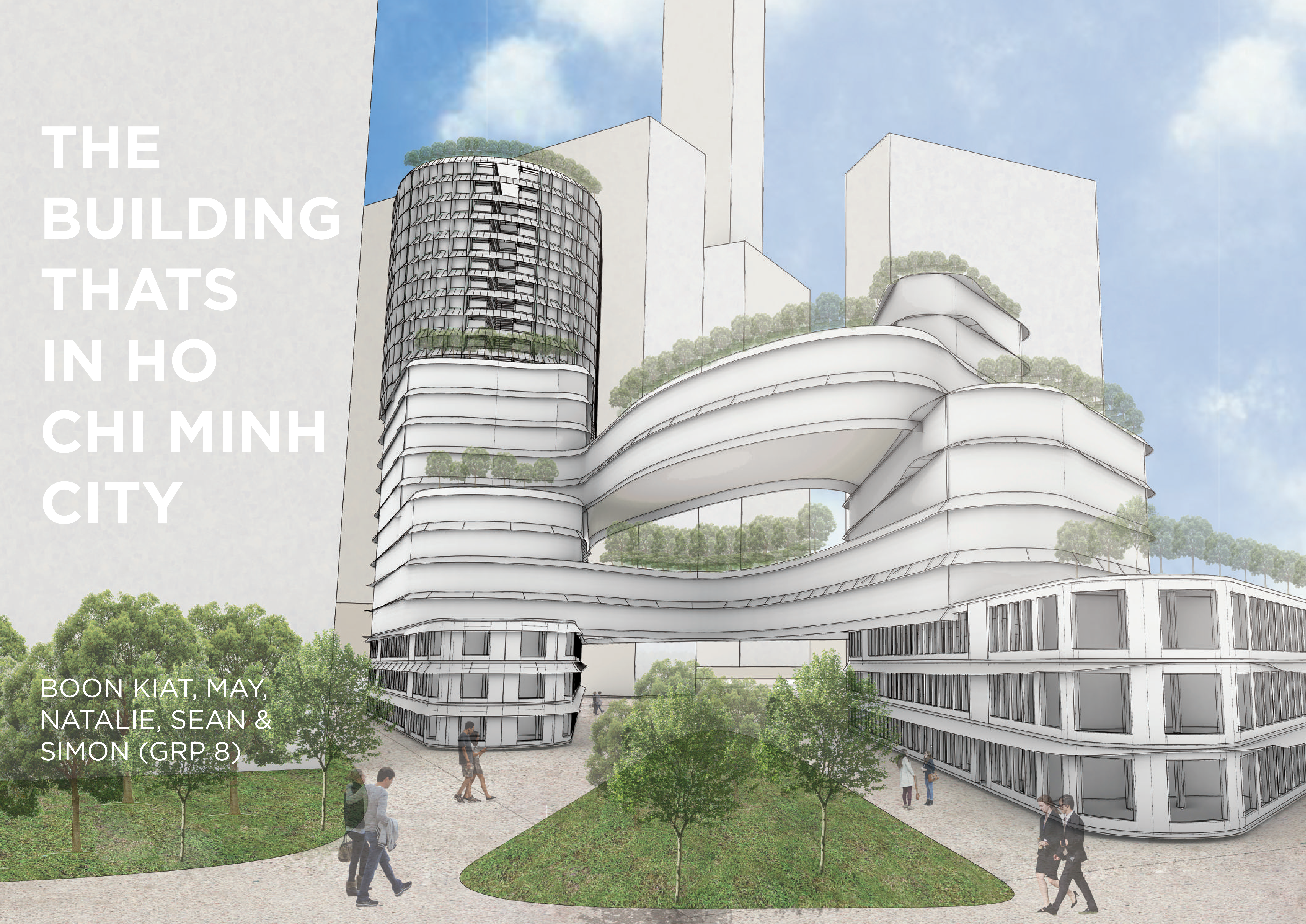
THE BUILDING THATS IN HO CHI MINH CITY



BOON KIAT, MAY, NATALIE, SEAN & SIMON (GRP 8)

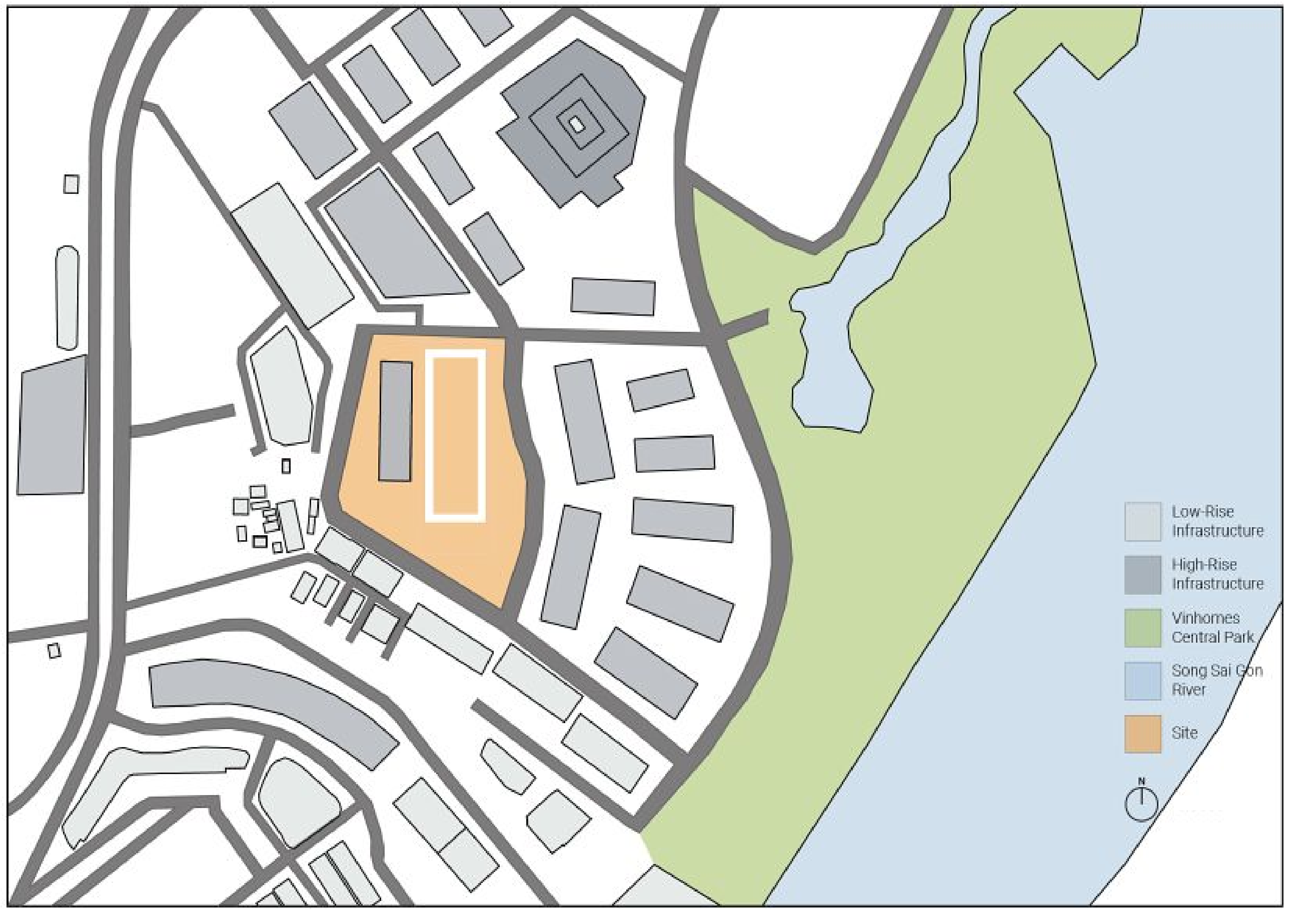
CONTENTS

SITE

Ho Chi Minh City
10,200 sqm
VINSCHOOL
Secondary school
20.9913° N,
105.8666° E

SITE CONTEXT

We chose this site as it is located between tall buildings. It has access to many public amenities and is located near a river.



CLIMATE

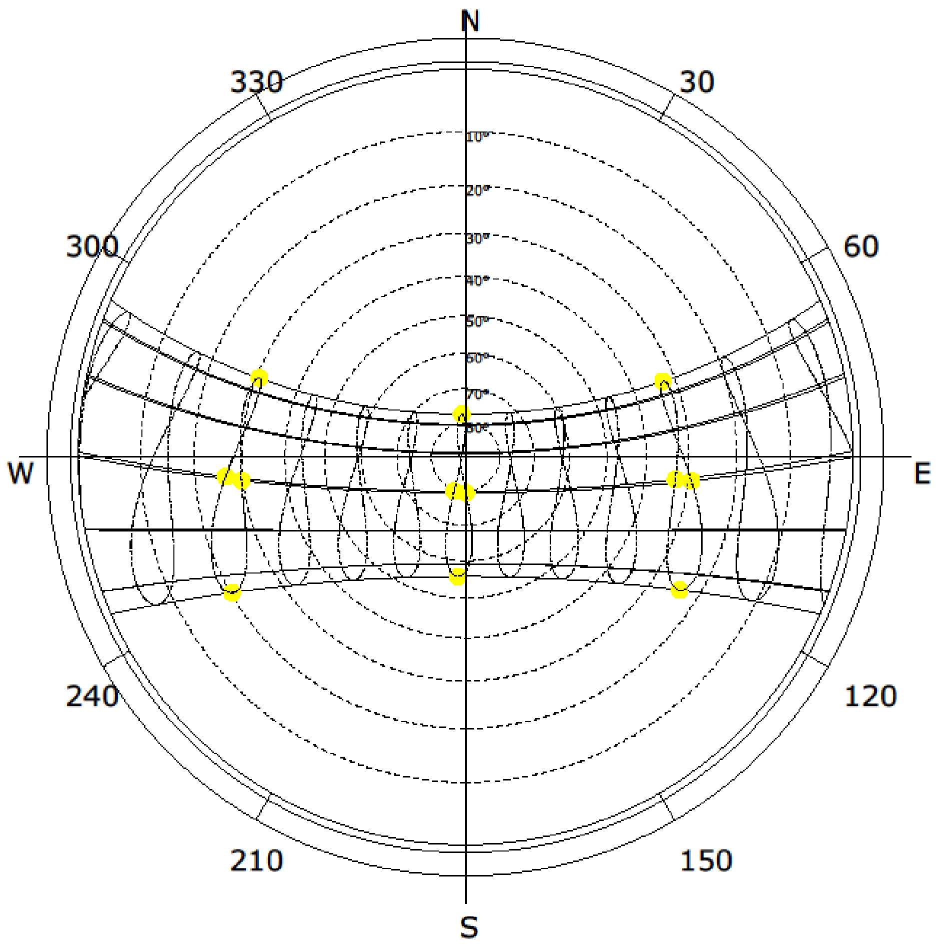
Tropical Savanna

Relative Humidity: 78-82%

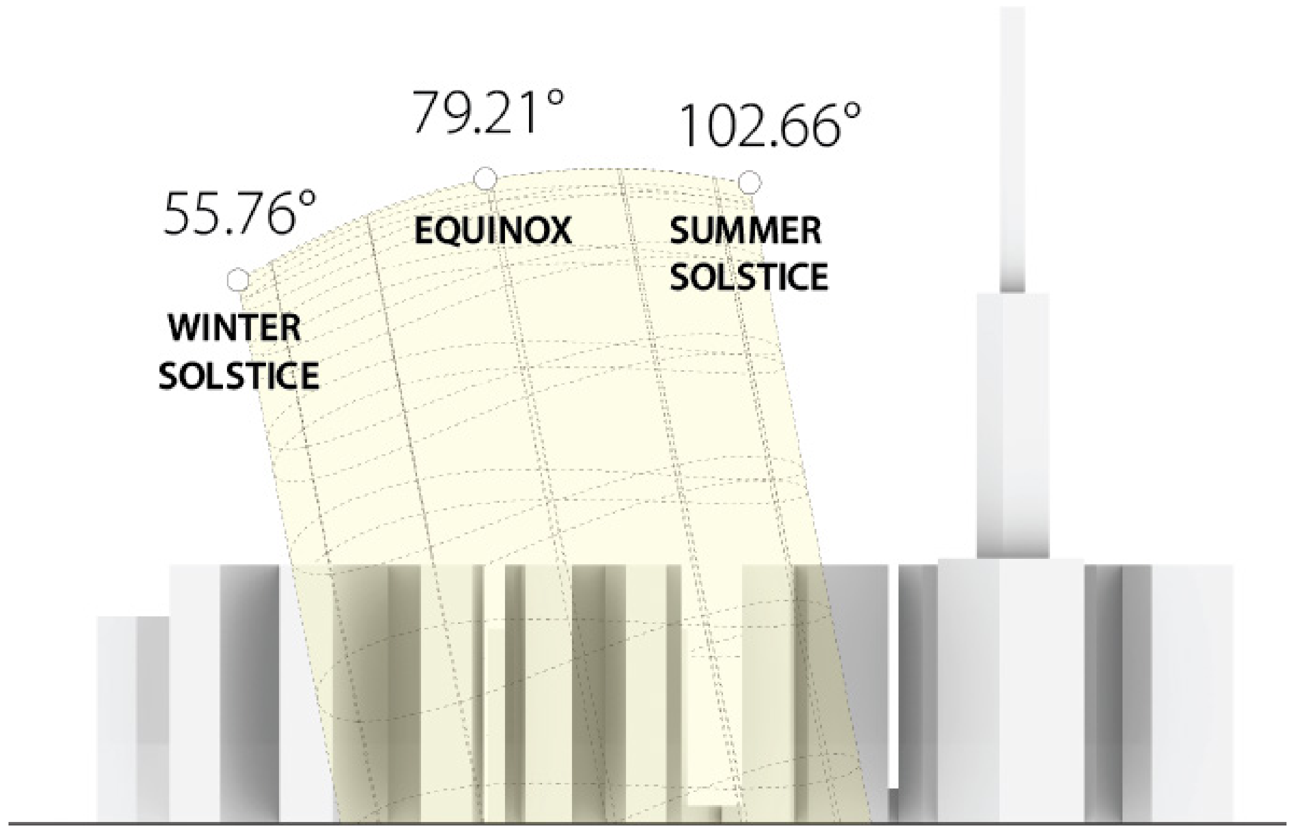
Average Temp: 28°C

150 rainy days annually

SUN PATH



SUN POSITION (SITE)



Based on both the Sun Path Diagram, which shows the movement of the sun across the site, and the Sun Position Diagram, which shows the angle of incidence of the sun at the site, we see that the sun is mostly overhead. The solar altitude angle (between 102 to 55° is relatively high throughout the year, even during the winter solstice. This means the incoming solar radiation experienced by the site is more direct and hence more intense.

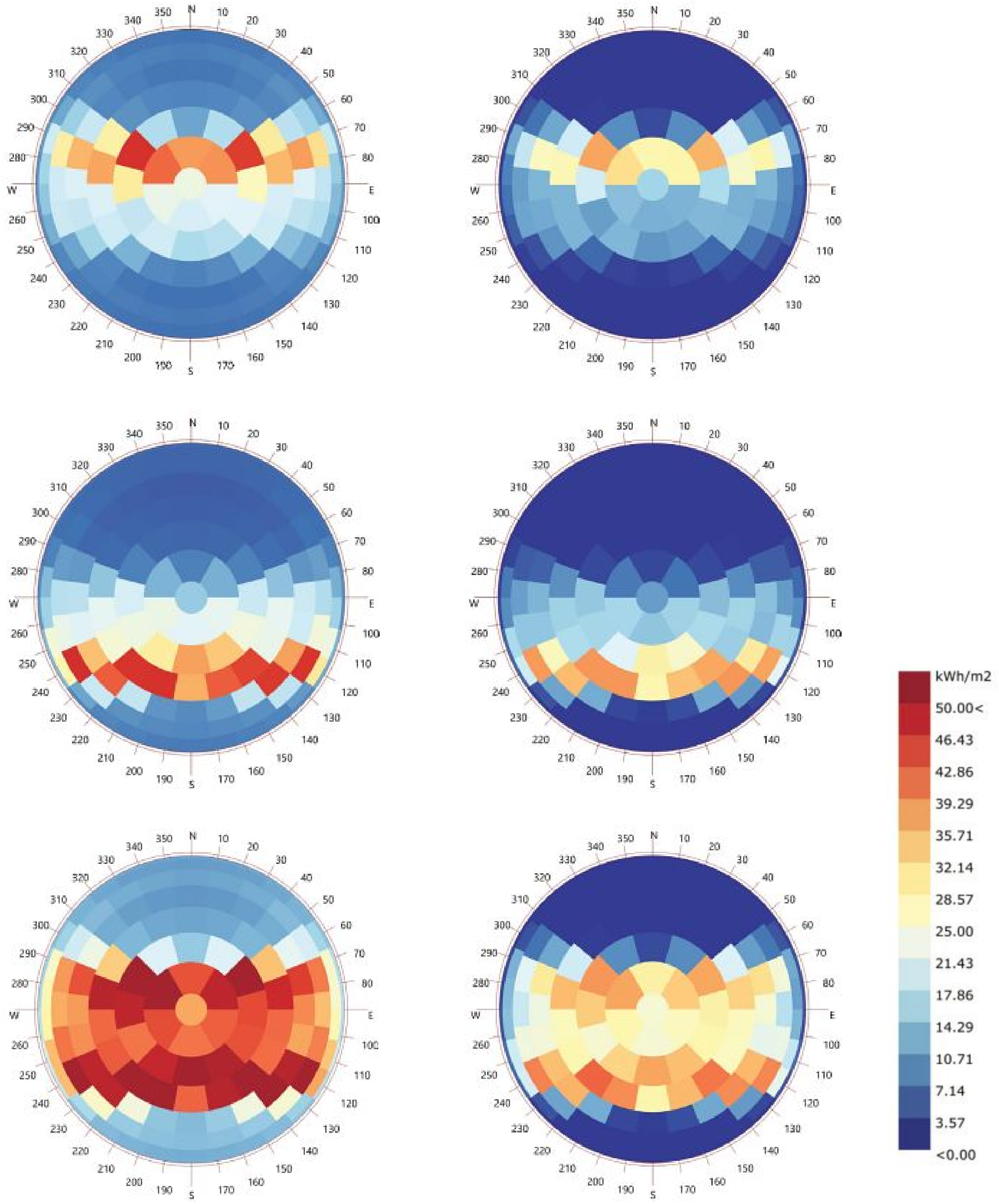
RADIATION

TOTAL | DIRECT

SOUTHWEST MONSOON (MAY-OCT)

NORTHEAST MONSOON (NOV-APR)

ANNUAL



Due to the city being in a tropical monsoon climate, Ho Chi Minh City's weather is constantly hot and humid. Its weather is largely dictated by two seasons, the Southwest Monsoon Season (wet season) and Northeast Monsoon Season. Radiation from the sun comes predominantly from the north at a high declination angle.

ANNUAL SOLAR RADIATION

+0m

+20m

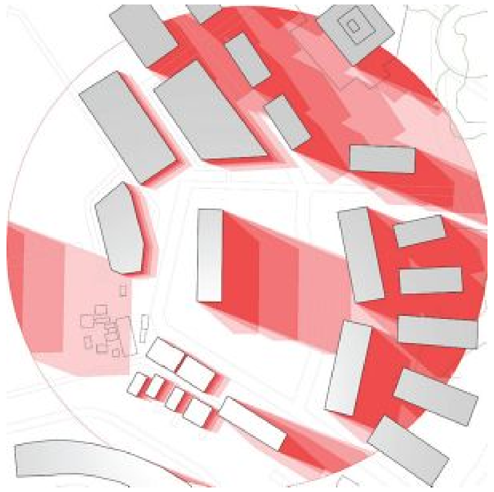
+50m

Based on the Solar Radiation diagrams, we see the site experiences heavy solar radiation throughout the year at all three heights.

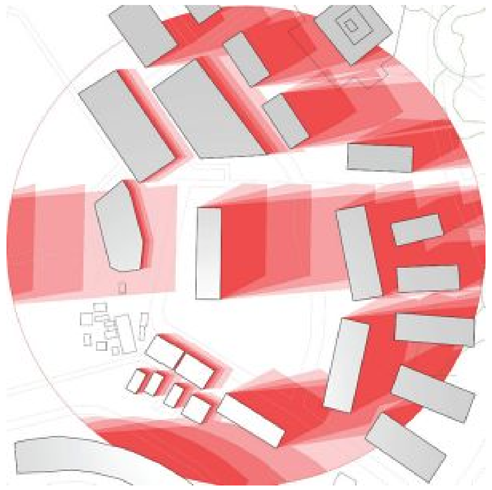
We realise that taller buildings interfere with incident radiation onto the site. This benefits the area in between these buildings as it self shades. This self-shading formed by clustering could be something we leverage in our building massing design.

AFTERNOON SHADOW HOURS

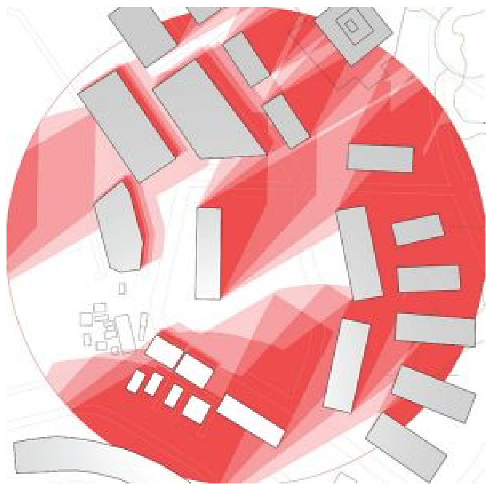
SUMMER

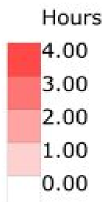


AUTUMN



WINTER

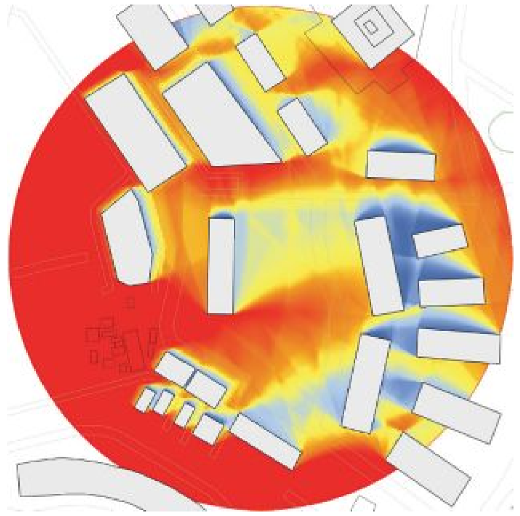




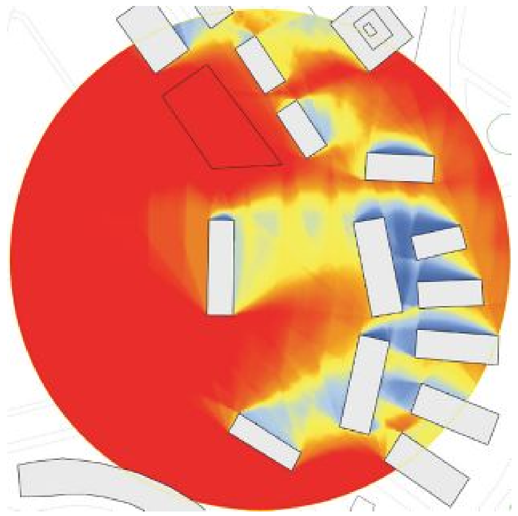
Based on the Shadow Hours, we realized the site experiences the shortest shadow hours during Autumn at noon. Our massing was designed with this in mind.

AUTUMNUL SOLAR HOURS

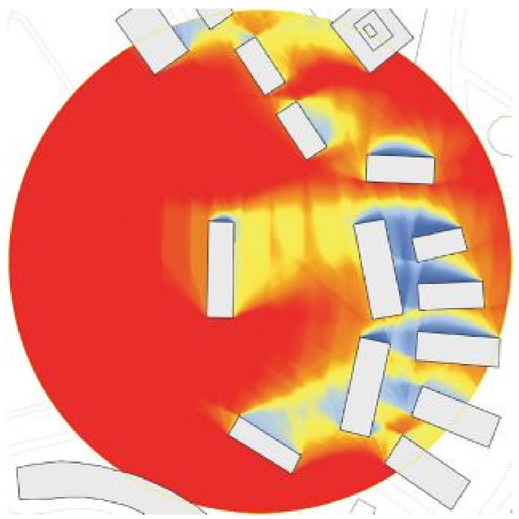
+0m

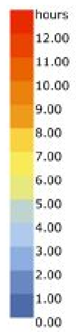


+20m



+50m

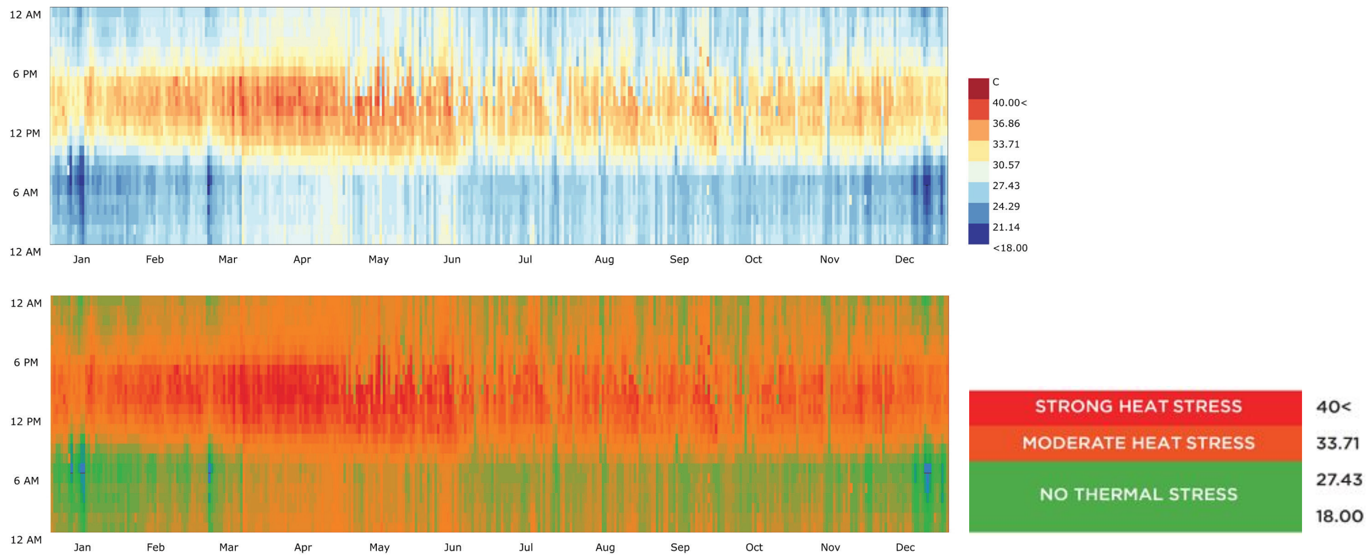




We chose to analyse Autumnal Solar Hours as it is the season with the most Solar Hours.

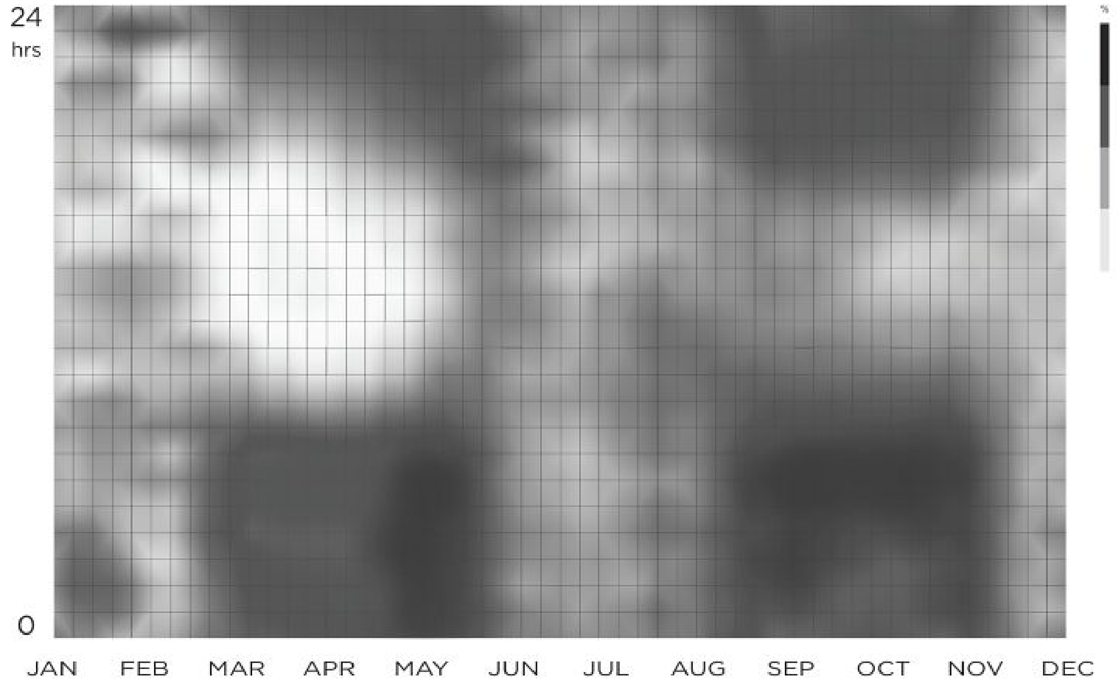
Based on the Solar Hours, there is an average of 7 hours of sunlight; an optimal amount for office environments.

THERMAL COMFORT



People in Ho Chi Minh experience moderate heat stress for most days of the year. Our massing would have to employ passive ventilation and cooling strategies to make our building environment comfortable.

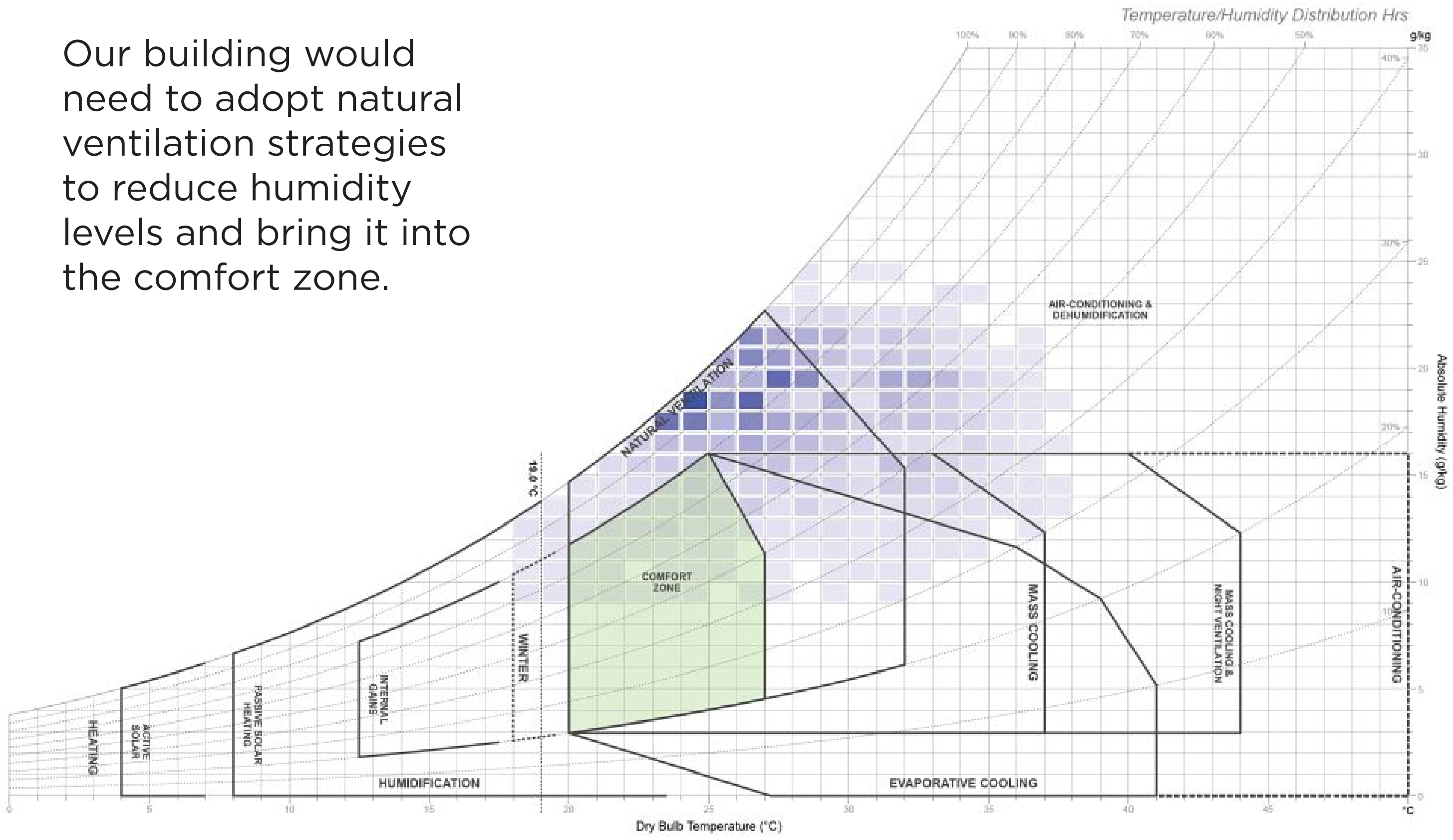
CLOUD COVER



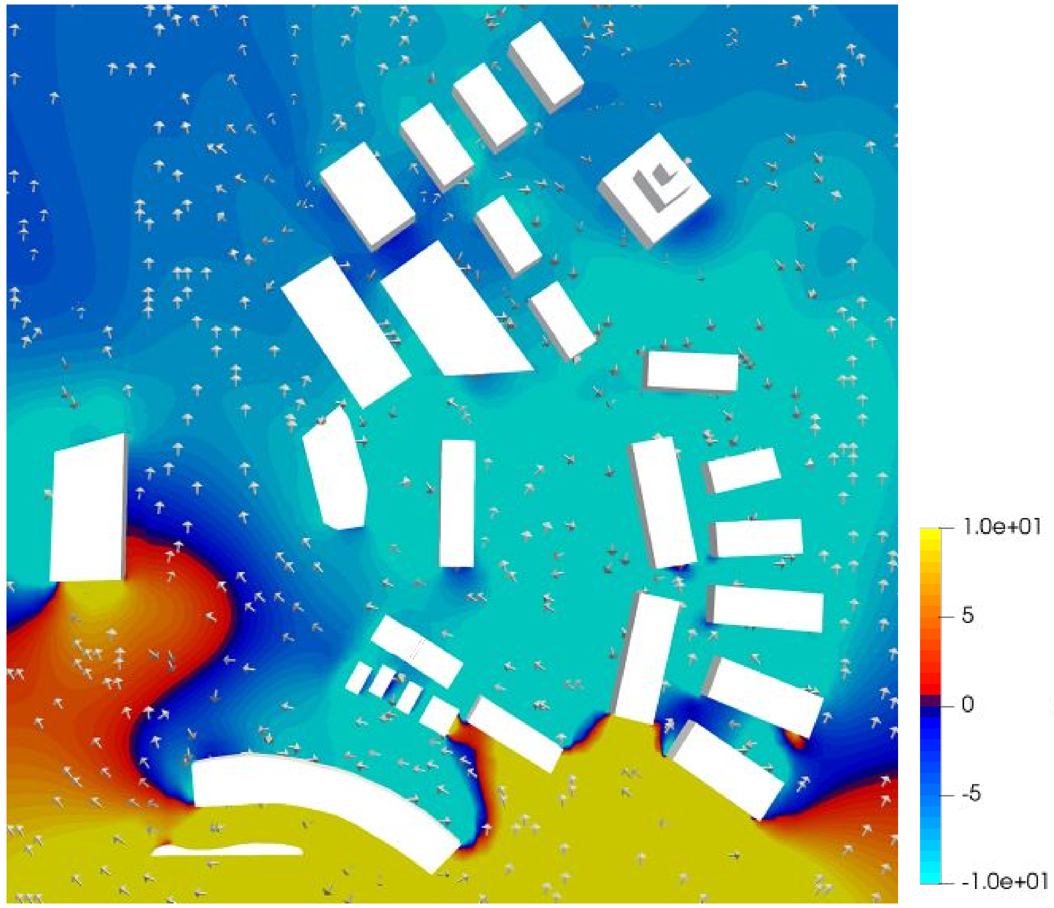
Cloud cover of 25-50% for most of the time. Buildings are still susceptible to glare due to high radiation. Passive design measures to reduce this glare and high radiation should be implemented into our design.

PSYCHOMETRIC CHART

Our building would need to adopt natural ventilation strategies to reduce humidity levels and bring it into the comfort zone.

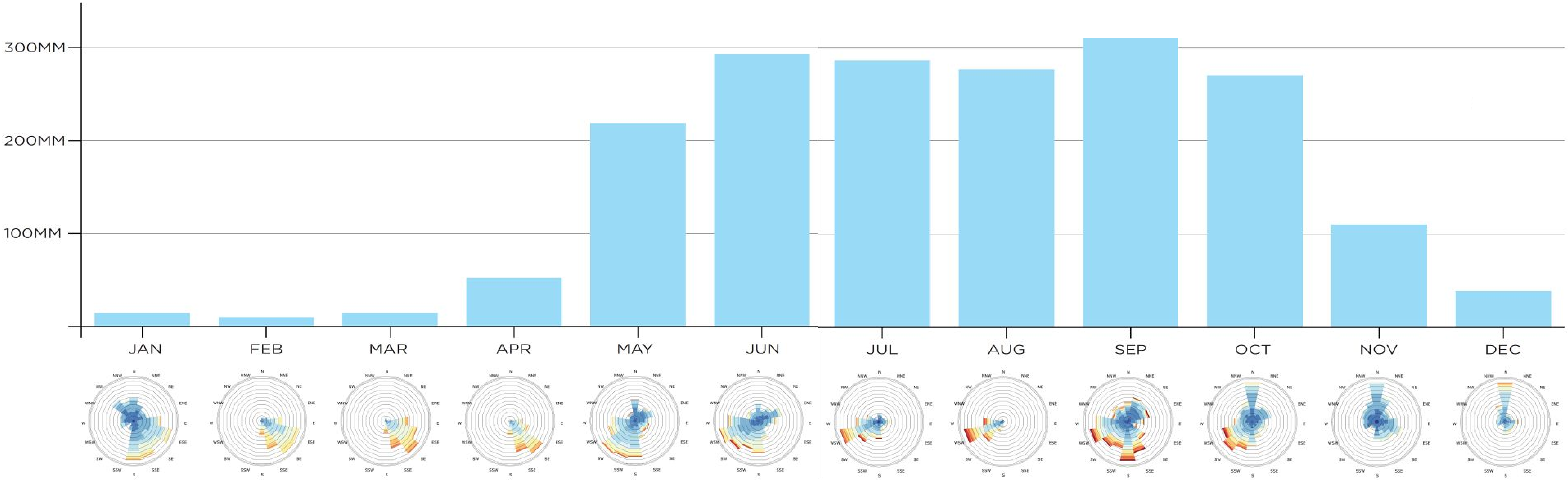


PRESSURE



Due to the high-rise developments bordering the our plot, pressure difference within the site is relatively low. We do see higher pressure differences develop between some of the closer-packed buildings, and this idea could be incorporated in our design.

PRECIPITATION / WIND ROSE



Ho Chi Minh City experiences generally higher rainfall from May to Oct.

The Precipitation and wind rose diagrams shows us the direction on wind and the amount of rainfall, allowing us to understand which areas of our building would be more susceptible to rain entry, and implement measures to counter it.

MASSING ITERATIONS

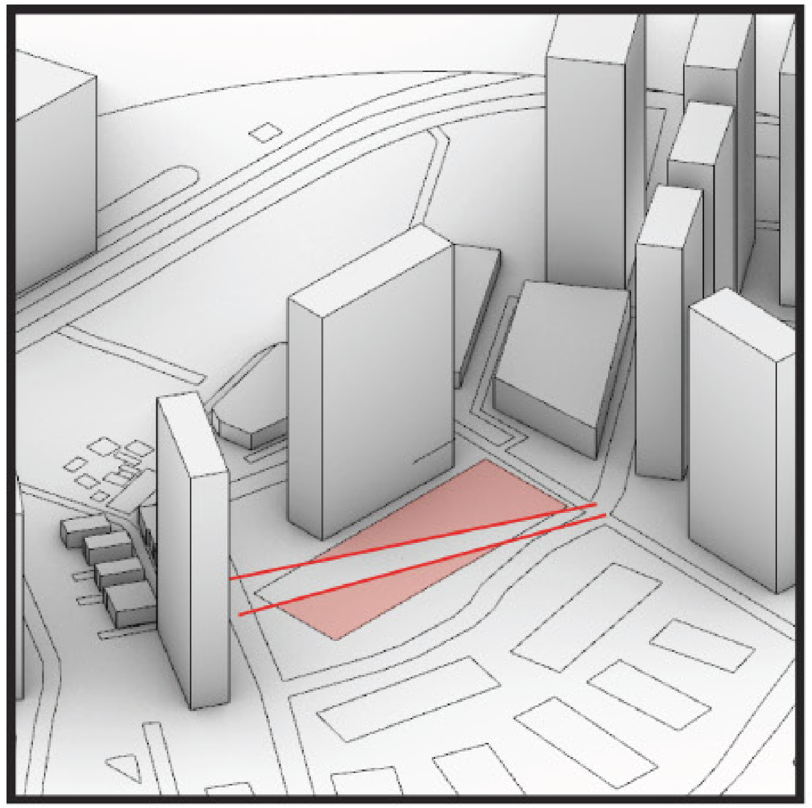
1 . WIND

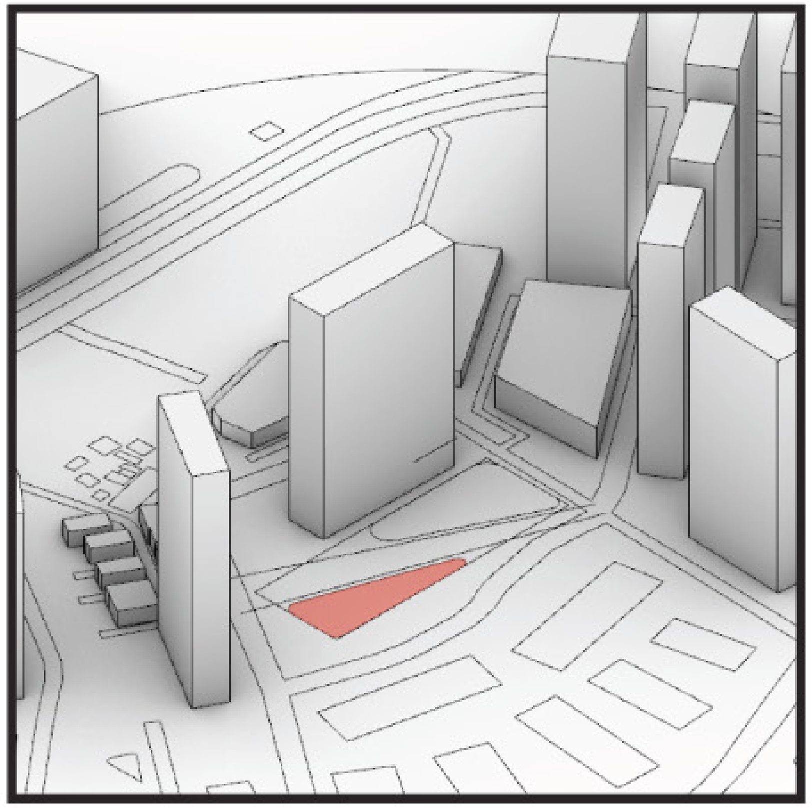
2. SOLAR HOURS

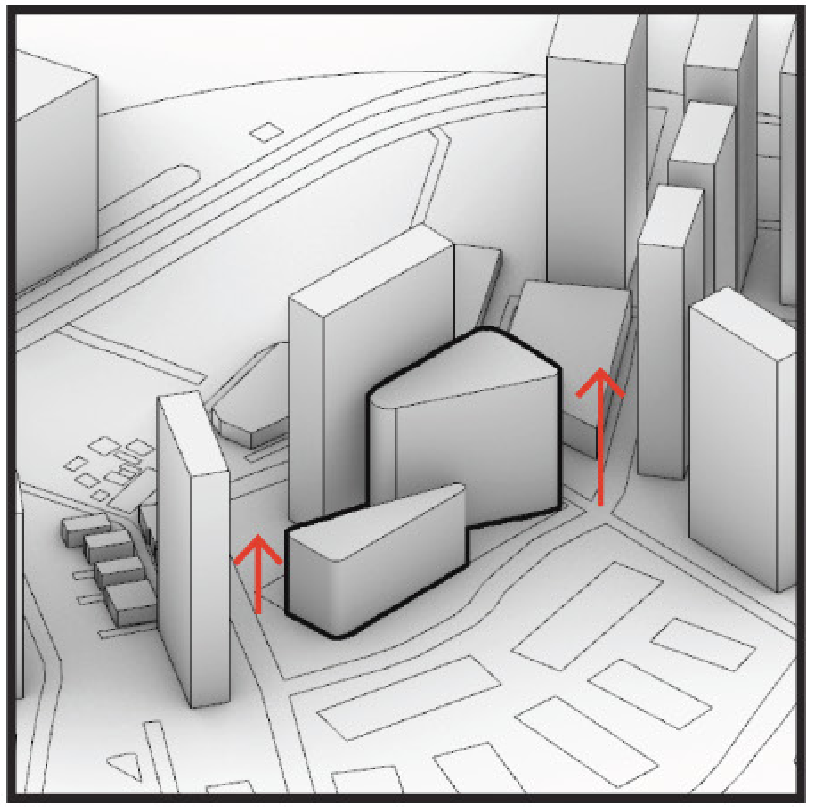
3. SHADOW HOURS

4. RADIATION

5. VIEWS







Predominant wind from the Southwest direction

Splitting the site due to create a 'wind tunnel' to allow ventilation through our building

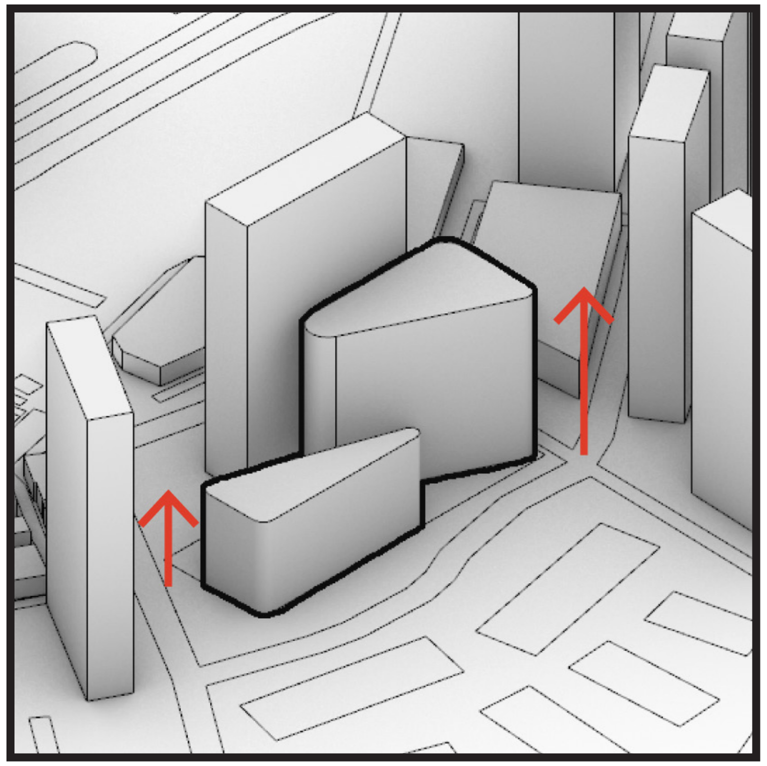
Circulation + Views

Rounding edges to facilitate circulation into the site

Views + Shading

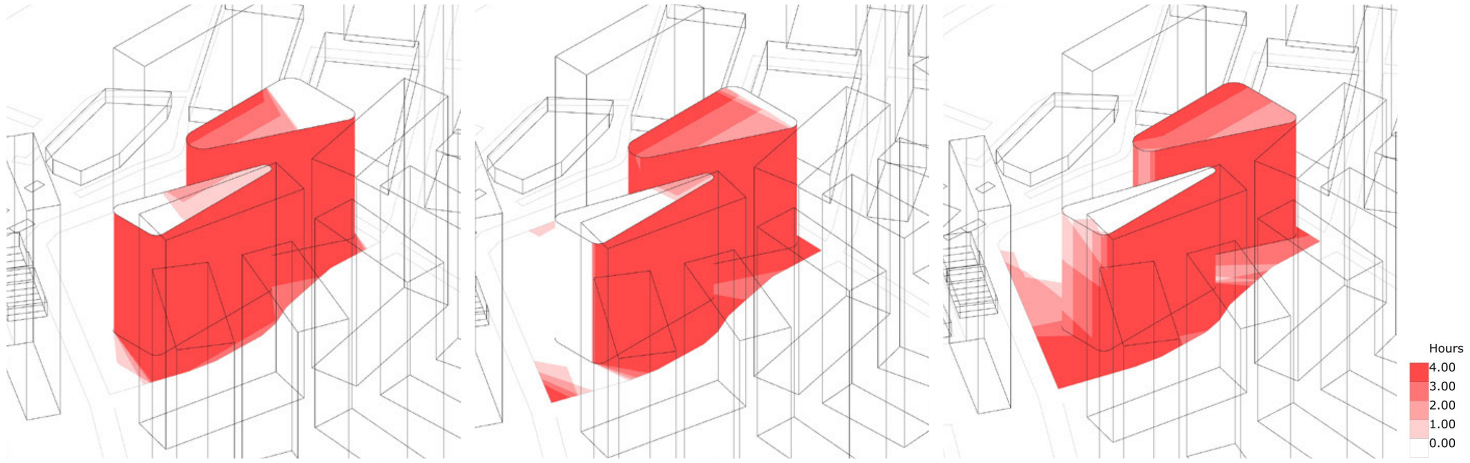
Different heights to provide self-shading

MASSING 1



In this massing, we decided to extrude two masses of different heights, leaving a gap in between. The difference in heights of the two blocks allows for self shading on the smaller block and in the courtyard space between the two blocks.

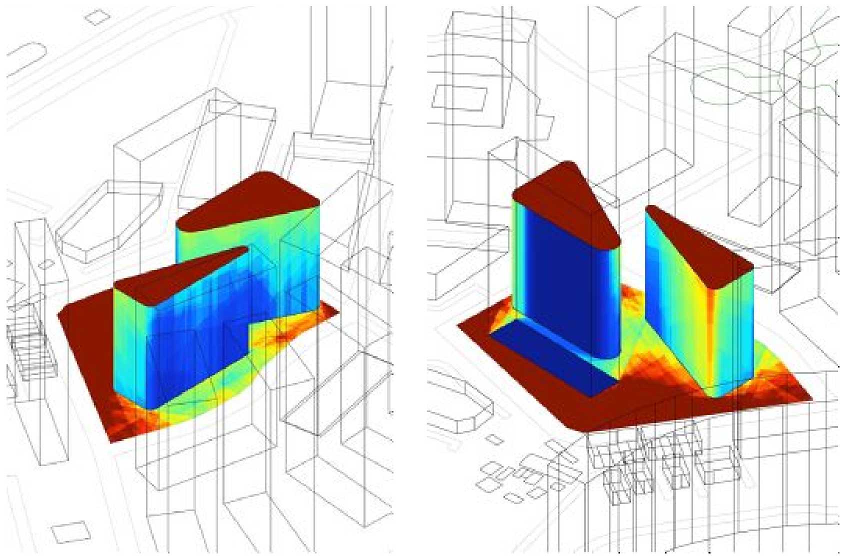
SE SHADOW HOURS



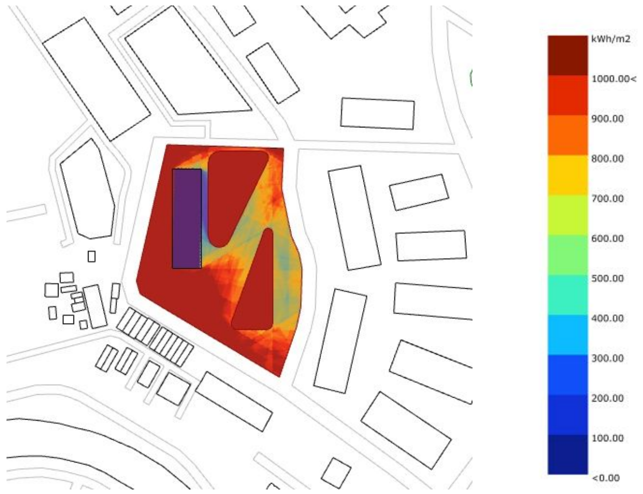
SUMMER **AUTUMN** **WINTER**

The shadow hours analysis show that the surrounding buildings casts large shadows for prolonged periods of time over the site. The only façade that will not be shaded by the surrounding buildings is the south facing façade during autumn. Our subsequent massing iteration and façade design needs to take into account this analysis in order to make an informed design decision.

RADIATION



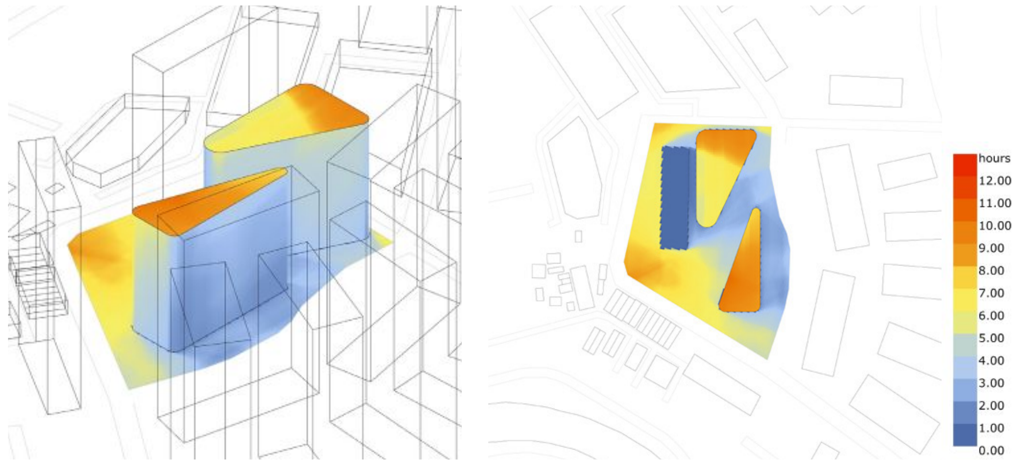
SE **SW**



Avg. Roof Radiation: 1645.5 kWh/m²
Avg. Façade Radiation: 277.0 kWh/m²

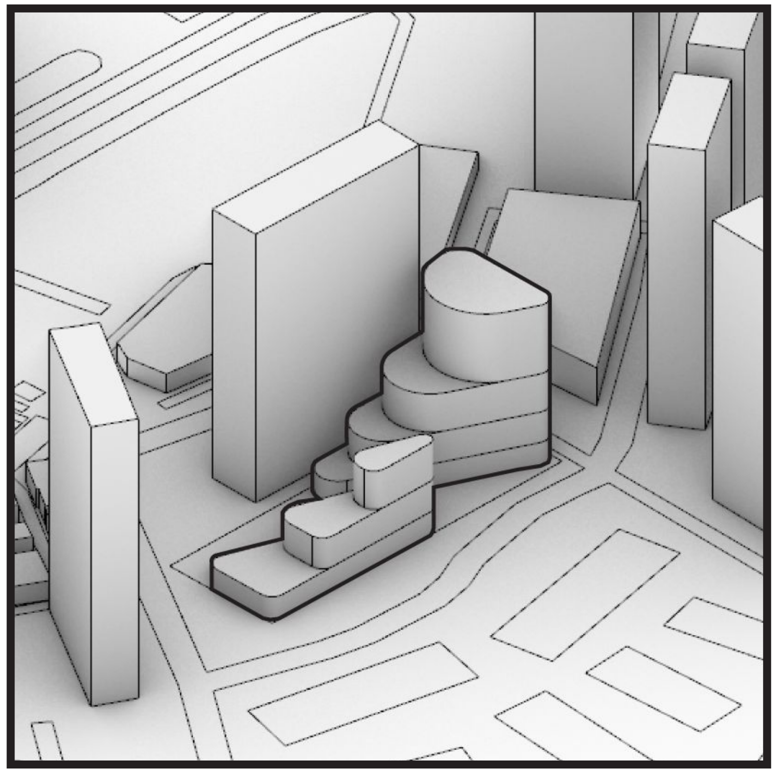
The results tells us that different sides of the building experiences different amount of radiation. The SW side has a tall building beside it and thus experiences less radiation as compared to the SE side. Moreover, the upper floors experiences greater radiation. Hence, measure have to be implemented base on the side of the building.

SE SOLAR HOURS



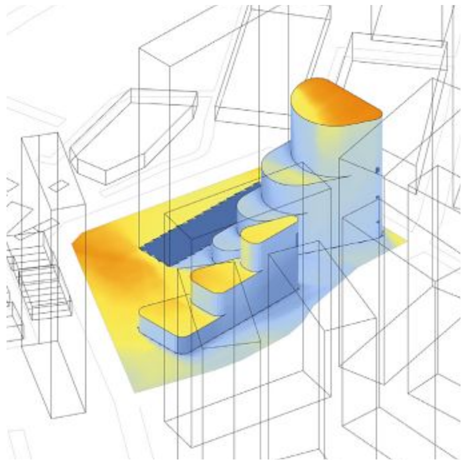
The solar hours correspond to the shadow hours as previously shown as the shading provided by the surrounding buildings reduce the solar hours experienced by our massing by a significant amount. The roof and the ground floor still experiences an average of 7 hours of sunlight when the sun is overhead. This is taken into consideration when designing public spaces on the ground or on the roof.

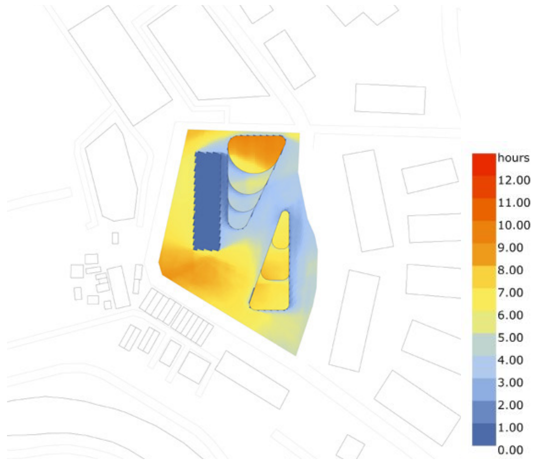
MASSING 2



As the rooftops experience high levels of solar radiation for prolonged hours, in this iteration, we decided to terrace the volumes to help reduce the number of solar hours experienced by the rooftops and increase self shading by the terraced volumes.

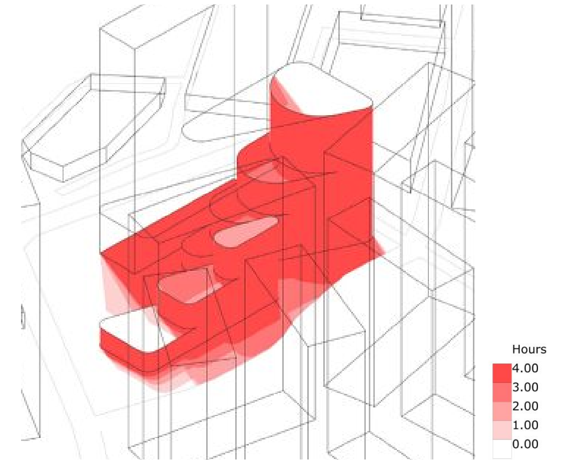
SE SOLAR HOURS





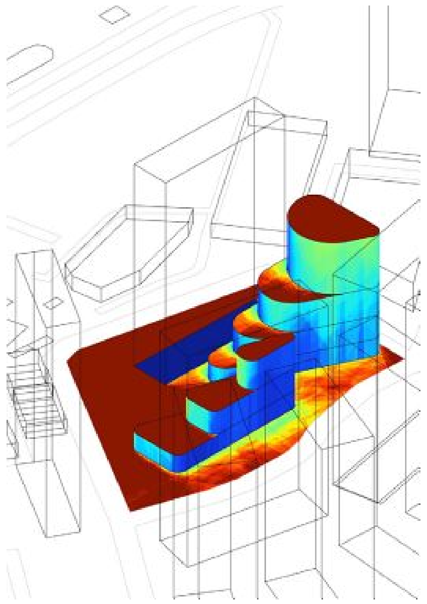
The splitting of the volumes by terracing gives rise to different spaces that receive an approximate of 7 hours of sunlight. The solar hours experienced by the facades remain relatively unchanged as it is already in a good range for office work. These variety in sunlit spaces allow us to design well-lit public spaces that can be enjoyed by both the residents and the public.

SE SHADOW HOURS
(AUTUMN)

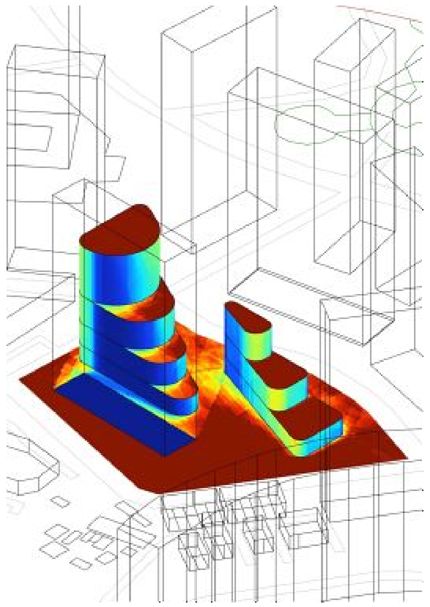


We now focused on the Autumn Shadow Hours because we found it had the shortest shadows.
By splitting the volumes in the form of terracing, we are able to increase the surface area of the building aided by self-shading, leaving only two surfaces, the roof and the surface furthest from the center of the site. The next iteration will take into consideration the areas of the building were we want to leverage the presence/absence of shadow.

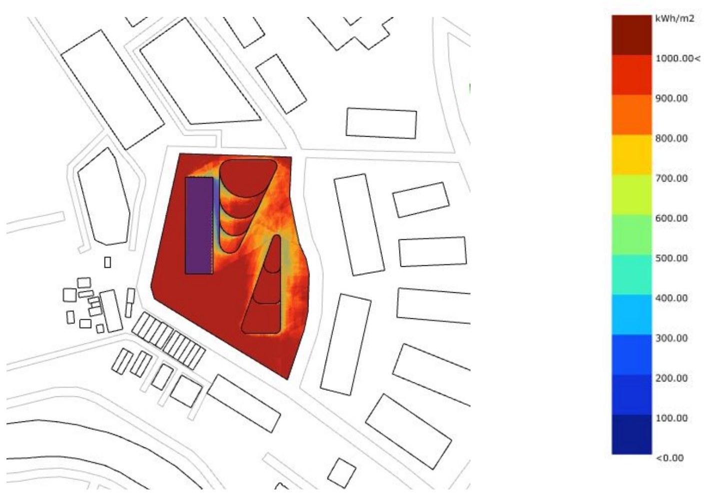
RADIATION



SE



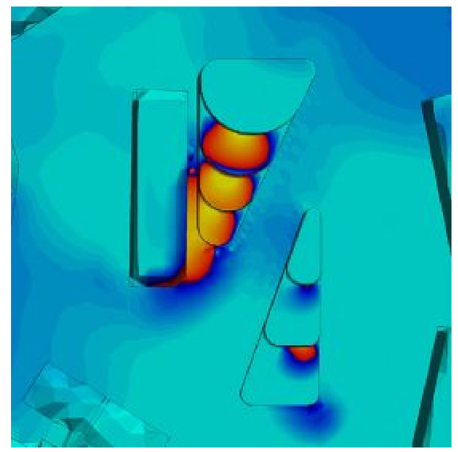
SW



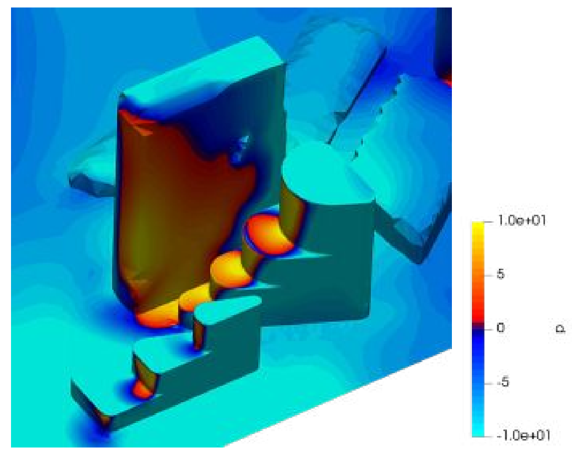
Avg. Roof Radiation: 969.1 kWh/m²
Avg. Façade Radiation: 256.9 kWh/m²

For this massing, we can see that by staggering the building creates roofs which experience high radiation, perfect for greenery. Staggering also helps to create more faces around the building that receives acceptable amount of radiation. We can also see that the area between the 2 masses experiences a lot of radiation.

PRESSURE

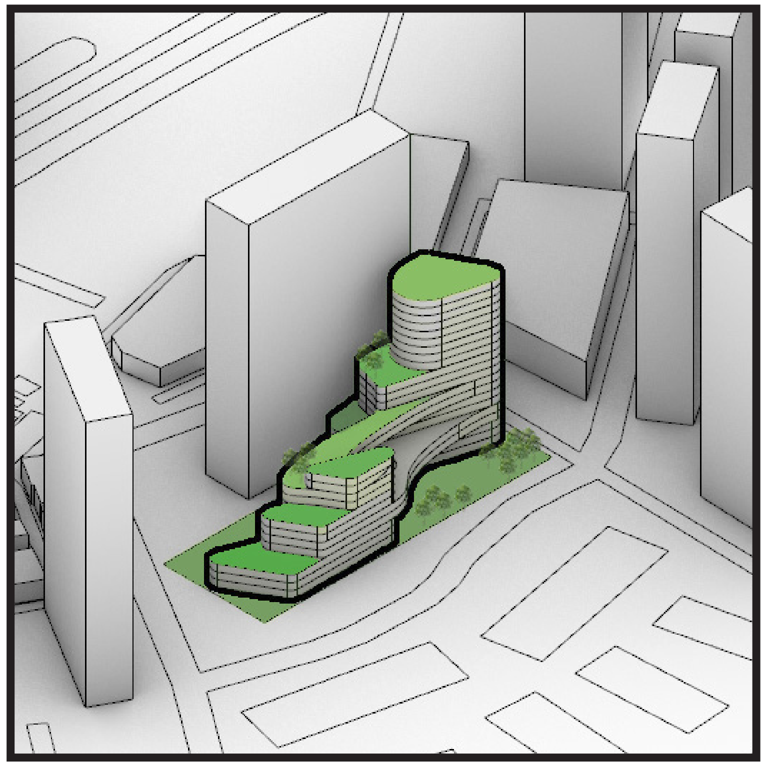


We analysed the wind pressure profile of our massing based on the prevailing wind that comes from the south. This gives quite an ideal situation where the pressure on the south façade is much higher than the pressure on the north façade. This difference in pressure allow us to cut a void through the volume and encourage cross ventilation through the building. This is important especially in a tropical climate as natural ventilation will help to reduce the humidity and allow for passive cooling to take place.

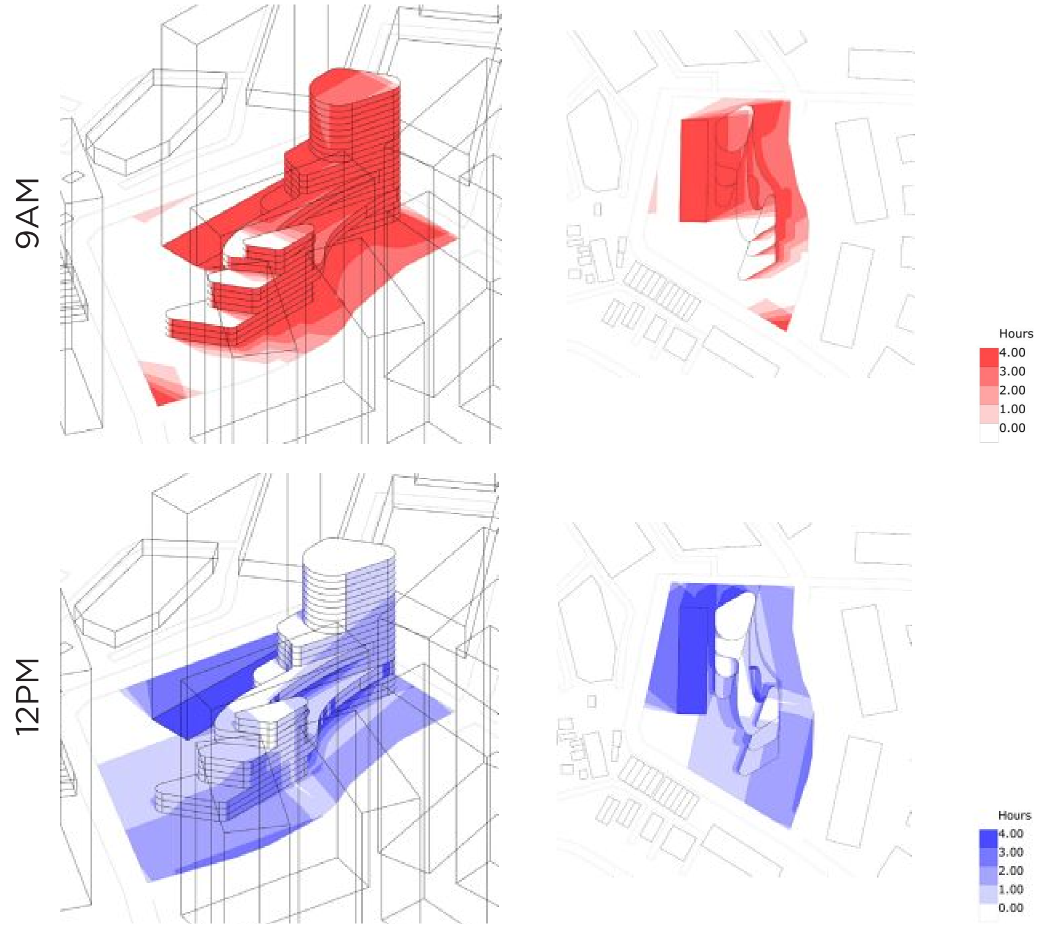


The second view shows that we need to make improvements to the massing on the volume on the right as it does not experience as much of a pressure difference as compared to the volume on the left. The next massing iteration will take that into account to encourage more cross ventilation throughout the site.

FINAL MASSING



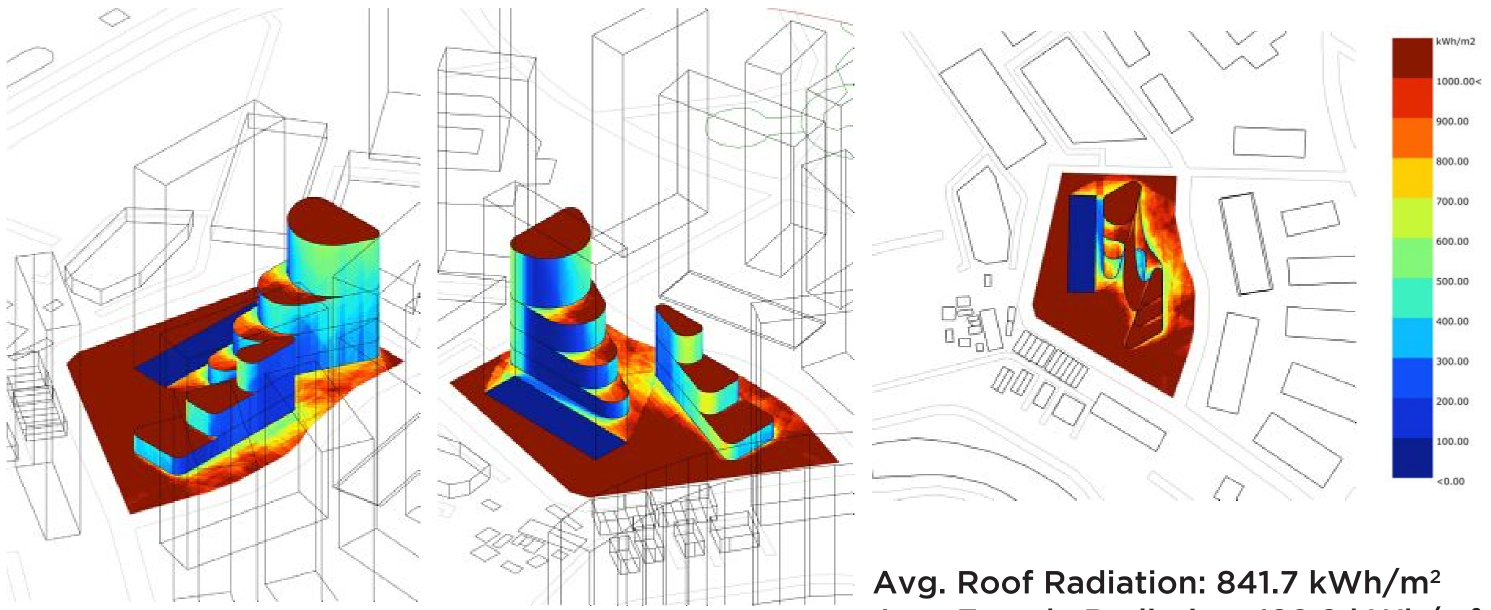
To further improve the wind flow through the building, we streamlined its form. We also added two connecting bridges to create a shaded public space underneath, allowing for better connectivity between the two blocks. Green spaces were placed on the rooftops and bridges to leverage the sunlight while mitigating the thermal effects provided by the high solar radiation.



SE SHADOW HOURS

For this massing, we can see that by staggering the building creates roofs which experience high radiation. Staggering also helps to create more faces around the building that receives acceptable amount of radiation. We can also see that the area between the 2 masses experiences a lot of radiation.

RADIATION

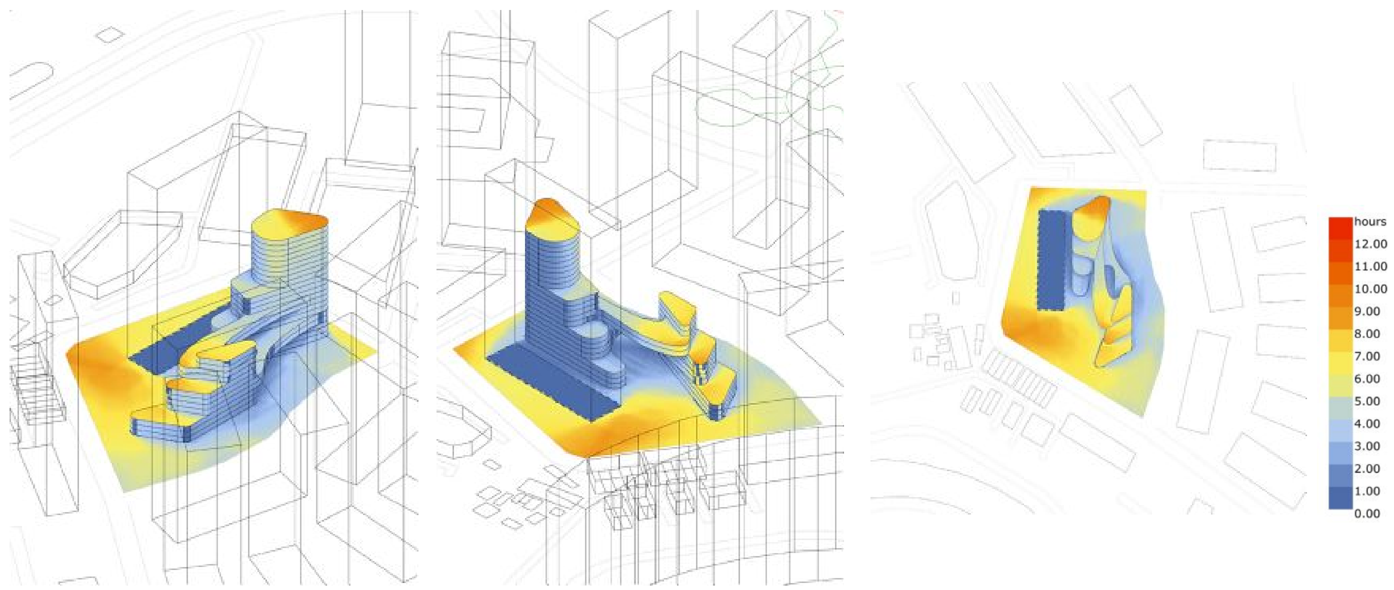


SE **SW**

Avg. Roof Radiation: 841.7 kWh/m^2
Avg. Façade Radiation: 198.9 kWh/m^2

The sky bridges helps to reduce the radiation experience by the areas between the two blocks. This gives us the opportunities to plan public spaces below the bridges and sky garden on the surfaces with high radiation.

SE SOLAR HOURS

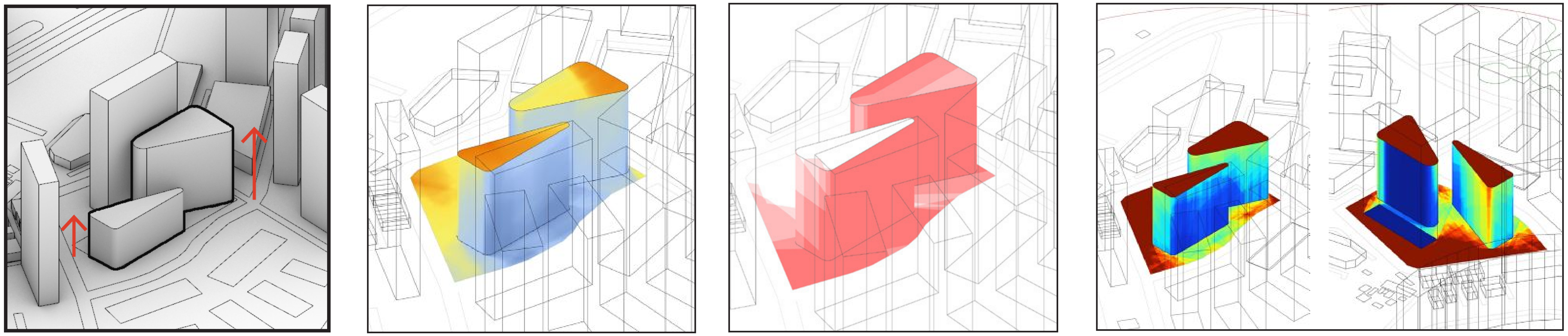


SE **SW**

By adding the skybridges, the areas below them now experiences lesser solar hours as compared to the previous massing. This gives us the opportunity to make use of these areas for public spaces. This analysis also helps us to allocate our residential, commercial and office spaces base on the average amount of sunlight needed for each purpose.

MASSING ITERATION SUMMARY

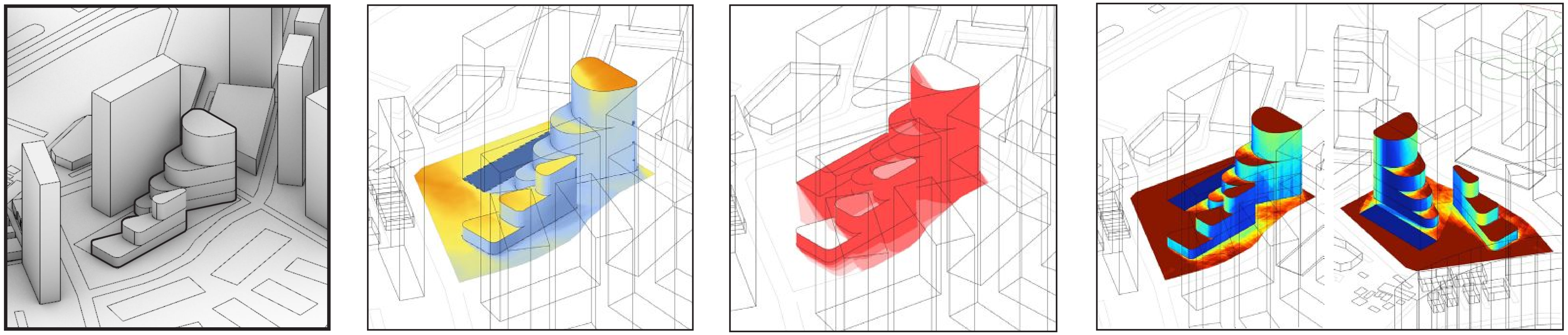
1



Avg. Roof Radiation:
1645.5 kWh/m²

Avg. Façade Radiation:
277.0 kWh/m²

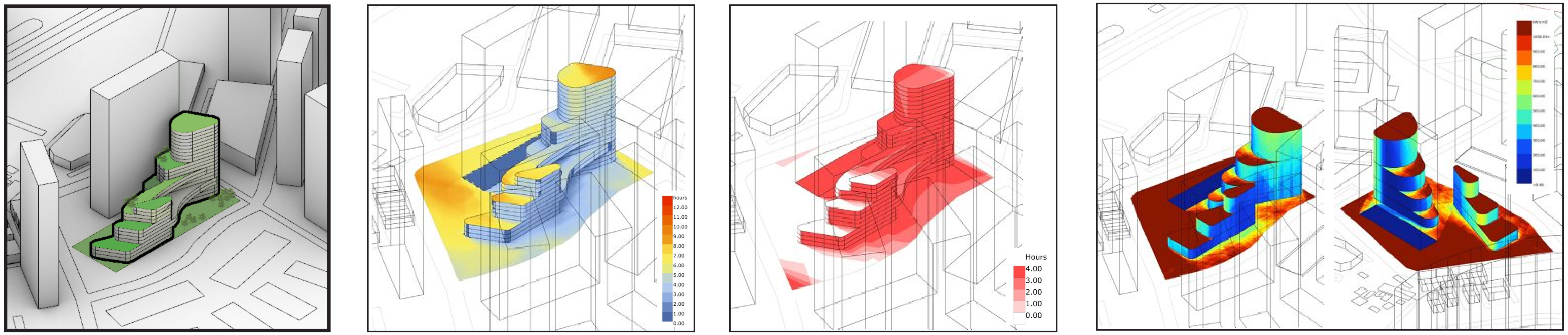
2



Avg. Roof Radiation:
969.1 kWh/m²

Avg. Façade Radiation:
256.9 kWh/m²

FINAL

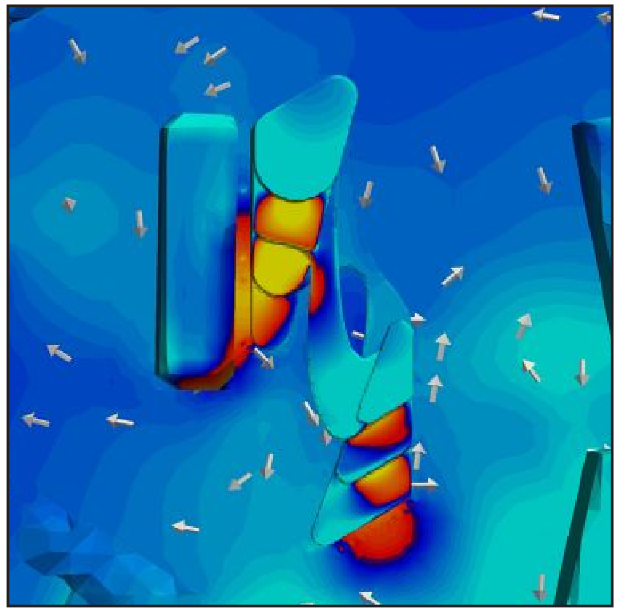


Avg. Roof Radiation:
841.7 kWh/m²

Avg. Façade Radiation:
198.9 kWh/m²

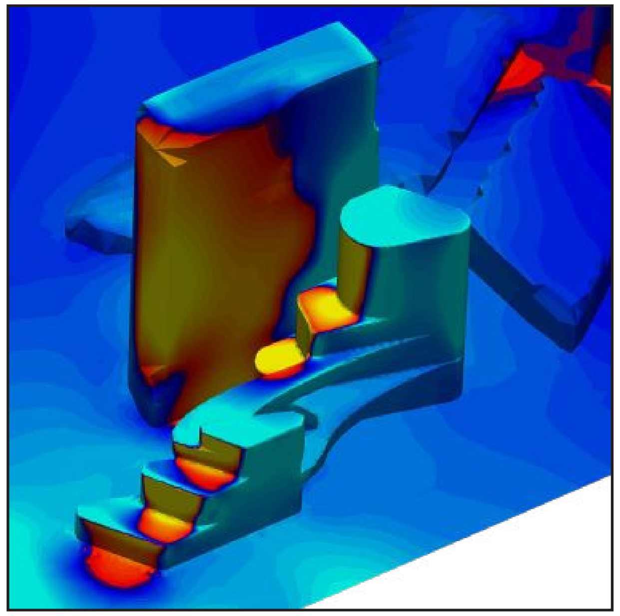
PRESSURE

PLAN



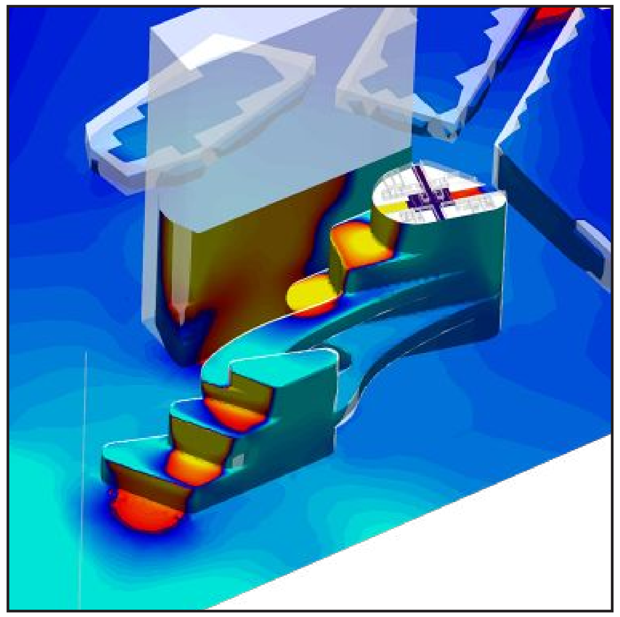
The overview plan shows that there is an adequate distribution of pressure differences across the various races of the building; giving rise to the potential of leveraging on cross ventilation to cool the building.

AXON

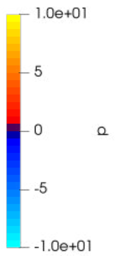


This result tells us that to effectively leverage on cross ventilation, we need to open a wind corridor through the north and south facade to facilitate wind flow, especially so for the residential levels.

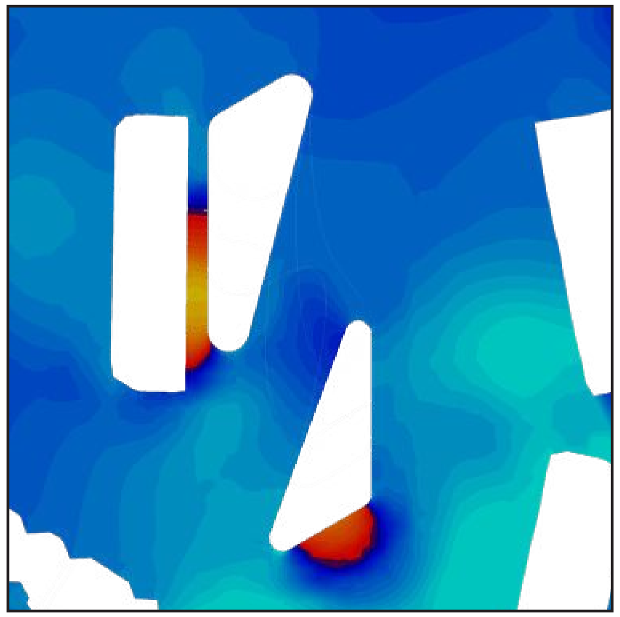
AXON (RESI CUT)



This view shows a cut of the building where the residences are located. This is a visualization of how we intend to utilize the pressure difference to encourage wind flow through the corridor.

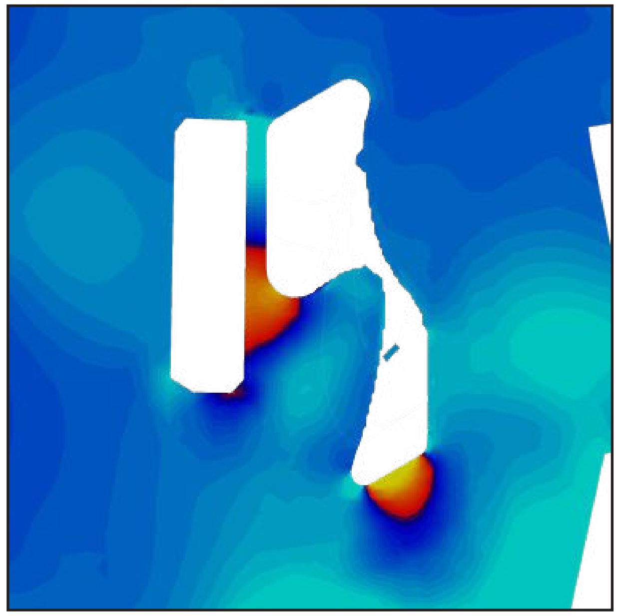


GROUND LEVEL



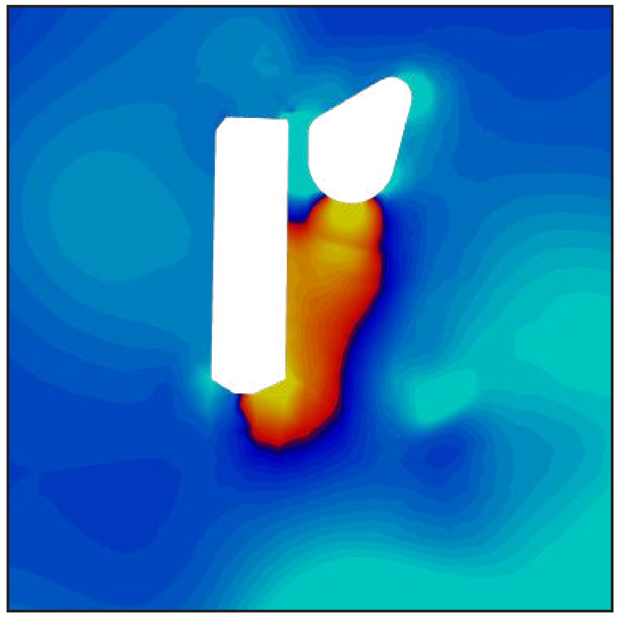
These 3 diagrams show the pressure profile at three different heights of the building. The lower level shown here shows that there is a high pressure difference in the gap between our building and the next, while the other tower has a high pressure difference on the south and north facade which is ideal.

SKYBRIDGE LEVEL

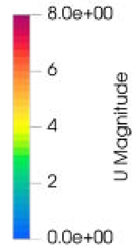


This diagram shows a similar profile to the one above, showing that cross ventilation is able to be applied across multiple levels.

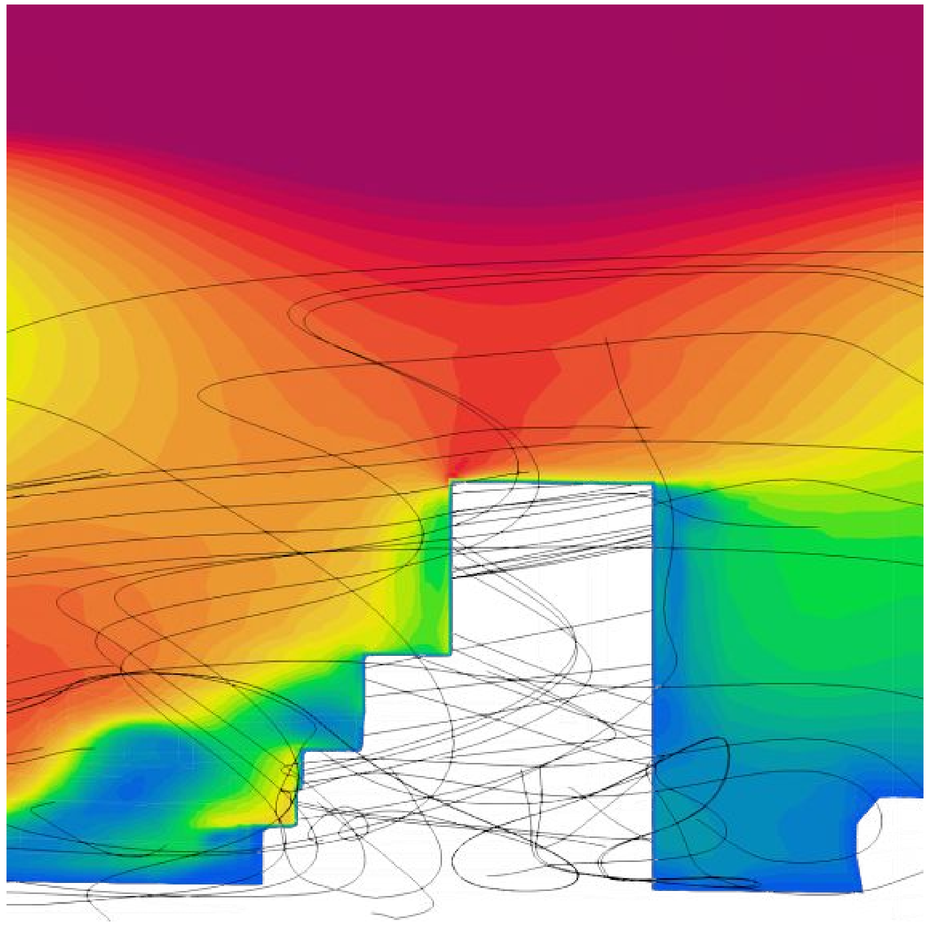
RESIDENTIAL LEVEL



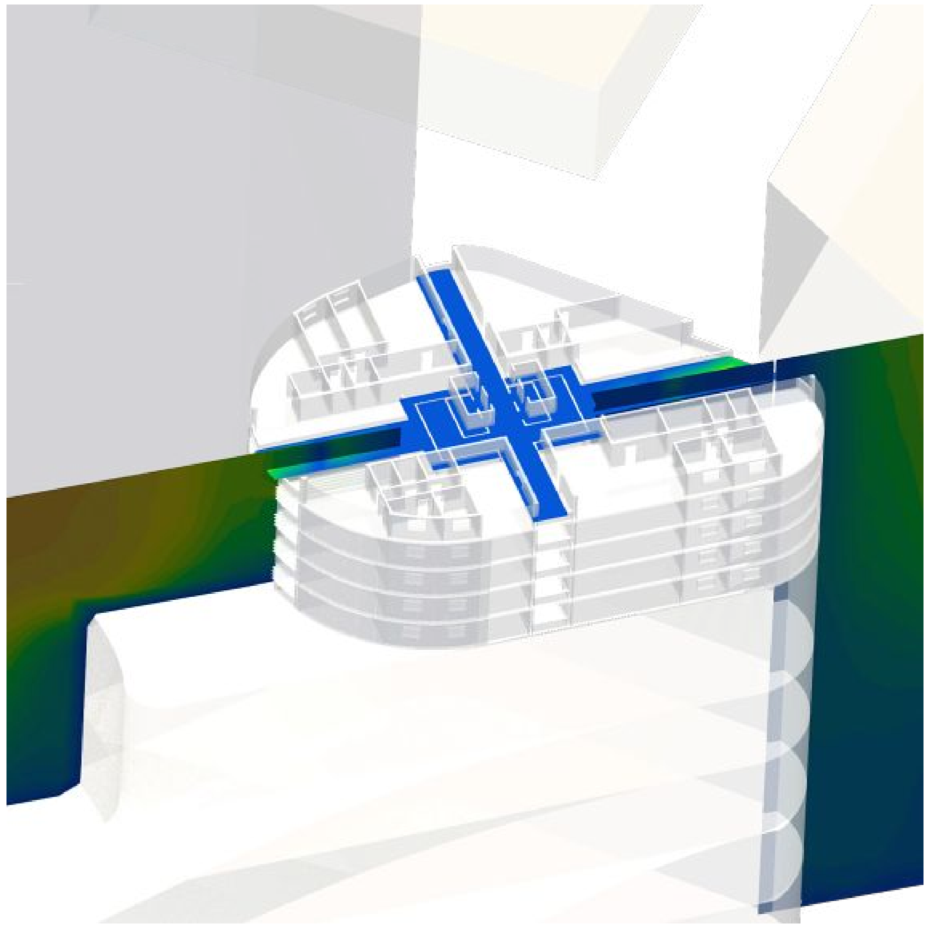
This profile shows a large region of high pressure on the south facade where the rooftop gardens are located as well. This pressure difference ensures that these rooftop gardens are well ventilation and has generous amounts of wind through the area, given that it is open to sky and susceptible to high temperatures. With adequate wind flow, it allows for these spaces to be cooling and relaxing.



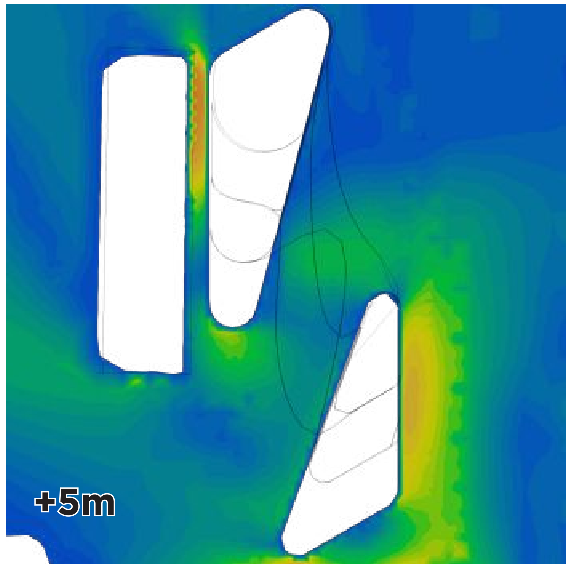
WIND SPEED

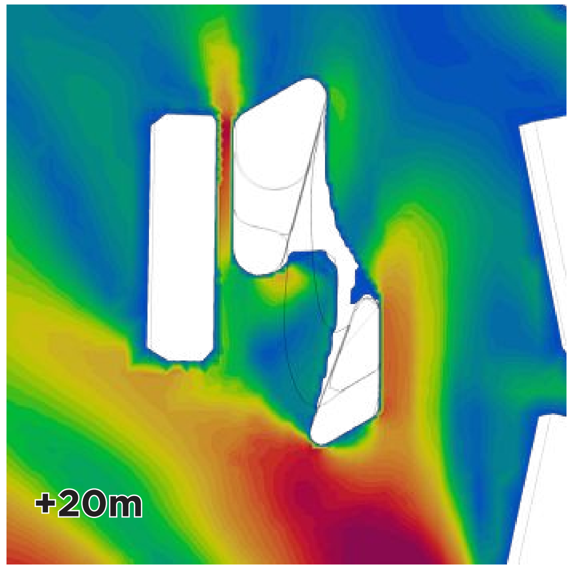


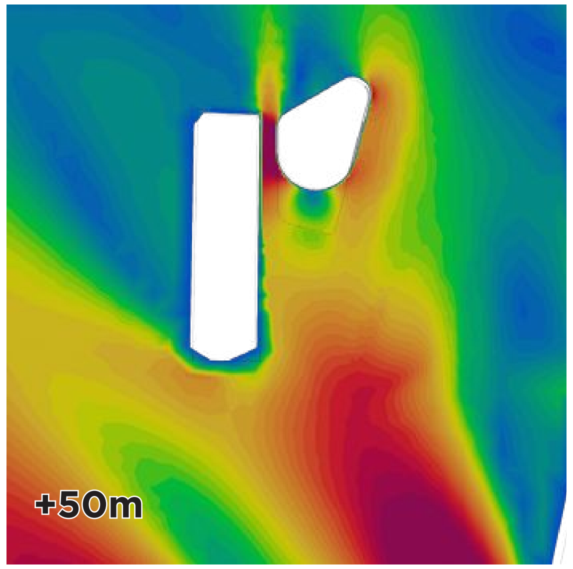
The sectional wind profile shows three major regions of wind speed, +5m, +20m and +50m.



In this axonometric cut you can see that there is a breeze that passes through our residential corridors, providing ventilation, due to the pressure difference between the corridors and the external environment





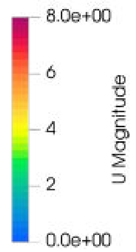


The sectional wind profile shows three major regions of wind speed, +5m, +20m and +50m.

The slice shows that wind speed is relatively constant around 3m/s which affirms the fact that the wind tunnel is well ventilated, thus ensuring natural cooling.

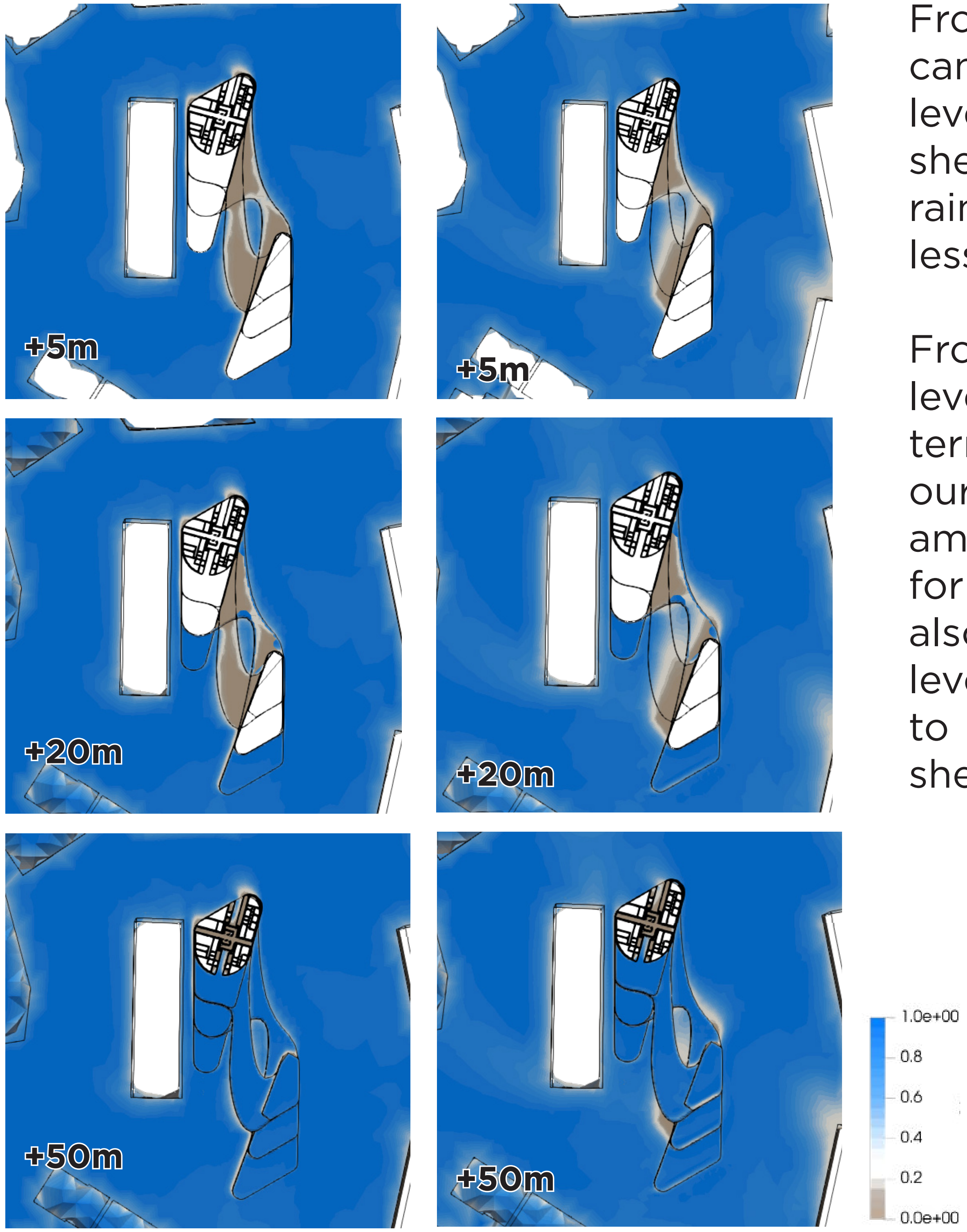
The wind speed diagram at +5m shows a relatively calm wind speed at around 2-3m/s which is where the mixed retail area is located. These spaces are more likely to be air-conditioned due to large volumes of people moving around.

For 20m and above, the wind speed is higher in the region of 4m/s. This is where the residences are located and where cross ventilation is encouraged. This is desirable for us as it'll effectively cool the apartments with little need for air conditioning



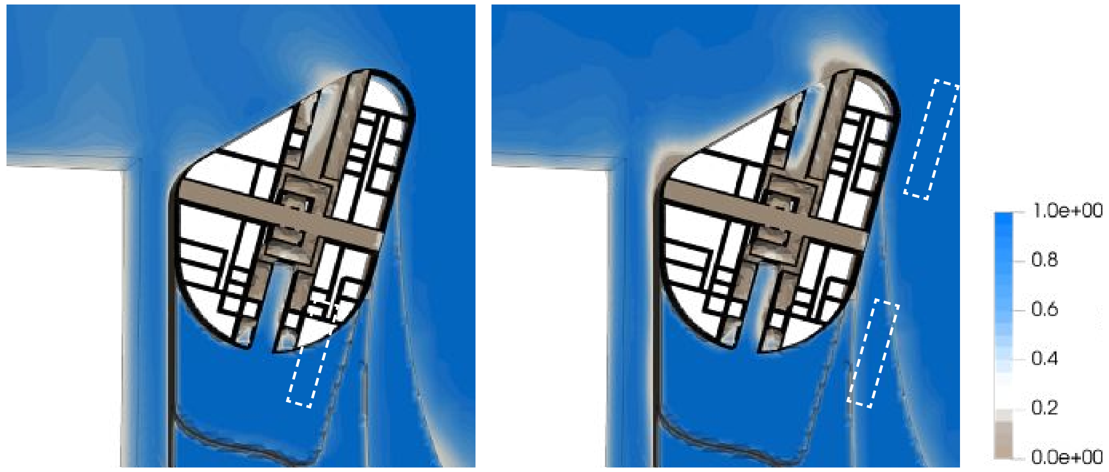
WIND DRIVEN RAIN SIMULATION

5mm 0.5mm



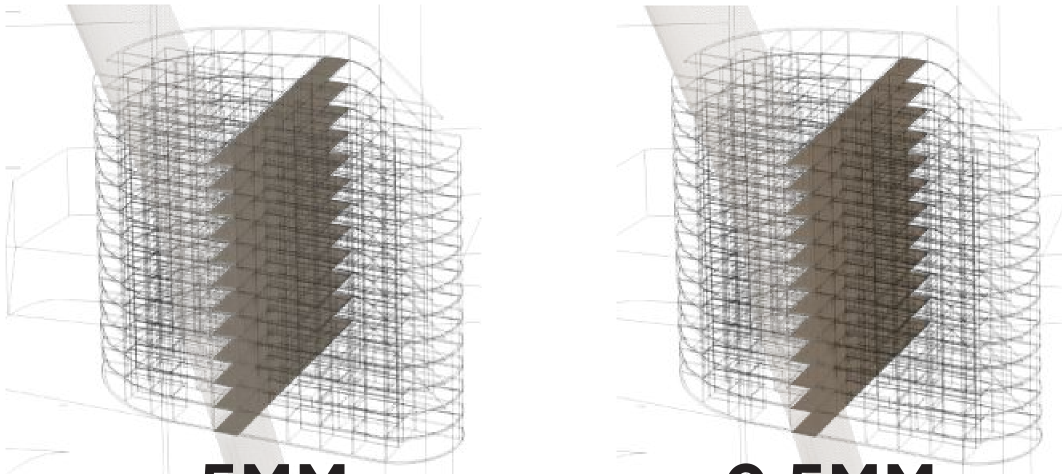
From the +5m level, we can see that our ground level public space is well sheltered from the large raindrops, and slightly less from smaller droplets.

From the +20 and +50m levels, we see that our roof terraces and the tops of our skybridges receive ample rainfall, perfect for outdoor gardens. We also see from the +20 level that the entrances to the skybridge remain sheltered from rain.



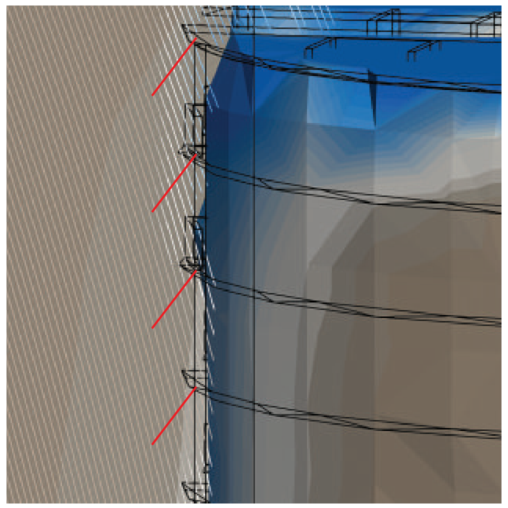
5MM 0.5MM

From these simulations, we see that the voids infront of our units' balconies (dotted white boxes) are susceptible to rain, and hence curb this by placing louvers along the balconies.



5MM 0.5MM

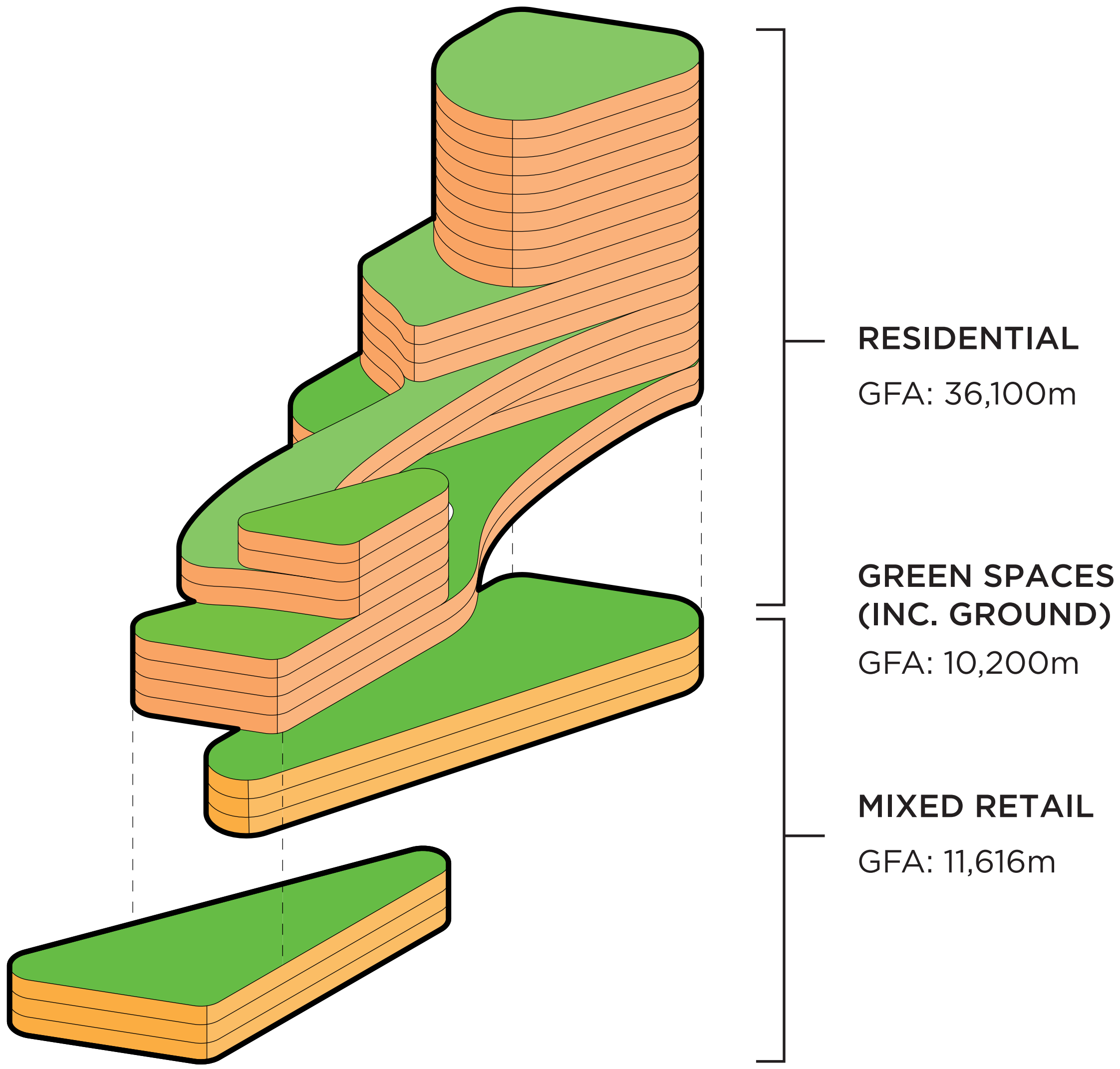
Based on these simulations, we can see that very little rain enters our residential corridors. In addition to this, we've added louvers to shelter potential ares more susceptible to rain along the corridors

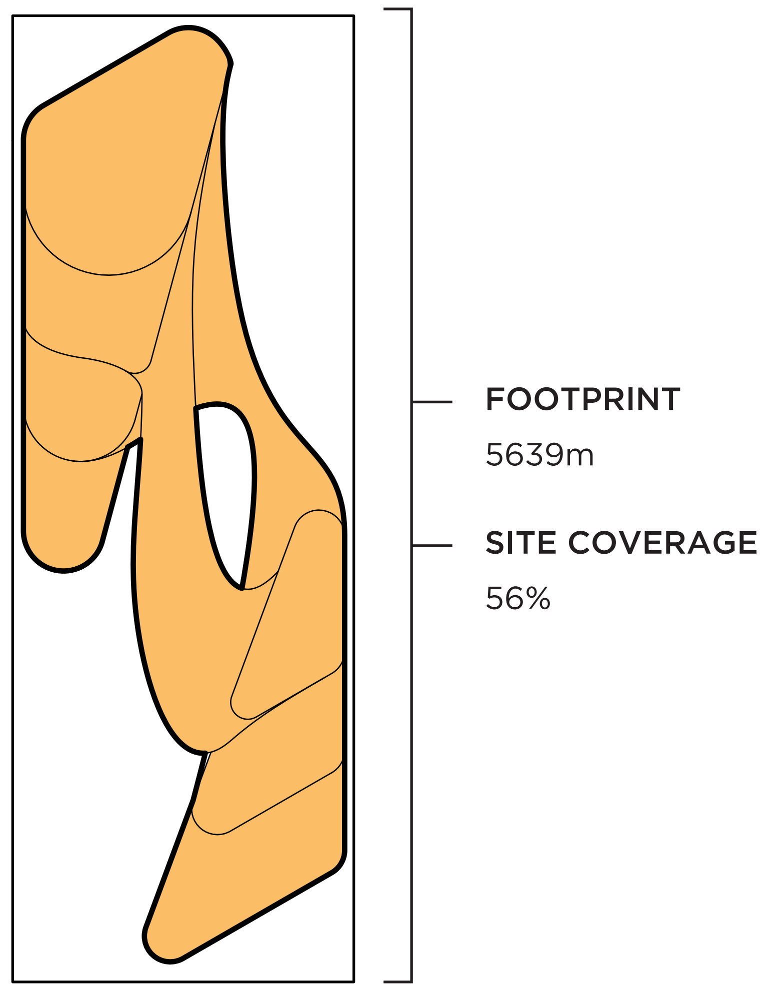


RAIN MITIGATION STRATEGY: LOUVERS

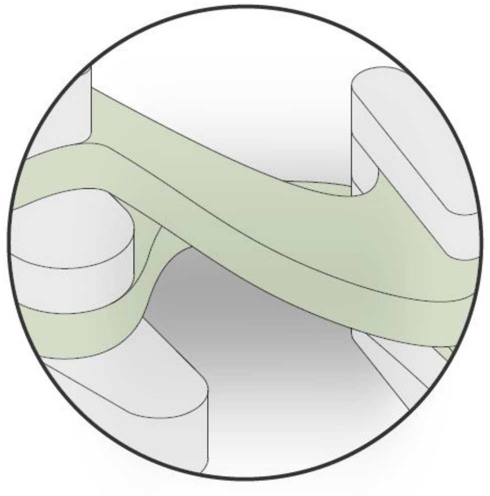
Louvers are angled to prevent rain from entering the corridors, while allowing ventilation.

FINAL MASSING



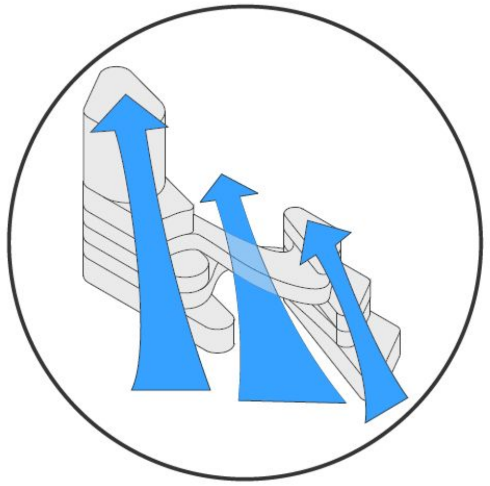


THERMAL COMFORT CONCEPT



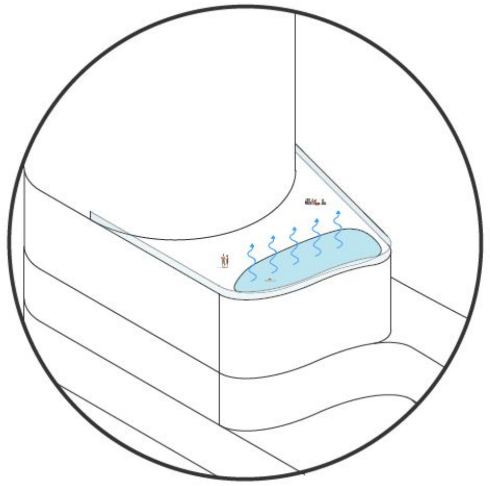
1. SHADE

blocks solar radiation to the human body and reduces solar gains on exterior surfaces



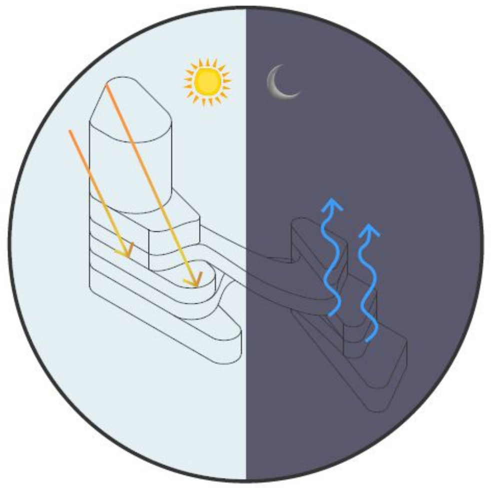
2. AIR MOVEMENT

improves comfort so that the body feels several degrees cooler



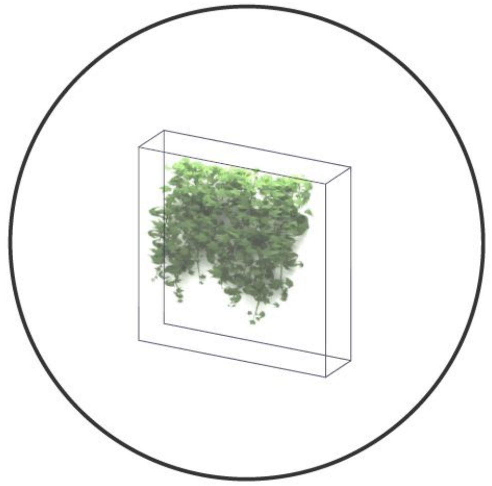
3. EVAPORATIVE COOLING

reduces air temperature through evaporation of water when the air is hot and dry



4. THERMAL MASS

heat stored in the day is released at night



5. GREEN SURFACES

they provide protection and shade to walls and floors so that they don't overheat, and they provide some evaporative cooling

FAÇADE ITERATIONS

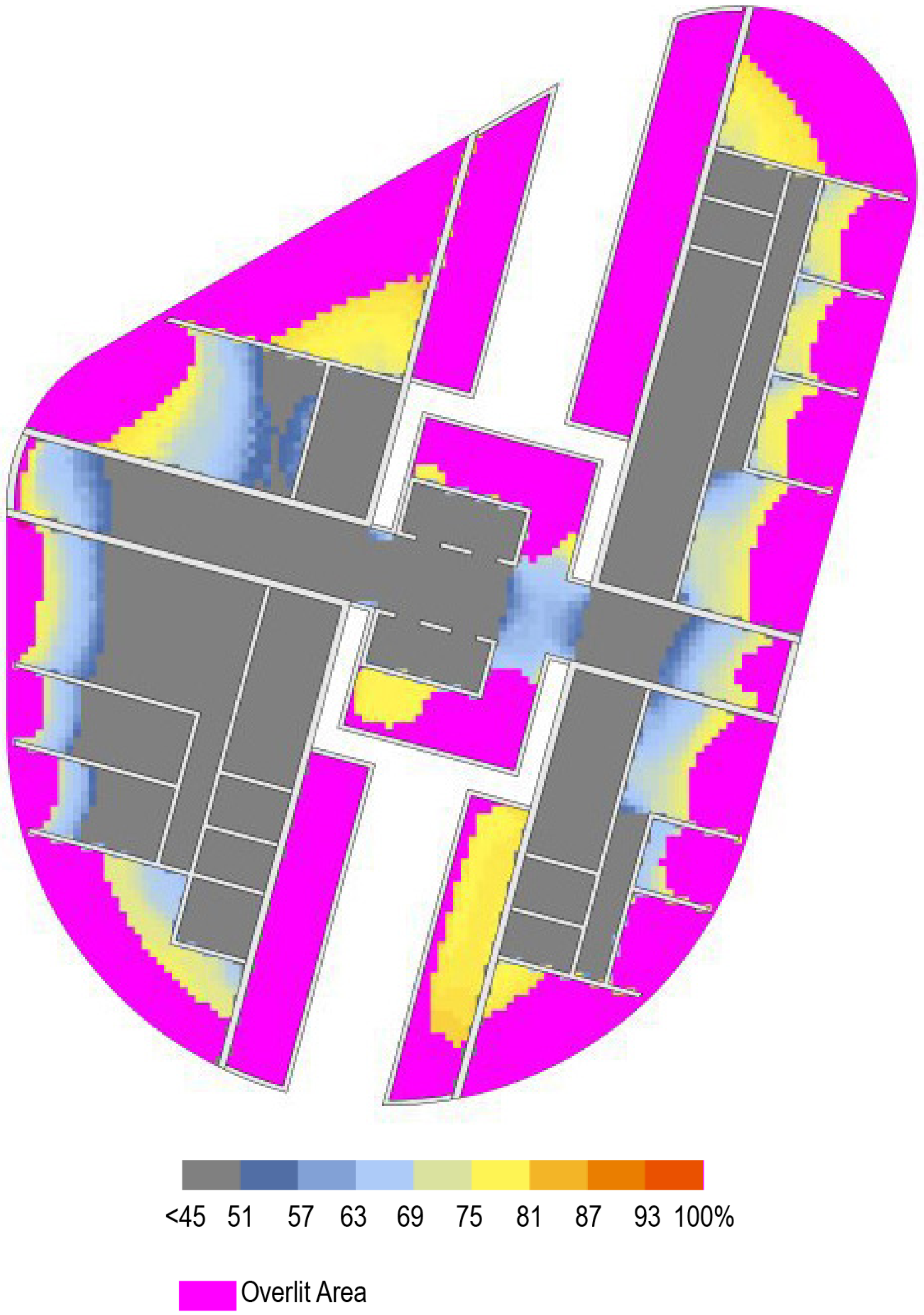
Baseline Model Analysis

We ran a baseline analysis on a typical floor of our building without a façade to determine which face would require shading. From the annual illumination simulation, we can tell that most of the areas near the windows are overlit.

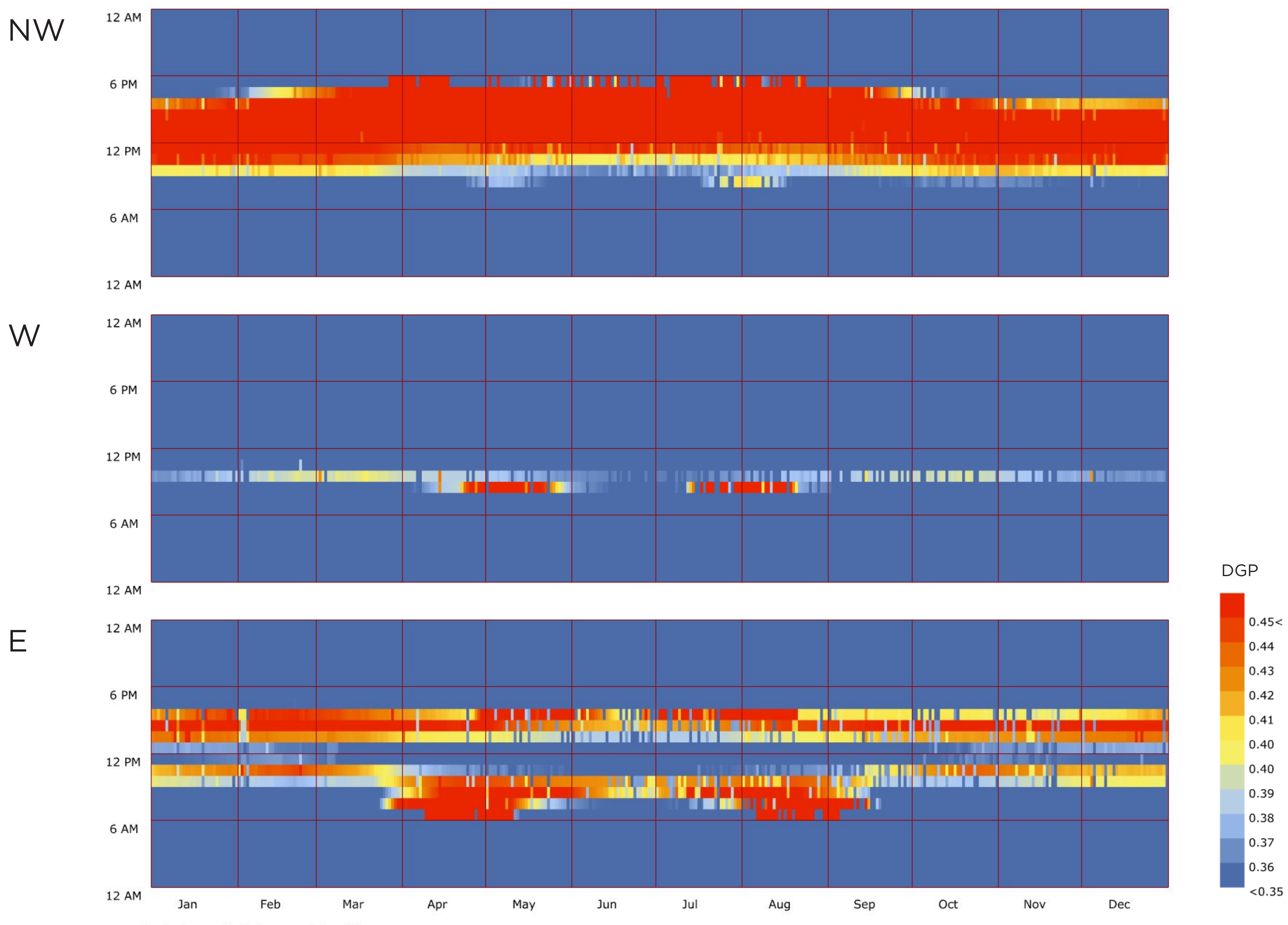
From the annual daylight glare simulation, we see that there is intolerareble glare in the afternoon throughout the year, espcially on the northwest facade.

Due to the adjacent building on the west side of our building, that face receives adequate shading and thus, the glare is comparatively lower than the other sides.

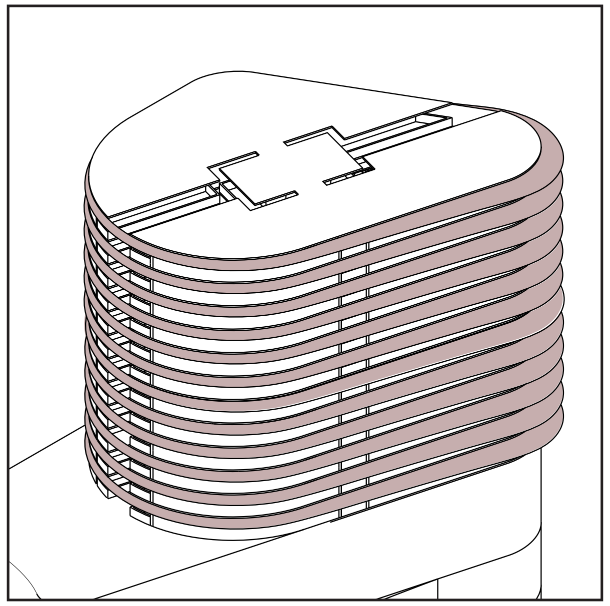
The east façade is not as well shaded and thus the ADG analysis shows a larger percentage of time where the building experiences intolerable glare especially in the morning and evening when the sun rises and sets. There is a consistent bar of imperceptible glare around 12pm, presumably because that's when the sun is directly overhead.



ANNUAL ILLUMINATION



ANNUAL DAYLIGHT GLARE POTENTIAL

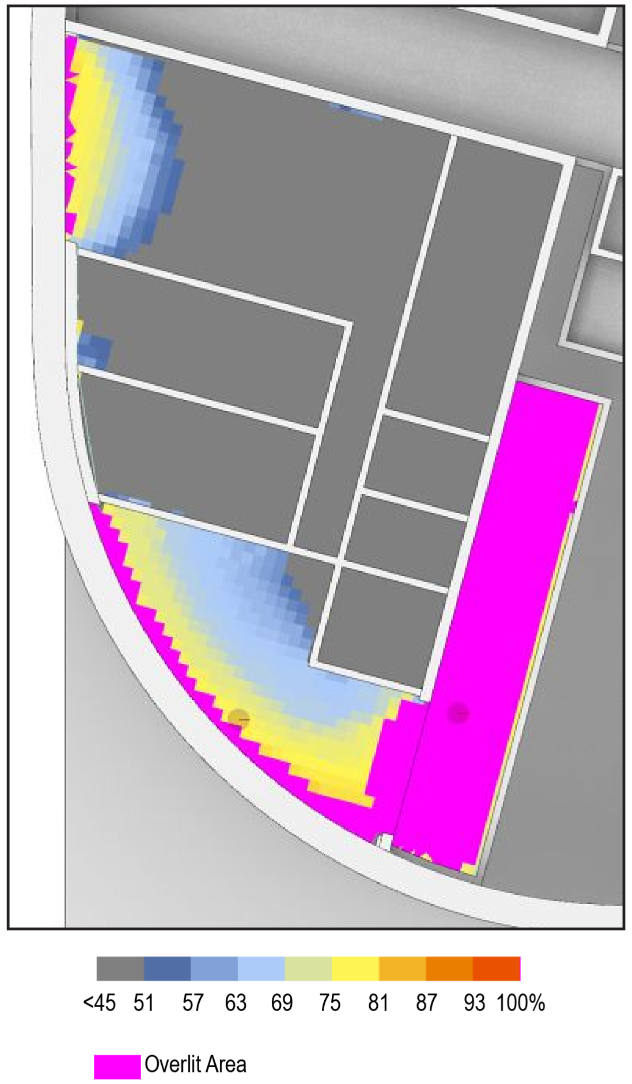


FACADE 1: OVERHANGS
(VARIED WIDTH, UNIFORM TILT)

We decided to implement louvers for our façade to allow air or light in while keeping sunshine or moisture out. We tilted the louvres and varied the length according to the different faces based on the previous analysis on which side would require greater shading.

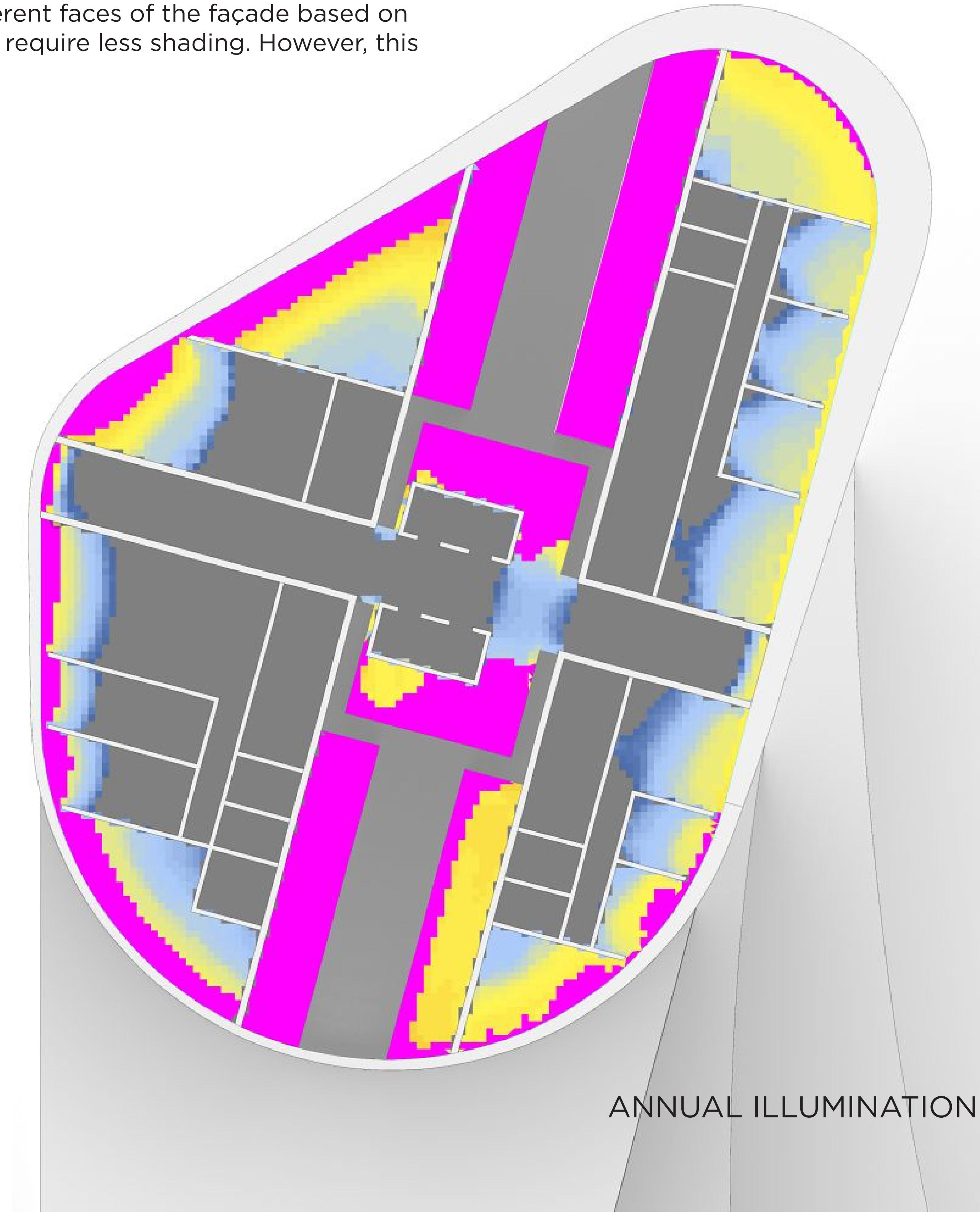
The annual illumination for the floor gives a visual representation of the daylit area (assuming no exterior walls) based on a overhang that is tilted down by 1 metre. Our intent for this façade was to vary the width of the overhang at the different faces of the façade based on our intuition that the side adjacent to the building would require less shading. However, this simulation shows that the overhang is insufficient.

UNIT ANALYSIS



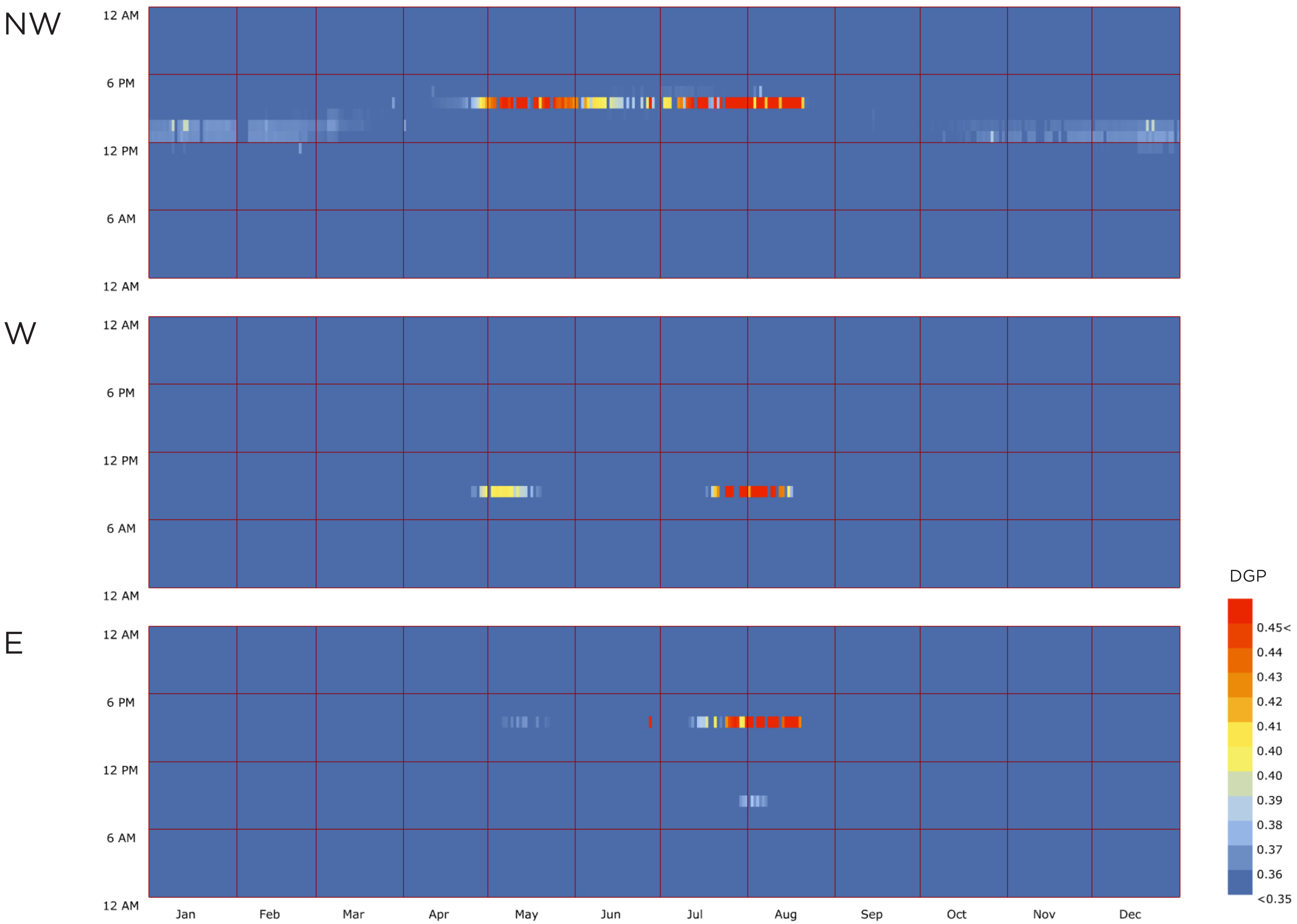
USEFUL DAYLIT AREA:	**10.8%**
UDI 3000 LUX 10% OF THE TIME:	**28.5%**
UDI 200 LUX 50% OF THE TIME:	**39.3%**

From the analysis, it looks like the entire unit is overlit and the façade is thus rather ineffective in shading the unit. Further iterations need to improve the performance especially on the south facing façade.



ANNUAL ILLUMINATION

FACADE 1: OVERHANGS
(VARIED WIDTH, UNIFORM TILT)



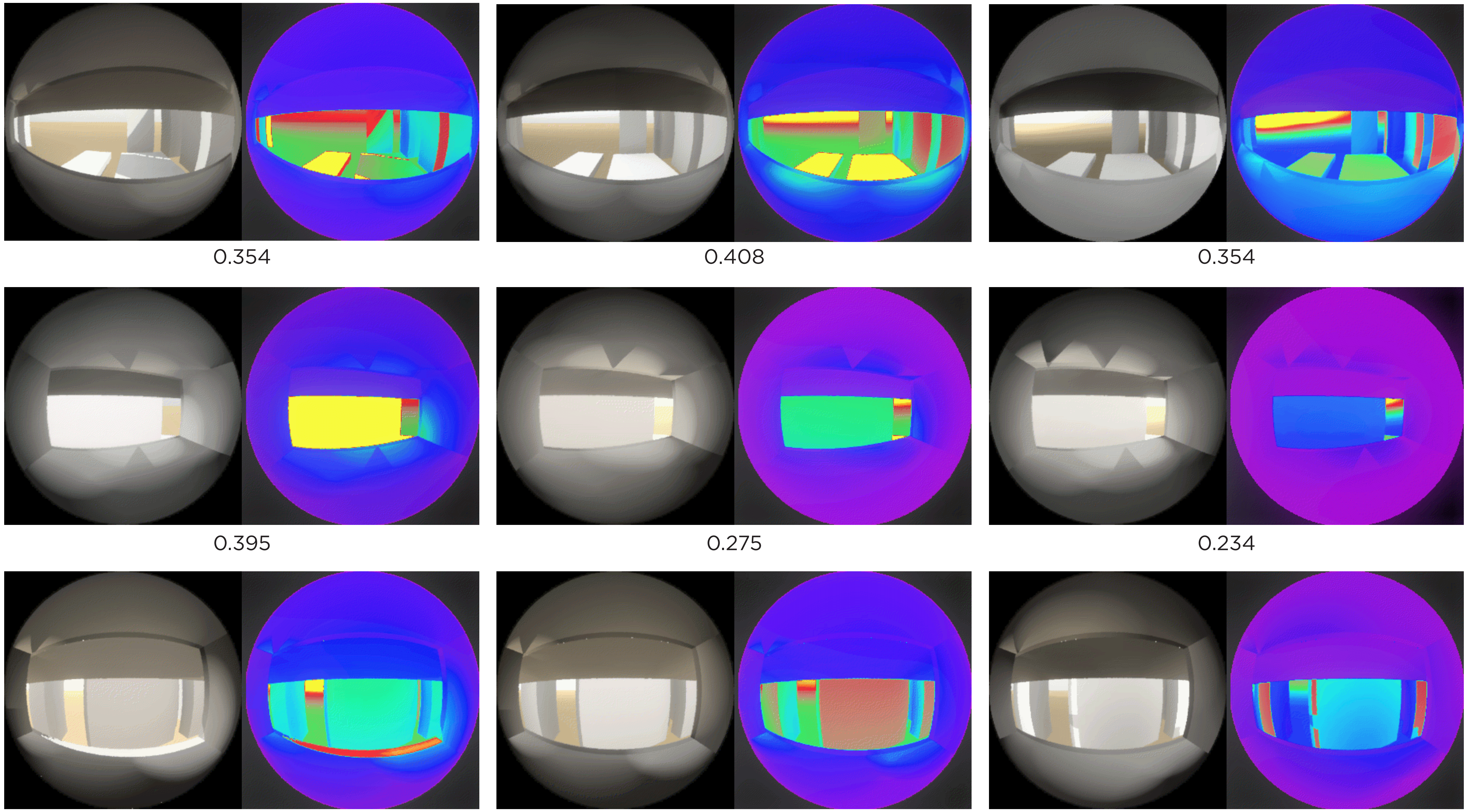
ANNUAL DAYLIGHT GLARE POTENTIAL

The Northwest façade receives mostly imperceptible glare through the day. Intolerable glare is experienced in May, July-Aug evenings, probably from the settigng sun. The façade design is more than sufficient in reducing the glare. Perceptible glare should be experienced and thus the façade design has to be changed so as to allow more light in.

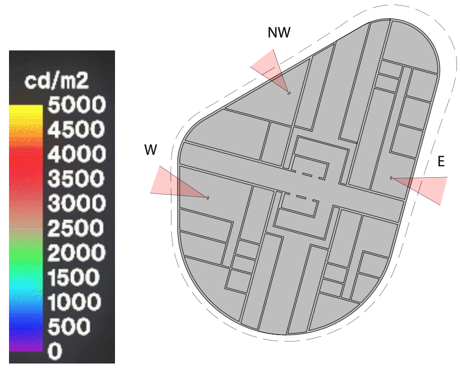
Due to the adjacent building on the west side of our building, there is adequate shading and thus, the glare is comparatively lower compared to the Northwest façade which is exposed to the Sun. The façade design has slightly reduced the prevalent glare but is not very signficant as the glare on the west façade was already low to begin with. It has also made the daylight glare for the rest of the months imperceptible which is undesirable.

The east façade is not as well shaded as the west façade and thus the ADG analysis shows a larger percentage of time where the building experiences intolerable glare especially in the morning and evening when the sun rises and sets. The façade design is insufficient in reducing the glare experienced on the east façade.

FACADE 1: OVERHANGS
(VARIED WIDTH, UNIFORM TILT)



	9AM	1PM	5PM
NW DGP	0.354	0.408	0.354
W DGP	0.395	0.275	0.234
E DGP	0.328	0.350	0.255

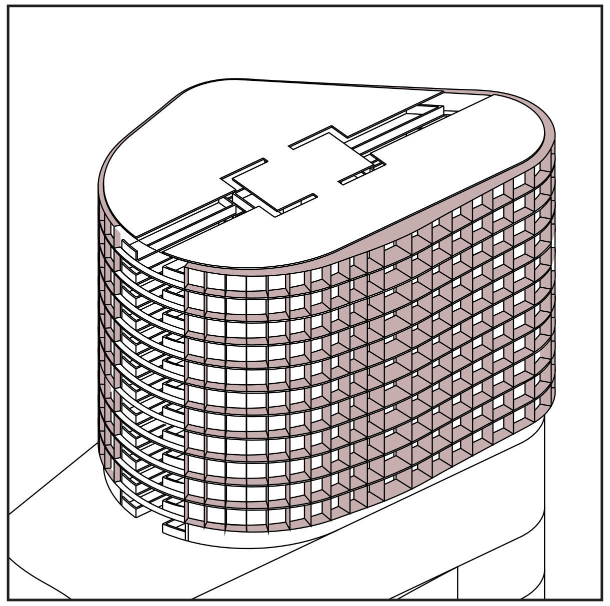


The northwest facades experiences desirable glare as the DGP values all fall within the perceptible glare range, except for 1pm where it slightly exceeds the optimal range.

The west facade has very low glare in general, thanks to the high rise neighbouring building on the west of the building. Most of the day the DGP is below 0.35 which means it is imperceptible at all. Except in the morning where there is reflection of the morning sun from the neighbouring building.

The east glare in the morning and evening is imperceptible while the east glare in the afternoon is perceptible.

IMAGE BASED GLARE



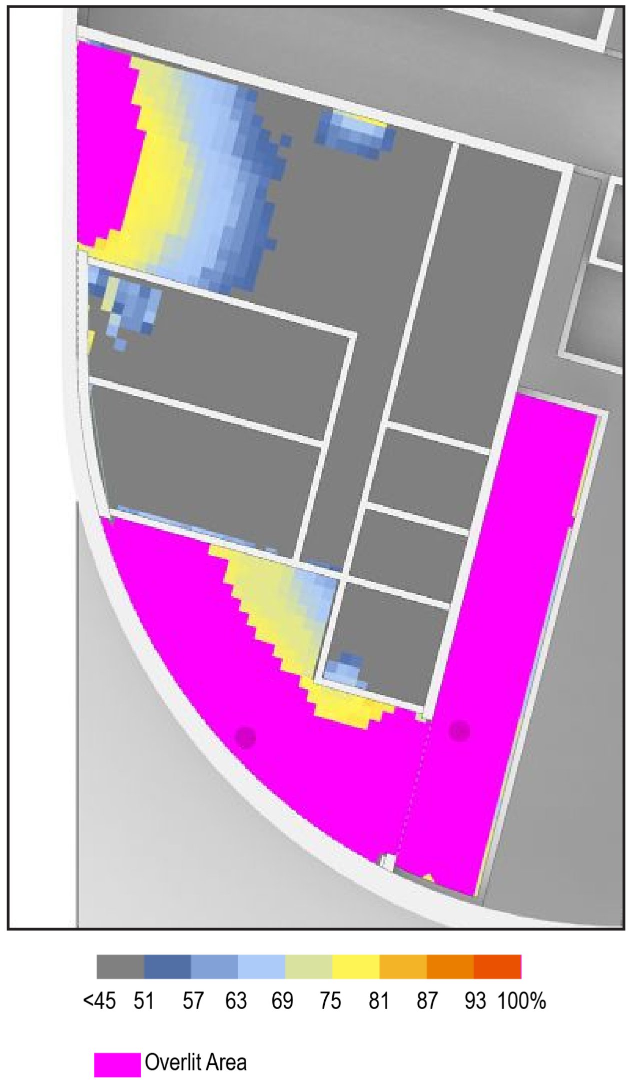
FACADE 2: ADD LOUVERS

(FLAT OVERHANGS, TILTED LOUVERS)

For this façade iteration, we included vertical fins to ensure privacy for the residents especially for the façade face that is near to the adjacent building. We hypothesise that it will also help to increase shading from the evening sun when the declination angle is lower and the overhangs would not help as much.

Based on visual analysis, it seems that the northwest facade still experiences significant areas that are overlit (not considering the service yards). However, it is an improvement from the previous facade iteration.

UNIT ANALYSIS



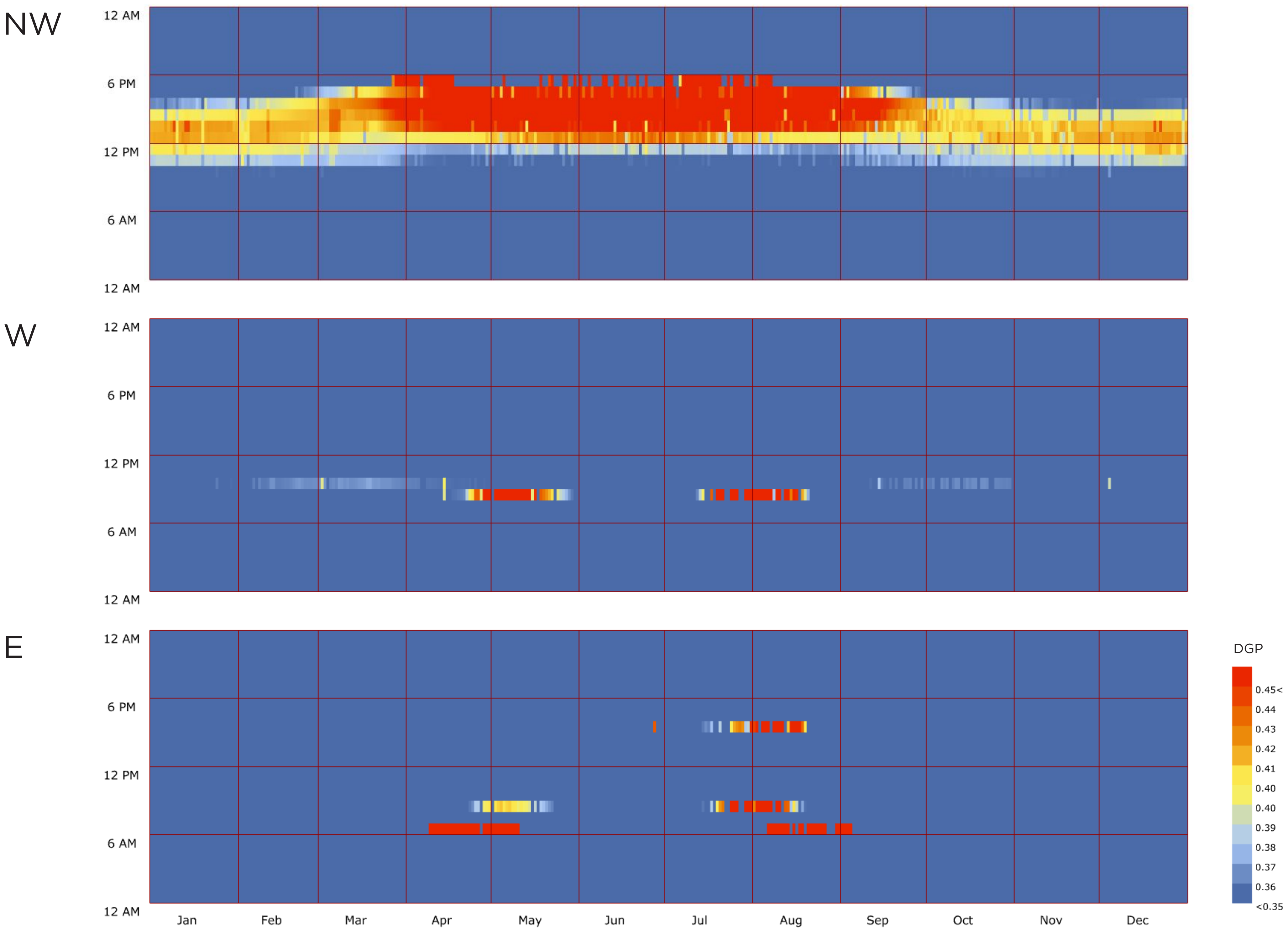
USEFUL DAYLIT AREA:	**19.0%**
UDI 3000 LUX 10% OF THE TIME:	**21.0%**
UDI 200 LUX 50% OF THE TIME:	**40.0%**

From the analysis, it looks like the south facing side of the unit is overlit. The west side has varied results, where the room intended for the living room is quite well lit with a percentage of area being overlit. The two bedrooms do not receive as much light as we've intended as we've reduced the size of the windows instead of curtain walls. It might be better for us to increase the size of the windows or revert to curtain walls to ensure sufficient sunlight into the bedrooms.

The UDI 200 lux (50%) value is quite desirable considering that we only have windows where the bedrooms and living room are located which is where we need the most light in.

ANNUAL ILLUMINATION

FACADE 2: ADD LOUVERS
(FLAT OVERHANGS, TILTED LOUVERS)



ANNUAL DAYLIGHT GLARE POTENTIAL

The annual daylight glare exceeds the perceptible glare range most of the time as the vertical fins do little to shade the unit from the sun. Thus, the rooms within the units receive a high amount of glare as reflected in the the DGP values being higher then 0.4.

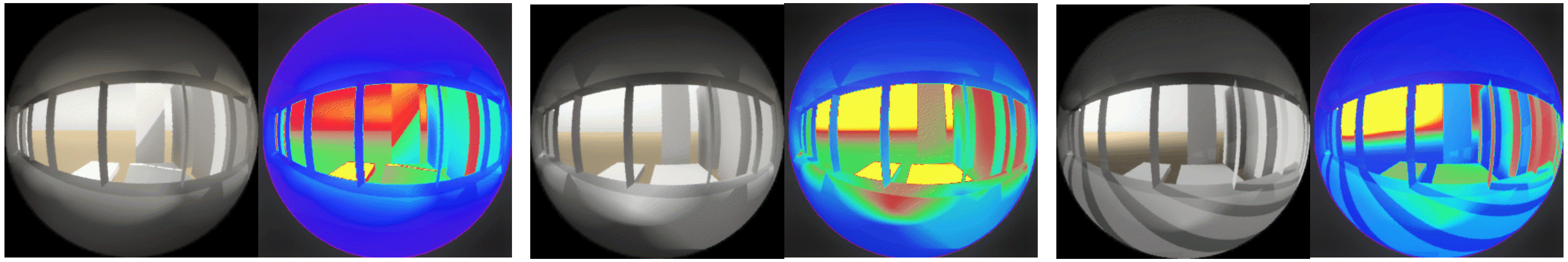
The west facade seems to perform satisfactorily as there is a building adjacent to ours and provides shading from the sun. Thus the illuminance incident on the building is significantly lower as compared to the other faces of the façade.

The east façade experiences imperceptible glare through the day. Early morning glare in Apr/May and Jul/Aug and afternoon sun in Jul/Aug is intolerable. Comparing it to façade 1, façade 2 helps to reduce the amount of glare experienced from the East.

FACADE 2: ADD LOUVERS
(FLAT OVERHANGS, TILTED LOUVERS)

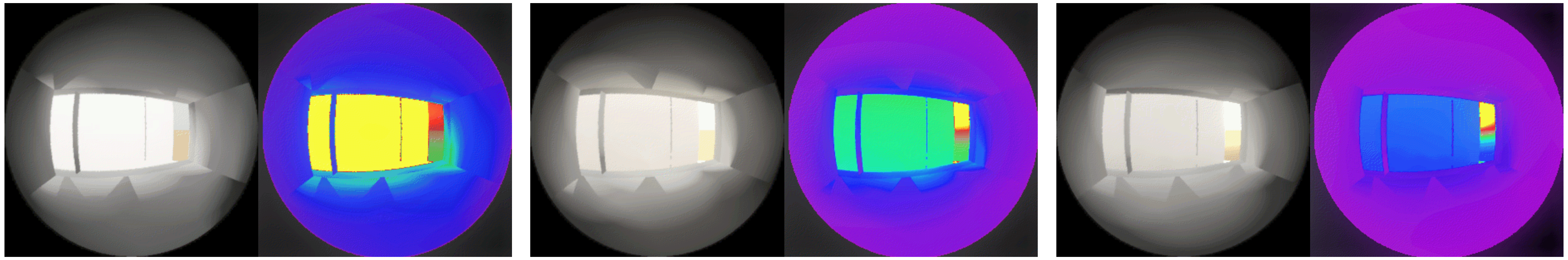
9AM **1PM** **5PM**

NW



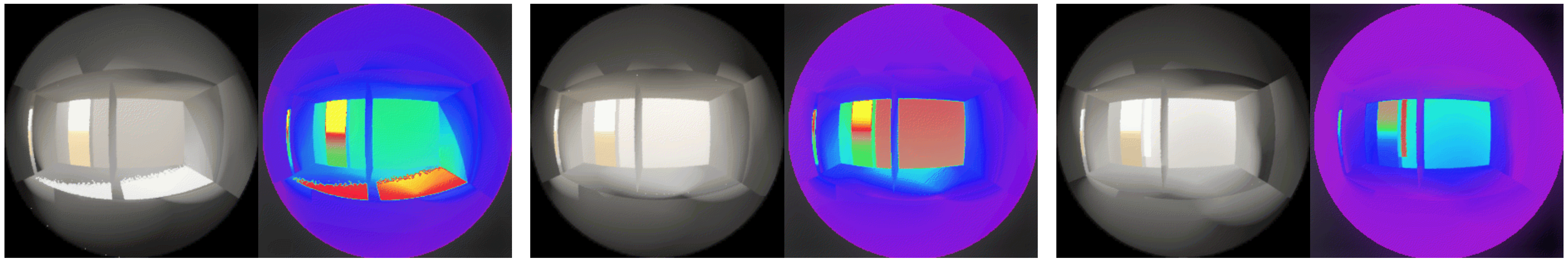
DGP 0.383 0.493 0.468

W

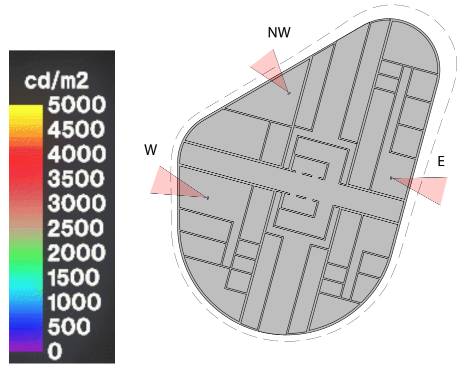


DGP 0.444 0.270 0.242

E



DGP 0.350 0.331 0.263

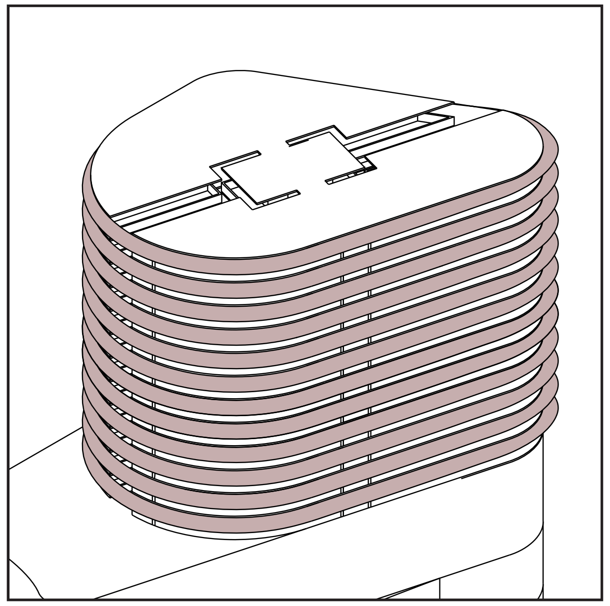


The glare on the northwest façade is relatively bad especially from 1pm to 5pm as it exceeds the disturbing glare range.This leads as to conclude that the titled vertical fins are not sufficient in combating the glare on the north west façade.

The glare on the west façade is most imperceptible except during the morning. This is mainly due to the reflection of the morning sun from the neighbouring building. Thus, the tilted vertical louvers are not enough to prevent the morning glare due to the reflection from the neighbouring building.

Base on the analysis, we can tell that east glare is generally acceptable through the day. As evening comes, the glare becomes imperceptible.

IMAGE BASED GLARE



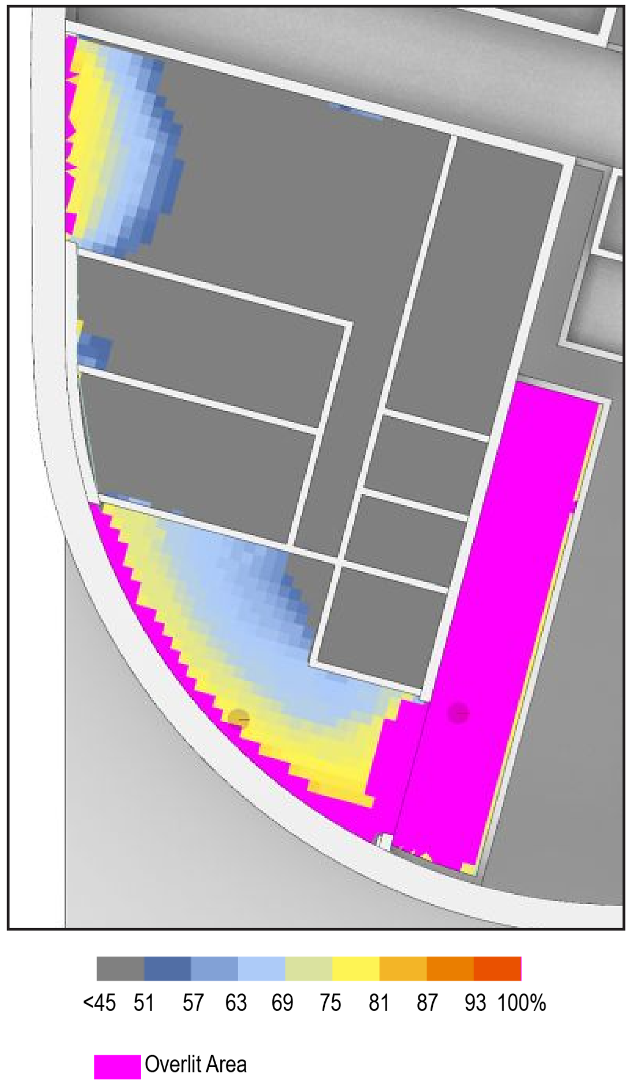
FACADE 3: WAVE OVERHANGS

(TILTED OVERHANGS, NO LOUVERS)

This façade is an iteration of the first façade design by angling the overhang differently using the results from the analysis of the first façade. This excludes the vertical fins as we wanted to see a direct comparison between the first façade design and this iteration.

This façade shows a slight improvement in the percentage of overlit areas on the general floor plan. The overlit areas at the southwest façade are reduced but the areas on the northwest facade still remains quite prominent.

UNIT ANALYSIS



USEFUL DAYLIT AREA: 23.0%

UDI 3000 LUX 10% OF THE TIME: 17.0%

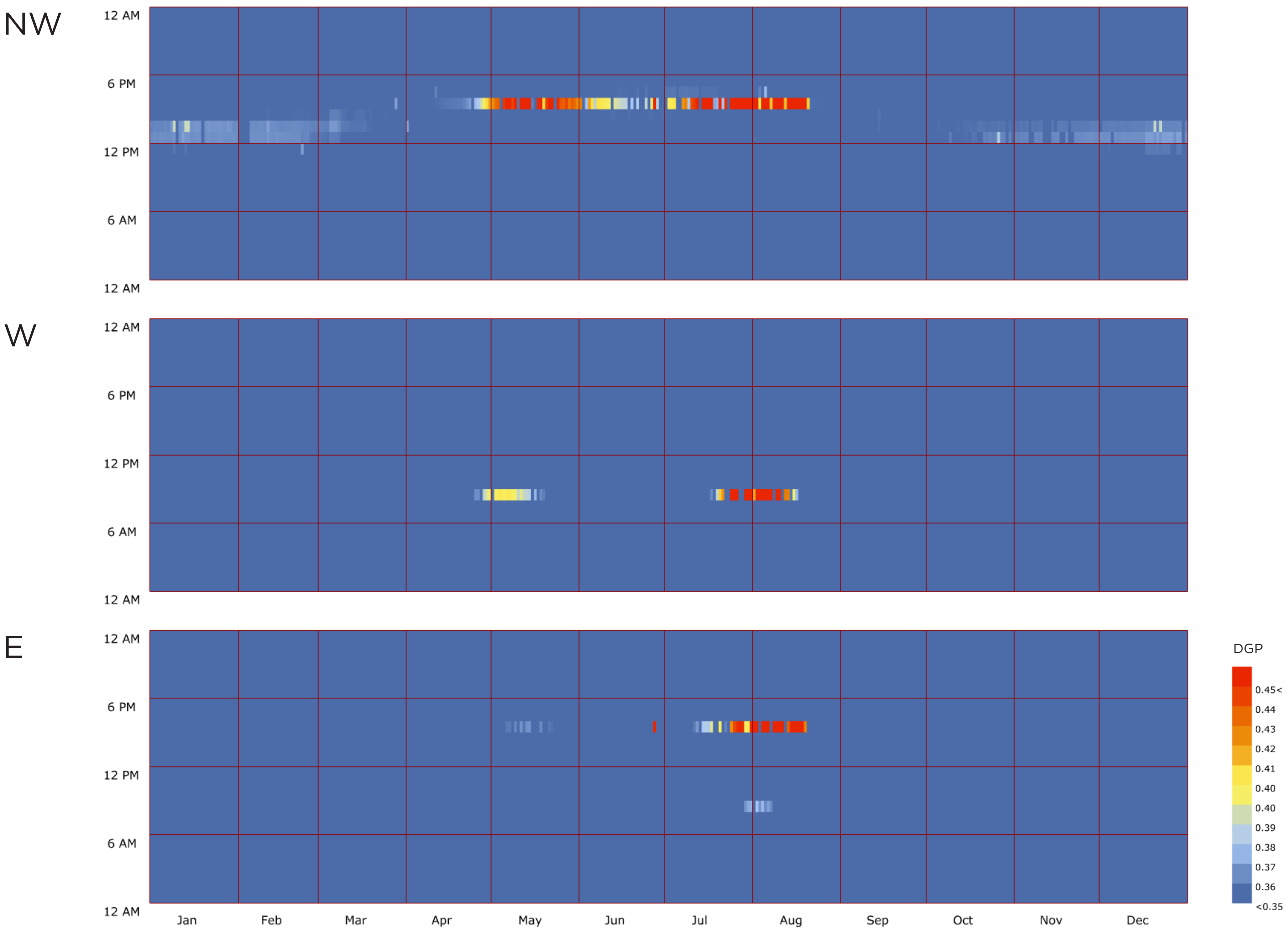
UDI 200 LUX 50% OF THE TIME: 41.8%

From the analysis, it looks like the south facing side of the unit is very well lit with minimal area being overlit. The living room space above has a good percentage as well. However we realised that the window for the two bedrooms are blocked by the angled louver and thus decreasing the daylit area significantly.

The UDI 200 lux (50%) value is quite desirable considering that we only have windows where the bedrooms and living room are located which is where we need the most light in.

ANNUAL ILLUMINATION

FACADE 3: WAVE OVERHANGS
(TILTED OVERHANGS, NO LOUVERS)



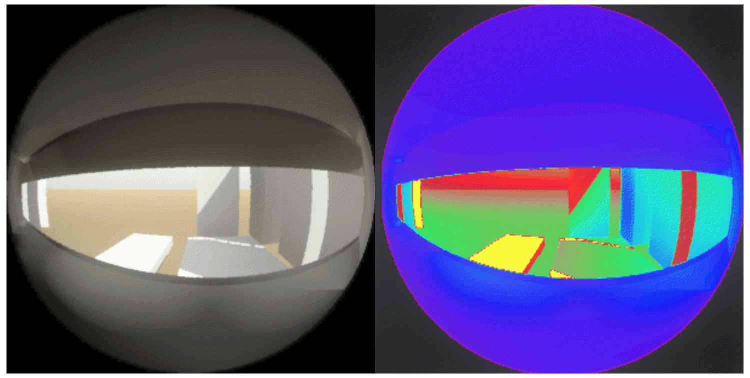
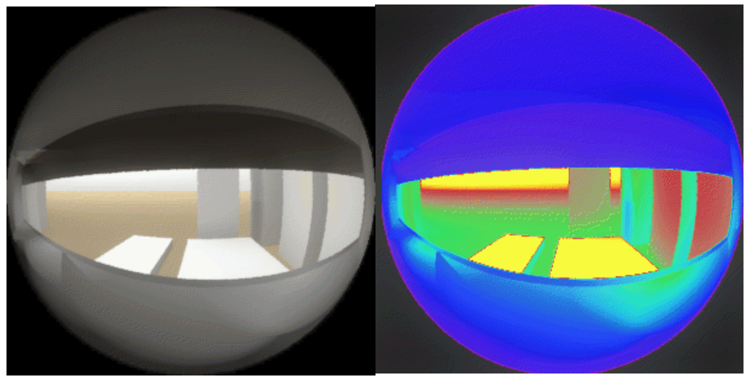
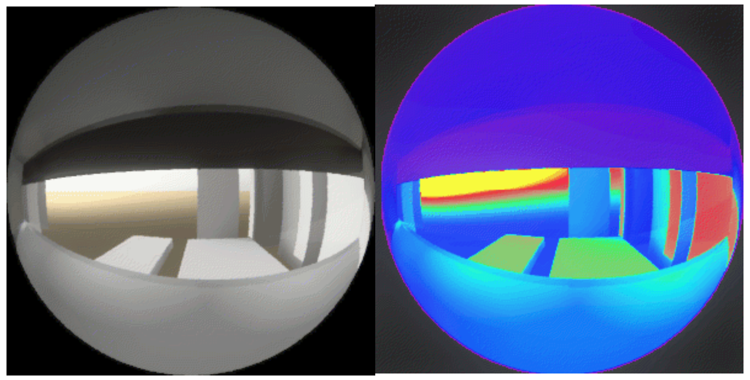
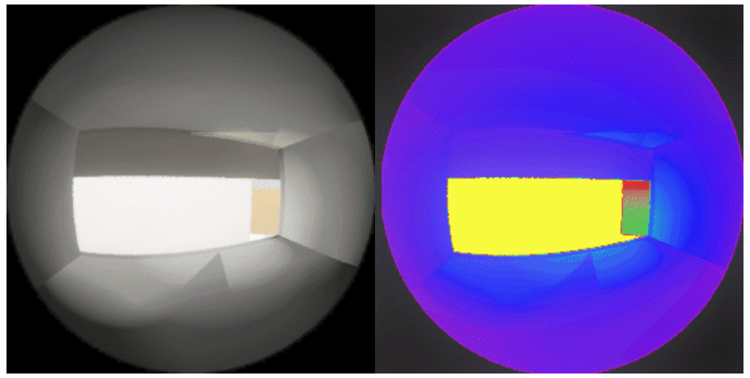
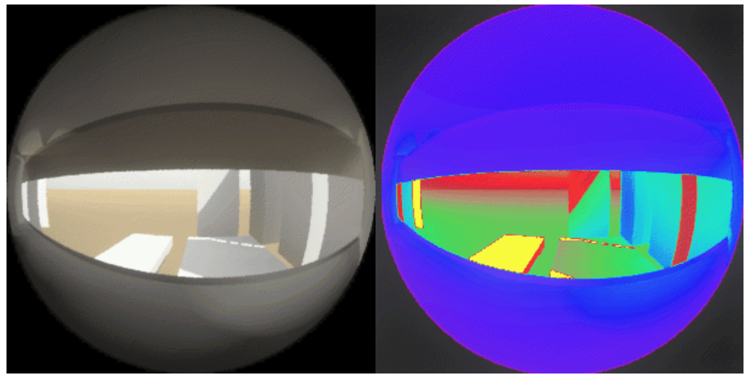
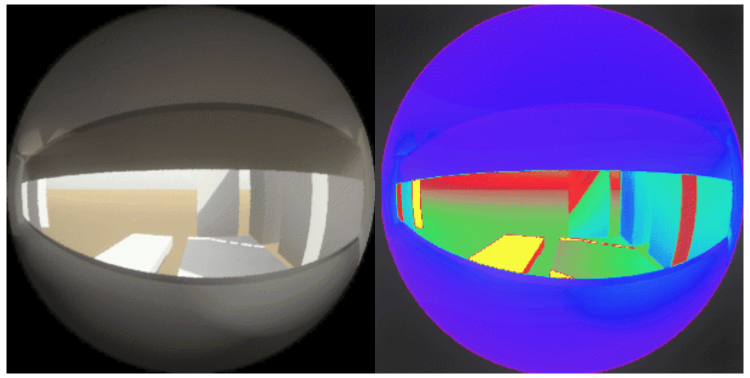
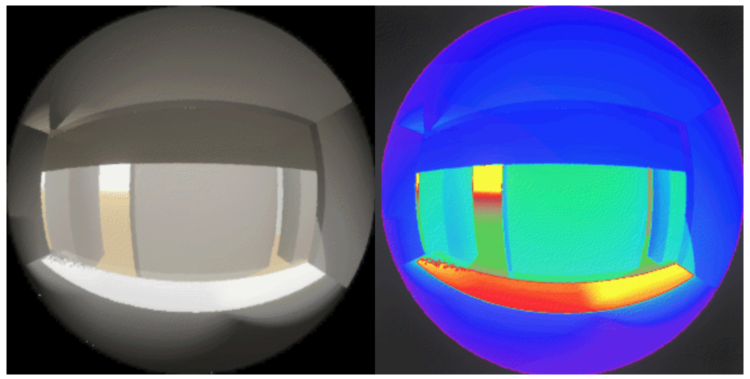
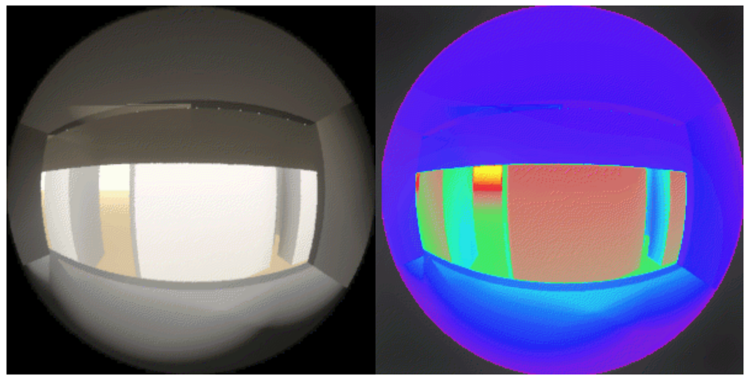
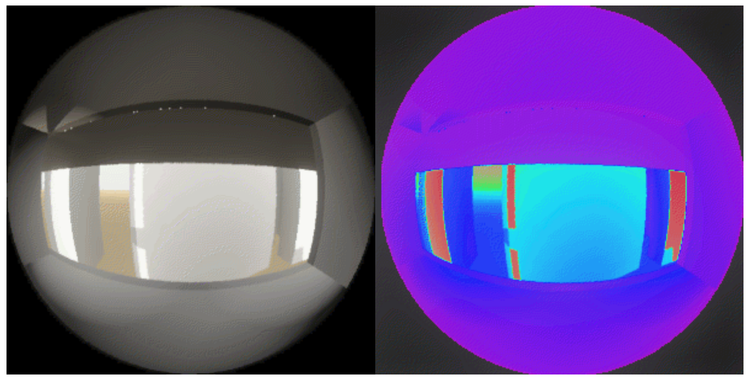
ANNUAL DAYLIGHT GLARE POTENTIAL

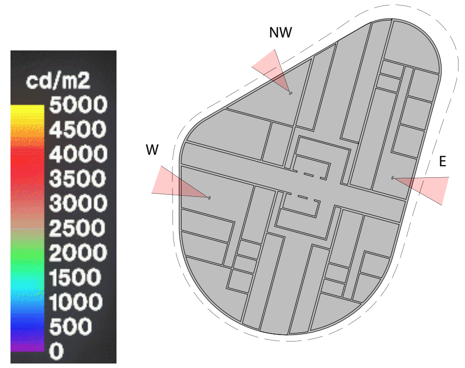
The glare still remains generally acceptable with the DGP exceeding the perceptible glare rangle during the months of May to Aug at roughly 3pm. The glare outside of this time fluctuates within the perceptible glare range which is ideal. This gives us the affirmation that the third façade iteration is more effective in lowering disturbing glare but maintaining the glare within the perceptible range.

The west facade remains relatively unaffected due to the adjacent building, with pockets of time at around 9am where there is intolerable glare during May and Aug. We chose not to rectify this as it would mean severely depleting the daylight entering the unit. Hence, we made this tradeoff by allowing the glare to enter the intolerable range for a short period of time but ensuring that the unit is sufficiently lit.

The east façade performs relatively well, with the period from mid July to mid Aug at around 9am and 4pm having the highest DGP value that exceeds the perceptible glare range. However, if additional measures are taken, it would reduce the DGP values to dip below the perceptible range which would not be ideal as we want to ensure that there is good perceptibility within the unit.

FACADE 3: WAVE OVERHANGS
(TILTED OVERHANGS, NO LOUVERS)

	9AM	1PM	5PM
NW			
DGP	0.356	0.414	0.361
W			
DGP	0.387	0.272	0.233
E			
DGP	0.387	0.414	0.261

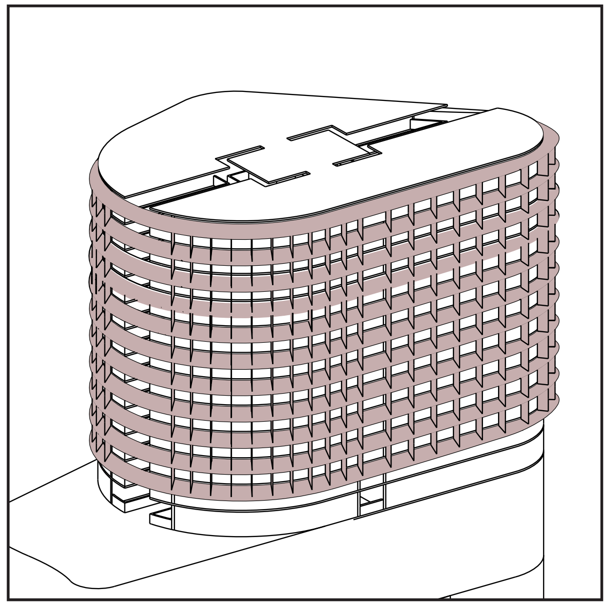


The northwest facades experiences desirable glare as the DGP values all fall within the perceptible glare range, except for 1pm where it slightly exceeds the optimal range.

Our building in close proximity with the tall neighbouring building on the western side. The tall building provides shading onto our building. The highest glare on the western side is in the early morning due to the reflection of the morning eastern sun from the neighbouring building. Base on this analysis, west glare is mostly acceptable through the day.

The east glare in the morning to noon is perceptible. The east glare in the afternoon is slightly disturbing and the evening east glare is however imperceptible as the sun starts to go down. Base on this analysis, east glare is mostly acceptable through the day.

IMAGE BASED GLARE



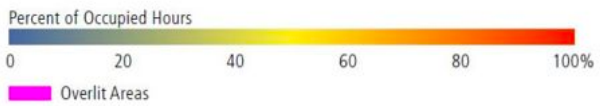
FACADE 4: FINAL

(TILTED OVERHANGS, TILTED LOUVERS)

The final iteration is a combination of the angled overhangs and the vertical fins. The vertical fins has taken into consideration the west sun and has been orientated to provide more shading.

This façade shows a slight improvement in the percentage of overlit areas on the general floor plan. The overlit areas at the southwest façade are greatly reduced with as the vertical fins creates more shade within the building.

UNIT ANALYSIS



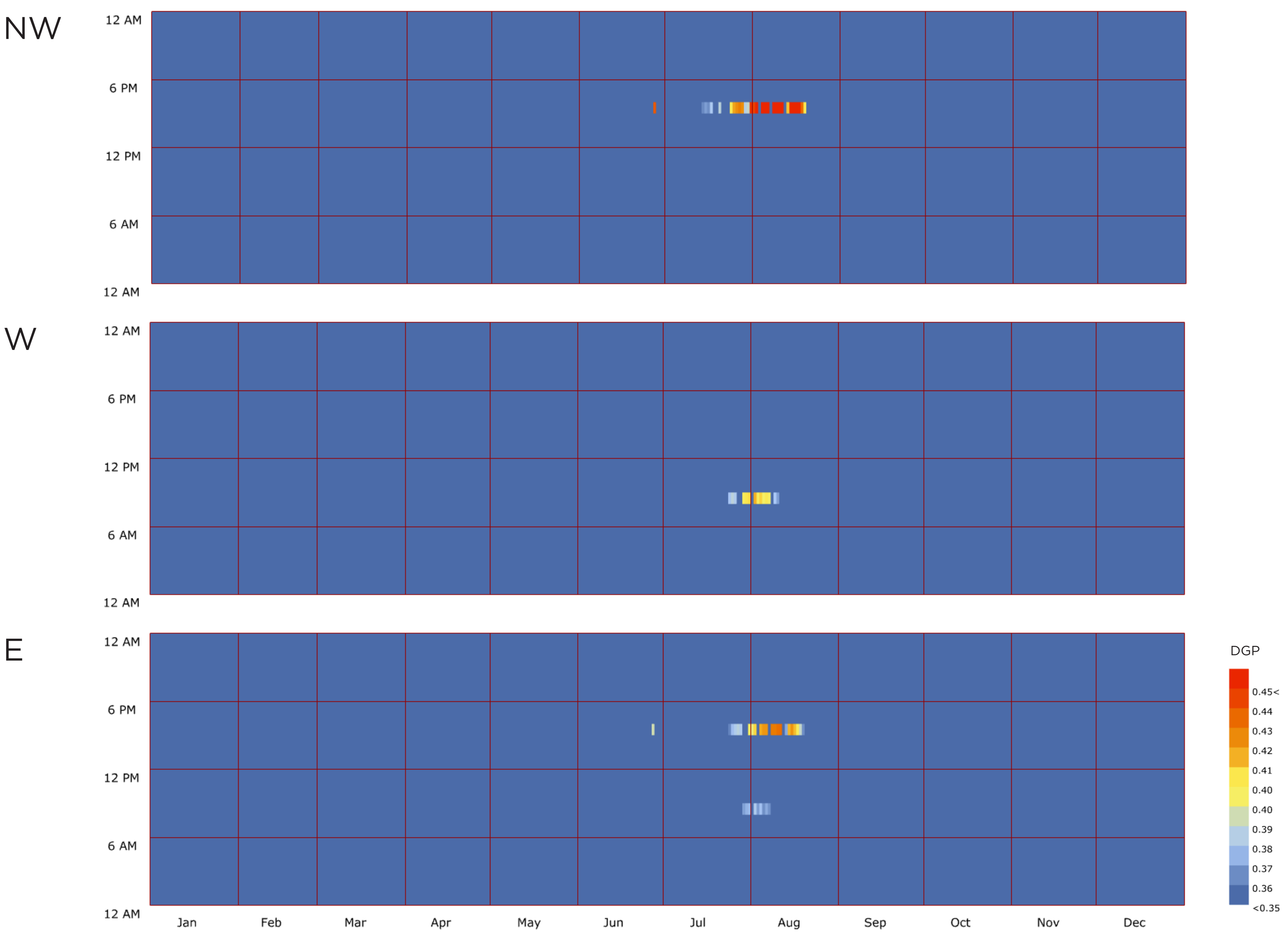
USEFUL DAYLIT AREA:	**52.44%**
UDI 3000 LUX 10% OF THE TIME:	**20.25%**
UDI 200 LUX 50% OF THE TIME:	**32.19%**

From the analysis, it looks like the south facing side is reasonably lit. The living room space above has a good percentage as well.

The UDI 200 lux (50%) value is quite desirable considering that we only have windows where the bedrooms and living room are located which is where we need the most light in.

ANNUAL ILLUMINATION

FACADE 4: FINAL
(TILTED OVERHANGS, TILTED LOUVERS)



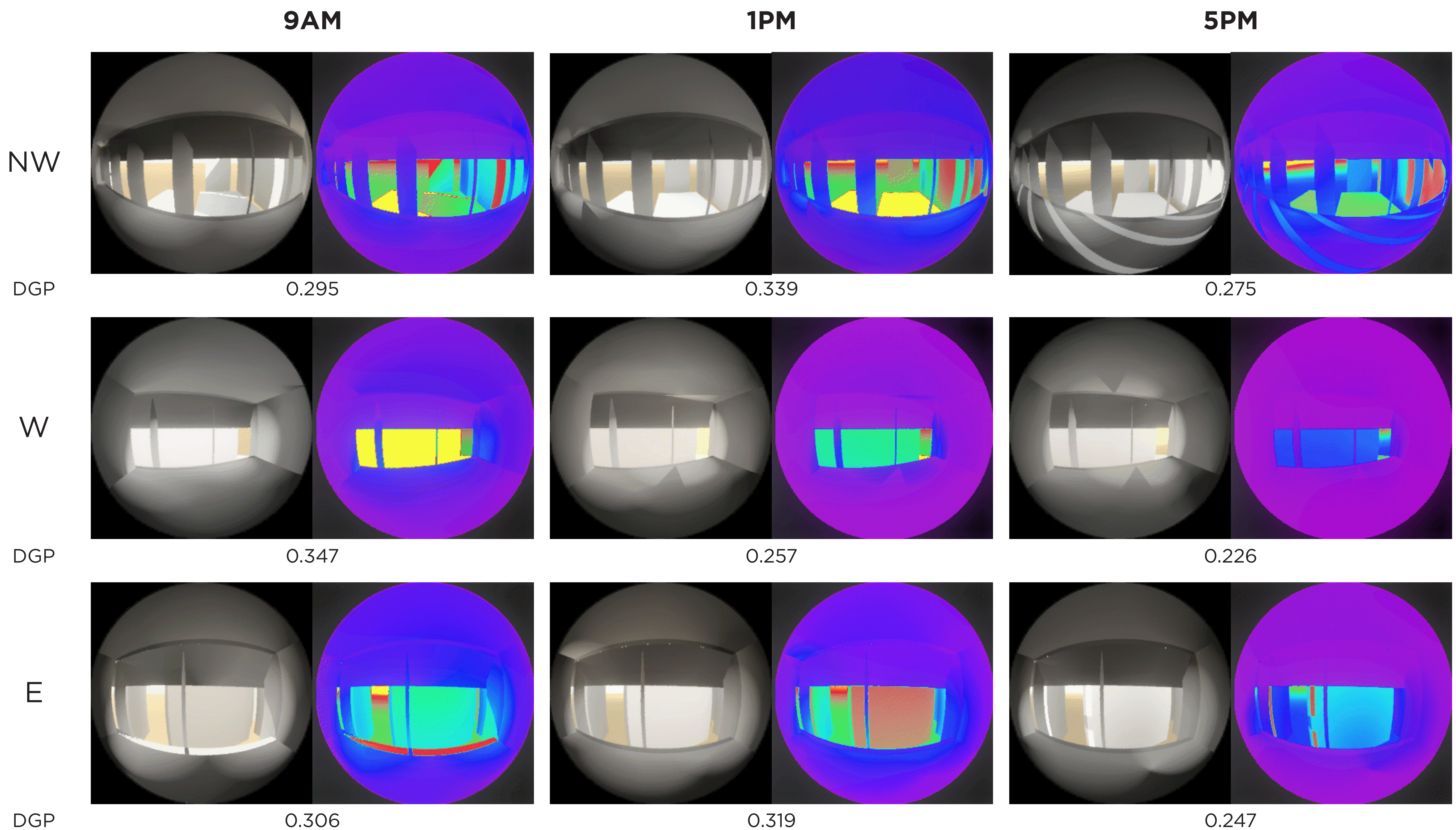
ANNUAL DAYLIGHT GLARE POTENTIAL

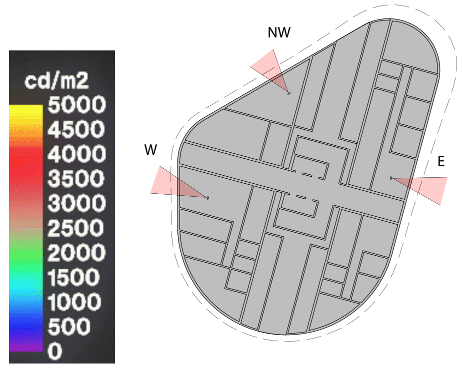
The still remains generally acceptable with the DGP exceeding the perceptible glare rangle during the months of May to Aug at roughly 3pm. The glare outside of this time fluctuates within the perceptible glare range which is ideal. This gives us the affirmation that the third façade iteration is more effective in lowering disturbing glare but maintaining the glare within the perceptible range.

The west facade remains relatively unaffected due to the adjacent building, with pockets of time at around 9am where there is intolerable glare during May and Aug. We chose not to rectify this as it would mean severely depleting the daylight entering the unit. Hence, we made this tradeoff by allowing the glare to enter the intolerable range for a short period of time but ensuring that the unit is sufficiently lit.

The east façade performs relatively well, with the period from mid July to mid Aug at around 9am and 4pm having the highest DGP value that exceeds the perceptible glare range. However, if additional measures are taken, it would reduce the DGP values to dip below the perceptible range which would not be ideal as we want to ensure that there is good perceptibility within the unit.

FACADE 4: FINAL
(TILTED OVERHANGS, TILTED LOUVERS)





The DGP values for the northwest façade are relatively low owing to the louvers that are tilted downwards at an angle, in addition to the vertical fins that complements the design. This was deemed necessary as we wanted to ensure a good UDI(200 lux 50%) for the unit and having less shading would result in a much higher illuminance than we desired.

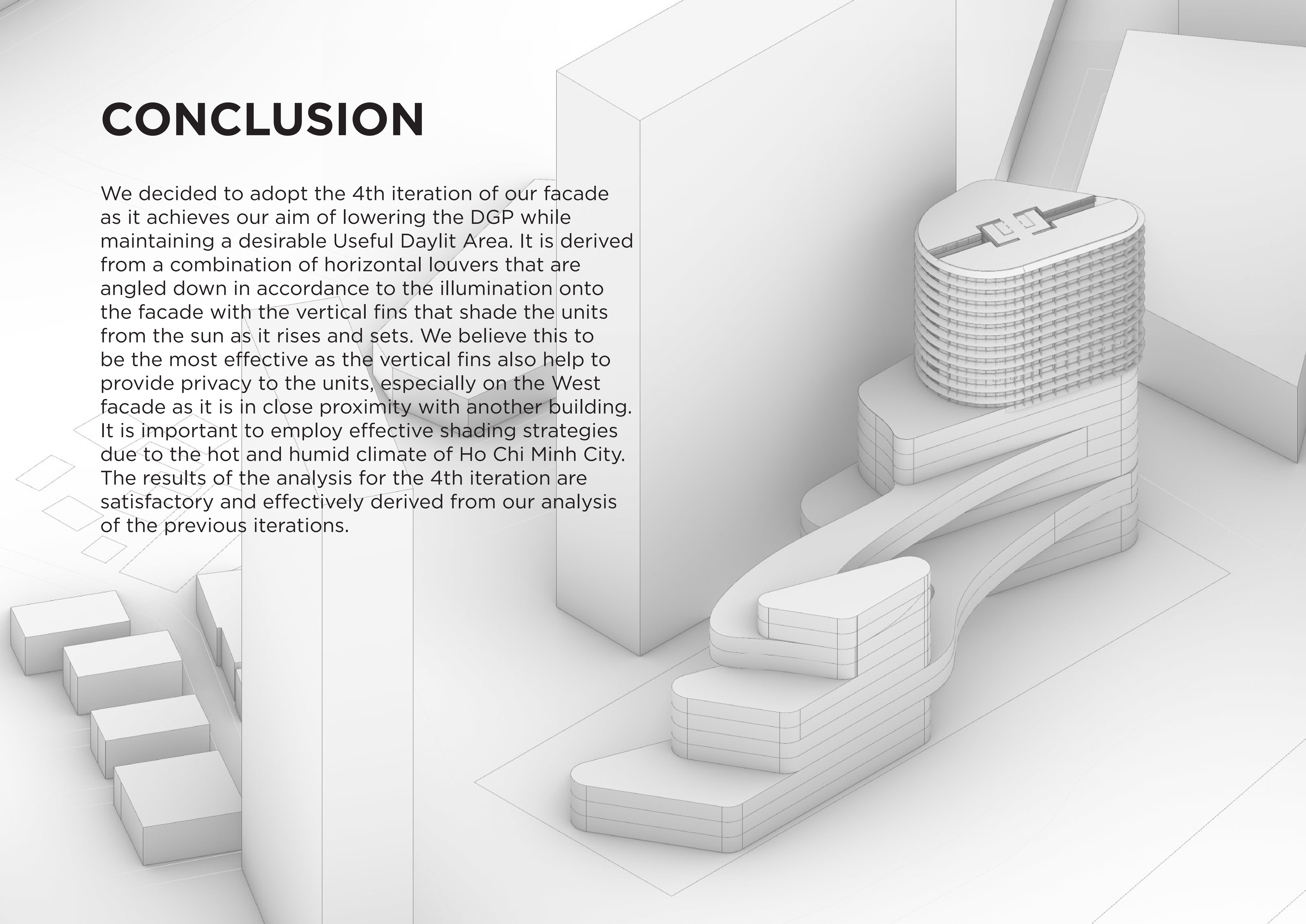
The DGP values for the west façade is relatively low due to the adjacent building shading the unit from harsh sunlight. This gives rise to the DGP values being slightly lower than the perceptible range. Shading is still required as we want to reduce the incident radiation into the unit to prevent the unit from heating up too much.

The DGP values dips slightly below the perceptible glare for the east facade values for the timings shown due to low hanging louver. The DGP value falls into the imperceptible range for 5pm as the sun sets in the west and does not experience as much illumination as it does in the morning. Although the DGP values are slightly low, we deemed it satisfactory in order to ensure that we achieve a desirable value for the UDI(200lux 50%) as it is a residential unit.

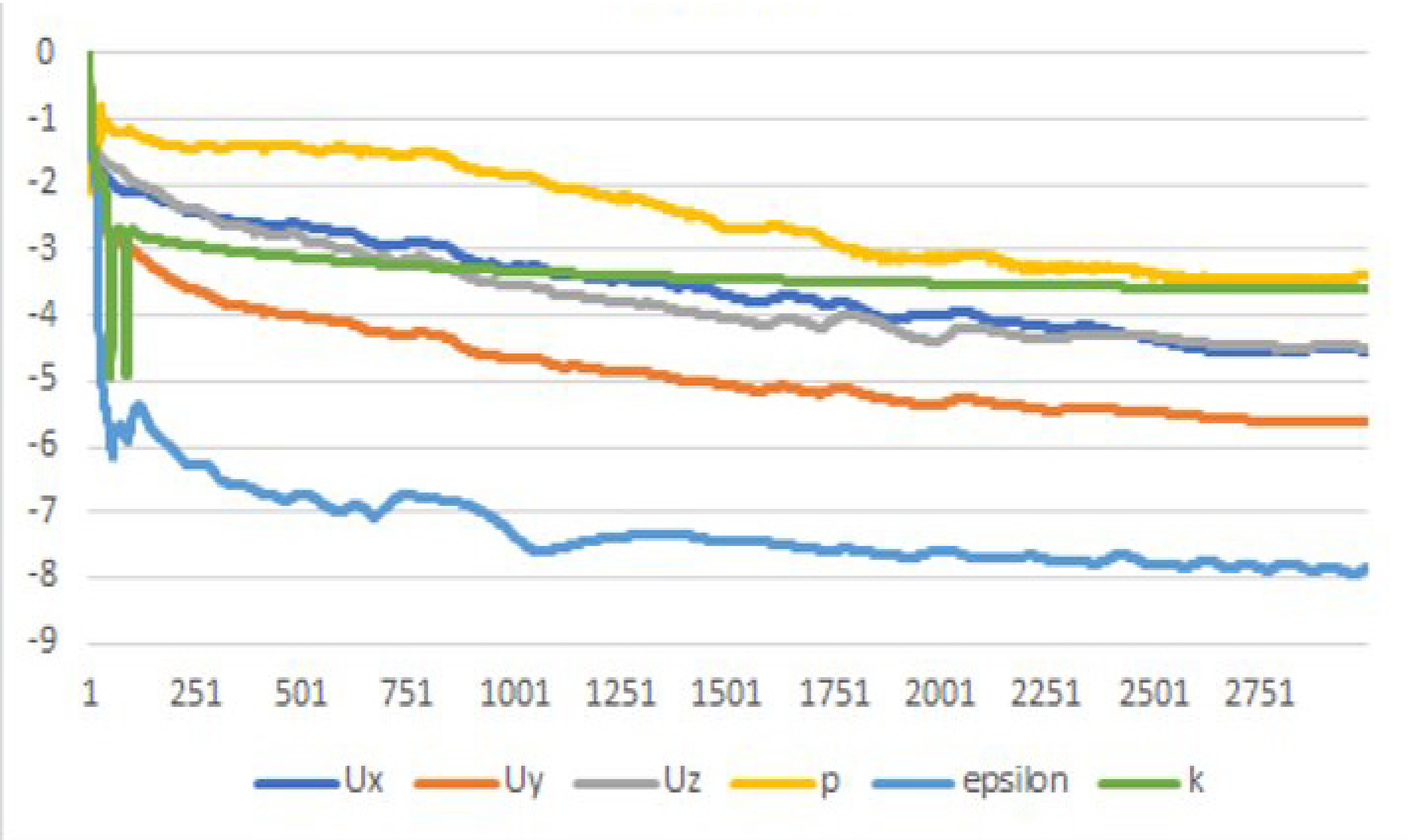
IMAGE BASED GLARE

CONCLUSION

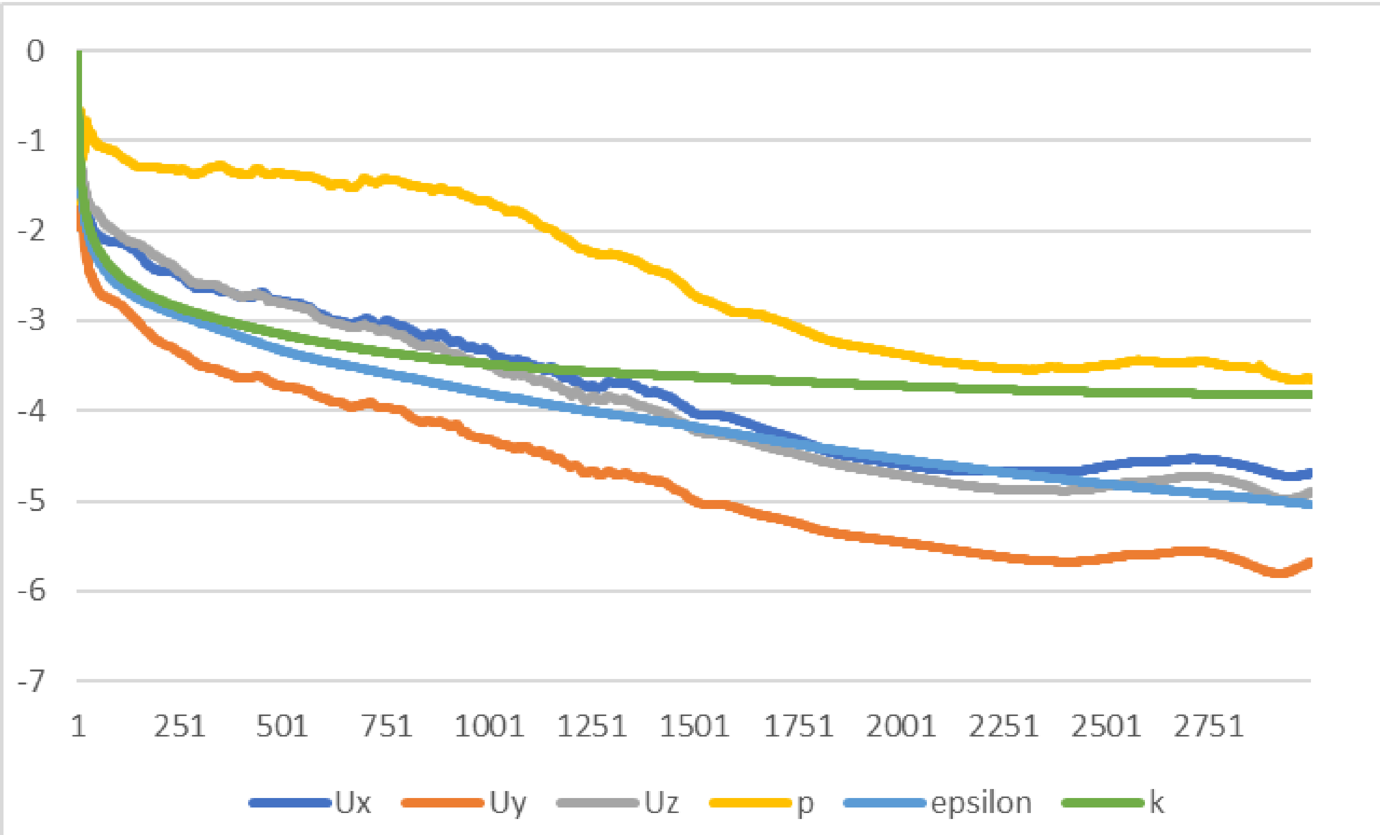
We decided to adopt the 4th iteration of our facade as it achieves our aim of lowering the DGP while maintaining a desirable Useful Daylit Area. It is derived from a combination of horizontal louvers that are angled down in accordance to the illumination onto the facade with the vertical fins that shade the units from the sun as it rises and sets. We believe this to be the most effective as the vertical fins also help to provide privacy to the units, especially on the West facade as it is in close proximity with another building. It is important to employ effective shading strategies due to the hot and humid climate of Ho Chi Minh City. The results of the analysis for the 4th iteration are satisfactory and effectively derived from our analysis of the previous iterations.



APPENDIX



Wind Simulation Convergence



WDR Simulation Convergence