PIRAEUS TOWER,GREECE

Building Analysis

2541332 Entech II Report 1

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01 Case Study

PIRAEUS TOWER, GREECE

Mixed Use Architecture, Office Buildings, Retail Piraeus, Greece

Architects: PILA
Area: 34623 m²
Heigth: 88m (22 Stories and 2 Basement)
Year: 2023
Lead Architect: Betaplan
Owner: Municipality of Piraeus
Client: Prodea Investments, EBRD, Dimand
Commissioning: VPC
City: Piraeus
Country: Greece

The Piraeus Tower is the first “green” high-rise building in Greece with the highest LEED Platinum certification and Greece’s second-tallest building at 84 meters, located near the Port of Piraeus. Built in the 1970s, it was underutilized for decades, earning the nickname “Sleeping Giant.” Recently, it underwent a major redevelopment, transforming it into a modern, sustainable, and functional landmark while honoring its historical significance.

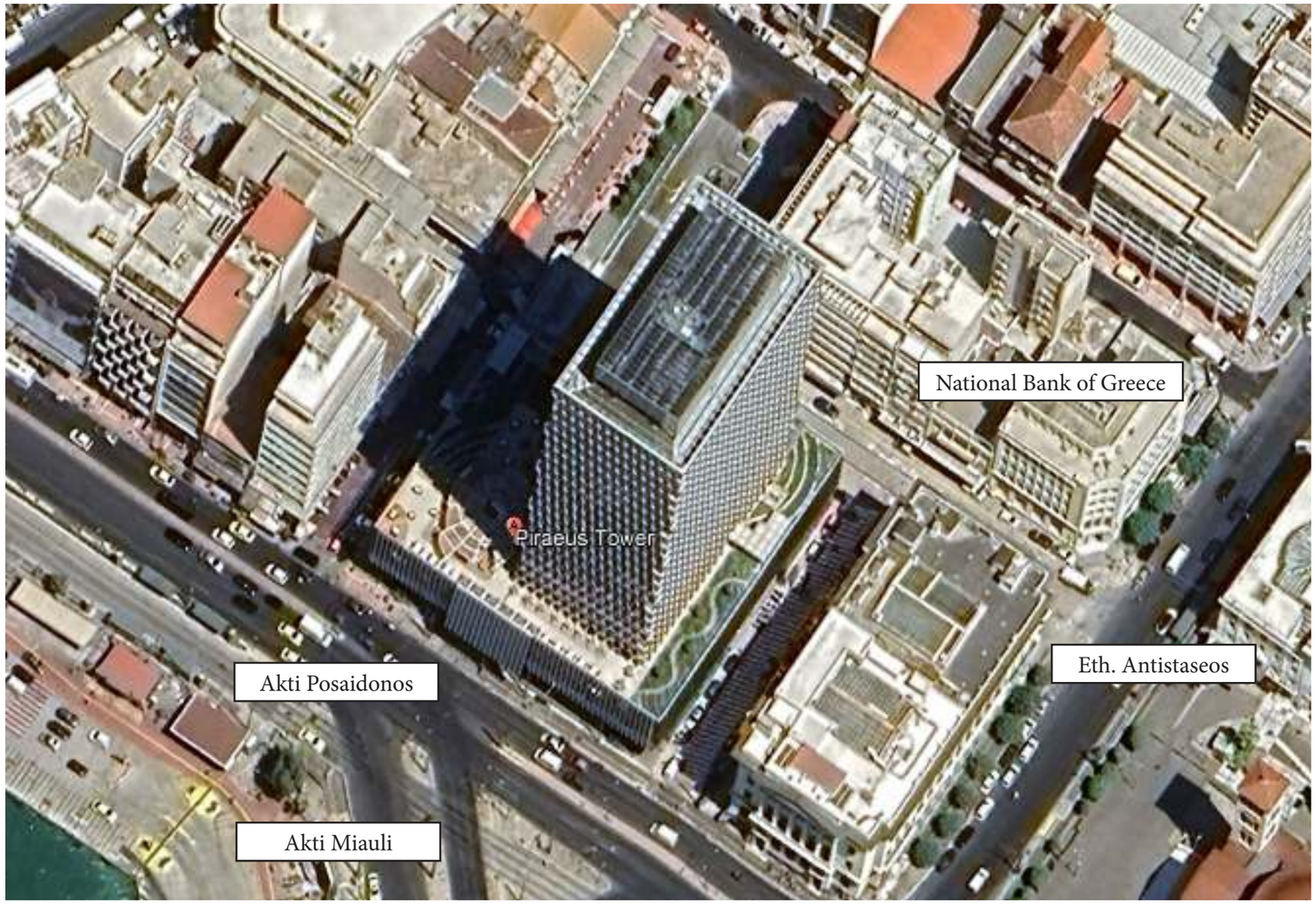
PILA

International Architect Studio

PILA is an international architecture studio based in Athens and New York, specializing in creating cultural, work, and living spaces worldwide. Emphasizing architecture’s enduring role in fostering meaningful connections, they counter the speed of modern life by reimagining program and function to inspire new experiences. Committed to lasting, adaptable designs, PILA approaches each project with curiosity and collaboration, tailoring solutions to contextual and client needs. Recent achievements include the award-winning Piraeus Tower, along with ongoing projects such as B’ Plaz Voulas’ rejuvenation, a food hall at Arsakeio Megaron, and various residential, hospitality, and office developments across Athens and the Greek islands.

LOCATION
Surroundings

Building as a part of It's Environment



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Address
2, Akti Posidonos Str, Pireas 185 31, Greece

Piraeus

Piraeus is a colorful port city in Greece, located 12 kilometers southwest of Athens.

As the largest port in the country and one of the busiest in Europe, it serves as a vital hub for trade, transportation, and tourism, connecting the mainland to the Greek islands. Rich in history, Piraeus played a significant role in ancient Greece as the naval and commercial center of Athens. Today, it blends its maritime heritage with modern developments, offering cultural landmarks, bustling markets, and seaside promenades.

Landmark Status and Civic Identity:
The tower, as one of Greece's tallest buildings, holds symbolic significance. Its transformation from a "Sleeping Giant" to a vibrant, functional structure uplifts the identity of Piraeus as a modern, forward-looking city. It now acts as a focal point for the community, drawing attention to Piraeus not just as a historic port but as a hub for innovation and sustainable development.

Catalyst for Economic Growth:
The redevelopment has attracted businesses, retailers, and service providers, creating jobs and stimulating local commerce.
The mixed-use nature of the tower—housing offices, retail spaces, and leisure areas—encourages activity in the area throughout the day, benefitting surrounding businesses and the

Improved Urban Connectivity:
The tower's strategic location near the port and major transit hubs integrates it seamlessly into the city's fabric, enhancing accessibility.
Its revitalization promotes a more cohesive urban landscape, making Piraeus a more attractive destination for residents, workers, and tourists.

Promoting Sustainable Urban Development:
The project sets a benchmark for integrating sustainability into urban renewal. By reusing an existing structure rather than demolishing it, the project avoided significant construction waste.
It demonstrates how neglected urban landmarks can be transformed into assets for their communities, reducing urban blight and encouraging sustainable redevelopment practices elsewhere in Greece.

LOCATION
Thermal Condition

Piraeus, Greece, has a Mediterranean climate (Köppen classification: Csa), characterized by:

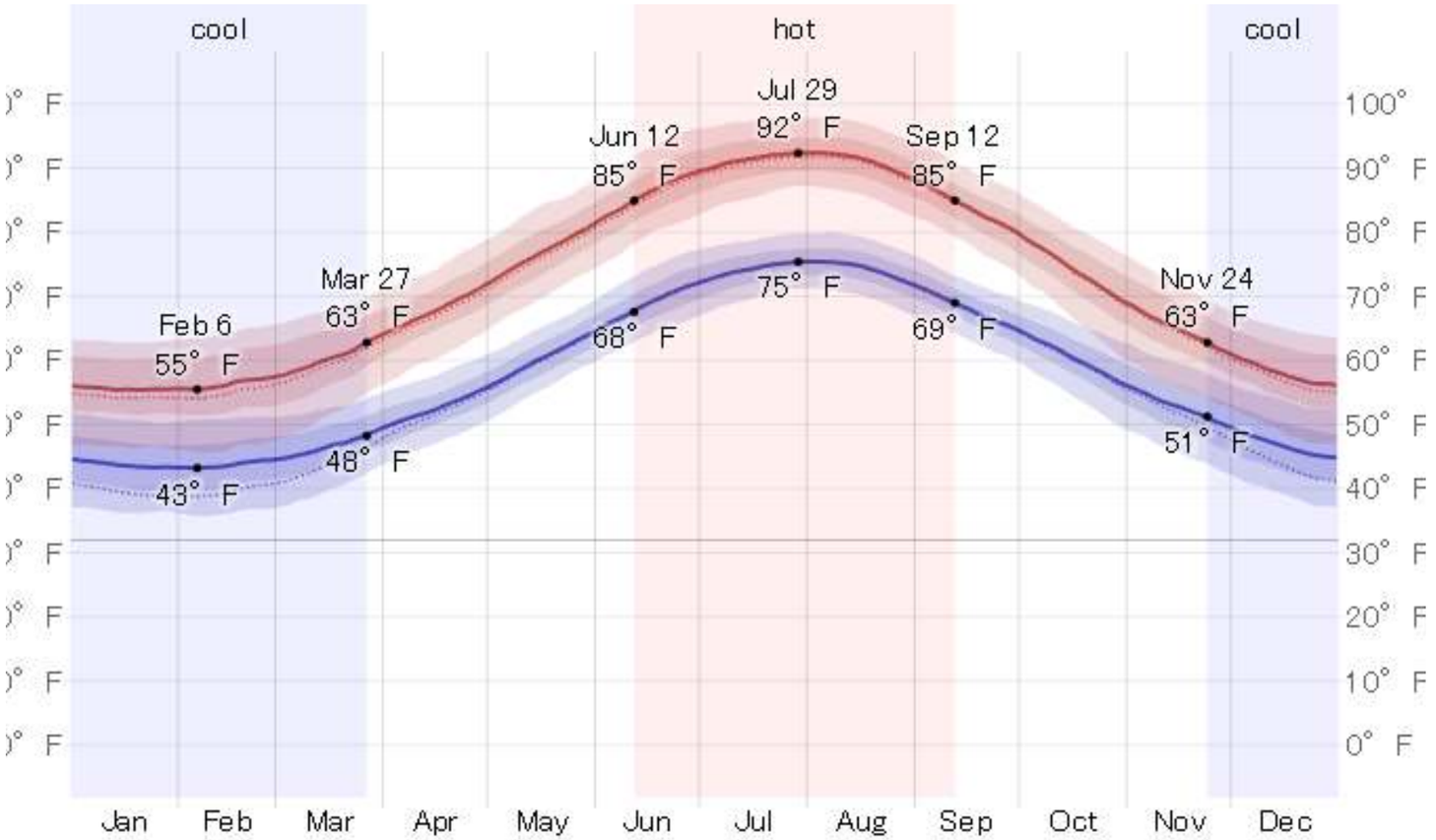
1. Summers:
Hot and dry, with average temperatures ranging from 25°C to 35°C (77°F to 95°F).
Heatwaves are not uncommon, pushing temperatures above 40°C (104°F).
Minimal rainfall during this season.

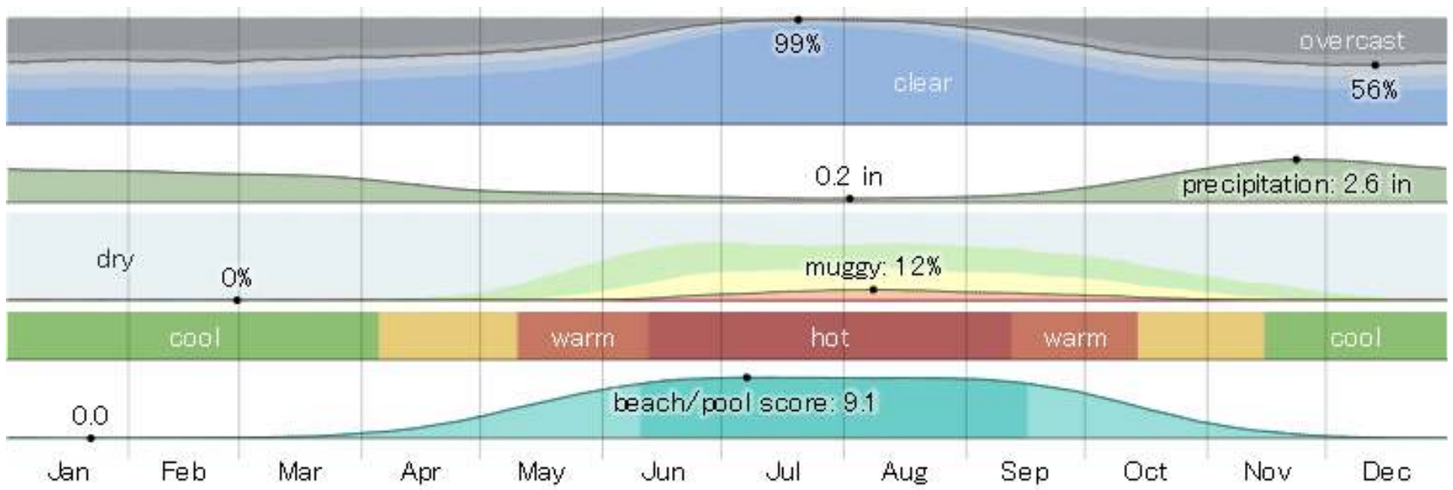
2. Winters:
Mild and wet, with temperatures typically ranging between 7°C and 15°C (45°F to 59°F).
Rain is more frequent, but snowfall is extremely rare.

3. Spring and Autumn:
Transitional seasons with mild and pleasant weather, averaging between 15°C and 25°C (59°F to 77°F).
Rainfall is moderate, and the weather is often sunny.

4. Sunshine and Rainfall:
Sunshine is abundant, with approximately 2,800–3,000 hours of sunlight annually.
Rainfall averages around 330–400 mm (13–16 inches) per year, mostly occurring in the cooler months.

5. Coastal Influence:
The port city’s proximity to the sea provides cooling breezes in summer, making it more comfortable than inland areas.
The coastal location also moderates winter temperatures, reducing extremes.





Climate and Average Weather Year Round in Piraeus from Weather Spark

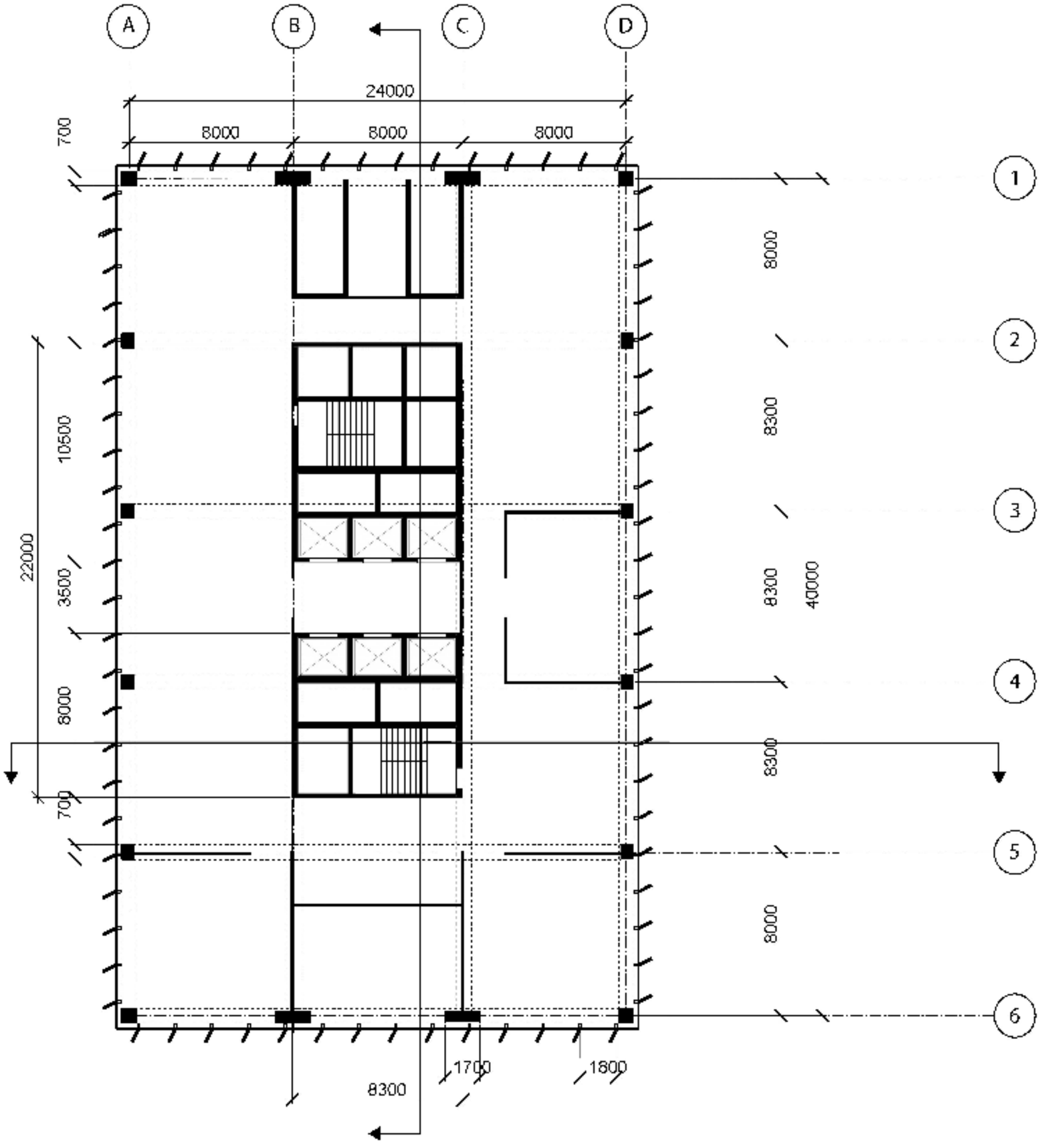
Precipitation and Sky Conditions (Image: Climate in Piraeus):
Rainfall:

Piraeus is generally dry, with an annual precipitation peak in winter (2.6 inches in December) and minimal rainfall during summer (0.2 inches in July).
Cloud Cover:

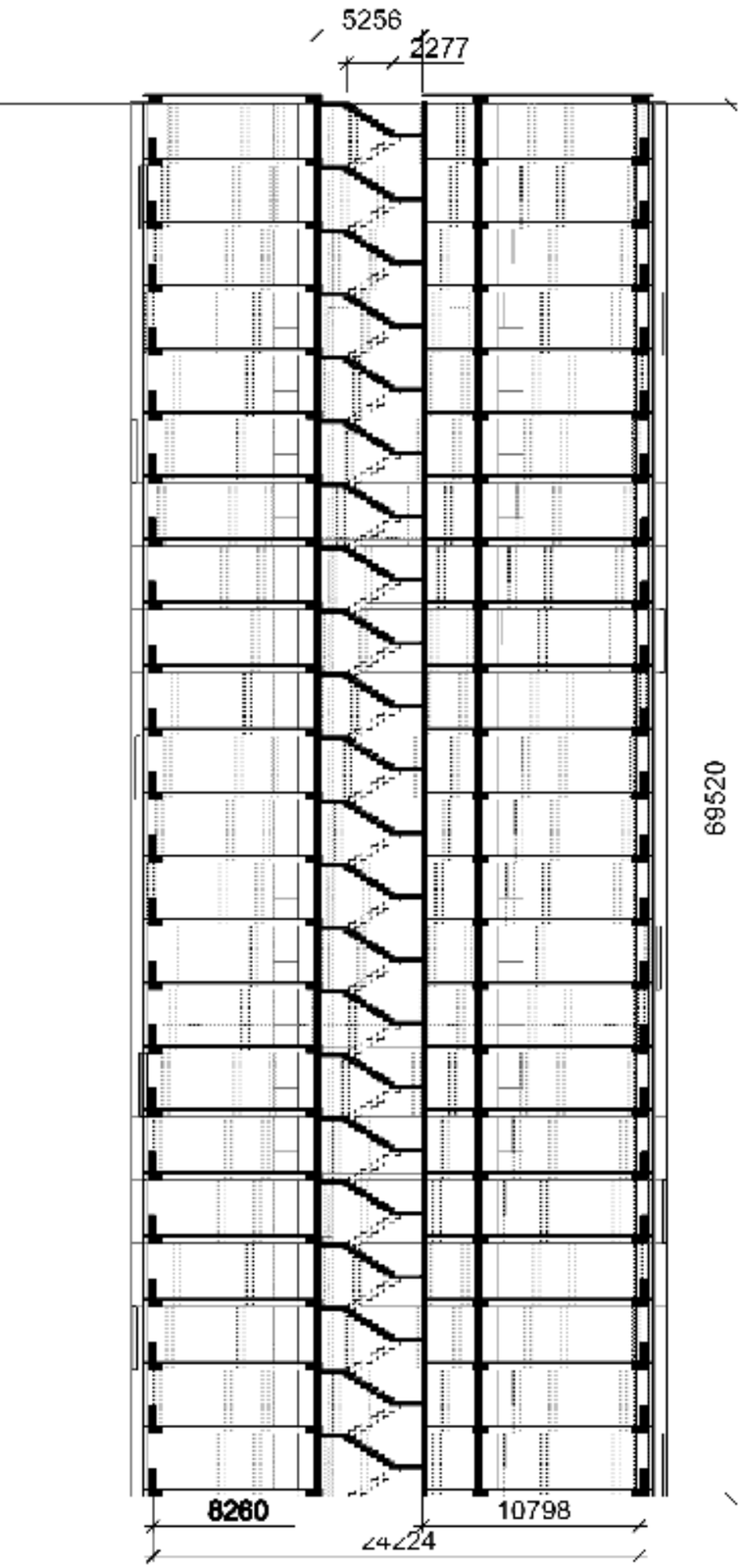
Clear skies dominate from late spring to early autumn, with 99% clear days in July.
Overcast days increase in winter, reaching up to 56% cloudiness in December.
Humidity and Muggy Conditions:

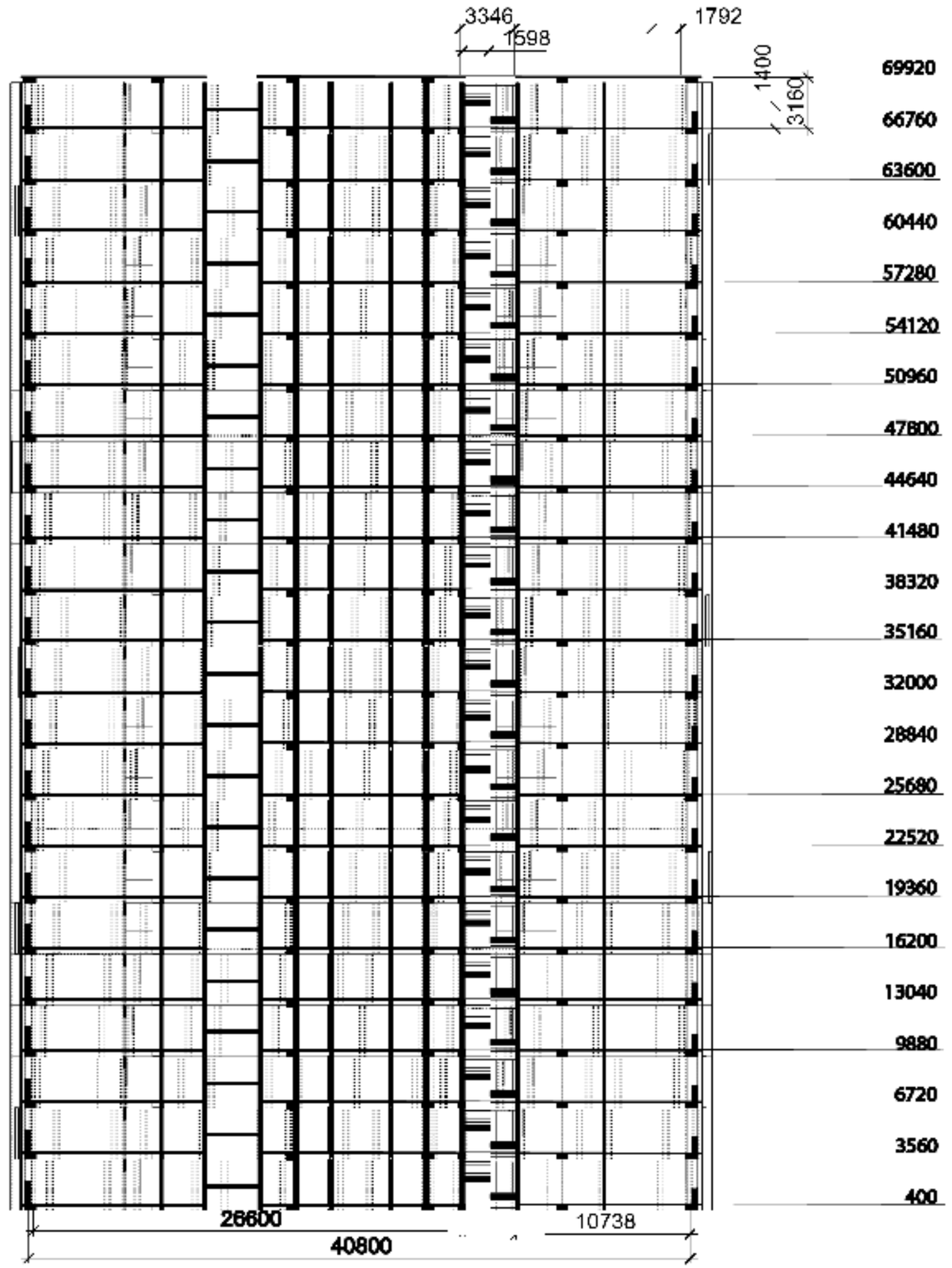
Humidity remains low year-round, with muggy days accounting for only 12%, mostly in late summer.

Typical Floor Plan

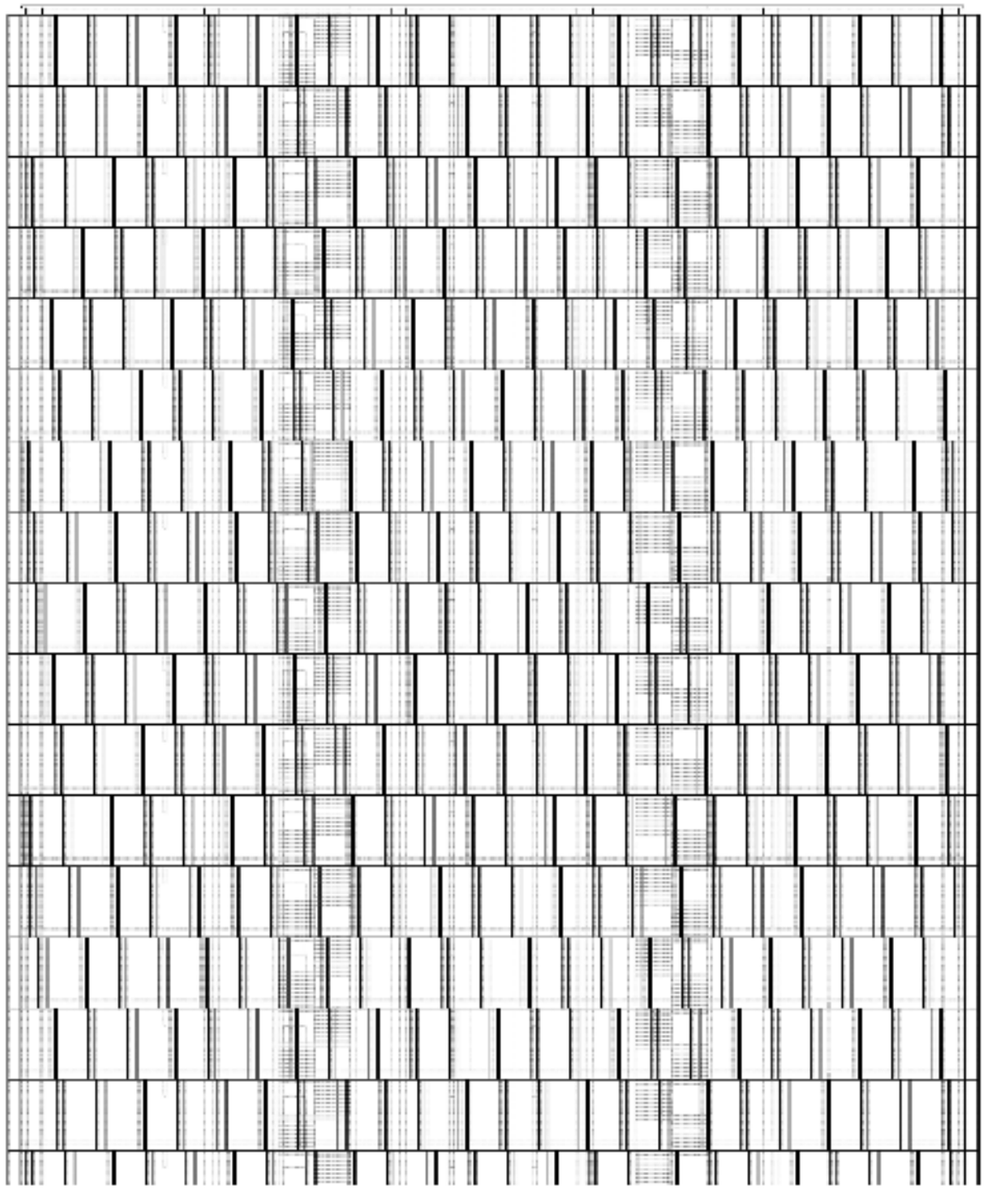


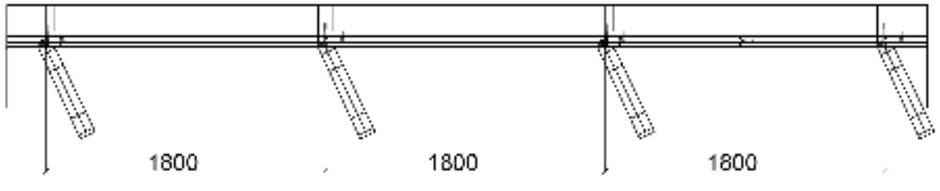
Building Section

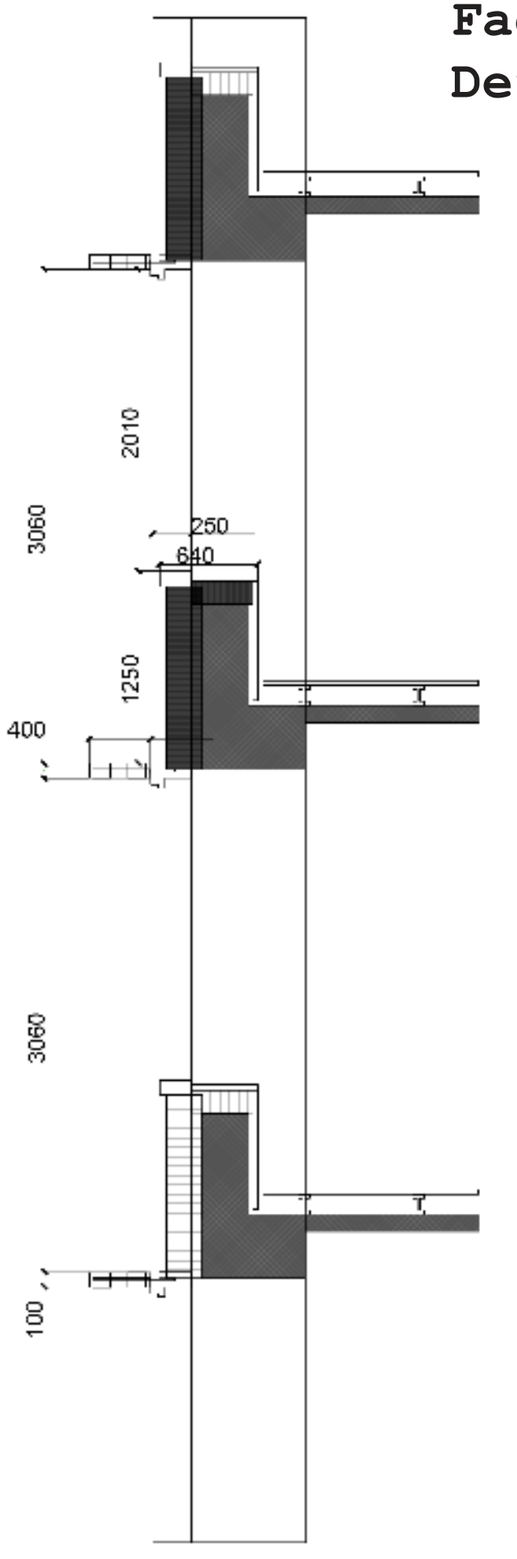




Facade
Detail Drawing

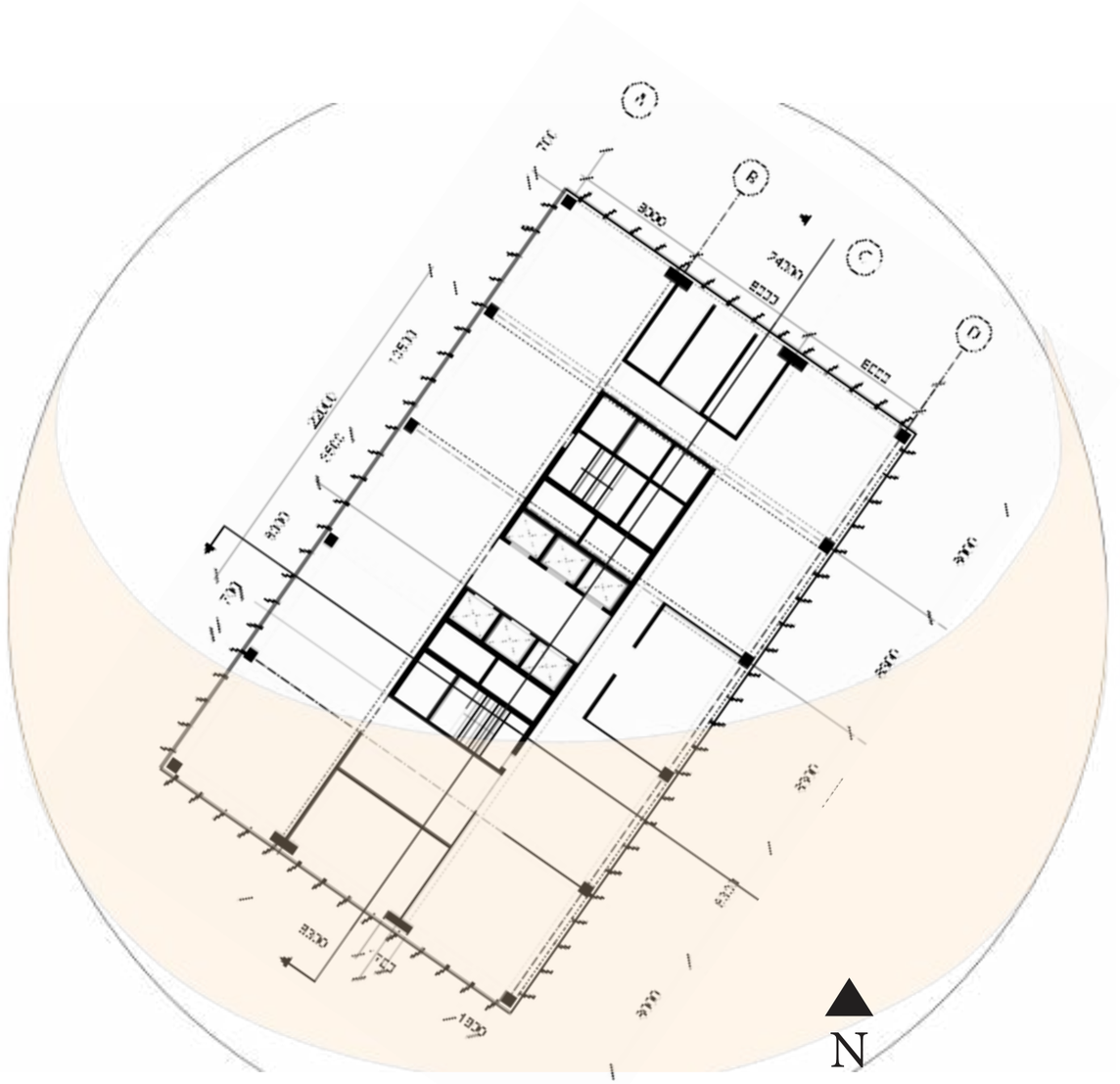




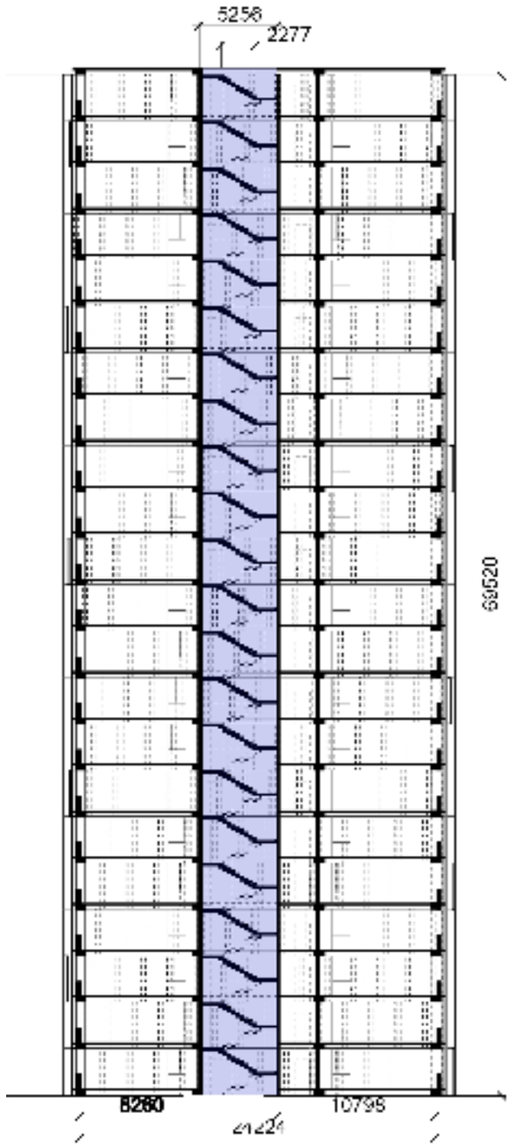


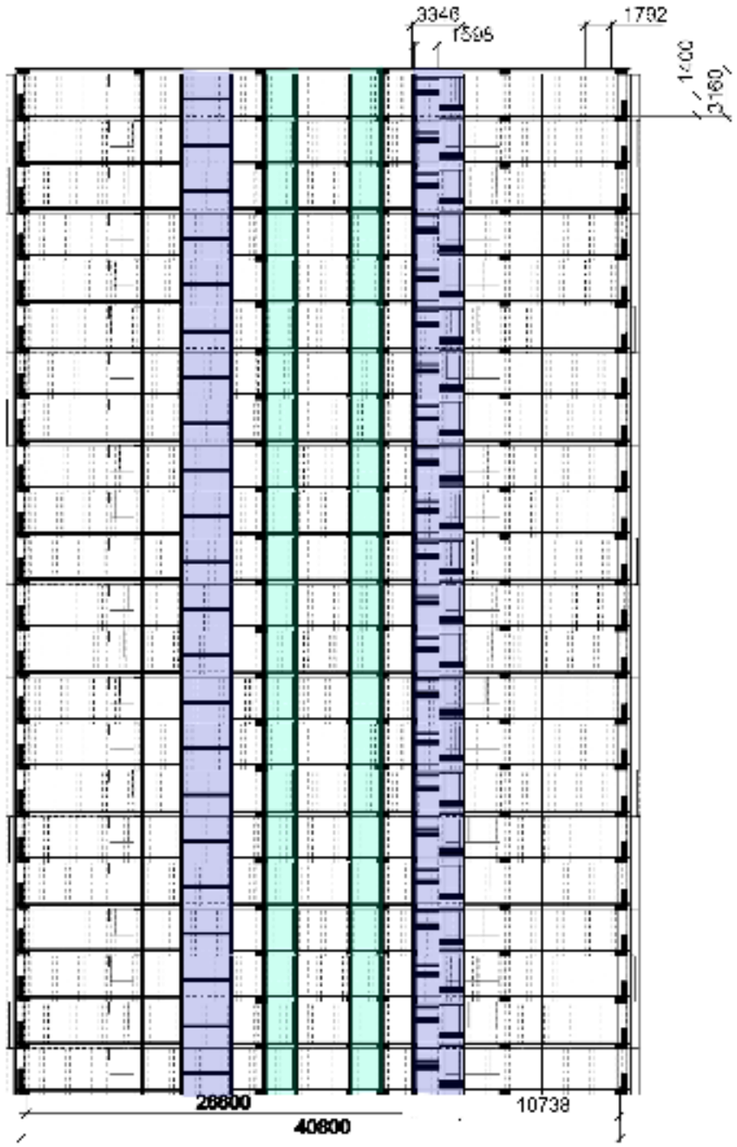
Shading Orientation

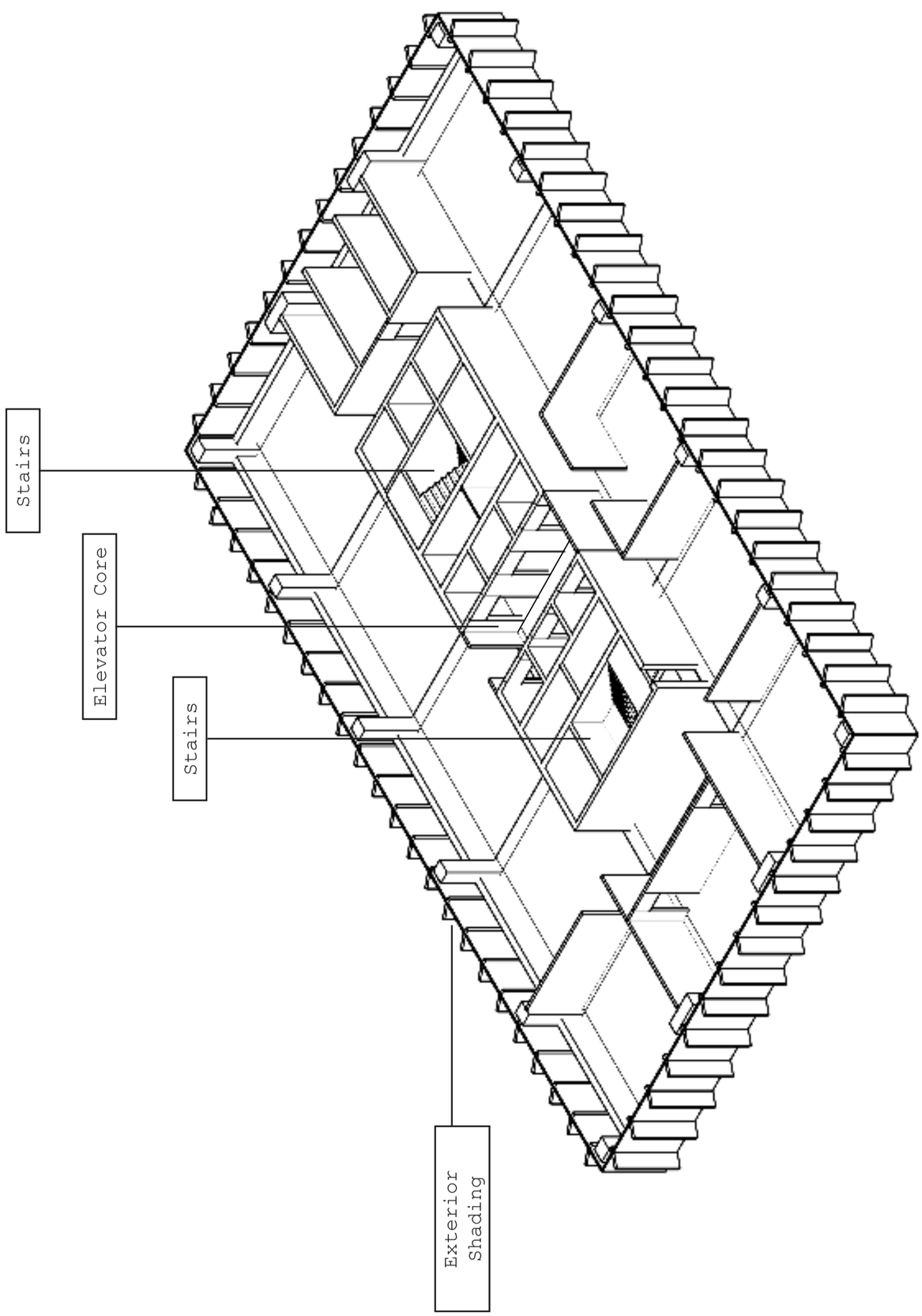
The vertical Shadings were designed to tilted , allowed the surfaces to facet the sundirectly, protect the building glass facade from direct sunlighe,



Circulation Core






Stairs
Elevator Core
Stairs
Exterior Shading

Material Exterroir

Light and Reflective

Aluminium Shading

Double Glazing Facade

Sustainable Material Selection

The facade incorporates shading structures that minimize solar heat gain, improving the building’s energy efficiency and reducing cooling costs.
Use of high-performance glazing to allow natural light while minimizing thermal transfer, contributing to the building’s LEED Platinum certification.

Recycling and Reuse.
Over 126 tonnes of glass from the old facade were recycled and integrated into the new structure, promoting a circular economy and reducing environmental impact.

Material Interior

Sustainable Material Selection

Use of eco-friendly and low-impact materials to align with the building's LEED Platinum certification. Incorporation of recycled materials, such as glass from the old facade, to promote a circular economy and reduce waste. The interior of this building mainly use marbles in the public area to enhance the luxuriness of the design.

As the interior of this building were aiming to be loose-fit green building, the space in the offive part were devided using dry wall.

Brown, Beige, Black (Dark)

Modern shapre

Marble Finishing

Green Building

Sustainable Characteristic

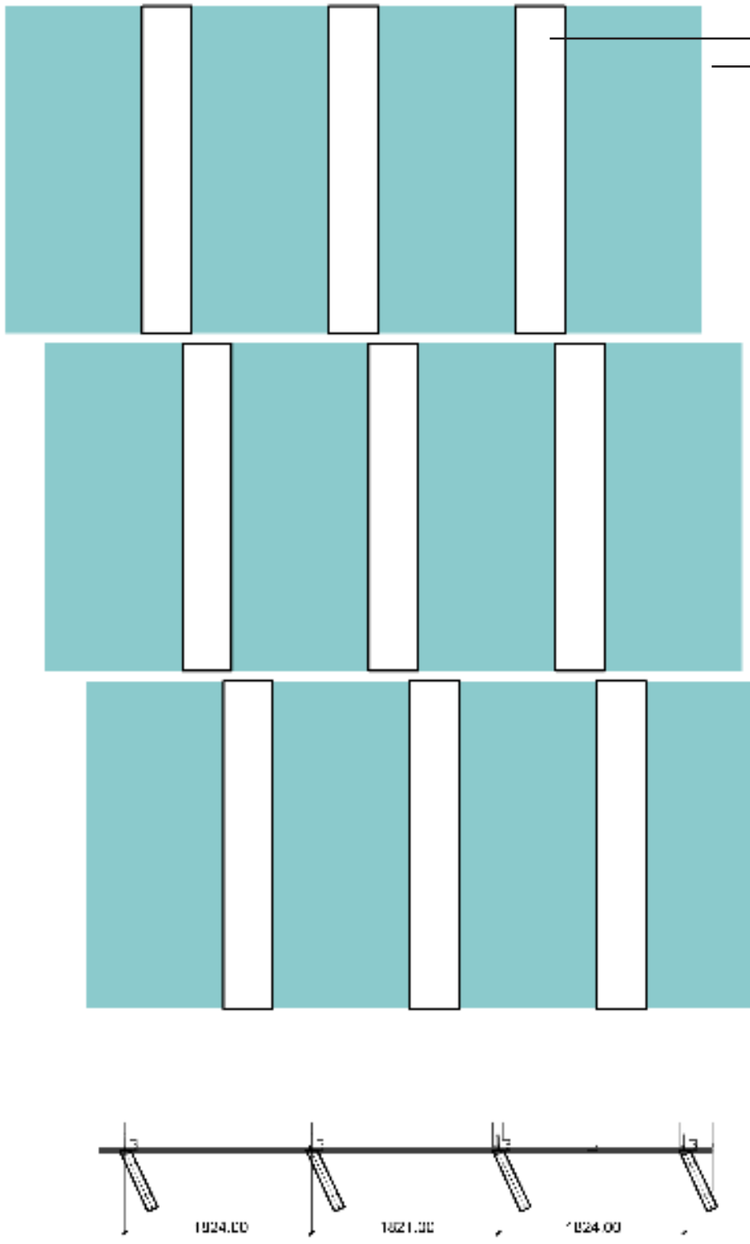
- Circular economy and embodied carbon reduction.
- Reducing carbon footprint through photovoltaic panels.
-Infrastructure for electric vehicles (100% of parking spaces).
-Reducing transportation’s carbon footprint with excellent access to public transportation.
-Recycling more than 5,000m² of glass, with a proportion reused in the project.
-Reducing indoor potable water consumption by 45%.
-Implementing a Covid-eliminating philosophy.
-Maximizing energy efficiency by meeting the strictest global energy standards.
-Installing no-touch WCs and water fixtures.
-Maximizing indoor air quality by complying with the strictest global air quality standards.
-Maximizing daylight within the building.
-Using state-of-the-art anti-Covid and air-purifying technology.
-Incorporating biophilic design elements.
-Maximizing views for occupants.
-Utilizing sustainable wood materials.
-Constantly monitoring and optimizing indoor air quality and thermal comfort parameters.
-Using recyclable materials in construction and finishes.
-Installing energy-efficient shading systems.
-Hosting sustainable tenants to promote eco-friendly operations.
-Employing efficient artificial lighting (LED).
-Including 1,000 square meters of vegetation irrigated by a smart digital system using 100% rainwater.
-Educating tenants and visitors to promote sustainability.
-Adopting an all-electric, all-digital infrastructure.

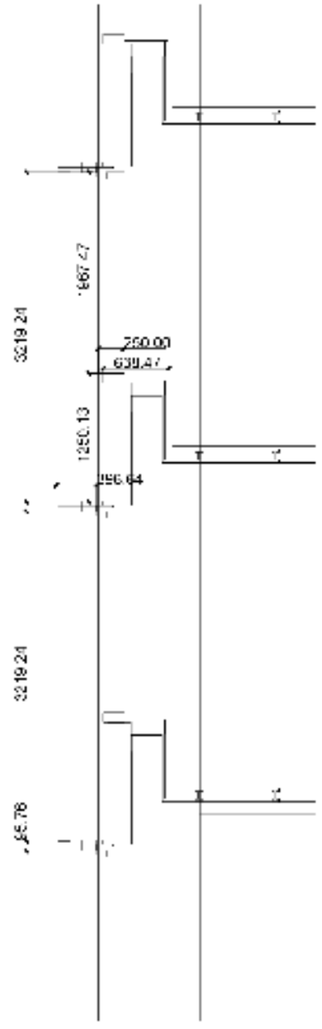
02 Thermal Envelope

Existing Building OTTV Calculation

The Existing facade design dedicated most area to the transparent area. Therefore, the OTTV calculation results higher than 50 W/sqm which can be suitable for the original region. On the other hand, moving this design to Thailand, the Ottp level must be reduced.

OTTV calculation				
Solar heat gain	Building façade orientation			
	NE	NW	SE	SW
Opaque Envelope Conduction	14550.3	23189.2	26087.8	15553.7
Transparent Envelope Conduction	7976.7	13166.6	13166.6	7976.7
Transparent Envelope Solar Radiation Transmission	119829.0	190262.6	213423.7	126191.6
Total heat gain	142355.9	226618.4	252678.1	149722.0
Total wall area	1772.6	2925.9	2925.9	1772.6
OTTV (W/m2)	82.09			
Comply with the Thai building code (< 50 W/m2)?	No			





Existing building Facade Design

From elevation, the shading device (opaque part) covered around 40% of the whole surface. Due to it's tilted angle, it helps engaging the natural light and provides shading at the same time.

Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	886.295			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	11.6			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	NE			
DSH	32.084672			
Material	Density (p)	Specific heat (c)	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**18187.8**			
2) Transparent envelope conduction -Low-E (Low Emissivity) Double-Pane Glass				
2.1) Transparent wall area (m2)	886.295			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1107.86875**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	886.295			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.85			
3.4) Effective solar radiation (ESR)	215.84			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	North			
ESR	215.84			
Transparent envelope radiation (W)	**68293.35487**			

Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	1462.96			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	11.2			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	NW			
DSH	32.084672			
Material	Density	Specific heat	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**28986.5**			
2) Transparent envelope conduction				
2.1) Transparent wall area (m2)	1462.96			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1828.7**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	1462.96			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.85			
3.4) Effective solar radiation (ESR)	207.62			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	NW			
ESR	207.62			
Transparent envelope radiation (W)	**108435.0926**			

wall are

Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	1462.96			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	12.6			
Building type	Office			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	SE			
DSH	32.084672			
Material	Density	Specific heat	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**32609.8**			
2) Transparent envelope conduction				
2.1) Transparent wall area (m2)	1462.96			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1828.7**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	1462.96			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.71			
3.4) Effective solar radiation (ESR)	263.14			
Building type	Office			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	SE			
ESR	263.14			
Transparent envelope radiation (W)	**114796.0544**			

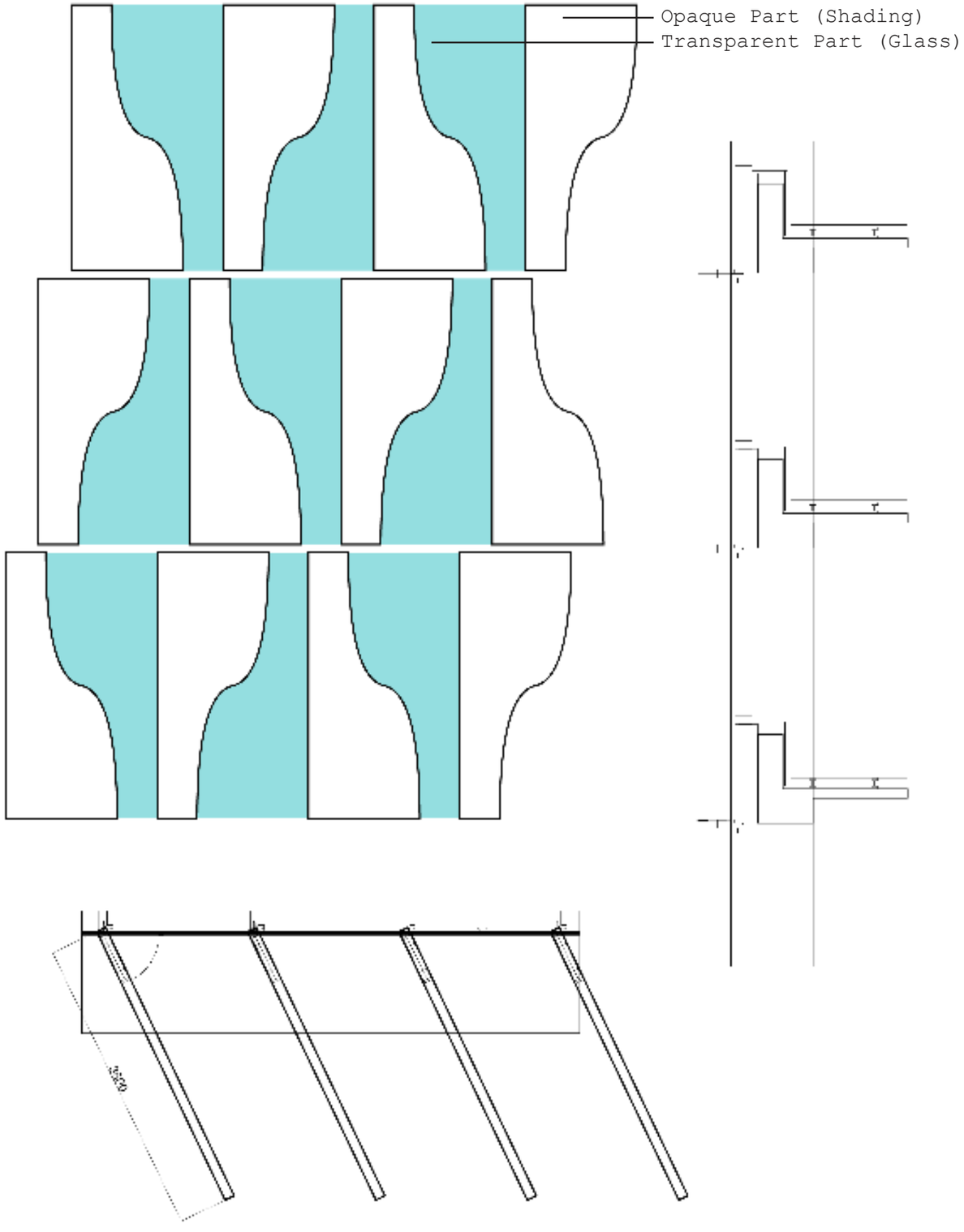
Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	886.295			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	12.4			
Building type	office			
Tilted angle of the wall (roof = 0, wall = 90)	SW			
Orientation of the wall				
DSH	32.084672			
Material	Density	Specific heat	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**19442.2**			
2) Transparent envelope conduction				
2.1) Transparent wall area (m2)	886.295			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1107.86875**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	886.295			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.71			
3.4) Effective solar radiation (ESR)	256.82			
Building type	office			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	SW			
ESR	256.82			
Transparent envelope radiation (W)	**67875.77166**			

02 OTTV

New Design OTTV Calculation

New facade design increased the opaque area to transparent area to be in 1:1 ratio, changed the material to the one with higher heat resistant and extending horizontal shading. As a result, the calculated OTTV was reduced to 49.43 from over 80.

OTTV calculation				
Solar heat gain	**Building façade orientation**			
	NE	**NW**	**SE**	**SW**
Opaque Envelope Conduction	18187.8	28986.5	32609.8	19442.2
Transparent Envelope Conduction	1107.9	1828.7	1828.7	1107.9
Transparent Envelope Solar Radiation Transmission	68293.4	108435.1	114796.1	67875.8
Total heat gain	87589.1	139250.2	149234.5	88425.8
Total wall area	1772.6	2925.9	2925.9	1772.6
OTTV (W/m2)	49.43			
Comply with the Thai building code (< 50 W/m2)?	Yes			

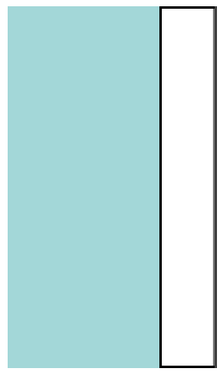


New Design
Facade Design

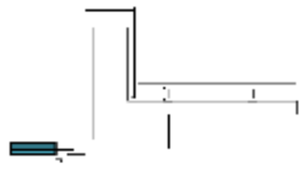
Utilizing the same strategy which is fin-shaped vertical shading, this new design adding length to the fin with new shape to cover more space in elevation. This curve cover 50% of the glass wall area which helps reduce the heat significantly.

Original Design

Old facade has an identity of stepping vertical shading. So we embrace that and make a little change on shape to experiment.

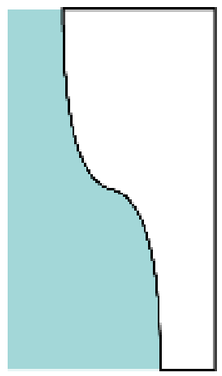


This overhang in the original building helps with the results but not significantly due to it’s lenght



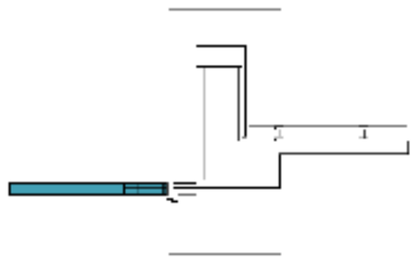
Normal glass plays a big role in transfering heat into the building. As the tower is covered in glass we must make sure the material is changed to the more suitable one.

New Design



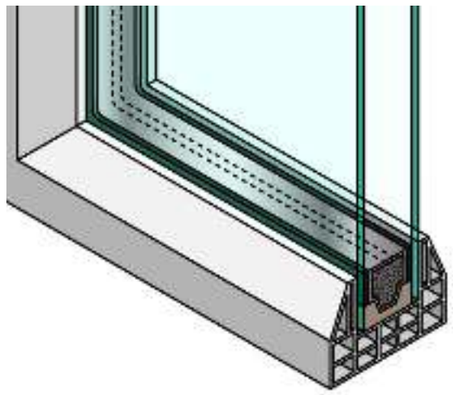
Covering 50%

Extend the vertical shading fin to cover 50% ot thesurface area from elevation view. This will reduce the transmission area which directly faced the sun.



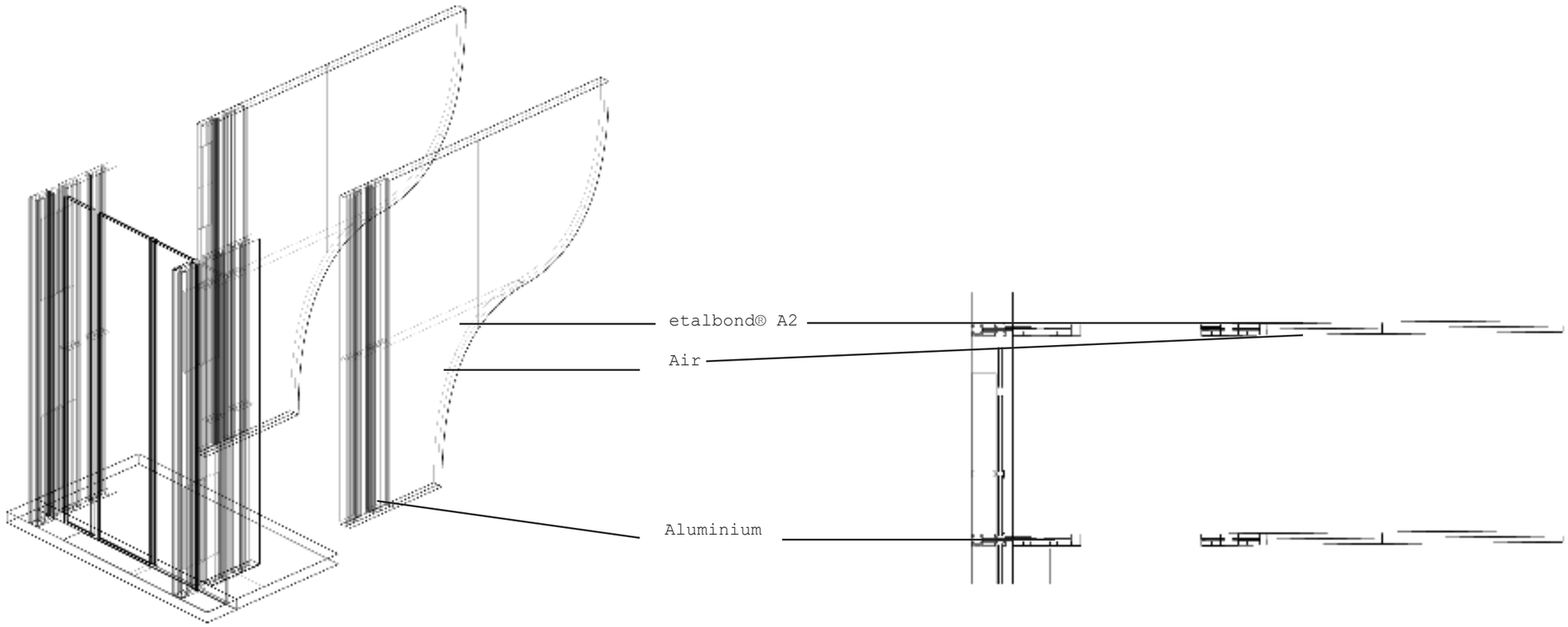
Extending overhang

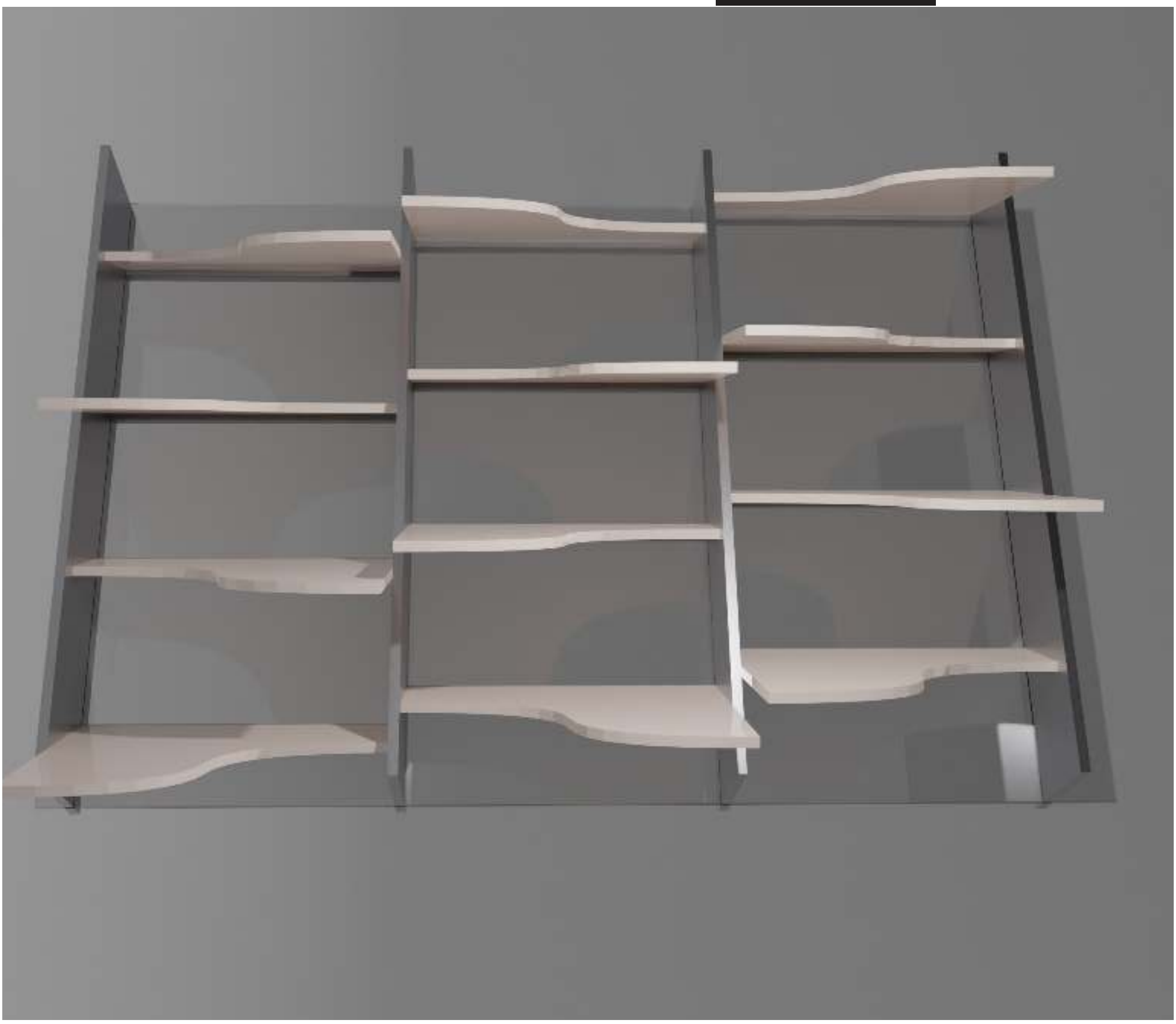
This will help with shading and reduce SC value that we use to calculate OTTV. By extending the horizontal shading, the transmission part will recieve less direct sunlight

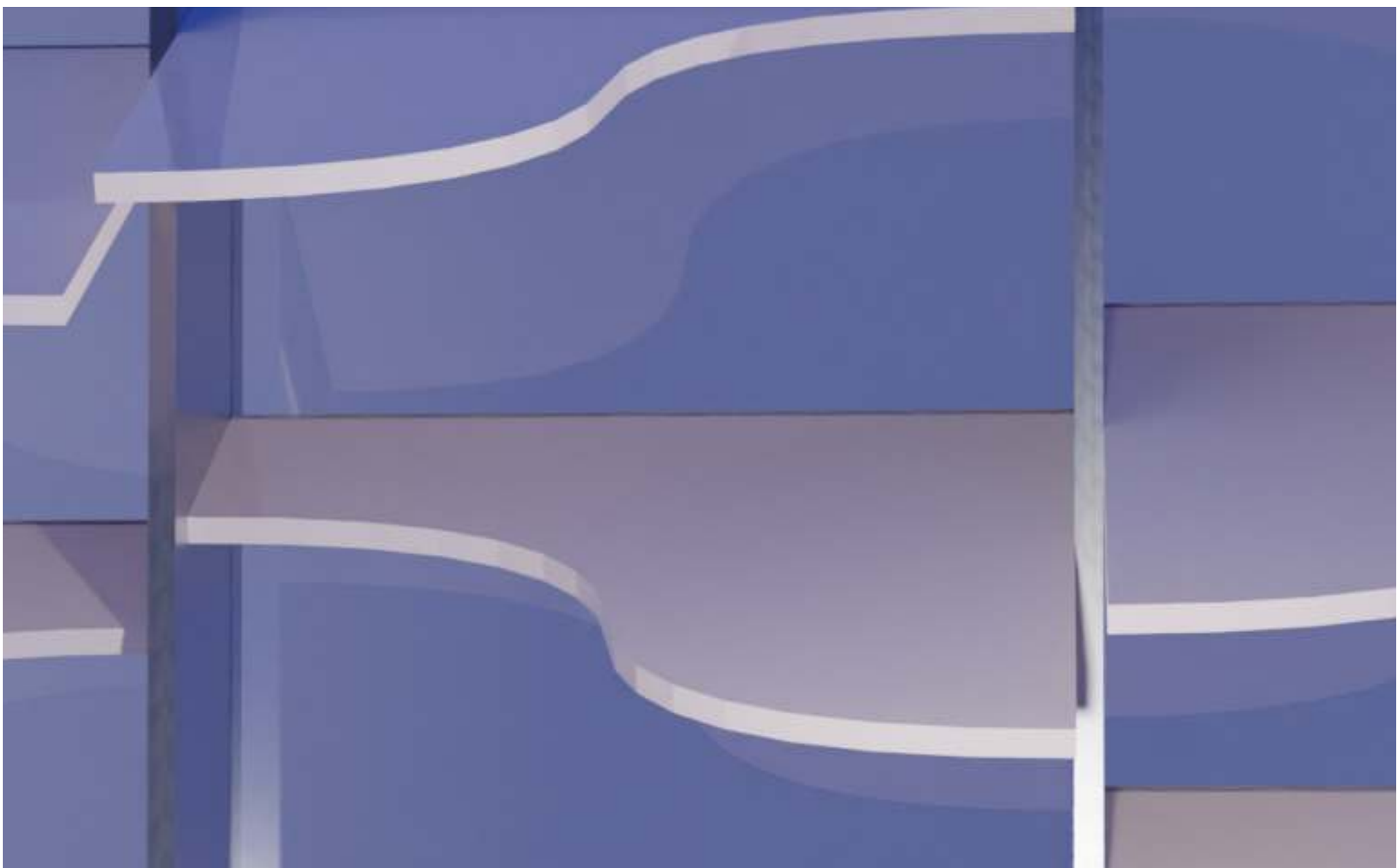


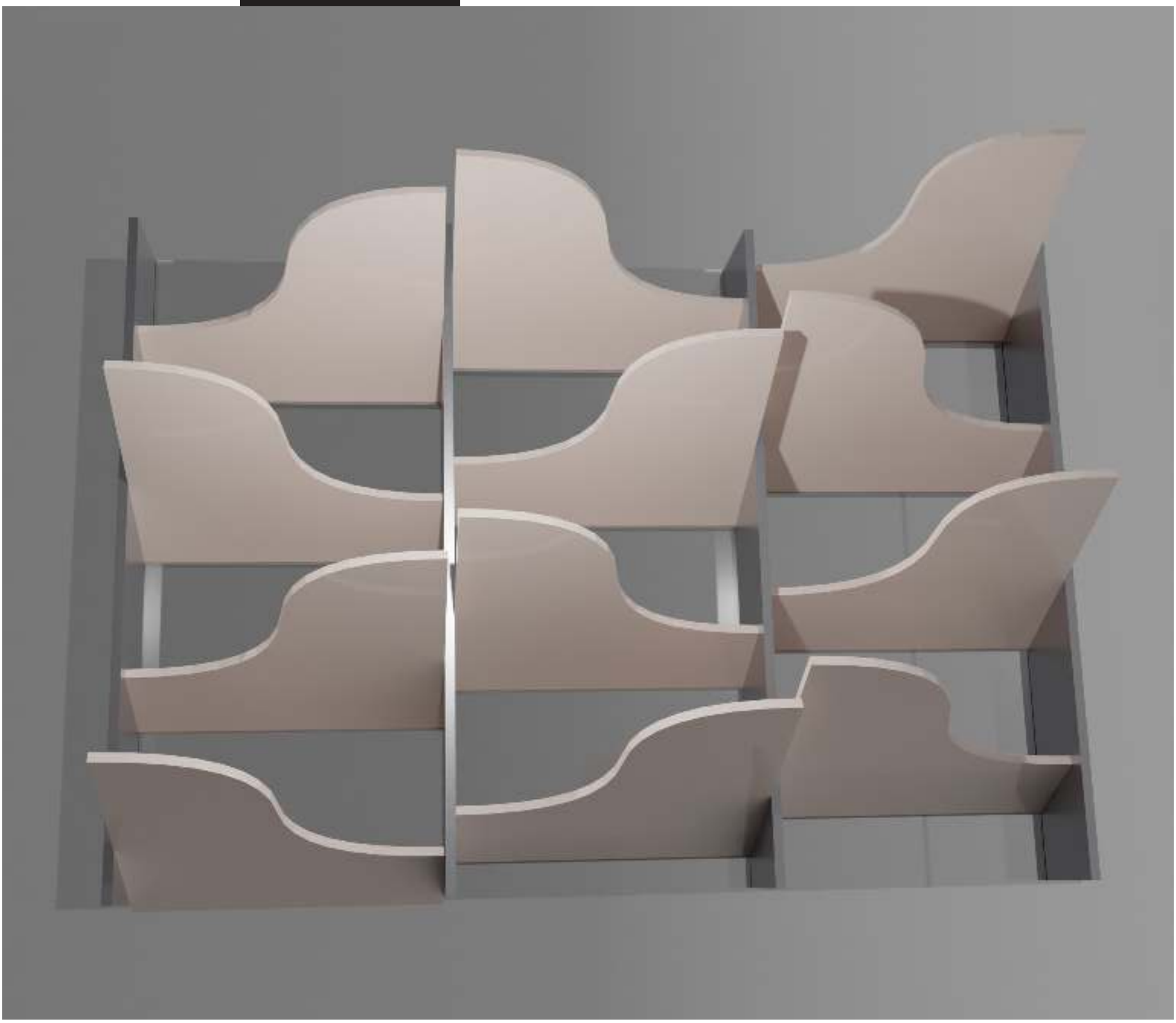
Low-E (Low Emissivity)
Double-Pane Glass

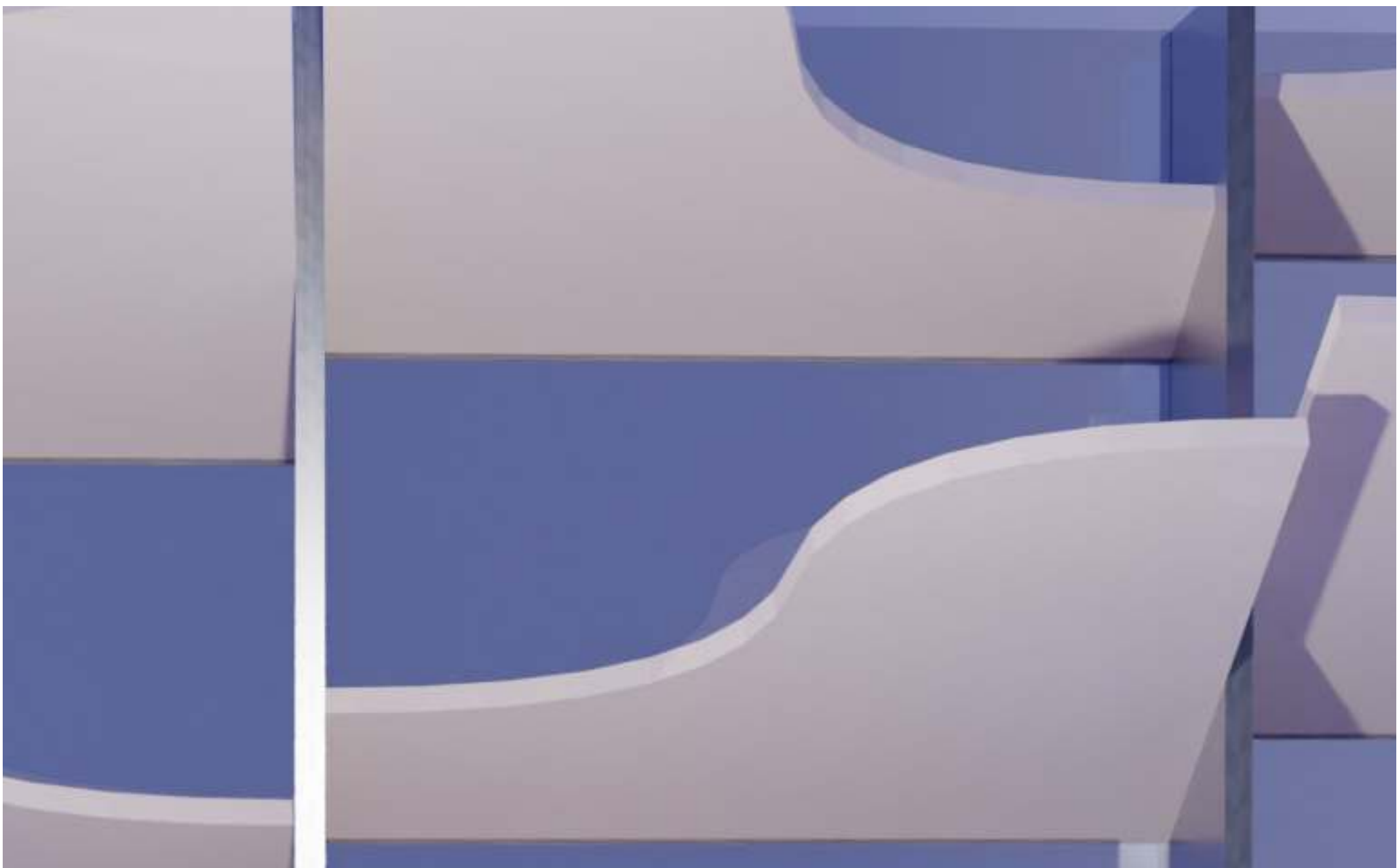
Change the material to this more expensive but better performance one. This transmission glass reduce the amount of heat transfered into the building.


etalbond® A2
Air
Aluminium









Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	886.295			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	11.6			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	NE			
DSH	32.084672			
Material	Density (p)	Specific heat (c)	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**18187.8**			
2) Transparent envelope conduction -Low-E (Low Emissivity) Double-Pane Glass				
2.1) Transparent wall area (m2)	886.295			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1107.86875**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	886.295			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.85			
3.4) Effective solar radiation (ESR)	215.84			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	North			
ESR	215.84			
Transparent envelope radiation (W)	**68293.35487**			

Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	1462.96			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	11.2			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	NW			
DSH	32.084672			
Material	Density	Specific heat	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**28986.5**			
2) Transparent envelope conduction				
2.1) Transparent wall area (m2)	1462.96			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1828.7**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	1462.96			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.85			
3.4) Effective solar radiation (ESR)	207.62			
Building type	Office Building			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	NW			
ESR	207.62			
Transparent envelope radiation (W)	**108435.0926**			

wall are

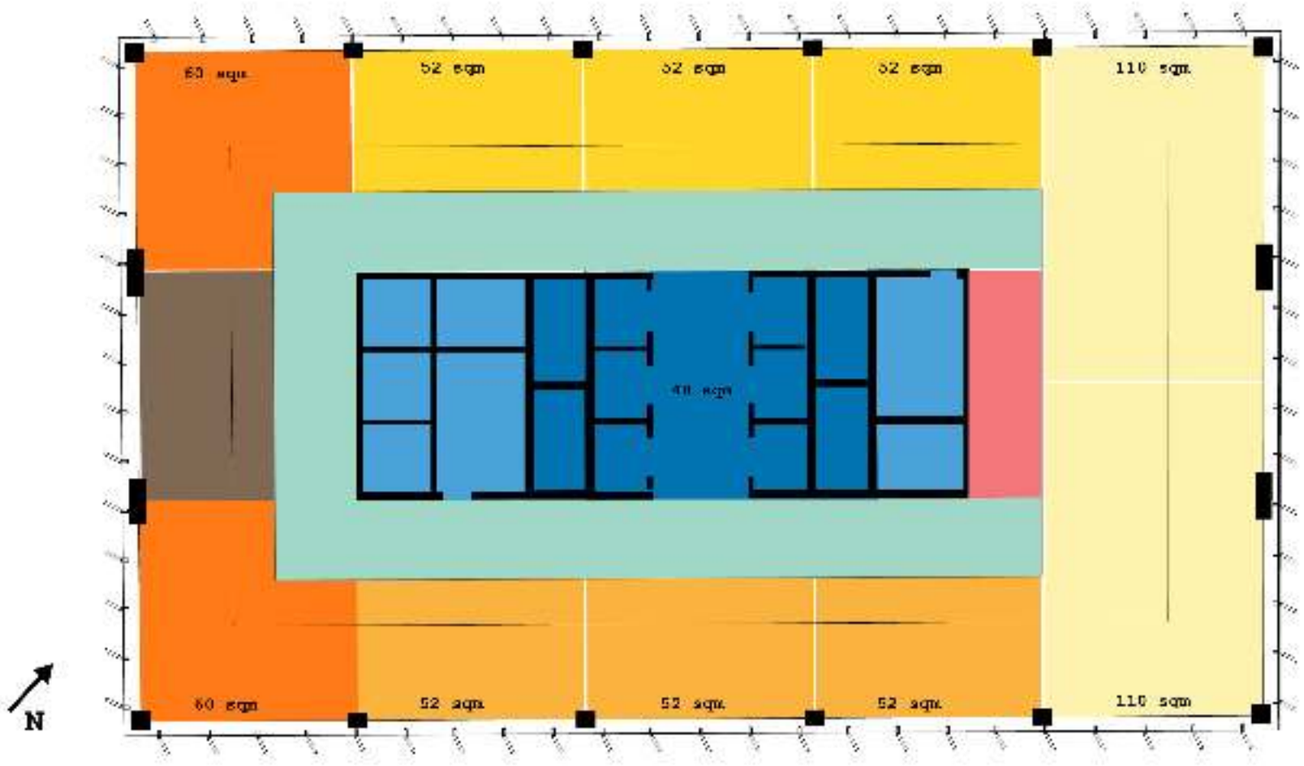
Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	1462.96			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	12.6			
Building type	Office			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	SE			
DSH	32.084672			
Material	Density	Specific heat	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**32609.8**			
2) Transparent envelope conduction				
2.1) Transparent wall area (m2)	1462.96			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1828.7**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	1462.96			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.71			
3.4) Effective solar radiation (ESR)	263.14			
Building type	Office			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	SE			
ESR	263.14			
Transparent envelope radiation (W)	**114796.0544**			

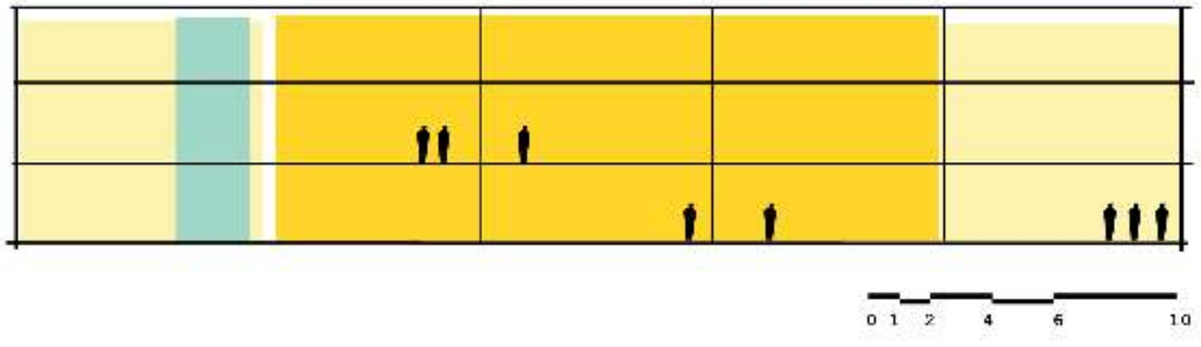
Façade Information				
1) Opaque envelope conduction				
1.1) Opaque wall area (m2)	886.295			
1.2) U-value (W/m.K)	1.769			
Material	Thickness	Thermal conductivity	R- value	
etalbond® A2	0.008	0.826	0.010	
Air	0.1	0.18	0.556	
Aluminium	0.006	211	0.000	
1.3) Equivalent temperature difference (Tdeq)	12.4			
Building type	office			
Tilted angle of the wall (roof = 0, wall = 90)	SW			
Orientation of the wall				
DSH	32.084672			
Material	Density	Specific heat	Thickness	DSH of the material
etalbond® A2	2500	0.88	0.008	17.6
Air	1.2	1	0.1	0.12
Aluminium	2672	0.896	0.006	14.364672
Solar Absorptance	0.3			
Opaque envelope conduction (W)	**19442.2**			
2) Transparent envelope conduction				
2.1) Transparent wall area (m2)	886.295			
2.2) U-value (W/m.K)	0.25			
2.3) Temperature difference (ΔT)	5			
Transparent envelope conduction (W)	**1107.86875**			
3) Transparent envelope radiation				
3.1) Transparent wall area (m2)	886.295			
3.2) Solar heat gain coefficient (SHGC)	0.42			
3.3) Shading coefficient (SC)	0.71			
3.4) Effective solar radiation (ESR)	256.82			
Building type	office			
Tilted angle of the wall (roof = 0, wall = 90)	90			
Orientation of the wall	SW			
ESR	256.82			
Transparent envelope radiation (W)	**67875.77166**			

02 CITY

03 HVAC System

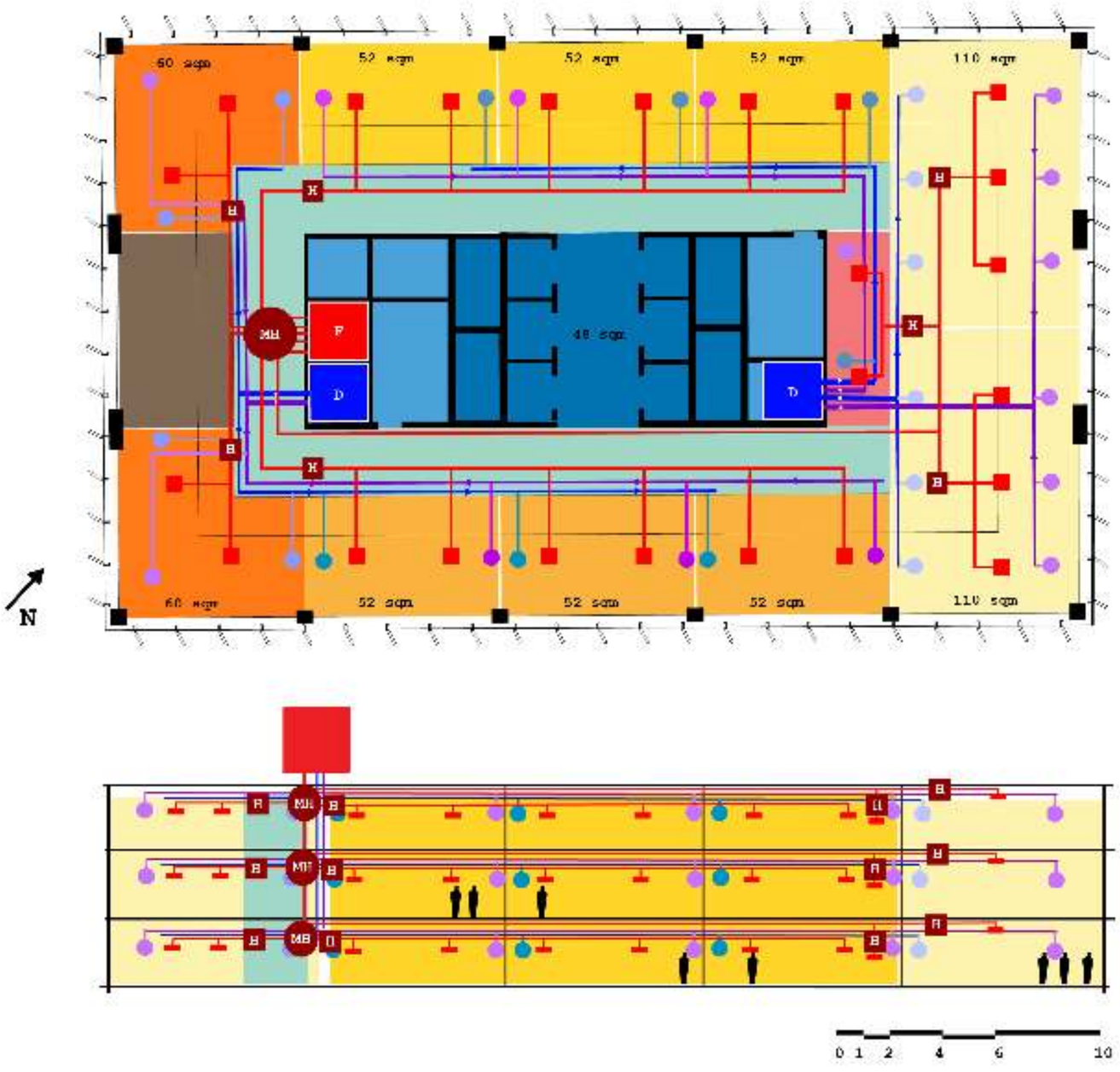
THERMAL ZONE





Thermal zone is created based on the usage of each area and the orientation. In short, it is devided in to 3 big parts, open plan zones, meeting room zones, and elevator core. Then,cut the zones in to smaller zones.

HVAC SYSTEM



Free Working Space: North East

Free Working Space: South West

Meeting Room: South East

Meeting Room: South West

Mini Kitchen

Corridor

Stair Cases

Elevator Core

Toilet

VRF Variable Refrigerant Volume

DOAS Dedicated Outdoor Air System (Supplies)

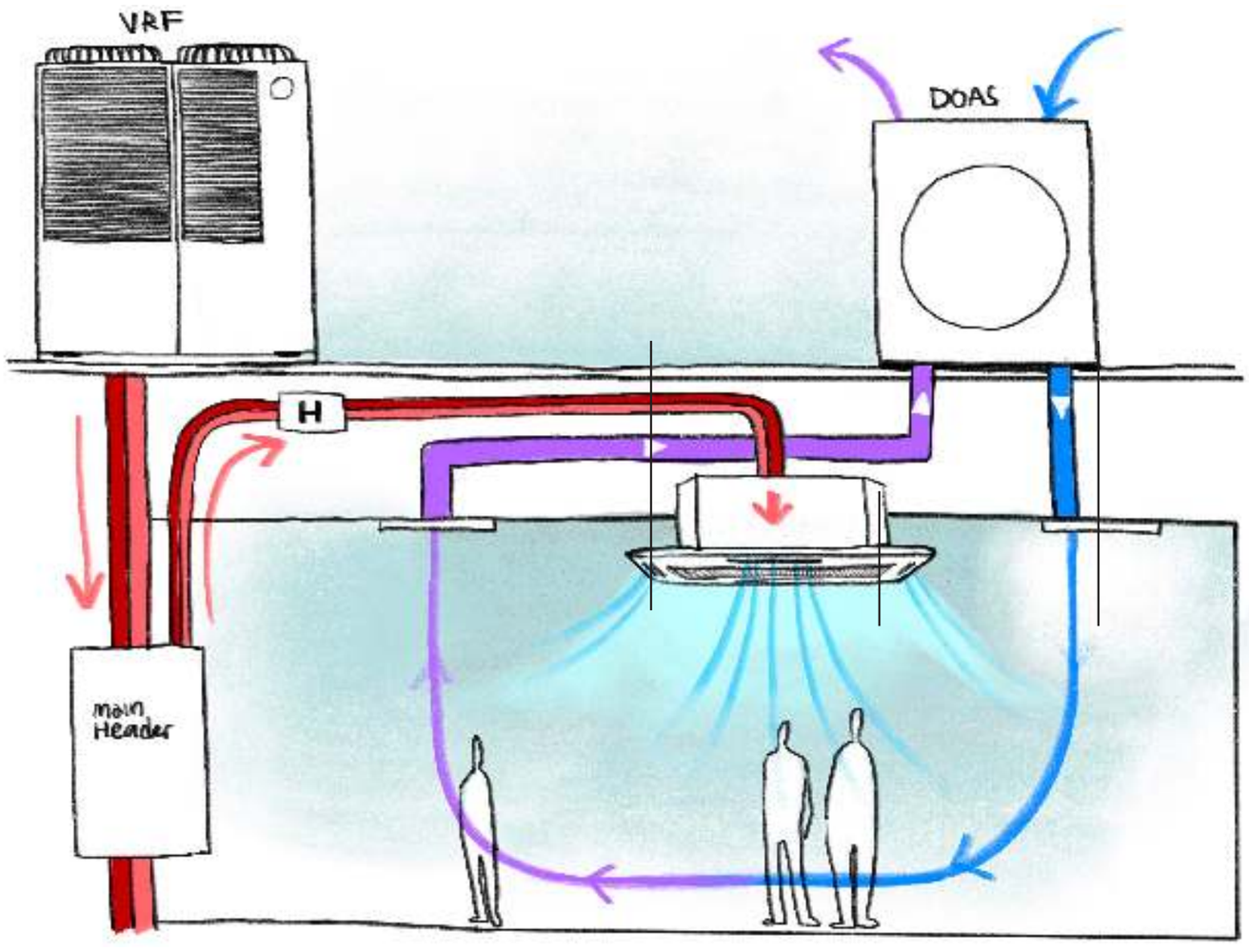
DOAS Dedicated Outdoor Air System (Return)

B Header

MH Main Header

Four Way Cassette AC

HVAC SYSTEM

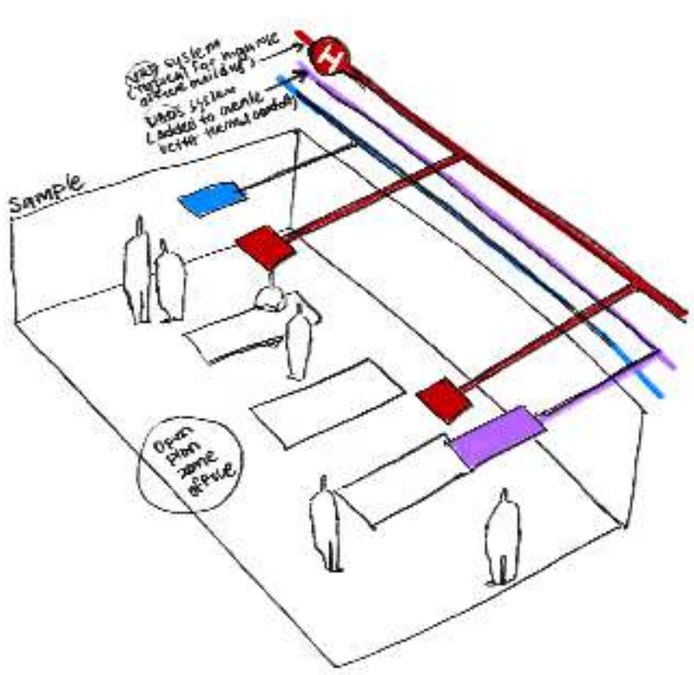


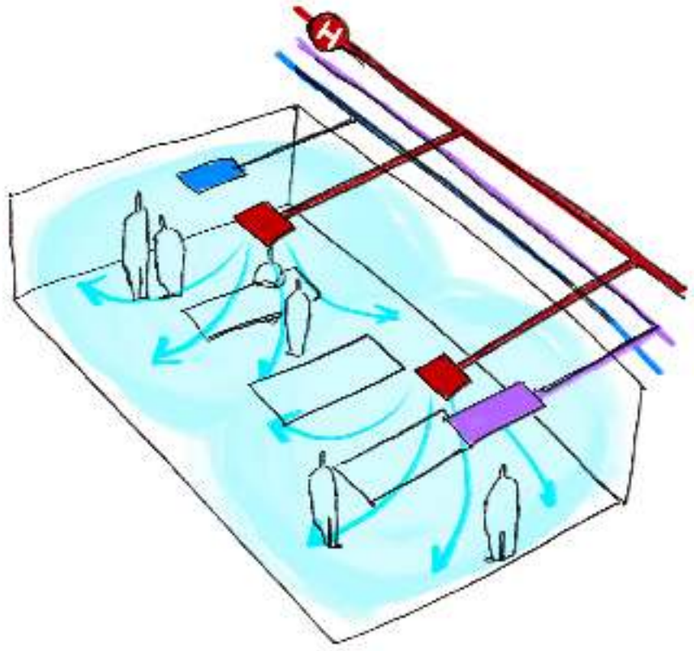
What is the differeces?

The old design of Piraeus Tower, originally suited for Greece's Mediterranean climate, lacks the high-efficiency cooling and humidity control needed for Bangkok's tropical conditions. By integrating VRF with DOAS, the building becomes more energy-efficient and climate-adaptive. The VRF system provides zoned cooling, reducing energy waste, while the DOAS system ensures proper ventilation and dehumidification, preventing indoor humidity buildup and mold growth. Unlike traditional HVAC systems, this setup reduces operational costs, enhances thermal comfort, and improves indoor air quality, making the tower far more sustainable and efficient for Bangkok's hot, humid environment.

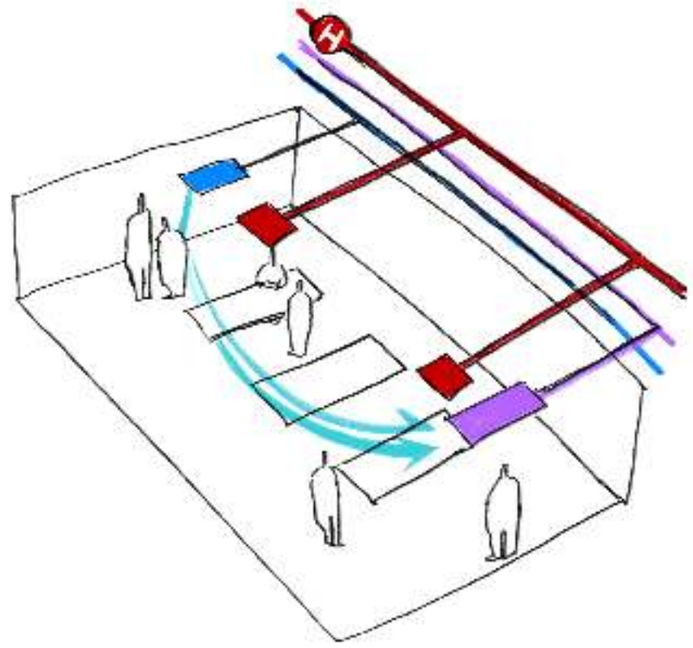
COMPONENT DIAGRAM

Simplified Diagram
of the system.





VRF

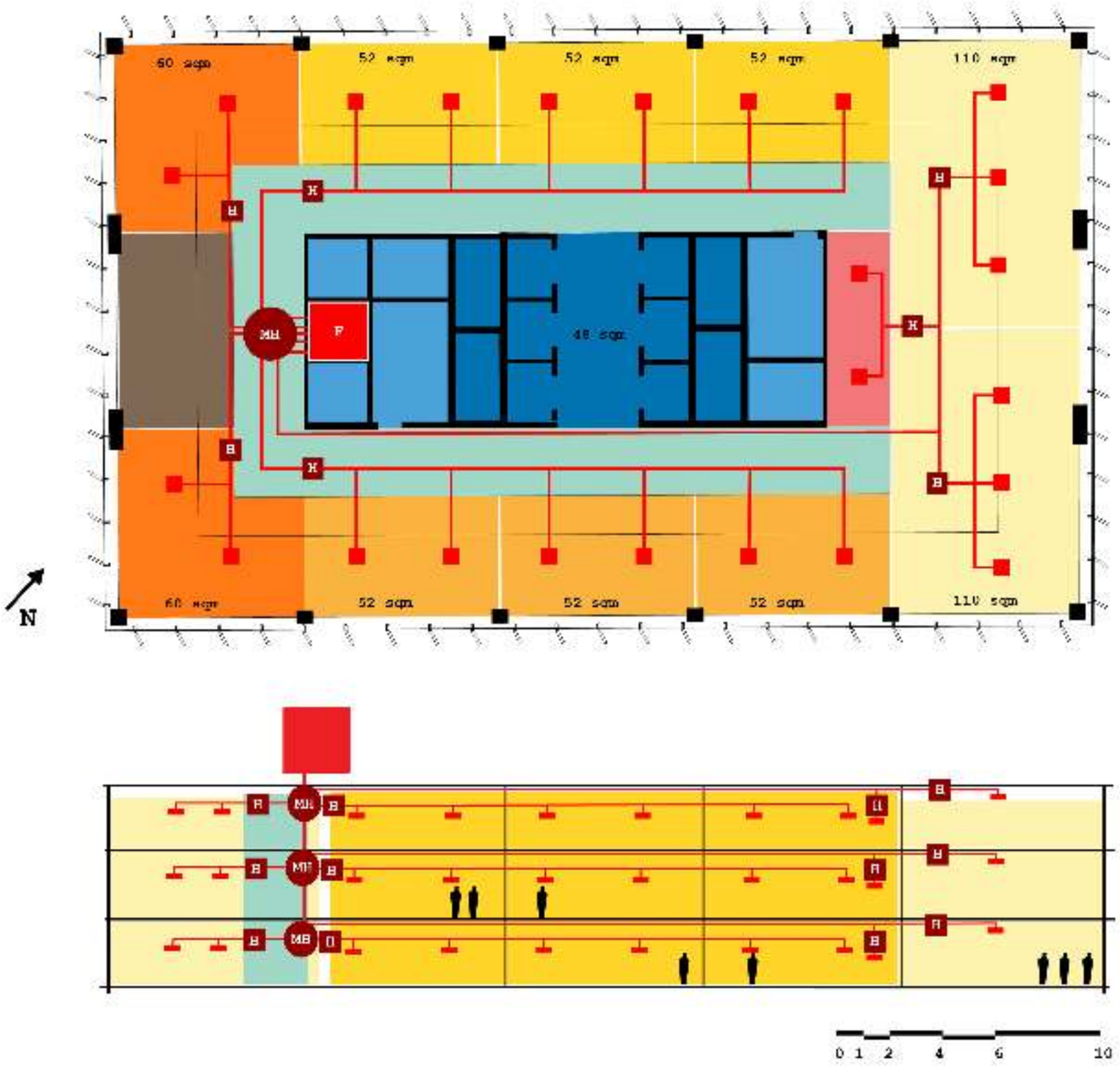


DOAS

Why is it suitable for Bangkok

VRF with DOAS is ideal for tropical climates like Bangkok because it efficiently handles both cooling and humidity control, which are critical in hot, humid environments. The VRF system provides zoned cooling, adjusting refrigerant flow based on demand, making it energy-efficient and well-suited for high-rise buildings. However, since VRF does not supply fresh air, the DOAS system ensures proper ventilation and dehumidification, preventing moisture buildup, mold growth, and indoor air quality issues. Together, VRF optimizes cooling efficiency while DOAS manages humidity and fresh air, creating a comfortable, sustainable, and cost-effective HVAC solution for Bangkok’s climate.

VRF SYSTEM



Free Working Space: North East

Free Working Space: South West

Meeting Room: South East

Meeting Room: South West

Mini Kitchen

Corridor

Stair Cases

Elevator Core

Toilet

VRF Variable Refrigerant Volume

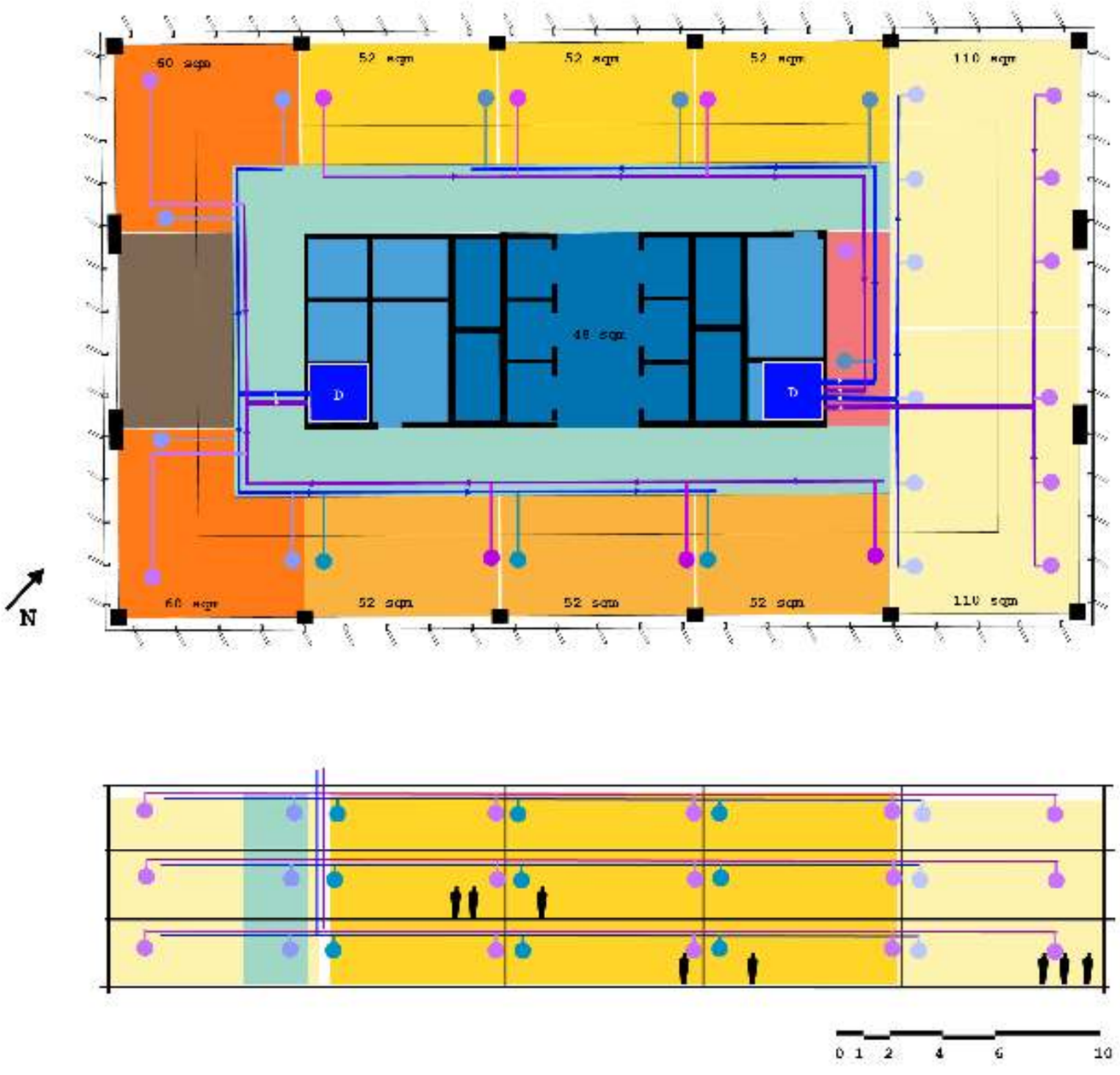
H Header

MH Main Header

Four Way Cassette AC

VRF system use pipe and Headers to distribute the pipe, brought cool air to each zone. The placement of the openings were designed based on the area of the zone and the headers were on the front of the openings to give a whole zone control.

DOAS SYSTEM



Free Working Space: North East

Free Working Space: South West

Meeting Room: South East

Meeting Room: South West

Mini Kitchen

Corridor

Stair Cases

Elevator Core

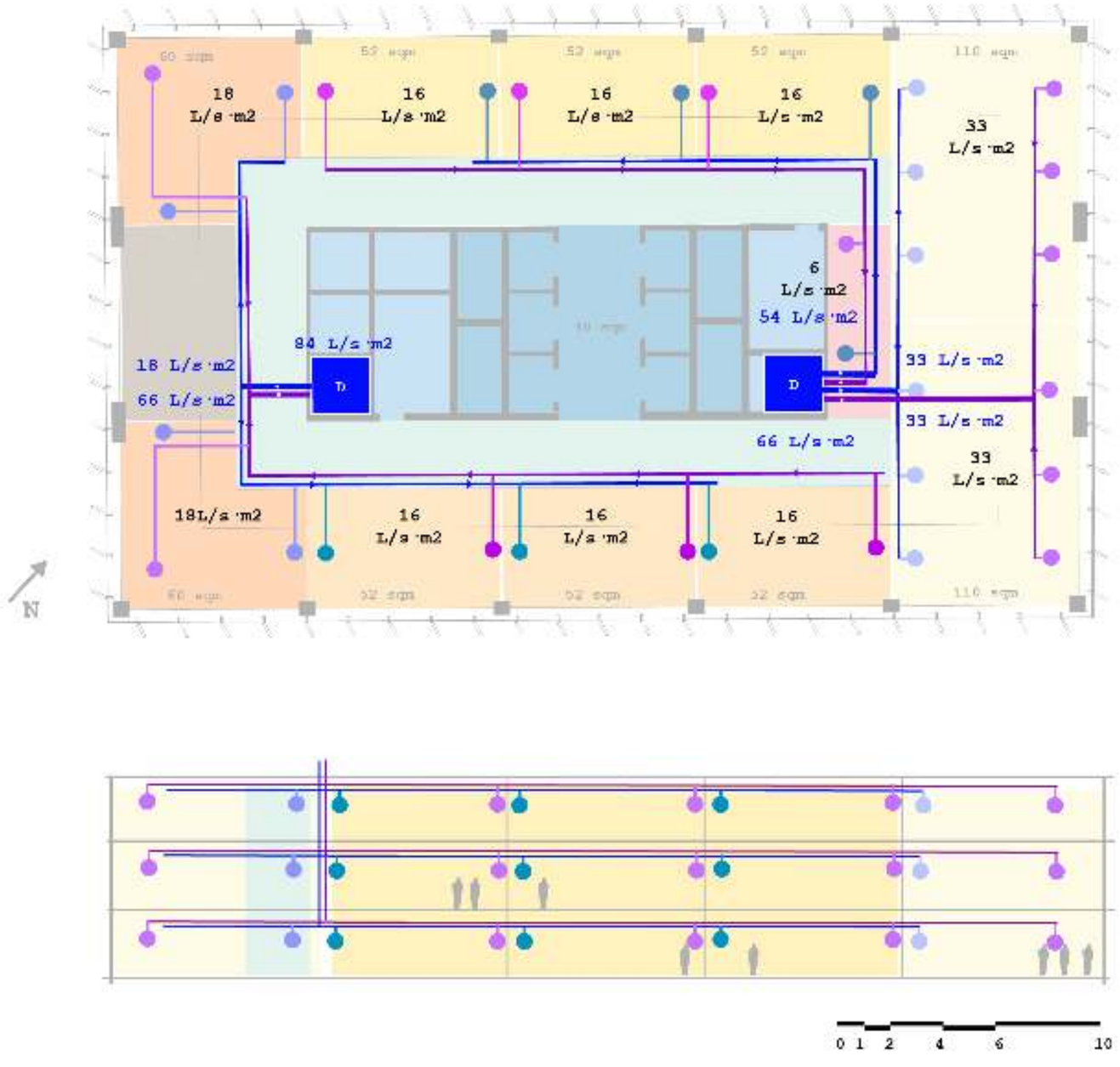
Toilet

DOAS Dedicated Outdoor Air System (Supplies)

DOAS Dedicated Outdoor Air System (Return)

DOAS system is designed to give fresh air from outdoor inside. The system included 2 routh, in and out. The air will be contained through the pipes. Then, another routh will bring out the air, creating ventilation in the room. This system also reducing Carbondioxide and humid in the building.

DOAS SYSTEM:
Calculation



Free Working Space: North East

Free Working Space: South West

Meeting Room: South East

Meeting Room: South West

Mini Kitchen

Corridor

Stair Cases

Elevator Core

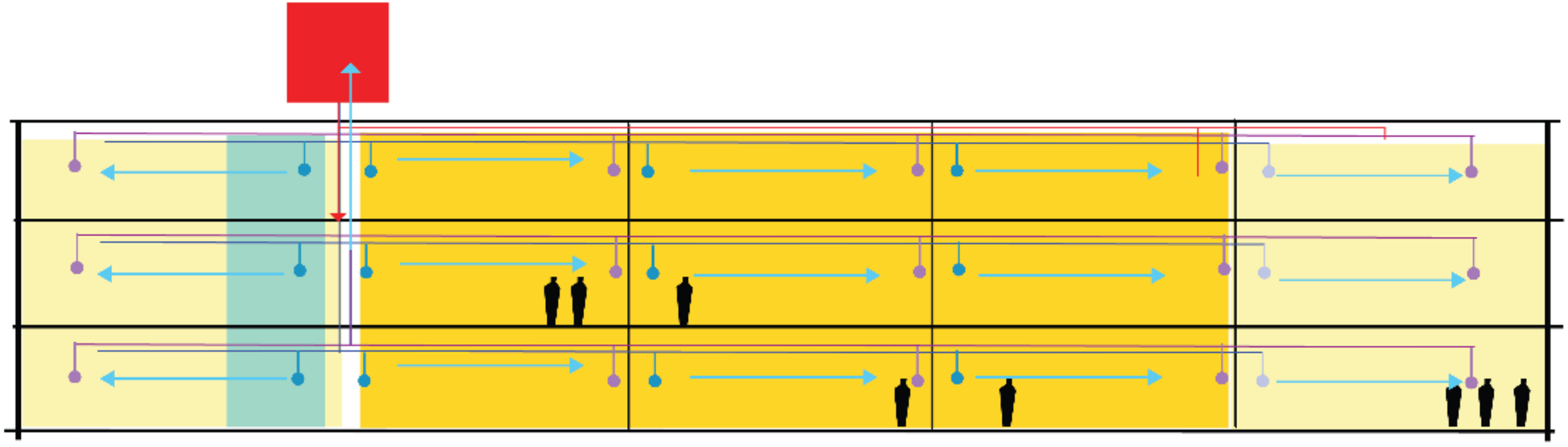
Toilet

DOAS Dedicated Outdoor Air System (Supplies)

DOAS Dedicated Outdoor Air System (Return)

Office building require 0.3 l per 1 sqm area therefore we calculate the air by mutiplying with each thermal zone area. This way, we can have enough supplies air for all space.

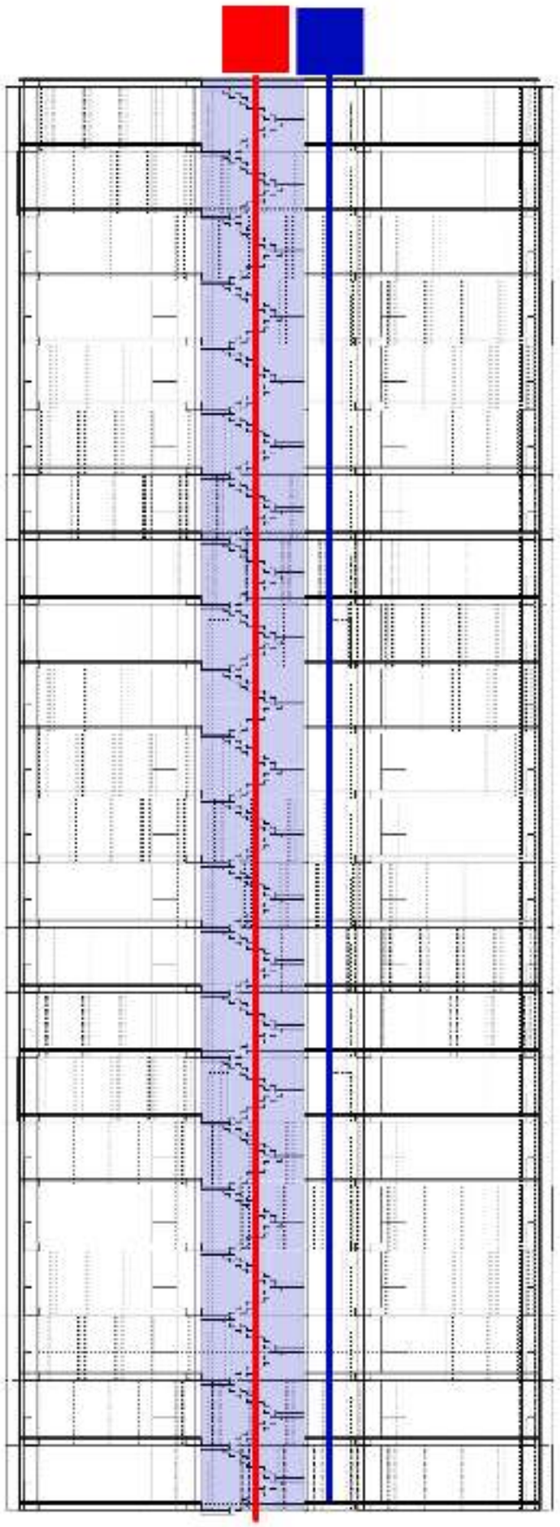
DOAS SYSTEM

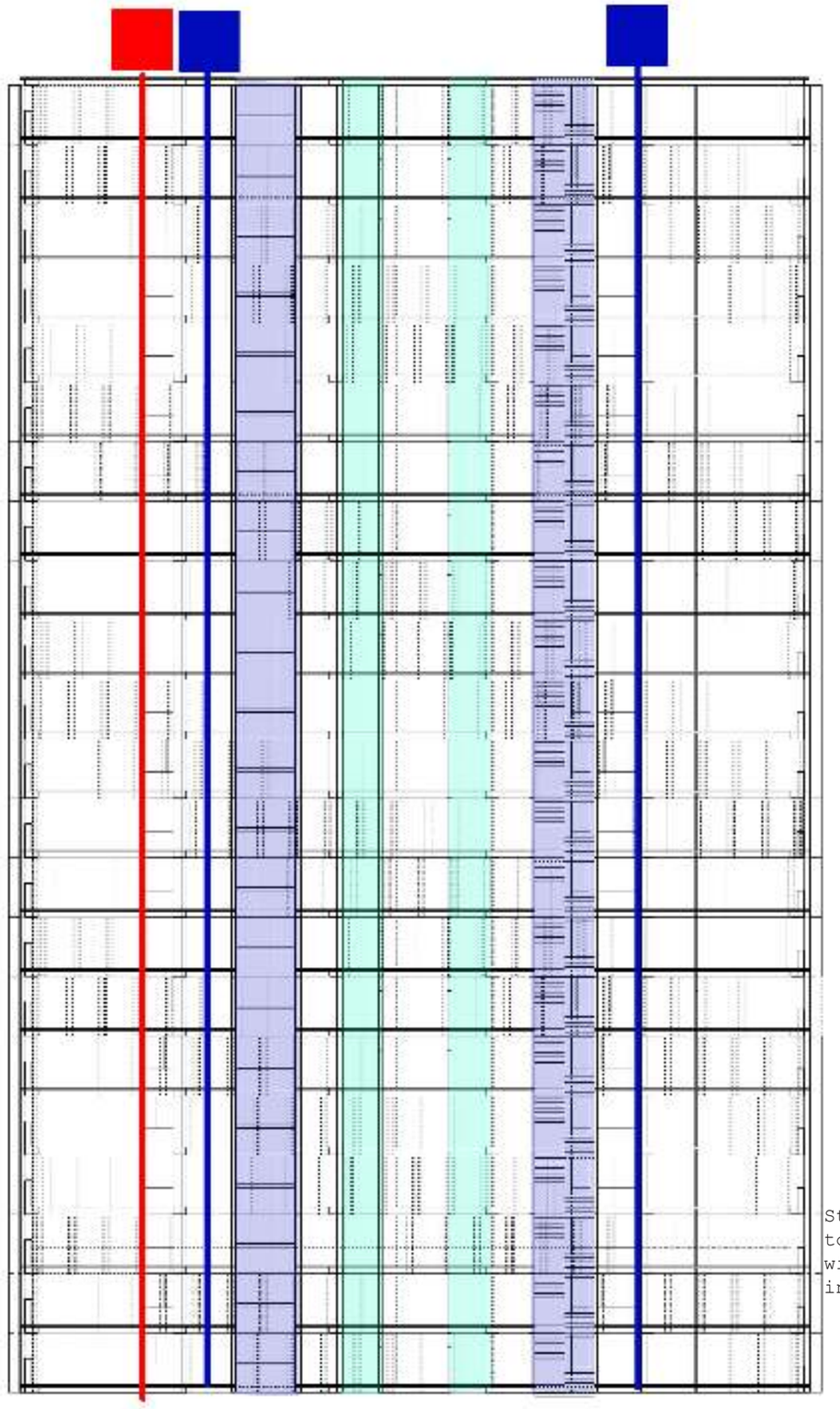


How the DOAS system Works.

Arrows are showing air flow direc-
tion.

0 1 2 4 6 10

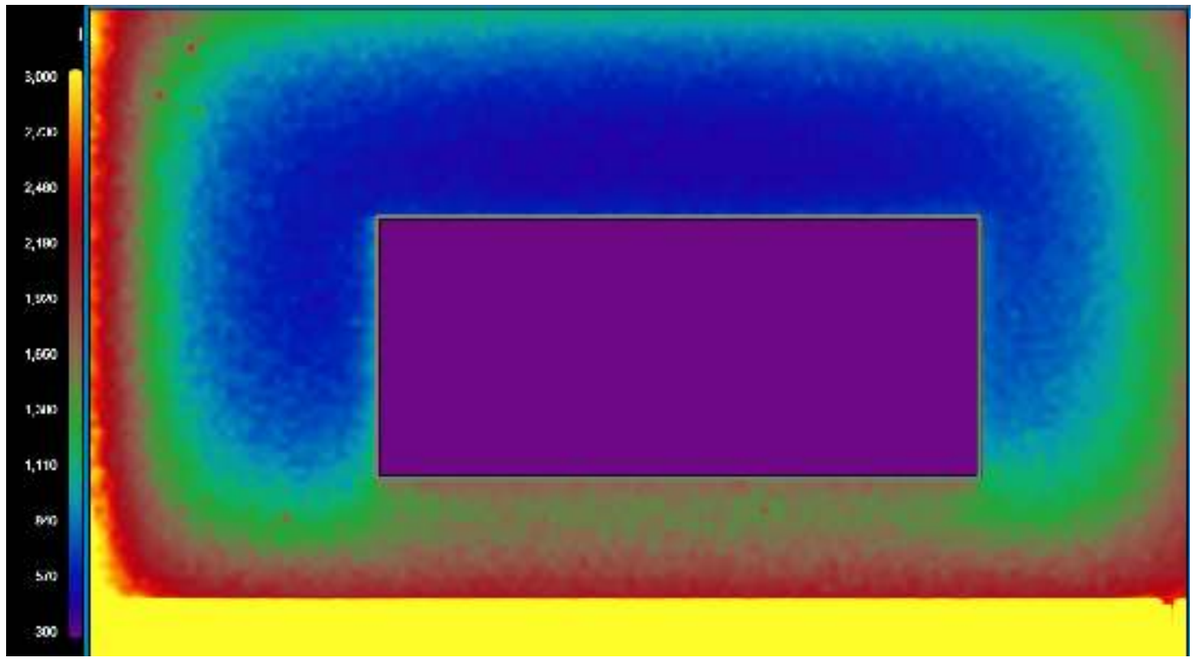


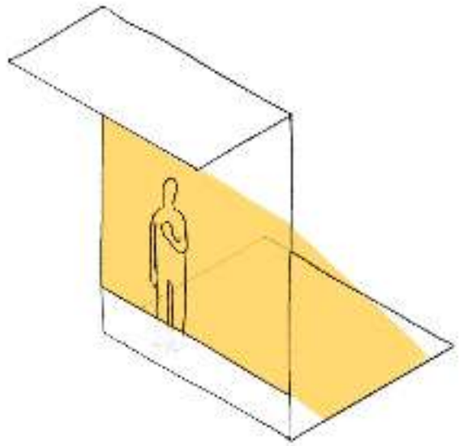


Stations will be put on the top of the building. The air will be push in to the building along its core.

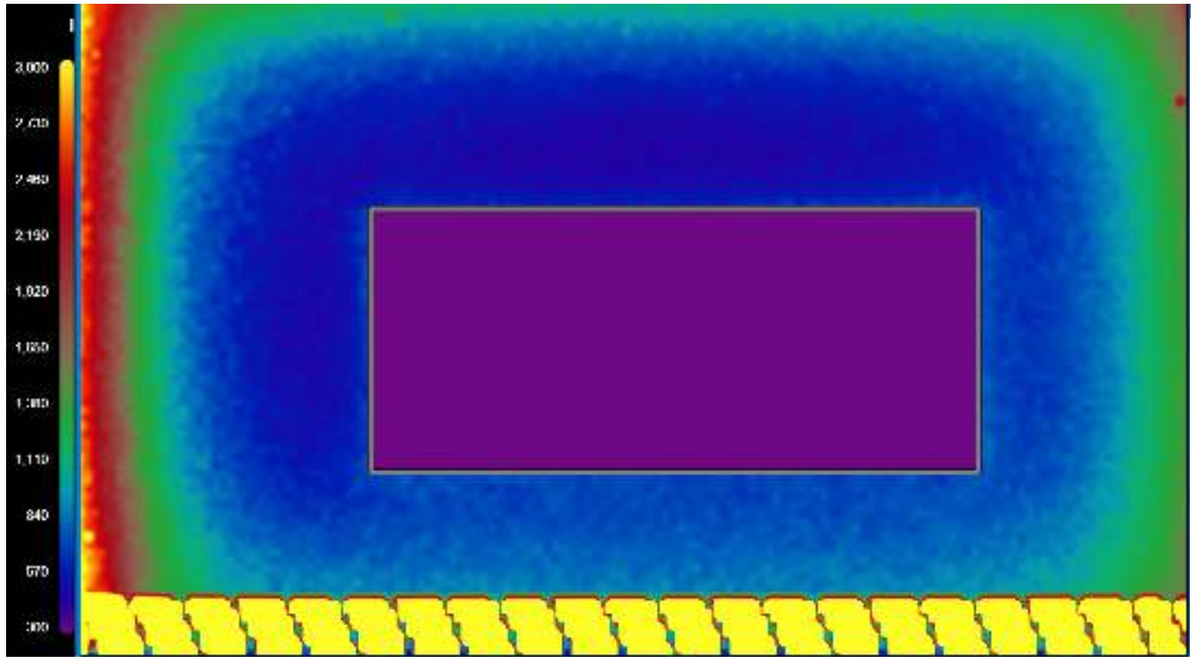
04 Light System

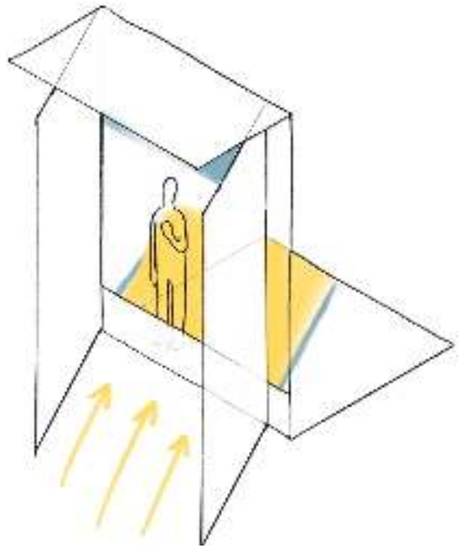
Vertical Fins Method



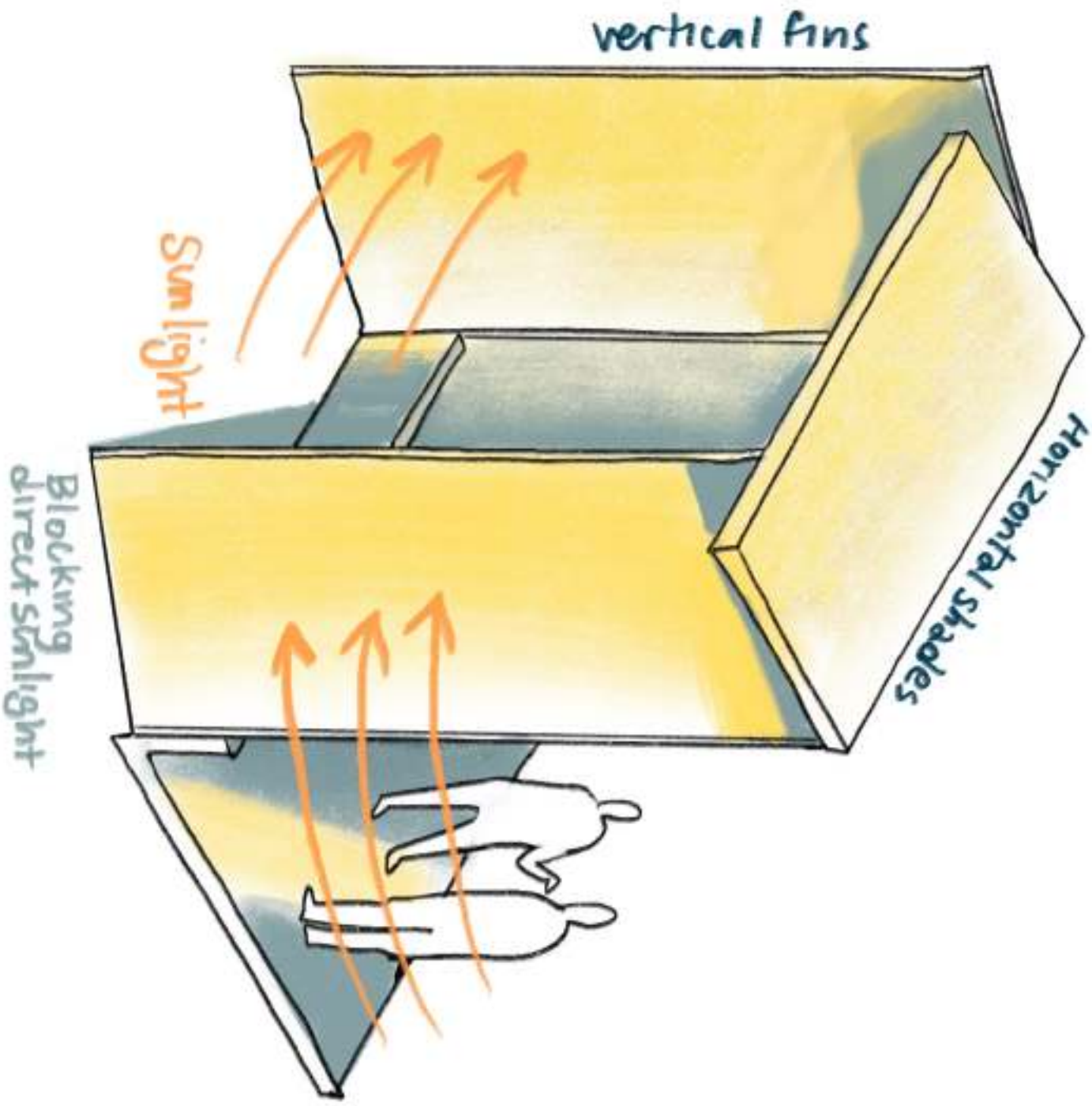


The area which over exposed to the sunlight is on the
direction that facing the sun. Only horizontal overhang cannot reduce enough brightness.



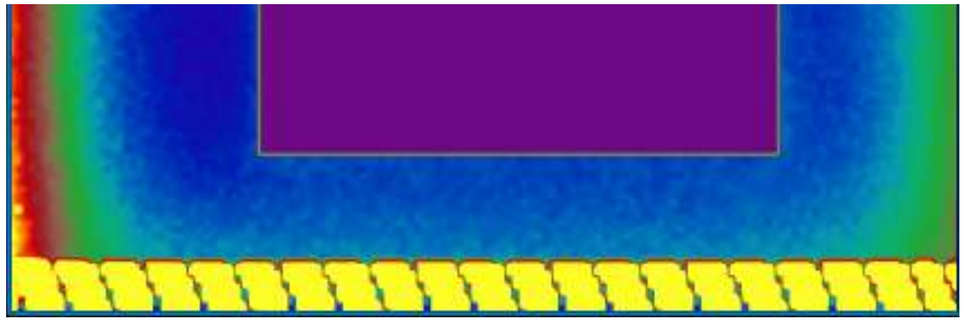


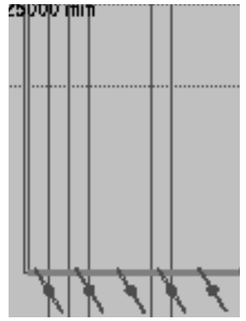
As this building has vertical fins we can see that it helps create shades and reduce the are that sre too bright.

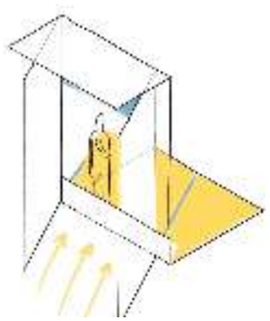

vertical fins
Sunlight
Blocking direct sunlight
Horizontal shades

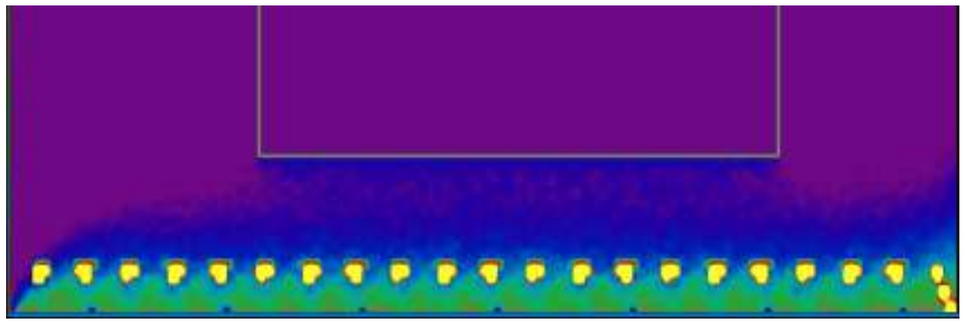
04 LIGHT

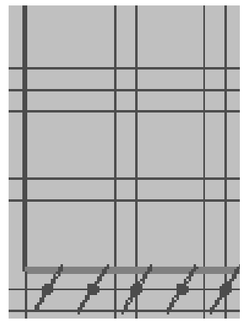
Vertical fin arrangement

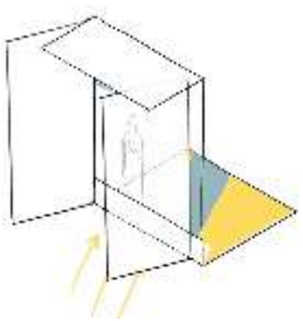


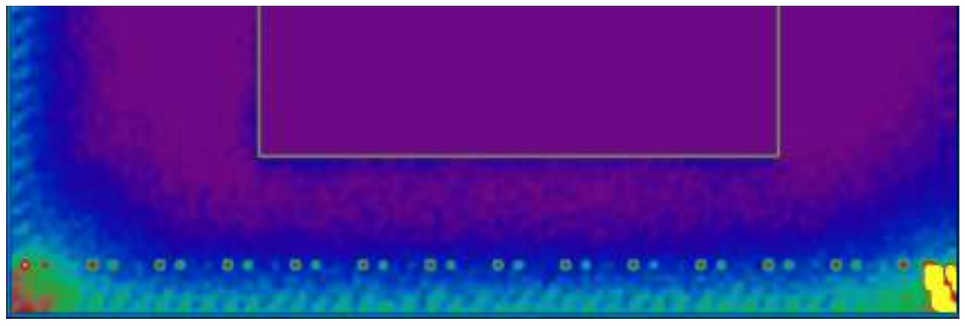


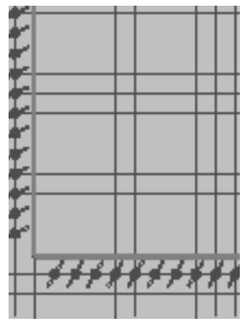


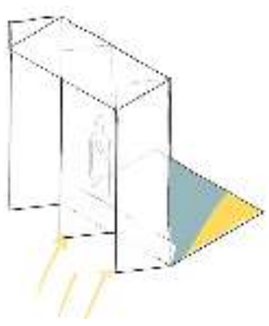




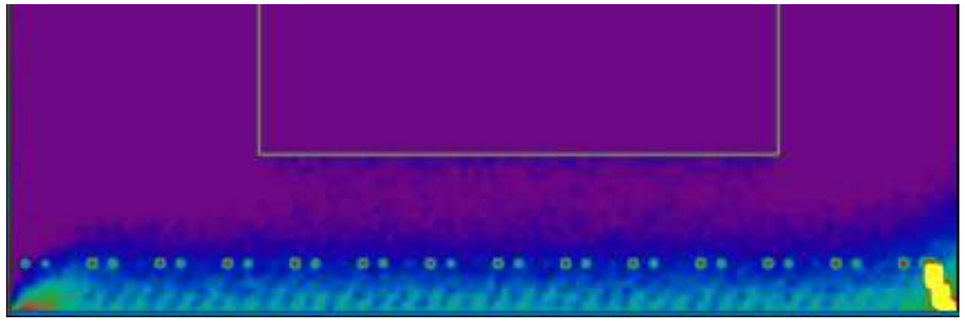


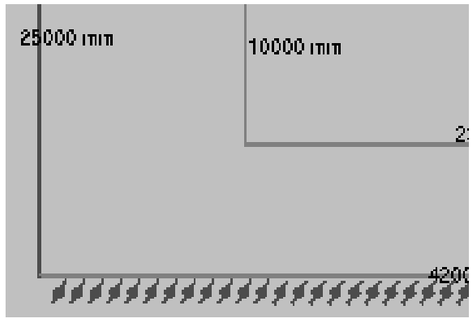


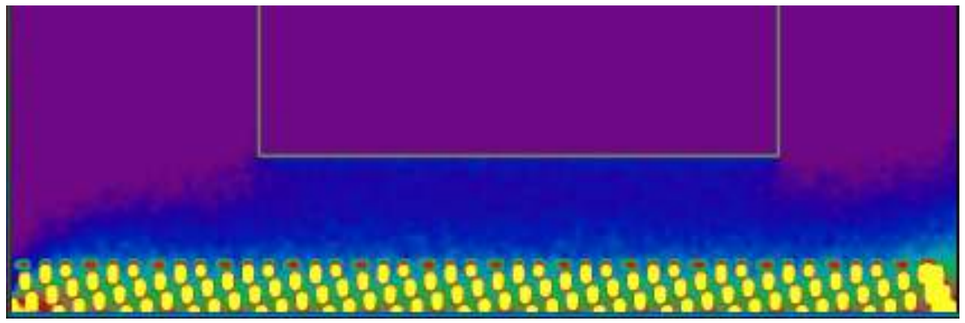


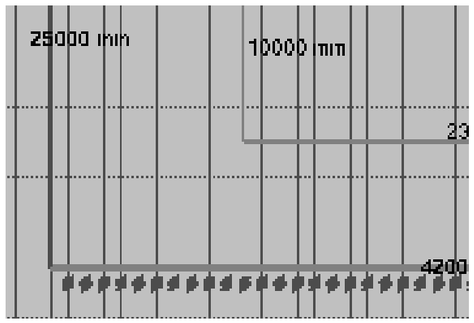


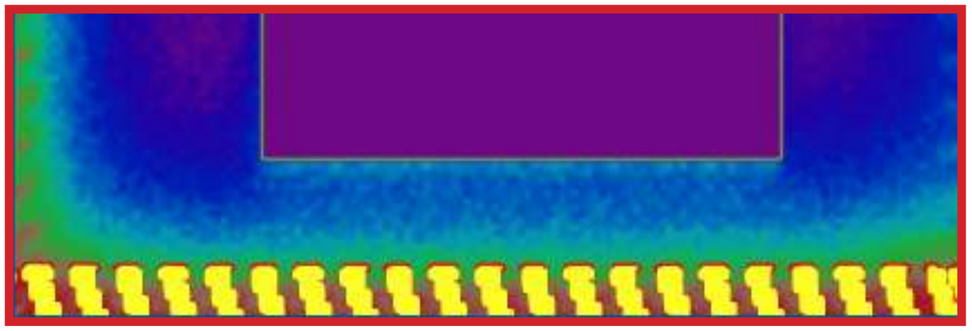
Vertical Fins
Frequences

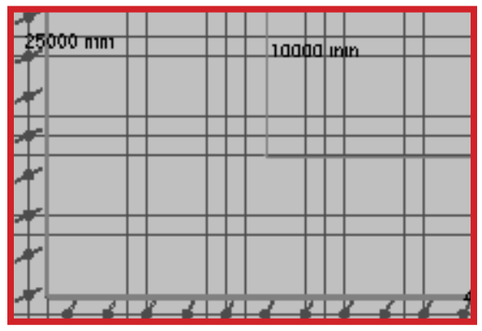




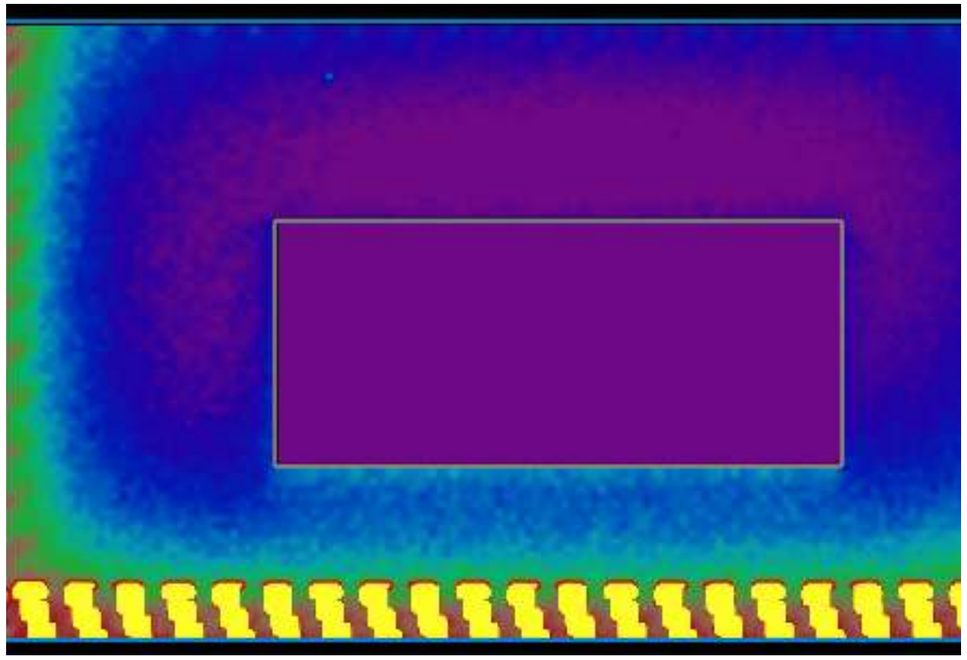


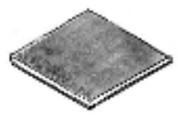






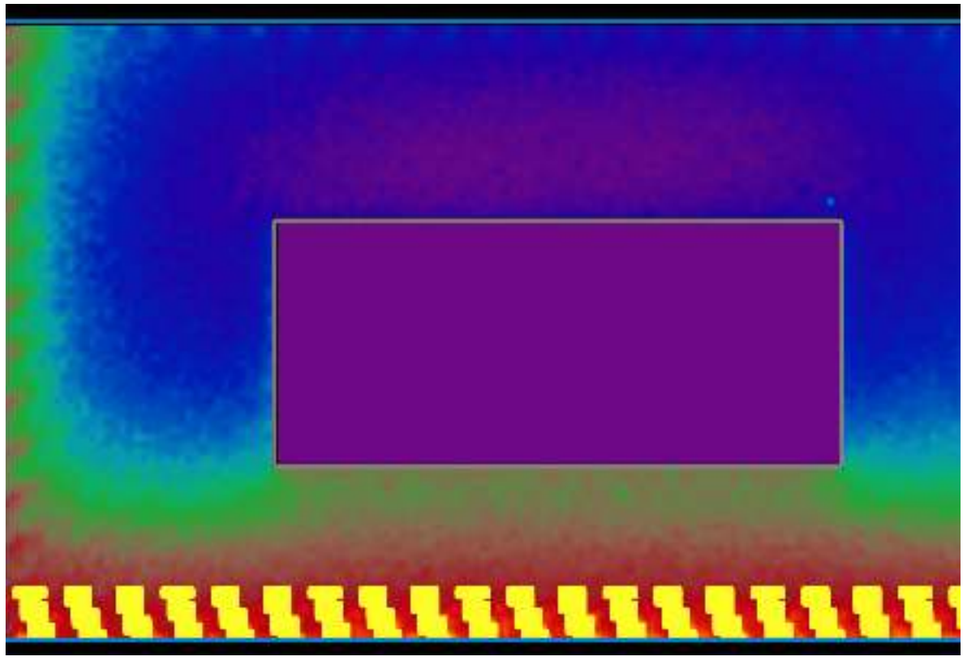
Finishing Materials





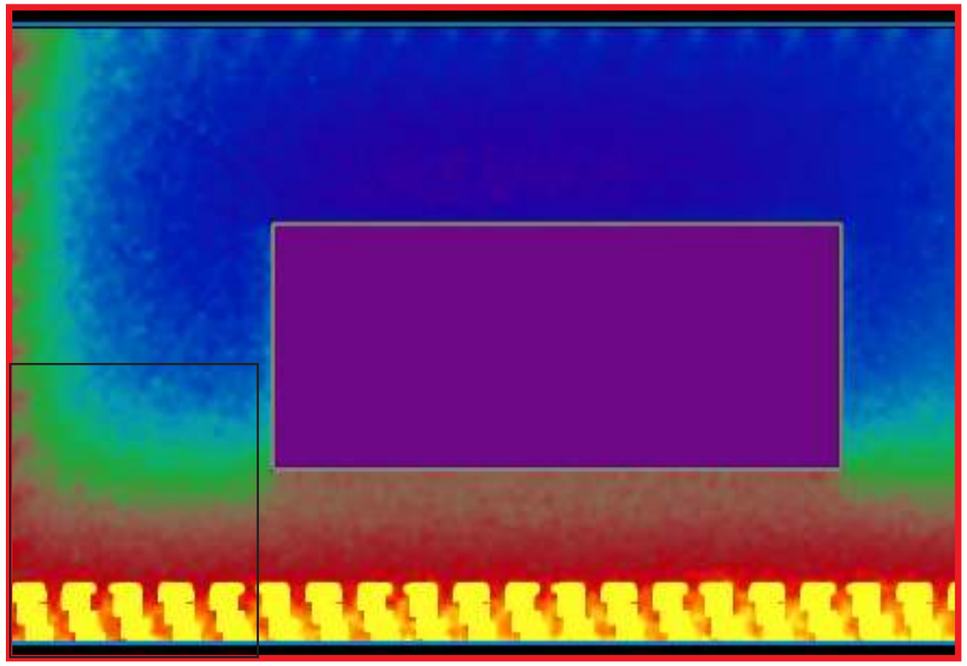
Carpet Finishing
Reflectance: 0.350
Roughness: 0.050

The light distribution is still not even resulting in the big purple area (lower than 300)



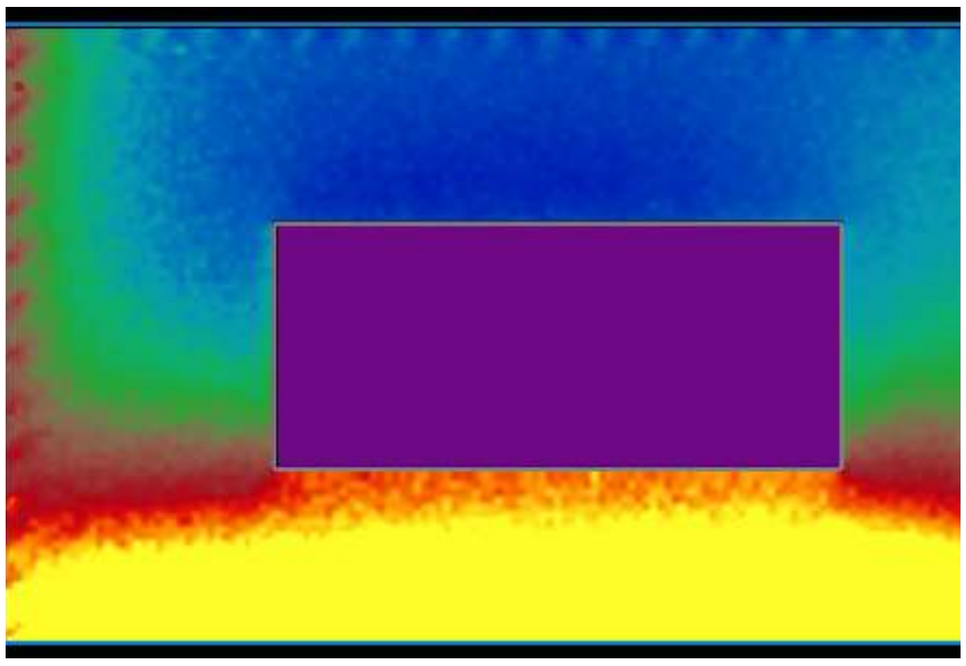
Plastic Finishing
Reflectance: 0.500
Roughness: 0.030

Better light distribution.



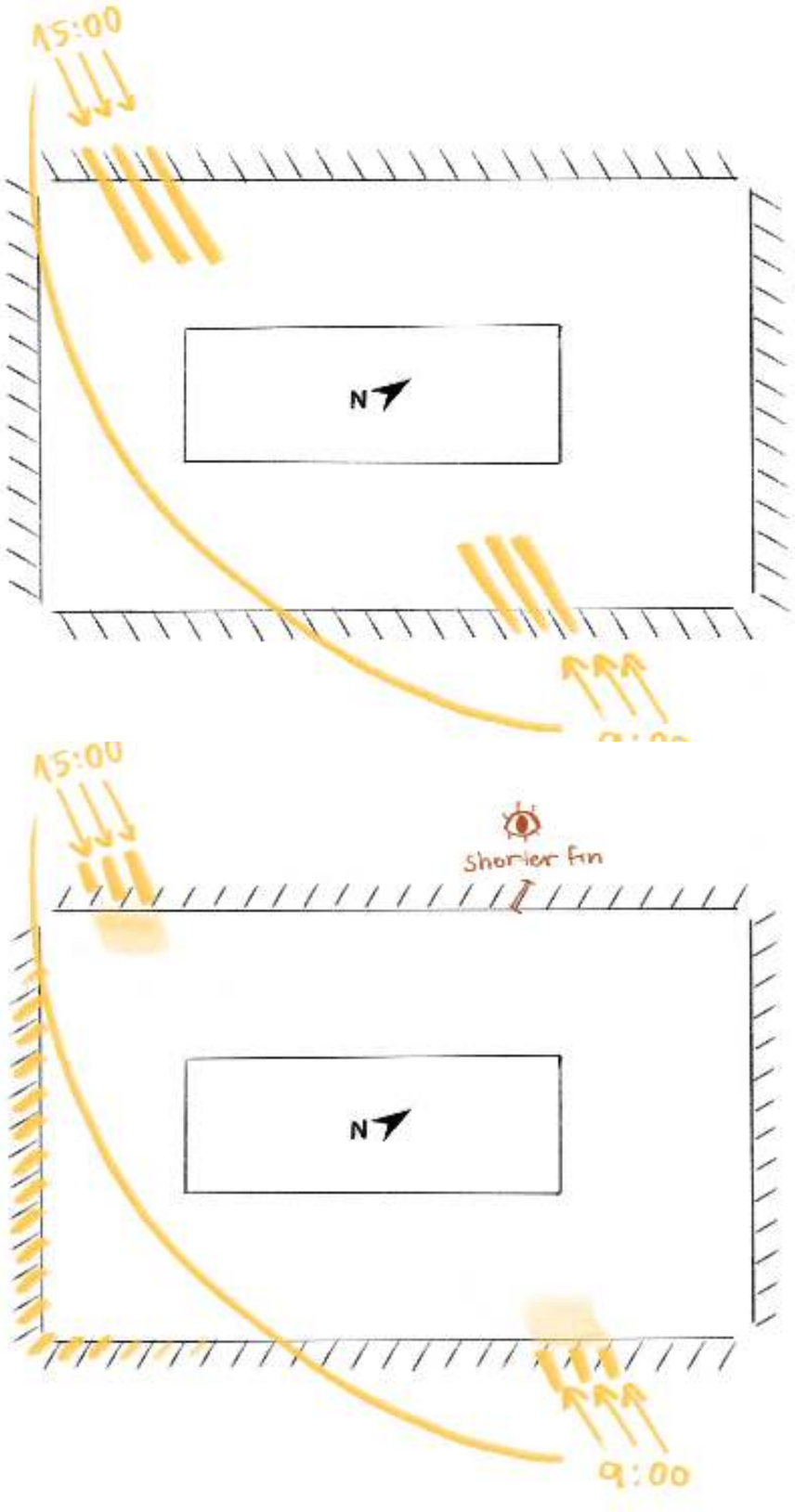
Carpet Finishing
Reflectance: 0.656
Roughness: 0.050

This choice of material has more yellow (Over 3000) area. However, it distributed the light more evenly to the whole floor



Wood Finishing
Reflectance: 0.842
Roughness: 0.030

The finishing overly distribute the brighness and make the area cannot be use confortably in 9:00AM.



Plan

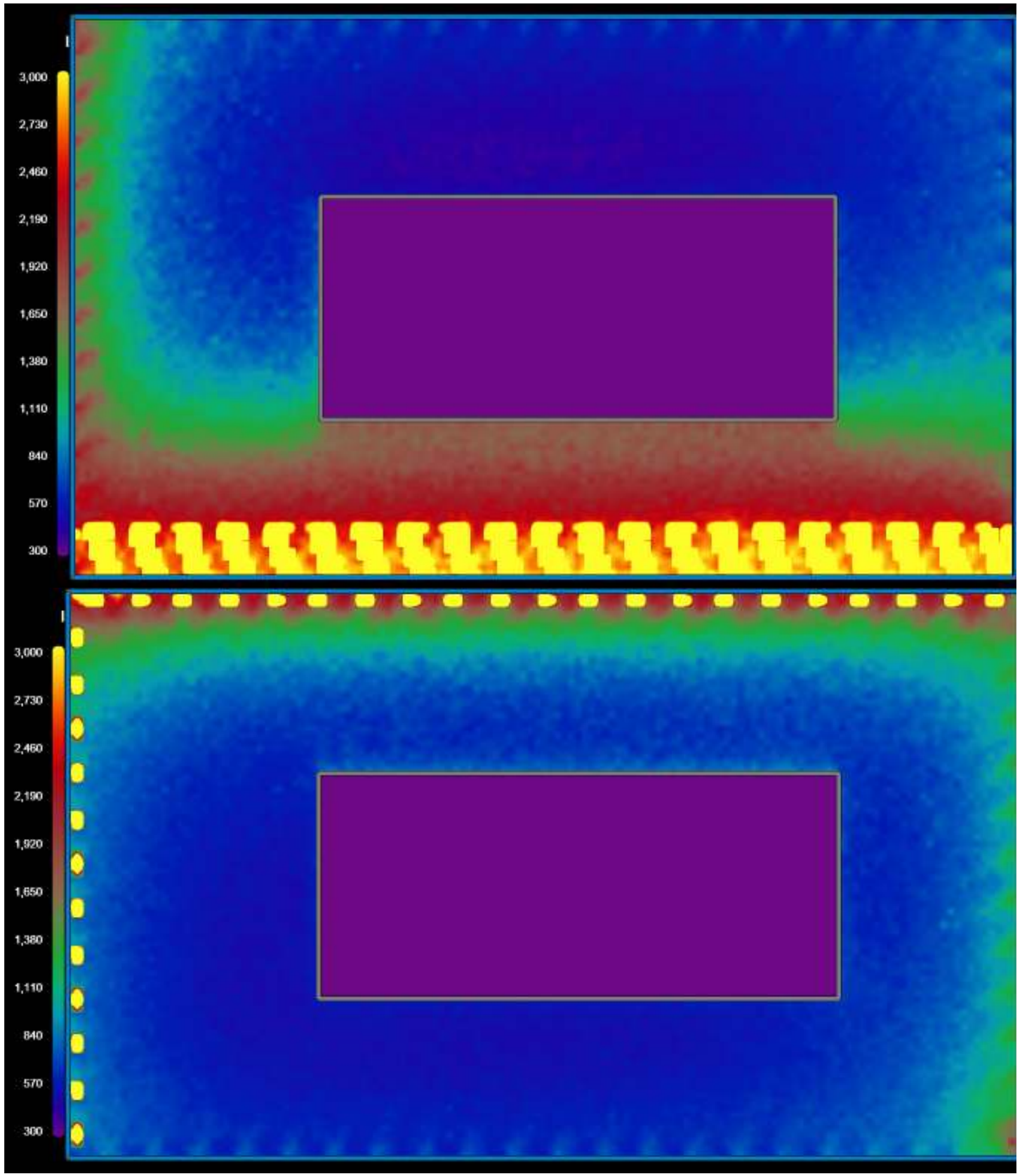
This plan exposed to too much sunlight during the peak (9:00 and 15:00) Which could makes the space uncomfortable to use. At the sametime, the brightness distribution is low which makes some space un reachable of natural light in a certain time.

Total Modification

Fins: Change the angle to make it more effective to Thai sun direction and reduce the lenght for better views from the inside.

Material: Using more reflective floor finishing carpet and high reflective ceiling to distribute the light more evenly

Results



Suitable Brightness: 93.3%

21 March
9:00 AM

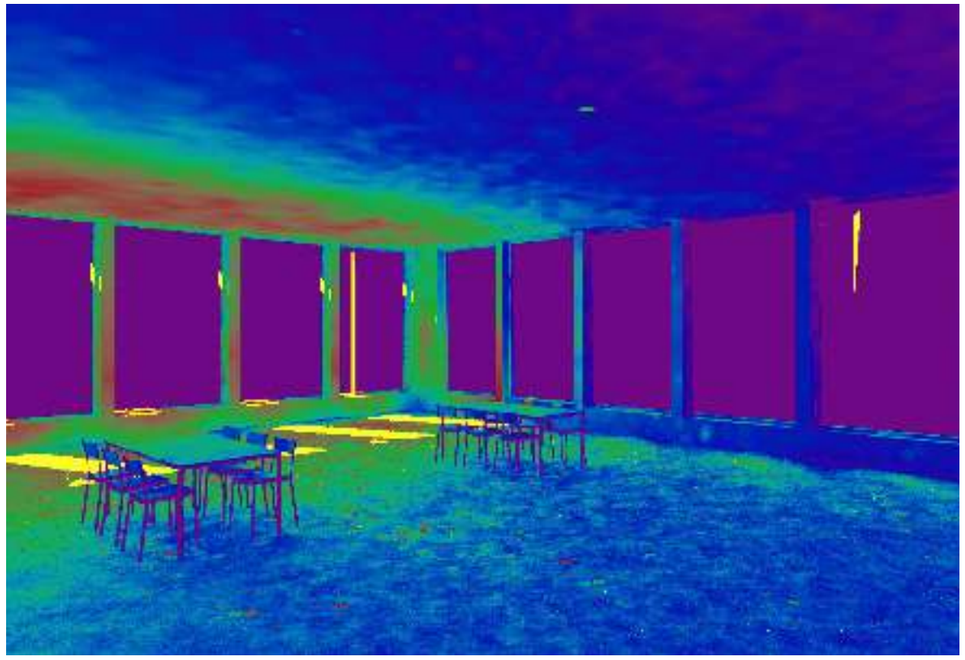
Suitable Brightness: 97.6%

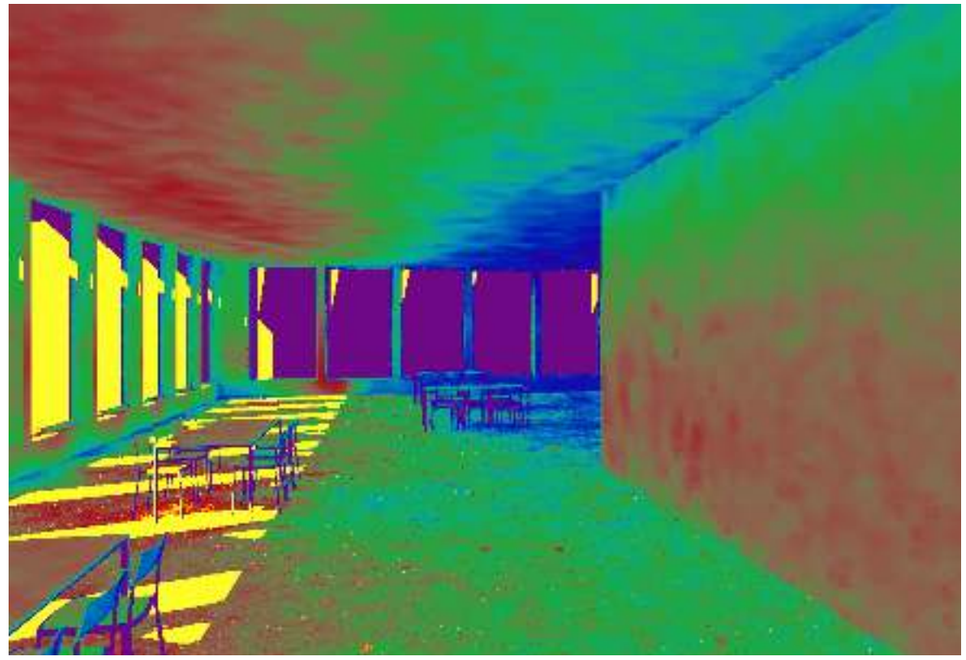
21 March
15:00

Finishing materials

Floor: Carpet
Vertical Fin: 10% Reflectance
Ceiling: 80-90% Reflectance Plastic

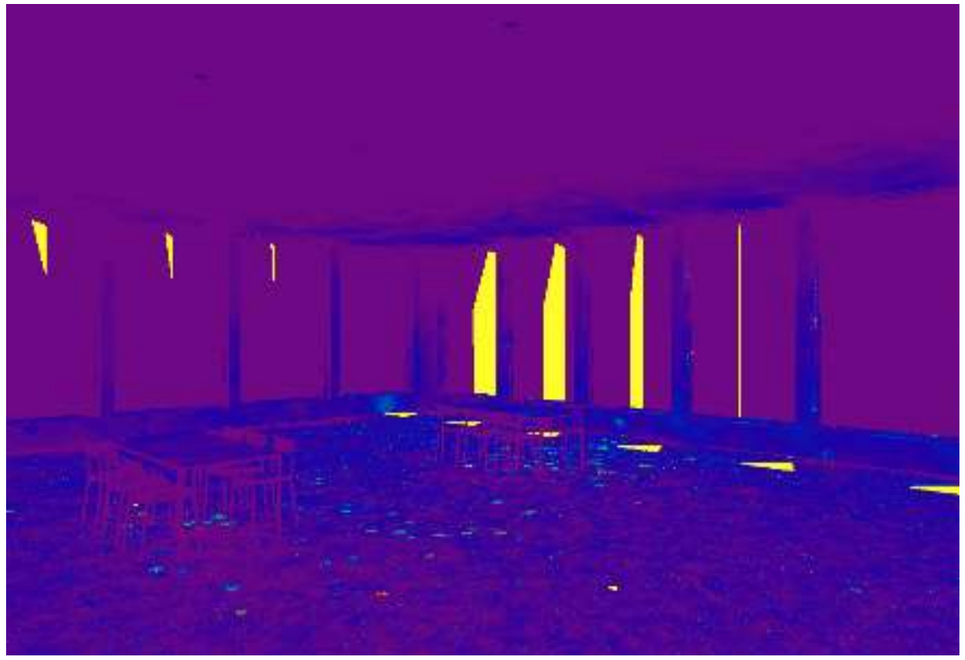
While the other choices of vertical fins and materials may perform better in creating suitable natural lighting condition, reducing the space with too intense brightness, the result is the choice which consider the balance between the lighting condition and other elements of design which are, materials to make sure it is comfortable and suitable for the office, scales that will not dominate all the other desing elements and aspecially user's experience where people inside must still be able to see look out the window.

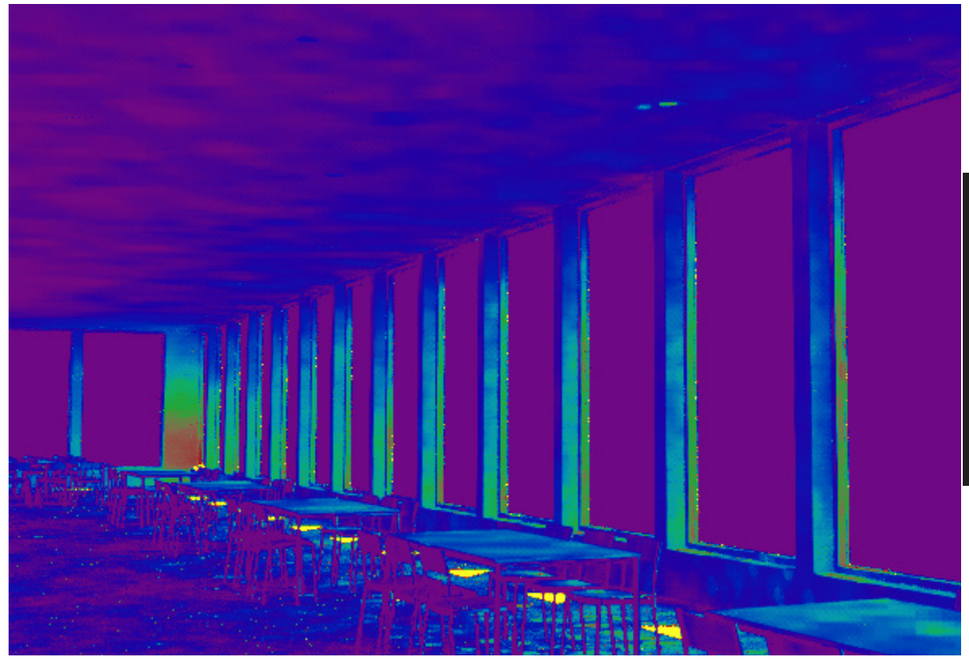




Suitable Brightness: 93.3%

21 March
9:00 AM

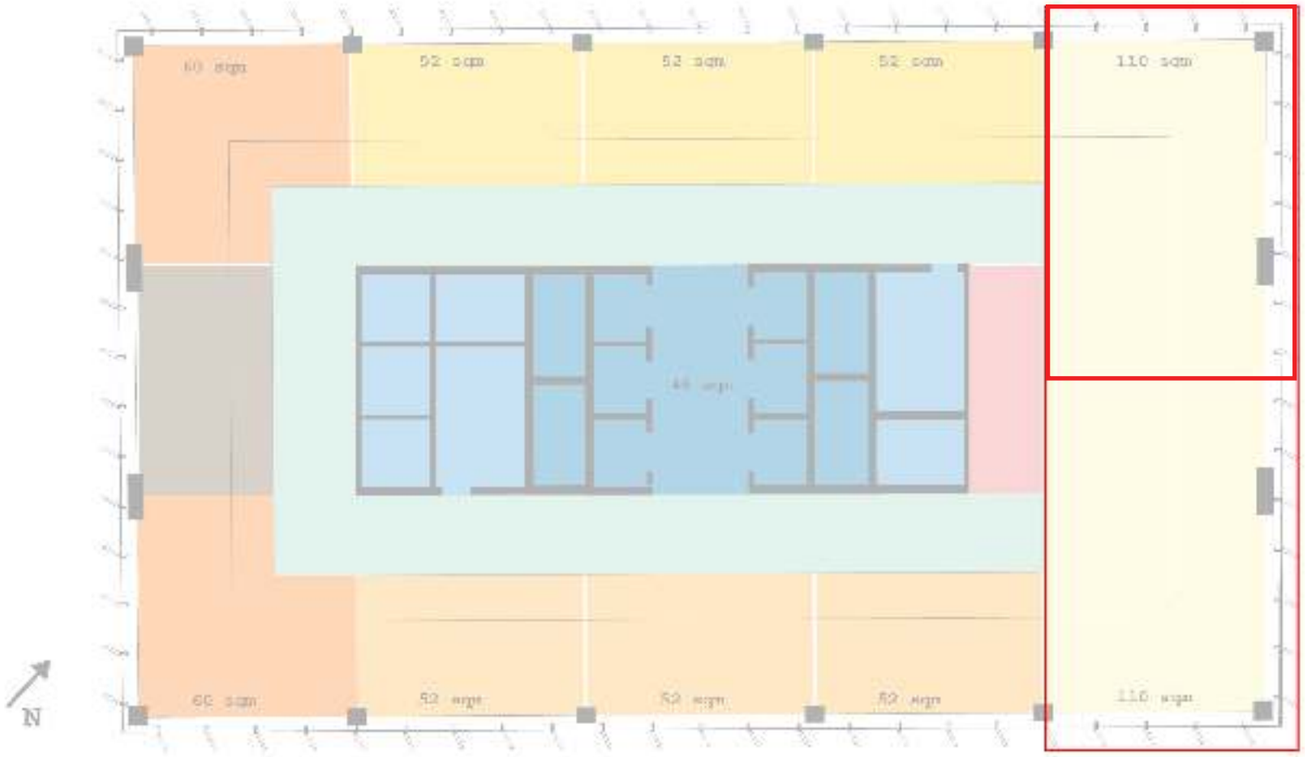


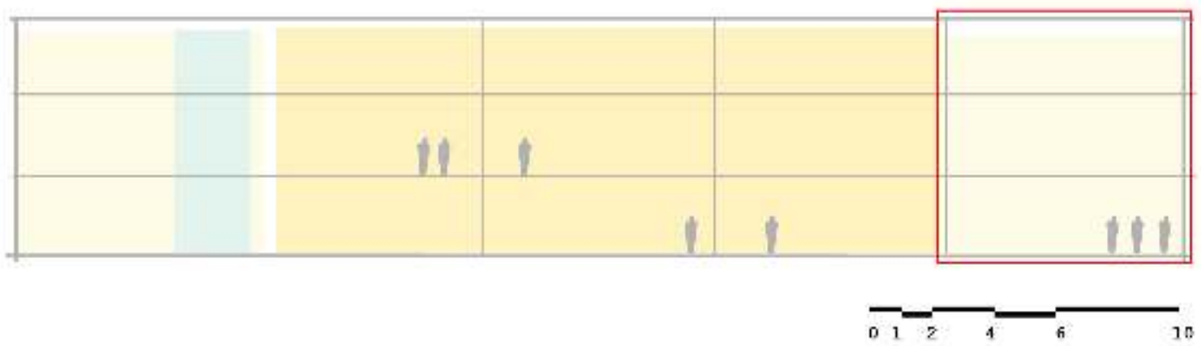


Suitable Brightness: 97.6%

21 March
15:00

Artificial Lighting



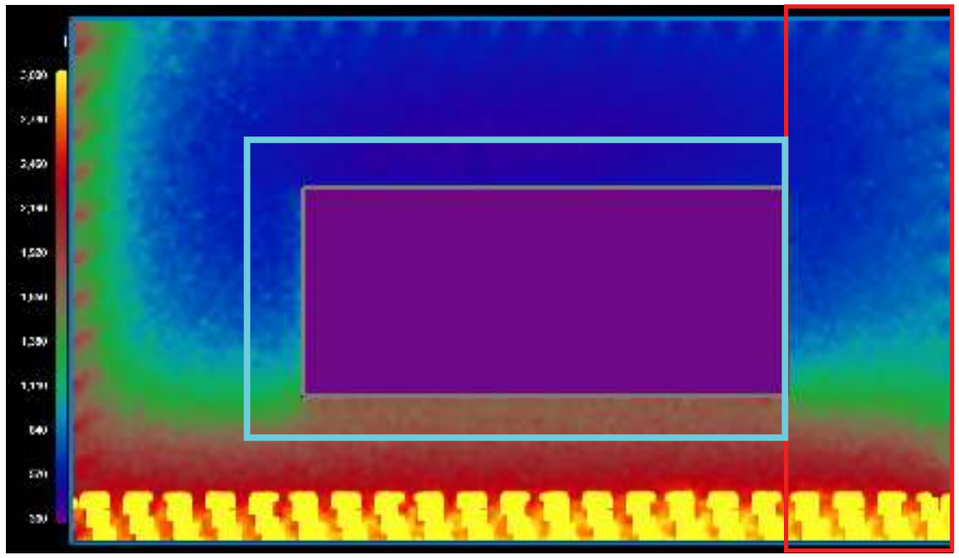


Free Working Space: North East
Free Working Space: South West
Meeting Room: South East
Meeting Room: South West
Mini Kitchen
Corridor
Stair Cases
Elevator Core
Toilet

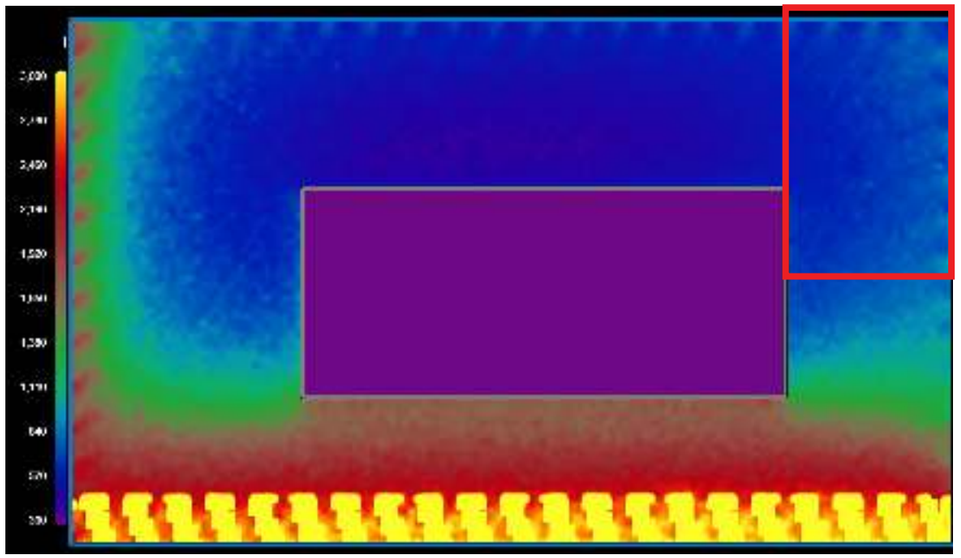
Selected Area

The area selectec is the free working space area with least daylight received through the whole day (North). This space also got two programs, free working spaces and relaxing space.

The area is devided into two half since it is simetrical.

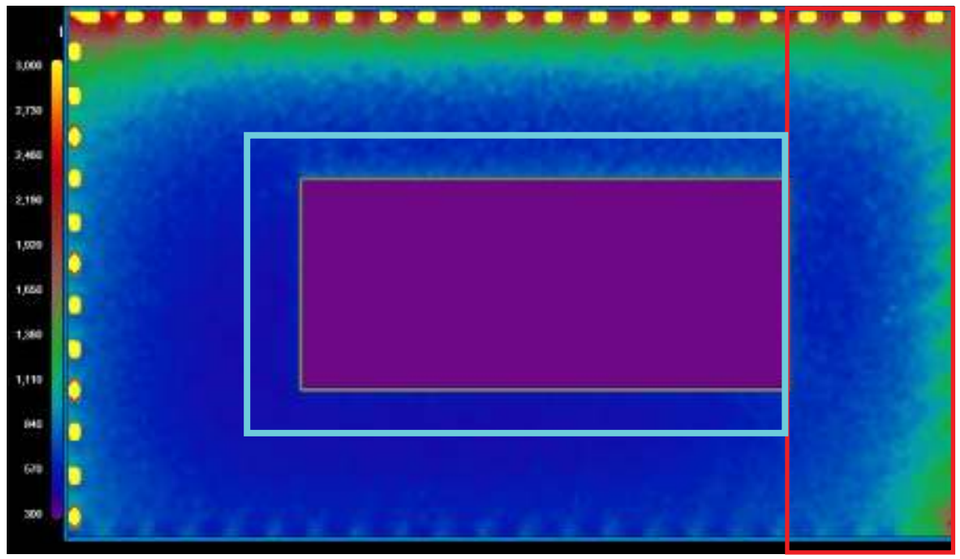


The North area is receiving least natural brightness compared to the whole working area (not including the corridor area in the blue rectangle)

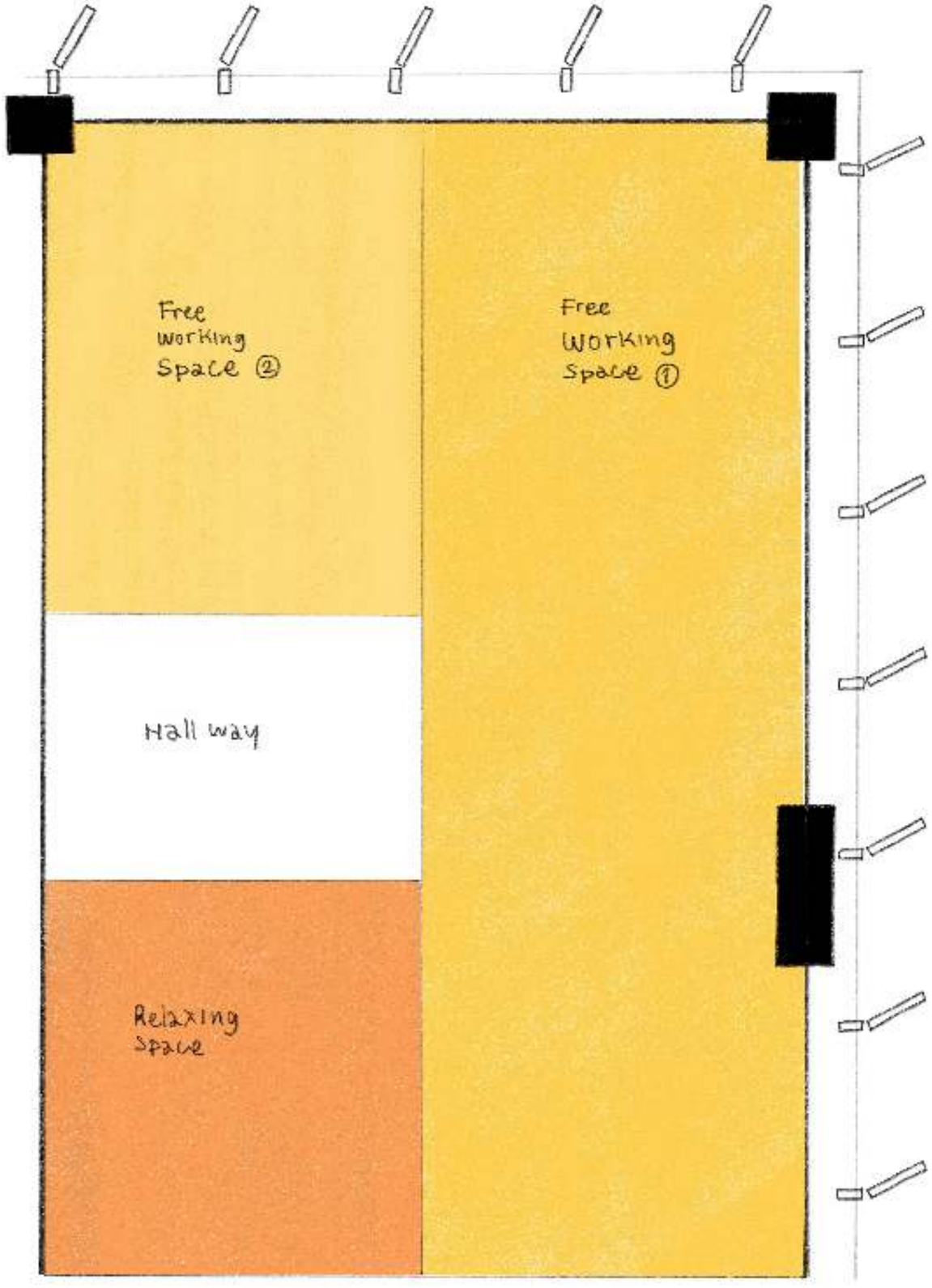


Since the plan are symetrical, the zone can be focused on one side first.

21 March
9:00 AM



21 March
15:00

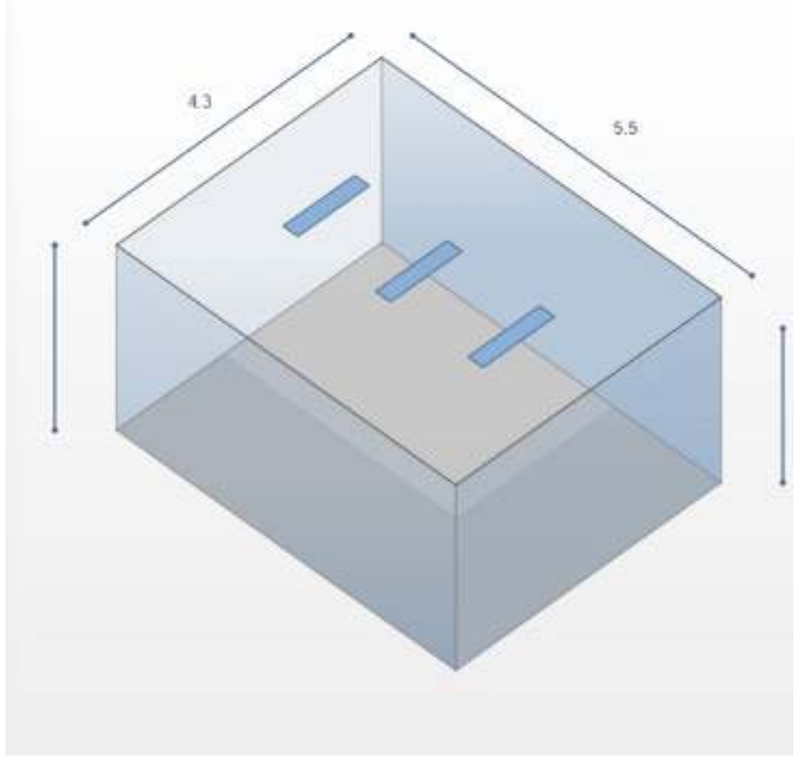


Ambient Lighting

Started by designing the ambient lighting to make sure the lighting is enough for the task needed in this area.

This area is the area that received least natural light, therefore the artificial light will be used almost through out the day. It will be distributed in to three main zones, 2 Free Working Spaces and relaxing space.

Other task lighting and decoration lighting will be add after.



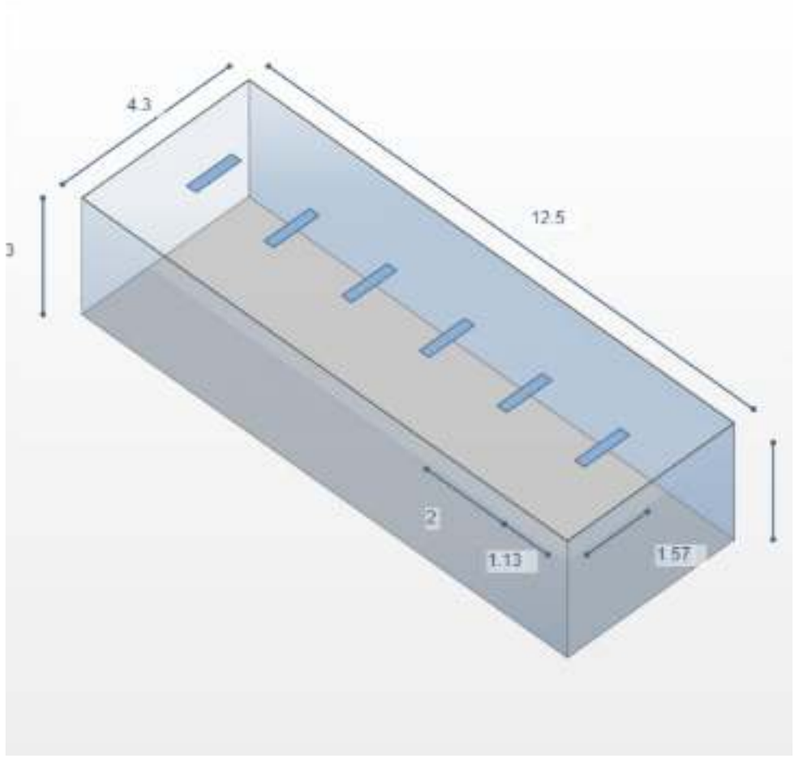
Free Working Area 2

This area will be used for working therefore we choose rectangular LED lighting that distribute more evenly to provides even and sufficient light for working

Illuminance: 348 lux

Power Density: 2.99 W/m2

Quantity: 3



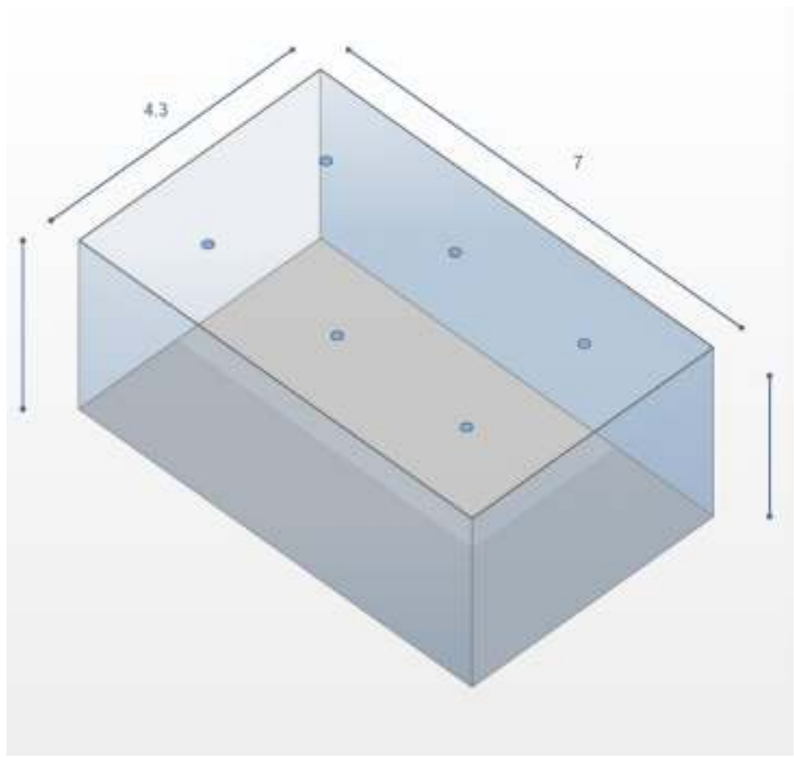
Free Working Area 1

Same with the Free Working Area 2, but it covered the larger area. This is also a free working space.

Illuminance: 330 lux

Power Density: 2.63 W/m2

Quantity: 6



Relaxing Area

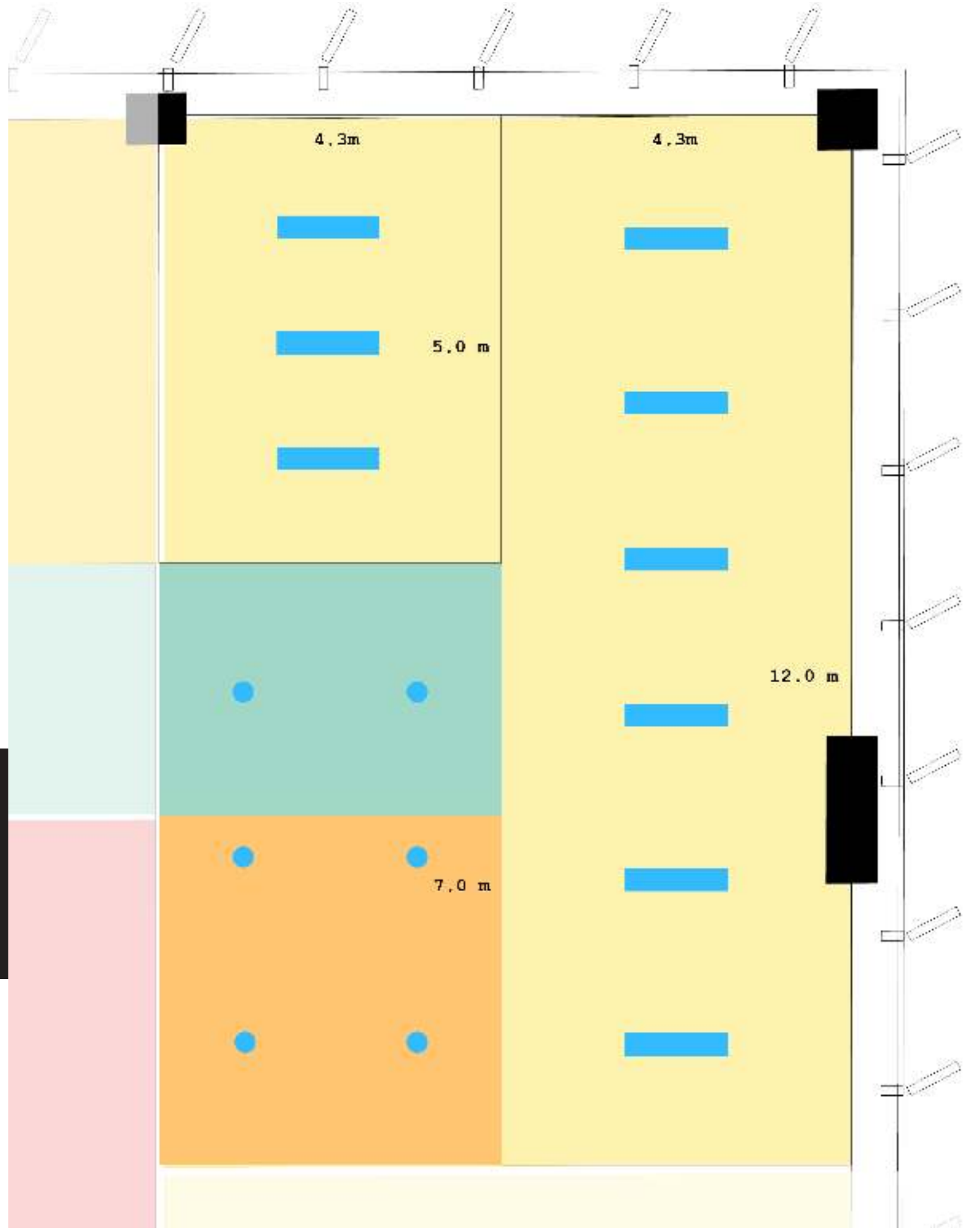
The area closest to the shared minikitchen is dedicated to the relaxing activities where the office provides bean bags and snacks. This area will use downlight.

Illuminance: 305 lux

Power Density: 3.63 W/m2

Quantity: 6

Working area and relaxing area required differnt brightness. However, the ambient lighting are designed to have around 300 lux similarly in responded to the natural light analysis. The office space were placed closer to the window that received more light while the relazing space is not exposed to the sunlight as much.



Free Working Space

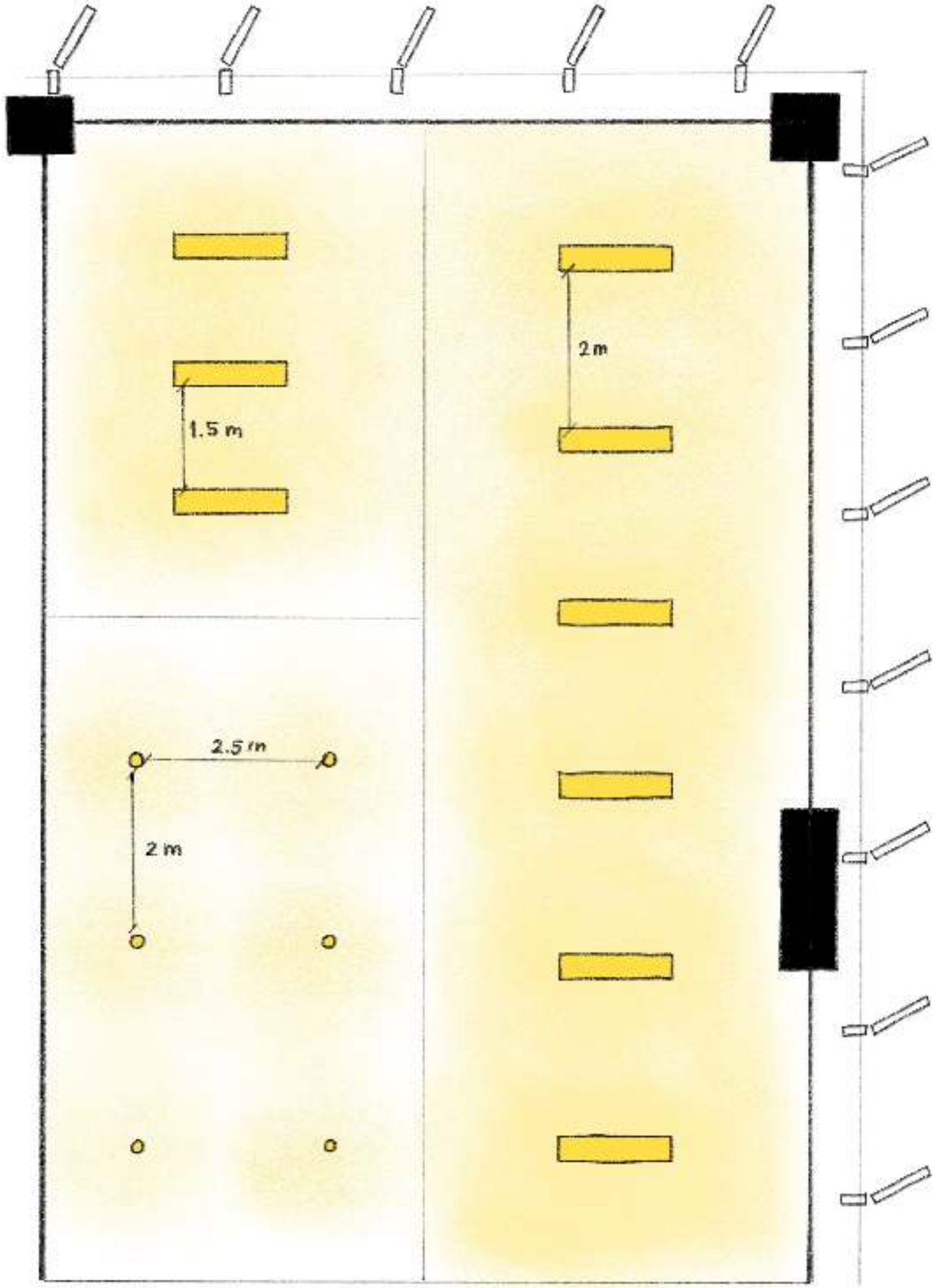
Resting Area

Mini Kitchen

Corridor

Luminaire LED
VRP 1X4 3000LM 50K 80 CRI 120V PTC250

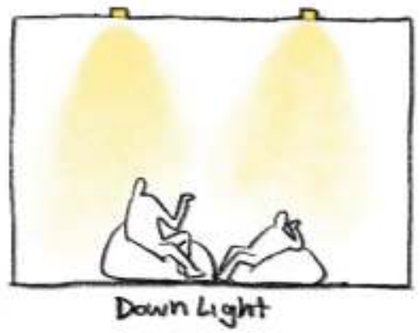
Luminaire LED
VRD16 1700LM WDIM HALR WD 90CRI CAL 30K



This type of LED given the equally distributed ambient light which is suitable for the office work activities.

Luminare LED VRP 1x4

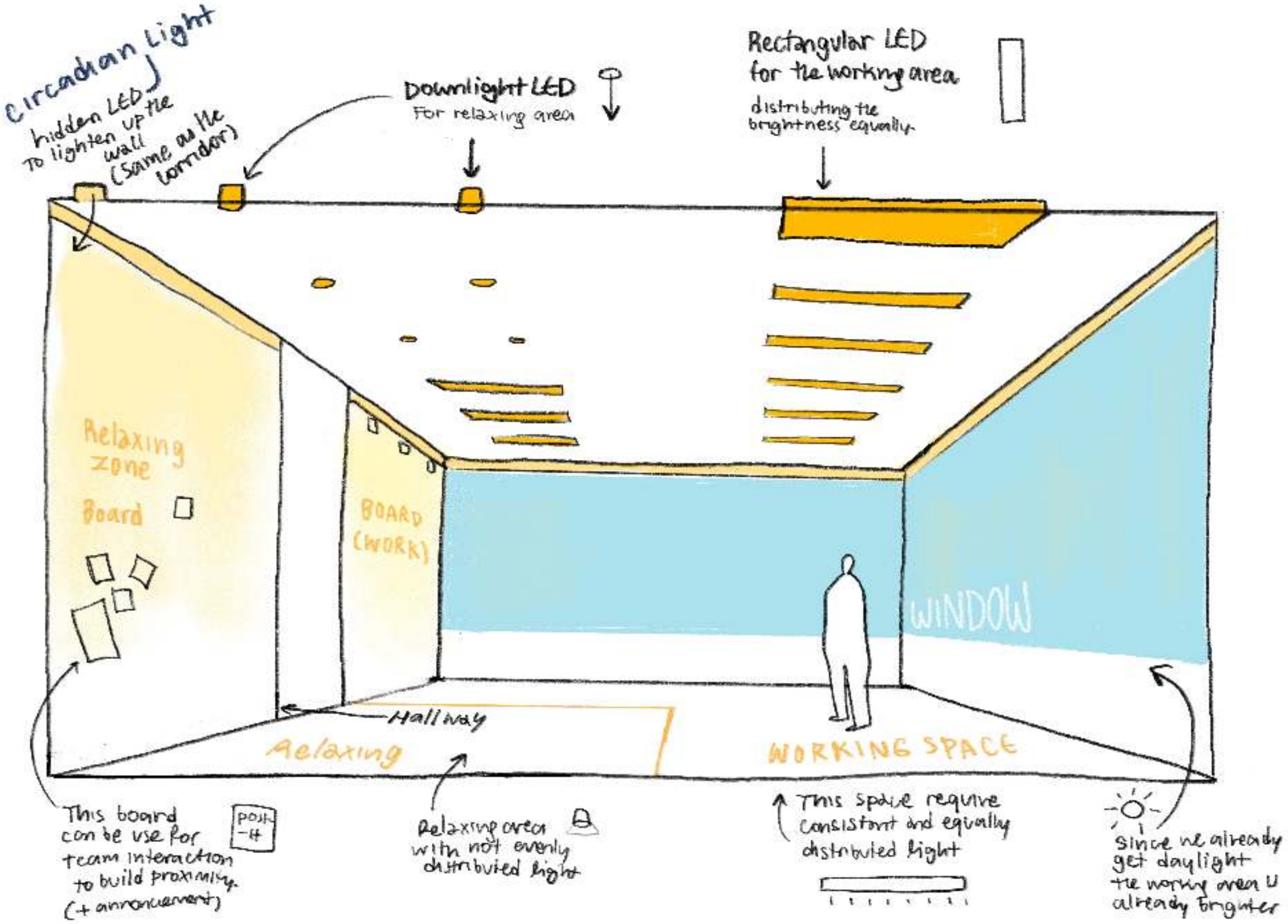
This will be installed in the ceiling finishing,the LED will be flat on the ceiling surface.

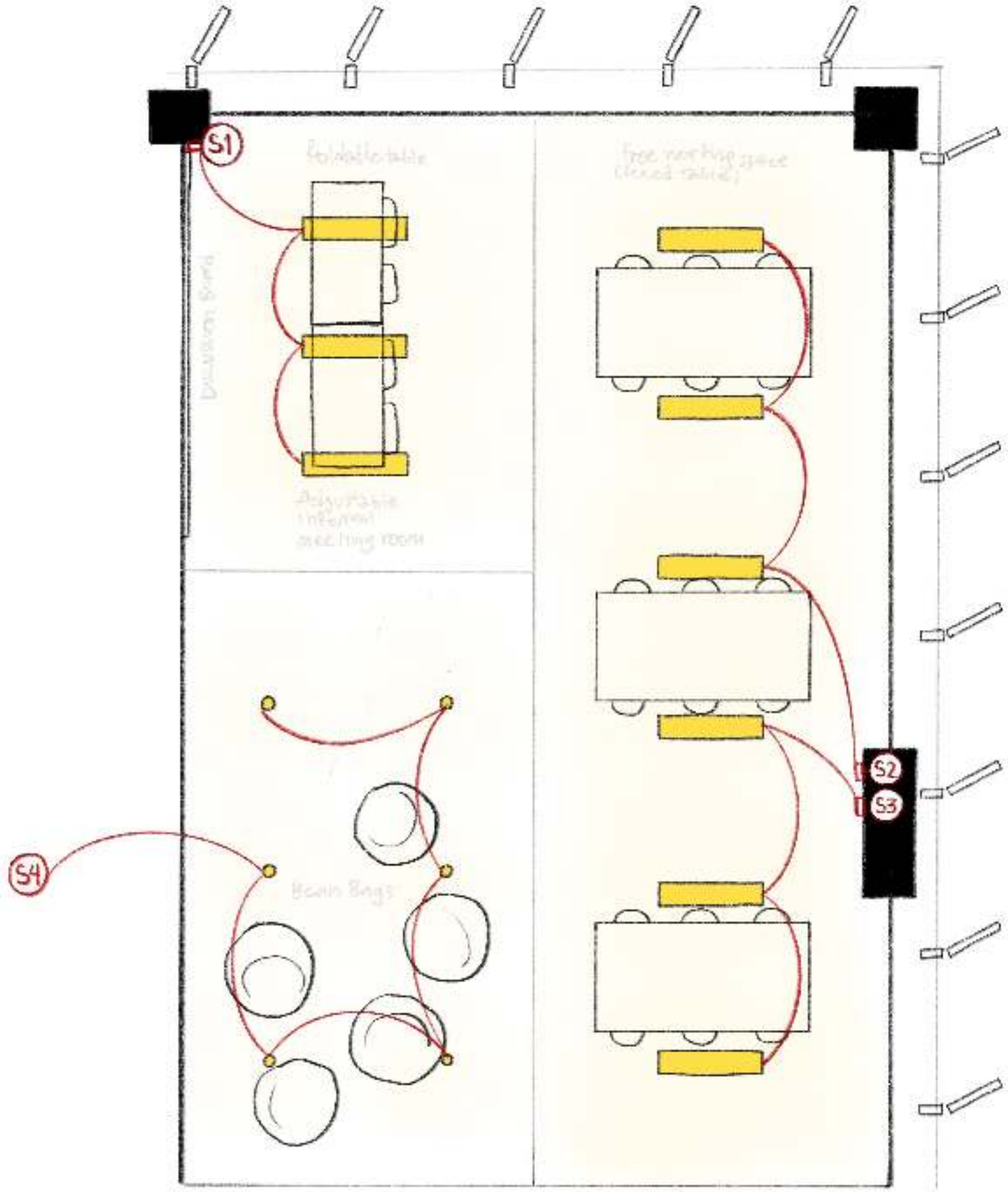


This type of downlight given enough light for the relaxing space to make it not too dim and sleepy while keep it more casual. Not distributing light evenly to give more dynamics.

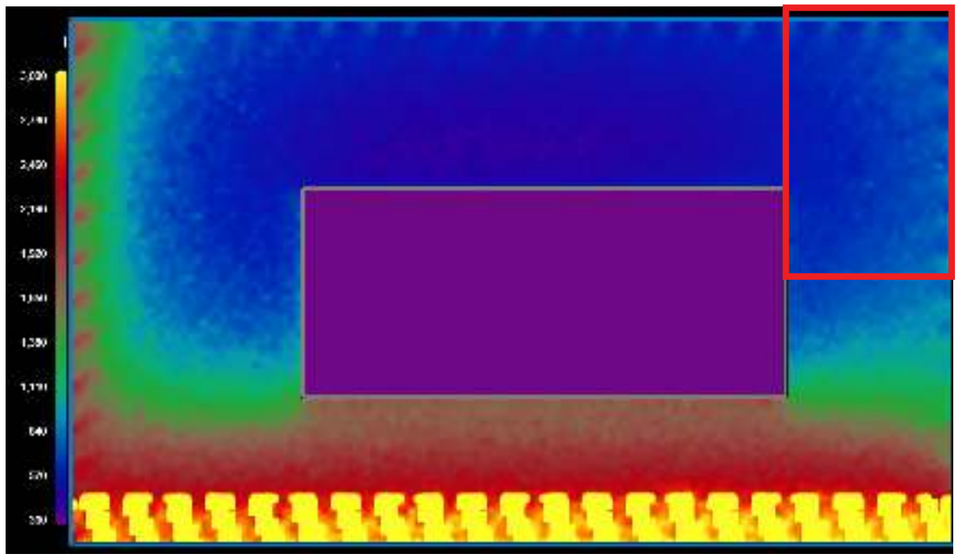
Luminare LED VRDL6 1000

Down light will also be installed in thceiling finishing.

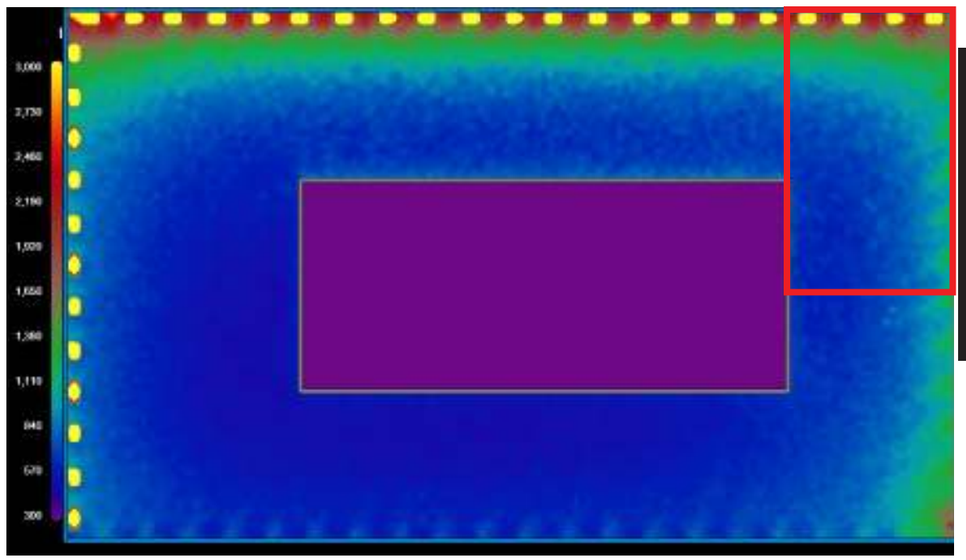

Circadian Light
hidden LED
To lighten up the wall
(Same as the corridor)
Downlight LED
For relaxing area
Rectangular LED
for the working area
distributing the brightness equally
Relaxing zone
Board
BOARD (WORK)
WINDOW
Hallway
Relaxing
WORKING SPACE
This board can be use for team interaction to build proximity. (+ announcement)
post-it
Relaxing area with not evenly distributed light
This space require consistant and equally distributed light
Since we already get daylight the working area is already brighter

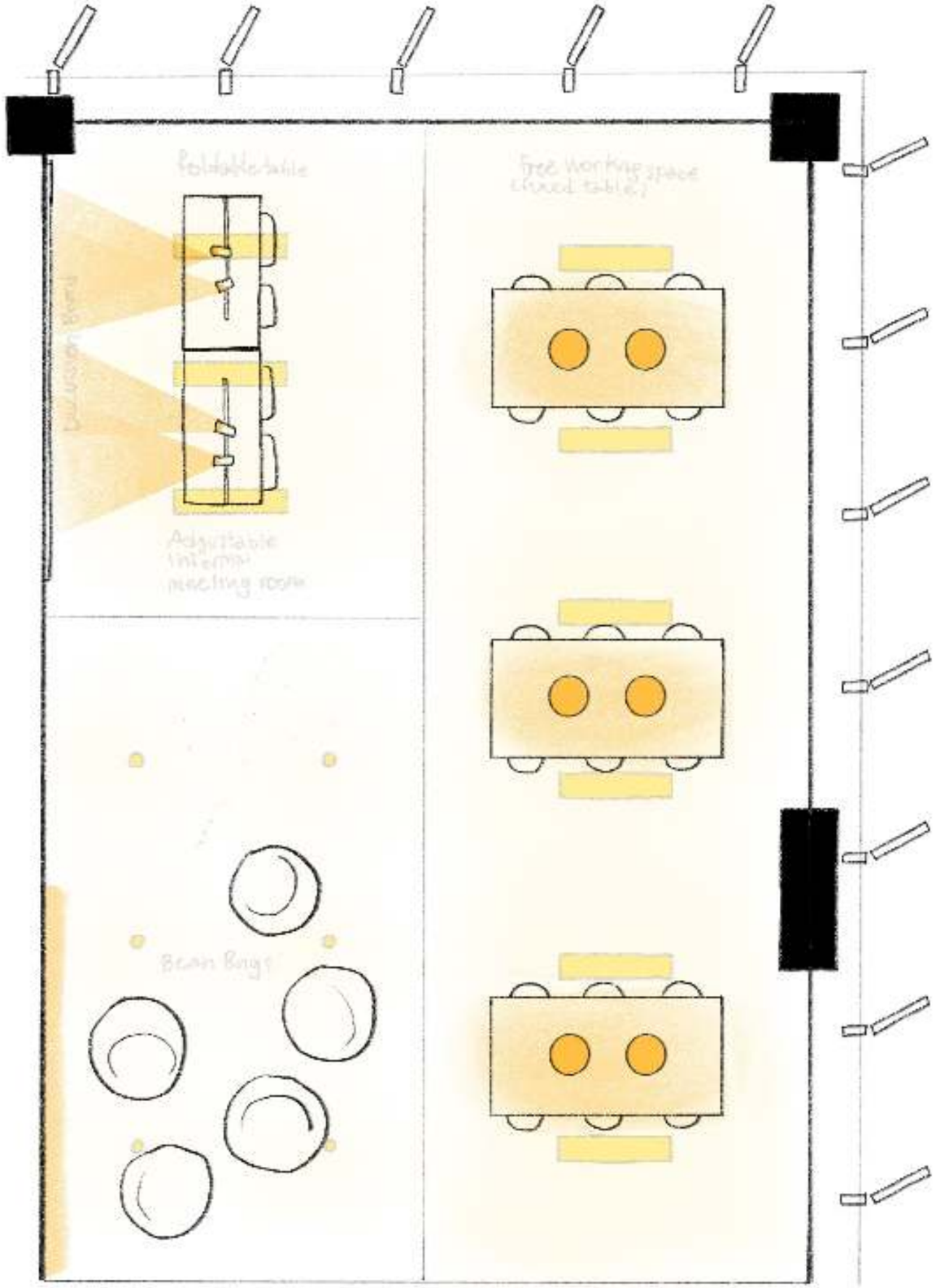


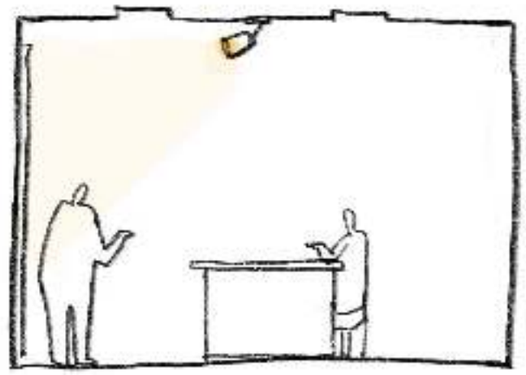
Switches



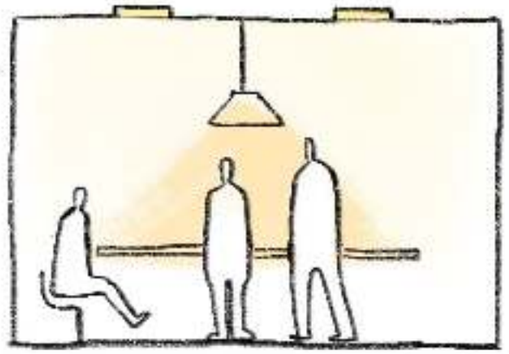
The switch zonings are based on the natural light zone and accessibility, therefore it has two zone near the west window and two at north so people can decided the zone to use and minimize the energy usage. Also the relaxing zone is separated.



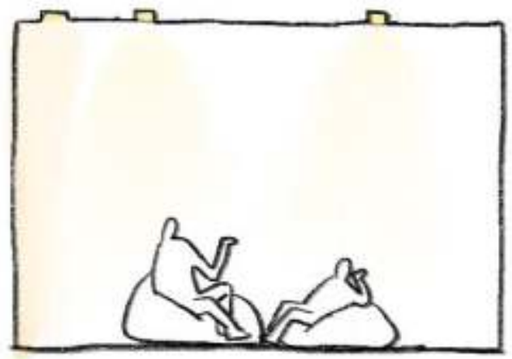




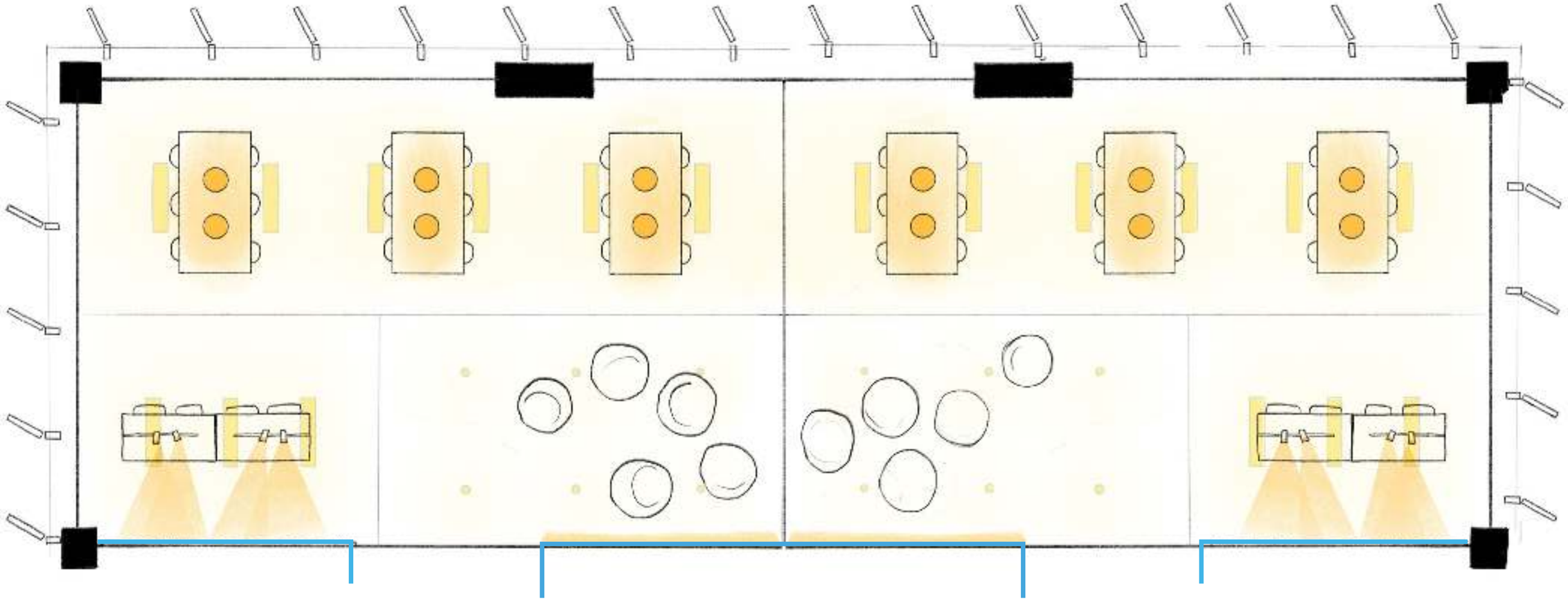
Addig Spot-light will help on focusing like on the informal meeting room. These spotlight are usually not fixed to one angle therefore it suits the adjustable space.

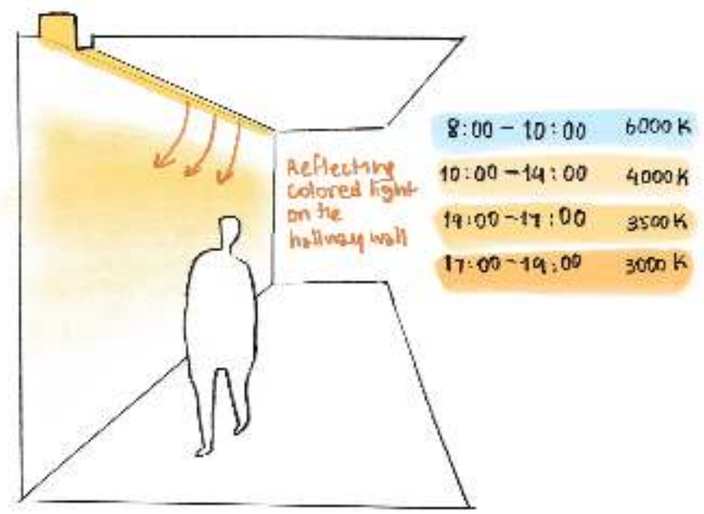


Task Lightings were add-ed to each table to provides more focused on the task. The switches will be separated so each table can control to suit the activities.



Wall light for relaxing zone since it gave us senses of comfort and calmness





Circadian Lighting
Wall (hidden light)

Circadian lighting supports our natural body clock by mimicking the changes in daylight throughout the day.
Therefore we integrated the smart LED that is able to changes its color during the day to keep the body clock of people's inside working nicely. The LED will be added above the wall and reflect down to the eye sight level.

All other spaces in this building already have cirtain wall, which mean, during the day, they get to receive natural circadian light already. However, this will help the darker hall-way and at night (these color will be reflecting on the glass of the cirtain wall too.

04 LIGHT

04 LIGHT