DYNAMIC FAÇADE SYSTEMS

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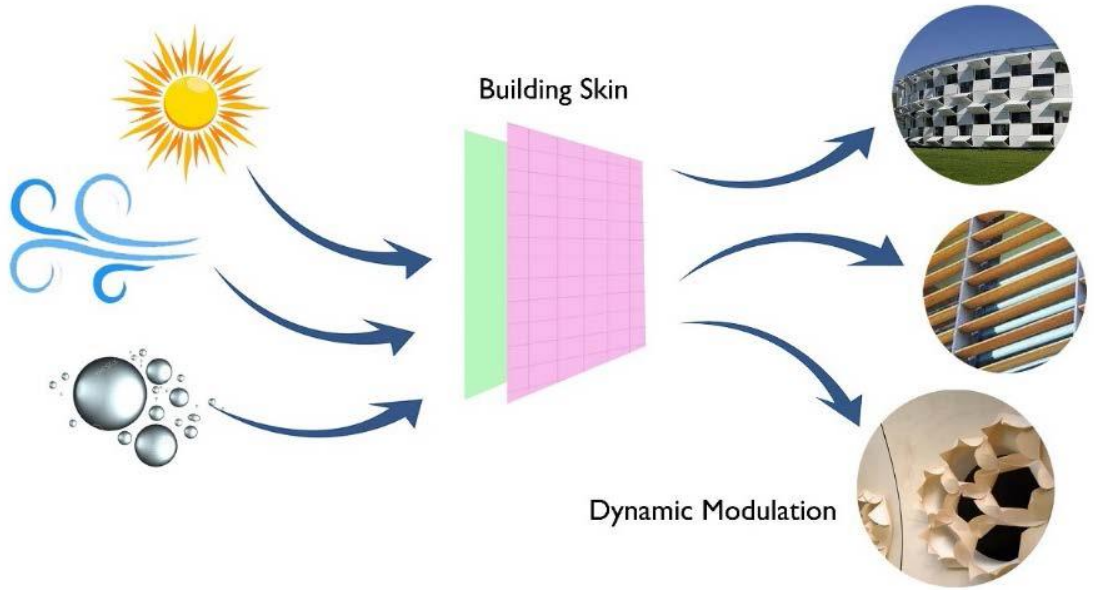
DESIGN INTENT

The facade is an integral part of the building that defines its interaction with its surroundings. And this interface between the building and its surroundings needs to be adaptive and responsive to the climatic forces acting upon it, rather than being static.

Our focus is the design of a dynamic facade prototype for the city of Ahmedabad in India, which is in the hot-dry climate. The current trend involves the blind aping of the western ‘glass box’ which is static and not suited to its climate. The intention of this project is to seek solutions to this issues of the built environment by emulating biomimetic logic and patterns in the facade system that modulate the extreme climate effectively.

Biomimicry is used as a problem solving methodology that will help in the discovery of dynamic, sustainable and effective solutions to issues such as thermal comfort, energy efficiency, durability and productivity.

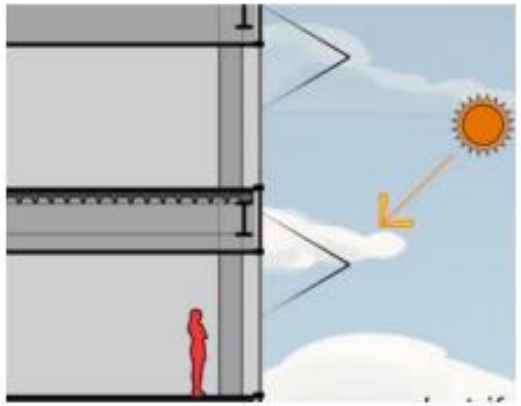
Hence, the intent of this project is to demonstrate the effectiveness of the design of smarter, climate responsive and more intuitive facades in a hot-dry climate in India.



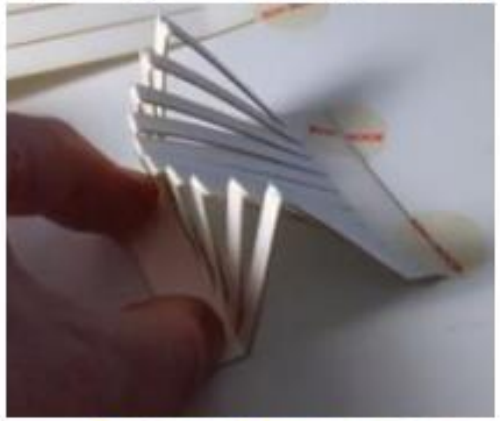
PRECEDENT RESEARCH : SUNBREAK

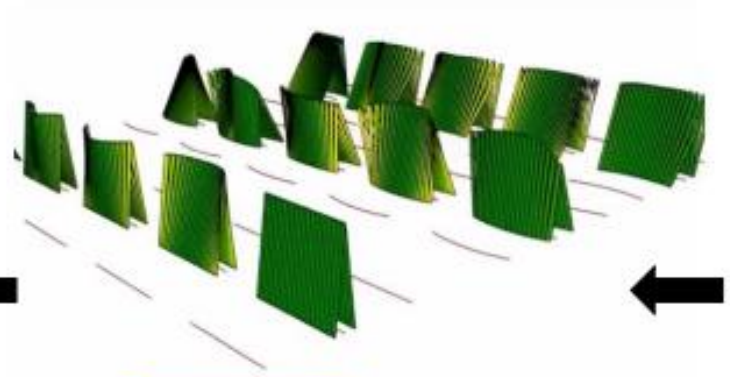
DESIGN INTENT:

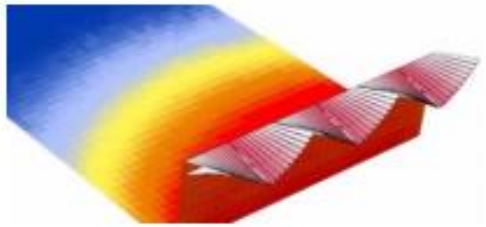
WHAT IF A BUILDING COULD RESPOND TO THE SUN?



Exploring a Three-hinged Design





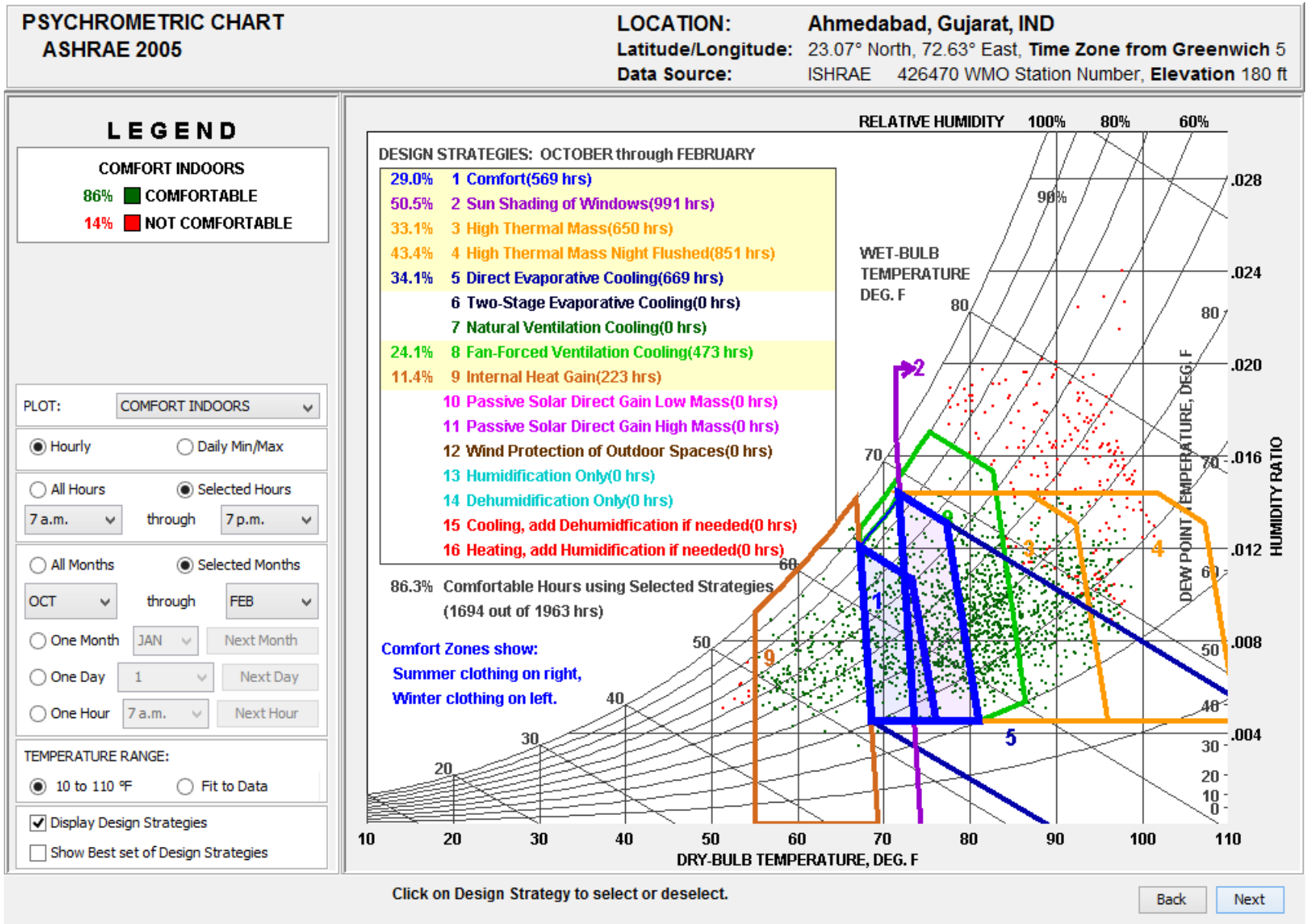


Modelling And Analysis Of Ideas

'The Sunbreak ' : Smart sunshades

SOURCE : NBBJ

AHMEDABAD, INDIA, HOT-DRY CLIMATE



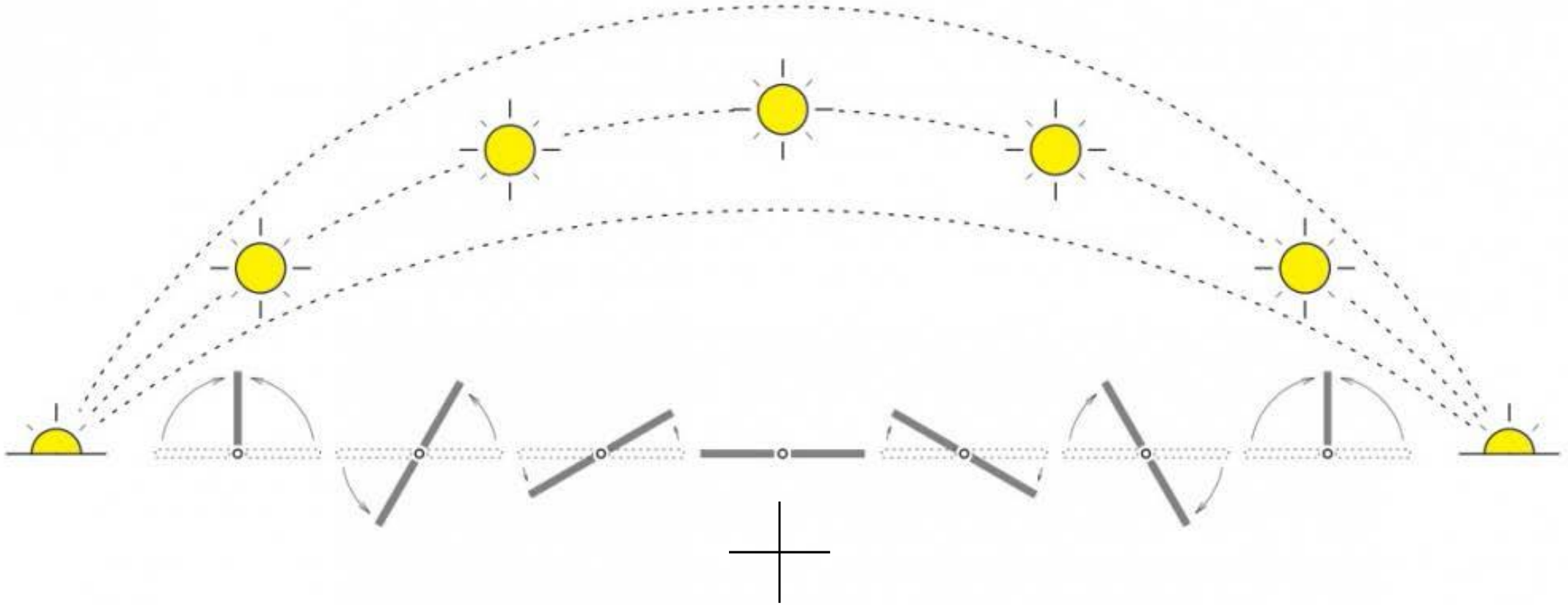
High Performance Shading

Heat Gain Reduction

Natural Ventilation

BIO-FAÇADE SYSTEMS

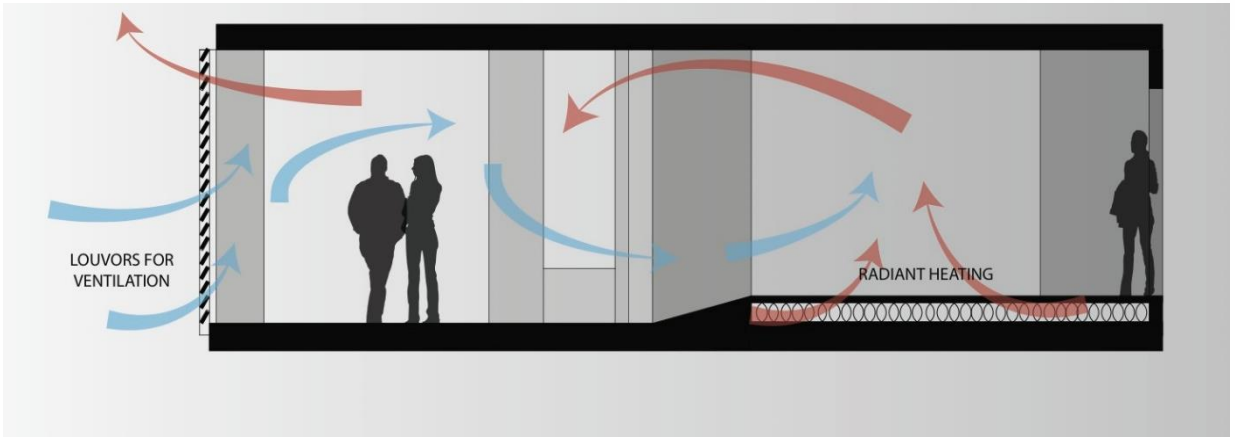
KEY DESIGN OUTCOMES



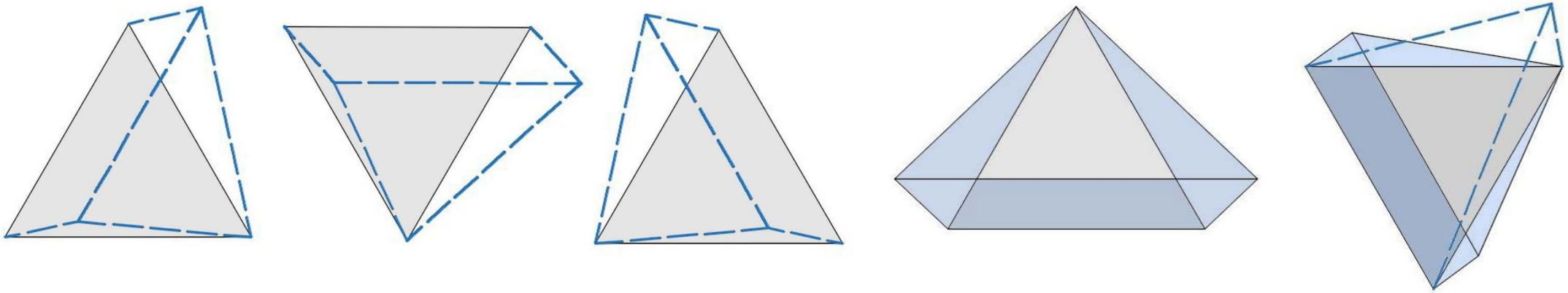
Shading

+

Ventilation



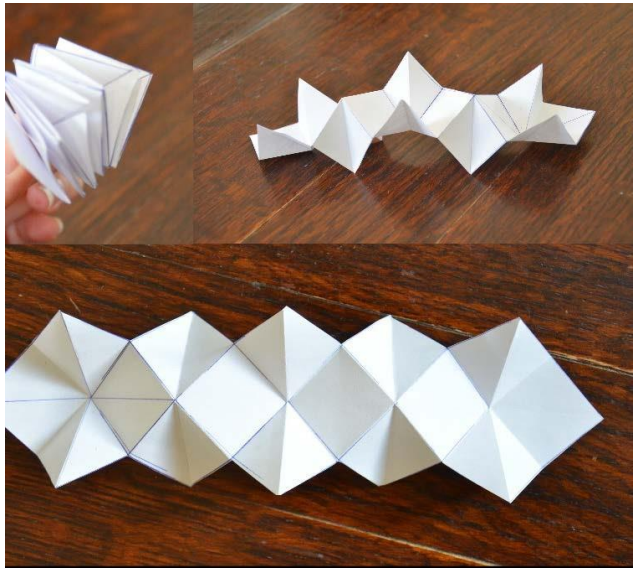
INITIAL FORM DEVELOPMENT

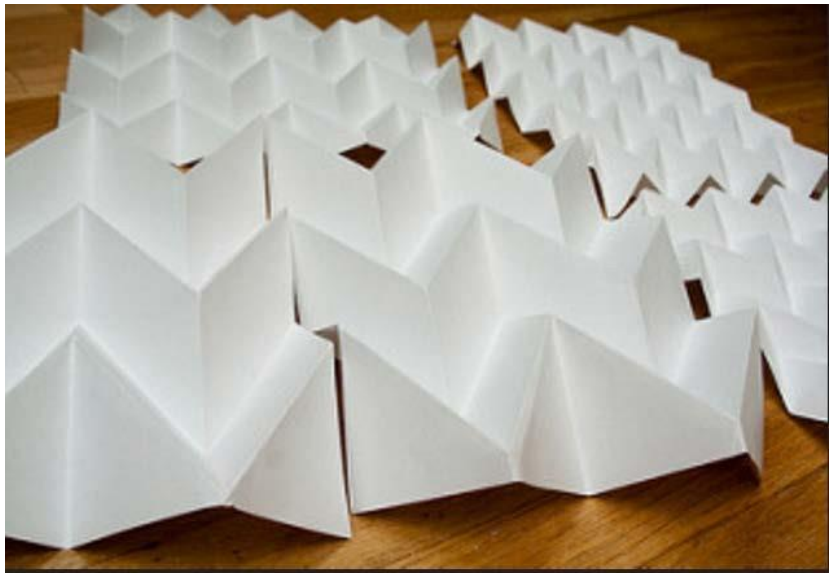


EXPLORING FOLDS

Exploring a variation in shading potential and possible types of dynamic movement to block sunlight from at a certain angle and a specific direction depending on the orientation of the façade and time of the day

Experimenting with origami : understanding various folding types and behaviours that the system could exhibit

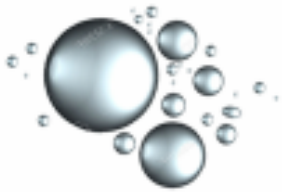




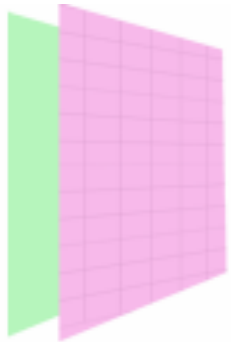
Algorithmic logic for the system :

- Sunpath
- Solar Radiation
- Temperature Ranges

- Wind-rose pattern
- Intensity
- Speeds



- Relative humidity
- Di-urnal swings
- Temperature ranges



Develop Form

Data Set

Determine
Extents of impact

Dynamic Modulation

Movement

Aperture

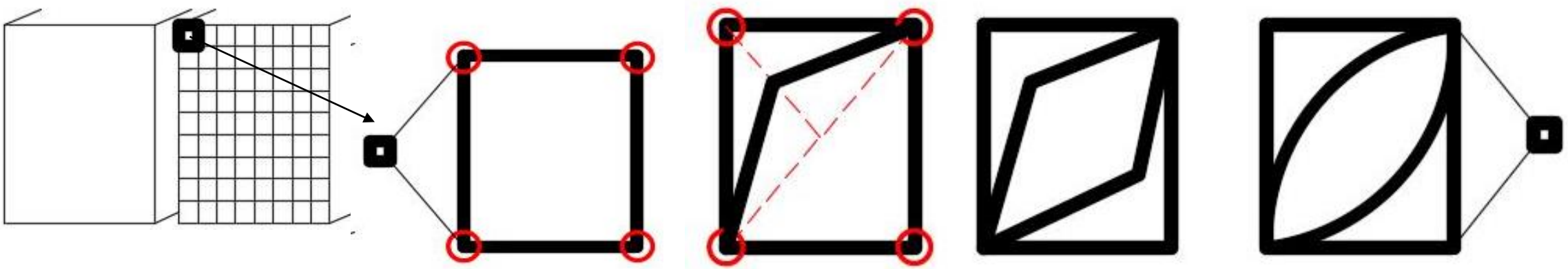
Structure

Action Forces

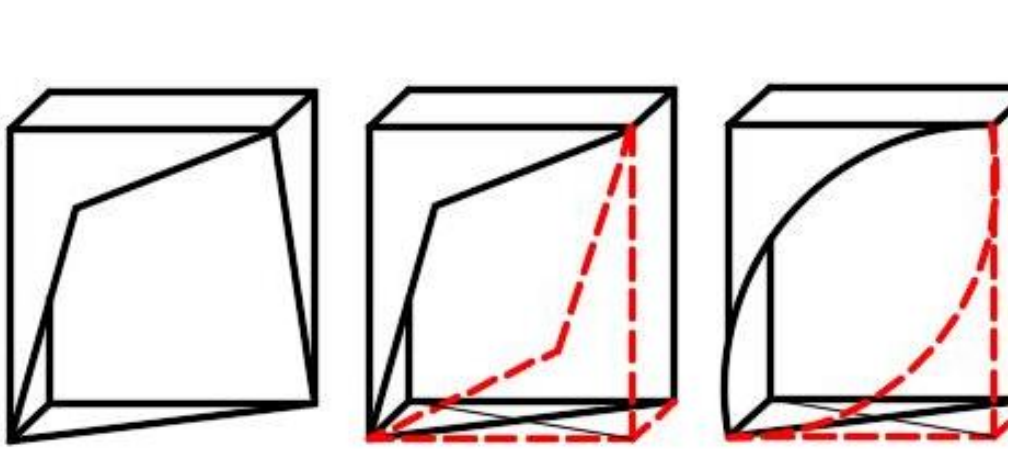
Quantified Response

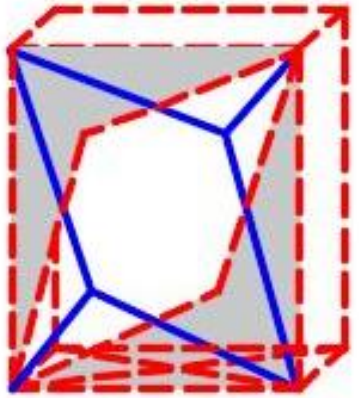
BIO-FAÇADE SYSTEMS

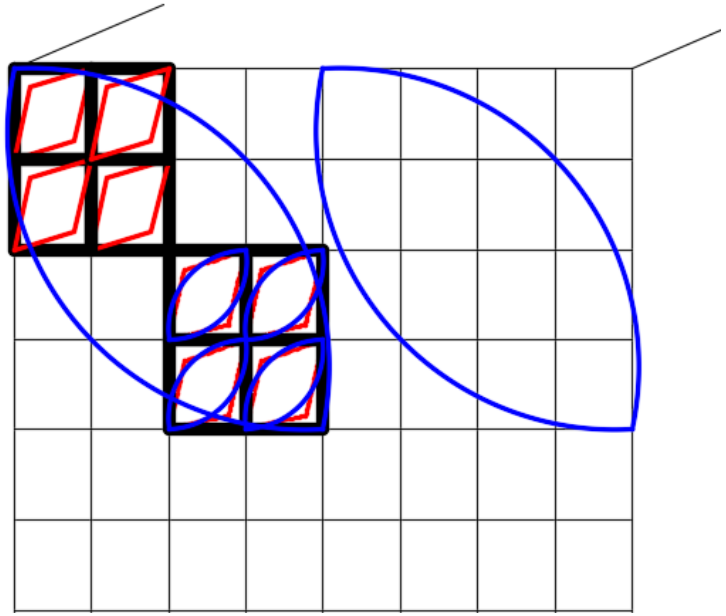
Design Development:



CONCEPT OF MODULES







A LAYERED SYSTEM OF SHADING ELEMENTS

What does the system do?

Input

- Weather File (.epw)
- Sun Path: Altitude, Azimuth
- Dynamic skin

Variables

- Sun Position
  - Hour
  - Day
  - Month
- Aperture and Overhang

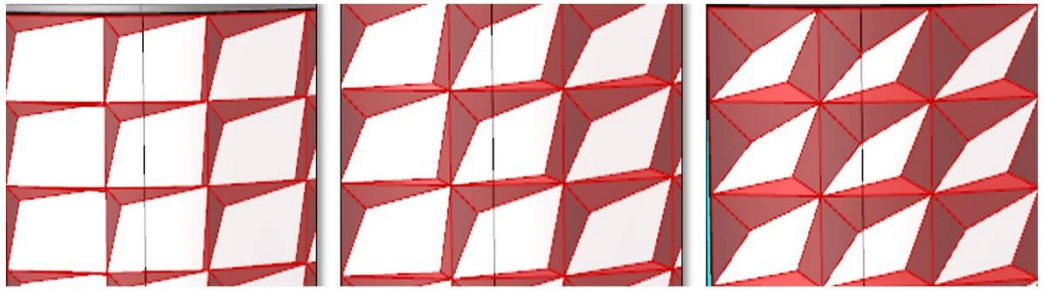
Outputs

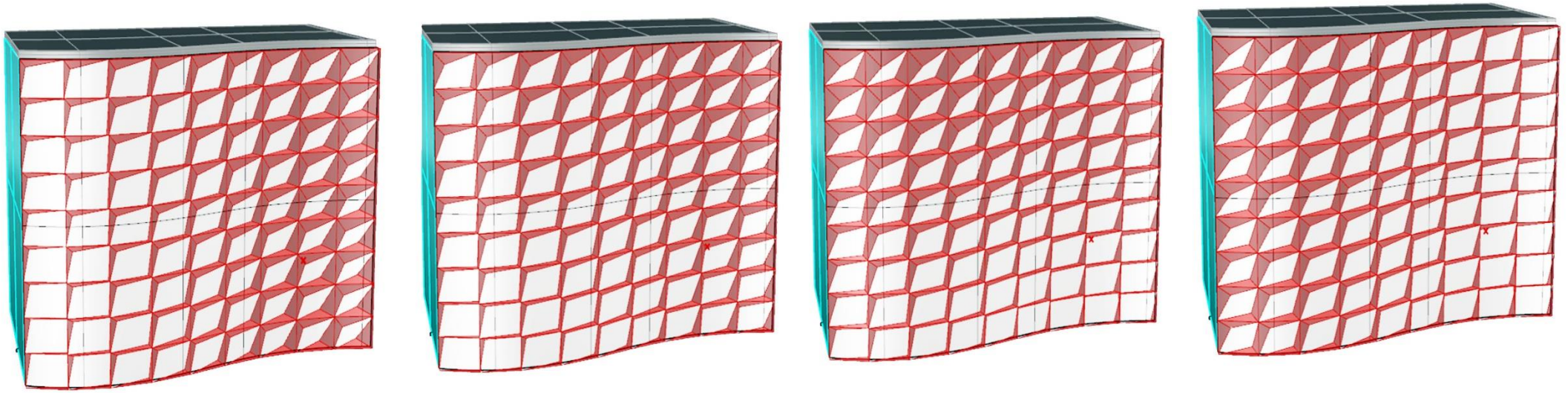
- Dynamic behaviour of system
- Radiation Map showing effectiveness

SHADING

Dynamic module 1

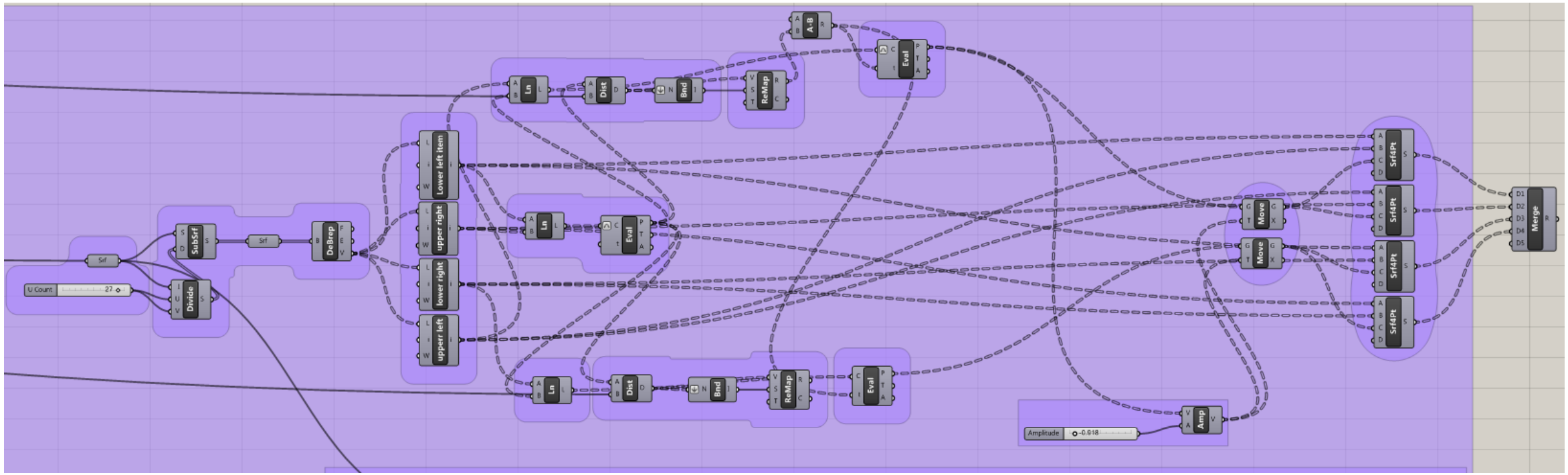
Grid of modules

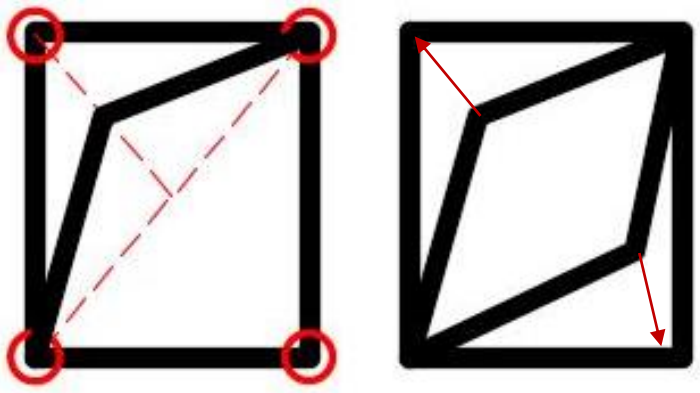




Distribution of the systems across the facade

Grasshopper algorithm for the module 1





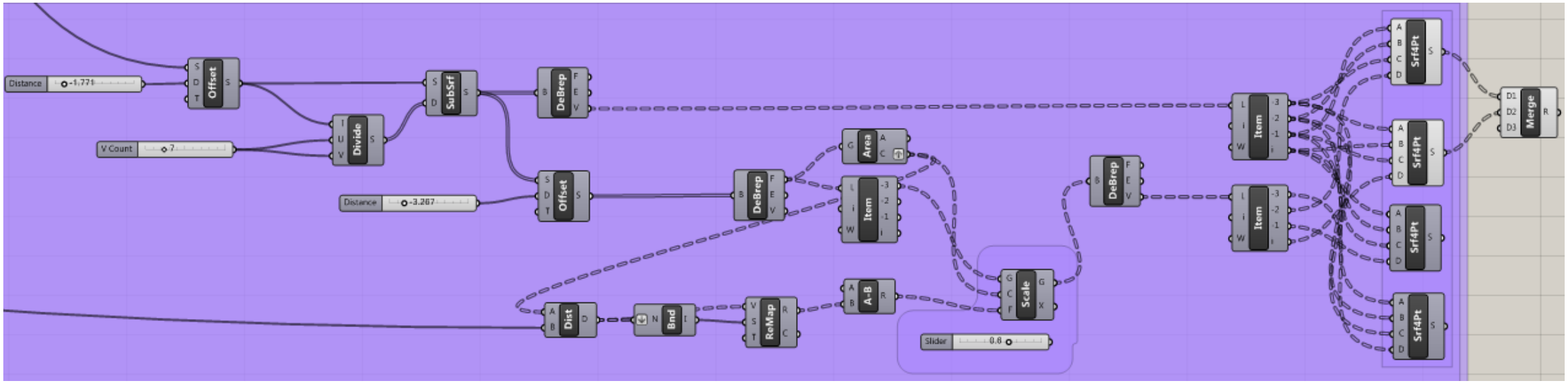
BIO-FAÇADE SYSTEMS

SHADING

Dynamic module 2

Distribution of the systems across the facade

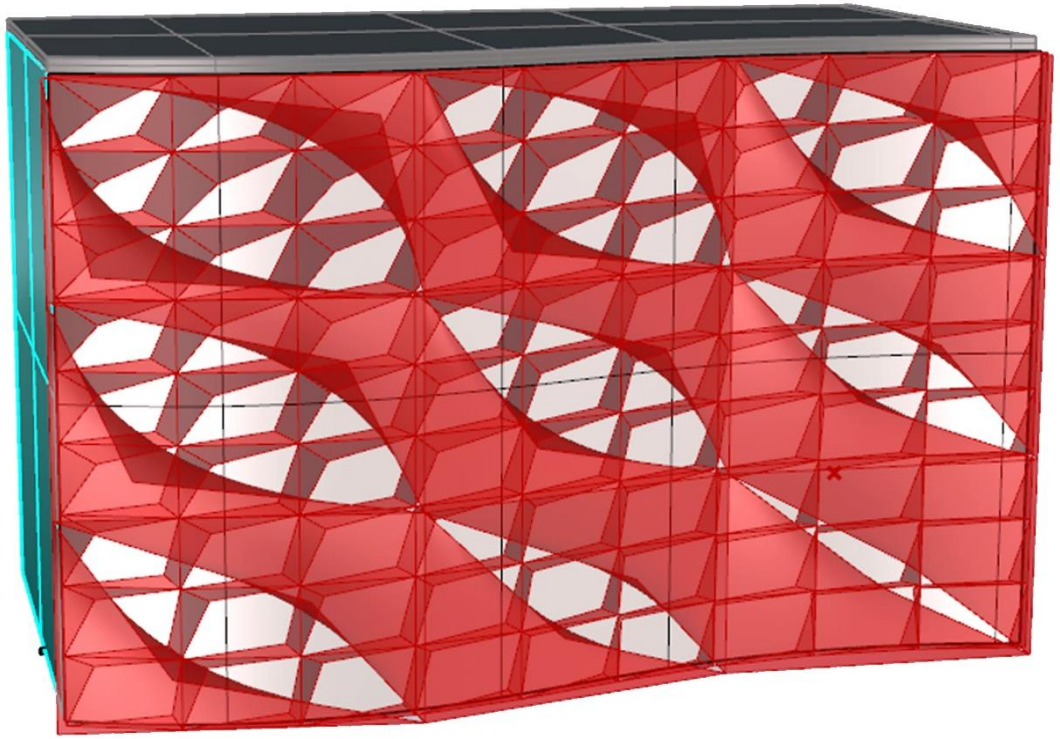
Grasshopper algorithm for the module 2

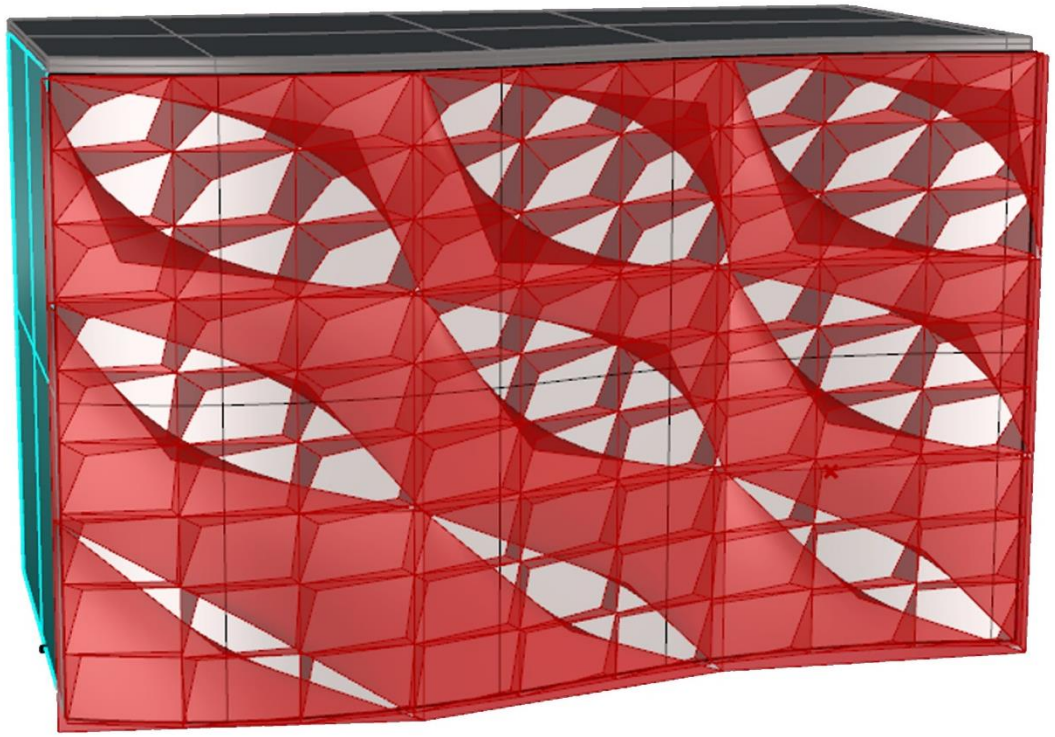


Pattern over pattern overlay : A coordinated shading system

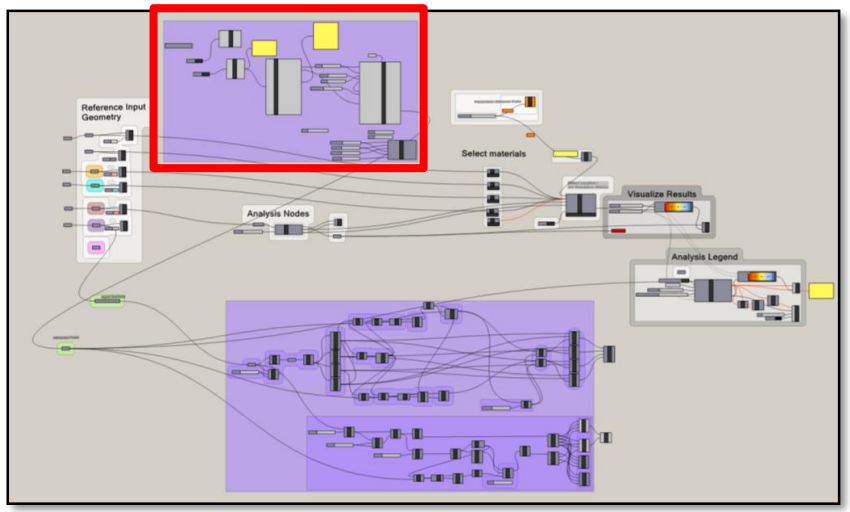
Overlapping of both façade systems in order to tackle sunlight and air flow simultaneously

Experimenting with the dynamic behavior of apertures



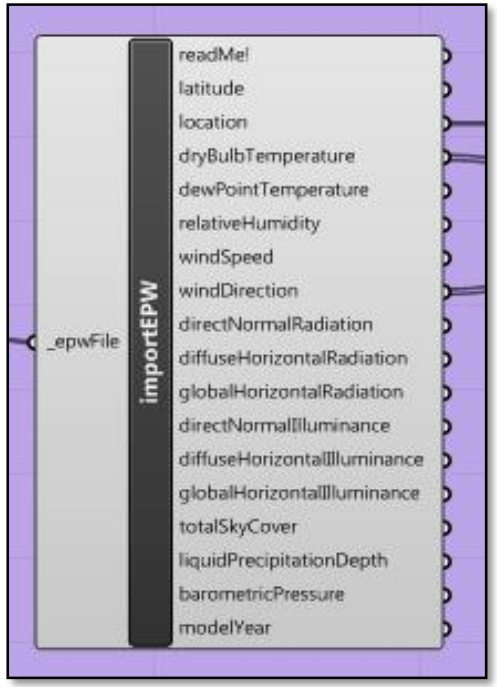


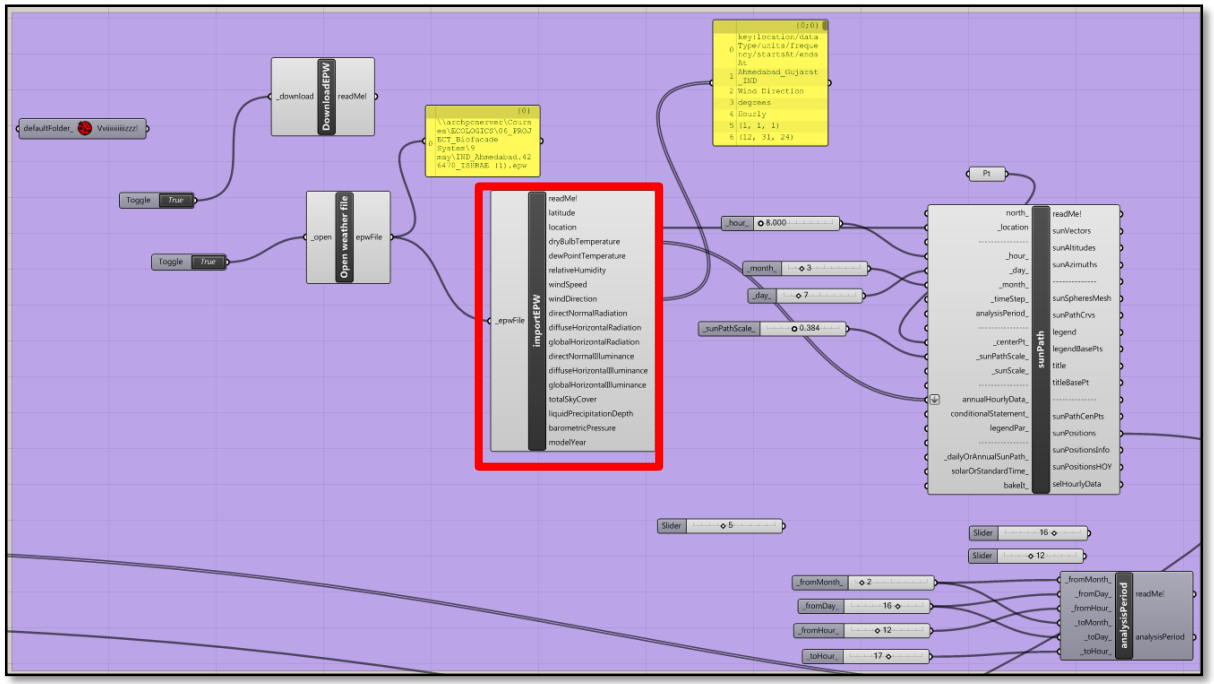
Controlling variability based on Climate data



Ladybug Weather file Input

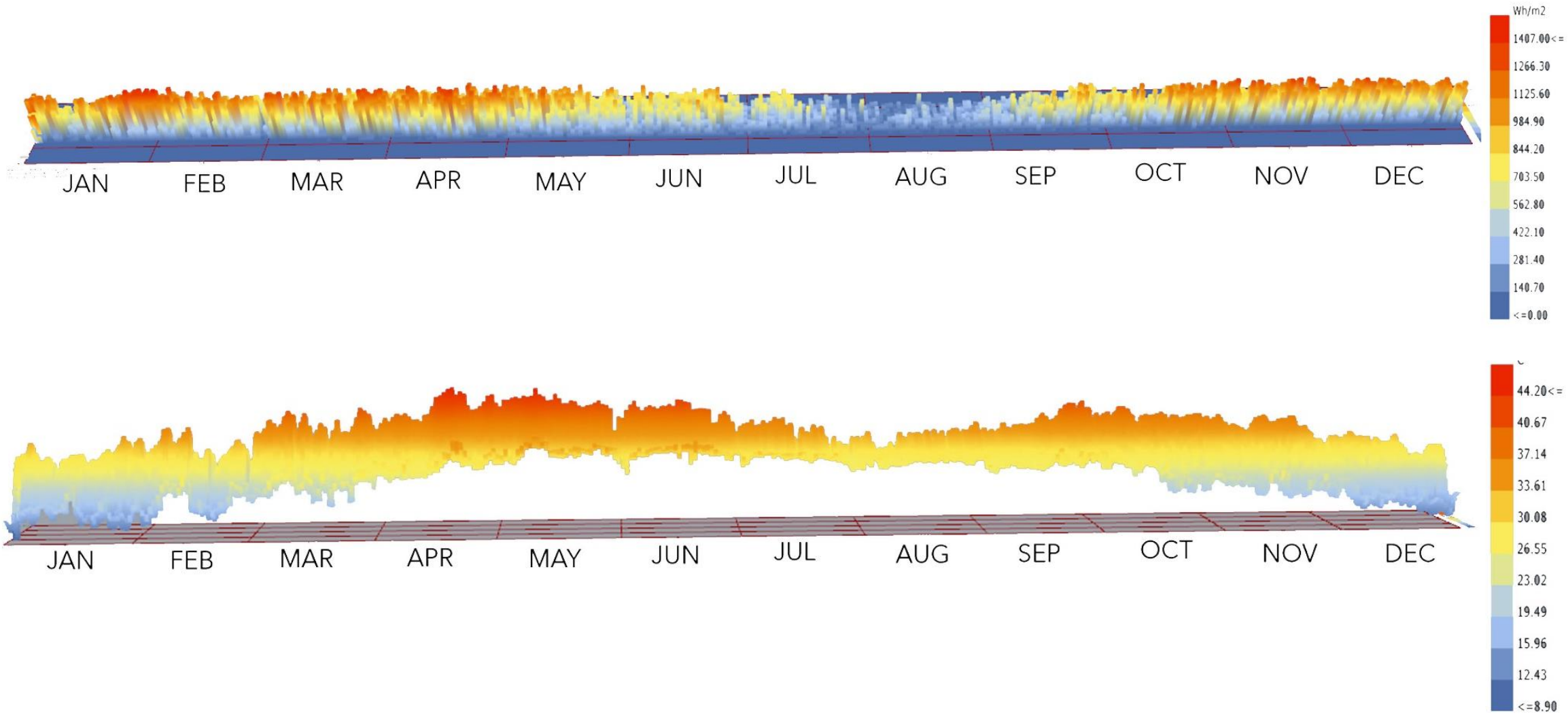
SUN as the attractor point that controls the dynamic nature of the facade





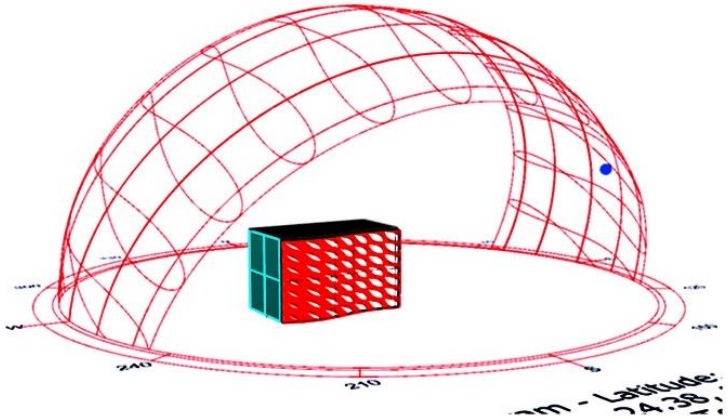
BIO-FAÇADE SYSTEMS

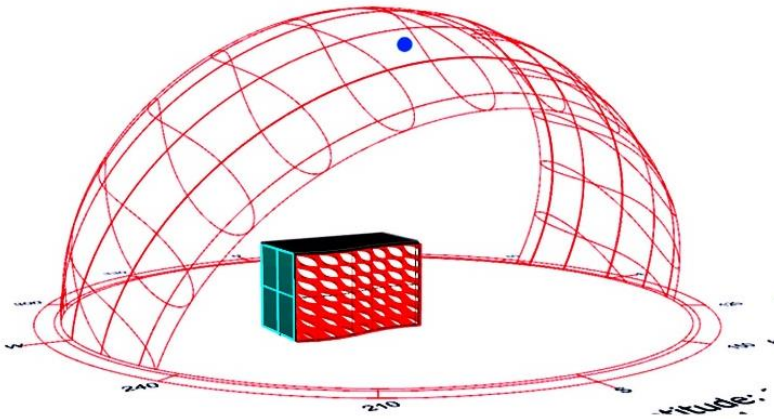
LADYBUG Input – Radiation & Temperature, Ahmedabad

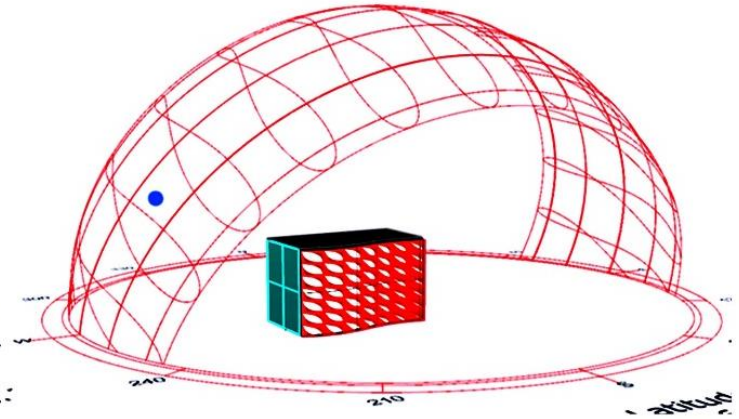


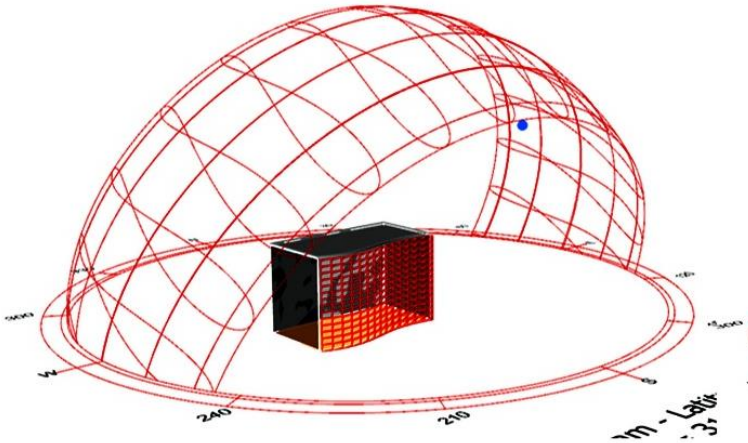
BIO-FAÇADE SYSTEMS

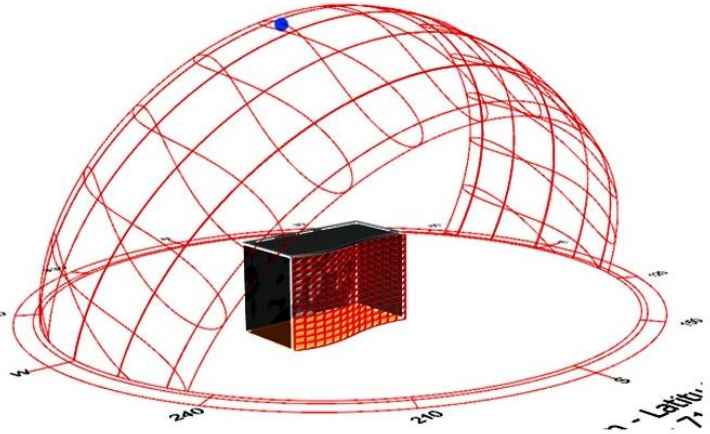
Ladybug: Variables

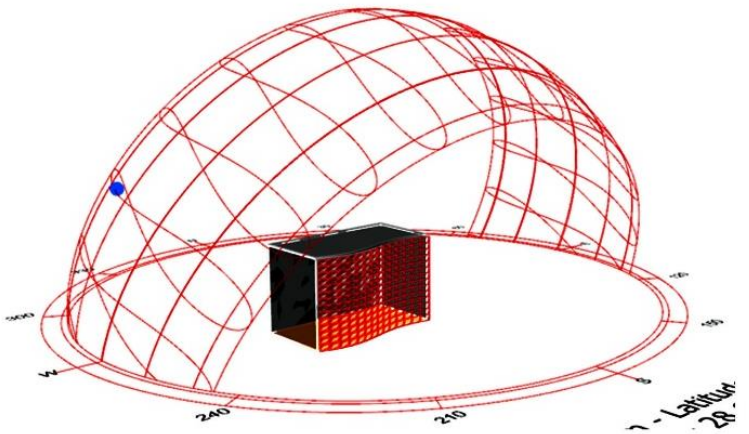












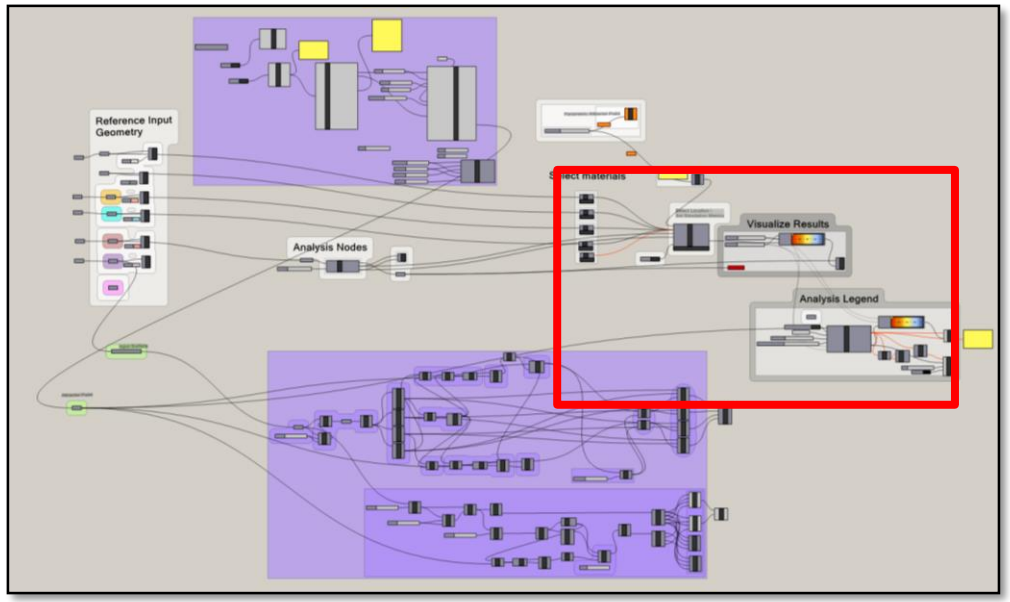
9am March December

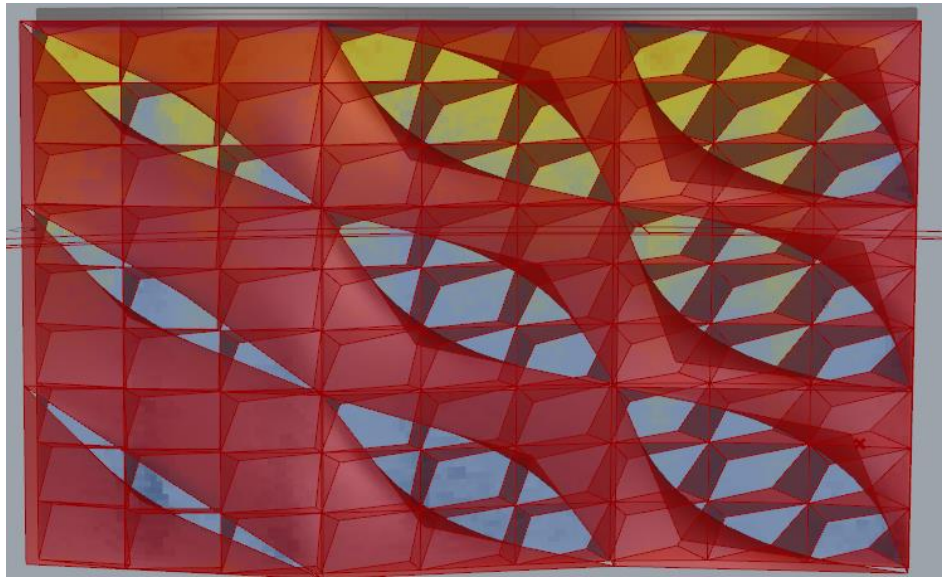
12pm March December

3pm March December

BIO-FAÇADE SYSTEMS

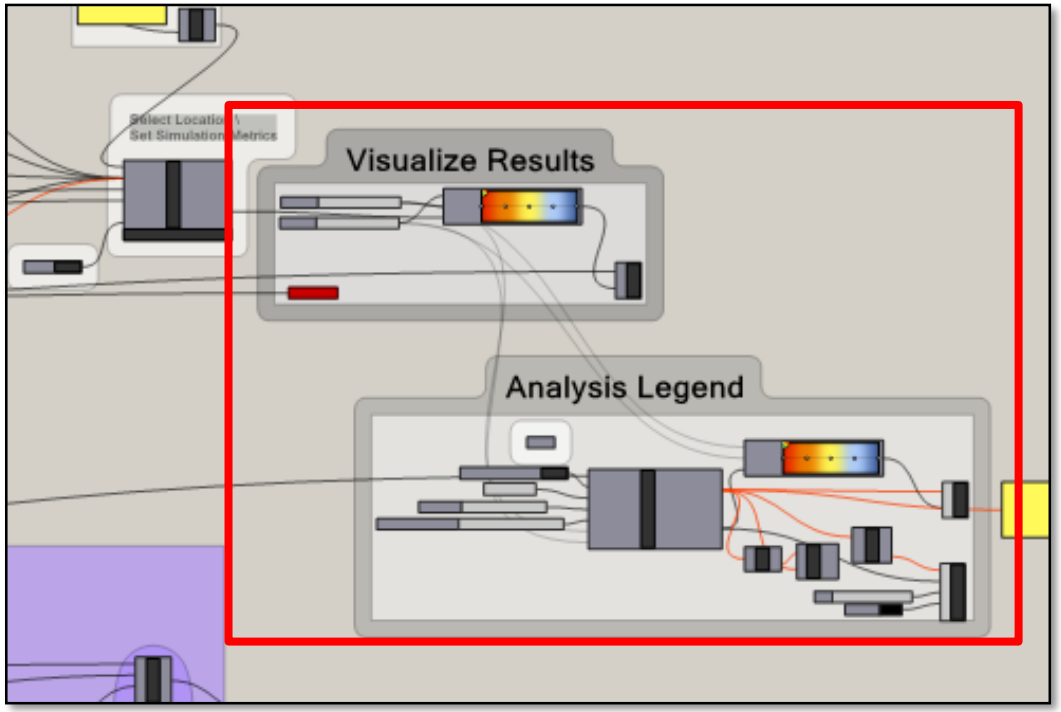
Controlling variability based on Climate data





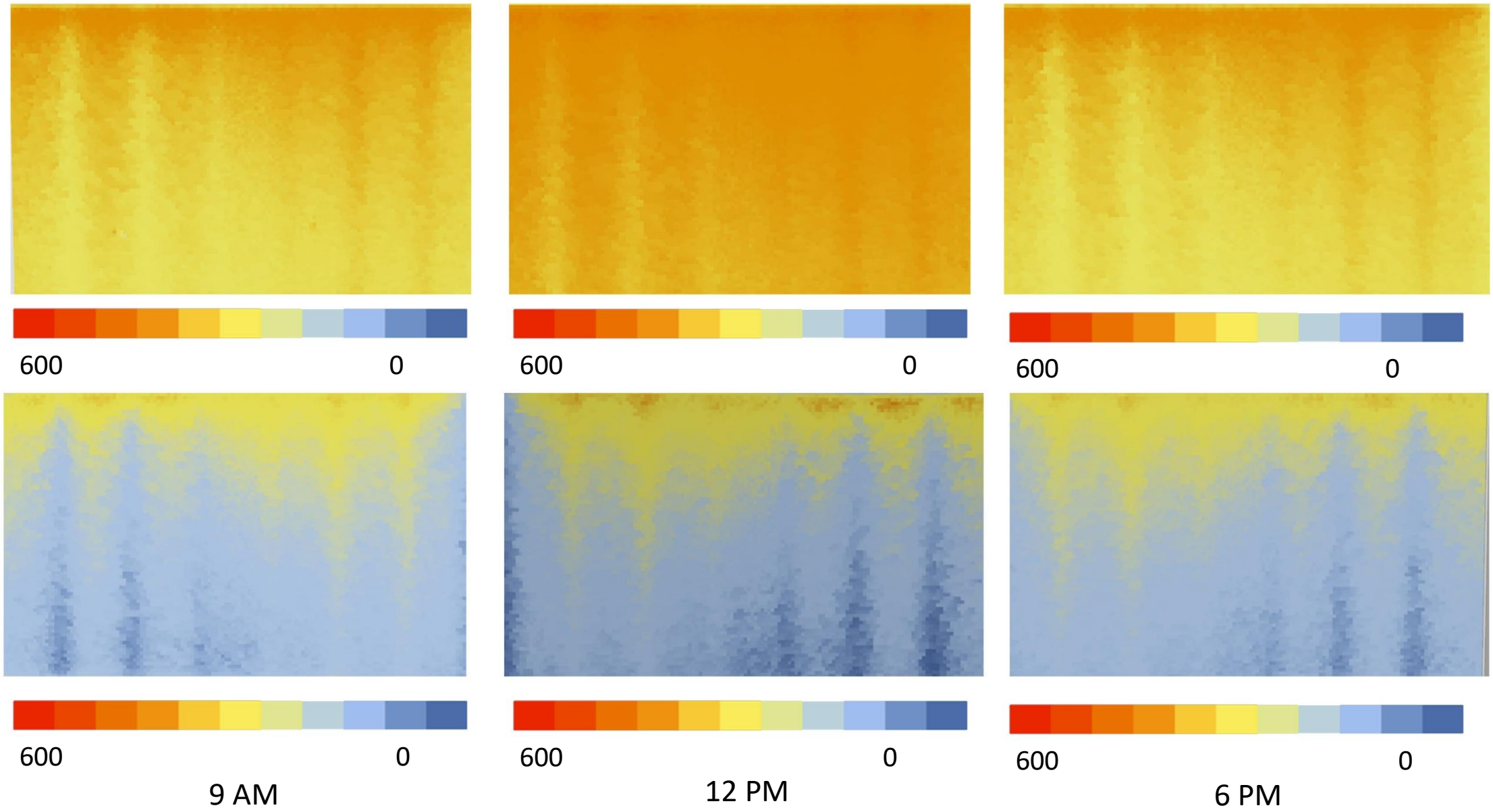
DIVA Weather file Input

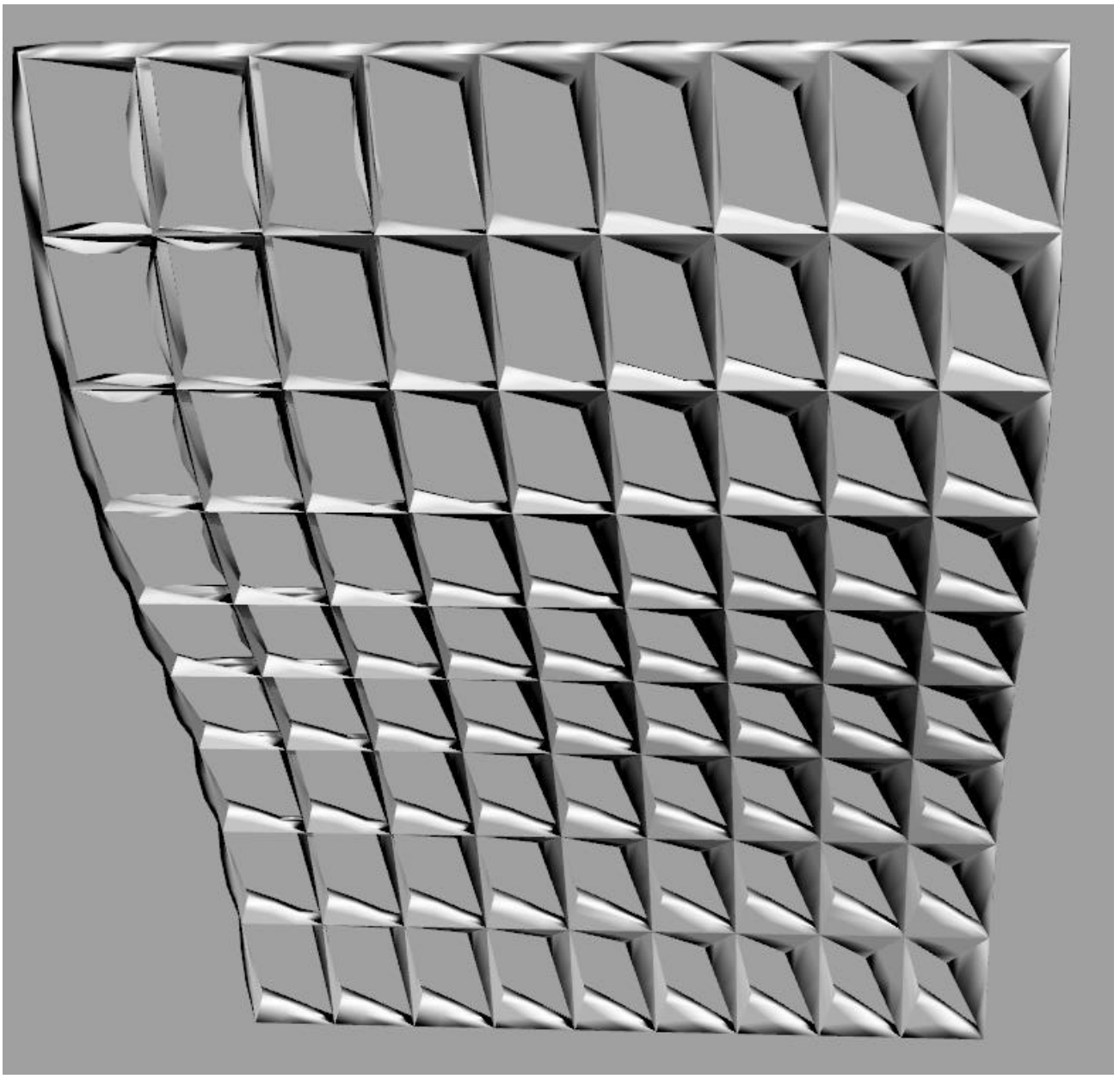
Solar Radiation Data to reduce radiation gains on facade

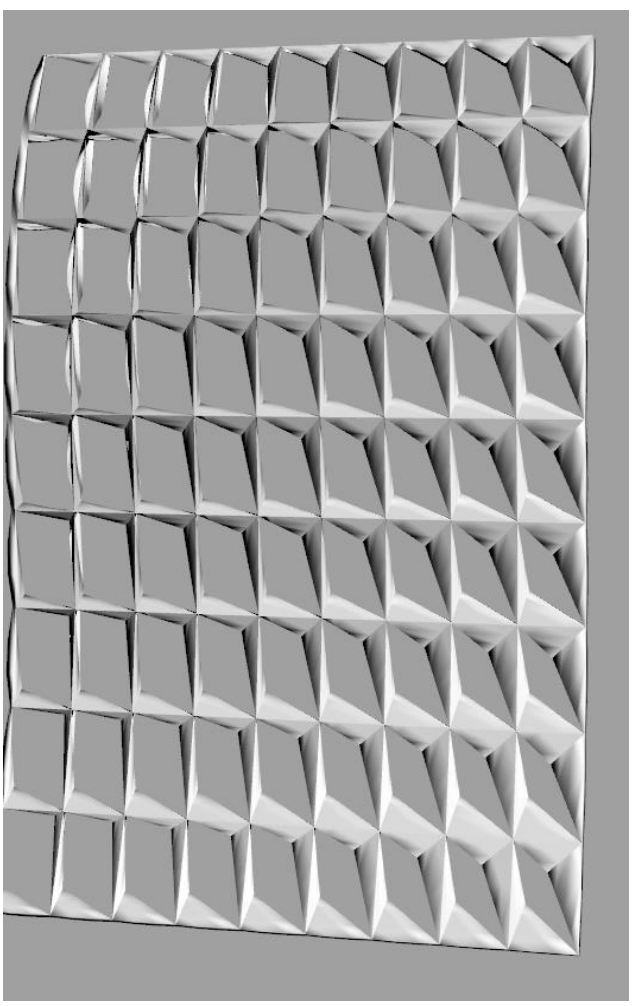


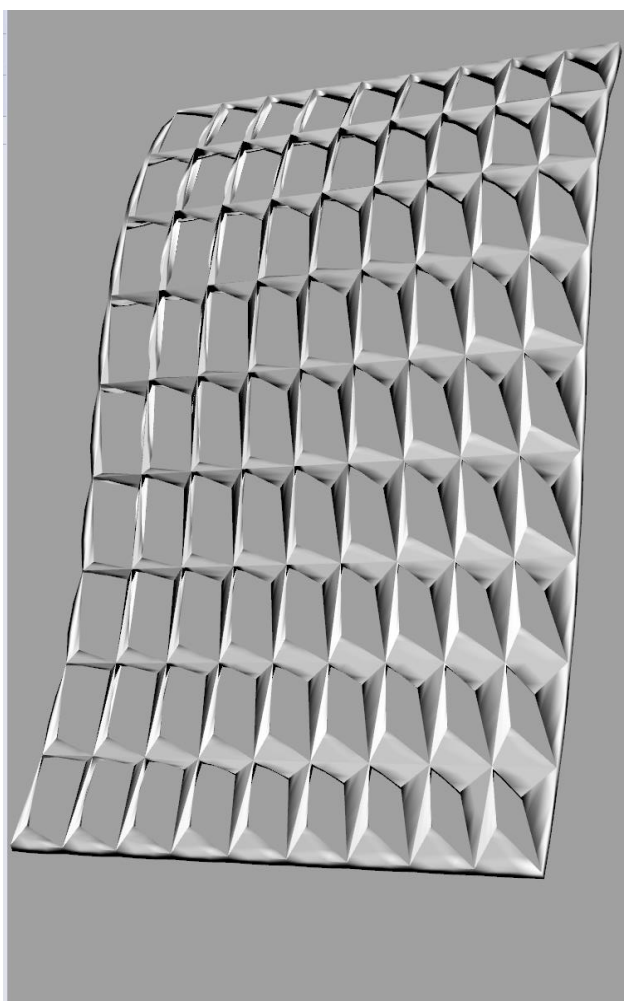
BIO-FAÇADE SYSTEMS

DIVA Output- Radiation Analysis









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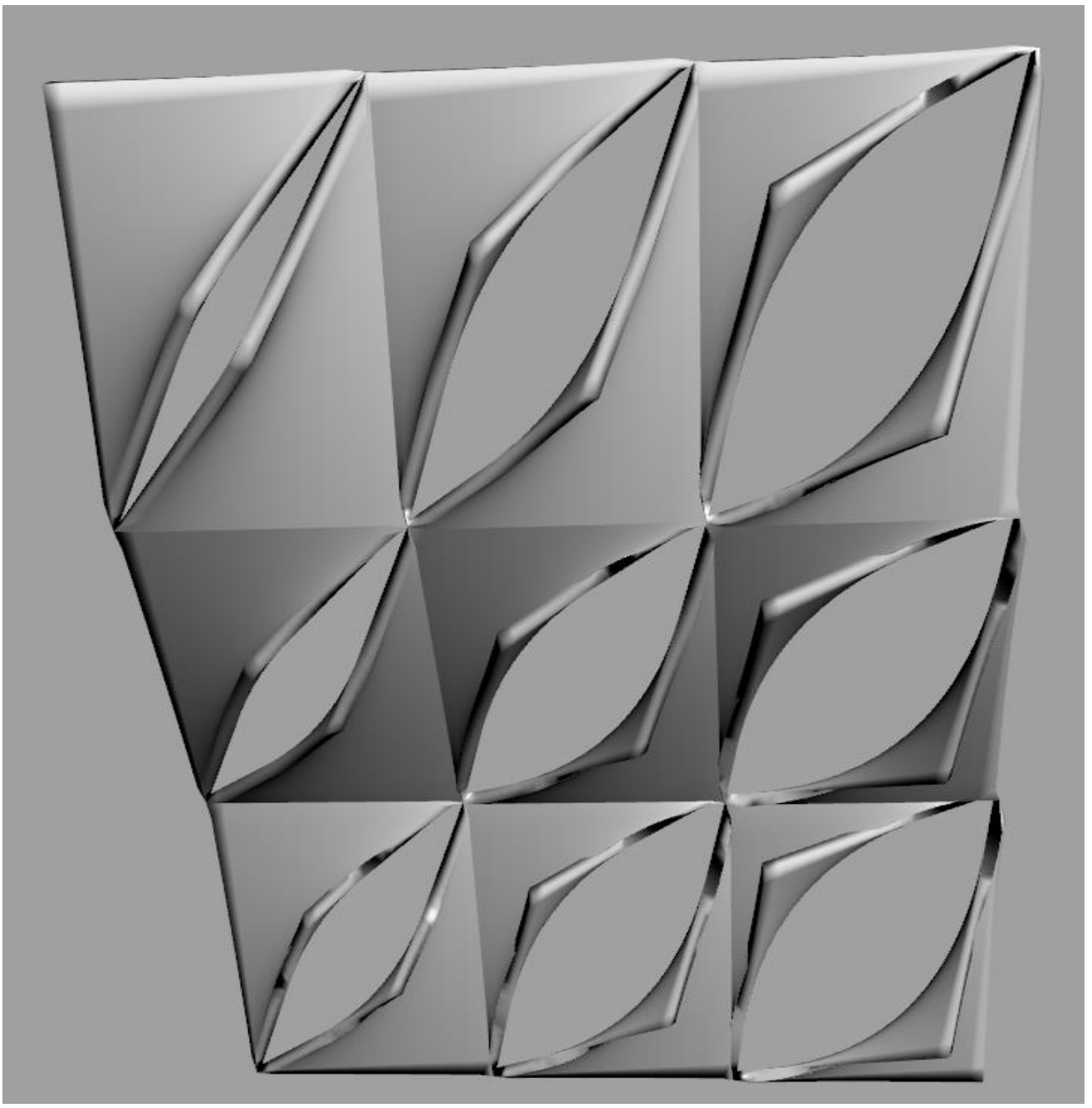

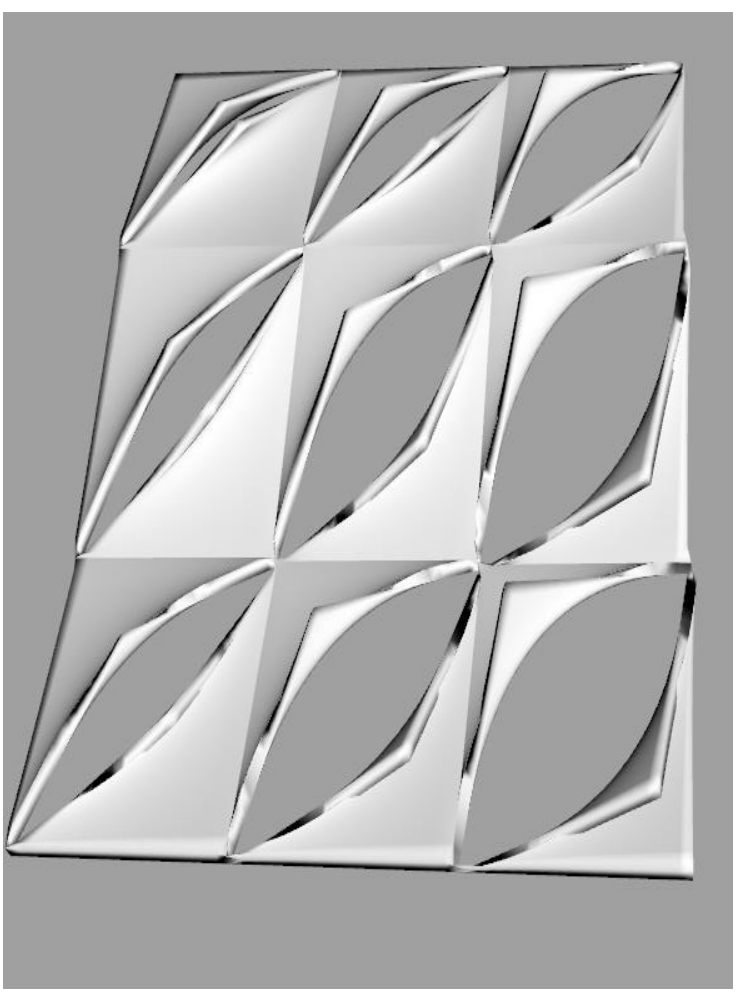

DYNAMIC FAÇADE SYSTEM