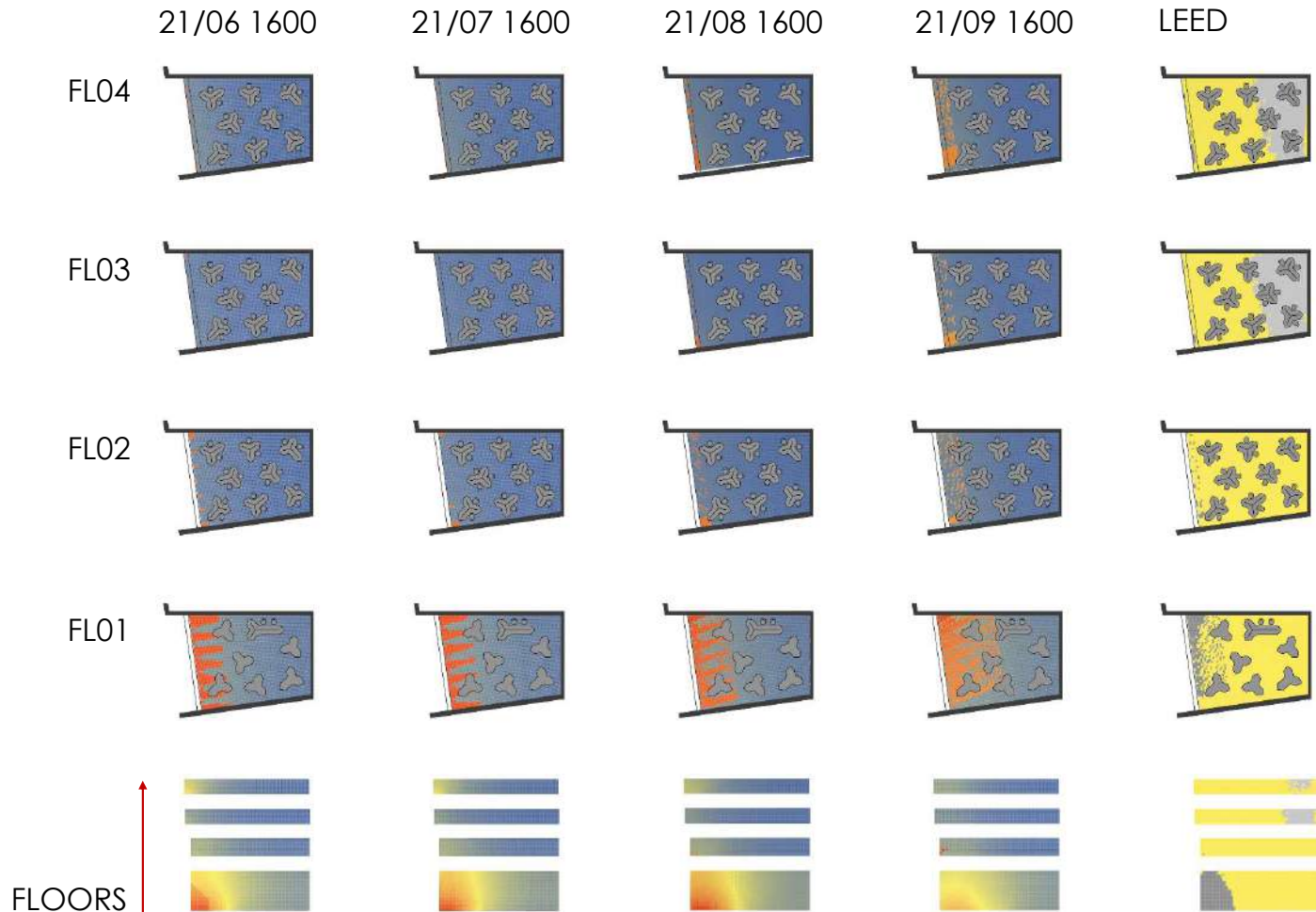
Irradiance rendering of Trees, Shrubs, Shading and Façade planters

# BARE STRUCTURE

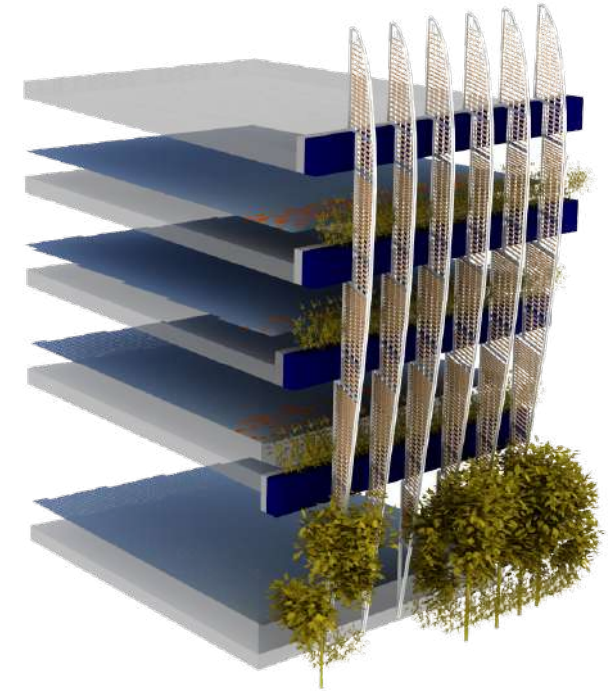
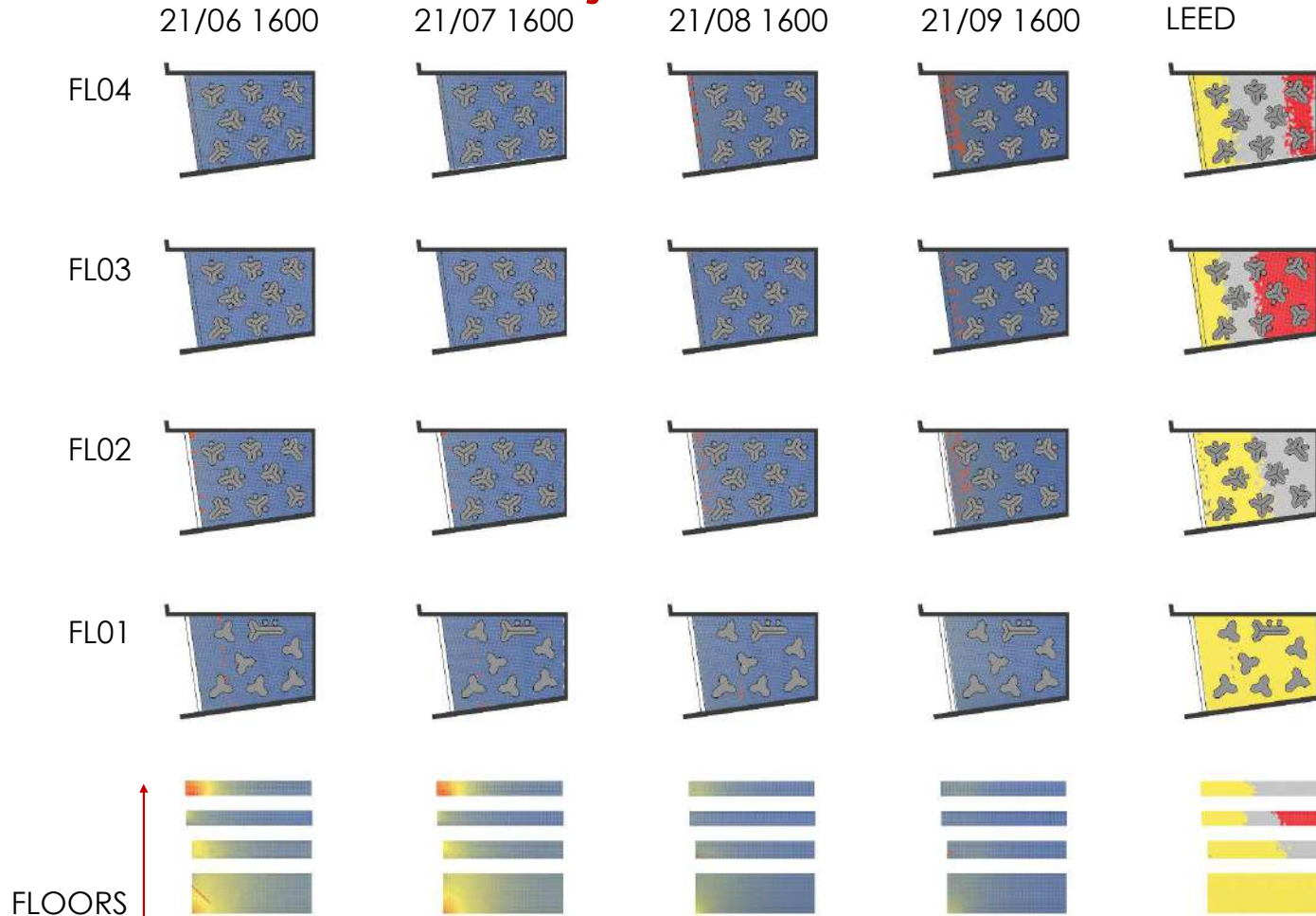




## + SHADING + FAÇADE PLANTERS

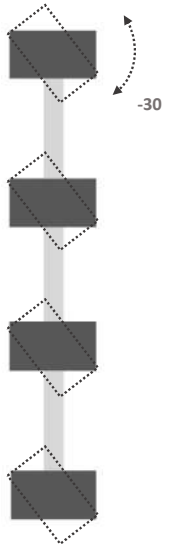
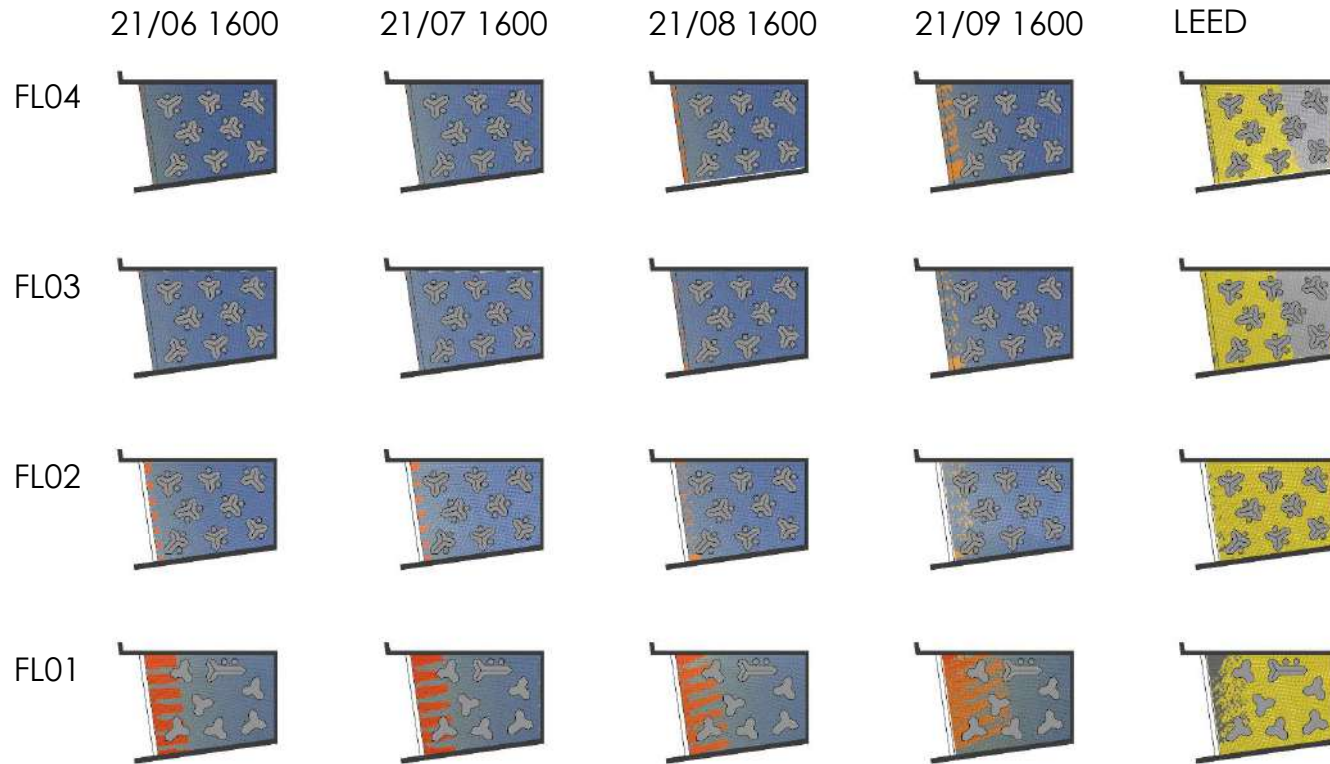
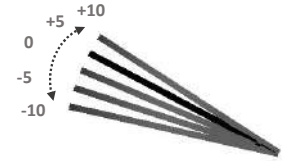


# + TREES, SHRUBS + SHADING + FAÇADE PLANTERS



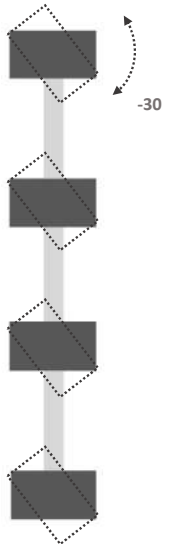
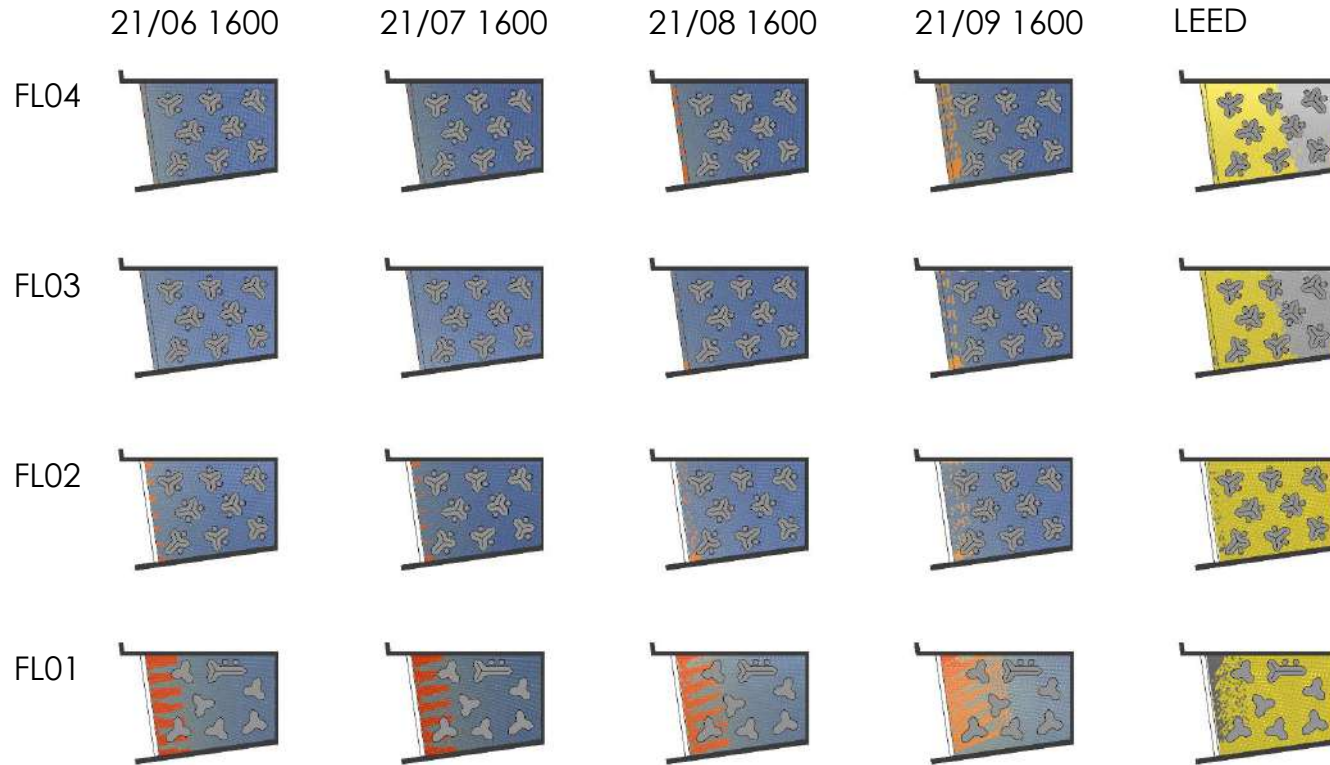
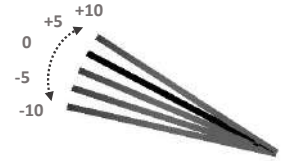
Vertical SAILS rotation [-10°] louvers [-30°]

## + SHADING + FAÇADE PLANTERS



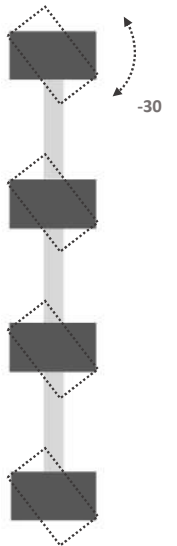
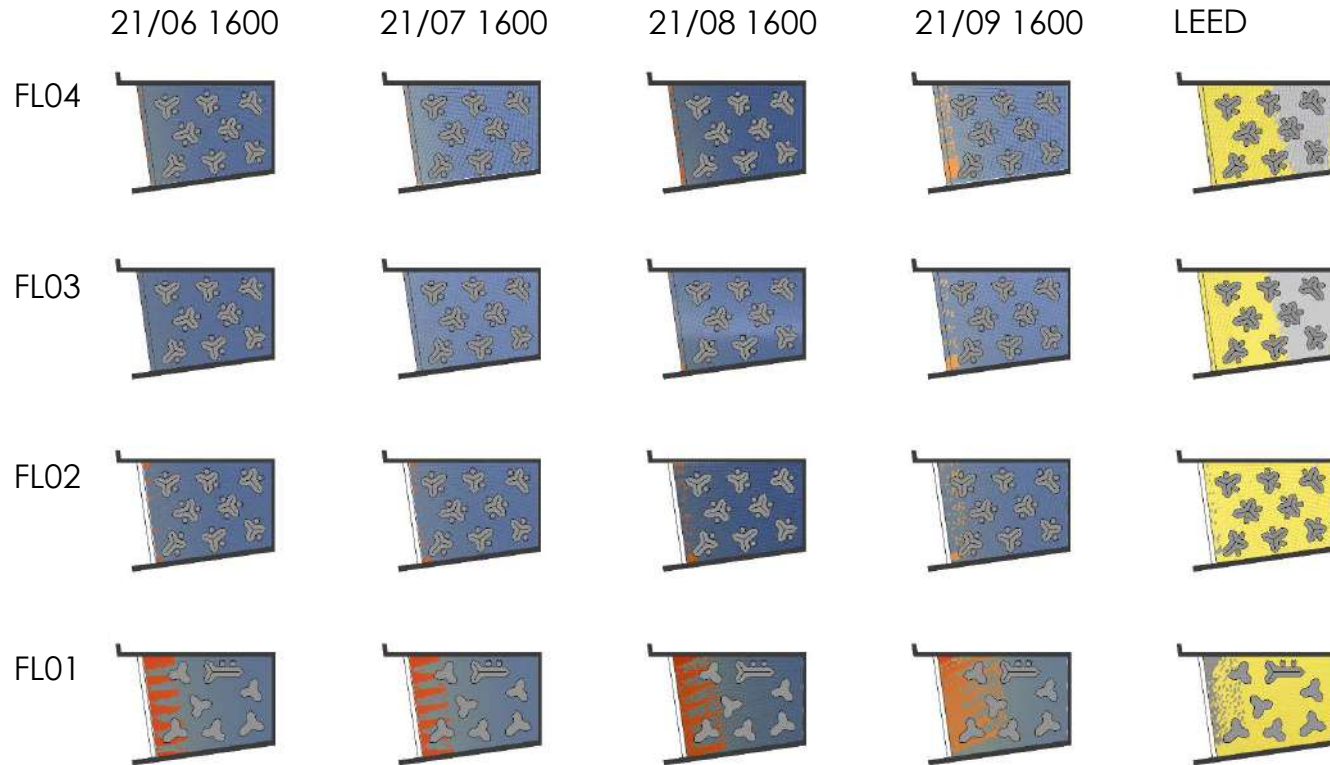
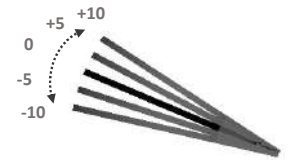
Vertical SAILS rotation [-5°] louvers [-30°]

## + SHADING + FAÇADE PLANTERS



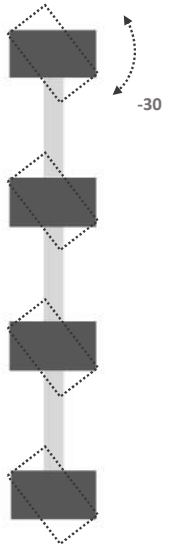
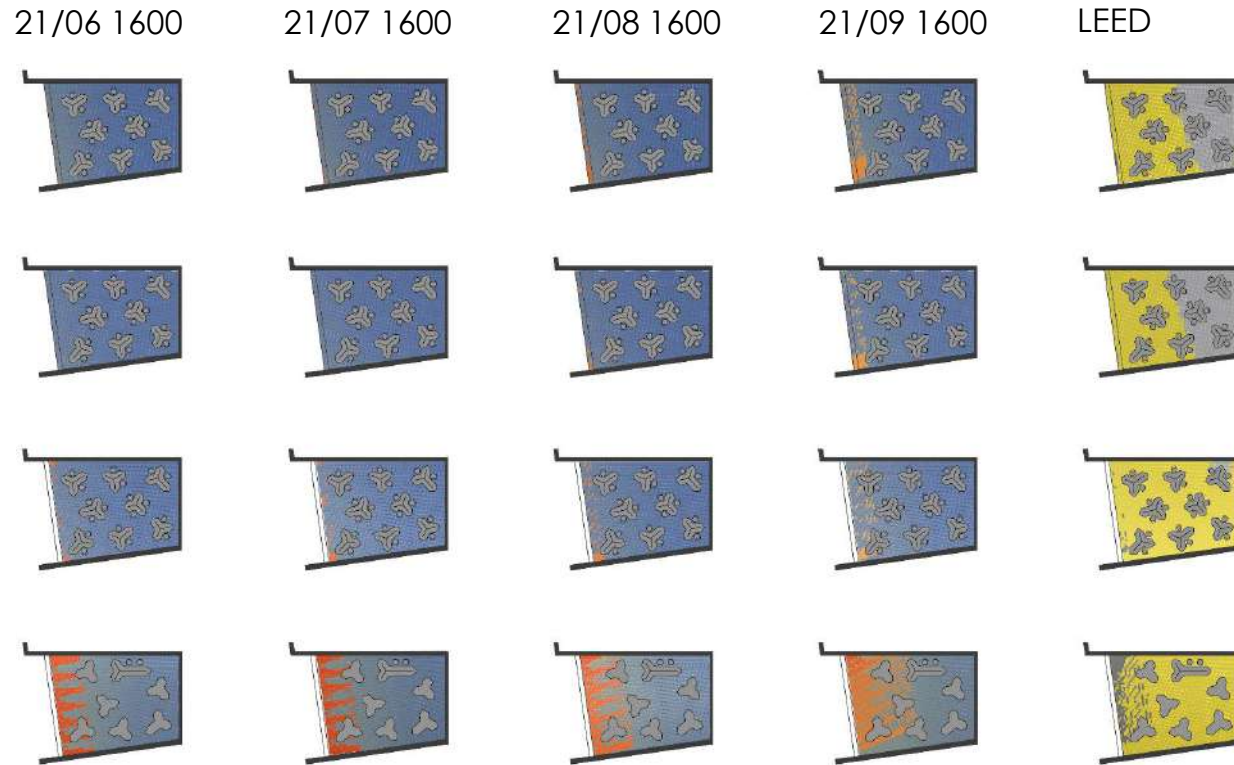
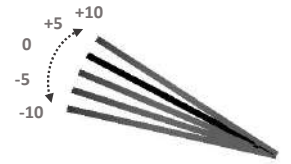
Vertical SAILS rotation [0°] louvers [0°]

## + SHADING + FAÇADE PLANTERS



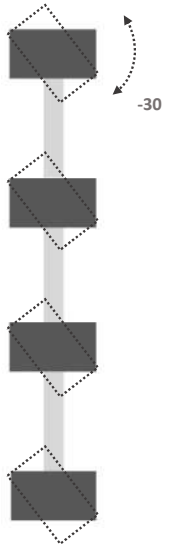
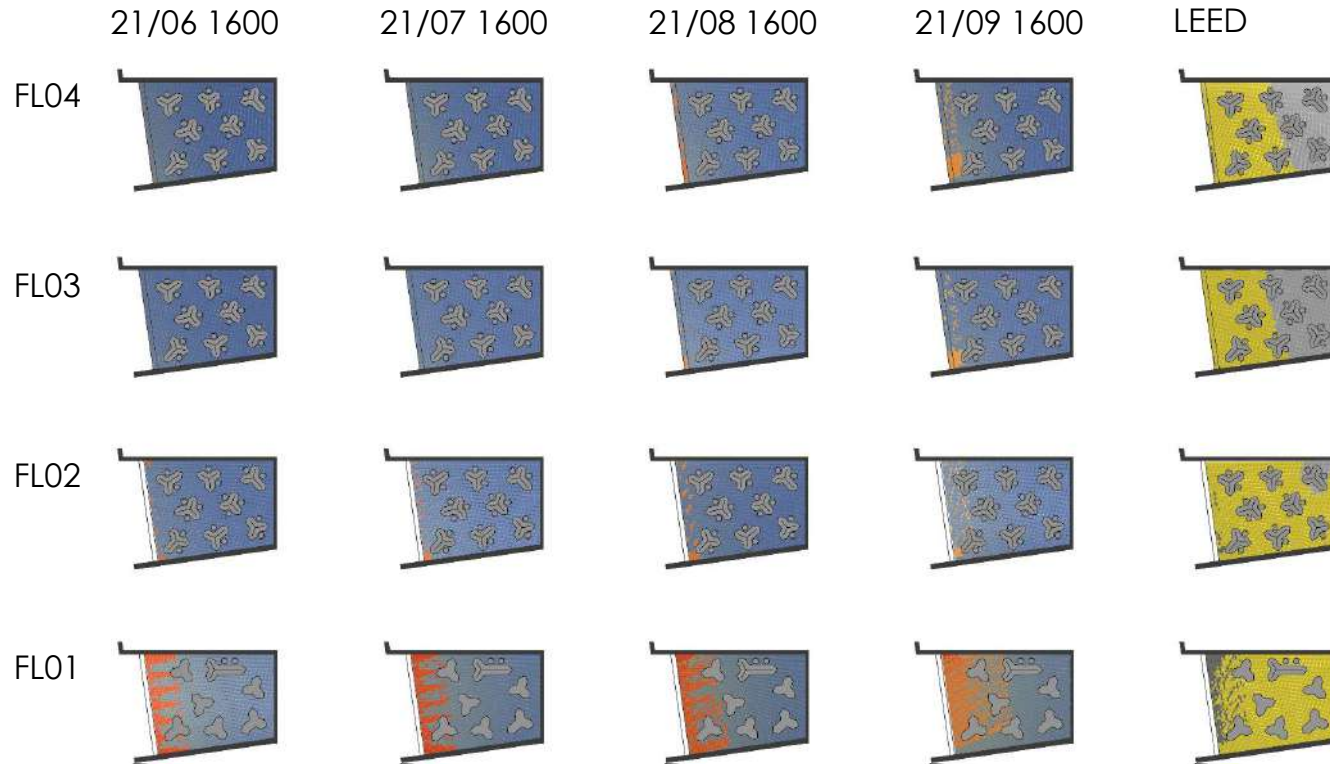
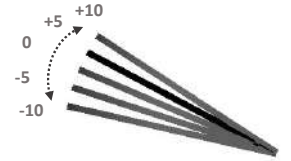
Vertical SAILS rotation  $[+5^\circ]$  louvers  $[-30^\circ]$

## + SHADING + FAÇADE PLANTERS

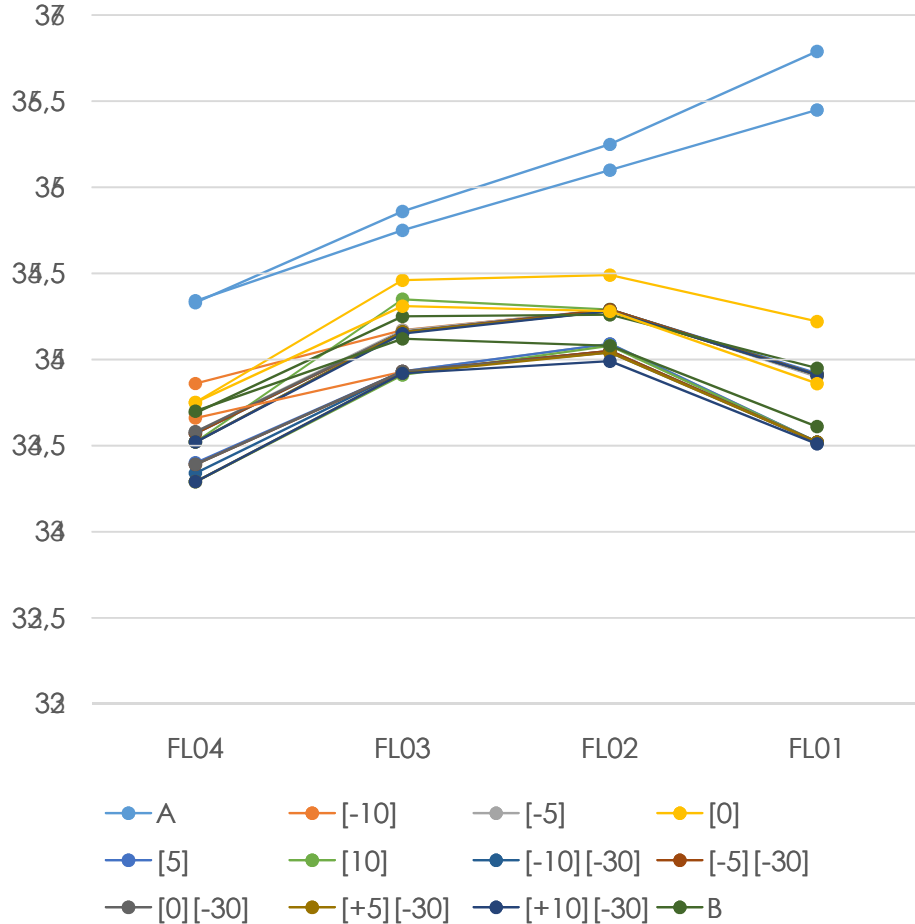


Vertical SAILS rotation  $[+10^\circ]$  louvers  $[-30^\circ]$

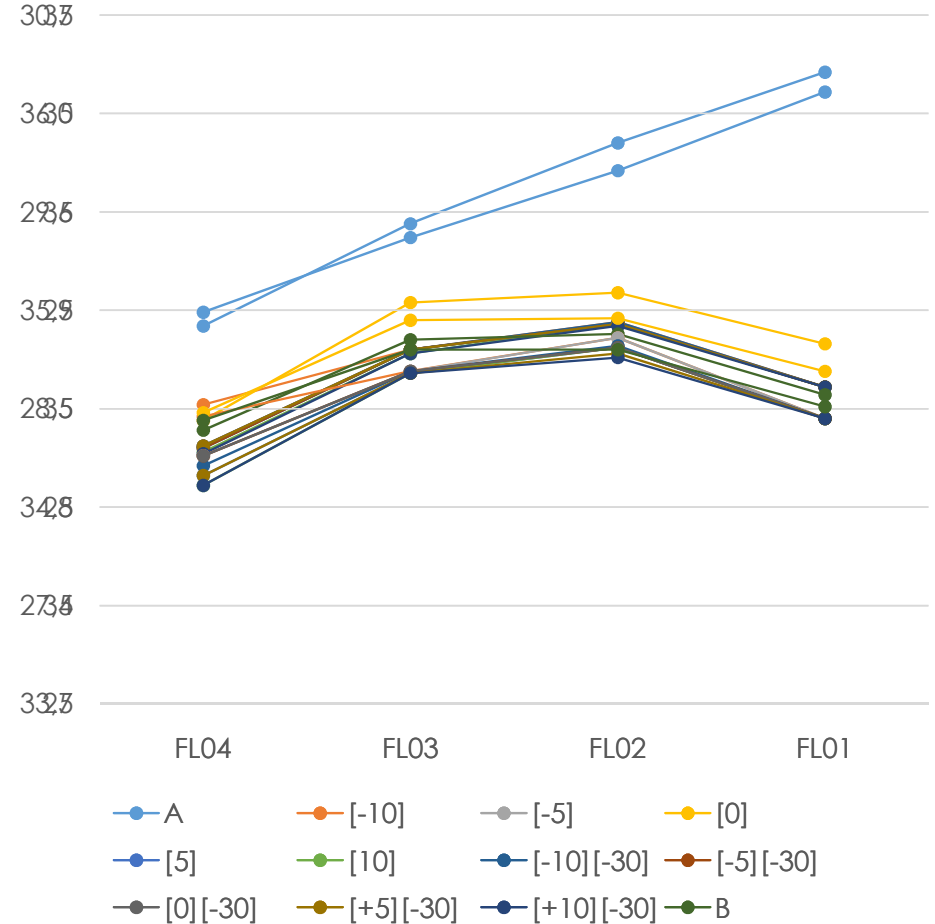
## + SHADING + FAÇADE PLANTERS



**Air Temperature [°C]**  
**21/08 16:00**

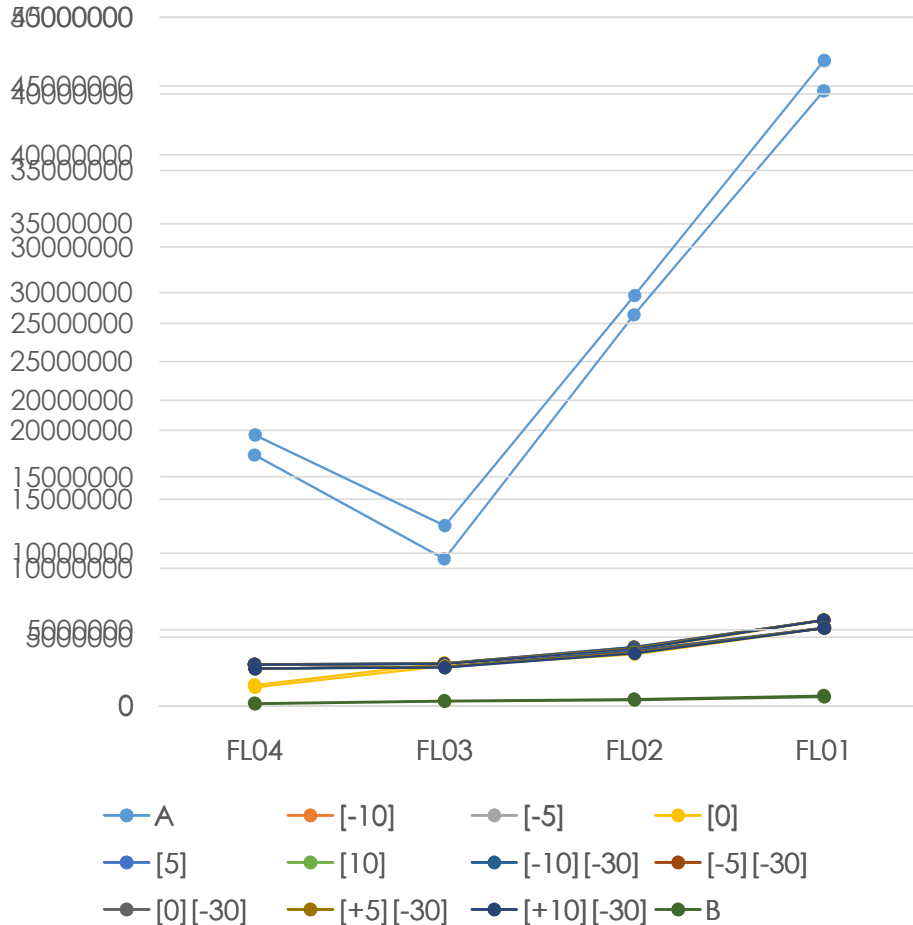


**Air Temperature [°C]**  
**21/09 16:00**

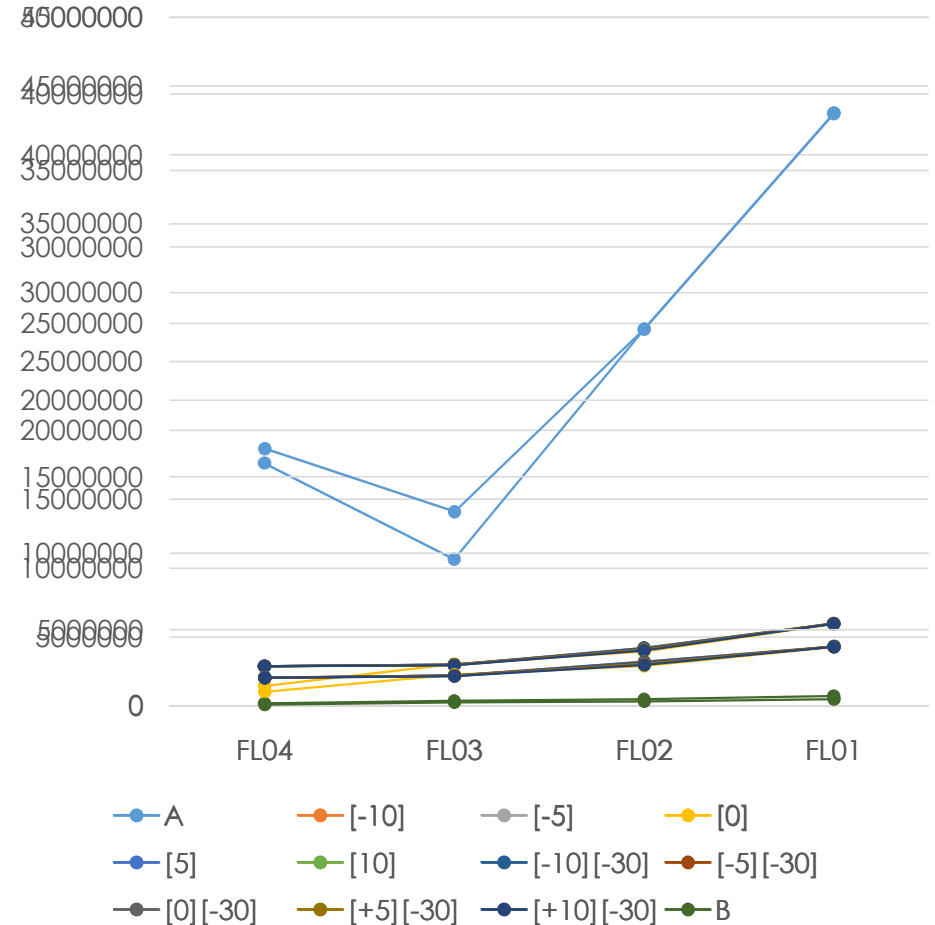




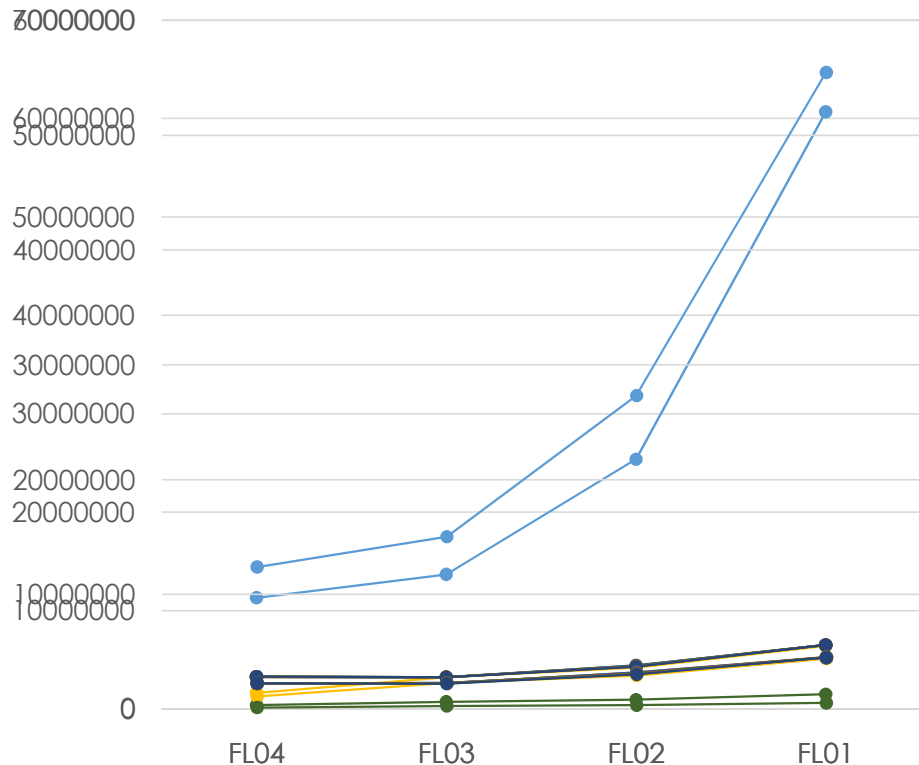
**Total Transmitted Solar Radiation Energy [J]**  
 21/08 16:00



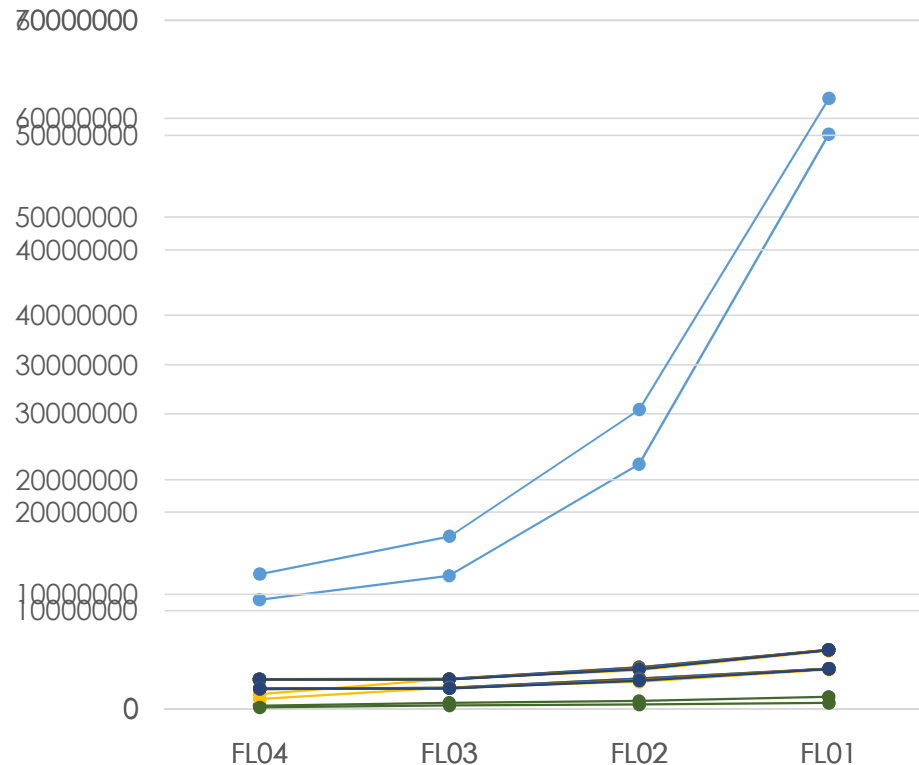
**Total Transmitted Solar Radiation Energy [J]**  
 21/07 16:00



**Total Heat Gain Energy [J]**  
21/08 16:00



**Total Heat Gain Energy [J]**  
21/09 16:00



- A
- [-10]
- [-5]
- [0]
- [5]
- [10]
- [-10] [-30]
- [-5] [-30]
- [0] [-30]
- [+5] [-30]
- [+10] [-30]
- B

- A
- [-10]
- [-5]
- [0]
- [5]
- [10]
- [-10] [-30]
- [-5] [-30]
- [0] [-30]
- [+5] [-30]
- [+10] [-30]
- B

A] BARE STRUCTURE, [-10], [-5], [0], [+5], [+10] + SHADING SYSTEM + FAÇADE PLANTERS B] + TREES, SHRUBS + SHADING SYSTEM + FAÇADE PLANTERS

# Analysis and development of an adaptive façade system integrated on a multi-storey office building

A. Couvelas, M. Matheou, M.C. Phocas

The above research is conducted under the European program MSCA Rise project OptArch.  
Work Package 5: Bioclimatic building design improved through performance optimization.

