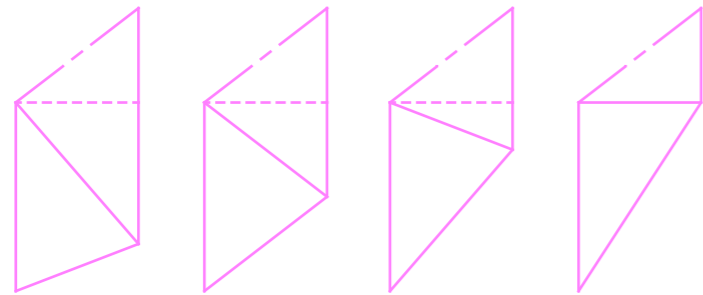


LUMAFOLD

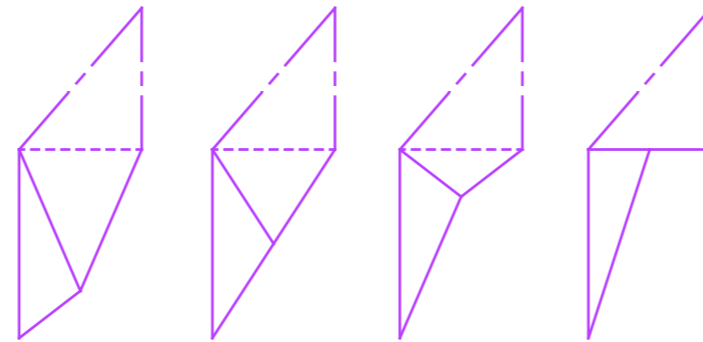
Presentation Group 6:

BEN 2103: Design Workshop
Michael Bugeja, Greta Stella Camilleri Laus, Daniel Schembri

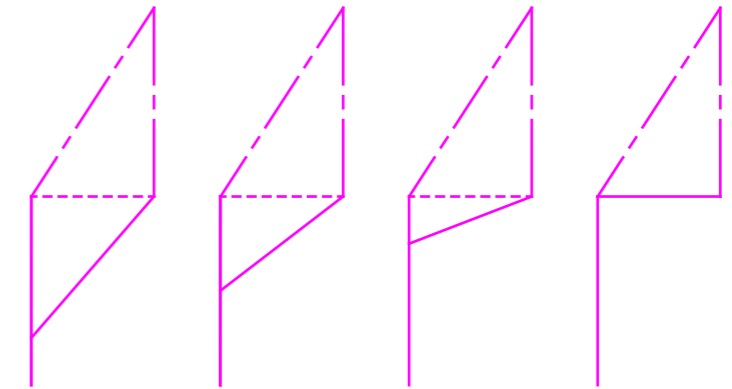
12 UNIQUE PANEL VARIATIONS TO CHOOSE FROM



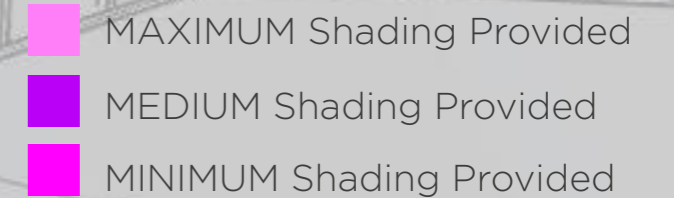
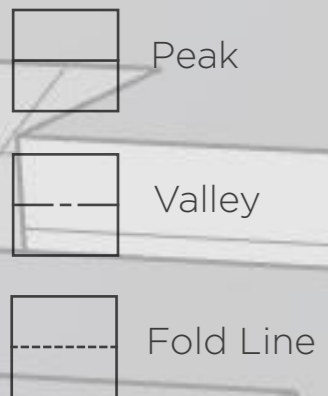
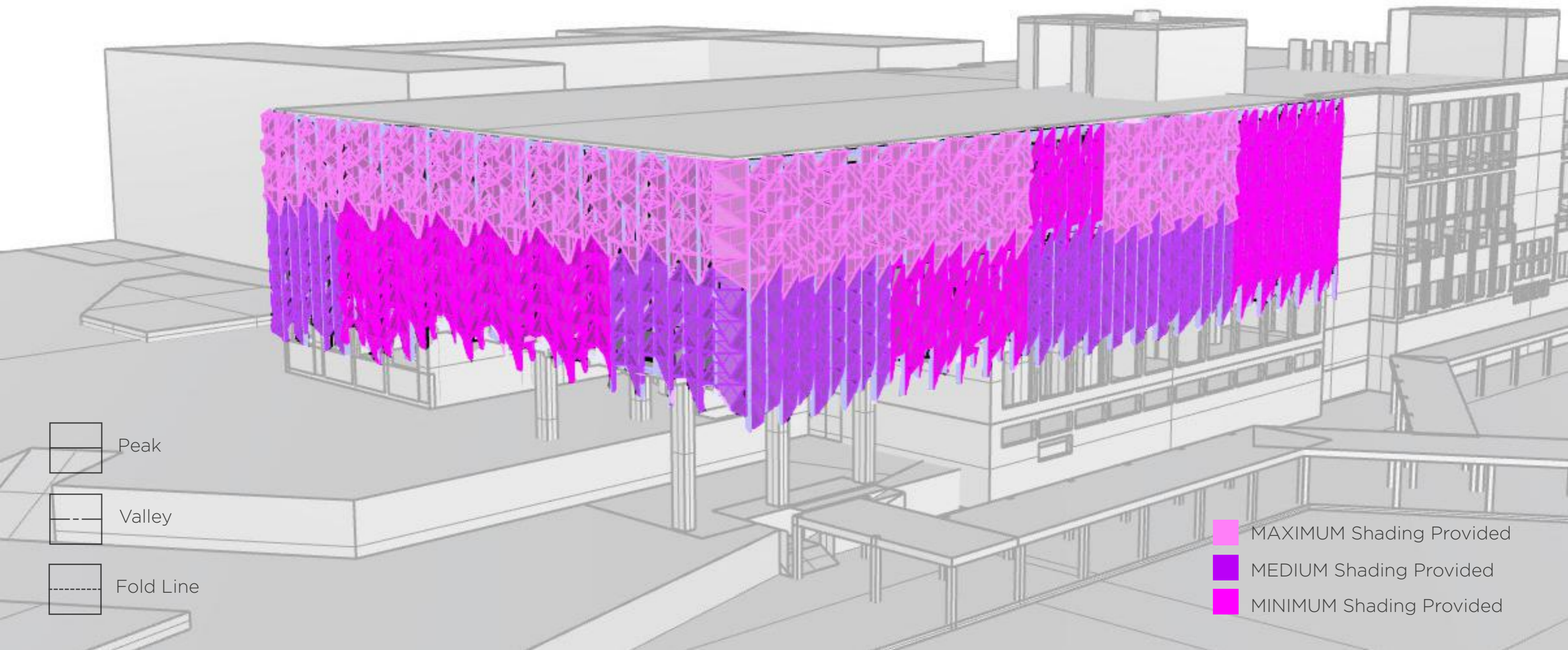
95% Effective



85% Effective



75% Effective

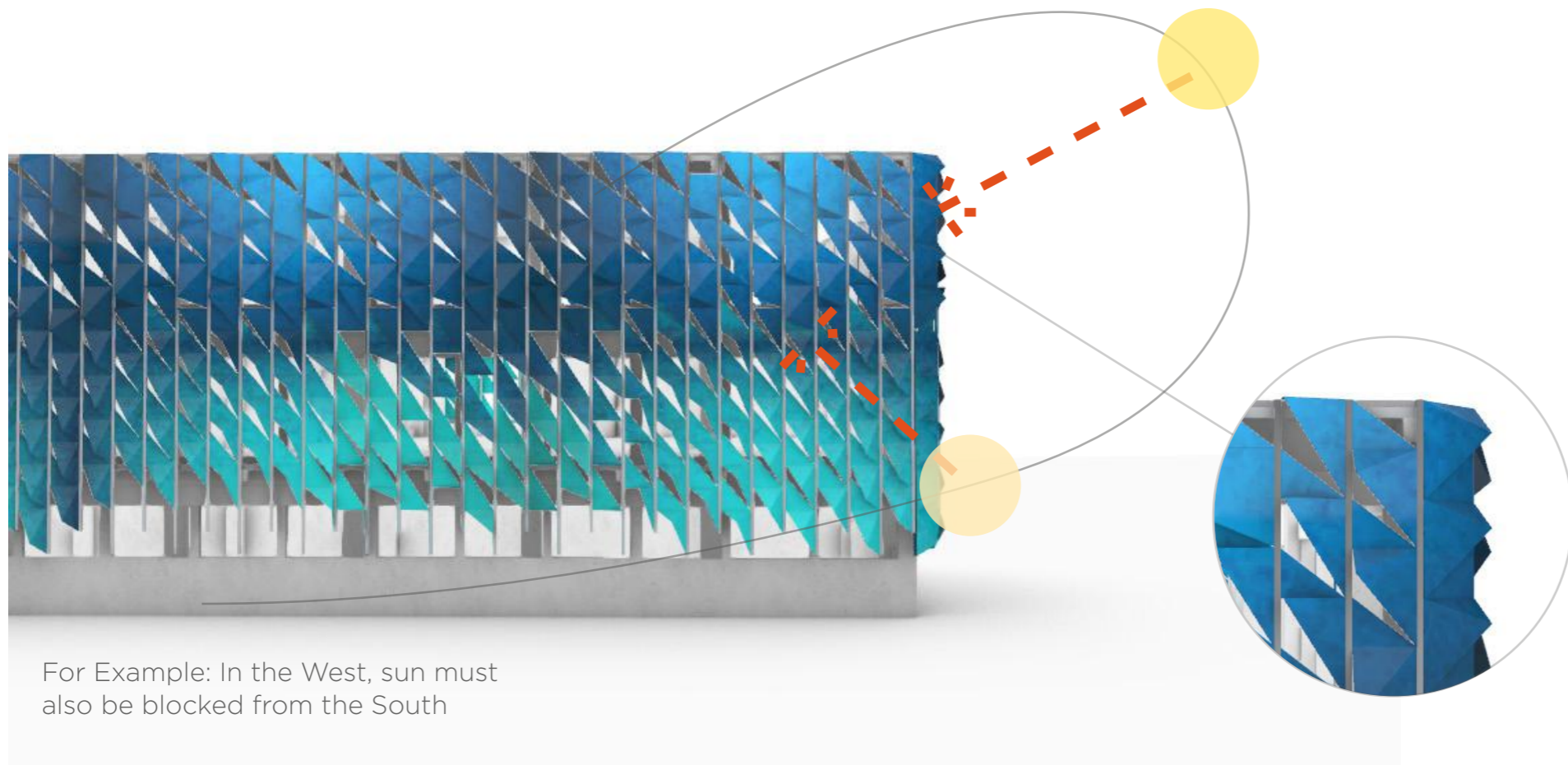
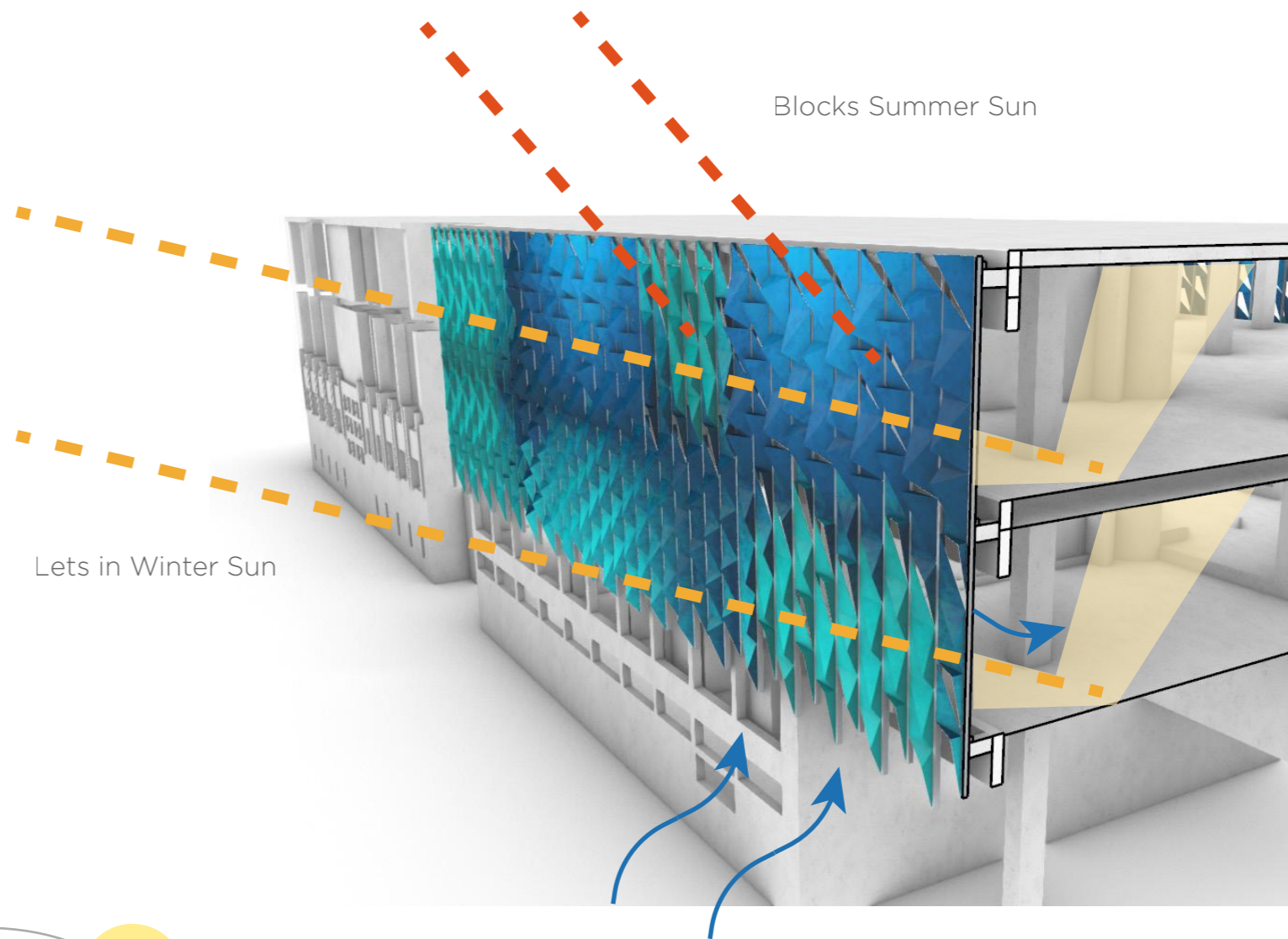


A COMPREHENSIVE SHADING SYSTEM

East/West Clusters

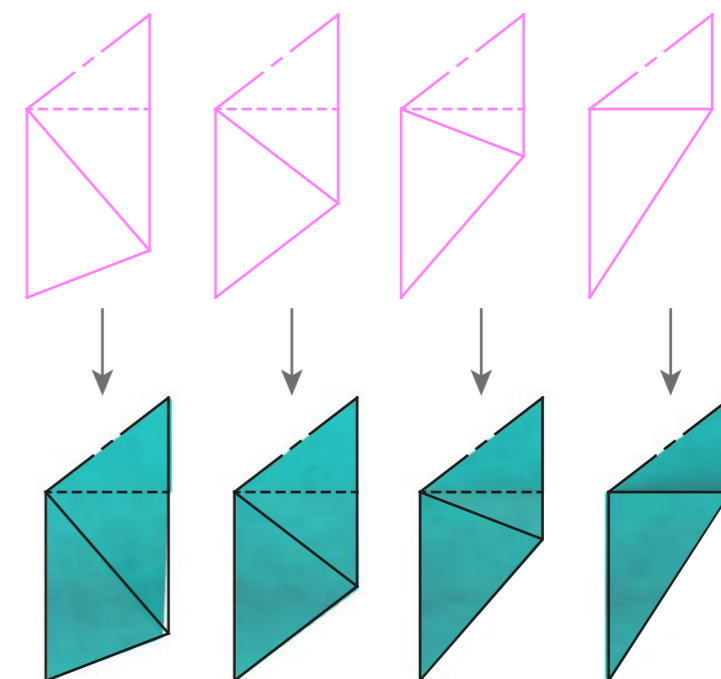


South Clusters



For Example: In the West, sun must also be blocked from the South

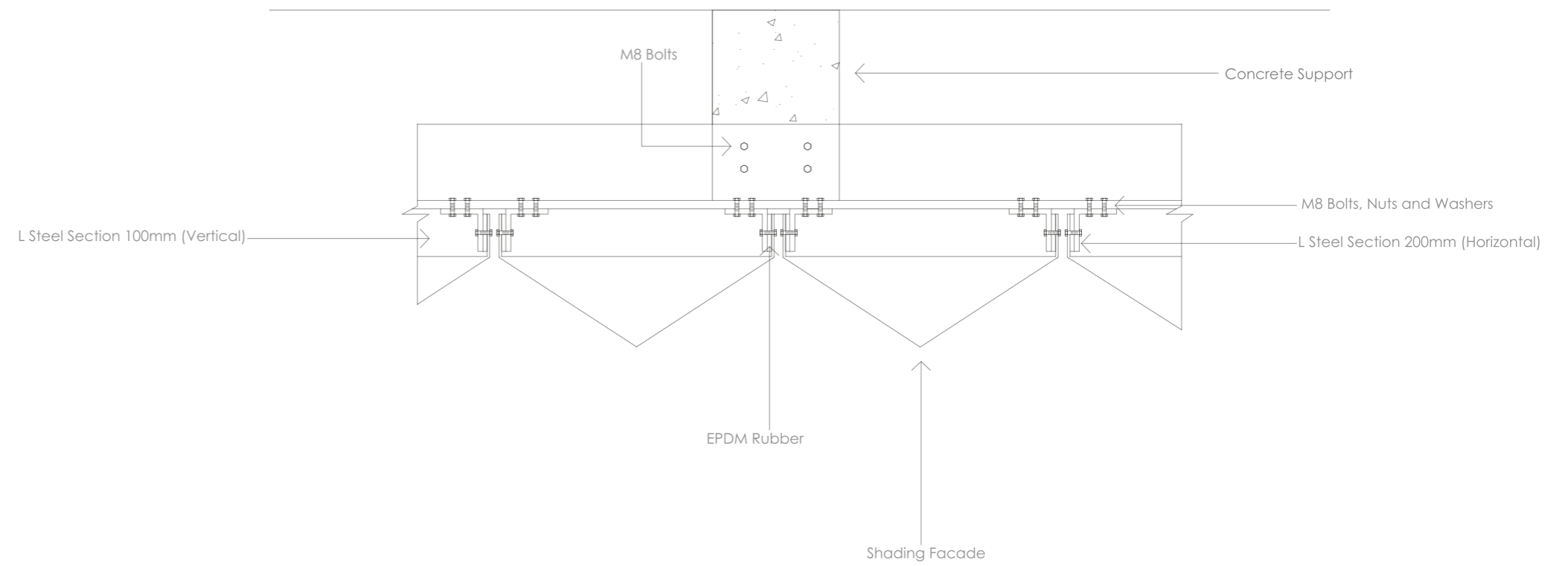
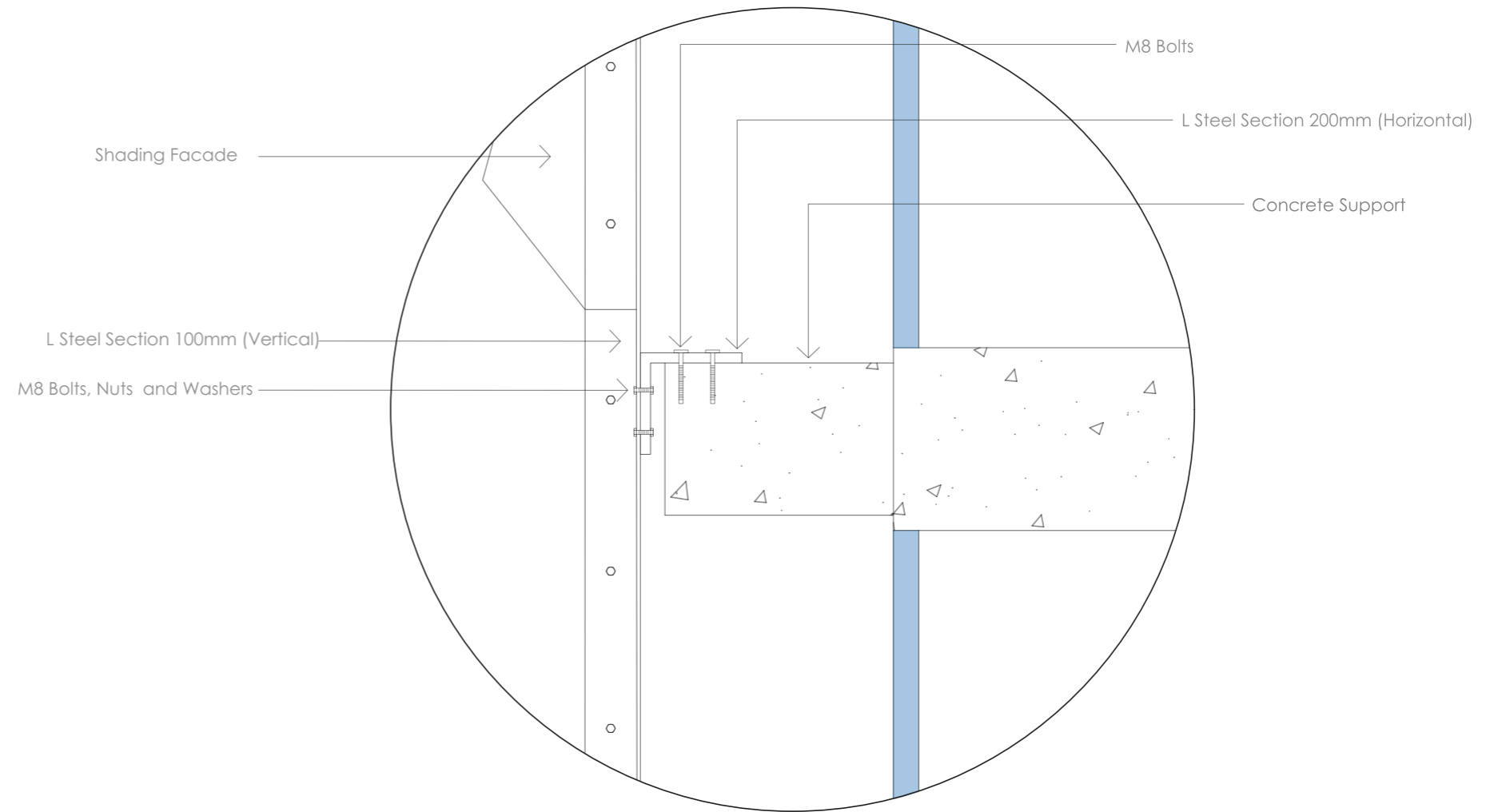
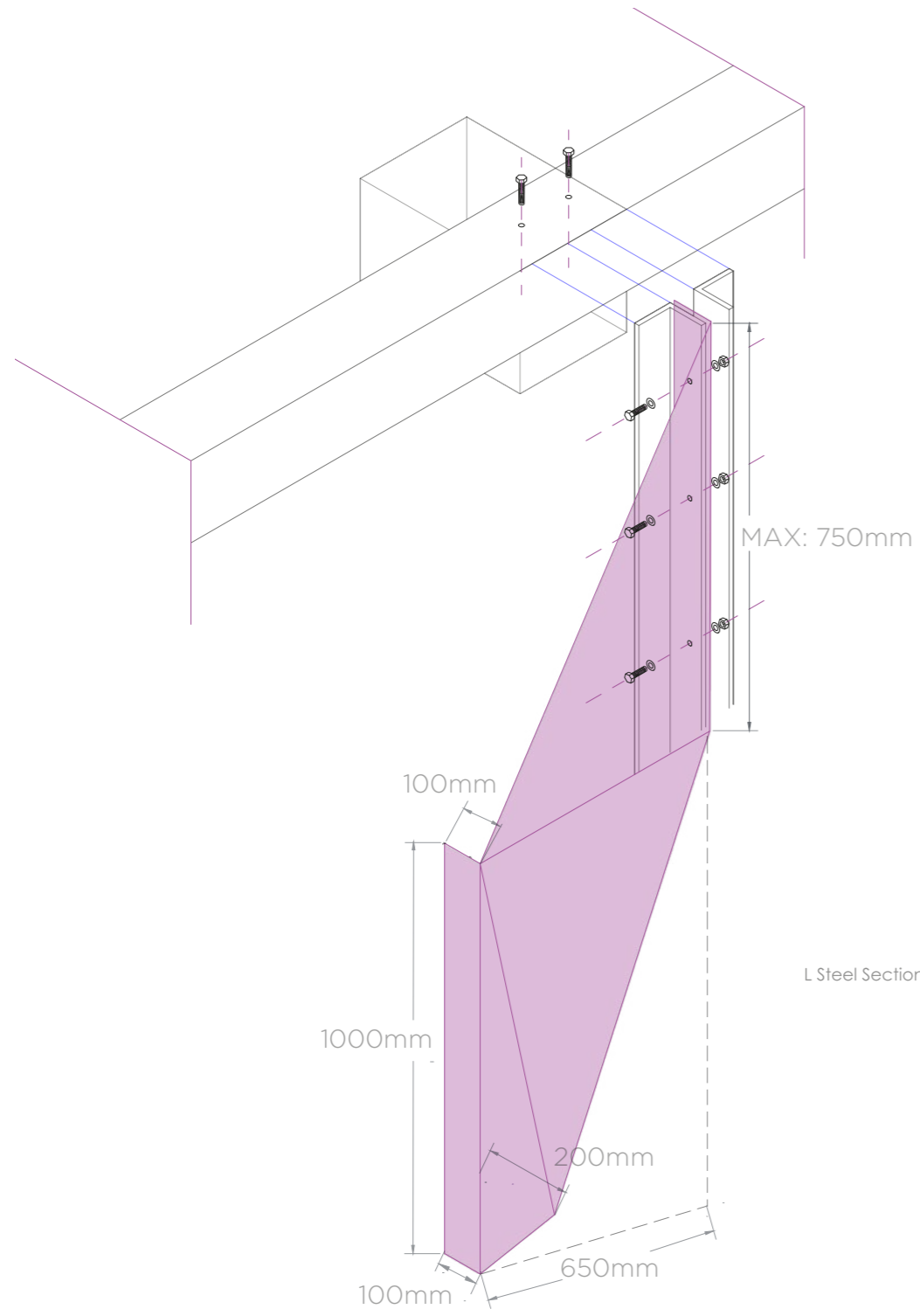
Natural Ventilation if Windows are Opened



Diagram

Rendered

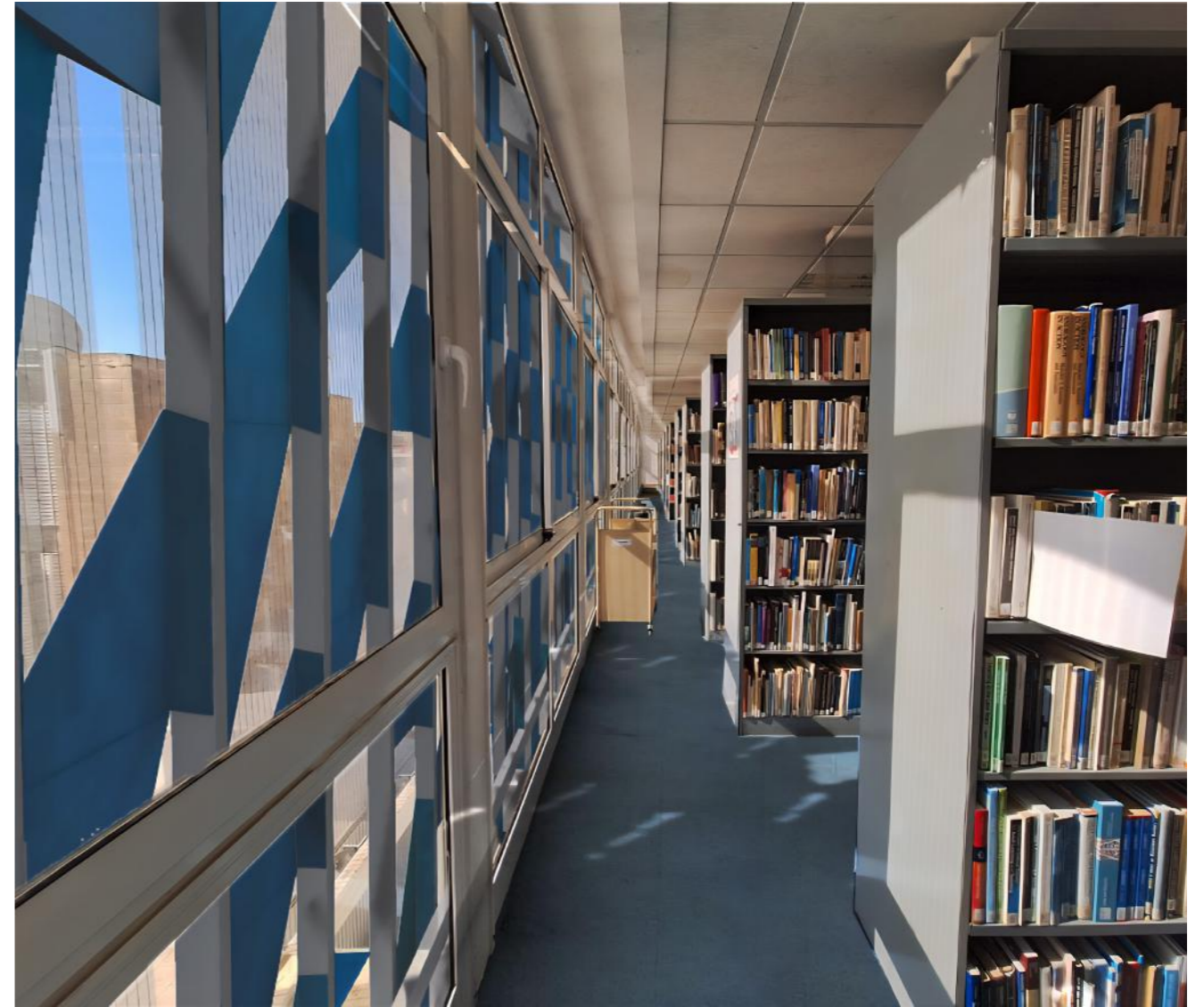
ARCHITECTURAL DETAILS



LOOKING INSIDE



Melitensia Study Area:
Moderate shading



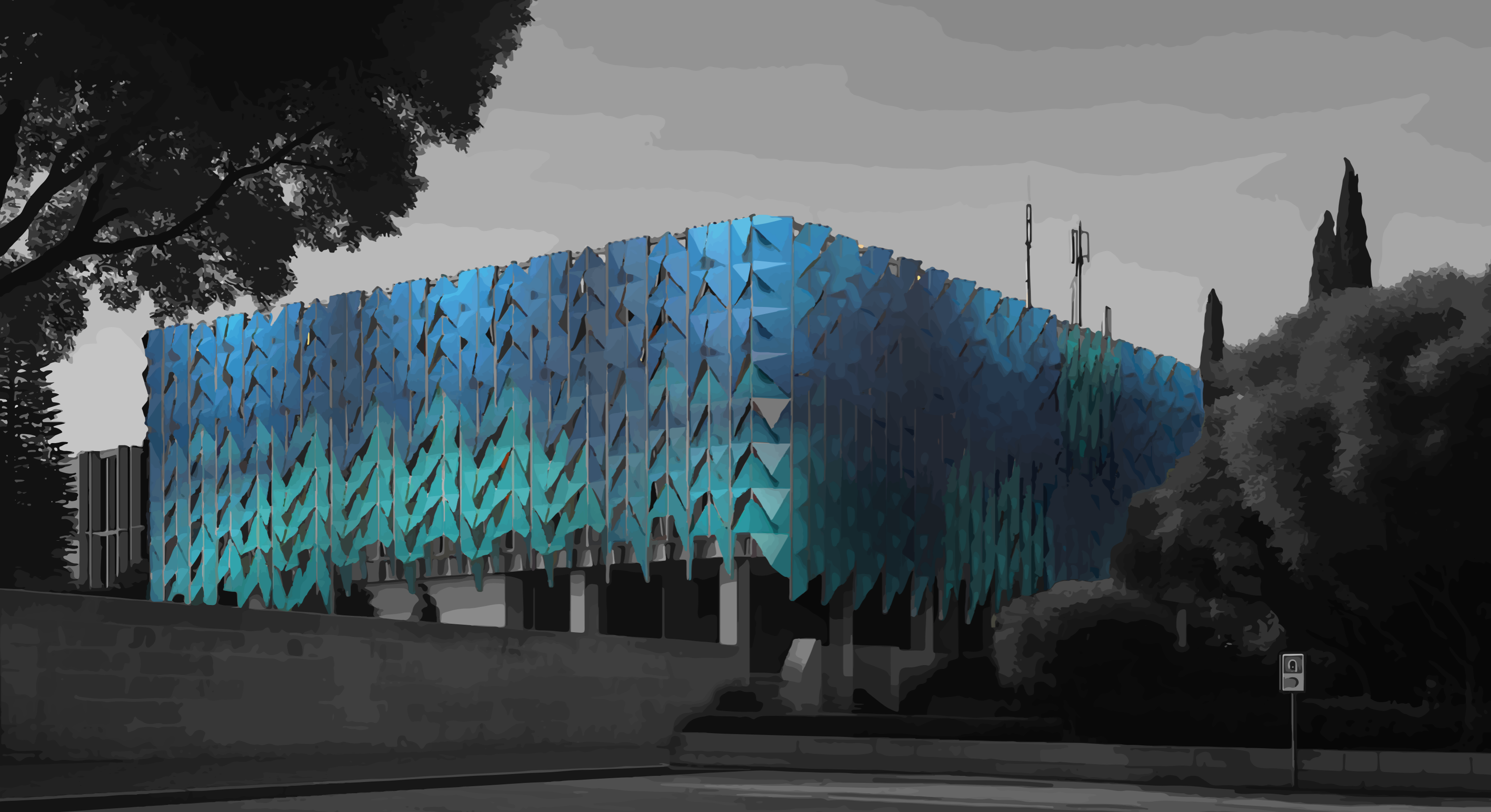
Second Floor Bookcases:
Extreme Shading

DESIGN IN ACTION - DAY VIEW



DESIGN IN ACTION - NIGHT VIEW





LUMAFOLD

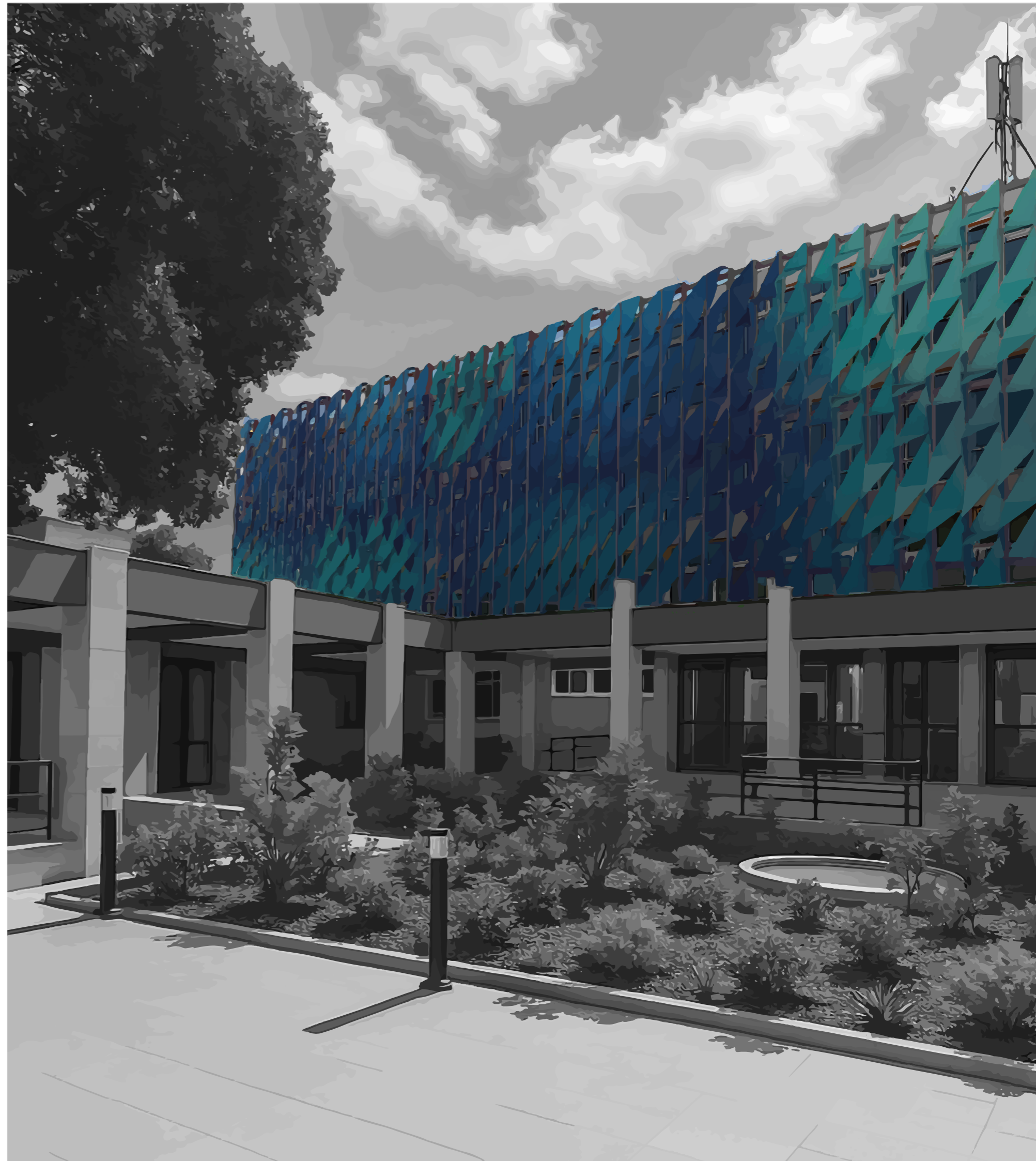
Report Group 6:

BEN 2103: Design Workshop

Michael Bugeja, Greta Stella Camilleri Laus, Daniel Schembri

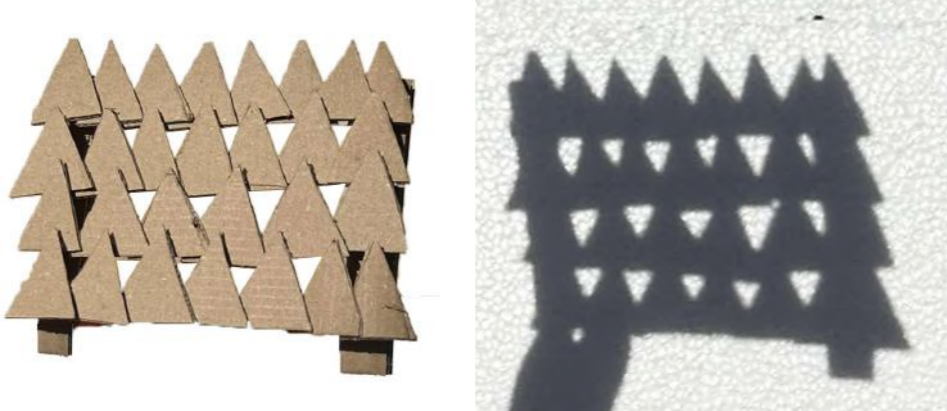
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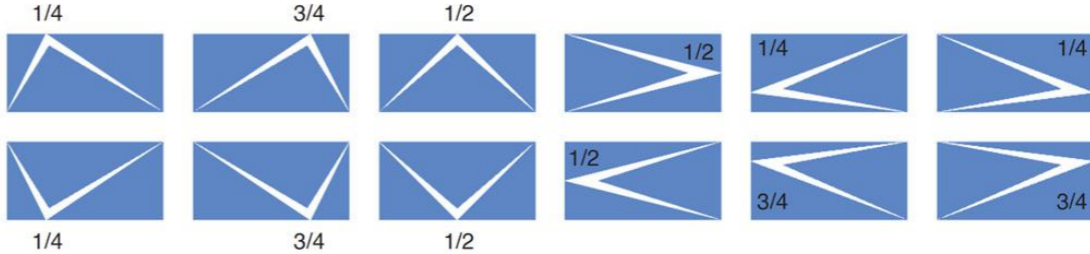


EARLIER CONCEPTS

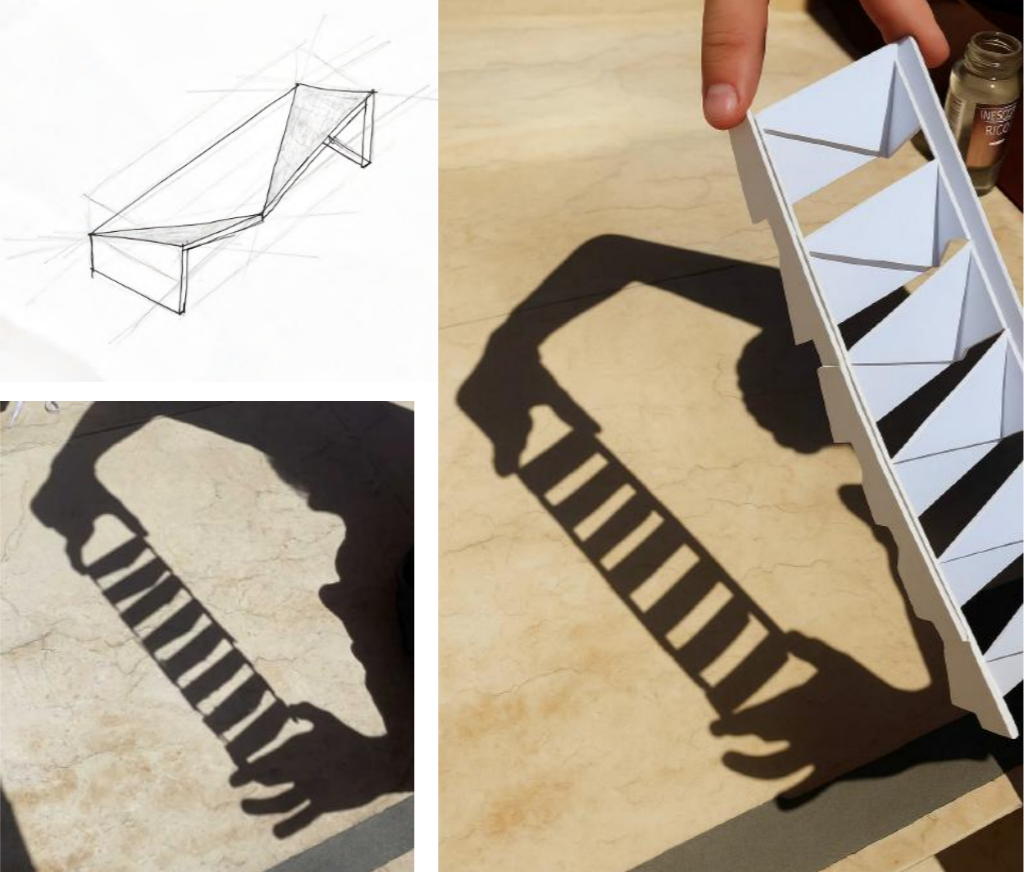
Concept 1



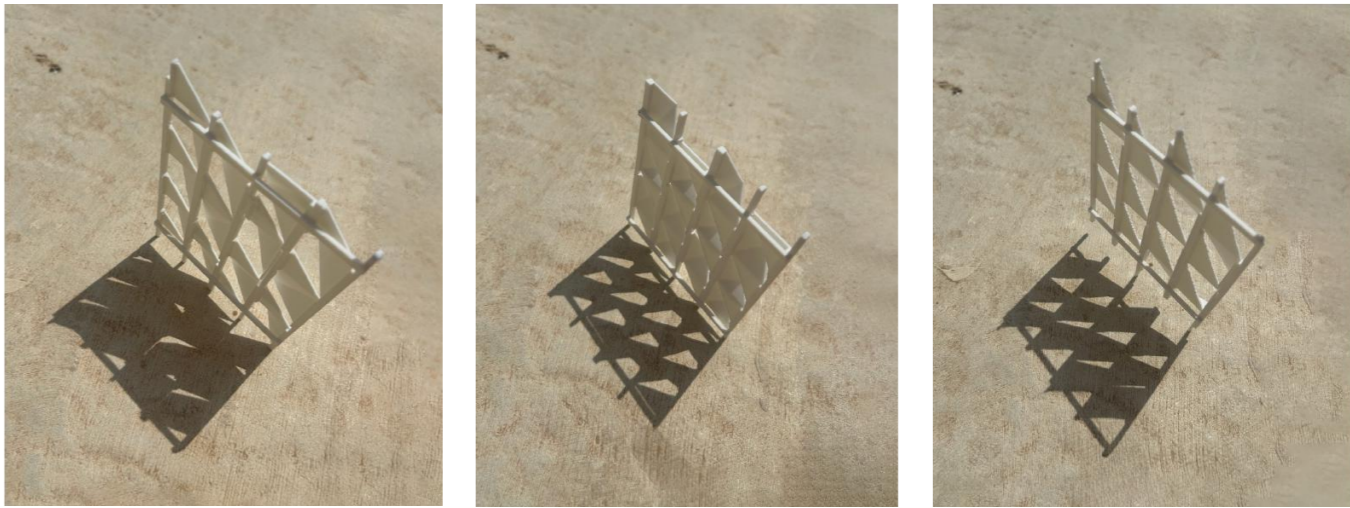
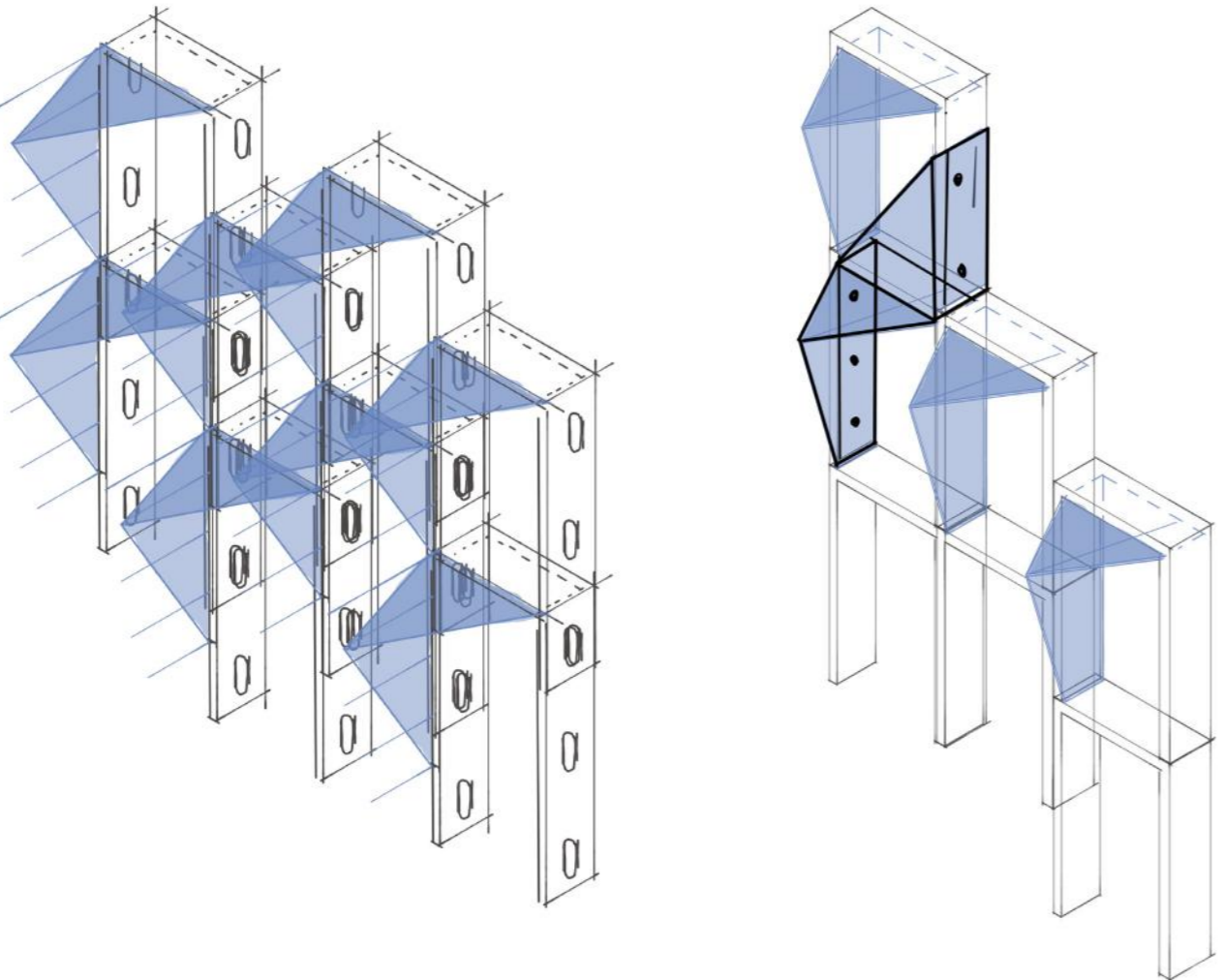
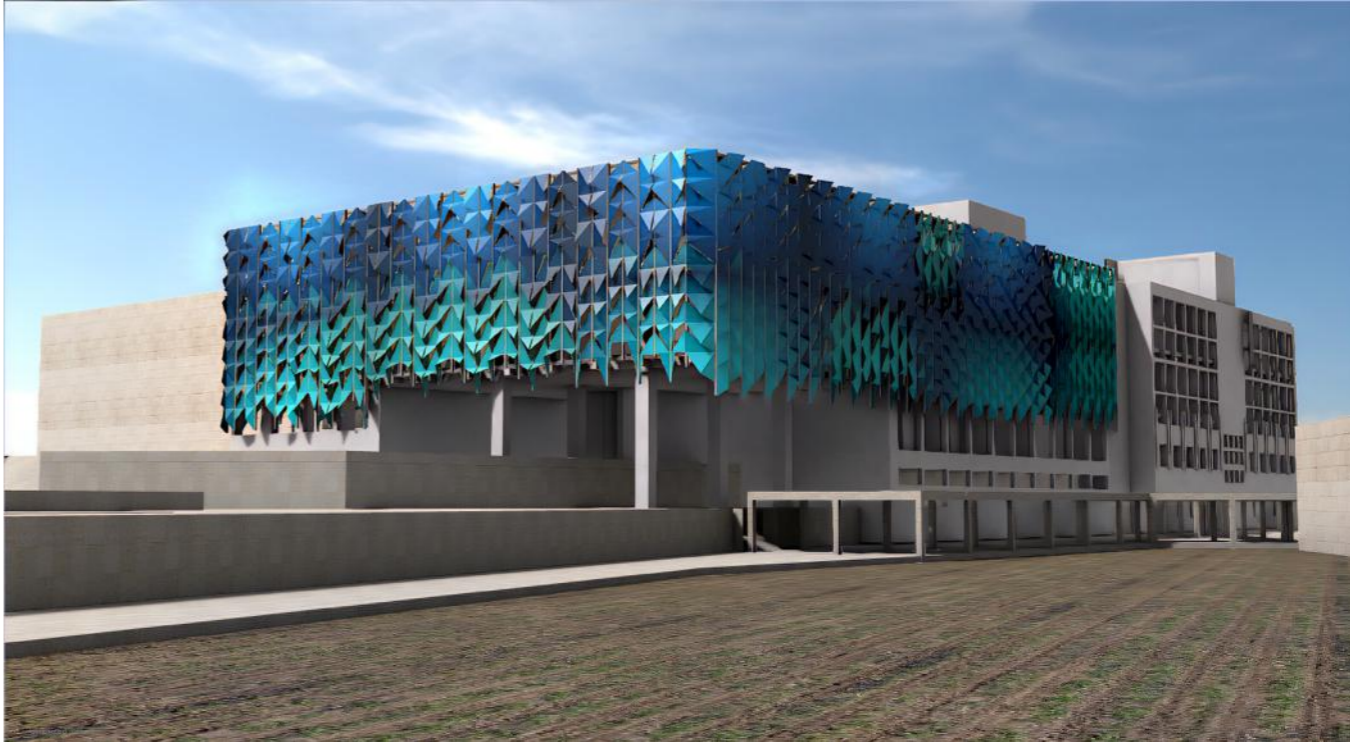
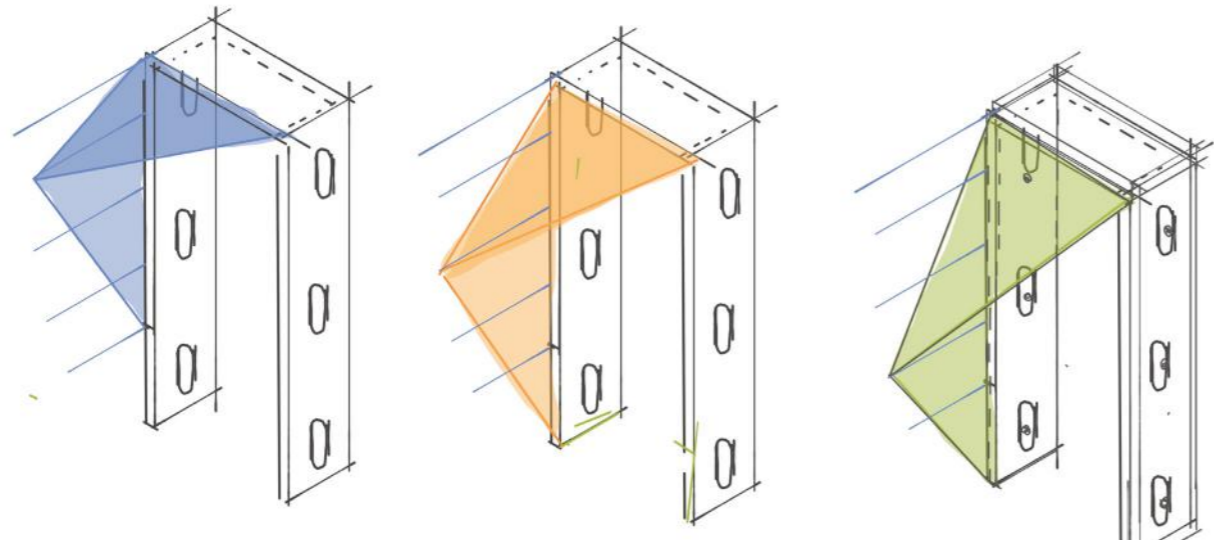
Concept 3



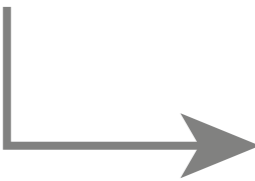
Concept 2



CHOSEN CONCEPT

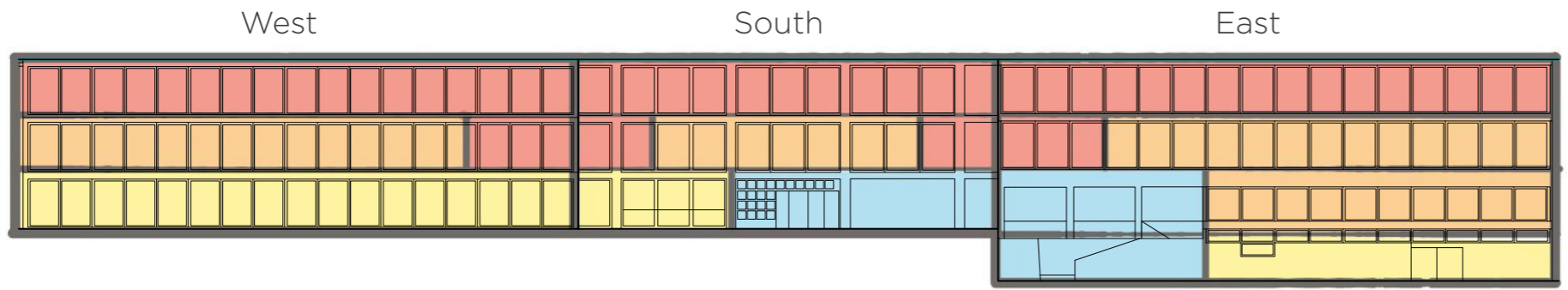


THE DESIGN PROCESS



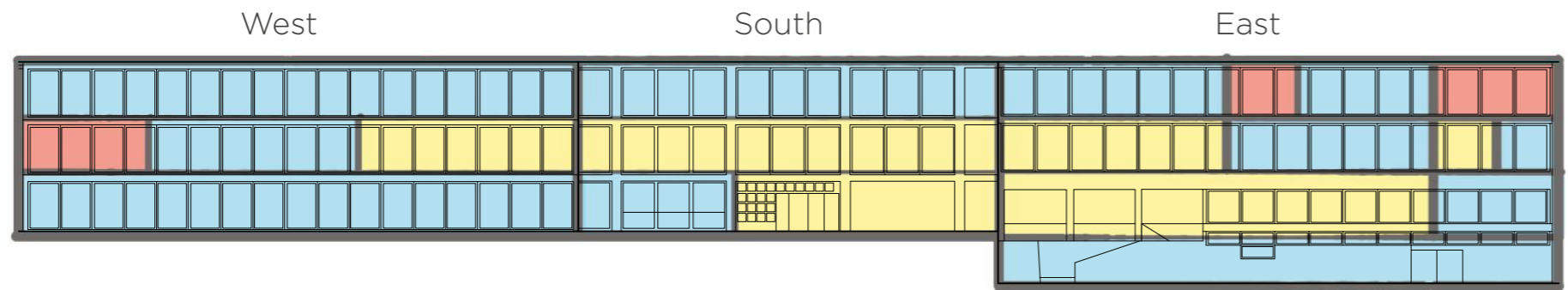
SITE ANALYSIS

Current Sun Exposure



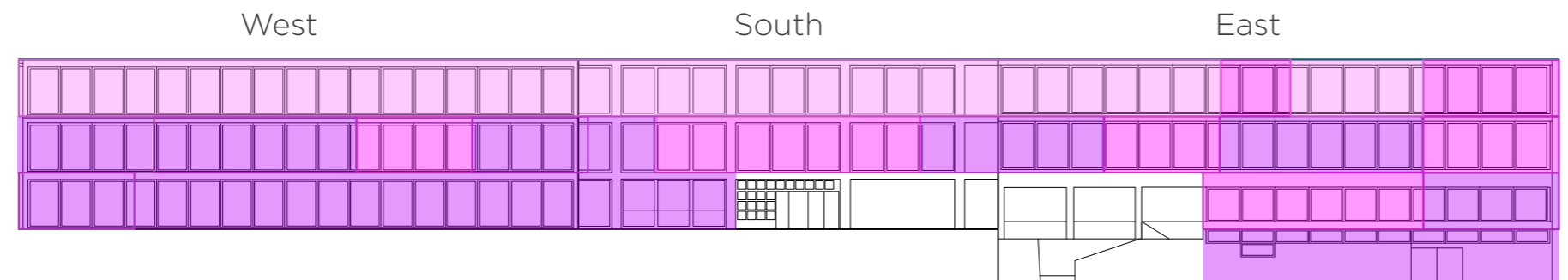
- MAX Sun exposure
- MID Sun exposure
- MIN Sun exposure
- Negligible Sun Exposure

Required Sun Exposure



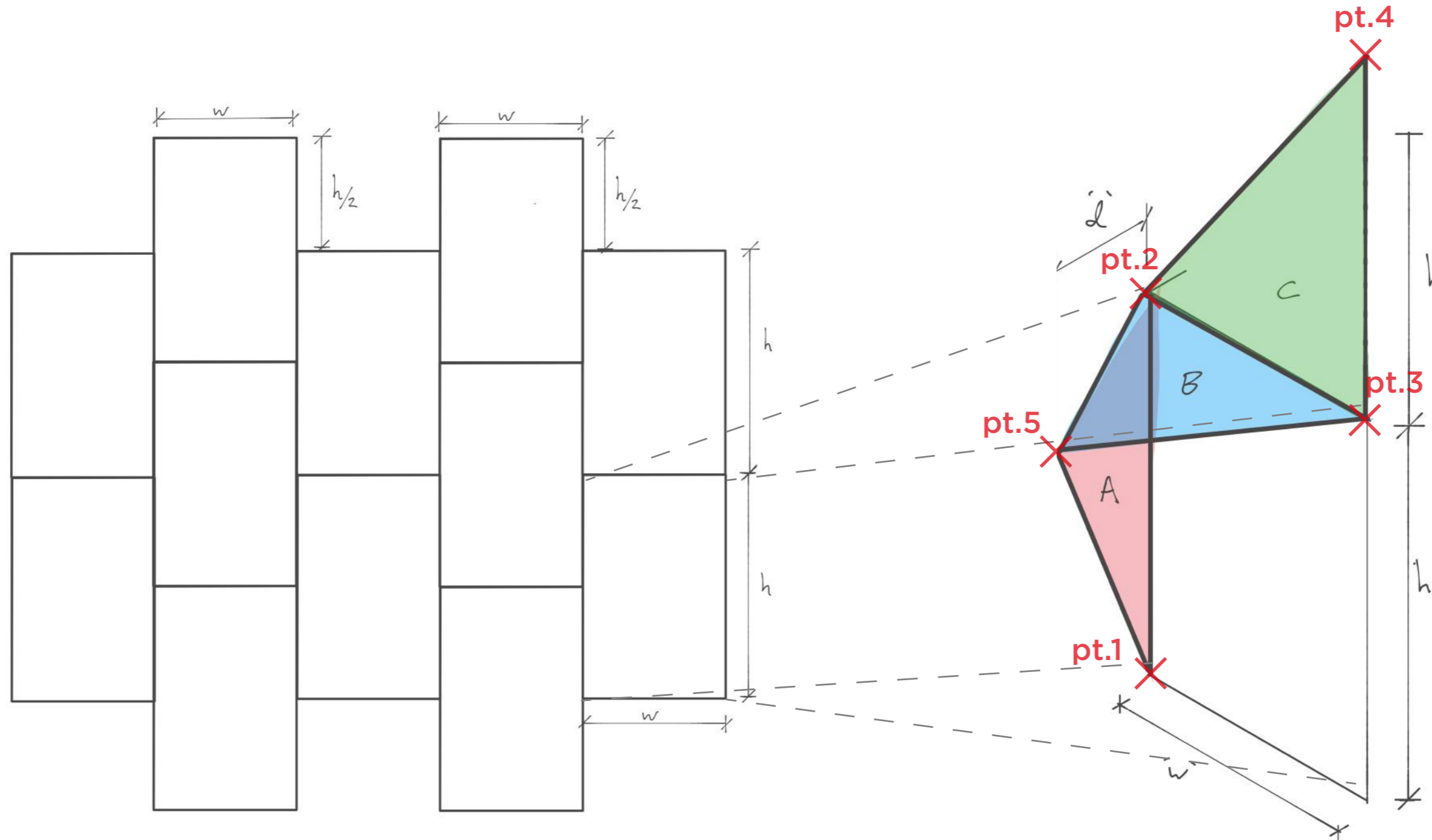
- MAX Sun required
- MID Sun required
- MIN Sun required

Required Shading



- MAX Shading required
- MID Shading required
- MIN Shading required

GEOMETRIC METHOD STATEMENT



The facade is split up into a grid of rectangles at alternating heights
Each of the rectangles is to be populated by 1 shading panel.
Each rectangle has the same dimensions of '**w**' wide and '**h**' tall.

Each shading panel is defined by 3 triangles; **A, B and C**
Triangles A, B and C are defined by **5 points**

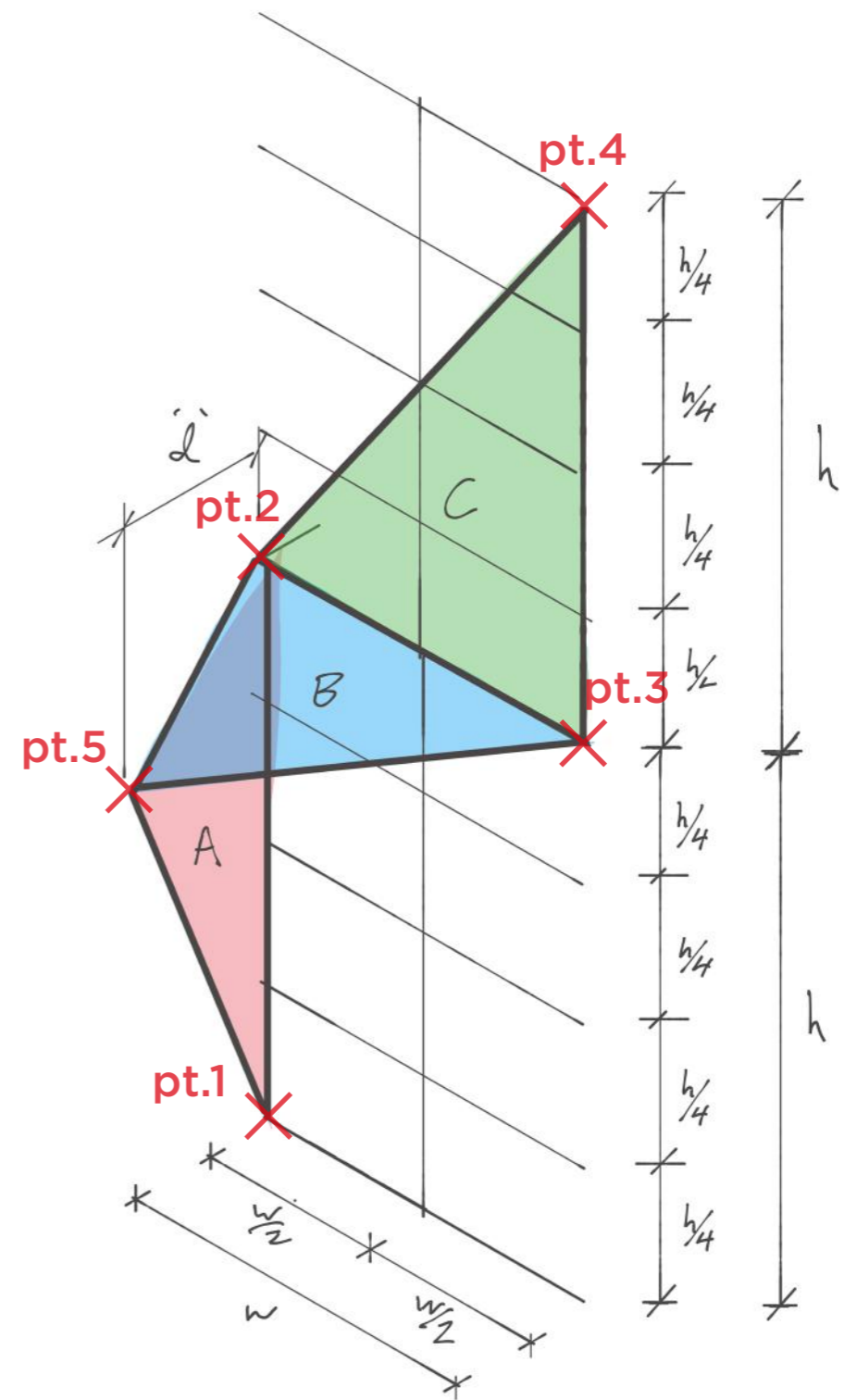
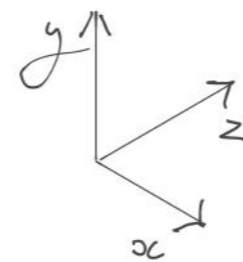
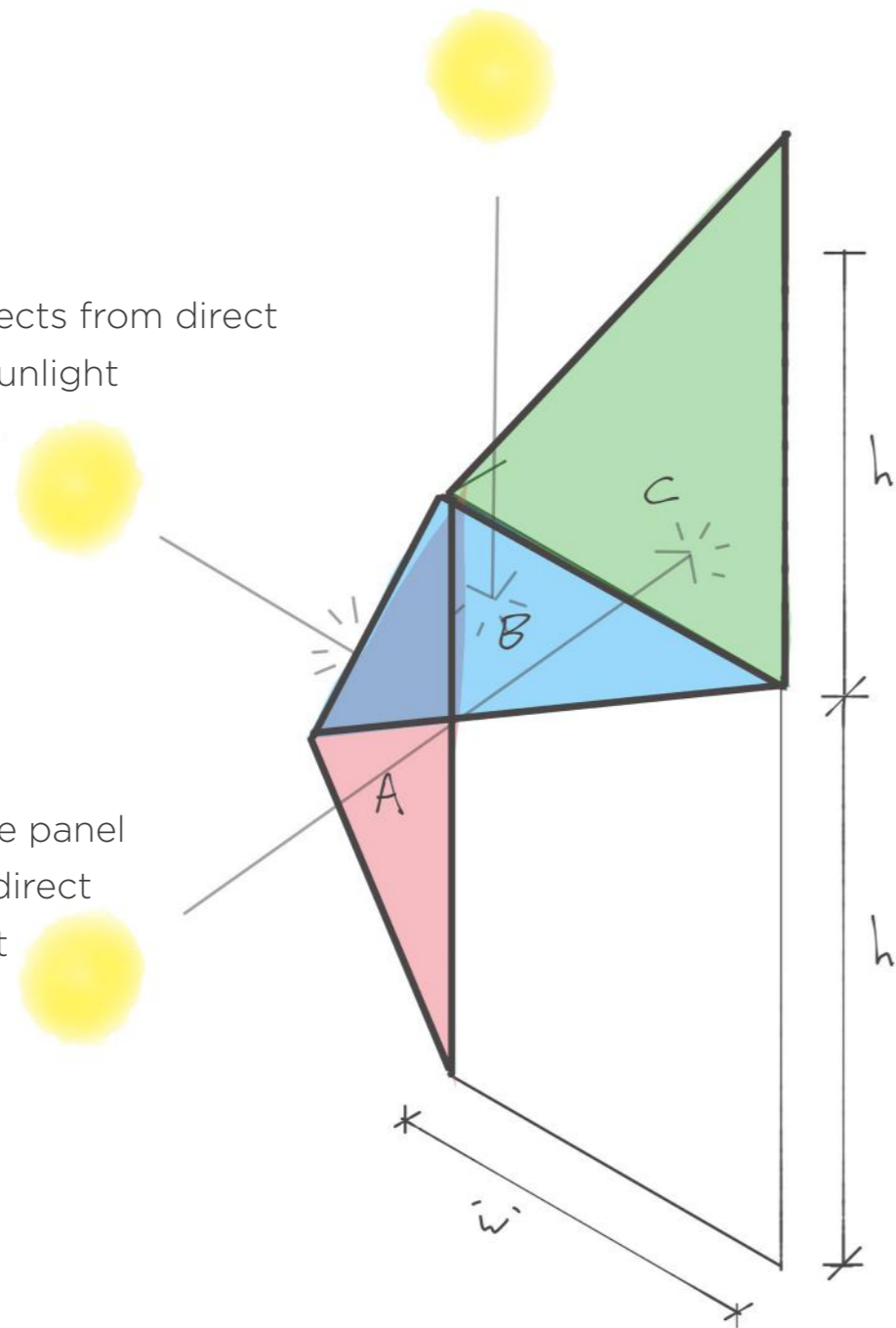
Points 1-4 are in the same plane.

Point 5 is at a constant distance 'd' from the base plane

B - Protects from direct **overhead** sunlight

A - Protects from direct **lateral** sunlight

C - Protects the panel **above it** from direct **frontal** sunlight



Each triangle protects the building from direct light from a different direction

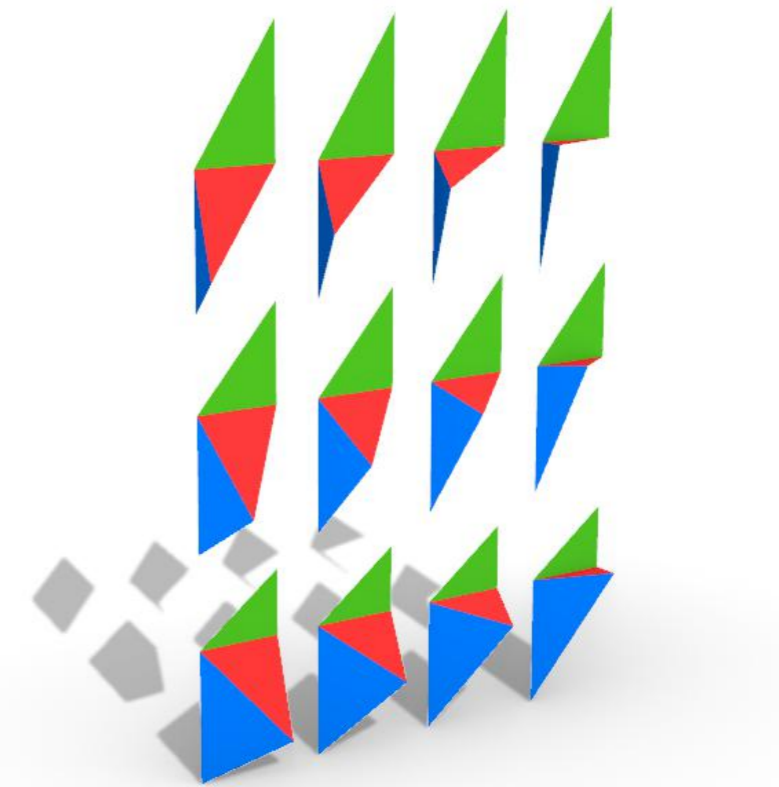
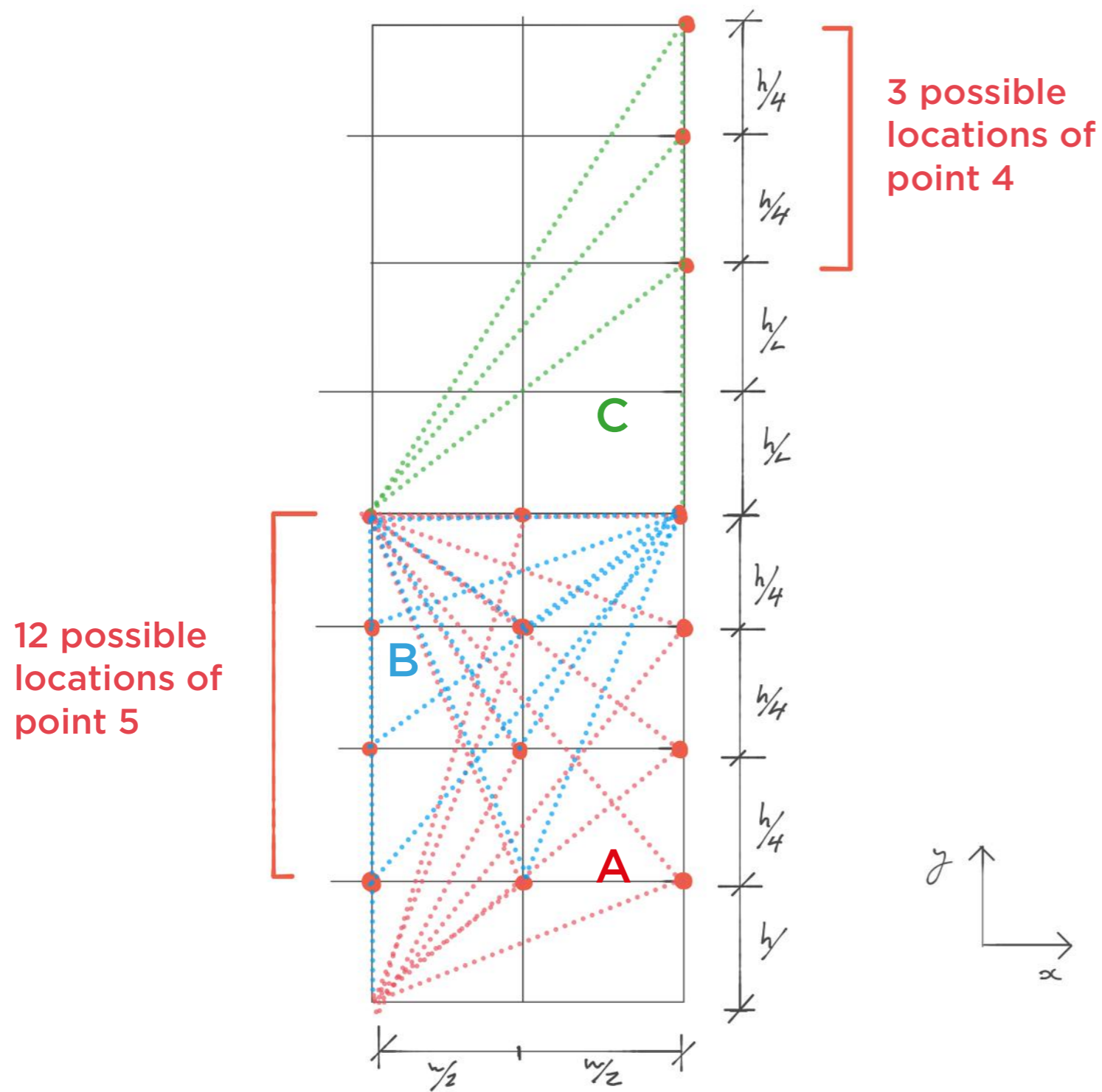
Sun is allowed to enter in the winter but is blocked during the summer

Each rectangular space is further subdivided in intervals of $h/4$ and $w/2$
The depth 'd' remains constant, i.e. **the panels do not vary in the z axis**

Points 1-3 **remain stationary**

Point 4 translates along the **y axis only**

Point 5 translates along the **x and y axes only**



Perspective View



Top View

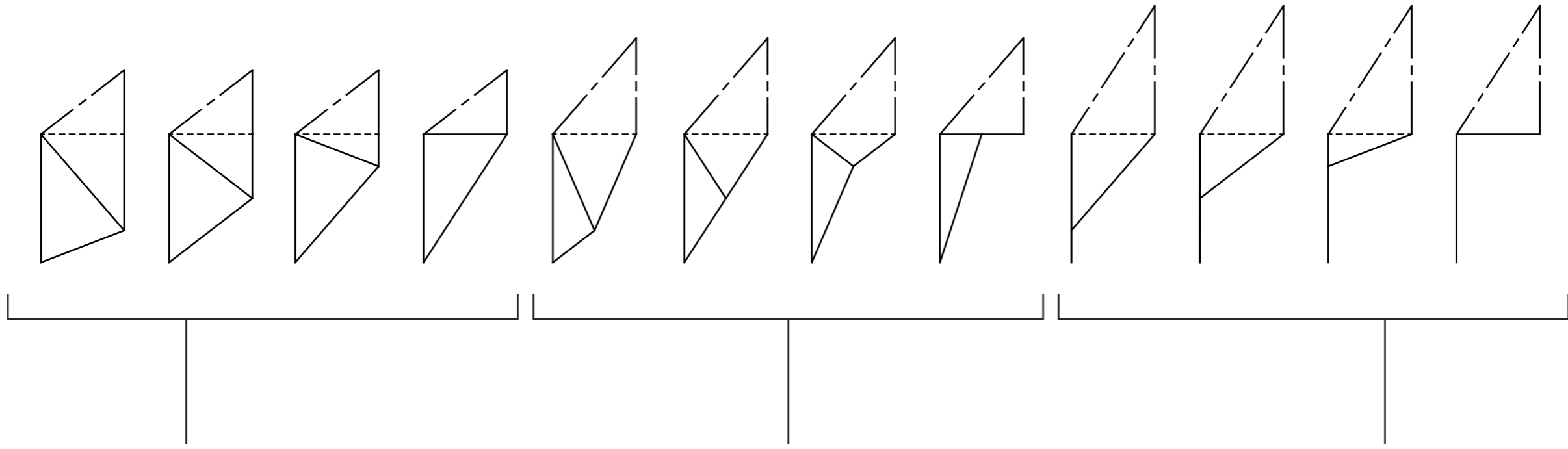
Points 4 and 5 are translated across the grid to produce a series of panel variations

The translations of point 5 produces **12 variations of triangles A and B**
 The translation of point 4 produces **3 variations of triangle C**

This produced 36 variations.

Through testing of different orientations and combinations of triangles A, B and C, this number was reduced to **12 possible variations**

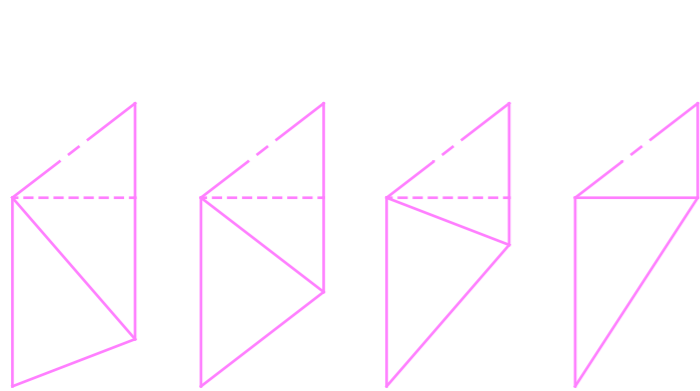
12 Final Variations



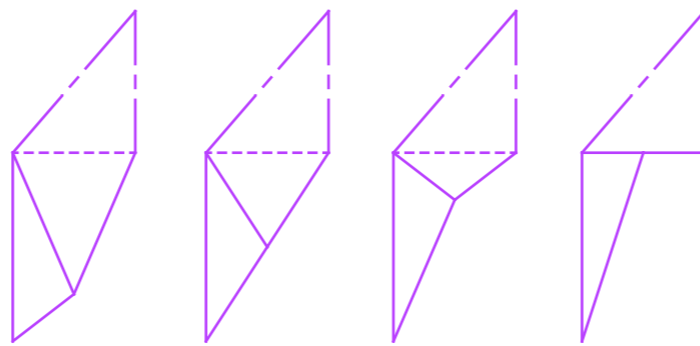
GROUP 1: MAXIMUM SHADING

GROUP 2: MEDIUM SHADING

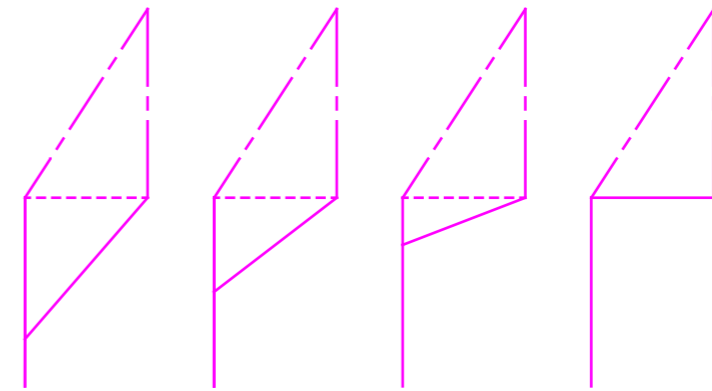
GROUP 3: MINIMUM SHADING



95% Effective



85% Effective

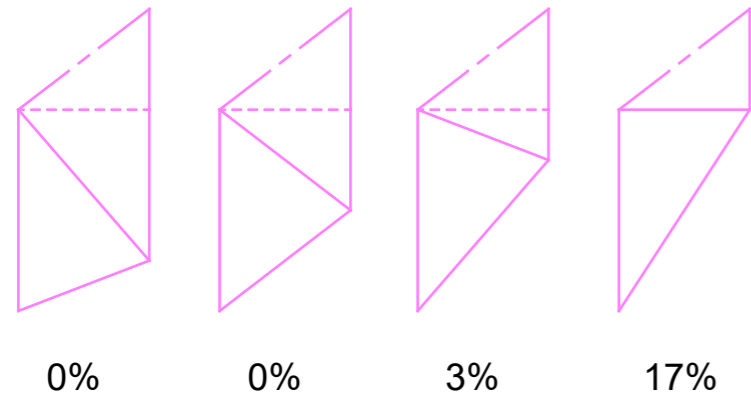


75% Effective

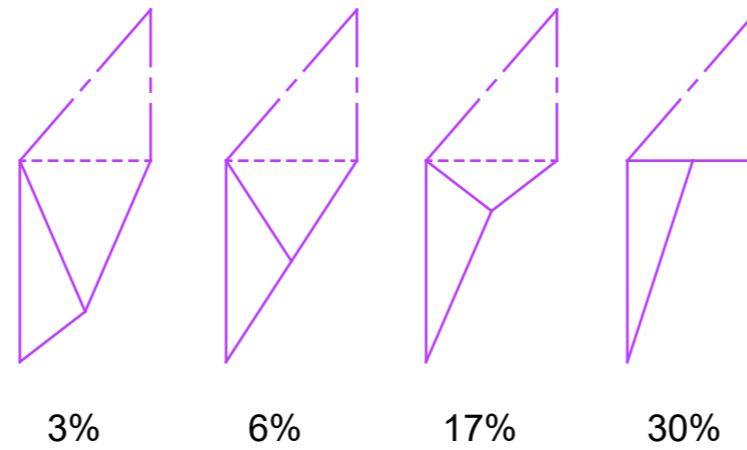


Shadow Study

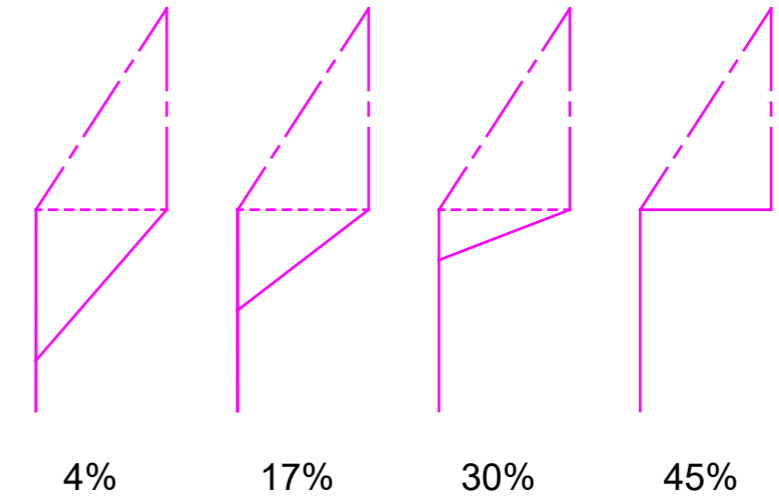
GROUP 1: MAXIMUM SHADING



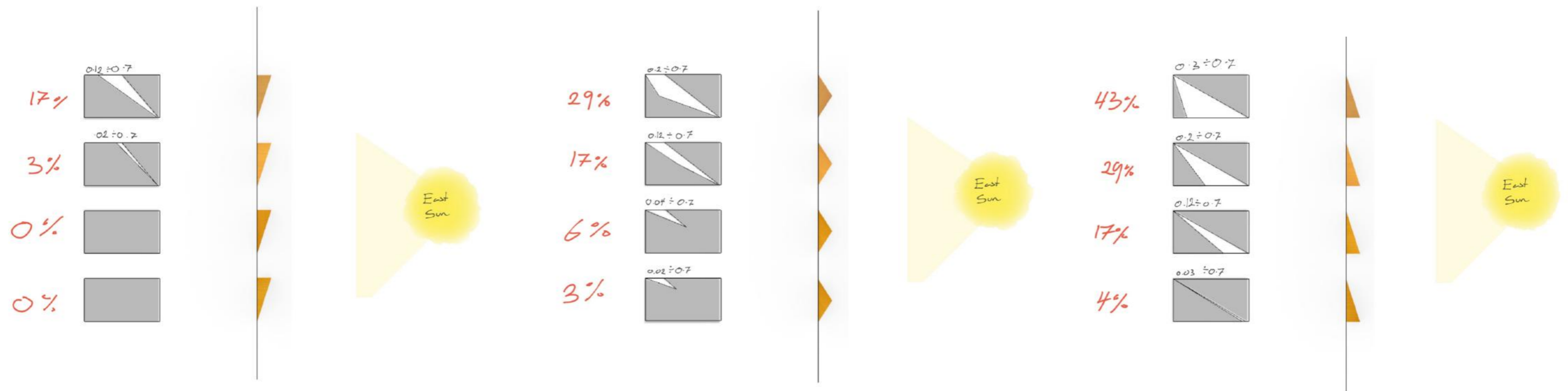
GROUP 2: MEDIUM SHADING



GROUP 3: MINIMUM SHADING

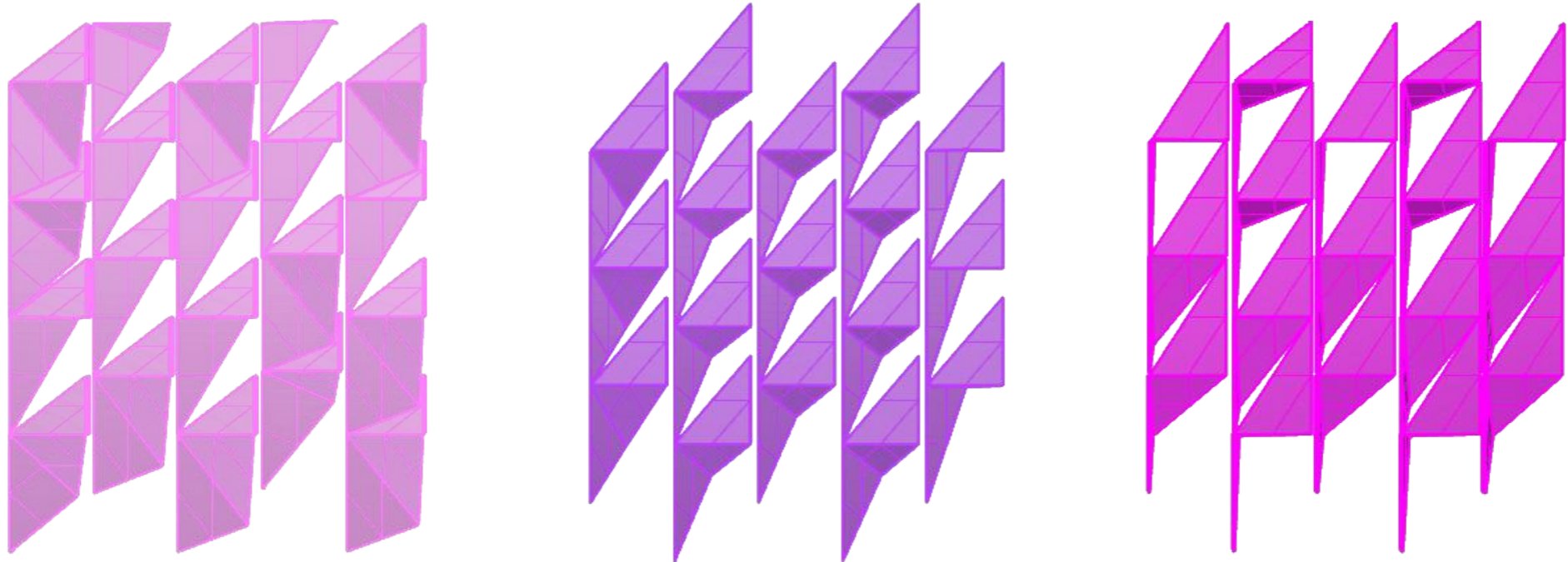


% of Direct Sunlight vs Shadow Passing Through the Space



The effectiveness of the individual panels was assessed by placing the sun at 01/07/2025 at 8:30am and calculating the ratio of light to shadow

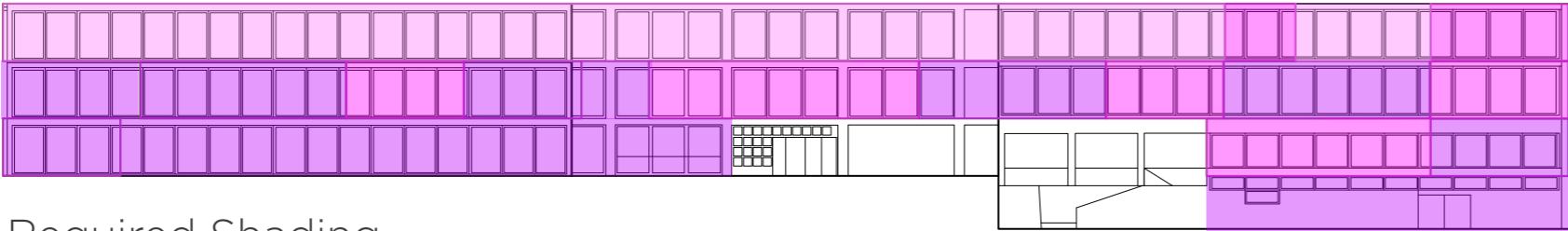
Shading Clusters



West

South

East

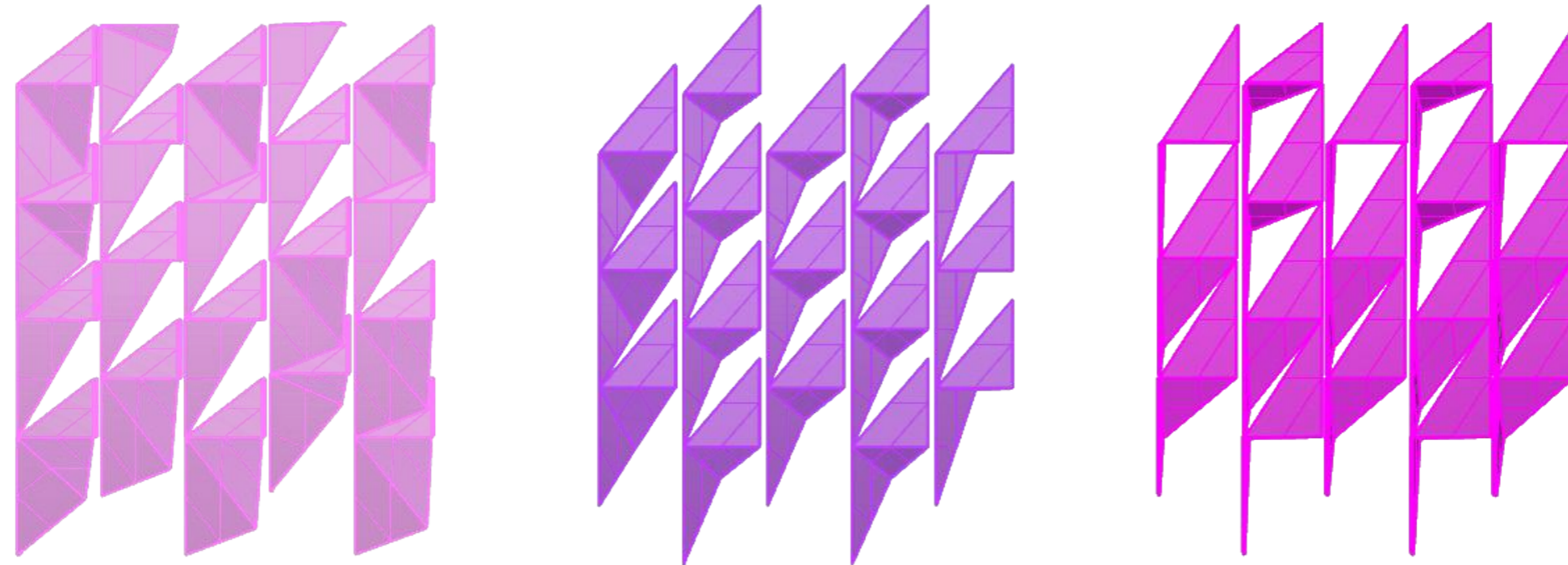


- MAX Shading required
- MID Shading required
- MIN Shading required

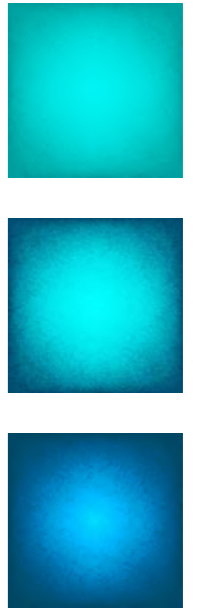
Required Shading

East and West Clusters

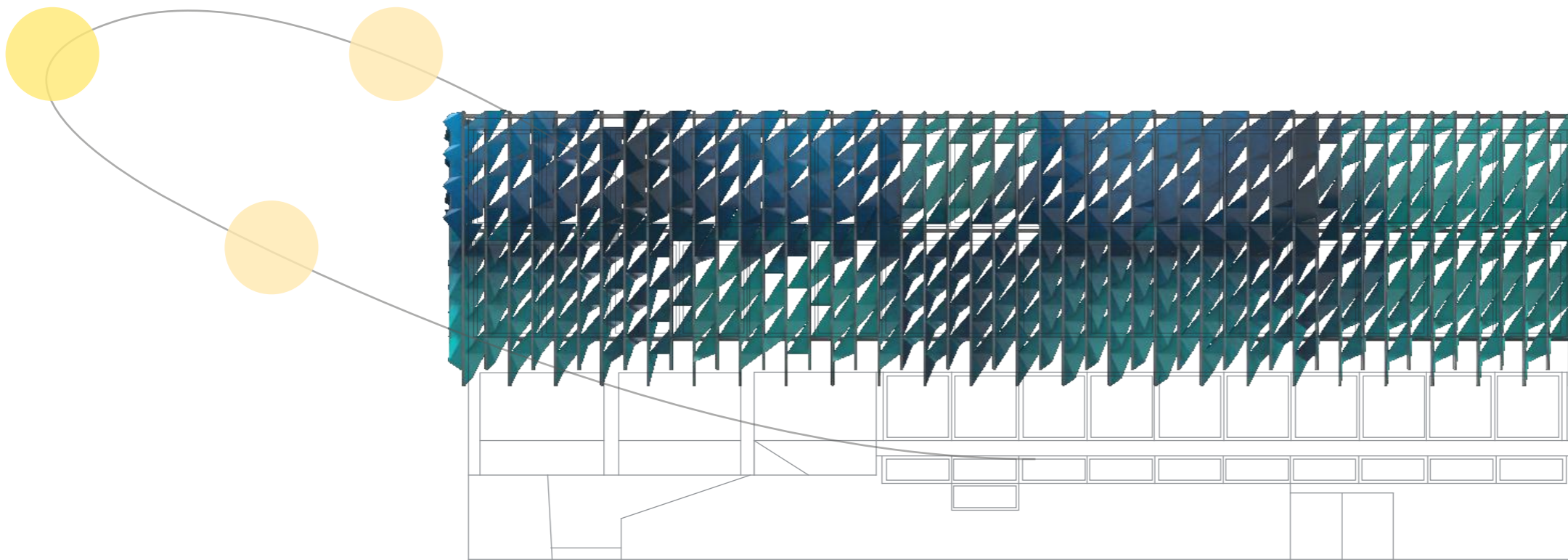
Shaded



Rendered

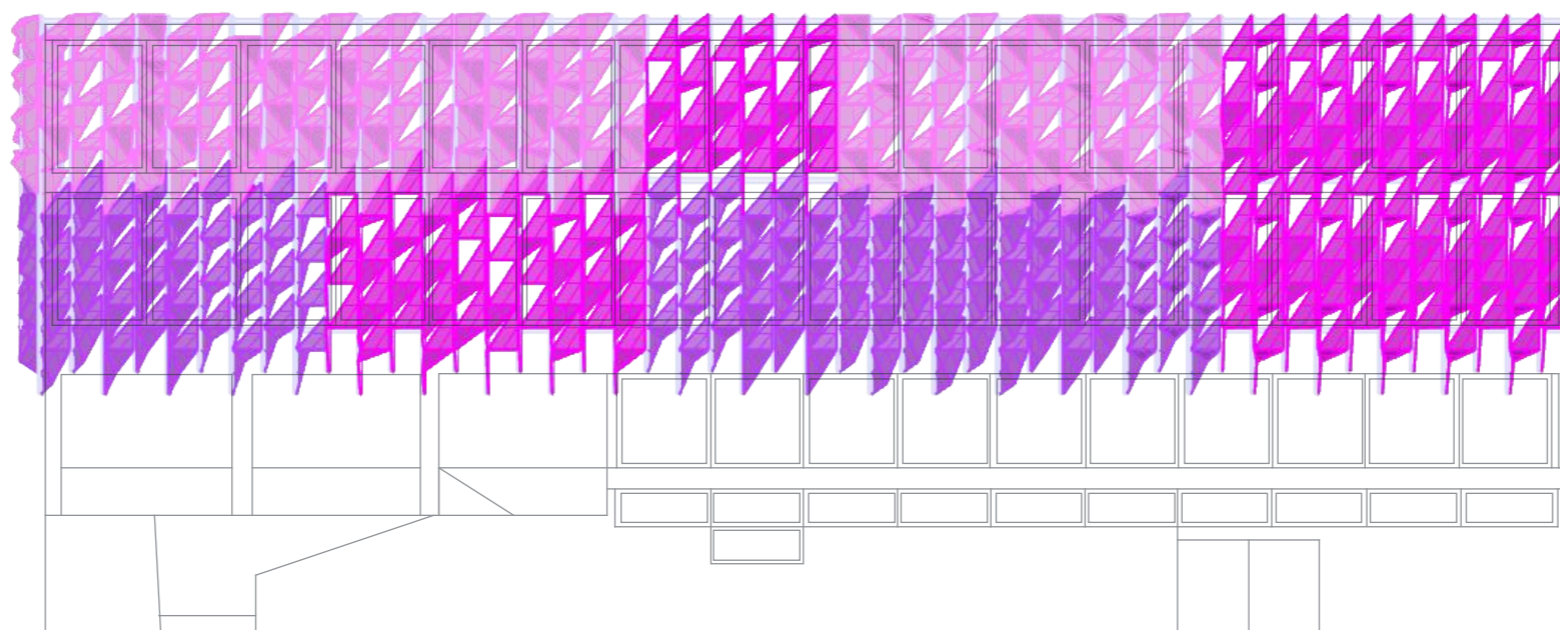


Each Shading Cluster is assigned a specific shade of blue



East Elevation (Rendered)

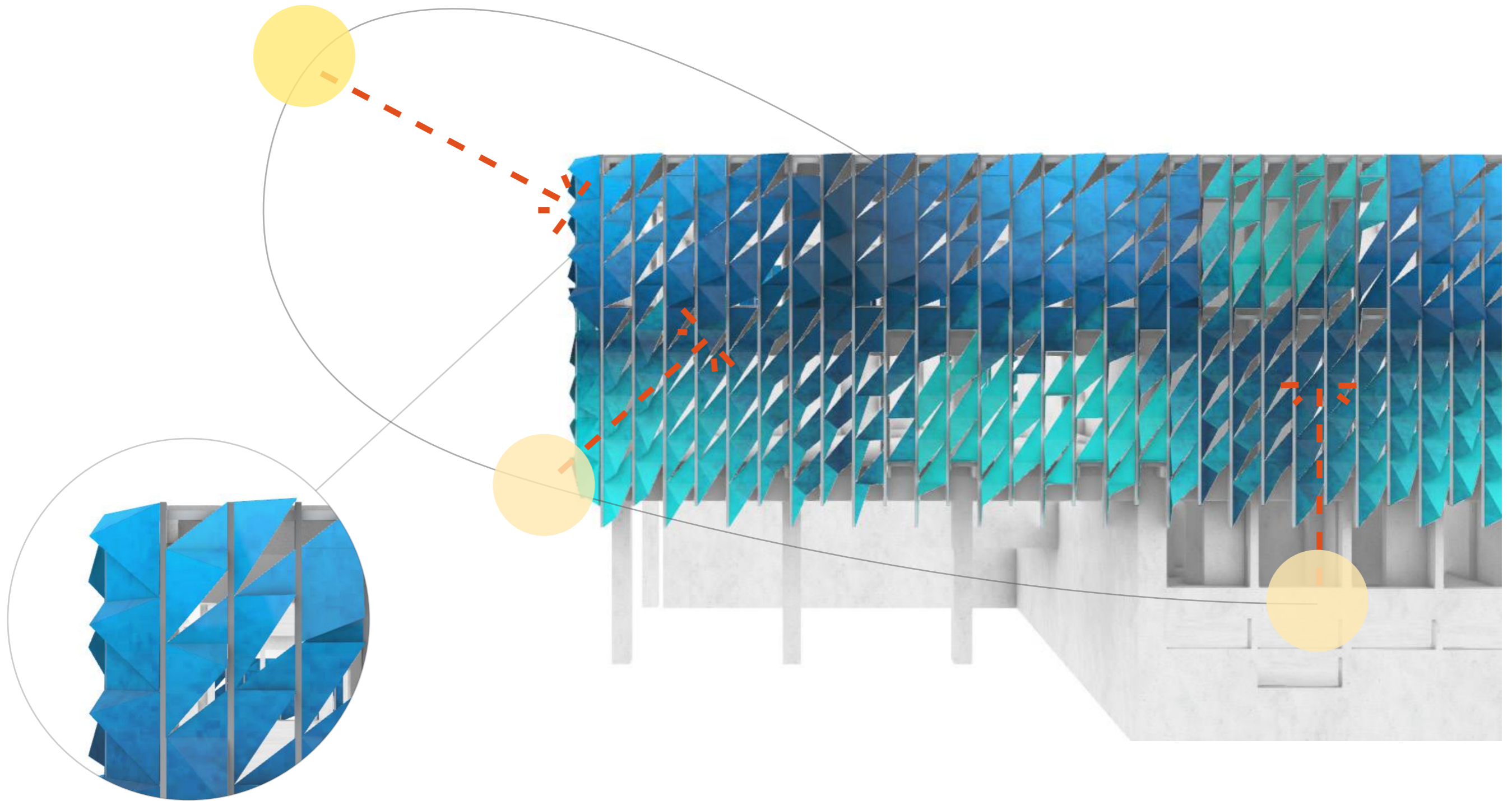
0 1:100 5m



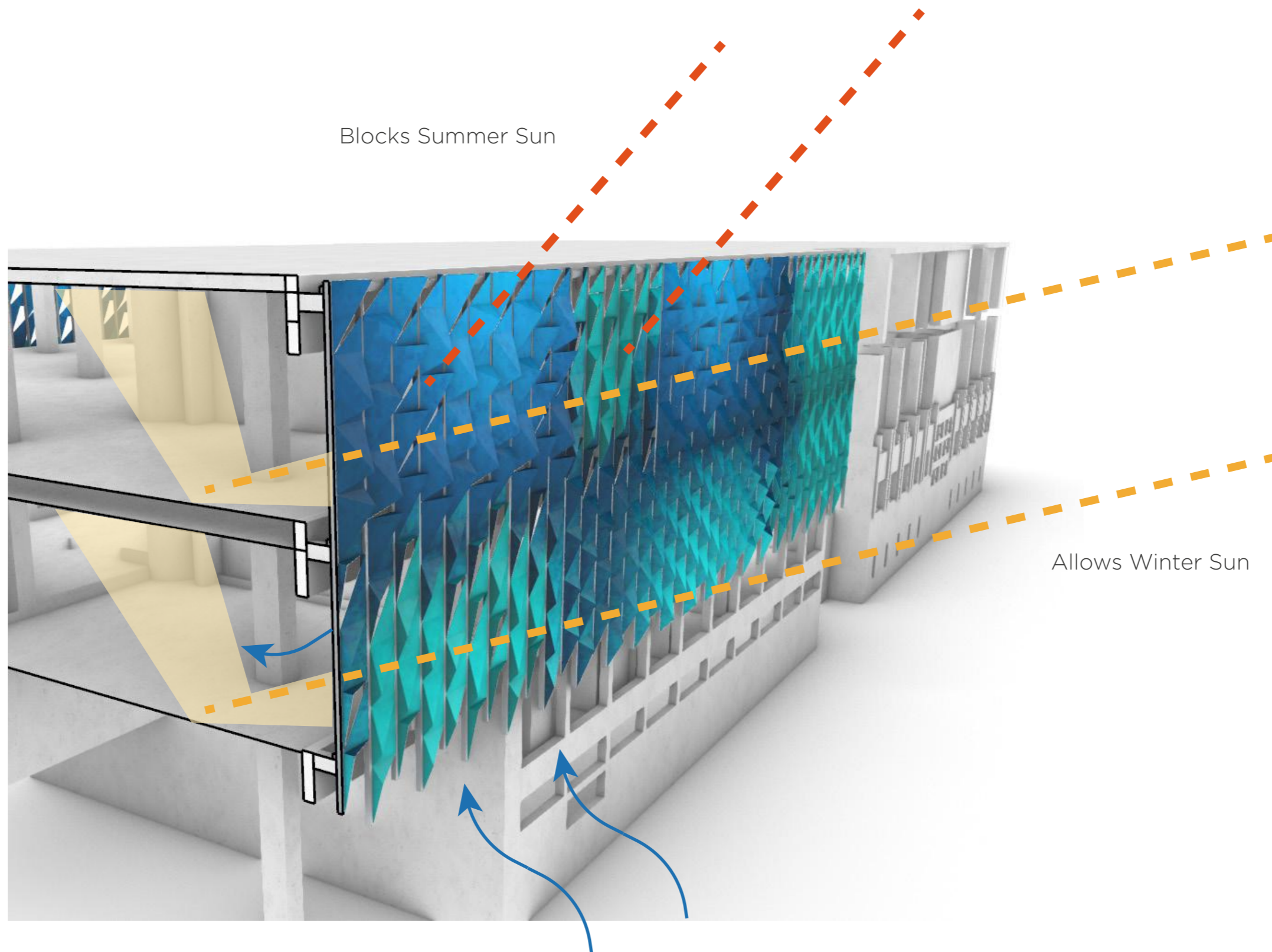
- MAX Shading required
- MID Shading required
- MIN Shading required

East Elevation (Shading Diagram)

0 1:100 5m



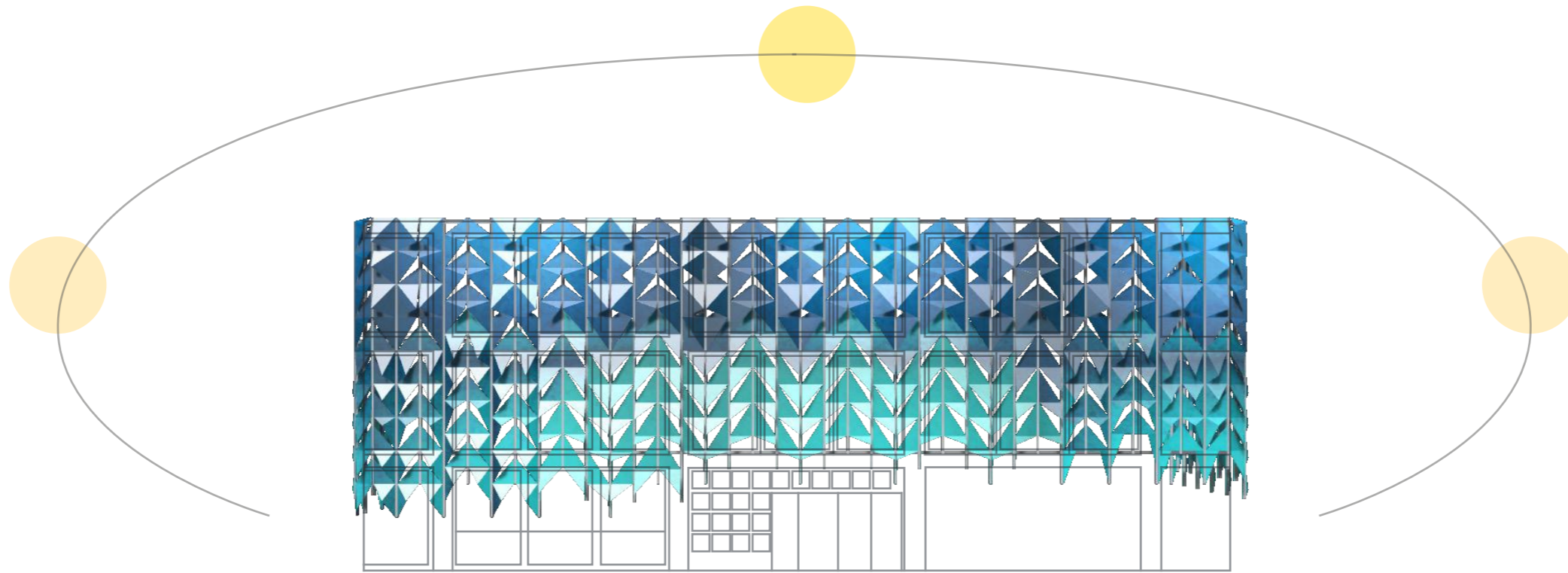
In the East, sun must also be blocked
from the South



Blocks Summer Sun

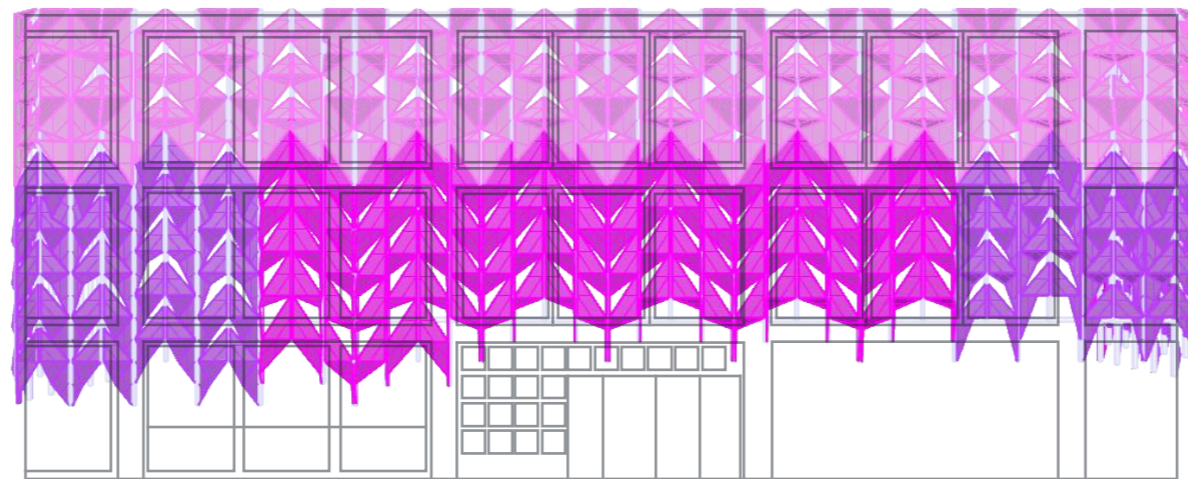
Allows Winter Sun

Natural Ventilation if Windows are
Opened



South Elevation (Rendered)

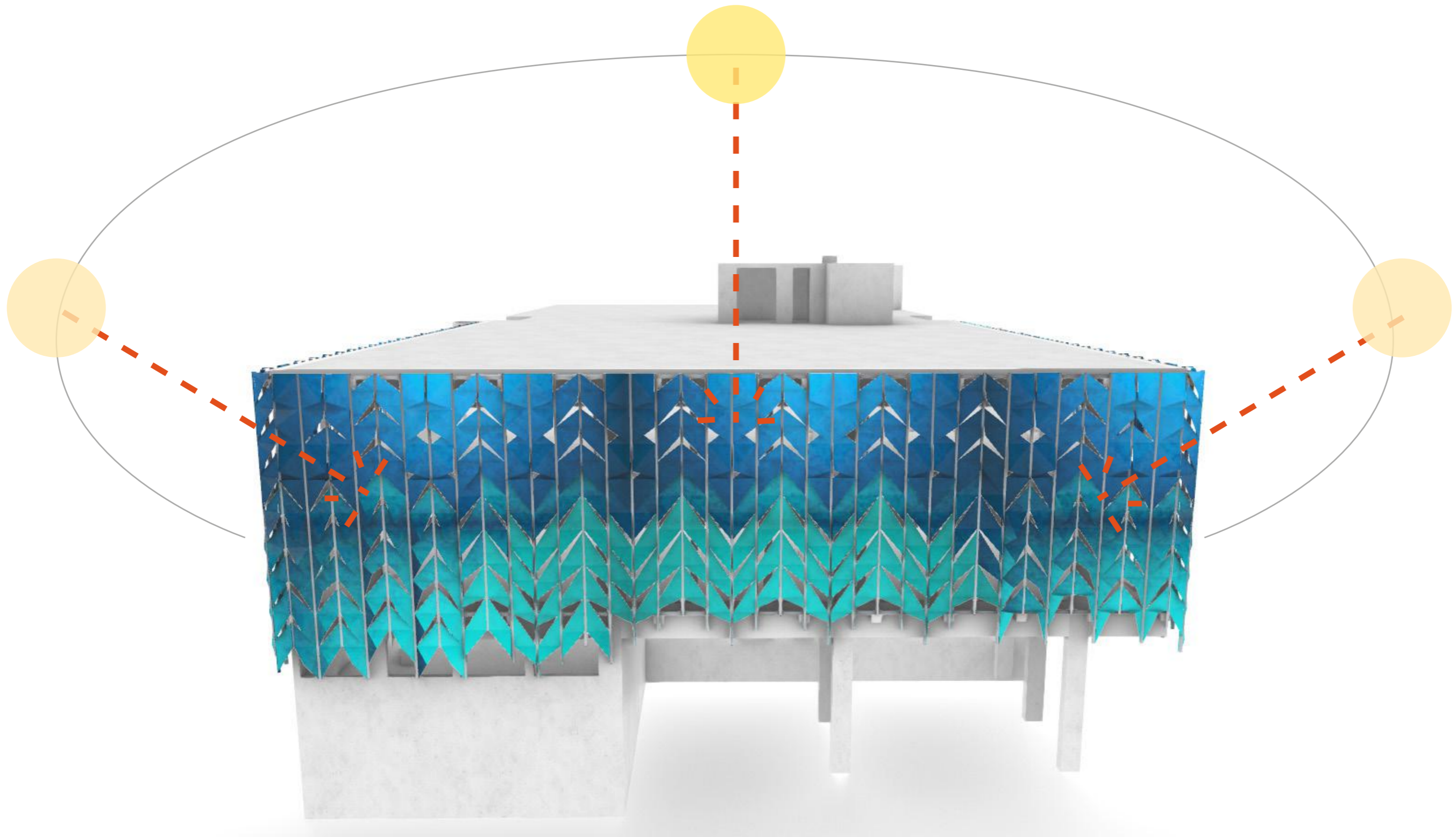
0 1:100 5m



South Elevation (Shading Diagram)

0 1:100 5m

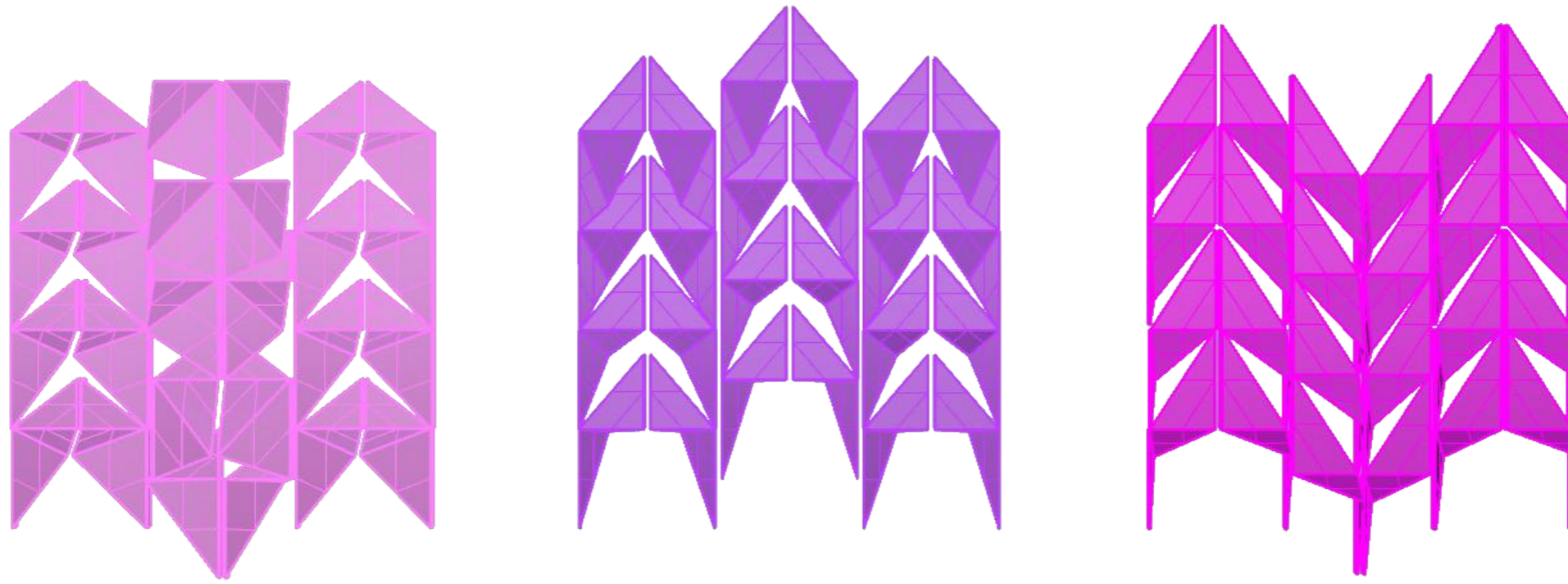
- MAX Shading required
- MID Shading required
- MIN Shading required



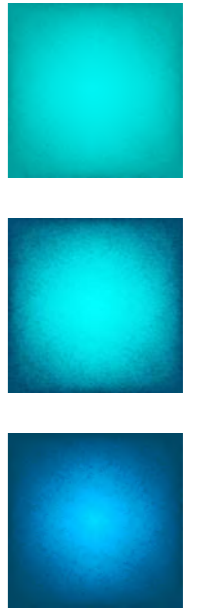
In the South, sun must also be blocked
from both the East & West

South Clusters

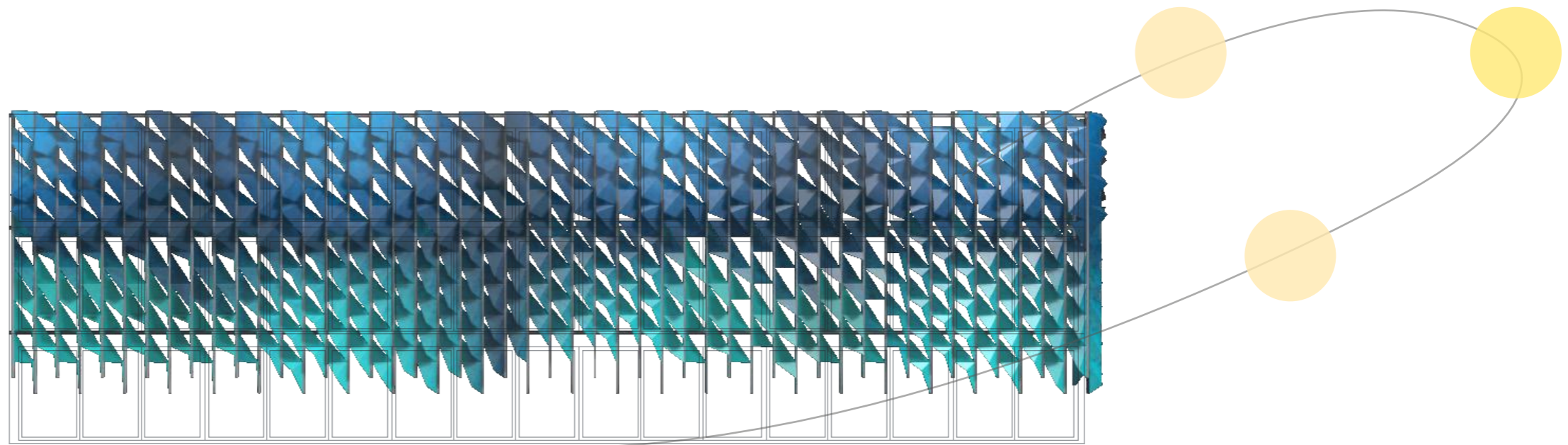
Shaded



Rendered

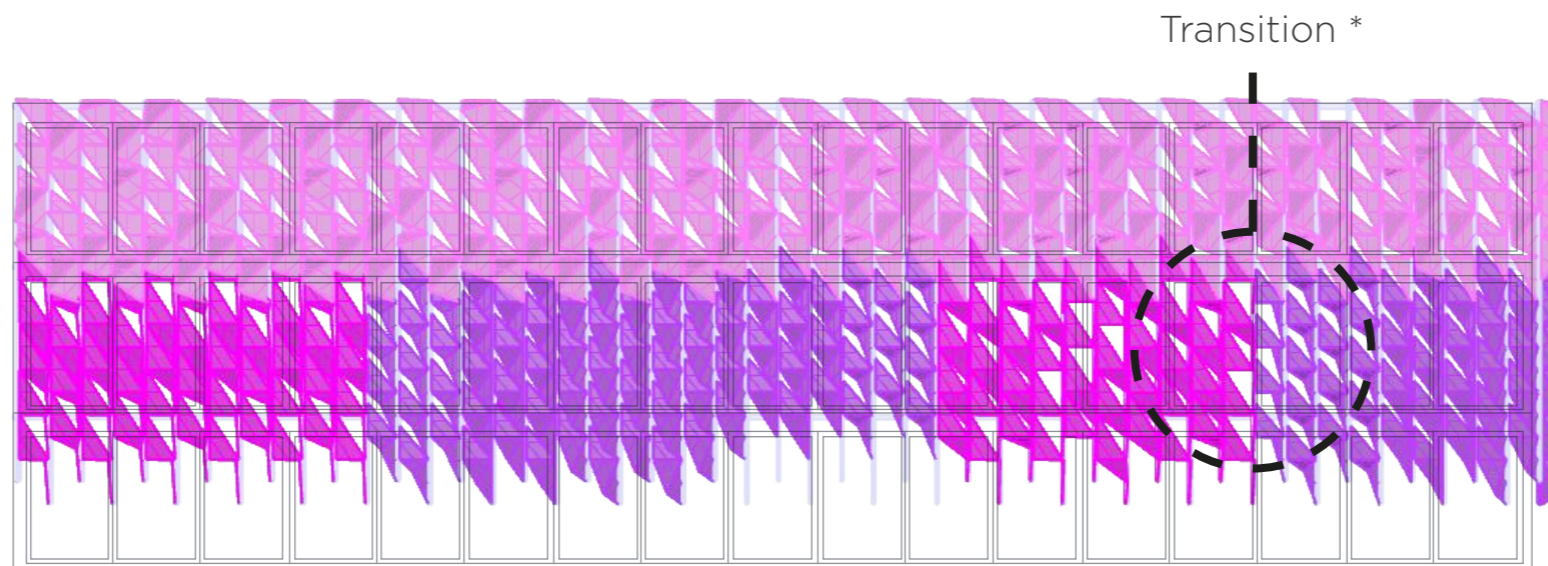


Each Shading Cluster is assigned a specific shade of blue



West Elevation (Rendered)

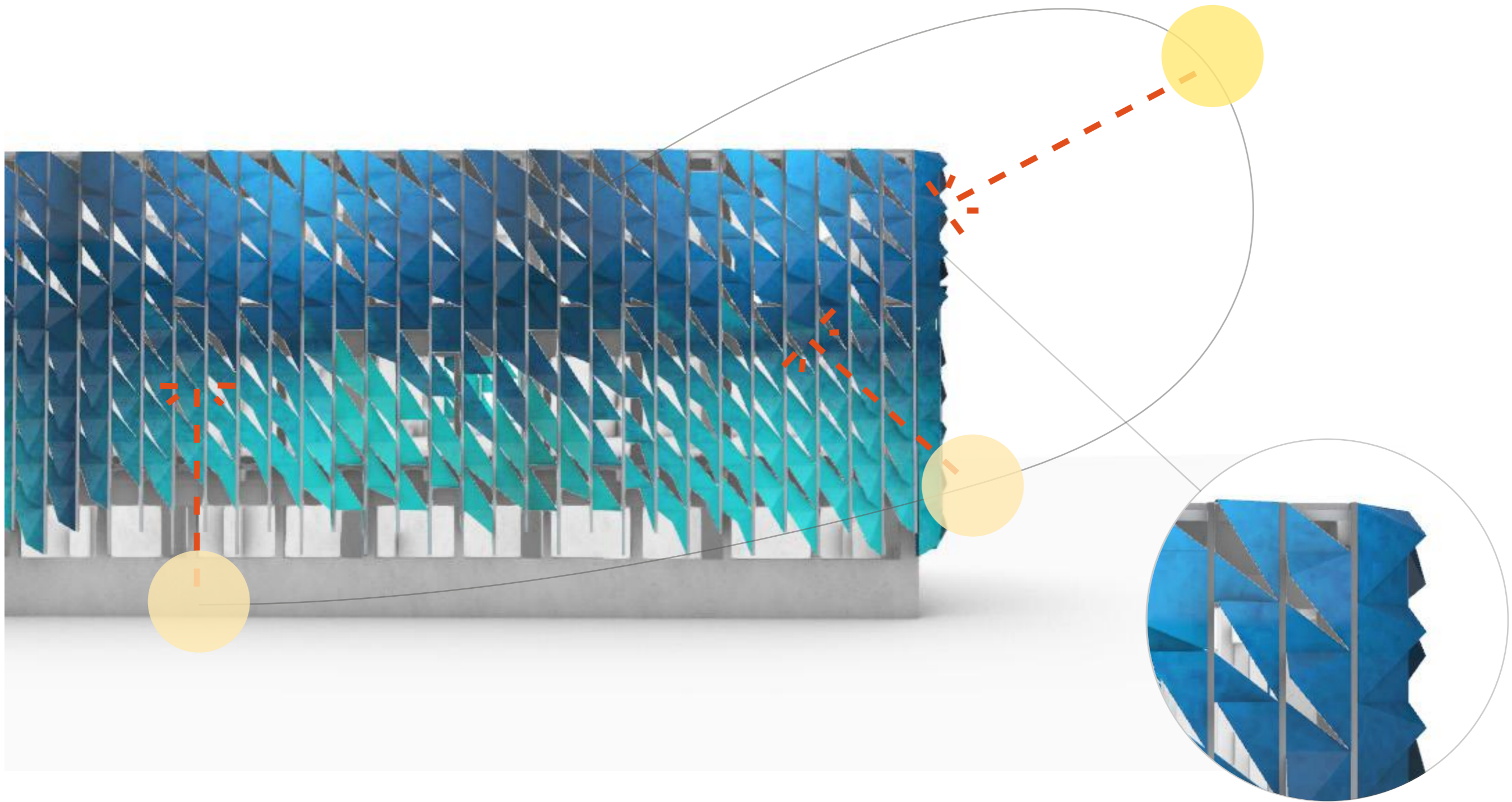
0 1:100 5m



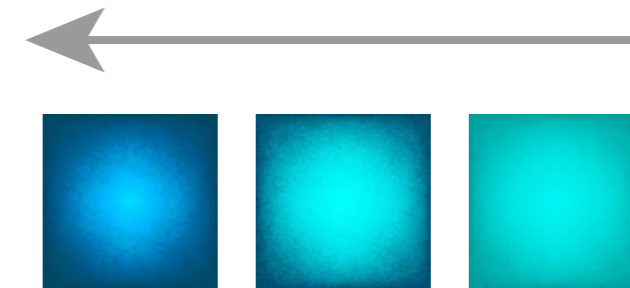
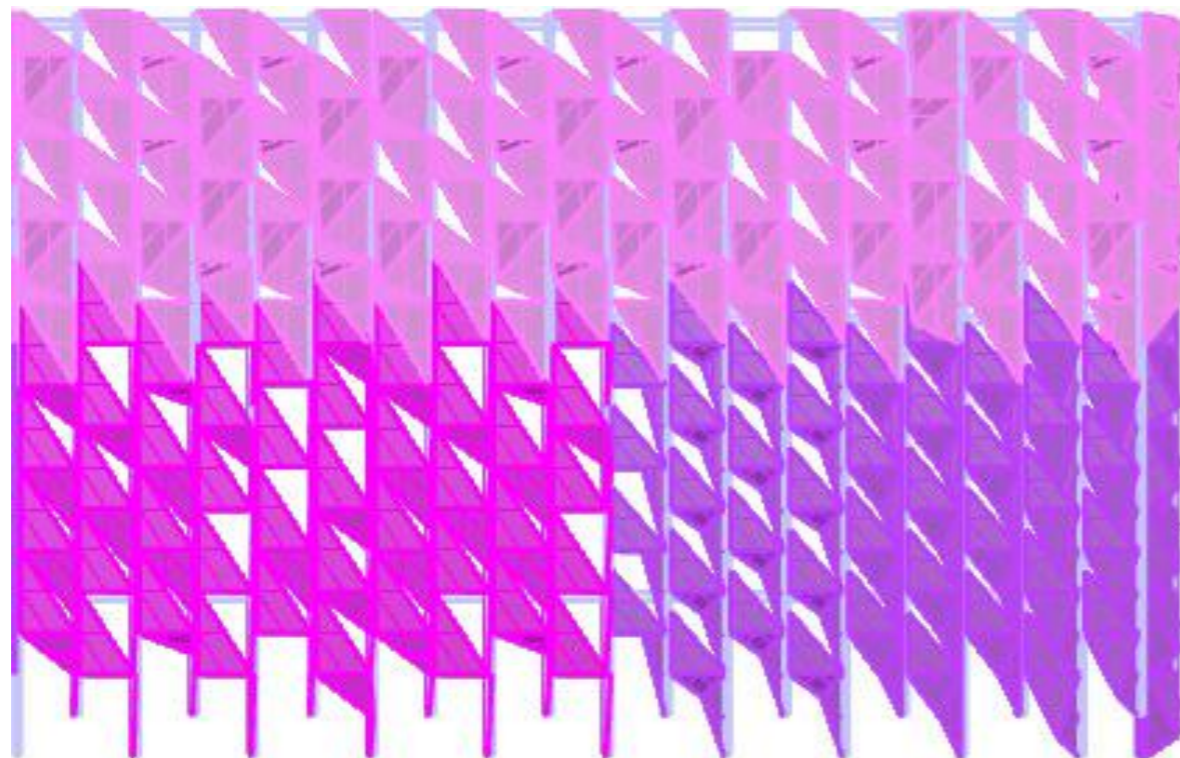
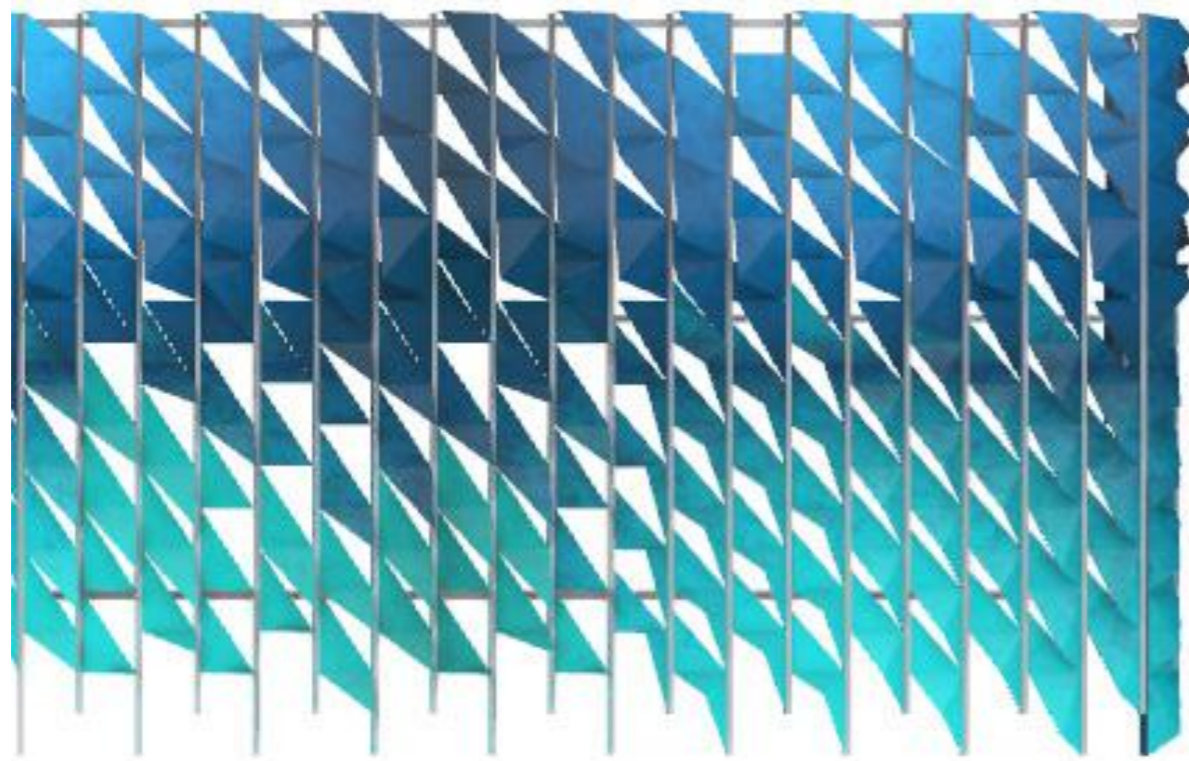
- MAX Shading required
- MID Shading required
- MIN Shading required

West Elevation (Shading Diagram)

0 1:100 5m



In the West, sun must also be blocked from the South



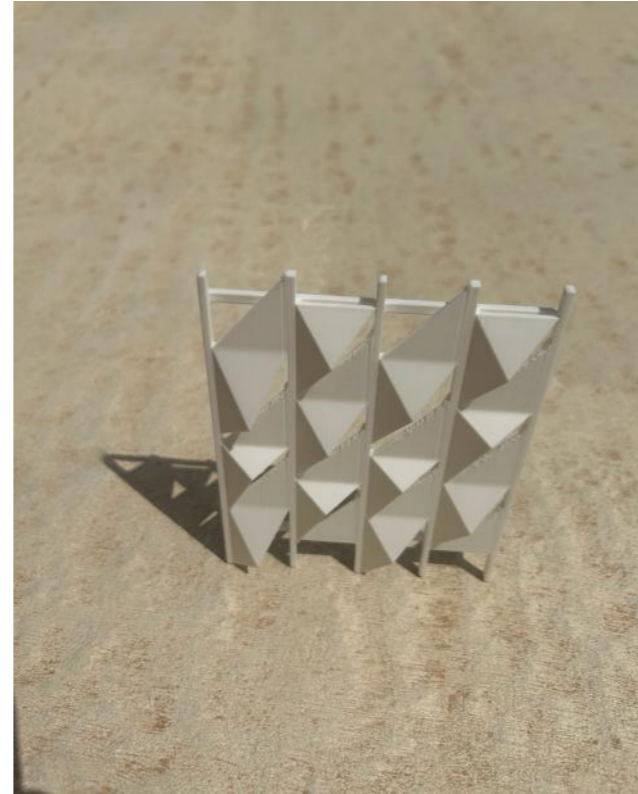
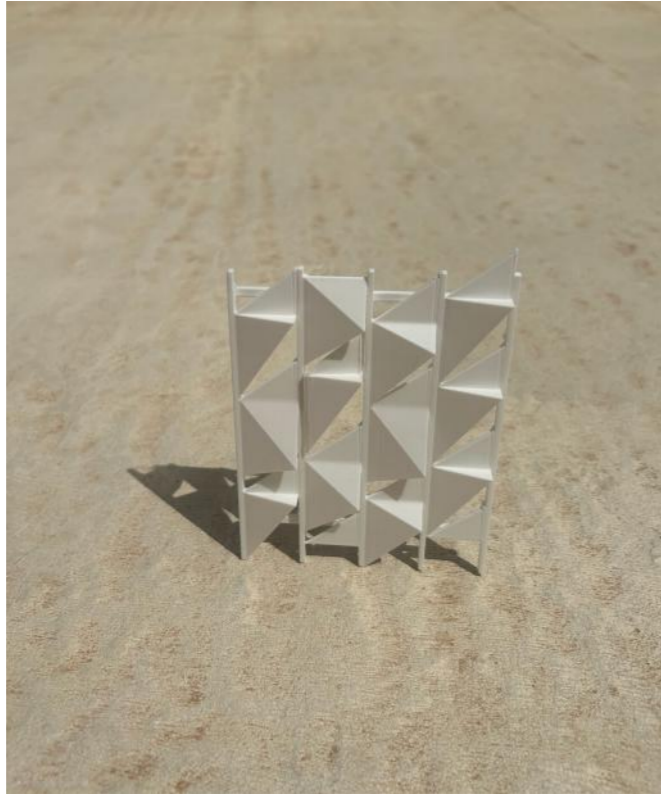
In transition zones, the panels of one zone gradually open/close to match with the panels of the adjacent zone

The change in aperture is also reflected in the shade of colour used, going from dark to light or vice versa

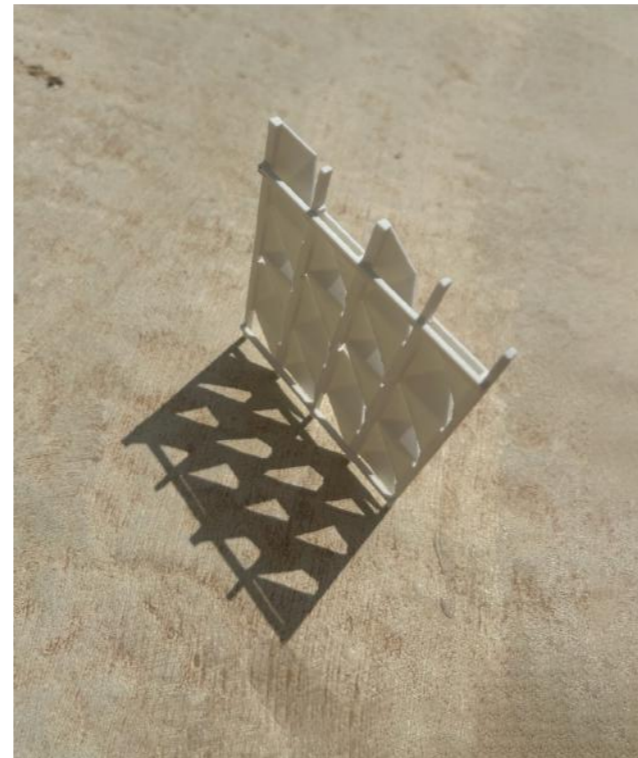
This gradual shift allows the panels to merge and flow across the facade

1:25 Cluster Model Images

Front



Back

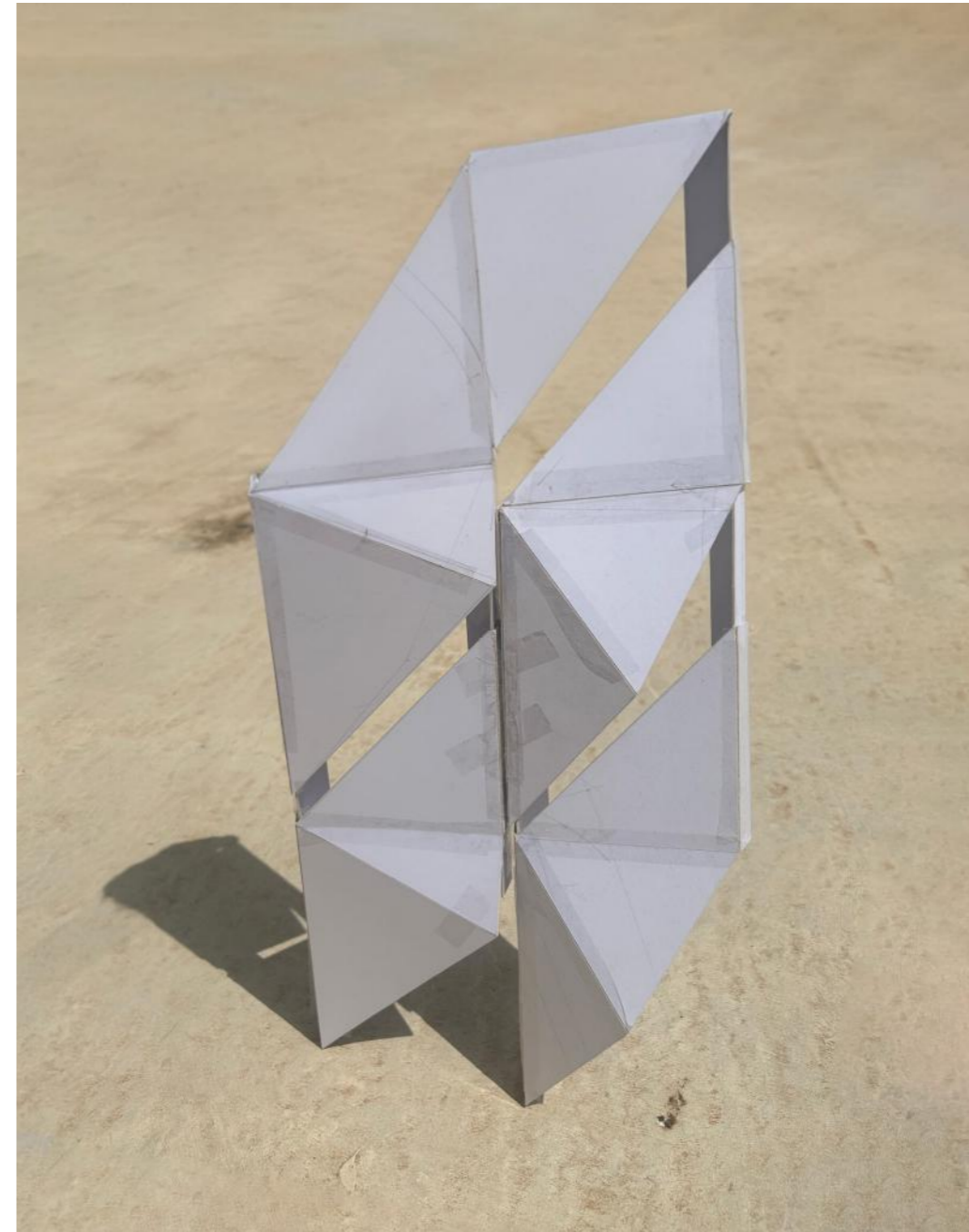
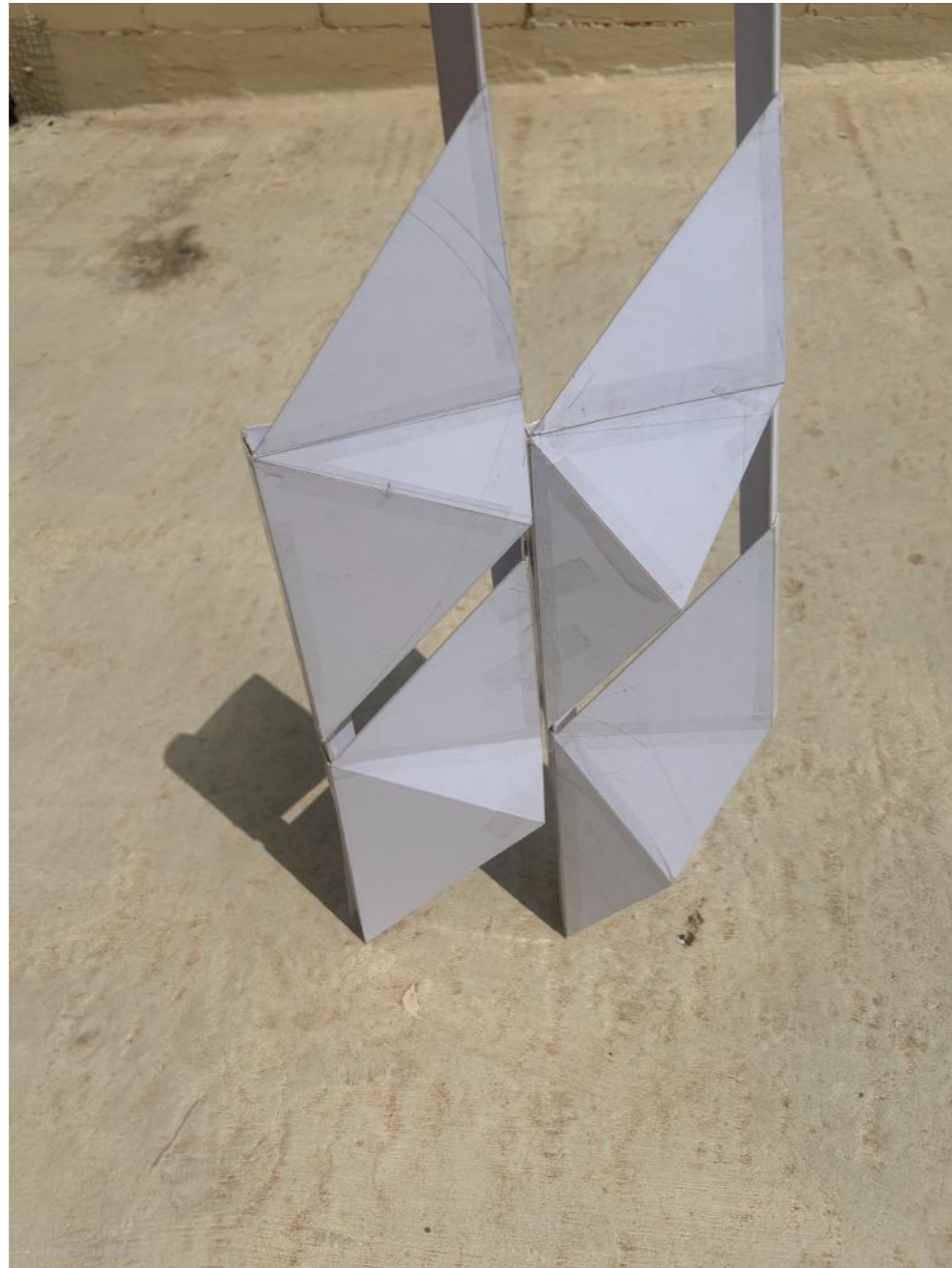


Minimal Shading Cluster

Medium Shading Cluster

Maximum Shading Cluster

Tiling Experiments



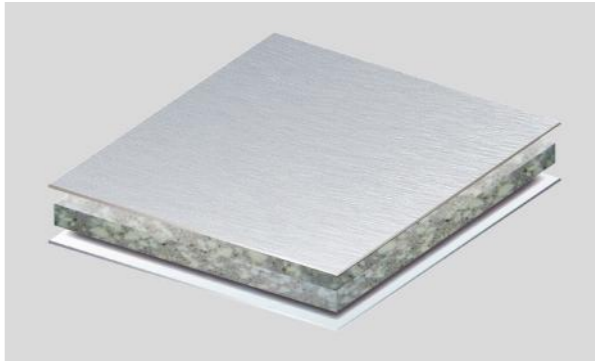
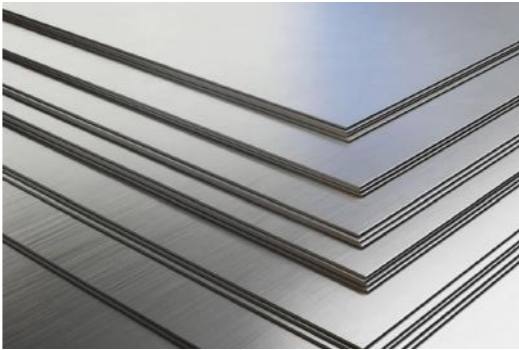
1:5 Scale models were used the attachment and tiling system

FABRICATION AND ASSEMBLY

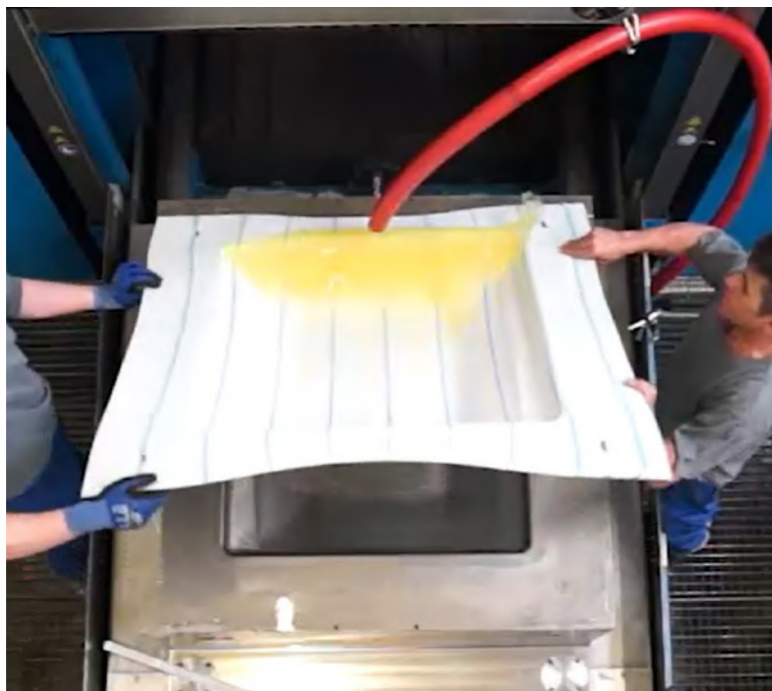
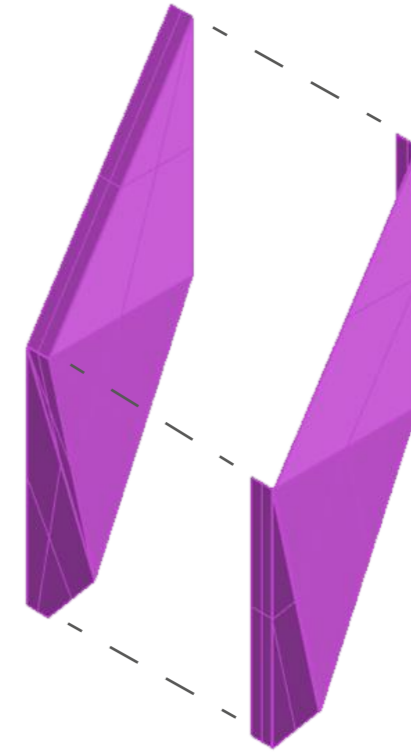
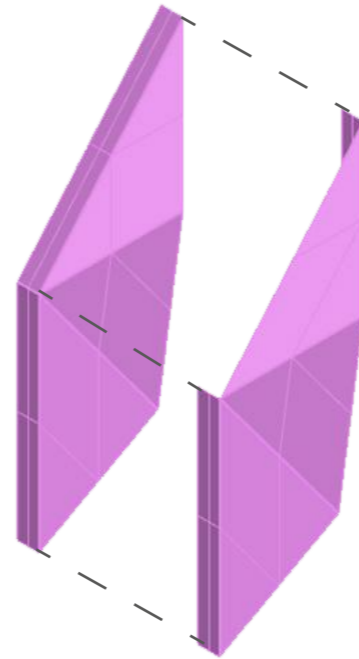
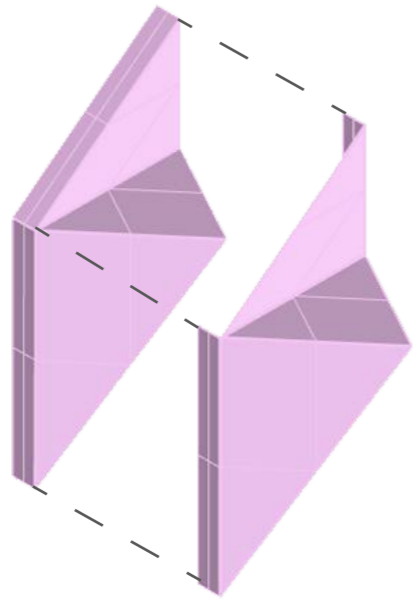
Materiality

Criteria:	Aluminium	Alucobond (ACP)
Durability	Corrosion- resistant with coating	Highly weather and UV resitsant
Weight	Lightweight	Lighter, with better stiffness
Formability	Limited- cracks under tight bends	Easy to bend, fold and route
Aesthetics	Prone to denting or warping	Excellent flatness, smooth surface
Structural Strength	Moderate, but needs reinforcement	Requires support, but more rigid per weight
Fire Performance	Naturally non- combustible	Fire rated core required
Sustainability	Fully Recyclable	Composite- harder to recylce
Installation	May require sub- framing	Lightweight easier to install
Cost	Moderate	Slightly higher

- Chosen material: Alucobond
- Easier to bend / form without cracking
 - Smoother appearance
 - Lightweight but rigid
 - Greater flexibility in design.



Panel Fabrication



Pressing the Alucobond Sheet on the solid mold

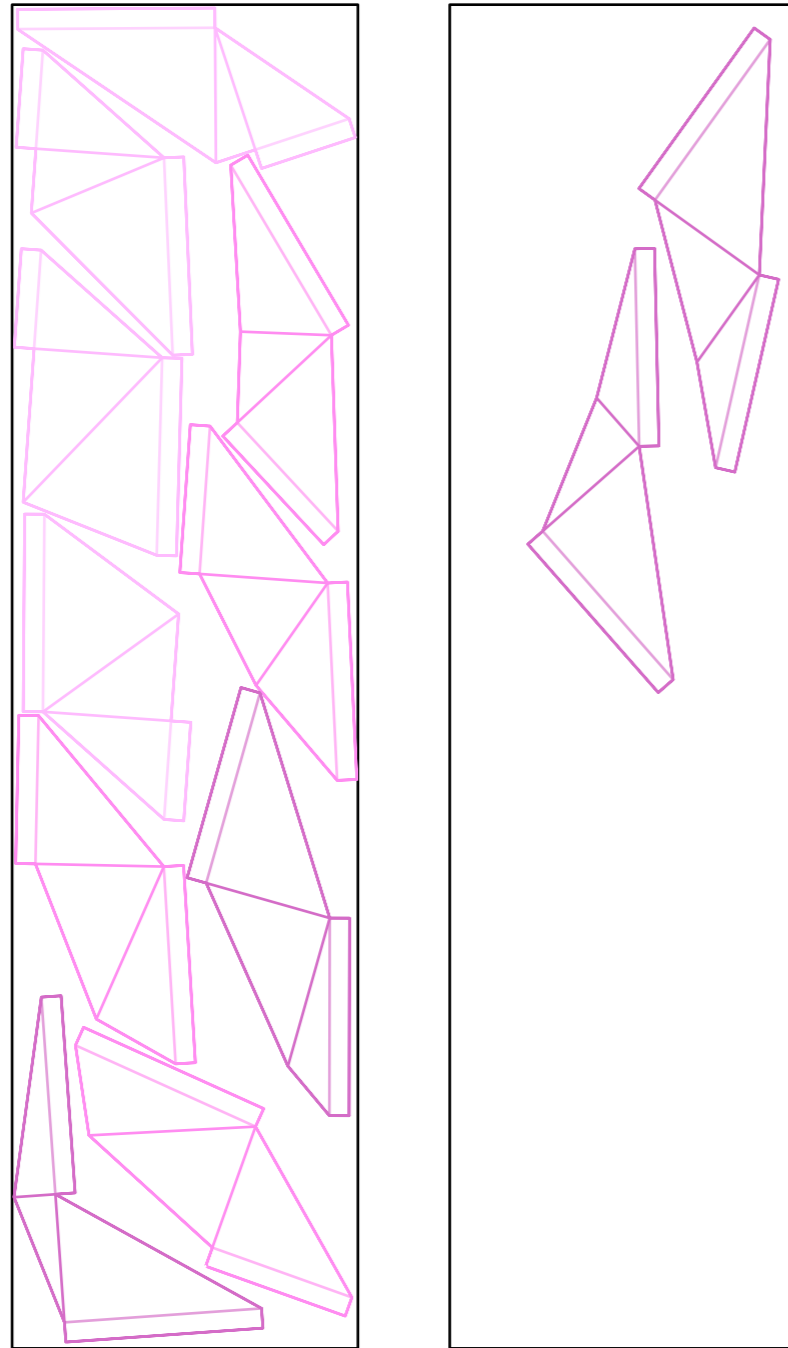


Visually examining the final form for any imperfections

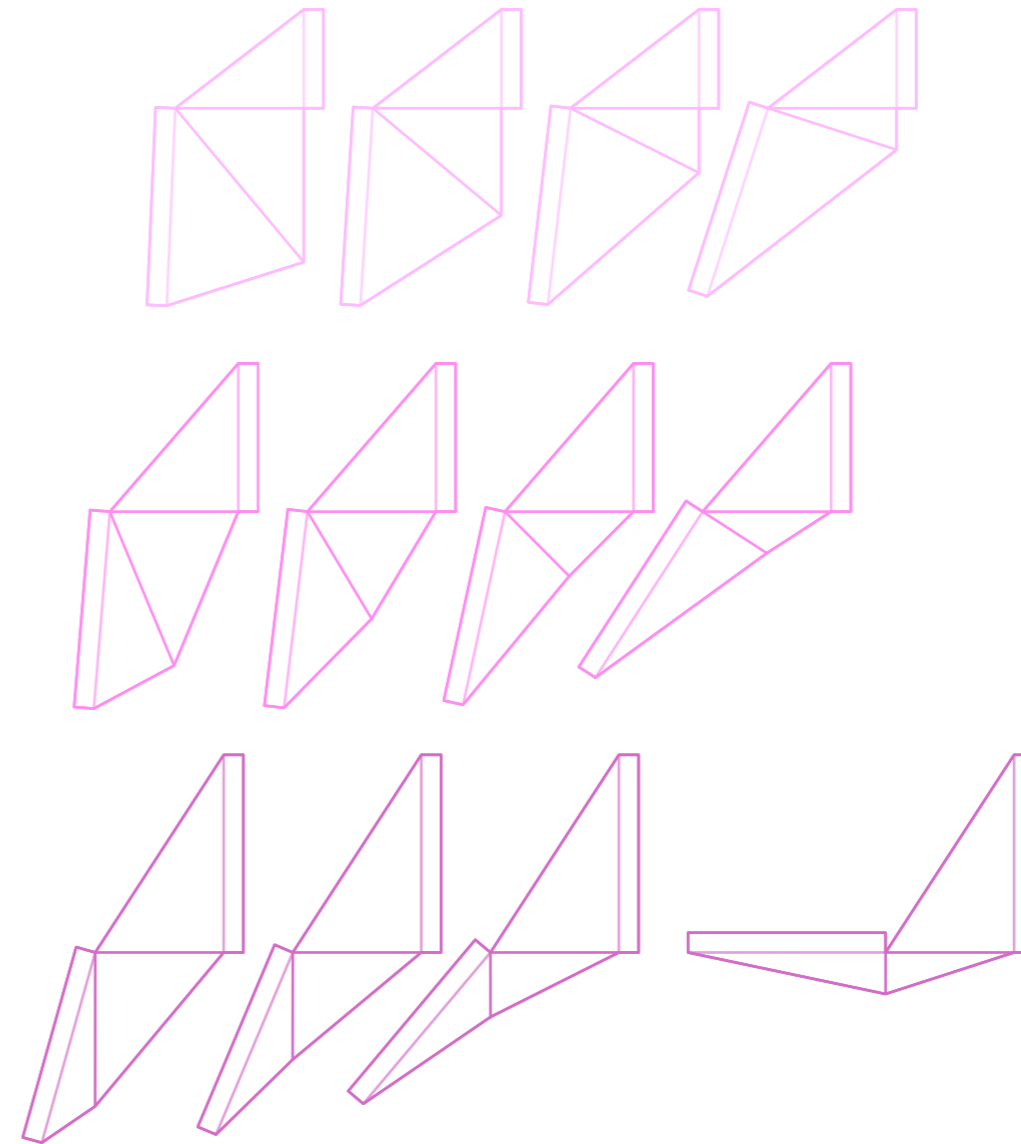


Cutting off excess material

Panel Fabrication



Chosen thickness: 6mm
Chosen width: 1750mm
Chosen Length: 6800mm
Area of sheet: $1.75\text{m} \times 6.8\text{m} = 11.9\text{m}^2$
Weight of sheet: $11.9\text{m}^2 \times 8.9 \text{ kg/m}^2 = 105.91\text{kg}$



Since 6 out of 8 panels fit on one sheet
Total area of 6 out of 8 panels is 8.01 m^2

Area of one sheet = 11.9 m^2

Remaining material = $11.9 - 8.01 = 3.89 \text{ m}^2$

$3.89/11.9 \times 100 \approx 32\%$ Material Wasted from 1 Sheet

Dimensions & Finishes

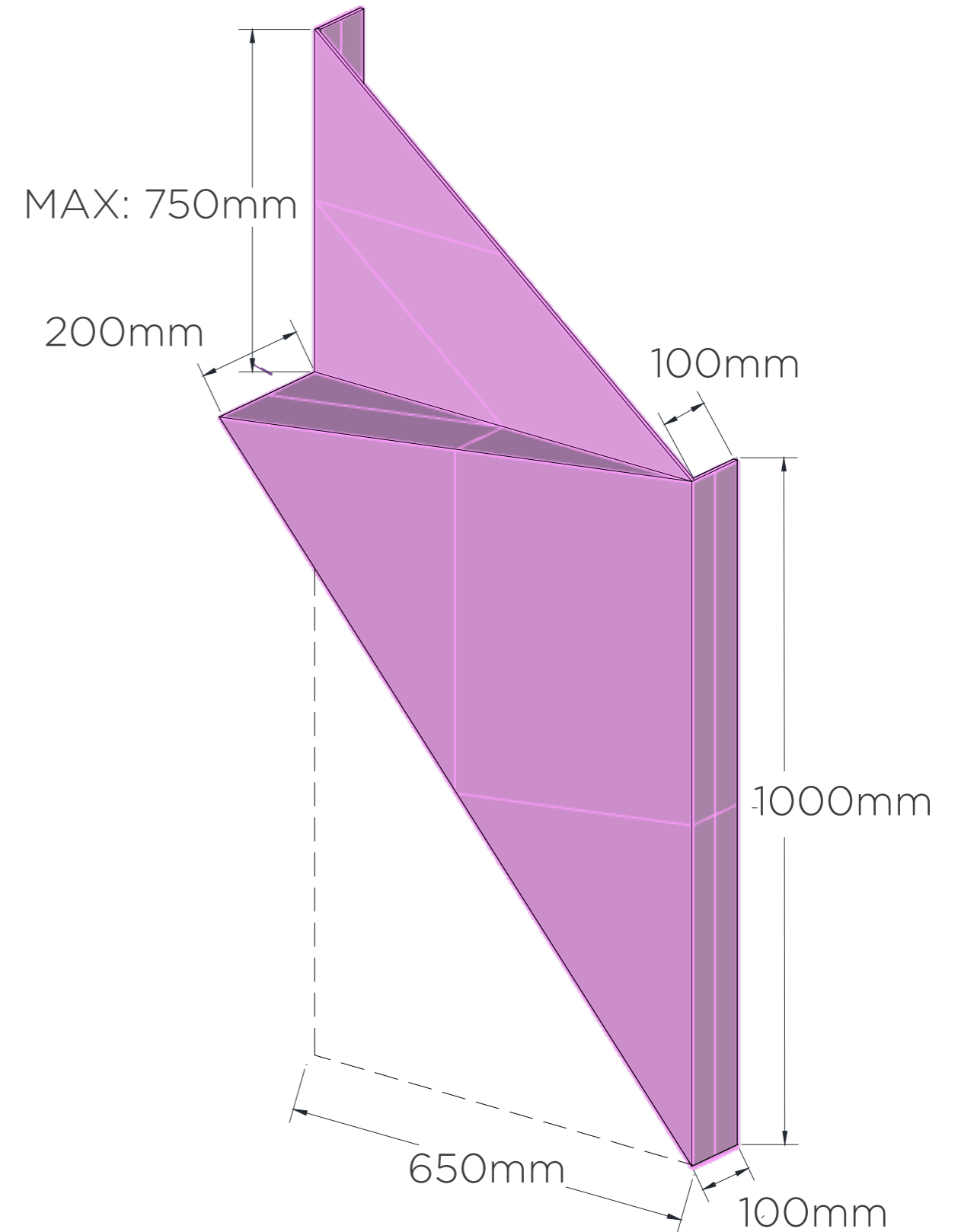
Polyvinylidene Fluoride Coating (PVDF) will be used to finish the Alucobond and give the colour we need.

- Applied using a four coat system - Primer, basecoat, topcoat and clearcoat
- Provides long term colour stability- even under intense sun and UV exposure
- Resistant to rain and humidity.
- Maintains original colour over many years
- Provides a clean look with a consistent, defect-free appearance.



Colour: Deepblue Metallic MG

Designation	Value
Type	ALUCOBOND® PLUS, ALUCOBOND® A2
Colour series	Sparkling
Colour tone	684 Deepblue Metallic MG
Colour type	metallic
Maximum length	6.800 mm
Thickness	6 mm
Weight	7,6 kg/m ²

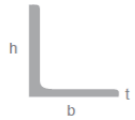


L Steel Section Specifications:



Equal Angles

Designation	Dimensions					Position of axes					Dimensions for detailing						
	h	b	t	G	h = b	t	r ₁	r ₂	r ₃	A	Z _y =Z _x	v	u ₁	u ₂	Ø	e _{min}	e _{max}
mm	mm	mm	kg/m	mm	mm	mm	mm	mm	mm	mm ²	mm	mm	mm	mm	mm	mm	mm
20	20	3	0.882	20	3	3.5	-	-	1.12	0.596	1.41	0.843	0.7	-	-	-	-
25	25	3	1.120	25	3	3.5	-	-	1.42	0.721	1.77	1.02	0.877	-	-	-	-
25	25	5	1.867														
30	30	3	1.360	30	3	5	-	-	1.74	0.835	2.12	1.18	1.05	-	-	-	-
30	30	4	1.780	30	4	5	-	-	2.27	0.878	2.12	1.24	1.06	-	-	-	-
30	30	5	2.967														
30	30	6	5.933														
100	100	8	12.200	100	8	12	-	-	15.5	2.74	7.07	3.87	3.52	M 24	43	59	
100	100	10	15.000	100	10	12	-	-	19.2	2.82	7.07	3.99	3.54	M 24	45	59	
100	100	12	17.800	100	12	12	-	-	22.7	2.9	7.07	4.11	3.57	M 24	47	59	
120	120	10	18.200	120	10	13	-	-	23.2	3.31	8.49	4.69	4.24	M 27	49	72	
120	120	12	21.600	120	12	13	-	-	27.5	3.4	8.49	4.8	4.26	M 27	51	72	
150	150	10	23.000	150	10	16	-	-	29.3	4.03	10.61	5.71	5.28	M 27	52	102	
150	150	12	27.300	150	12	16	-	-	34.8	4.12	10.61	5.83	5.29	M 27	54	102	
200	200	16	48.500	200	16	18	-	-	61.8	5.52	14.14	7.81	7.09	M 27	61	151	
200	200	20	59.900	200	20	18	-	-	76.3	5.68	14.14	8.04	7.15	M 27	65	151	



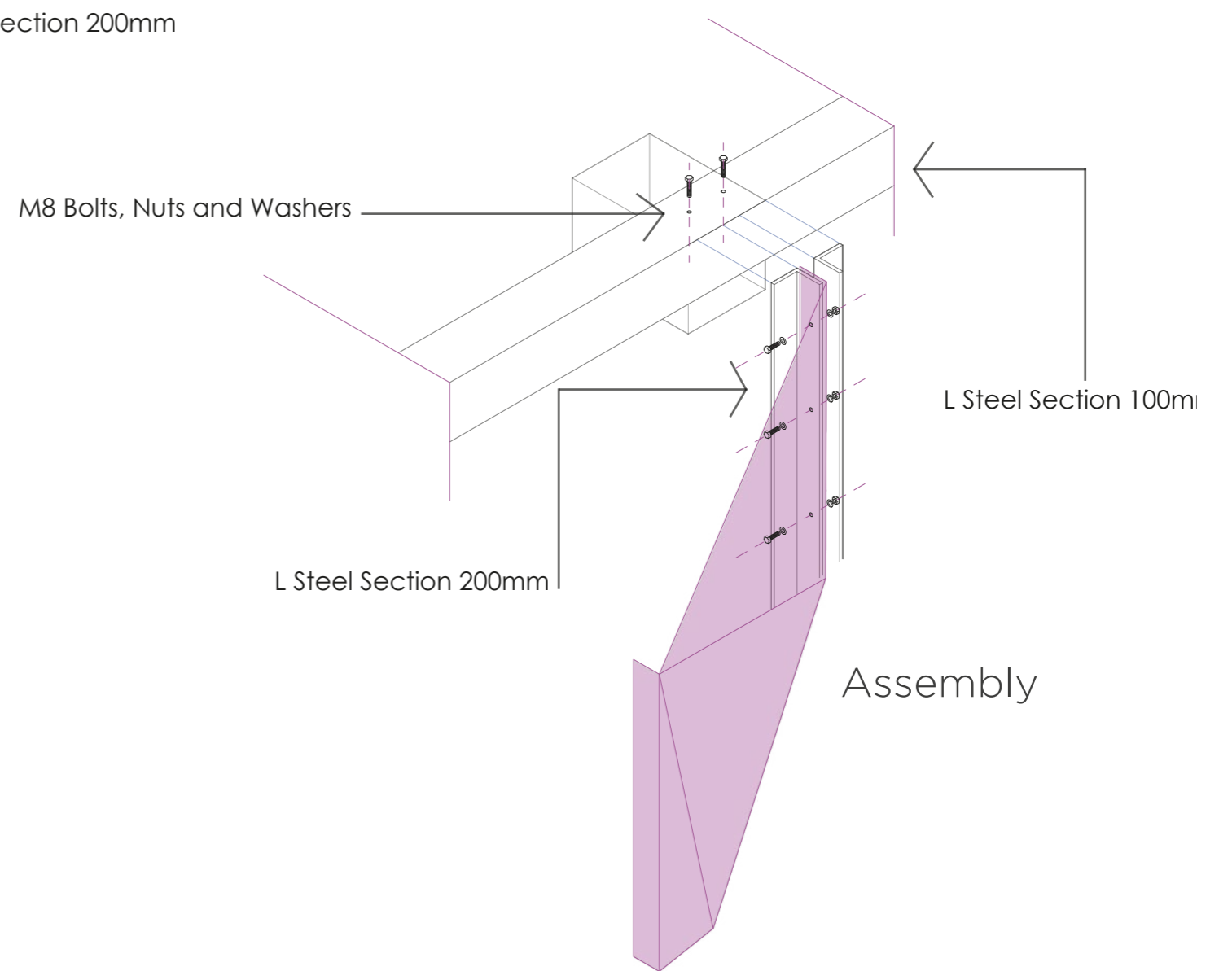
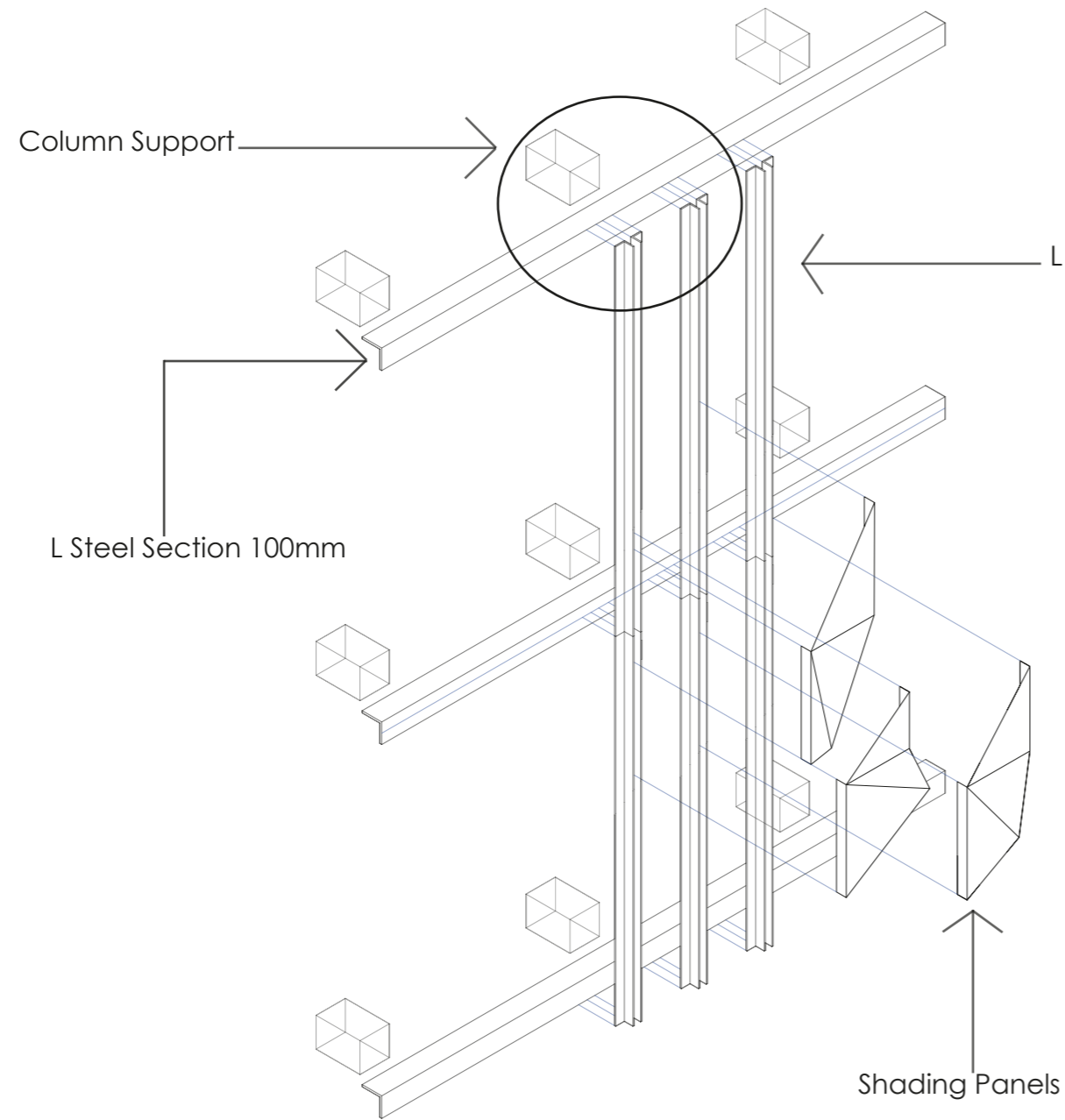
L Steel Section Chosen
Weight: 17.8 kg/m

L Steel Section Chosen
Weight: 60 kg/m

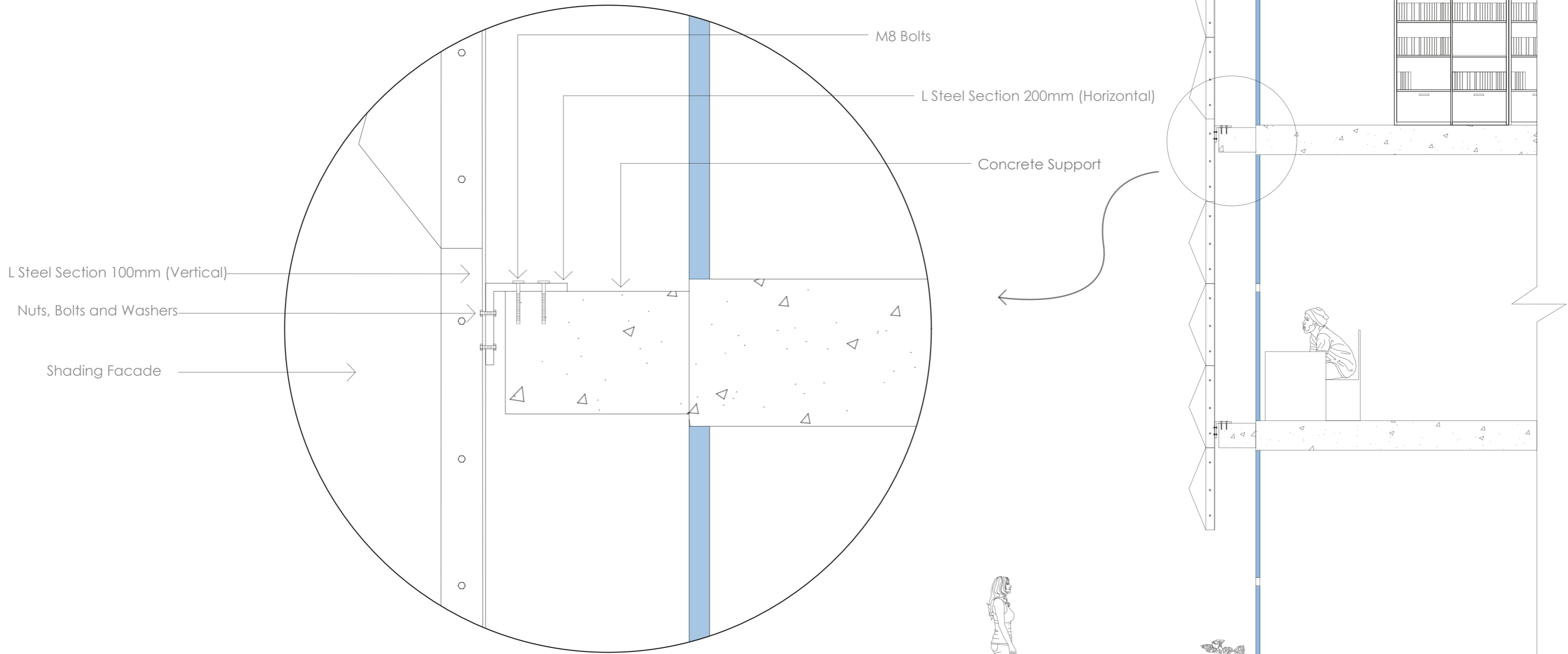
Other Components that will be used:

Component:	Specification:	Purpose:
Bolt	M8 Bolt	Suitable for Structural loads
Nut	M8 Nut	Secures bolt from the opposite side
Flat Washer	Stainless M8 Flat Washer	Distributes load and prevents panel damage

Architectural Details - Detail of Attachment System



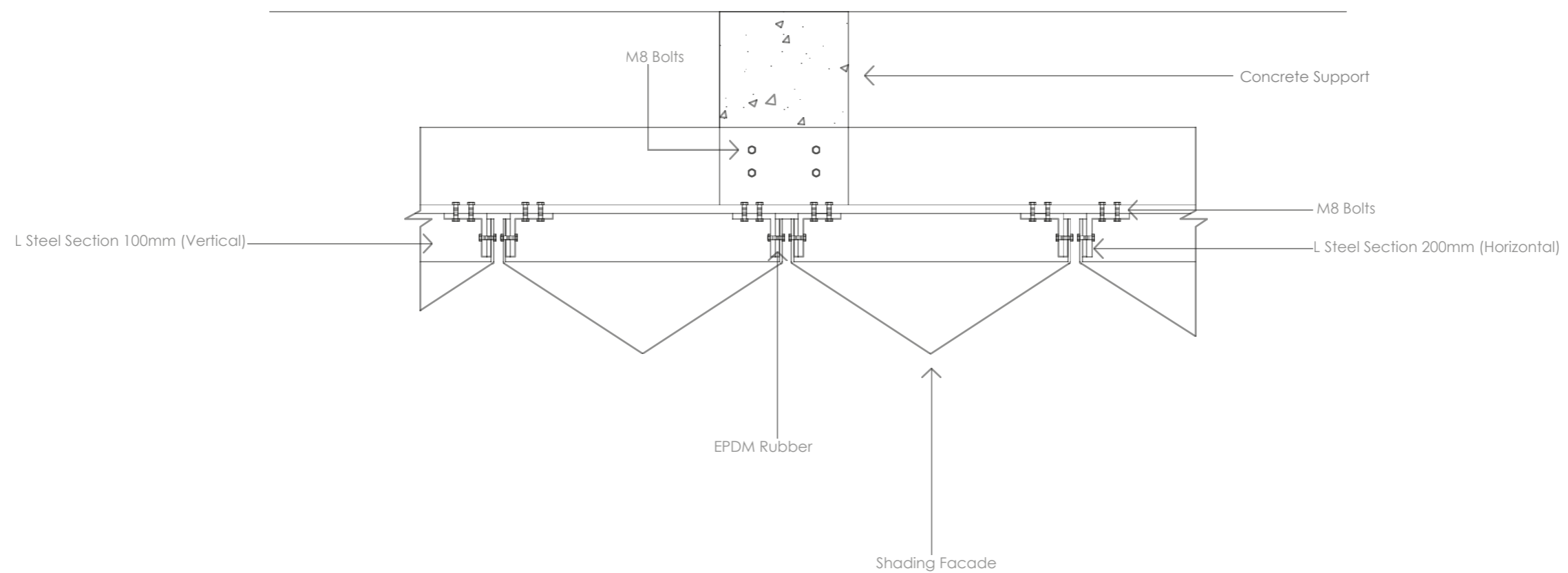
Architectural Details - Connection to the existing concrete supports



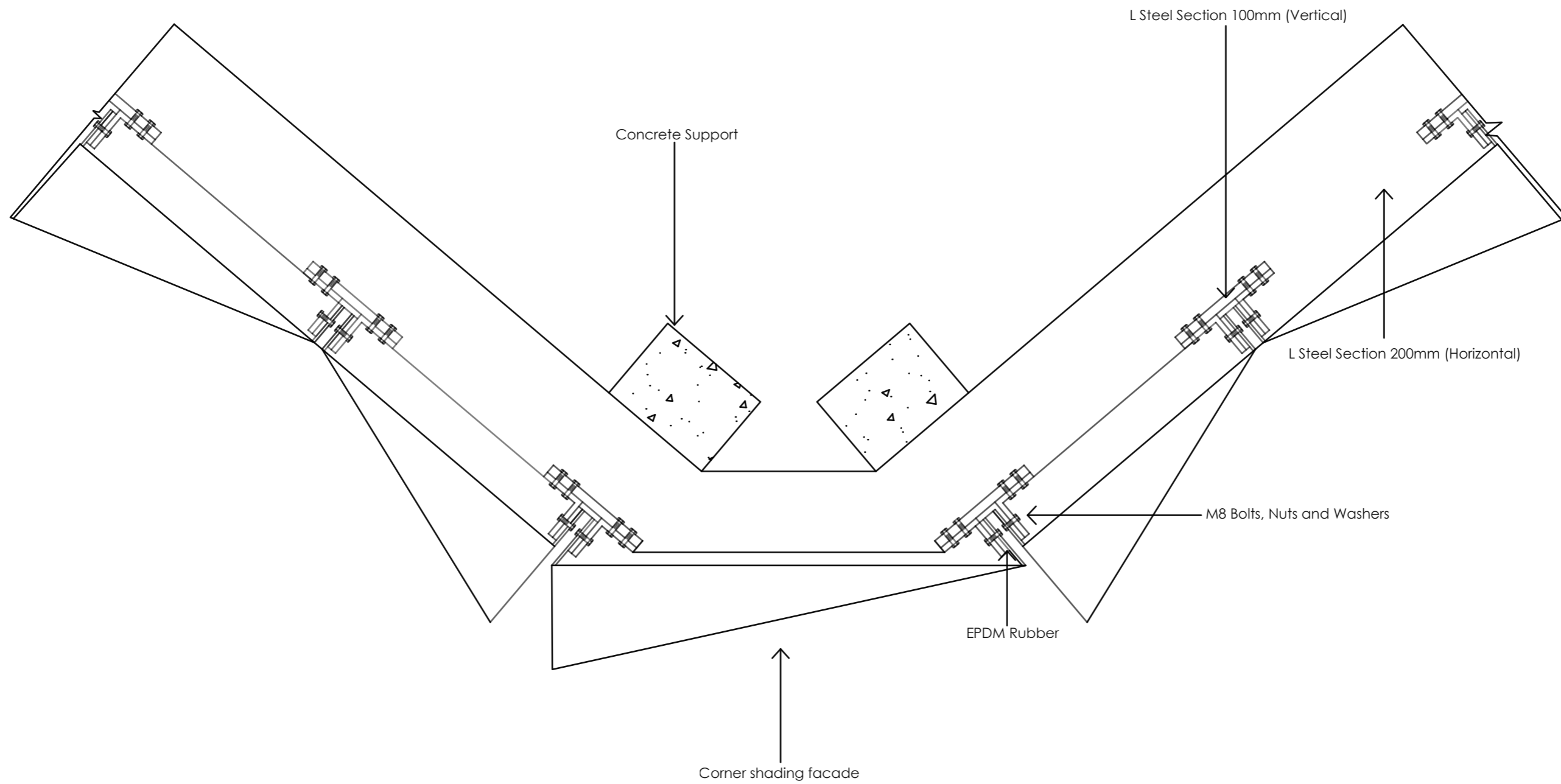
Scale 1:10
1:10
0 1000mm

Scale 1:50
1:50
0 5000mm

Architectural Details - Detail of Attachment System

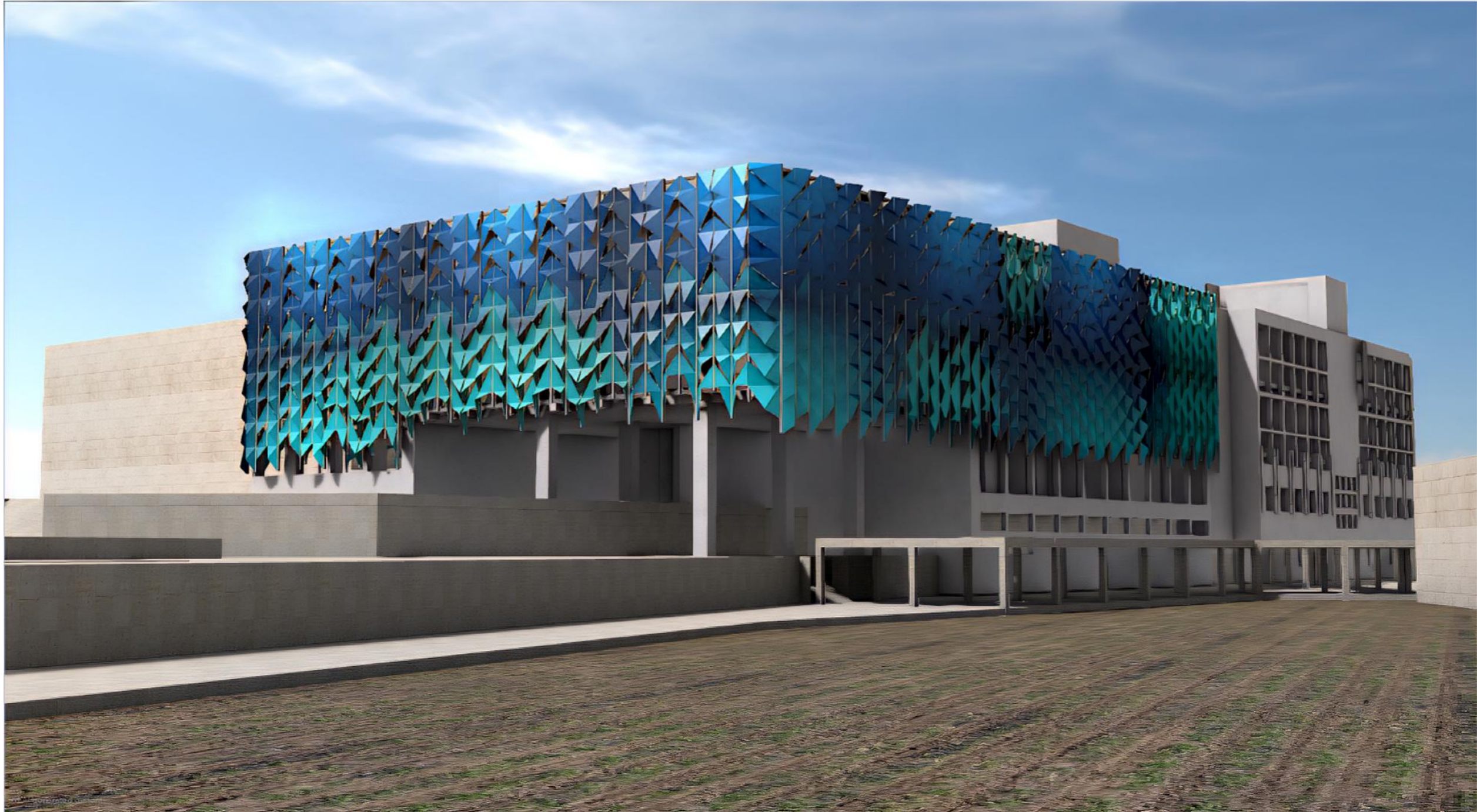


Architectural Details - Detail of Corner Panel



1:10
0 1000mm

VISUALS

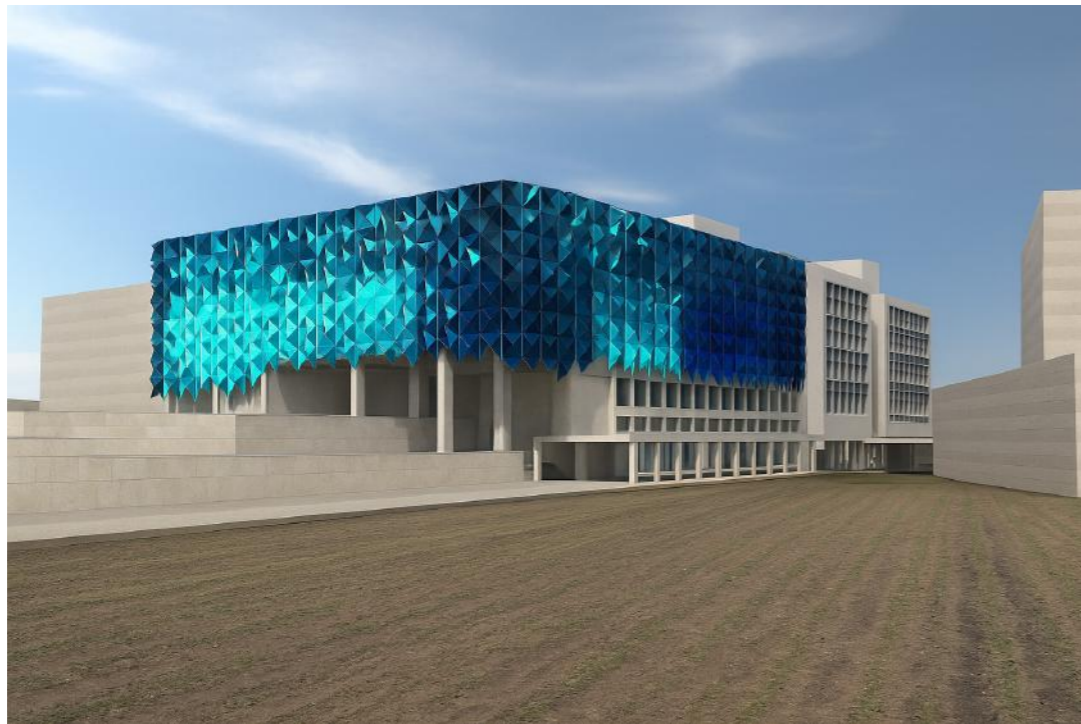


South View

Colour Tests

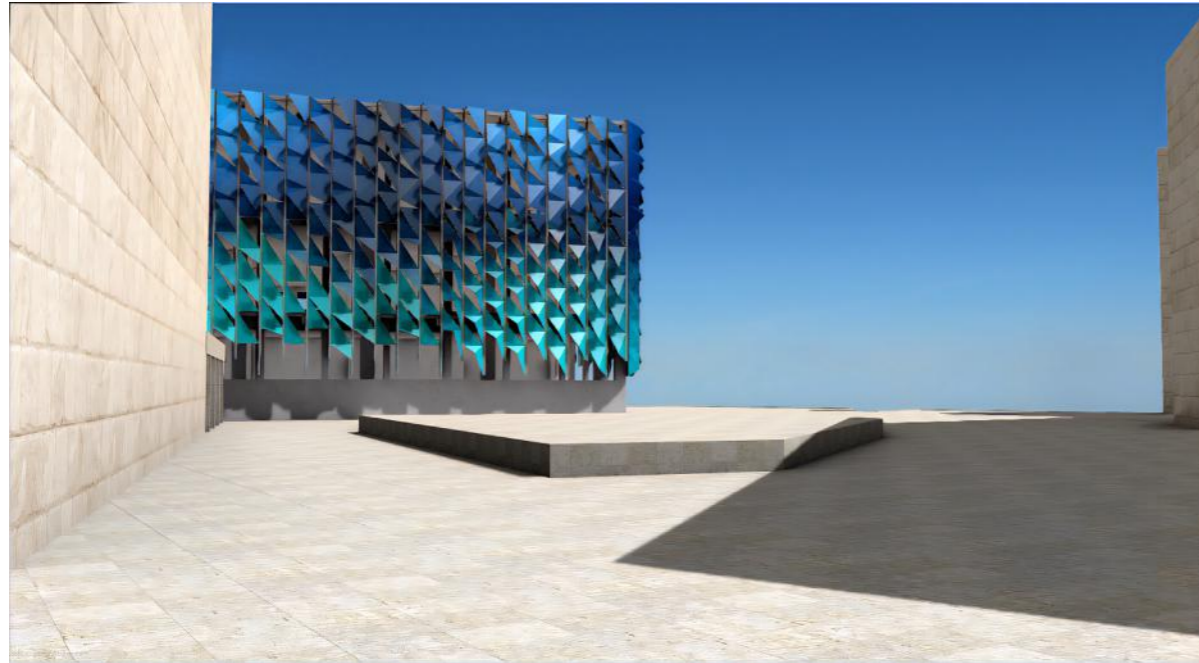


AI Colour Tests



CHOSEN COLOUR SCHEME

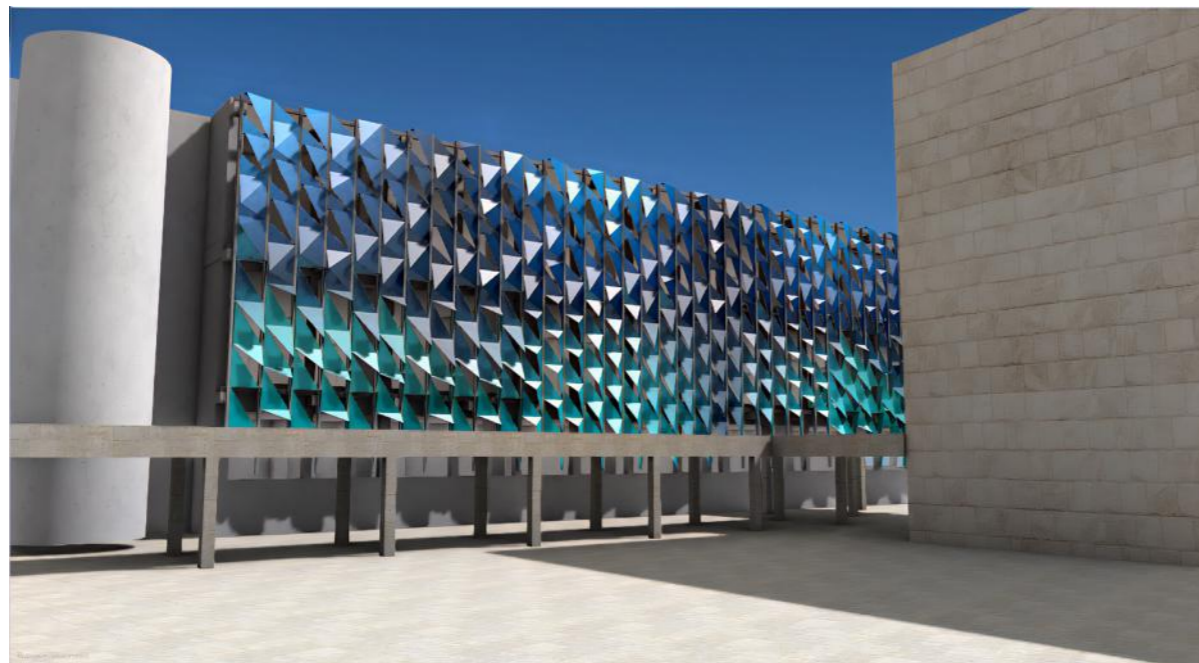
Chosen Colours



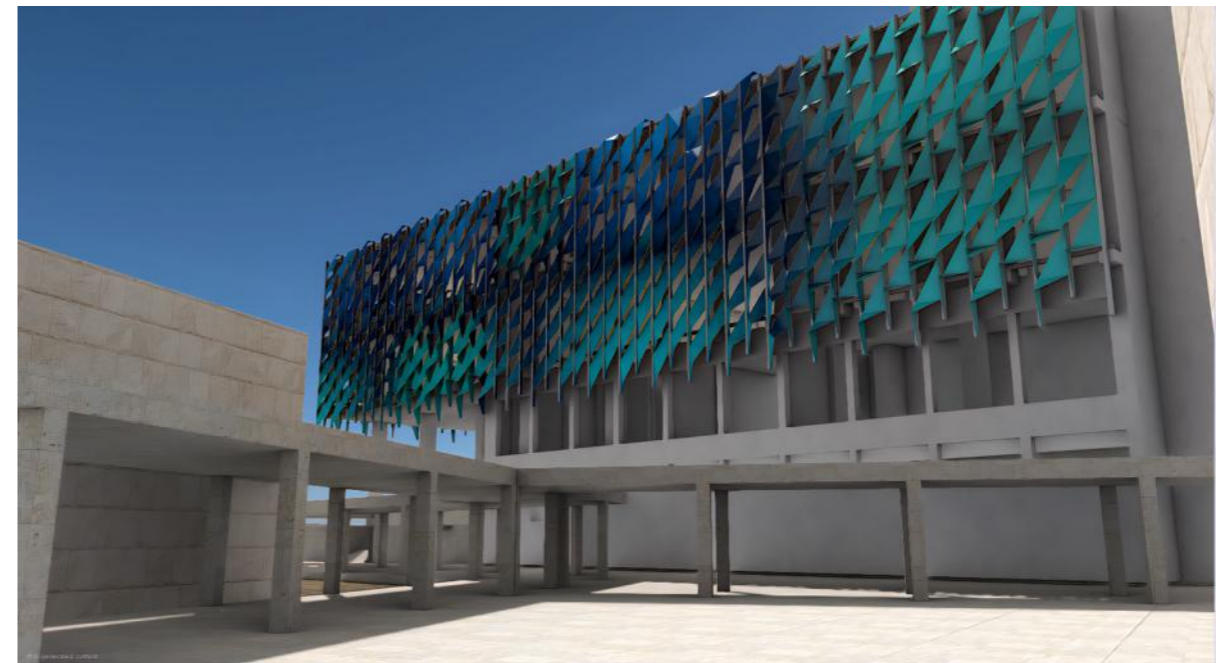
West View



South View



West View



East View

Photomonatages



South-West Perspective

Photomonatages



South Perspective

Photomonatages



East Perspective

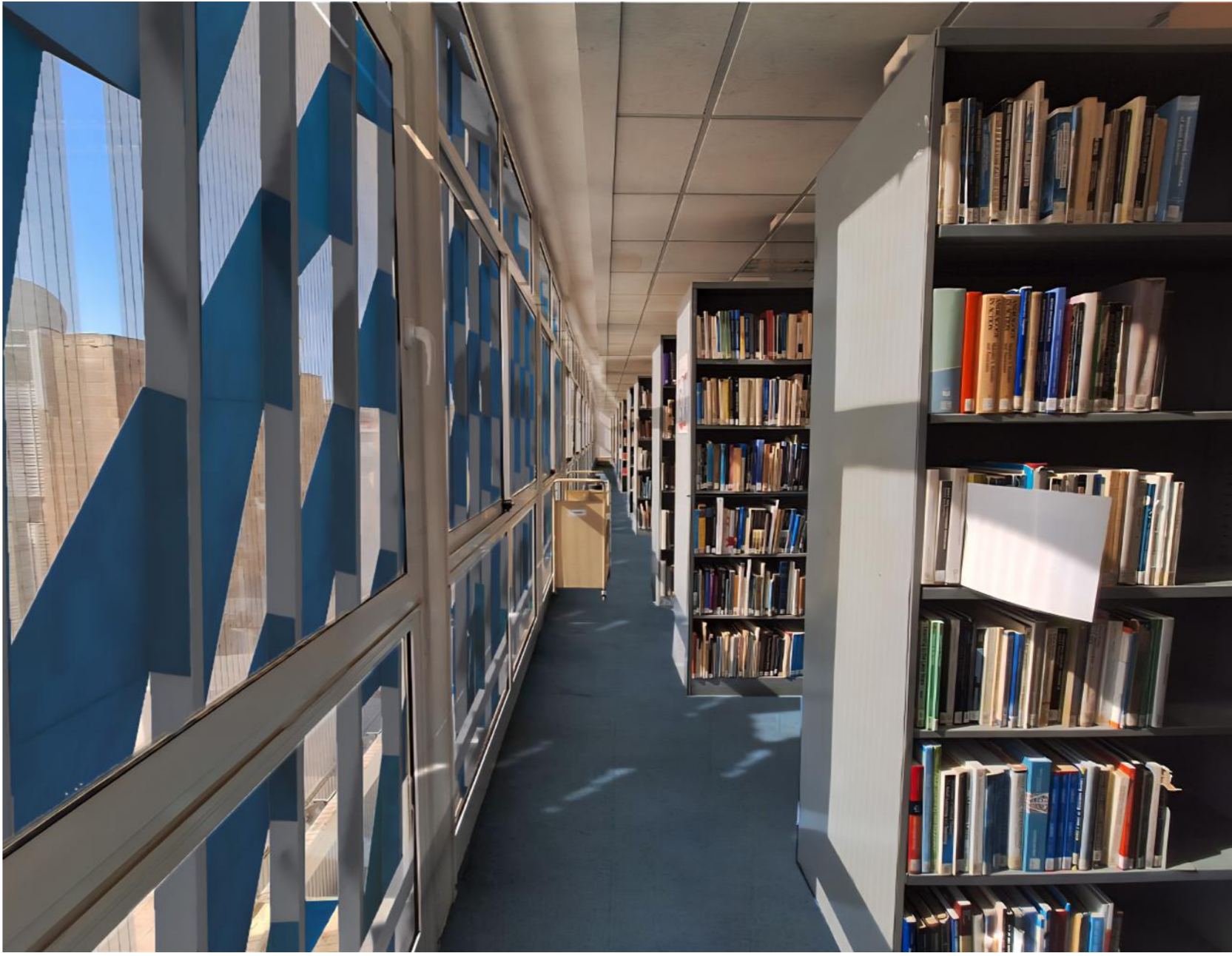
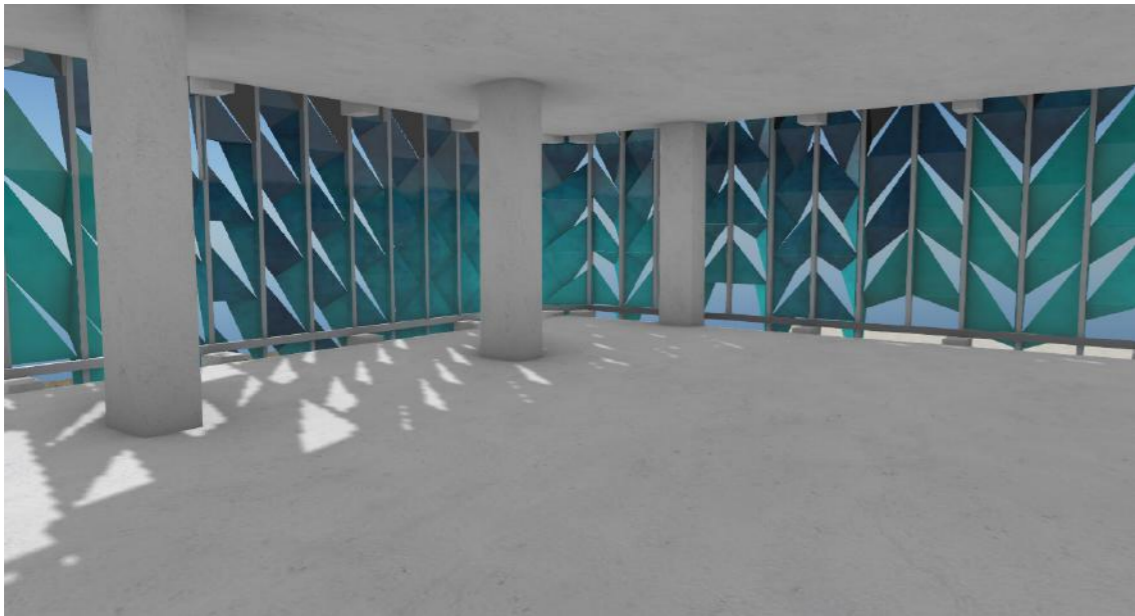


Second Floor Bookcases

Photomonatages



Melitensia Study Area

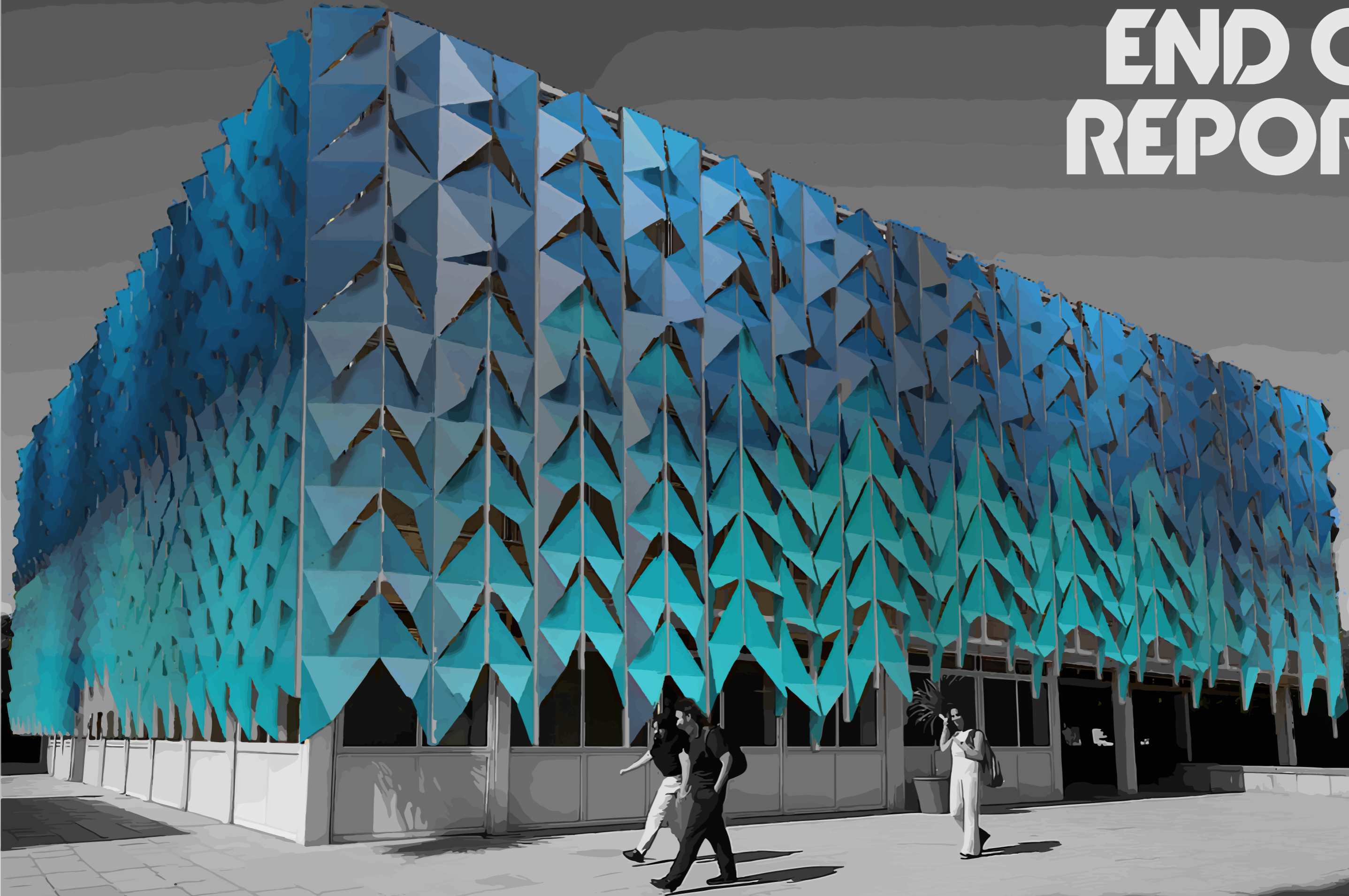


Second Floor Bookcases



Night view

END OF REPORT





**PROGRESS
WORK**

Library Programme



Ground Floor Plan



Offices



WC- Sanitary Facilities



Archives

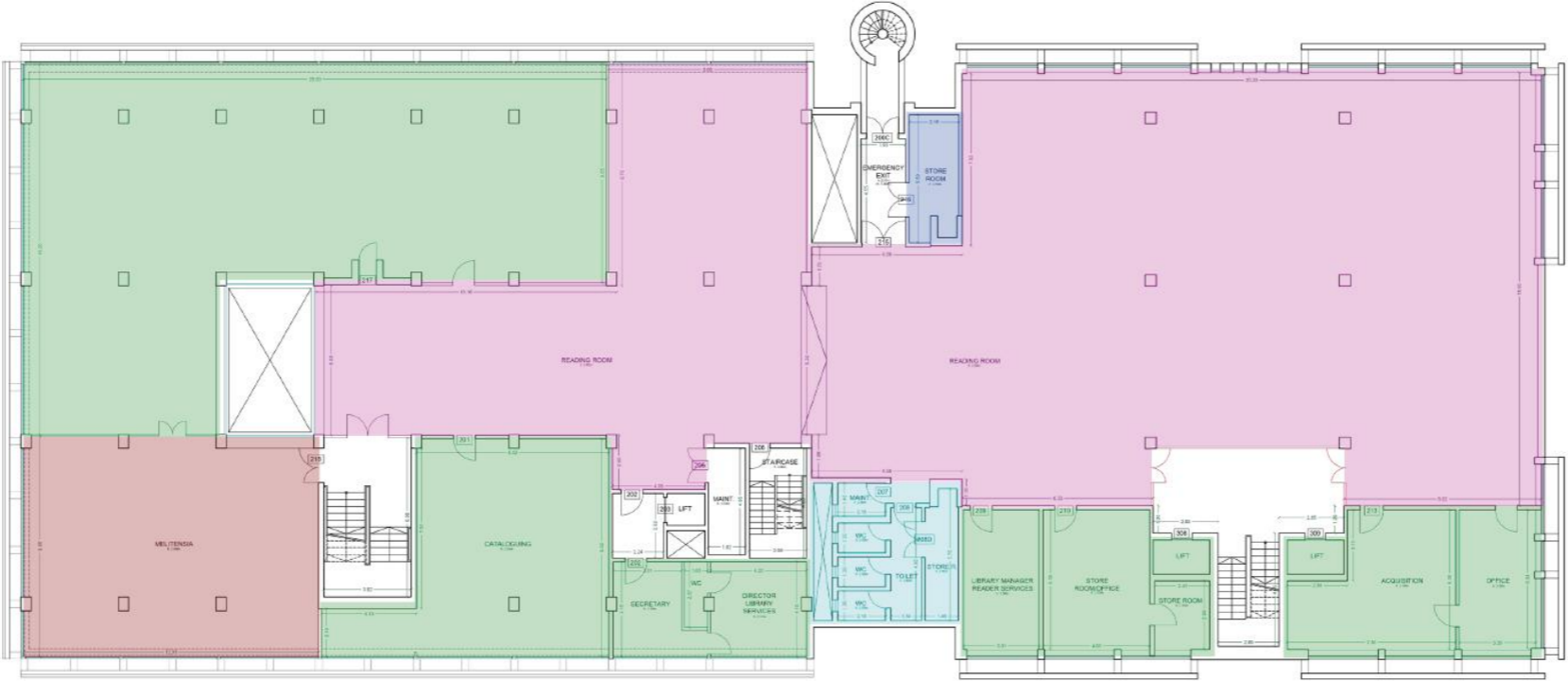


Reading Room- Desks, Shelving & Seating

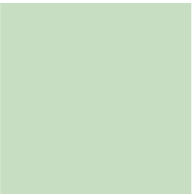


Melitensia (Silent Study Area) Desk and Seating

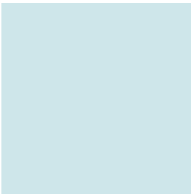
Library Programme



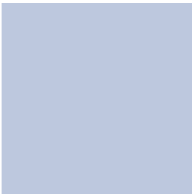
First Floor Plan



Offices



WC- Sanitary Facilities



Archives



Reading Room- Desks, Shelving & Seating



Melitensia (Silent Study Area) Desk and Seating

Library Programme



Second Floor Plan



Offices



WC- Sanitary Facilities



Archives

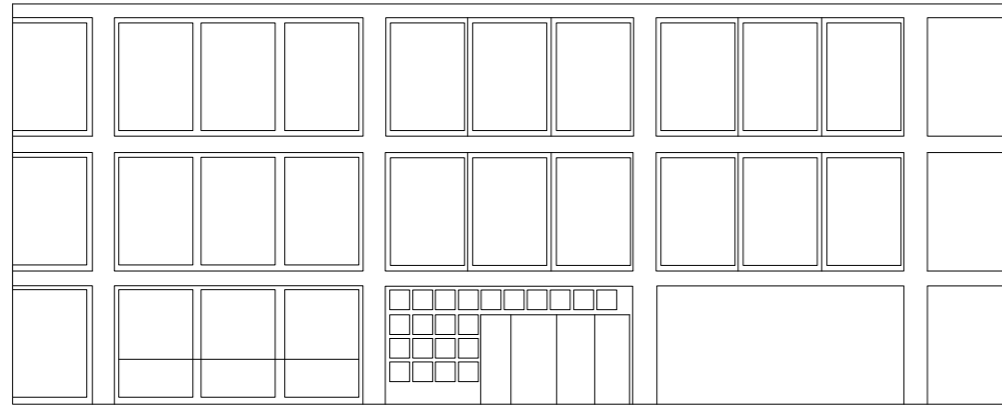
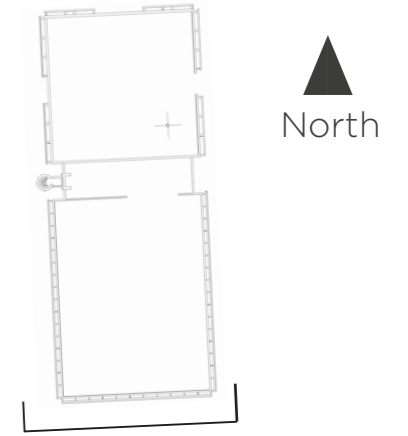


Reading Room- Desks, Shelving & Seating



Melitensia (Silent Study Area) Desk and Seating

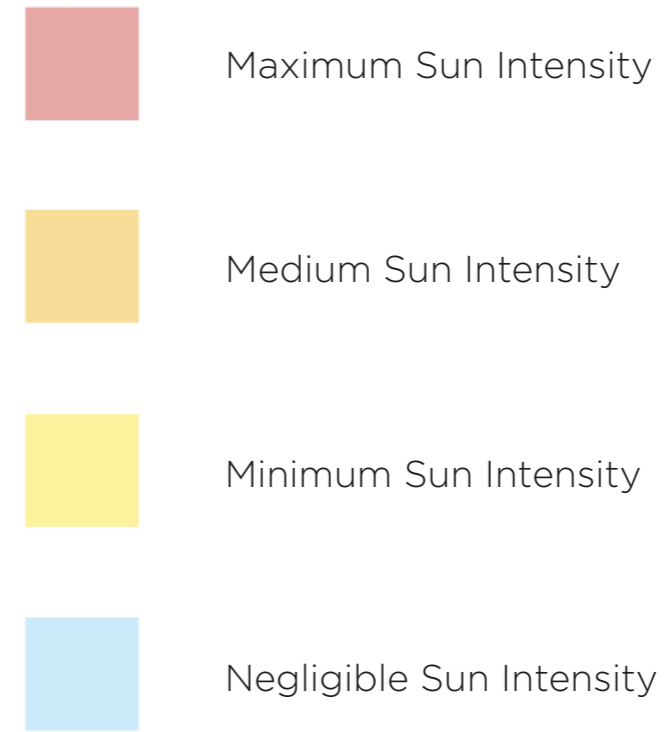
Library Elevations & Current Sun Exposure



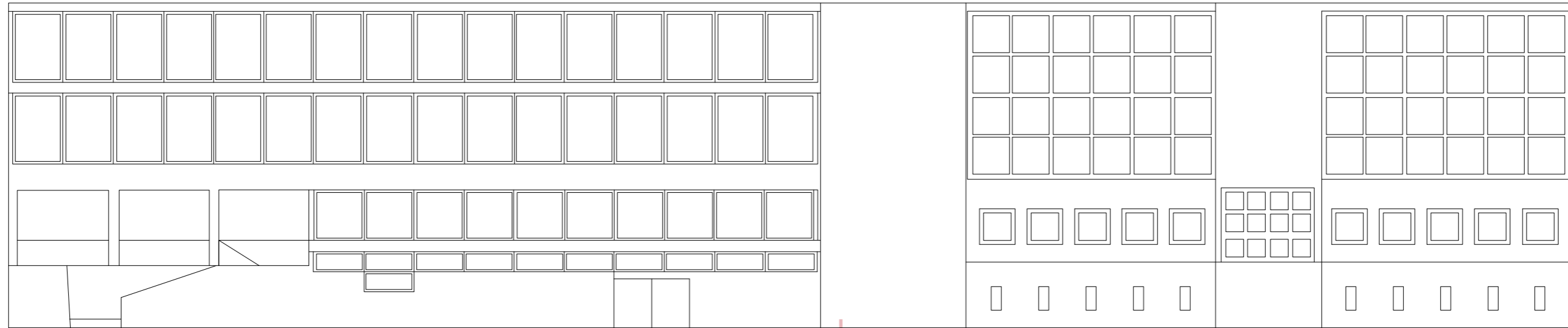
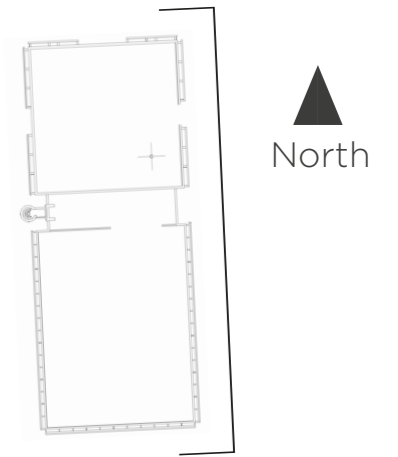
South Elevation



Current Sun Exposure

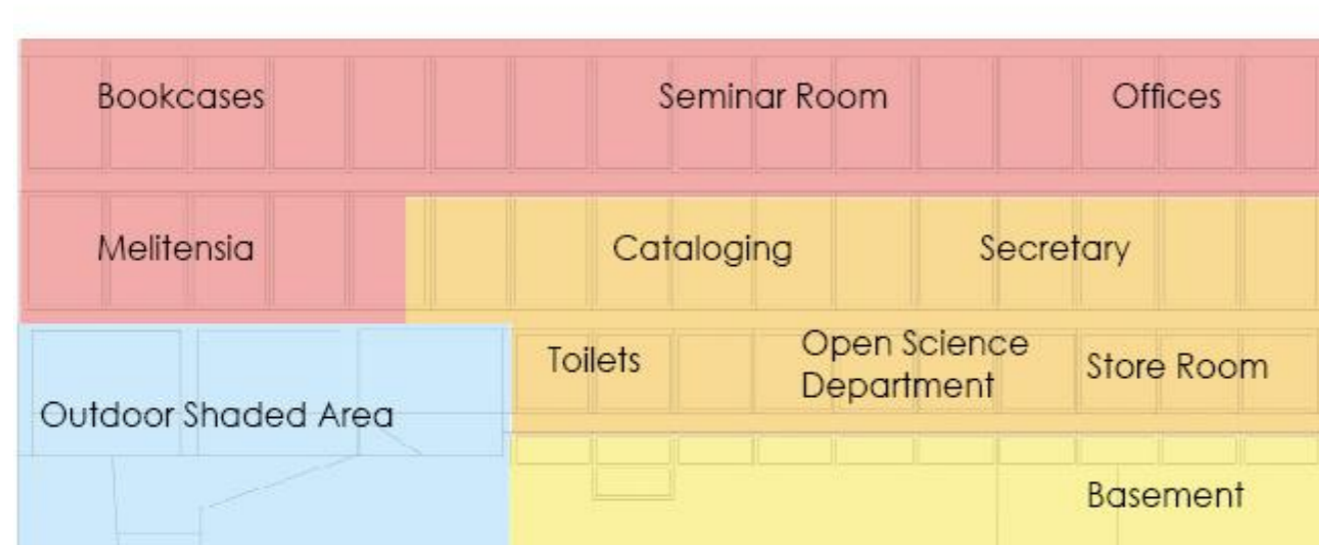


Library Elevations & Current Sun Exposure



Area Being Considered

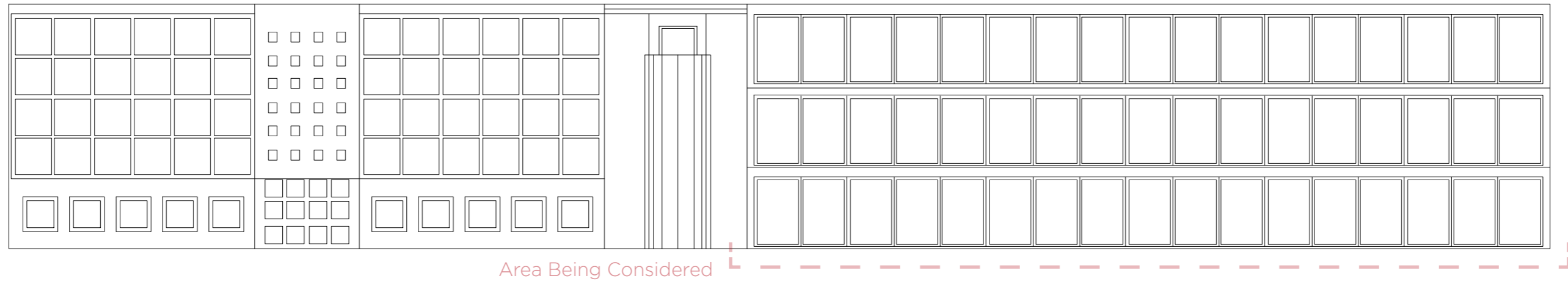
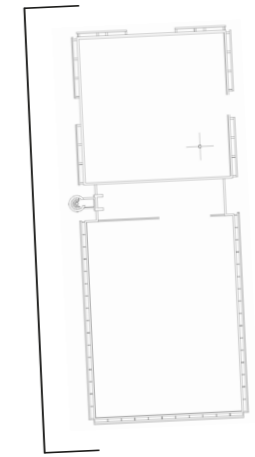
East Elevation



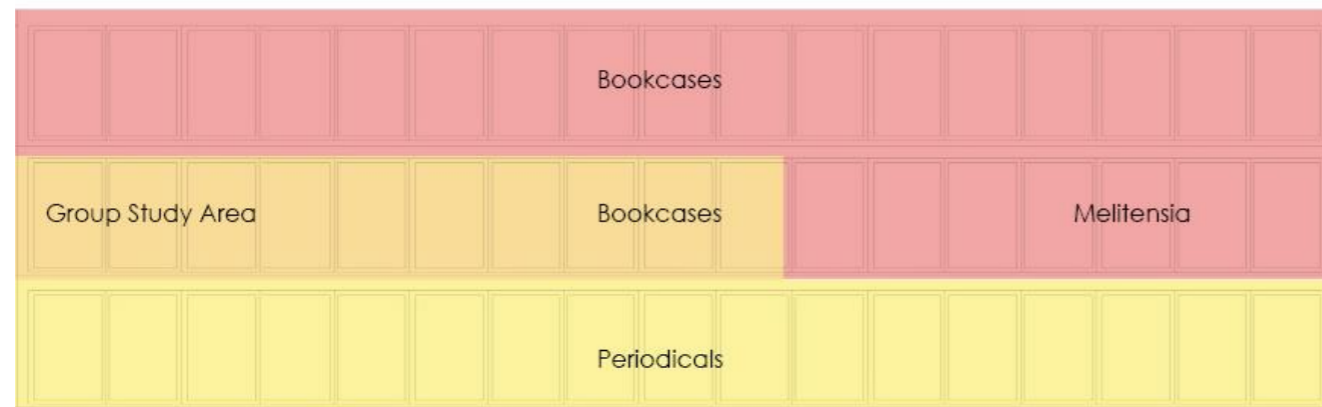
- Maximum Sun Intensity
- Medium Sun Intensity
- Minimum Sun Intensity
- Negligible Sun Intensity

Current Sun Exposure

Library Elevations & Current Sun Exposure



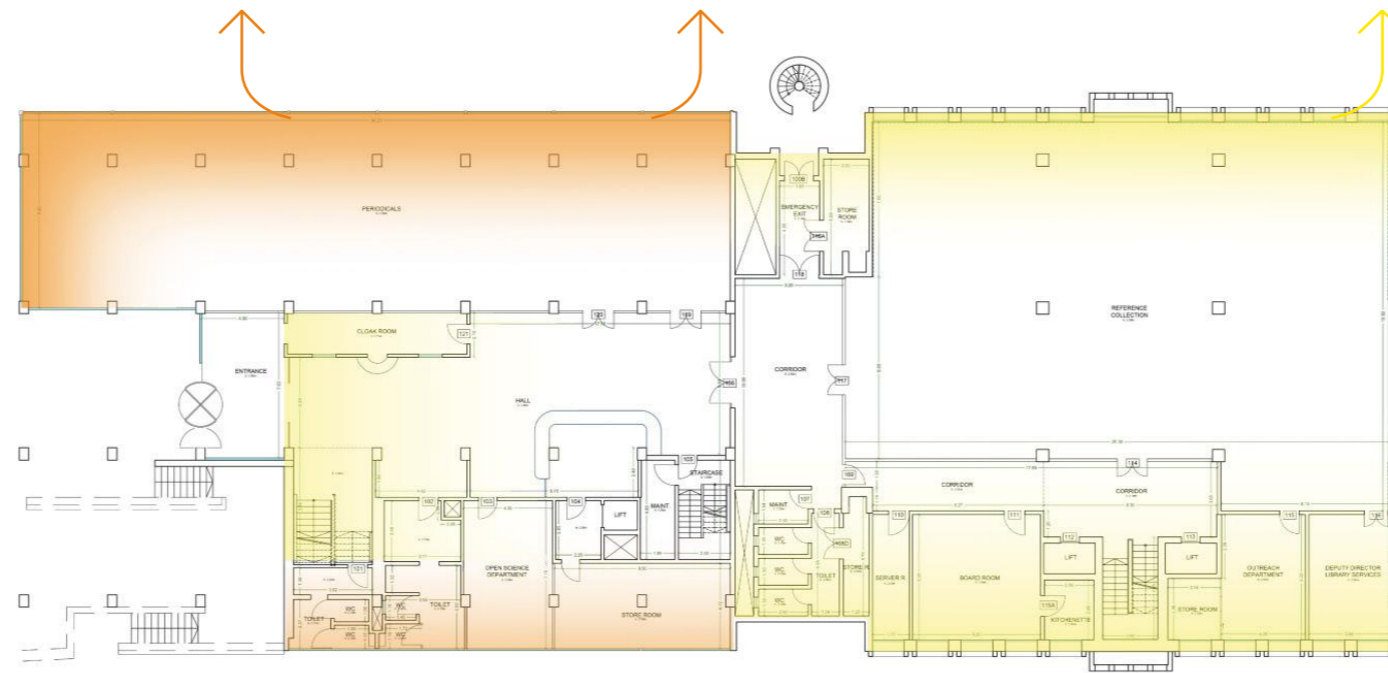
West Elevation



- Maximum Sun Intensity
- Medium Sun Intensity
- Minimum Sun Intensity
- Negligible Sun Intensity

Current Sun Exposure

Sun Penetration Requirments



Ground Floor Plan



High Sun Penetration Needs

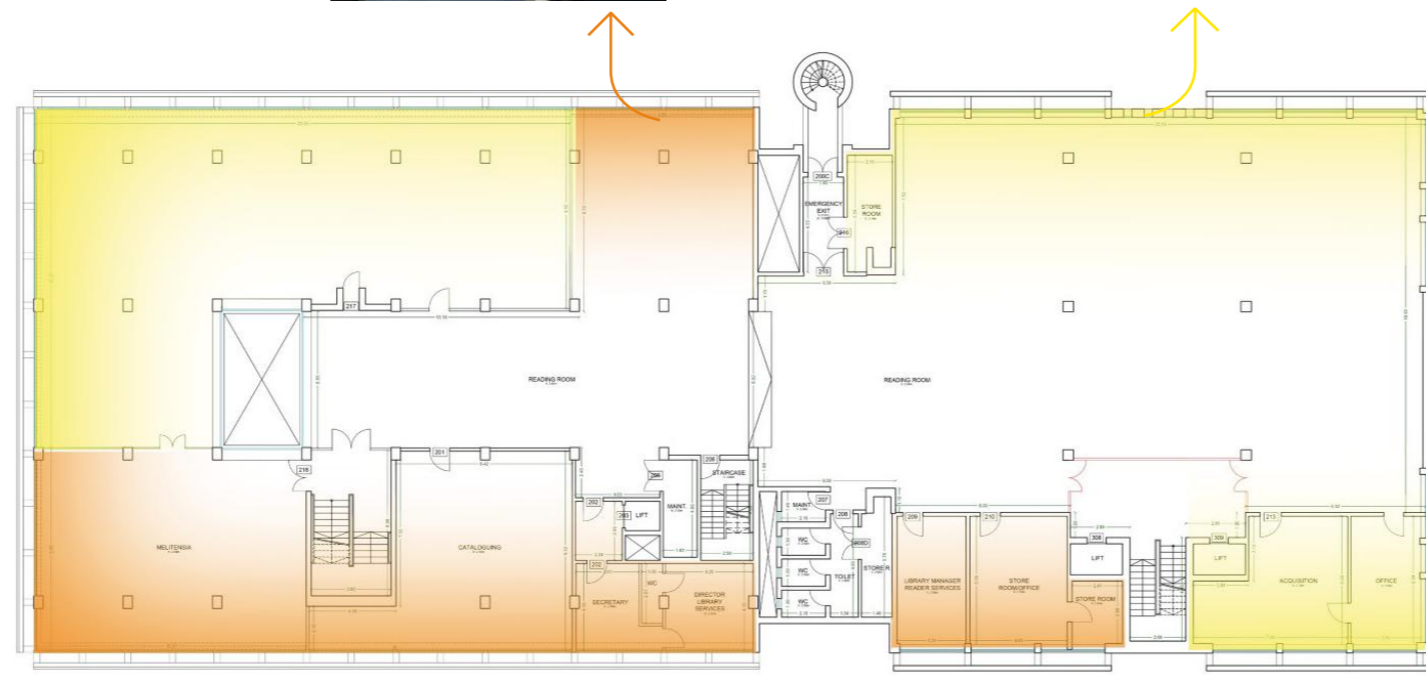


Medium Sun Penetration Needs



Low Sun Penetration Needs

Sun Penetration Requirments



First Floor Plan



High Sun Penetration Needs

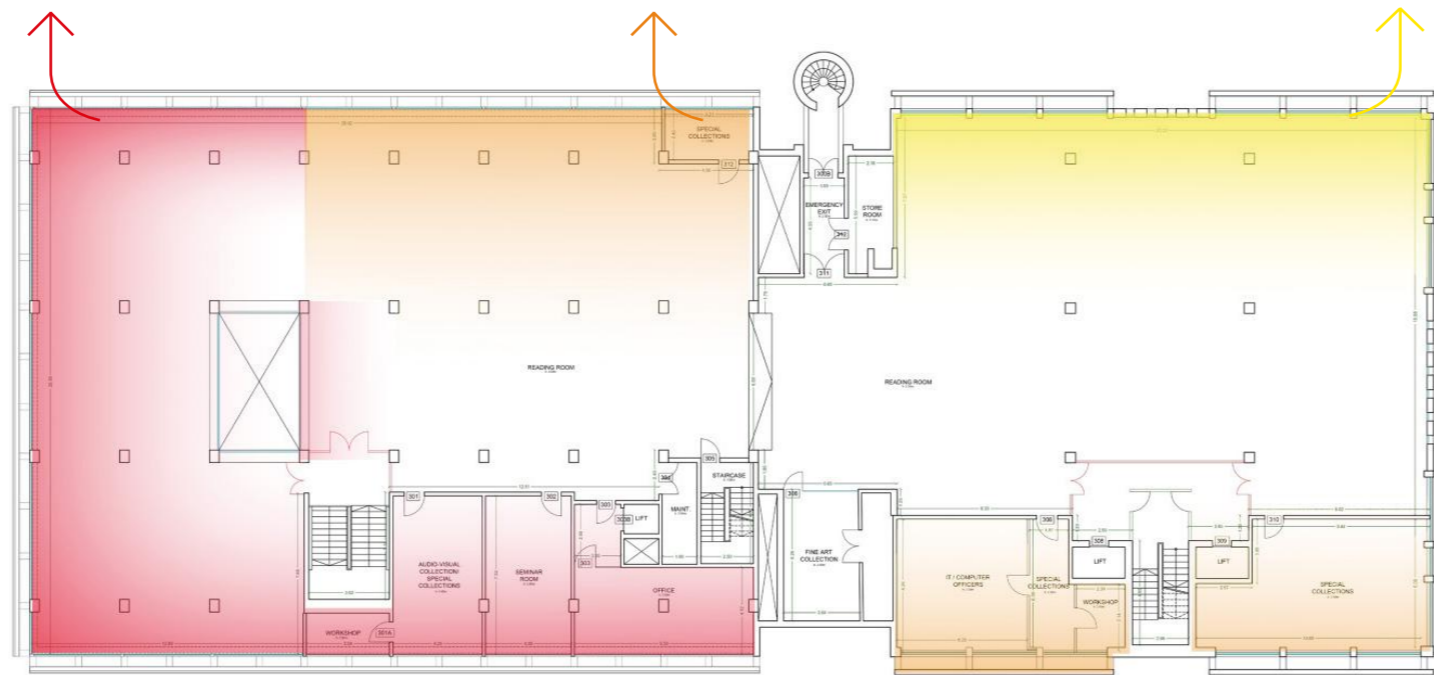


Medium Sun Penetration Needs



Low Sun Penetration Needs

Sun Penetration Requirments



Second Floor Plan



High Sun Penetration Needs

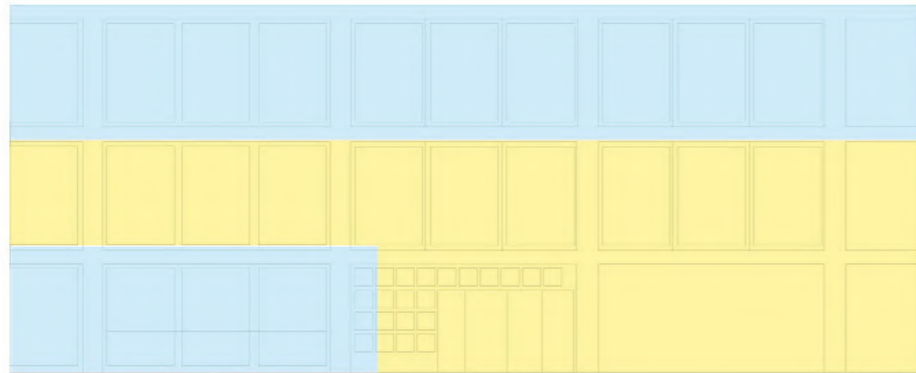


Medium Sun Penetration Needs

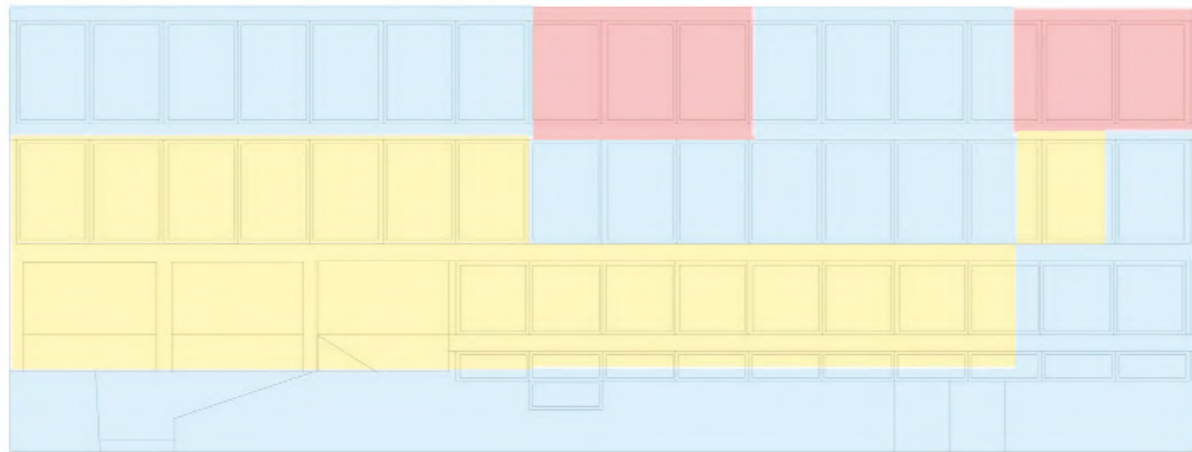


Low Sun Penetration Needs

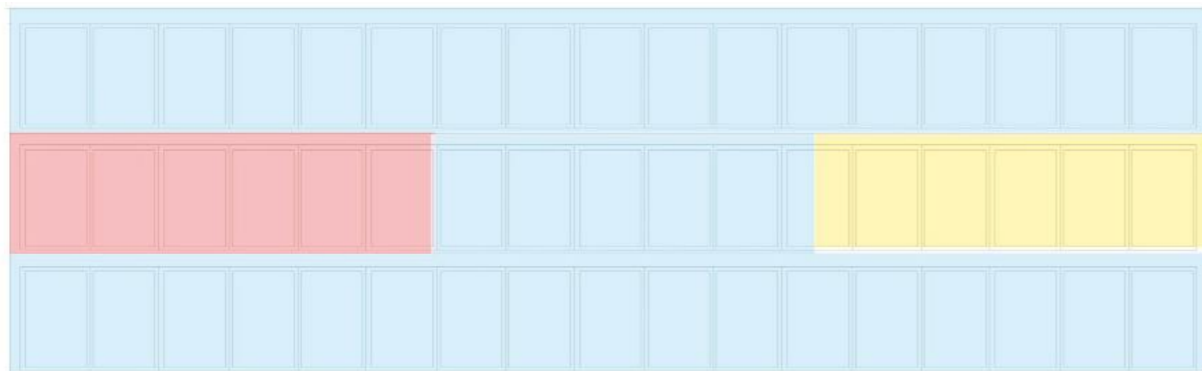
Sun Penetration Requirments



East Elevation



East Elevation



East Elevation



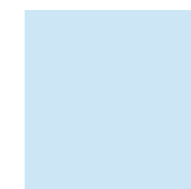
High Sun Intensity



Medium Sun Intensity

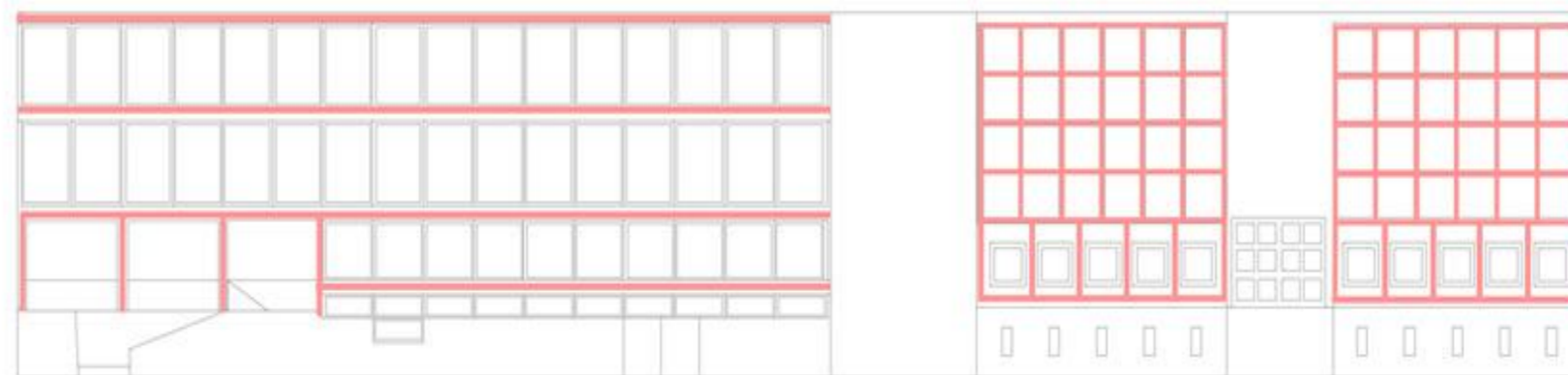
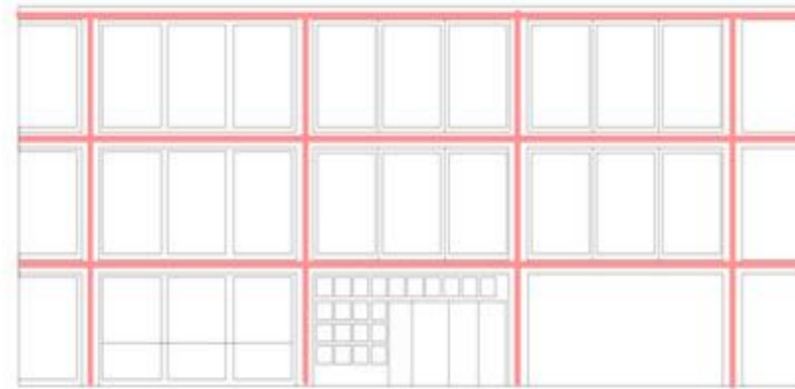
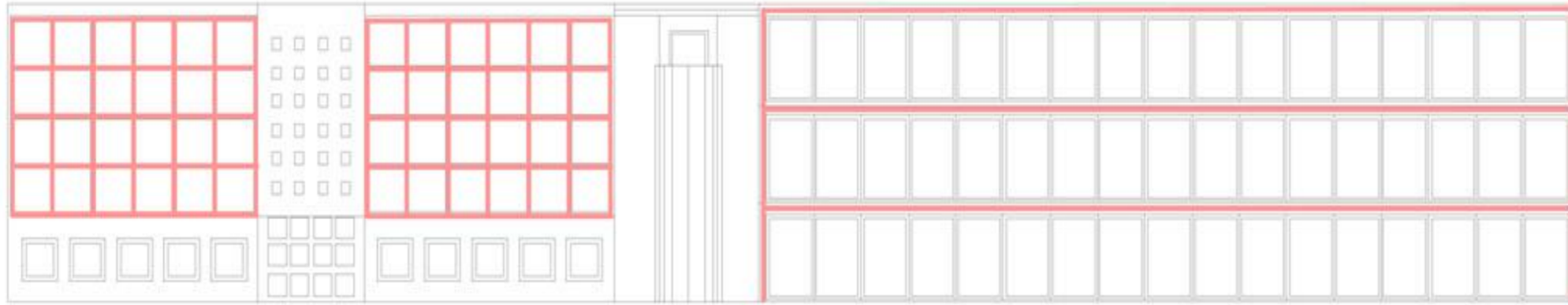


Low Sun Intensity

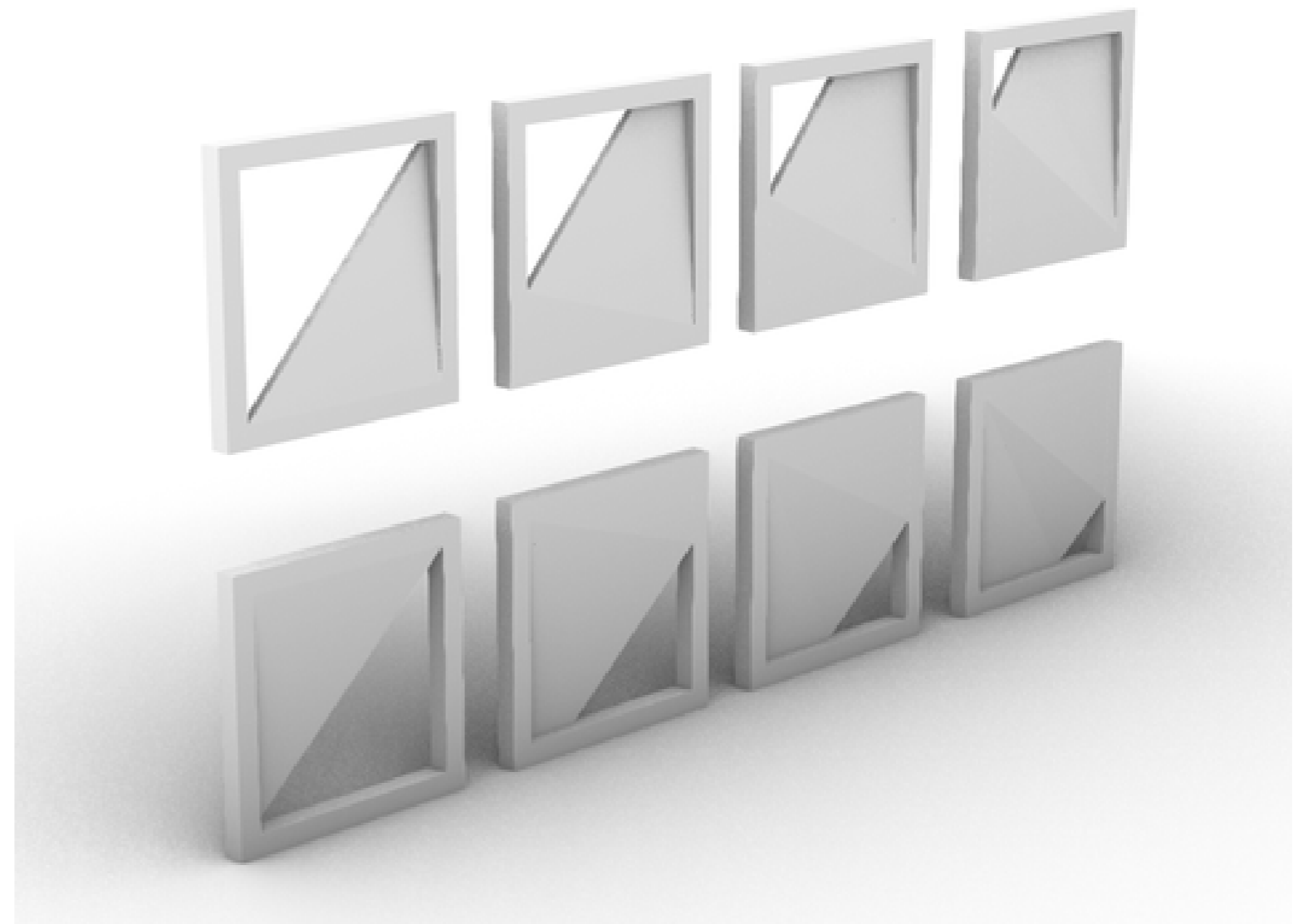
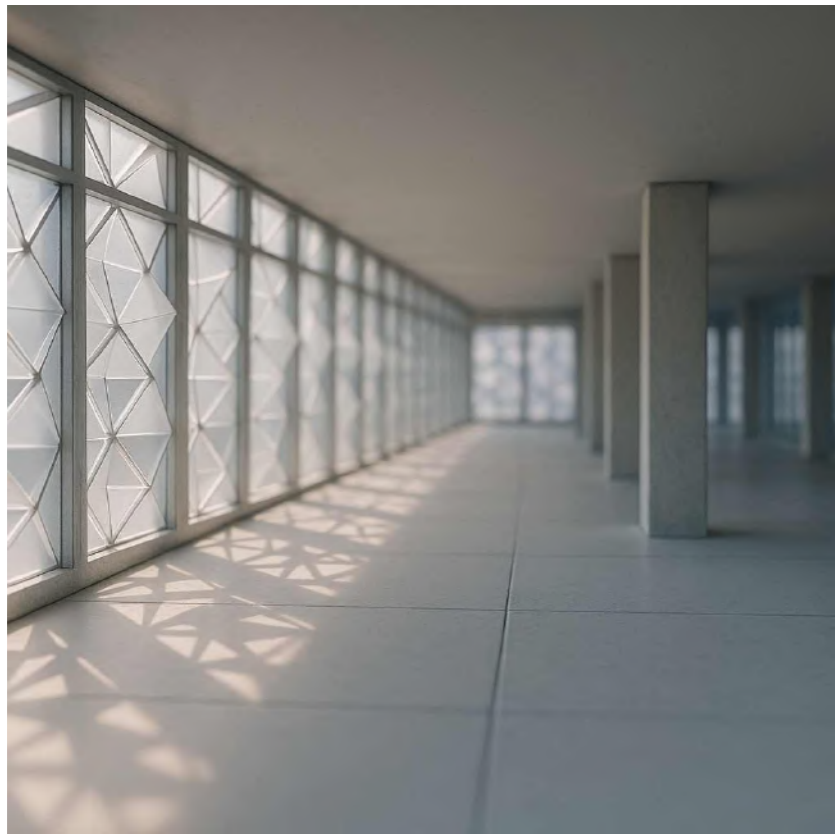


No Sun Intensity

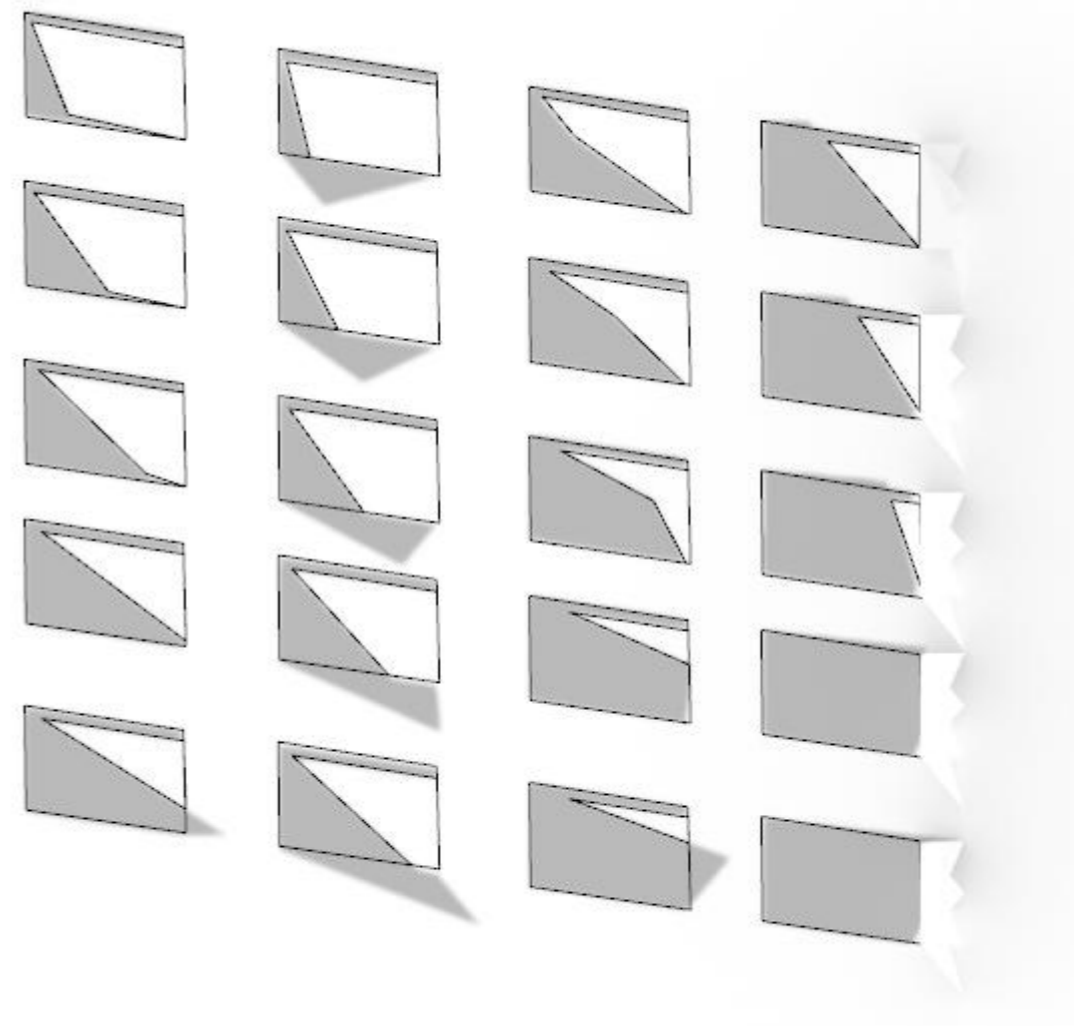
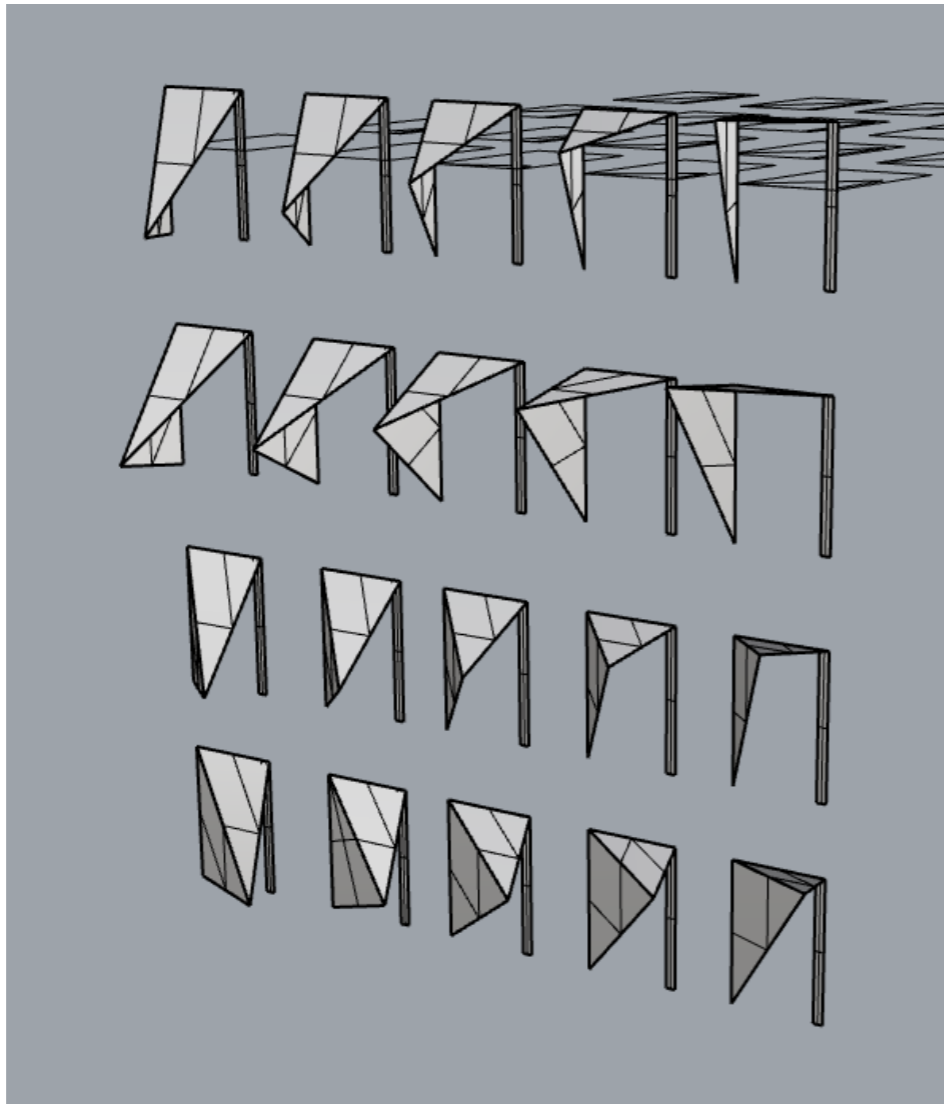
Load Bearing Structural Elements



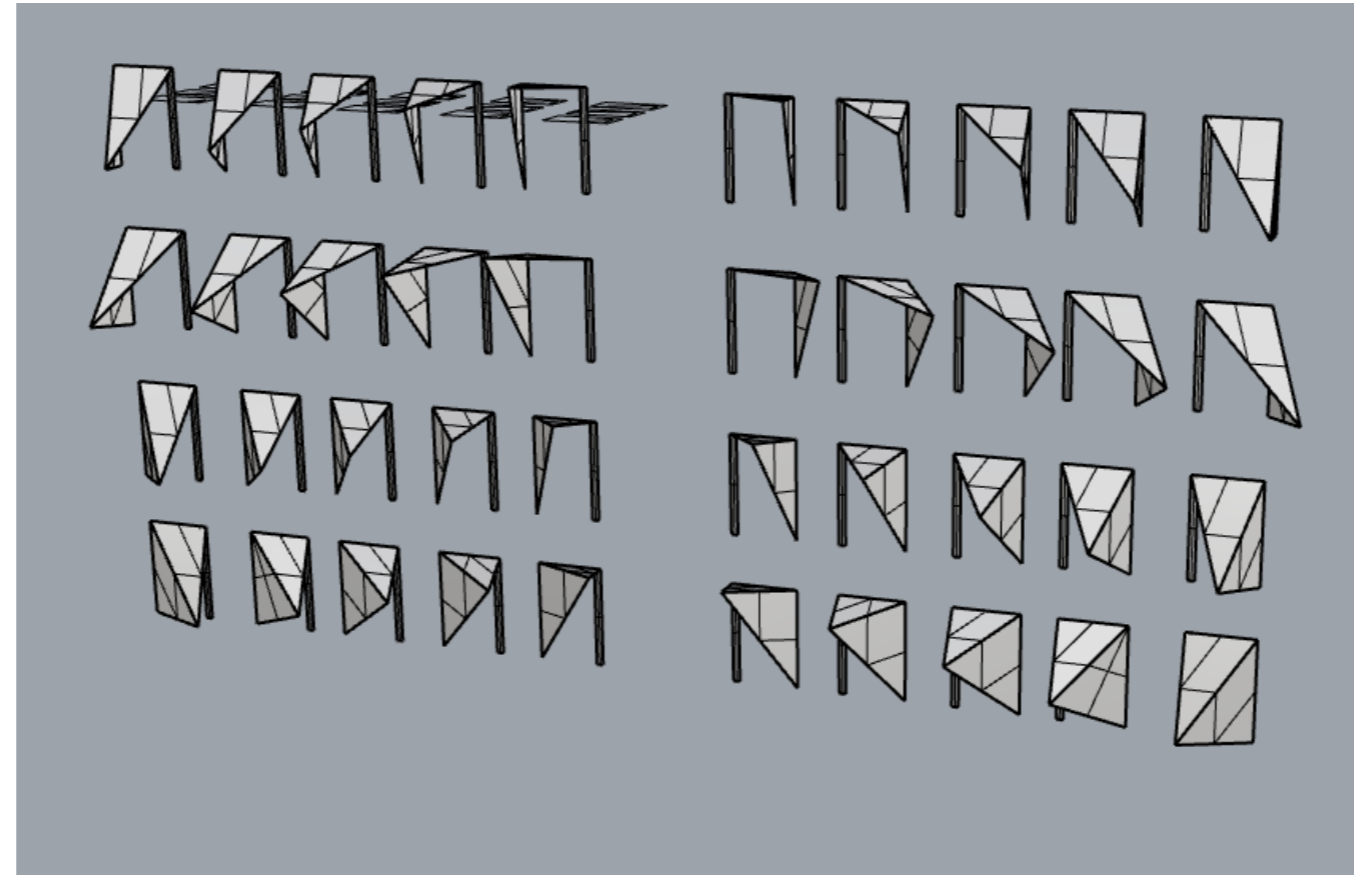
Concept Development



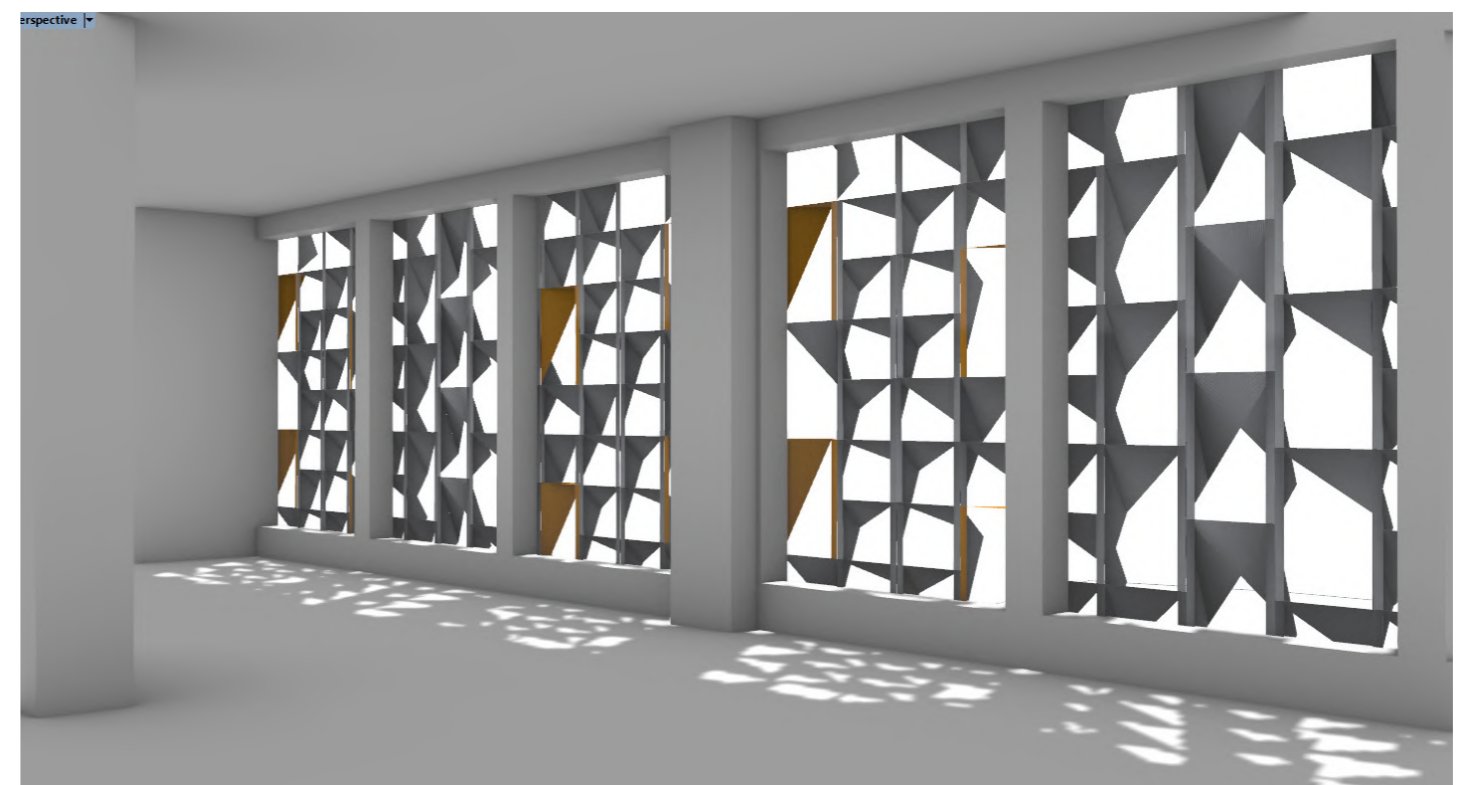
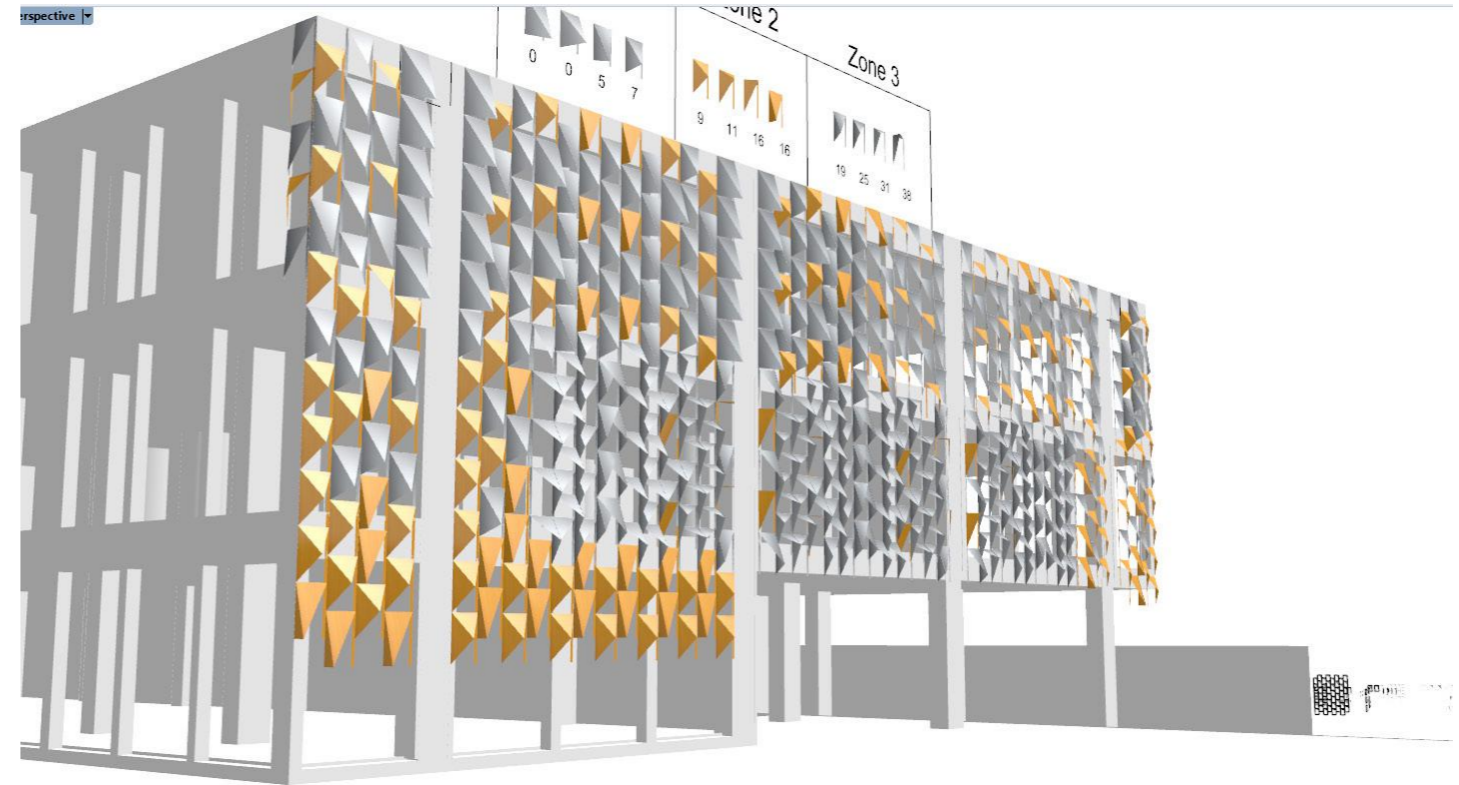
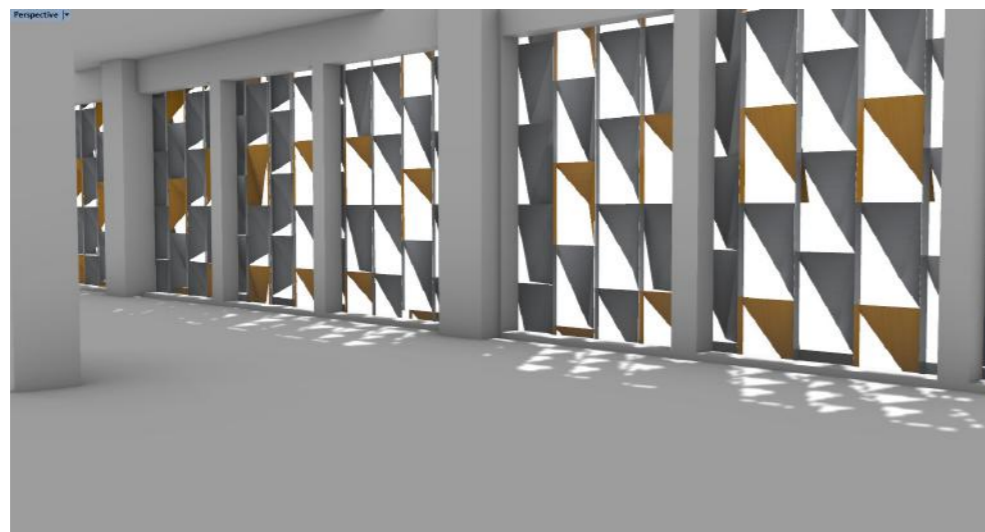
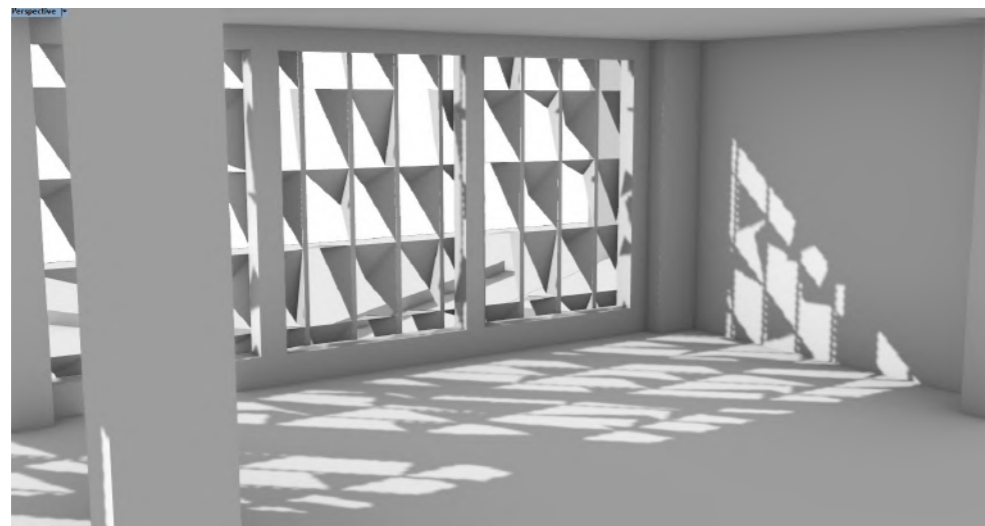
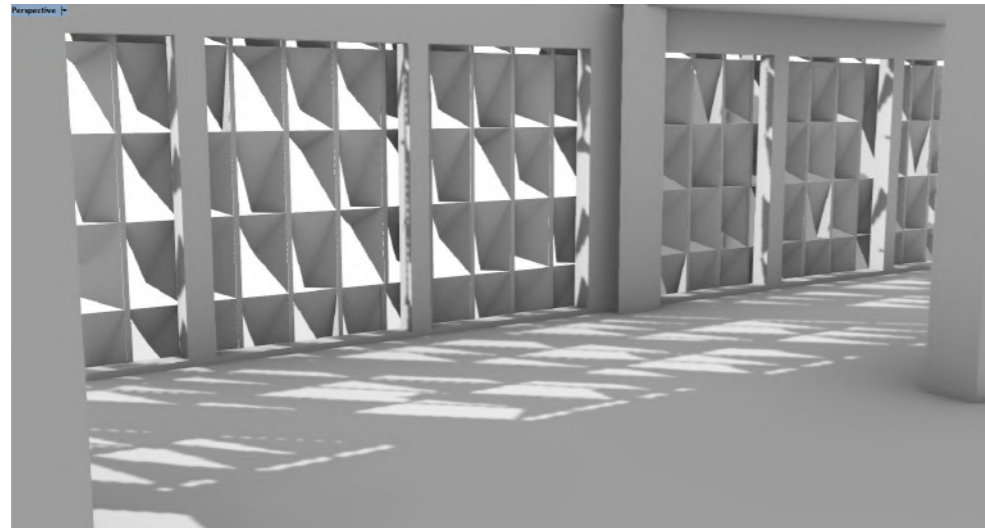
Concept Development



Concept Development

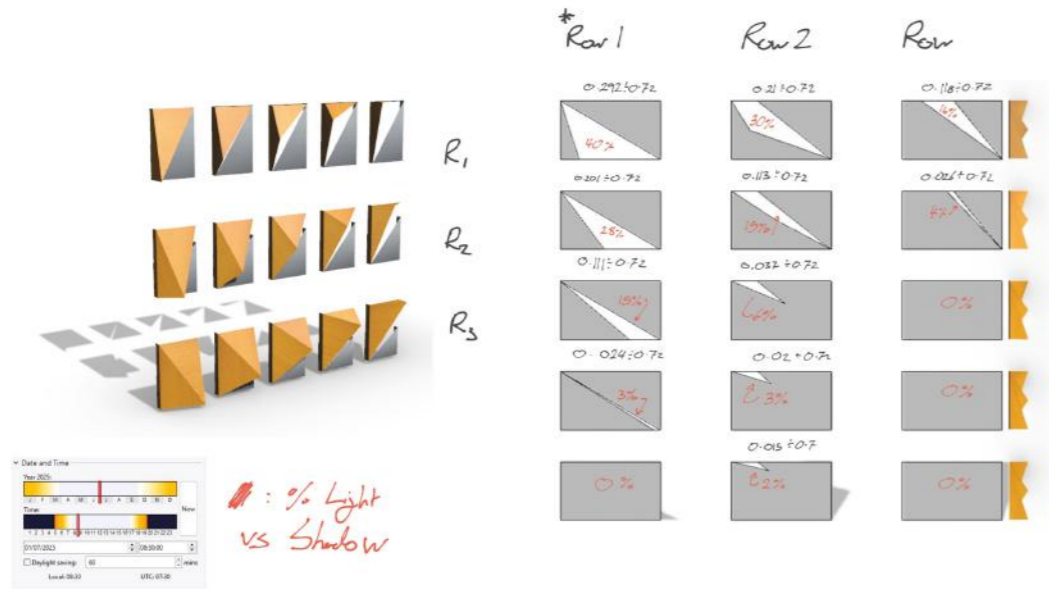


Concept Development

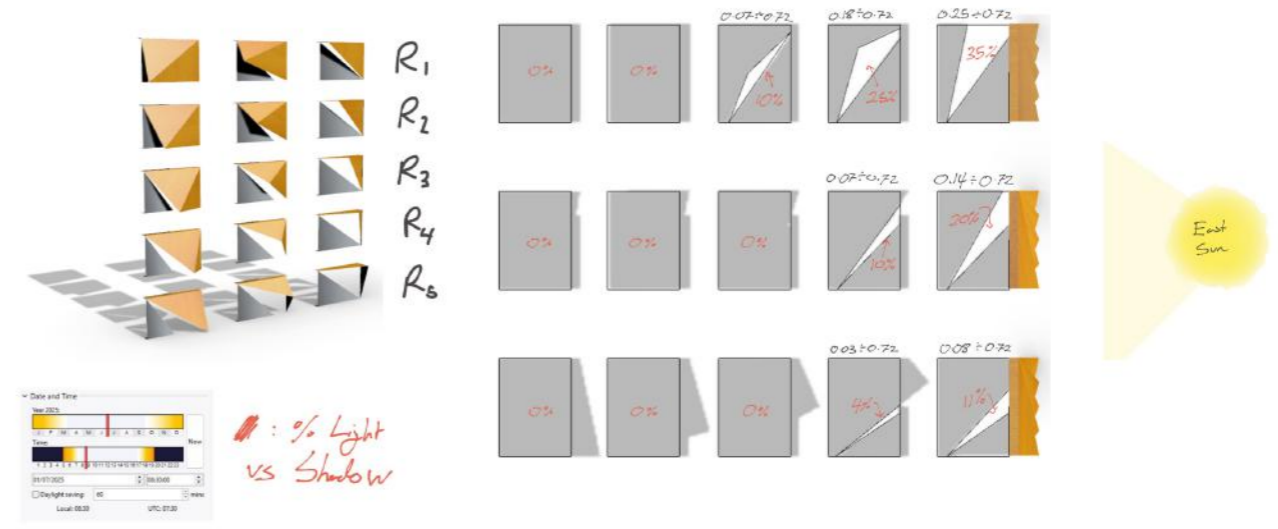


Final Concept Sun Studies

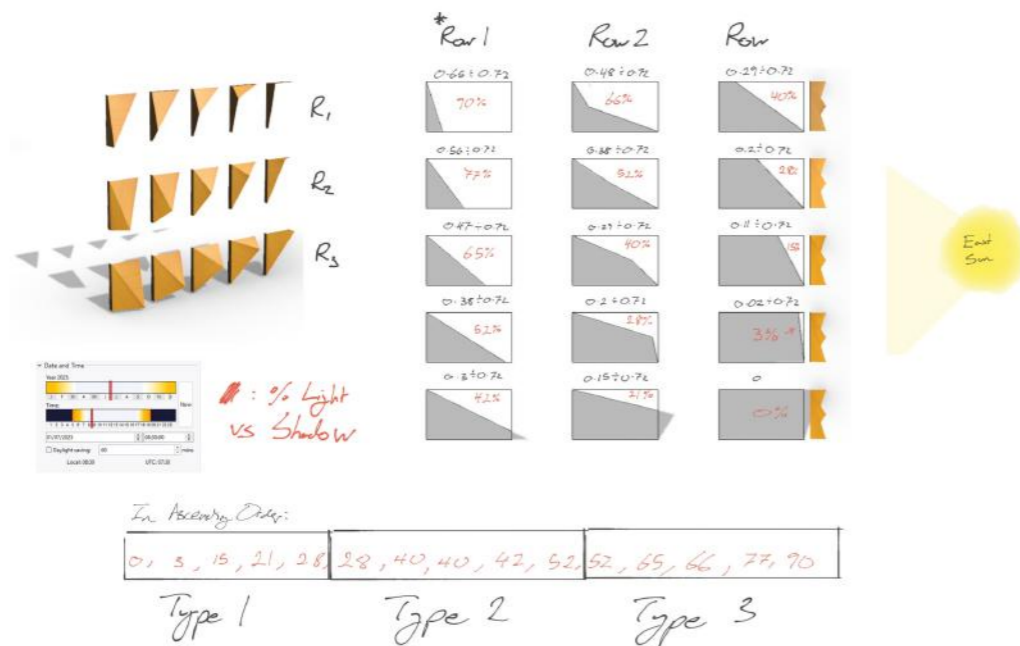
SUN STUDY VERTICAL PANELS (With Inner Triangle)



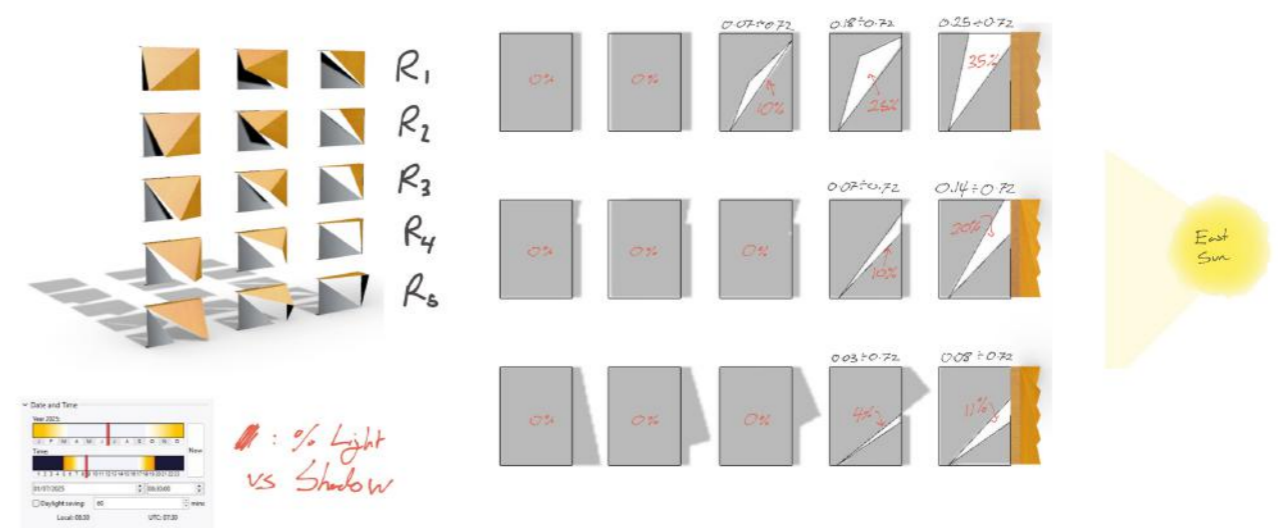
SUN STUDY HORIZONTAL PANELS (With Inner Triangle)



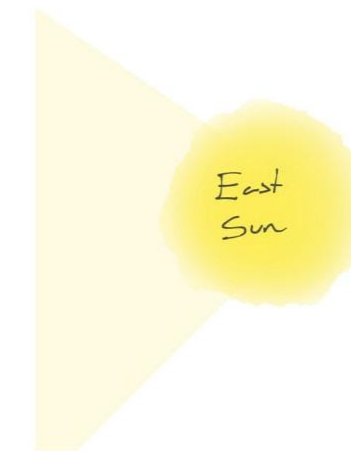
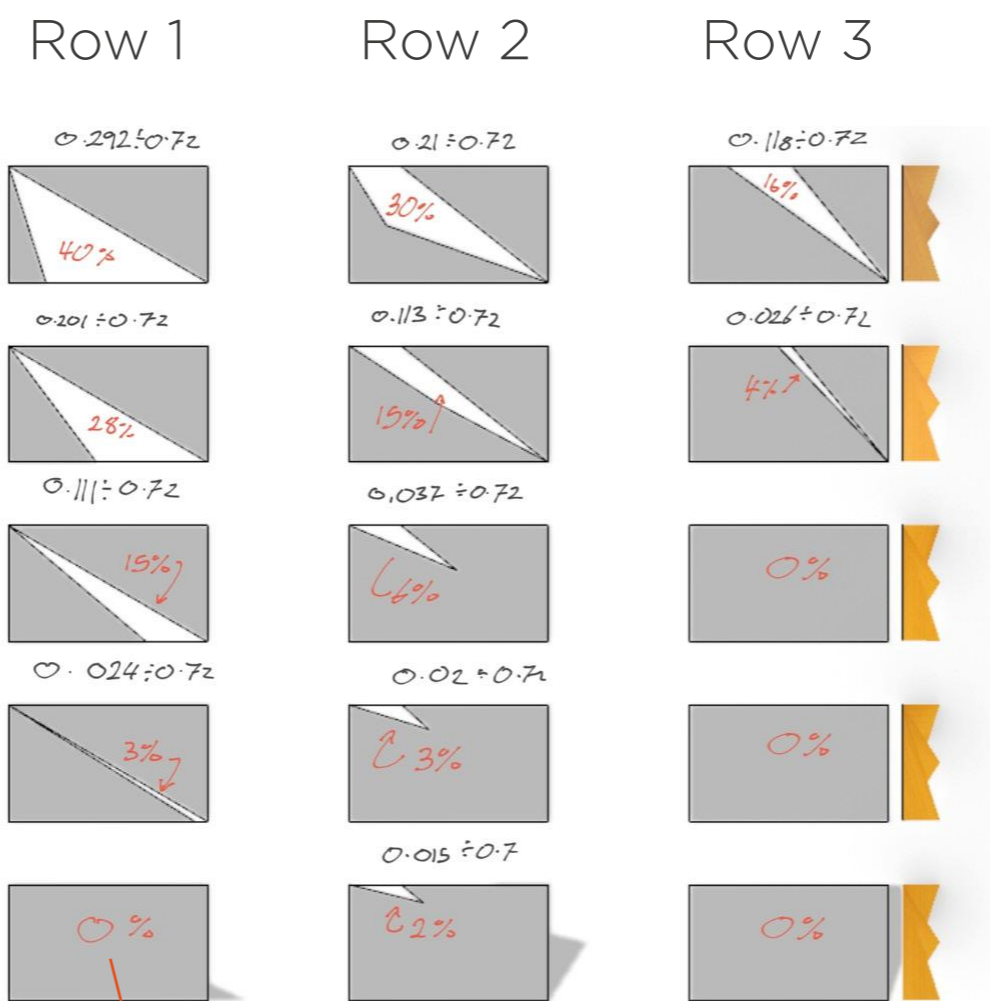
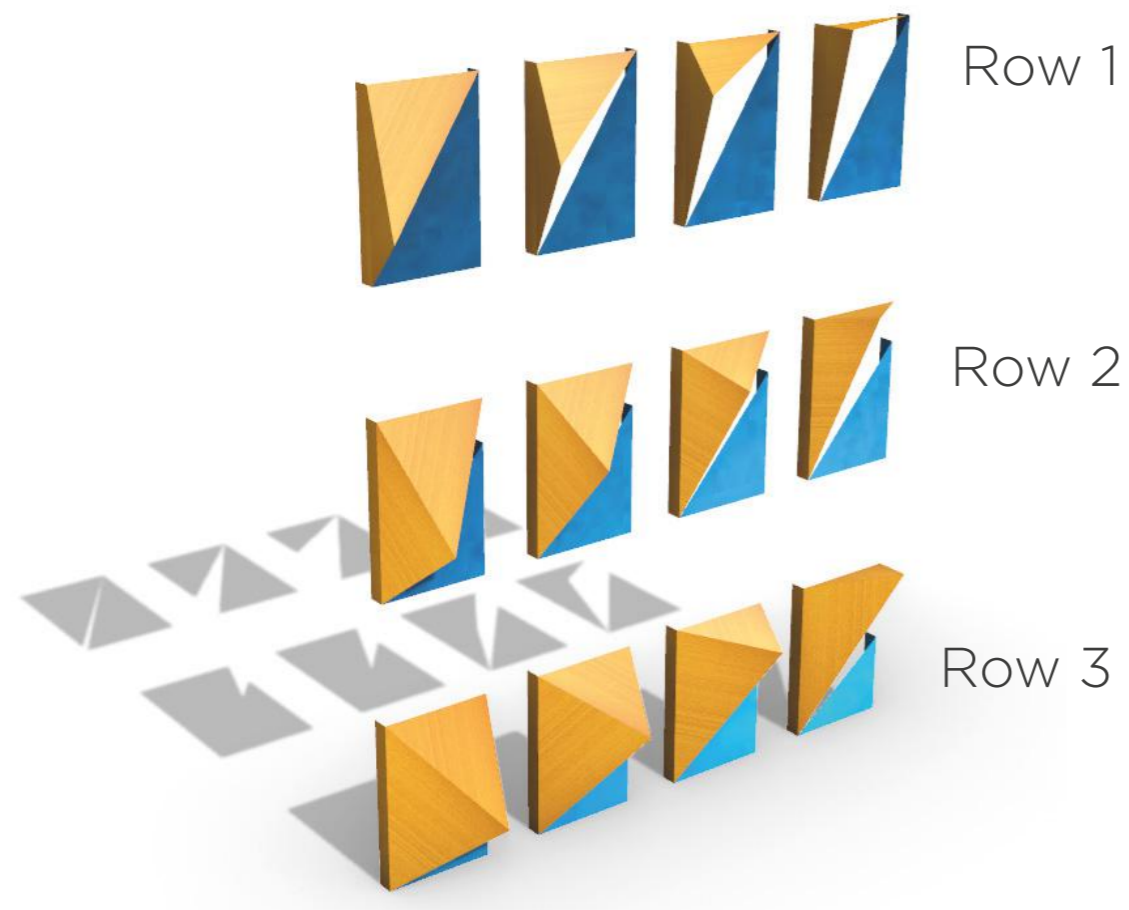
SUN STUDY VERTICAL PANELS (Without Inner Triangle)



SUN STUDY HORIZONTAL PANELS (With Inner Triangle)



Final Concept Sun Studies



▼ Date and Time

Year 2025:

J F M A M J J A S O N D

Time:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

01/07/2025 08:30:00

Daylight saving: 60 mins

Local: 08:30 UTC: 07:30

% of Light Entering through the area of 1 panel

Alucobond Specifications

ALUCOBOND® PLUS

Thickness: 3/4mm

(6mm on request)

Width [mm]	1000	1250	1500	1575	1750
Length [mm]	2000-6800	2000-6800	2000-6800	2000-6800	2000-6800
Solid	•	•	•	•	On request
Metallic	•	•	•	•	On request

Chosen thickness: 6mm

Chosen width: 1750mm

Chosen Length: 6800mm

Area of sheet: $1.75\text{m} \times 6.8\text{m} = 11.9\text{m}^2$

Weight of sheet: $11.9\text{m}^2 \times 8.9 \text{ kg / m}^2 = \mathbf{105.91\text{kg}}$

AERIAL VIEW

