Boston, MA
101 Tremont St
42°21'27.0"N

BOSTON

Massachusetts, USA

20.203 : ARCHITECTURAL ENERGY SYSTEMS
GROUP 6

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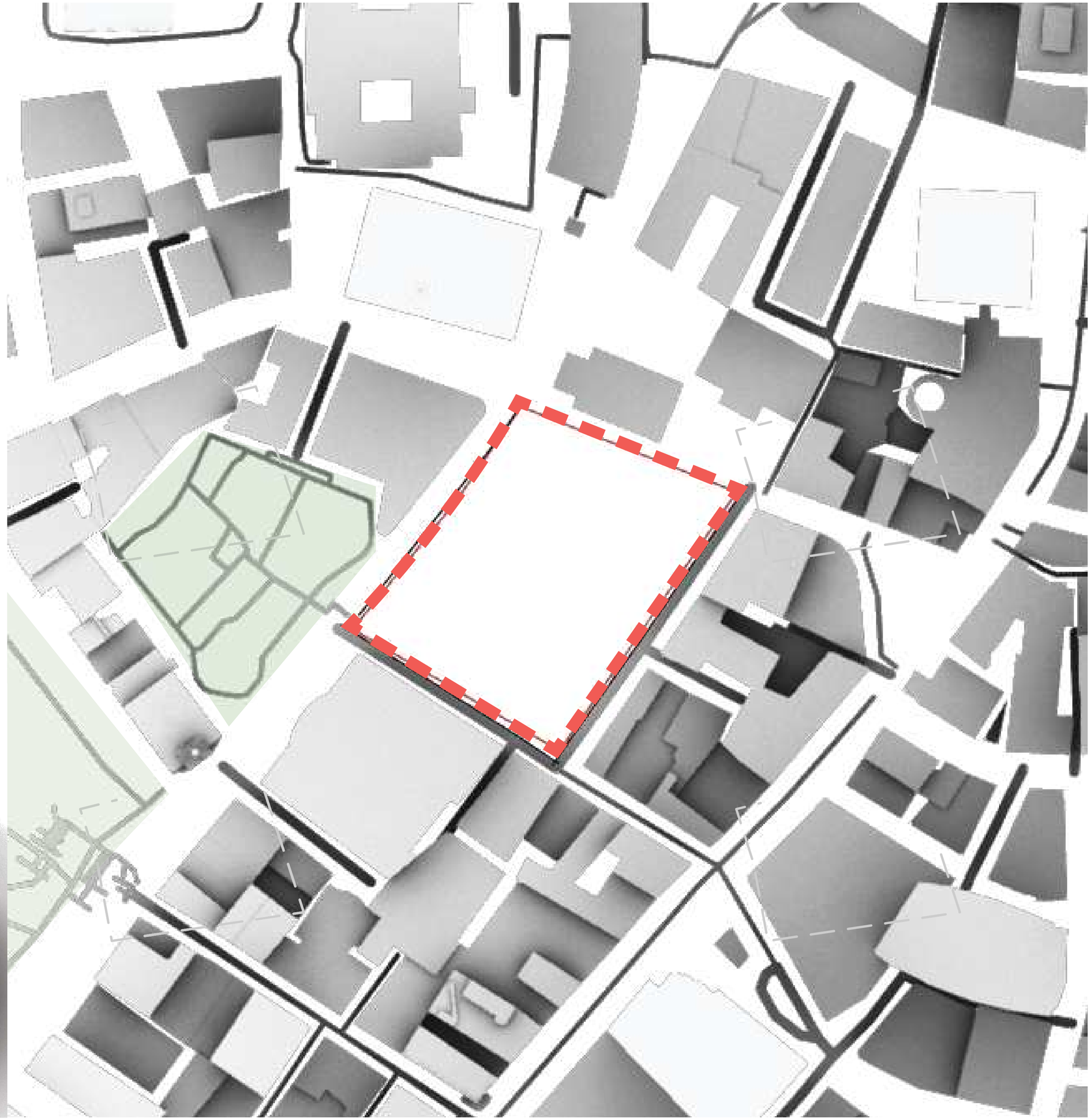
Boston, MA
101 Tremont St
42°21’27.0”N

Contents:

Boston, MA
101 Tremont St
42°21′27.0″N

Site Analysis

- Open to green spaces towards the south-west side
- Near the coast of boston (to the North and East sides)
- Near the Charles River Basin (to the West)
- Surrounding building heights vary from 9m to183m



Boston, MA
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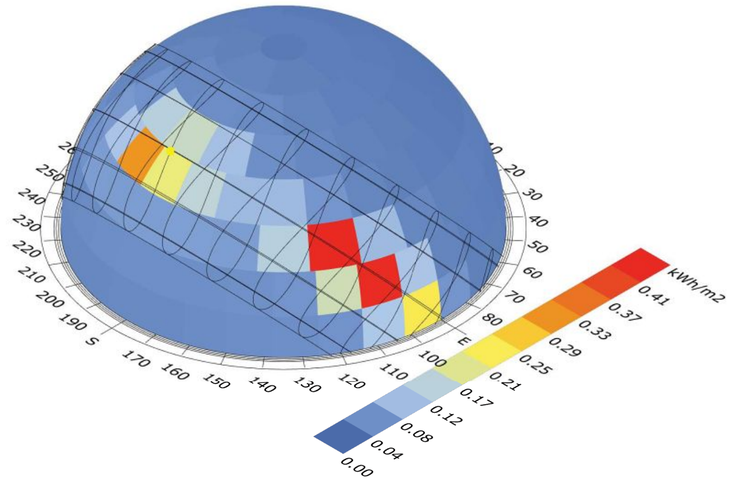
Spring

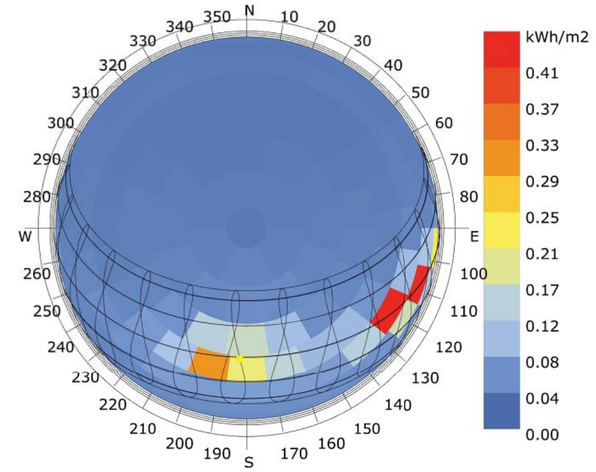
ANALYSIS

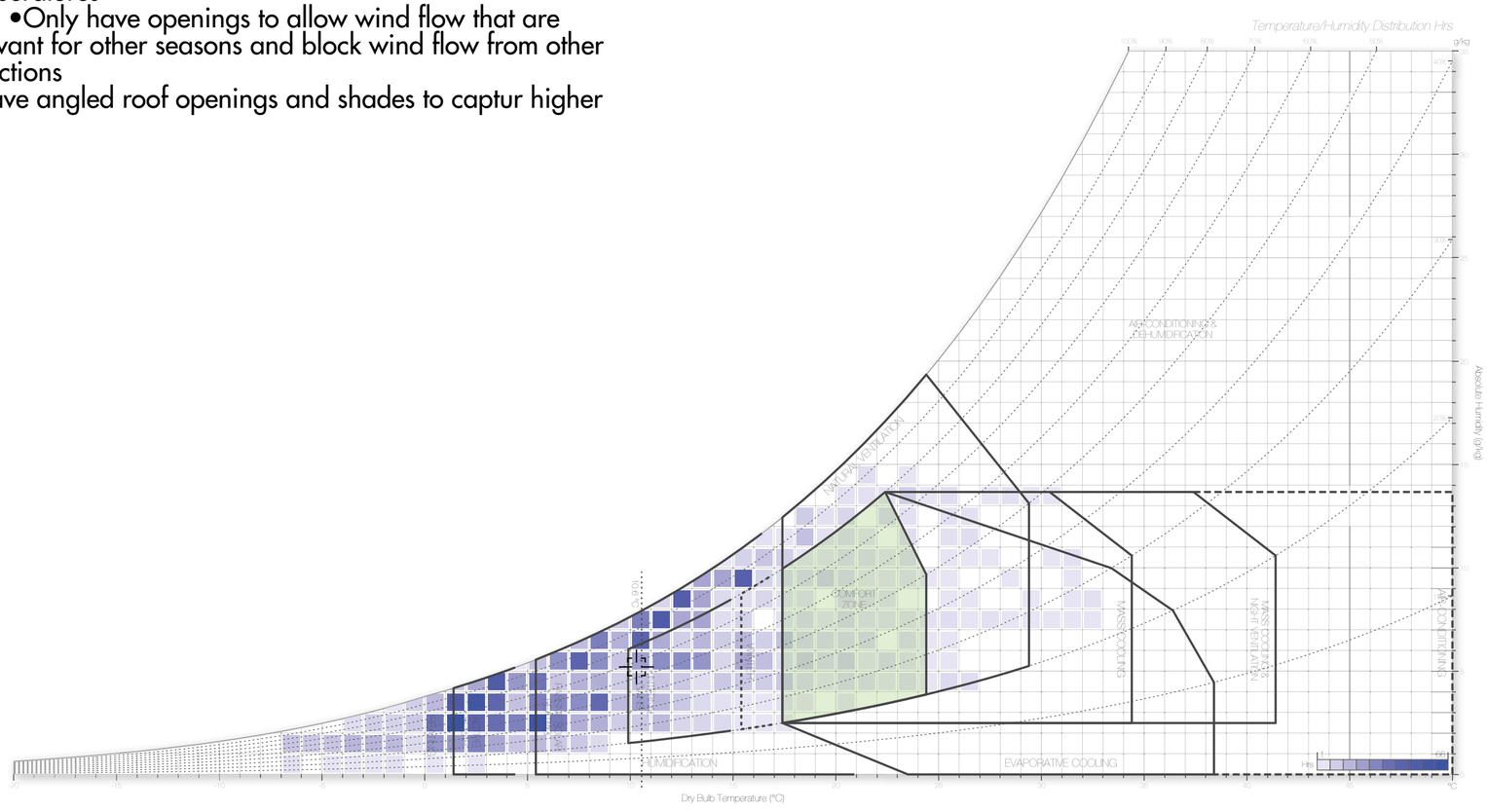
- Sun path + Radiation: Relatively Higher Sun position and Radiation
- Cloud Cover: Relatively higher cloud cover
- Precipitation: Has the median amount of precipitation
- Dry Bulb Temperature: Generally colder than the comfortable range
- Windrose: Strong winds from most directions

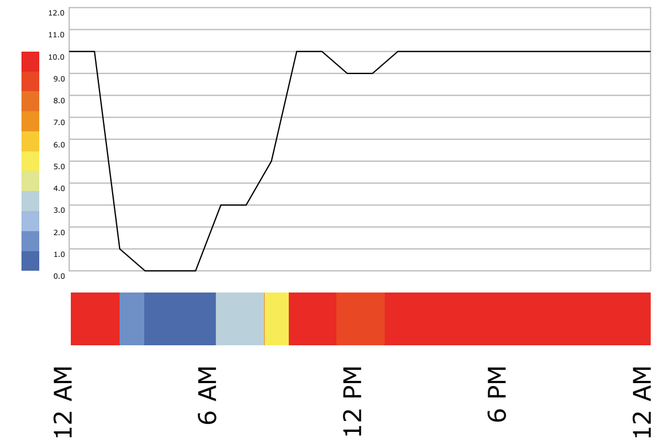
OPPORTUNITIES & STRATEGIES

- Higher cloud cover could have affected the level of sun radiance, lower temperatures that could have been comfortable for people
    - Use materials that have better insulative qualities
- Winds coming from most directions would further lower temperatures
    - Only have openings to allow wind flow that are relevant for other seasons and block wind flow from other directions
- Have angled roof openings and shades to captur higher sun









Boston, MA
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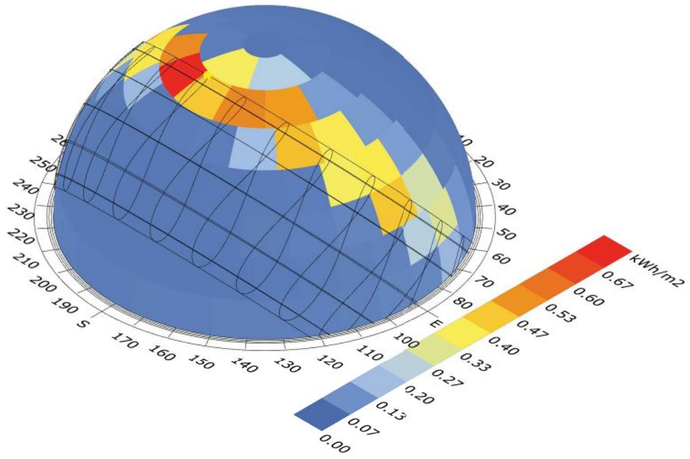
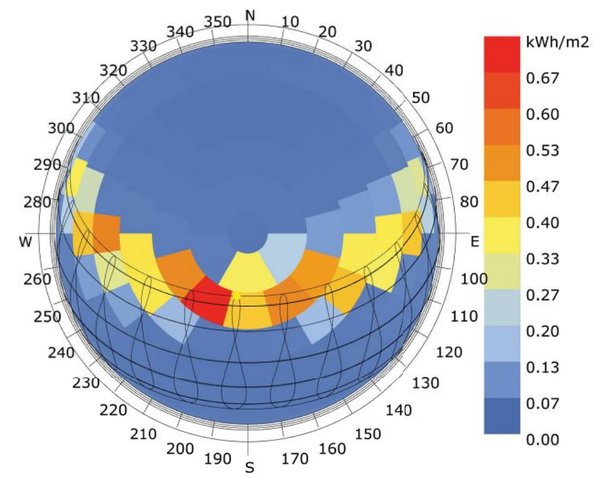
Summer

ANALYSIS

- Sun path + Radiation: High radiation from Highest positioned Sun
- Cloud Cover: Low Cloud Cover
- Precipitation: Highest precipitation
- Dry Bulb Temperature: Comfortable temperatures at the start and end, with temperature exceeding comfortable range during midsummer
- Windrose: Cold winds from NW





OPPORTUNITIES & STRATEGIES

- Opening winds for natural ventilation during summers.
- Possibly movable portions of the building or flexible installations.
- Roofs with outward extension (shelter). Roofs and facades which are sloping to encourage surface runoff in summer rain and can act as shelter from the hot sun.
- Possibly reflective elements below roof for indirect lighting with less solar radiation.

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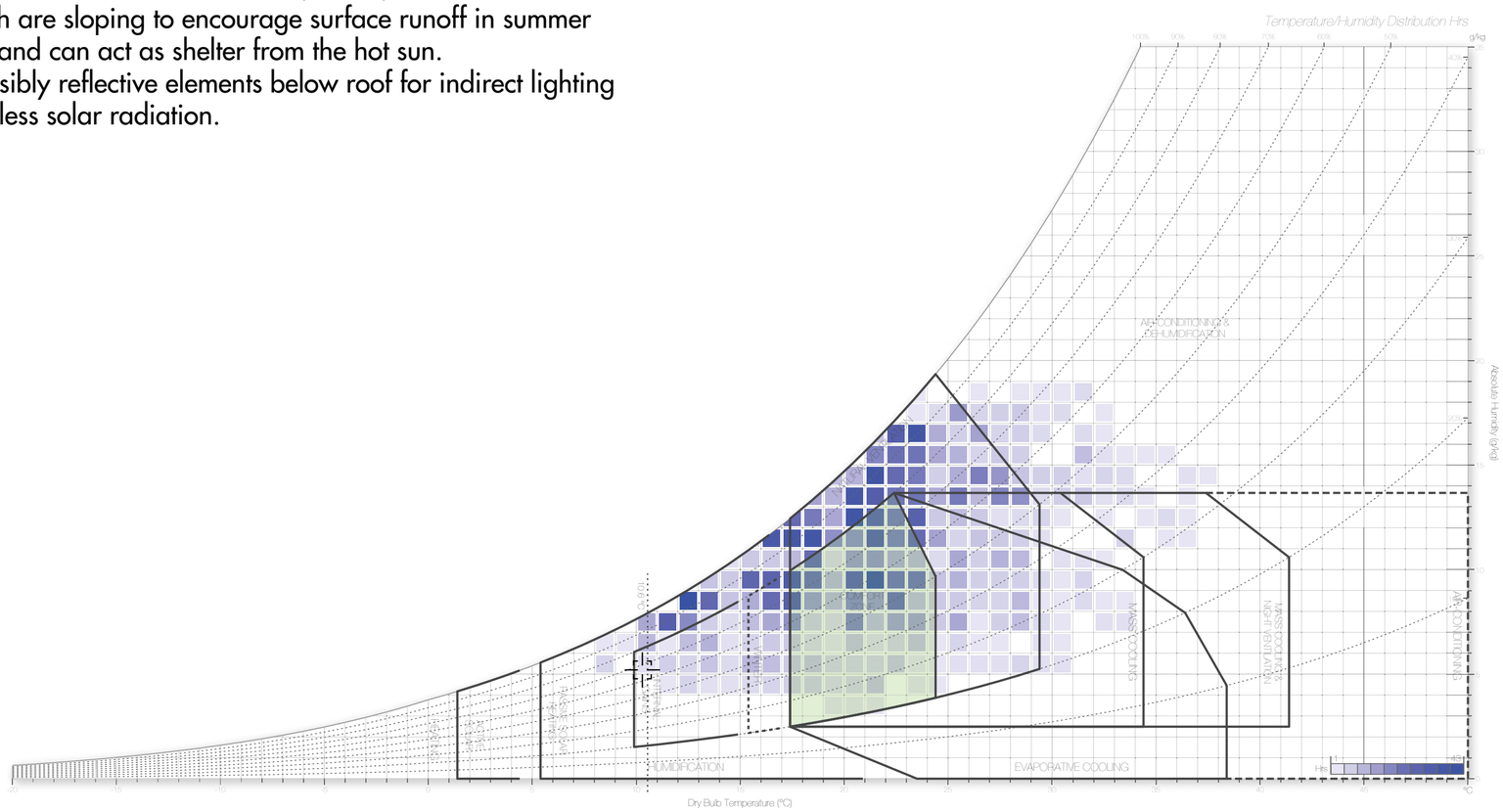

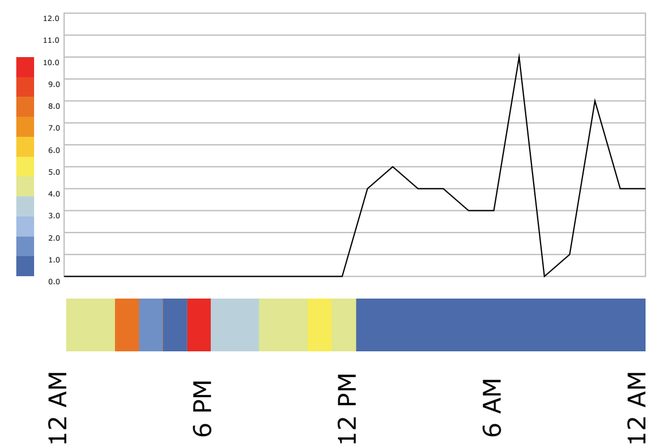

Boston, MA
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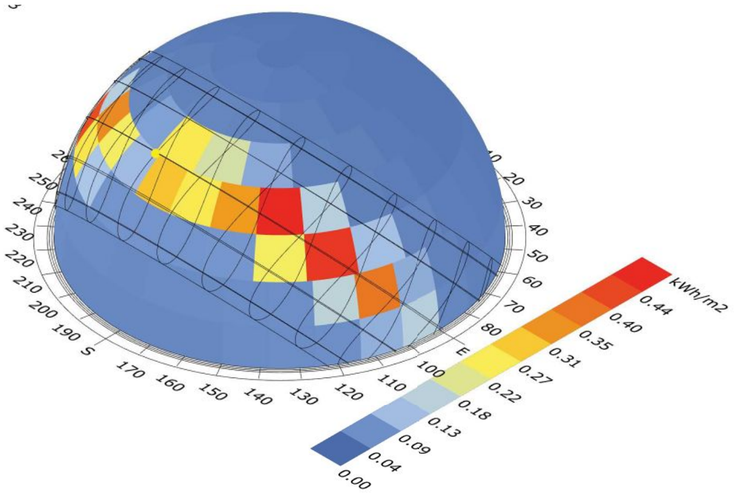
Autumn

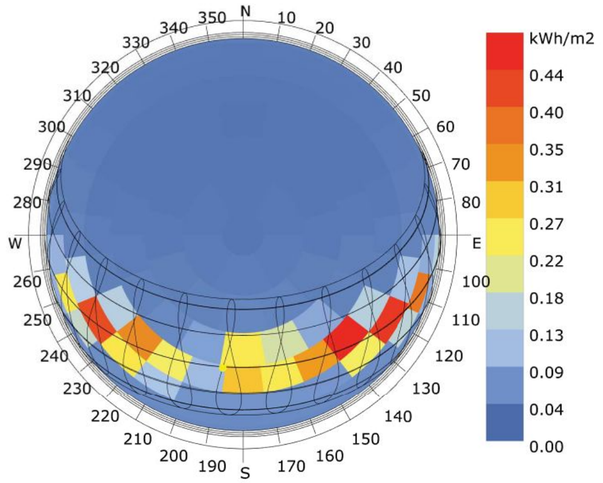
ANALYSIS

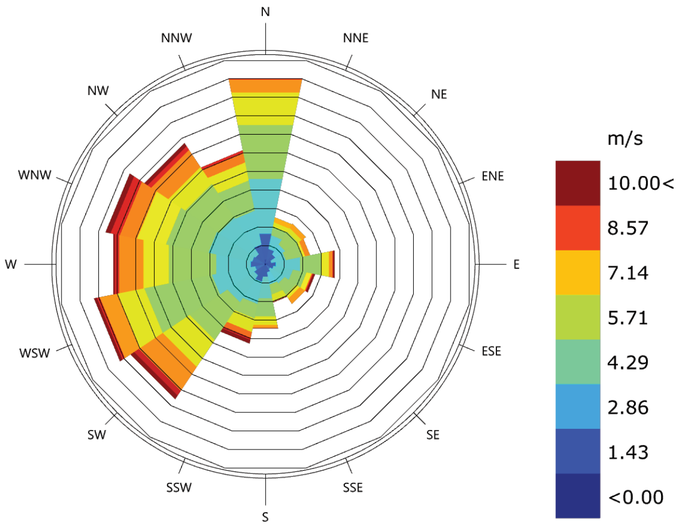
-Sun path + Radiation: Relatively Lower Sun position and Radiation
-Cloud Cover: Relatively lower cloud cover
-Precipitation: Has relatively lower amount of precipitation at the start and increases as winter approaches
-Dry Bulb Temperature: Comfortable temperature at the start and gradually becomes too cold as winter approaches
-Windrose: Moderate winds ranging from N to SW

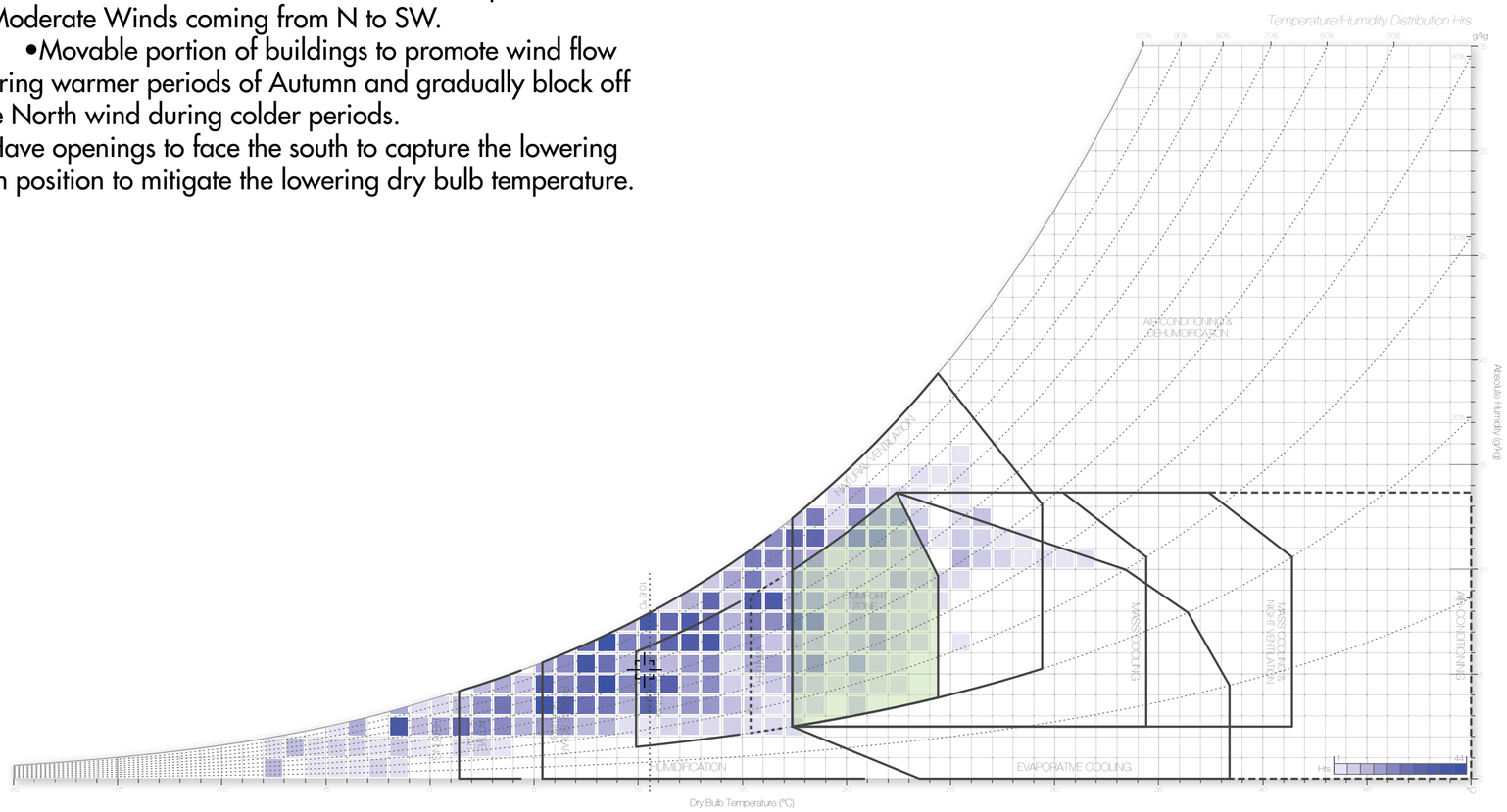
OPPORTUNITIES & STRATEGIES

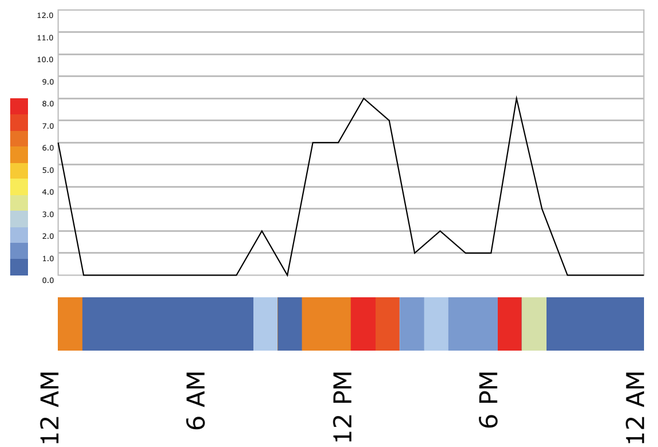
- Lower cloud cover is useful in providing more radiation for the building to capture.
    Use materials that have better insulative qualities.
- Moderate Winds coming from N to SW.
    •Movable portion of buildings to promote wind flow during warmer periods of Autumn and gradually block off the North wind during colder periods.
- Have openings to face the south to capture the lowering sun position to mitigate the lowering dry bulb temperature.











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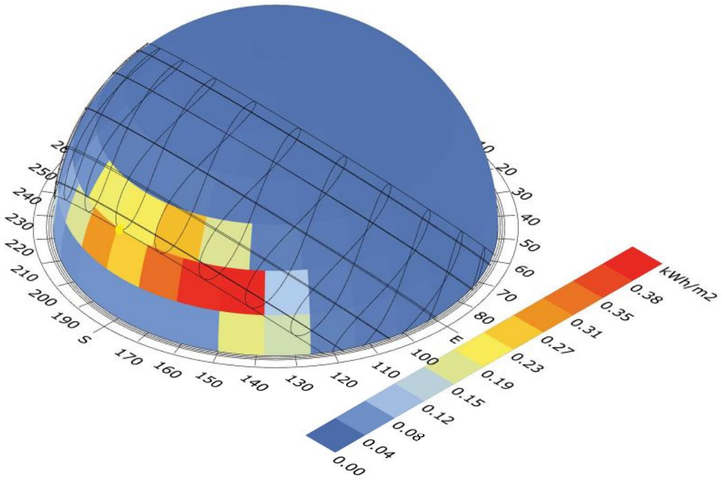
Winter

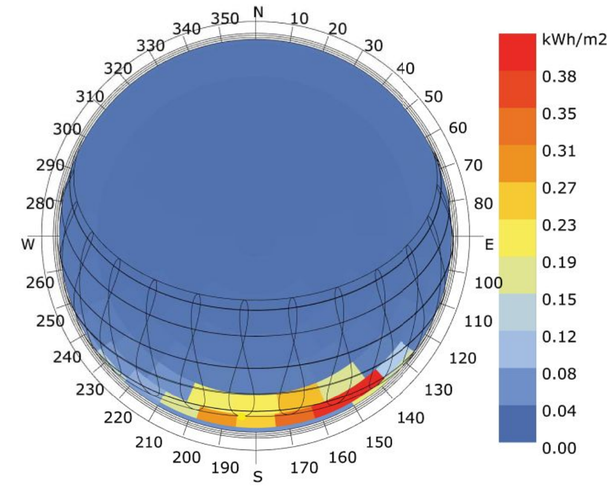
ANALYSIS

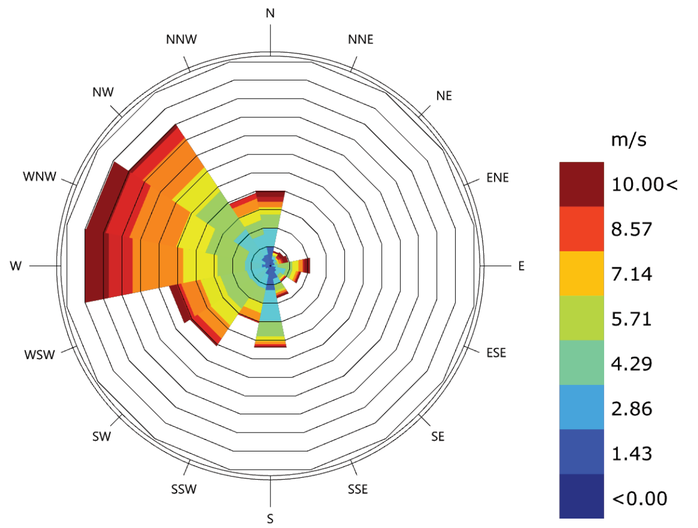
- Cloud Cover: Lowest cloud cover at some points
- Precipitation: Lowest precipitation
- Dry Bulb Temperature: below comfortable range
- Sun Path + Radiation: Low Radiation from Lowest positioned sun
- Windrose: Cold winds from NW

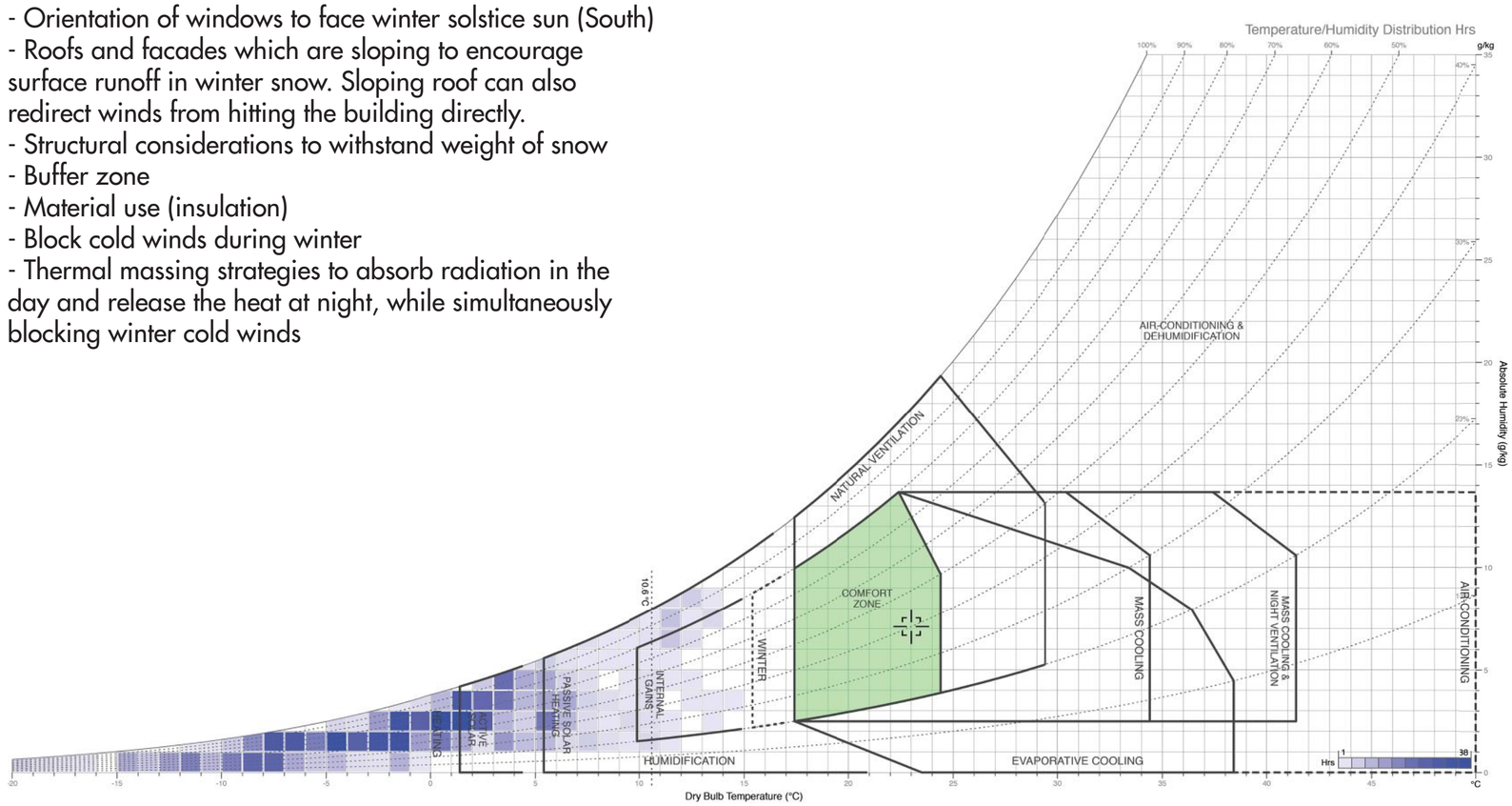
OPPORTUNITIES & STRATEGIES

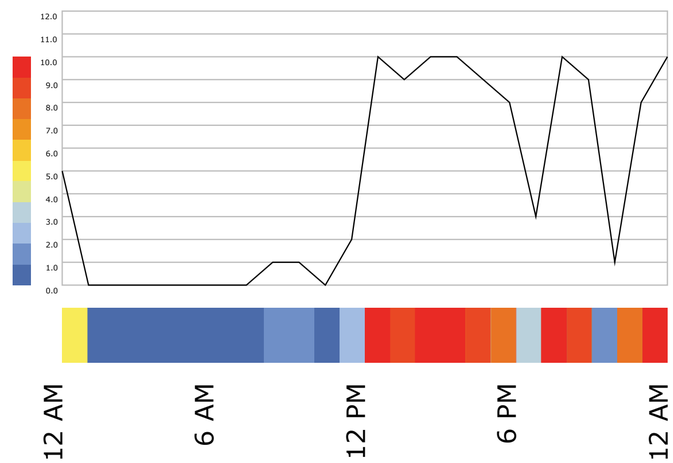
- Low Cloud Cover during winter can be a good thing and allow for more direct sunlight.
    - Placing windows lower to capture low-positioned winter direct sunlight, while avoiding high-positioned summer sun.
- Orientation of windows to face winter solstice sun (South)
- Roofs and facades which are sloping to encourage surface runoff in winter snow. Sloping roof can also redirect winds from hitting the building directly.
- Structural considerations to withstand weight of snow
- Buffer zone
- Material use (insulation)
- Block cold winds during winter
- Thermal massing strategies to absorb radiation in the day and release the heat at night, while simultaneously blocking winter cold winds











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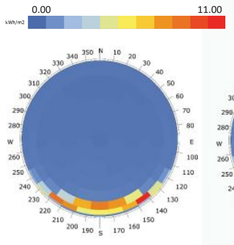
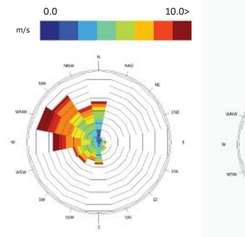
Summary

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

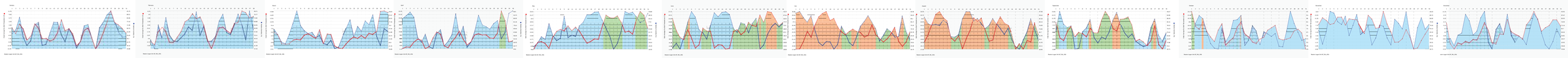
RADIATION

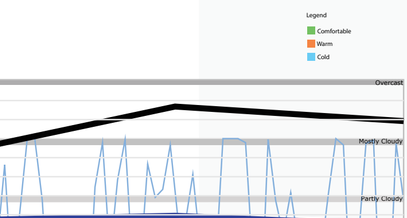


WIND ROSE



DRY BULB &





PRECIPITATION & CLOUD COVER

CLOUD COVER

PRECIPITATION

WINTER SPRING SUMMER AUTUMN

Boston, MA
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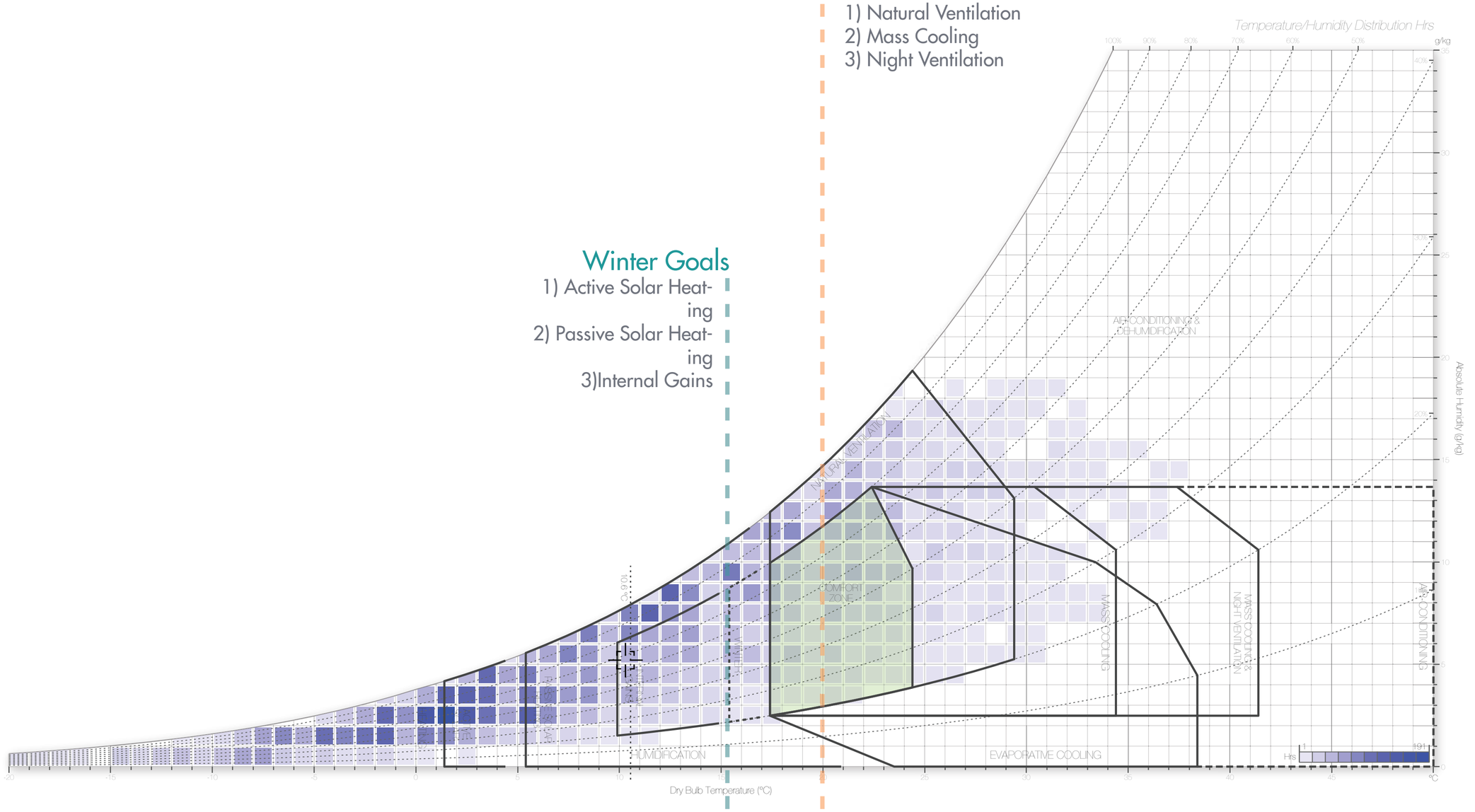
Goals for Massings

Summer Goals
1) Natural Ventilation
2) Mass Cooling
3) Night Ventilation

Winter Goals
1) Active Solar Heating
2) Passive Solar Heating
3)Internal Gains



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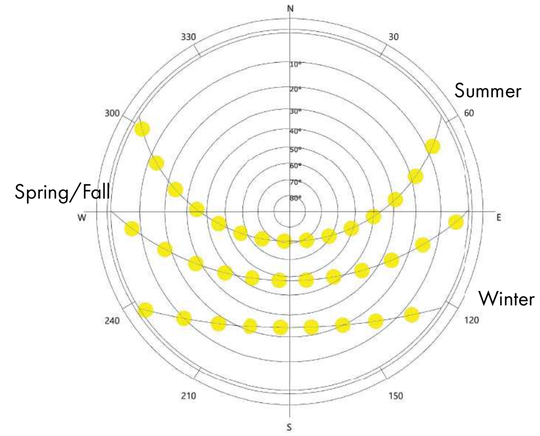
42°21’27.0”N

Solar Analysis

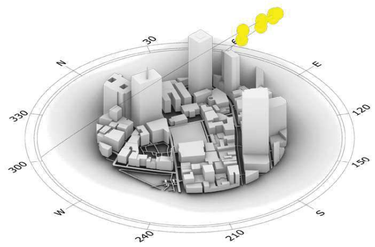
MAXIMISING LOW SUN

Along with the limited sunlight from the north of the site in winter, it is partially shaded by a tall surrounding building during **fall** and **winter** as well.

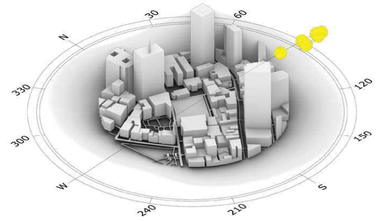
To place more windows in regions that are exposed to the winter sun for heat energy. Openings or staggering the building can allow low winter sunlight to reach units facing north.



Morning Hours



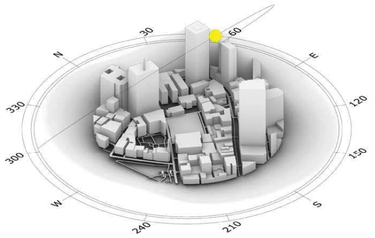
Azimuth Range:
65.12 to 189.82 degrees



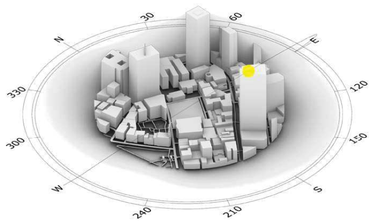
Azimuth Range:
93.90 to 188.65 degrees

Azimuth Range:
130.35 to 184.40 degrees

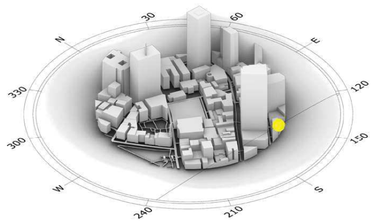
Highest Sun Position



Time: 11:46
Altitude: 70.85 degrees
Azimuth: 189.82 degrees

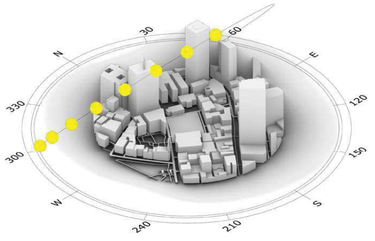


Time: 11:36
Altitude: 47.28 degrees
Azimuth: 188.65 degrees

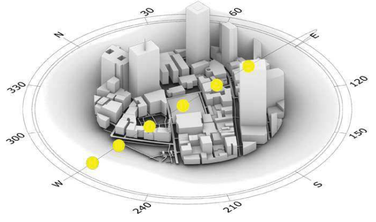


Time: 11:43
Altitude: 24.11 degrees
Azimuth: 184.40 degrees

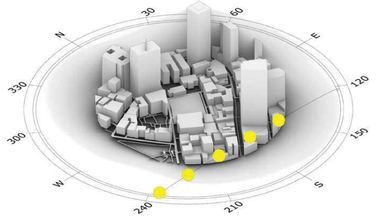
Afternoon Hours



Azimuth Range:
189.82 to 299.37 degrees



Azimuth Range:
188.65 to 263.73 degrees



Azimuth Range:
184.40 to 235.84 degrees

Summer Solstice

Fall Equinox

Winter Solstice

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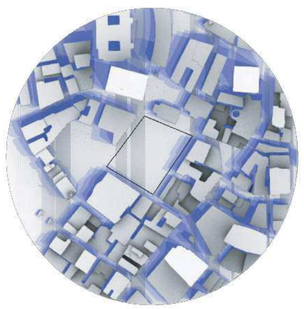
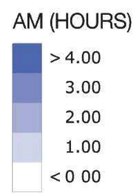
Shadow Analysis

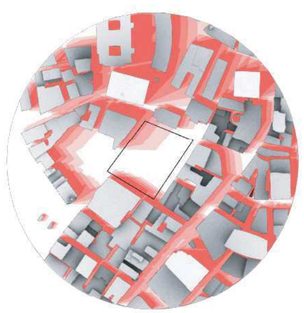
Surrounding building heights
vary from 9m to 183m

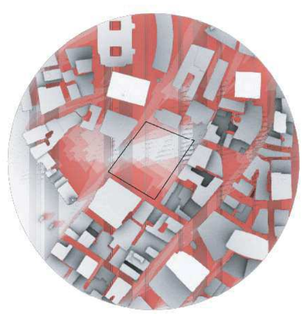
Morning

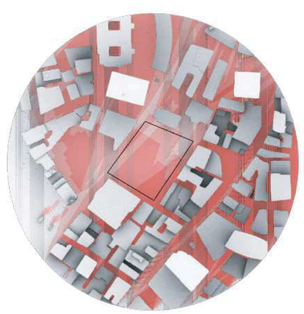


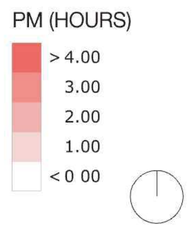


Afternoon









Summer **Fall** **Winter**

PUBLIC SPACE ALLOCATION

Closely packed surrounding buildings provides opportunities of shaded regions within the site during **summer** period. There is relatively well-shaded south-west region during **fall** period as well.

(S) To make use of overlapped regions of shade during summer and sun during winter to design and allocate public spaces

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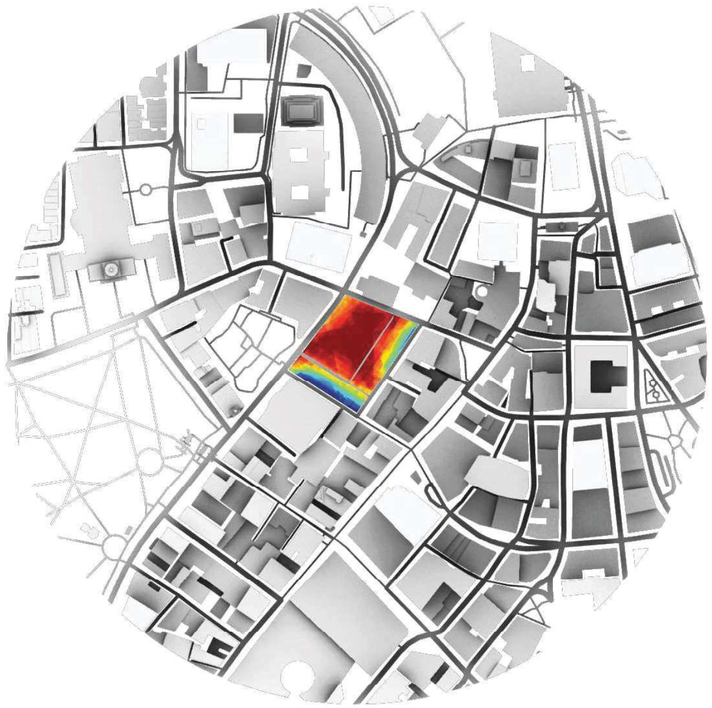
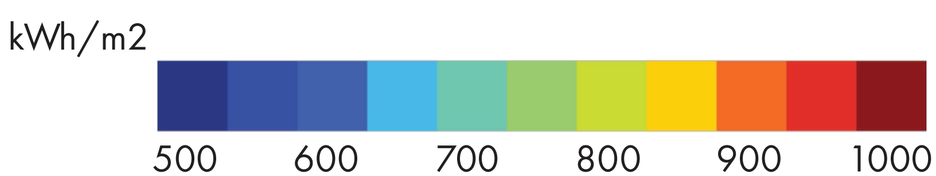
Solar Radiation Analysis



0m

20m

50m



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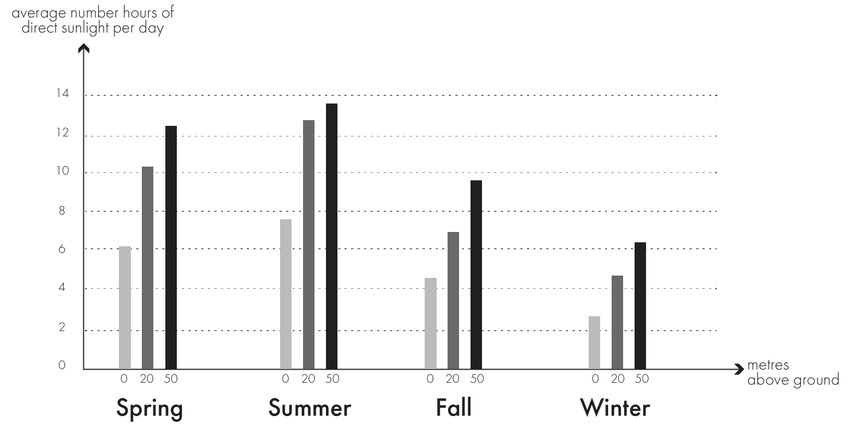
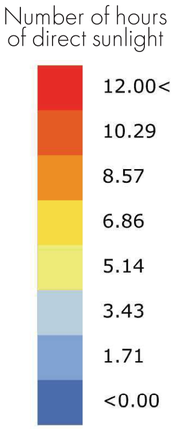
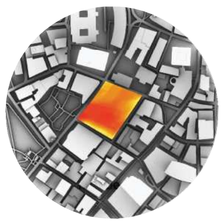
Solar Hours

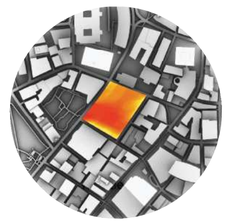




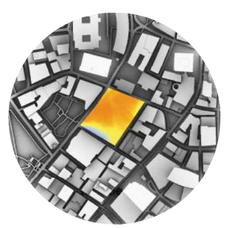
Spring



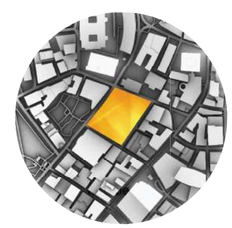
Summer



Fall



Winter

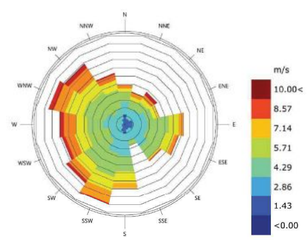


PLACEMENT OF UNITS AND PV

Radiation and direct sunlight hours increase with height (0m, 20m, 50m) and from winter to summer. Due to the higher buildings around lower levels (~20m) are getting less direct sunlight for daily usage.

(S) Tapering of form of building as the levels go up to reduce the surface area for radiation on high levels. Residential units should located at least 20m above to receive suffcient light and radiation during winter.

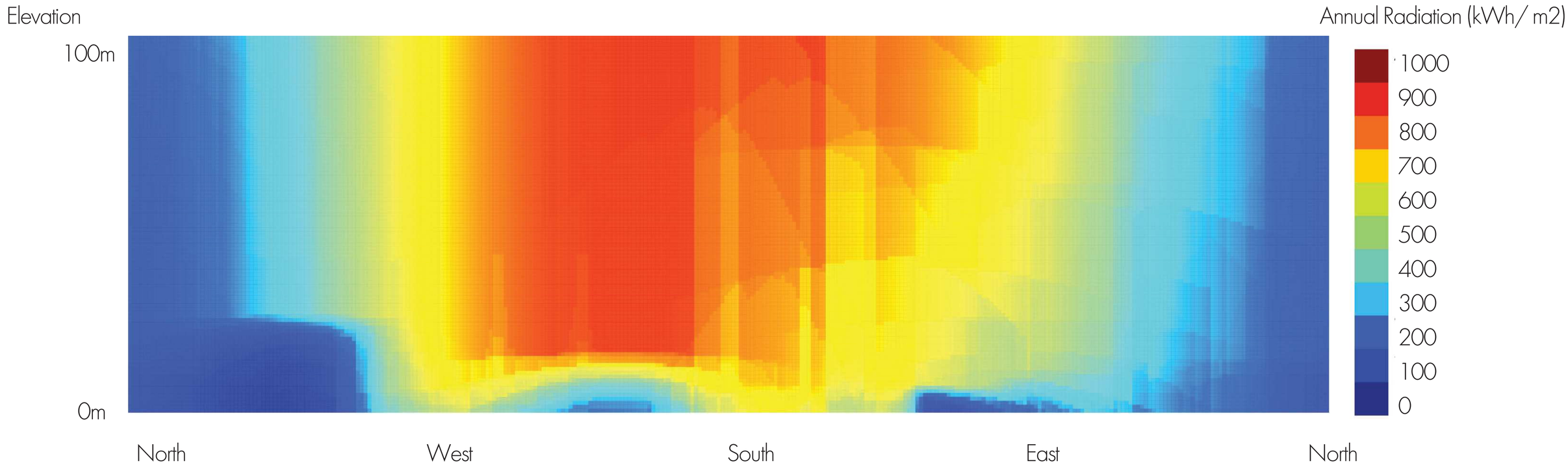
(S) With the high radiation levels on levels 50m and above for all seasons, photovoltaics can be placed on the roof



(S) During the summer, wind channeling techniques in the north-west-south directions can be used to further dissipate heat gained by the building on higher levels by natural ventilation.

Boston, MA
101 Tremont St
42°21’27.0”N

Facade Orientation Radiation Analysis



ALLOCATION OF CORES AND COMMON AREAS

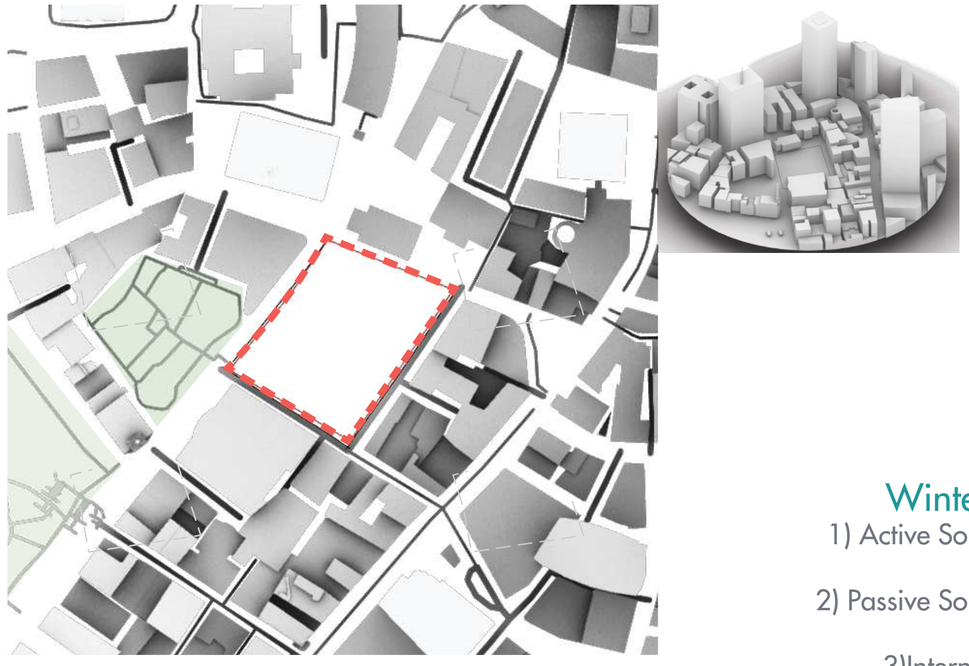
Avoiding South-West-facing units due to high radiation across 7m elevation and above

(S) Potential allocation of lift core and common spaces in this direction through the levels. If unable to fit sufficient units in the higher floors due to this, overhanging facade can be considered for extra shading.

Boston, MA
101 Tremont St
42°21’27.0”N

Goals for Massings

About Site



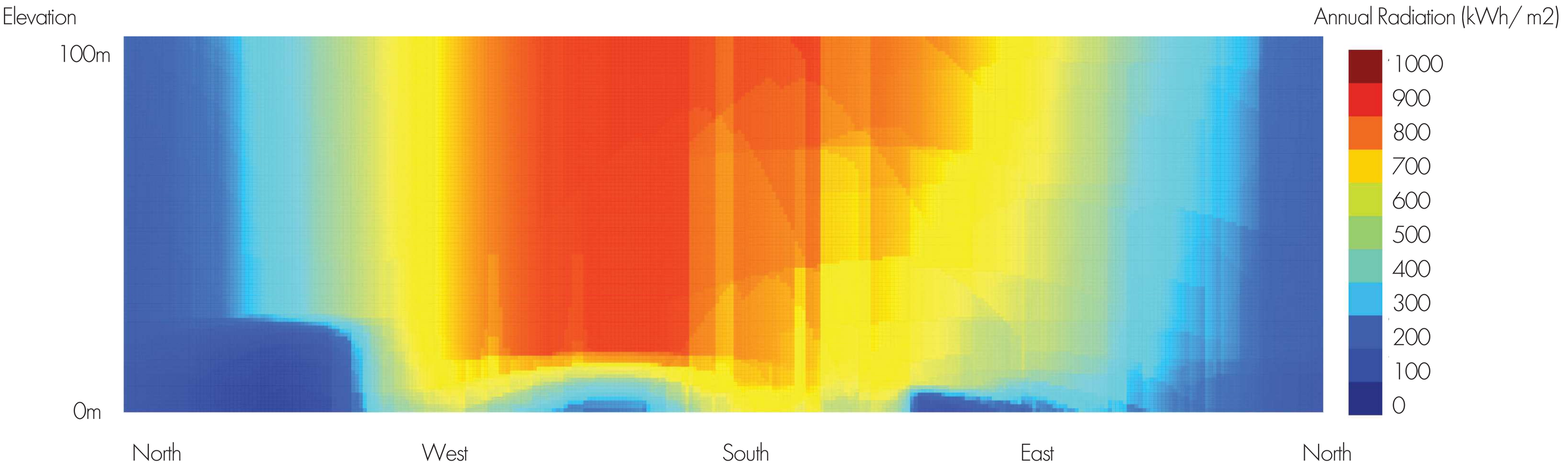
- Open to green spaces towards the south-west side
- Near the coast of boston (to the North and East sides)
- Near the Charles River Basin (to the West)
- Surrounding building heights vary from 9m to183m

Summer Goals
1) Natural Ventilation
2) Mass Cooling
3) Night Ventilation

Winter Goals
1) Active Solar Heating
2) Passive Solar Heating
3)Internal Gains

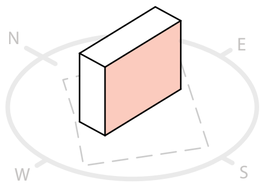
Boston, MA
101 Tremont St
42°21’27.0”N

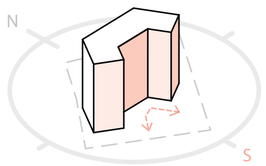
Radiation Analysis (Precedent Analysis)



Boston, MA
101 Tremont St
42°21’27.0”N

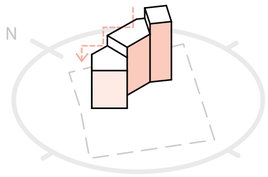
Massing Strategy





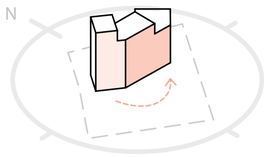
Bending the mass to capture more south sun

Terracing it to allow more exposed surface area

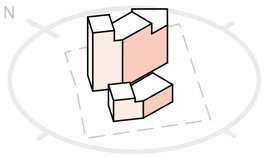


Rotating it round as previous iteration was minimising rather than optimising

Iteration 1

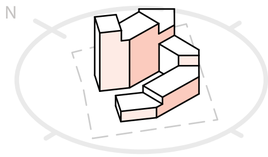


Doubling the massing to increase building footprint



Joining the massings

Iteration 2



Cutting it back to reduce surface area that recieves minimal solar radiation

Iteration 2.5

Increasing the depth of the building in a way that does not drastically increase shaded surface area

Iteration 3

West facing terracing to increase total exposed surface area experiencing direct sunlight

Boston, MA
101 Tremont St
42°21’27.0”N

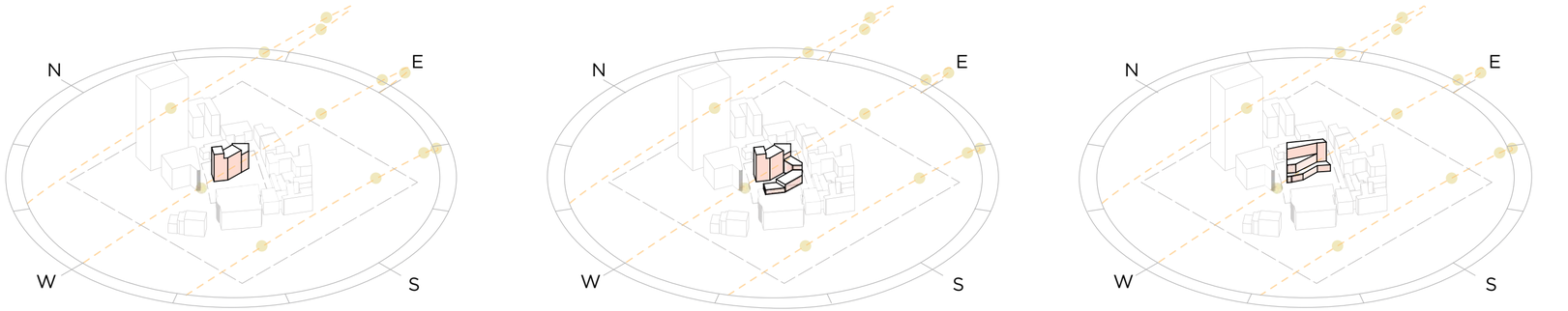
Iterations

1
Based on the previous site analysis, with a low lying winter sun, most of the building’s surfaces should be south facing to optimise solar gains in a temperate country.

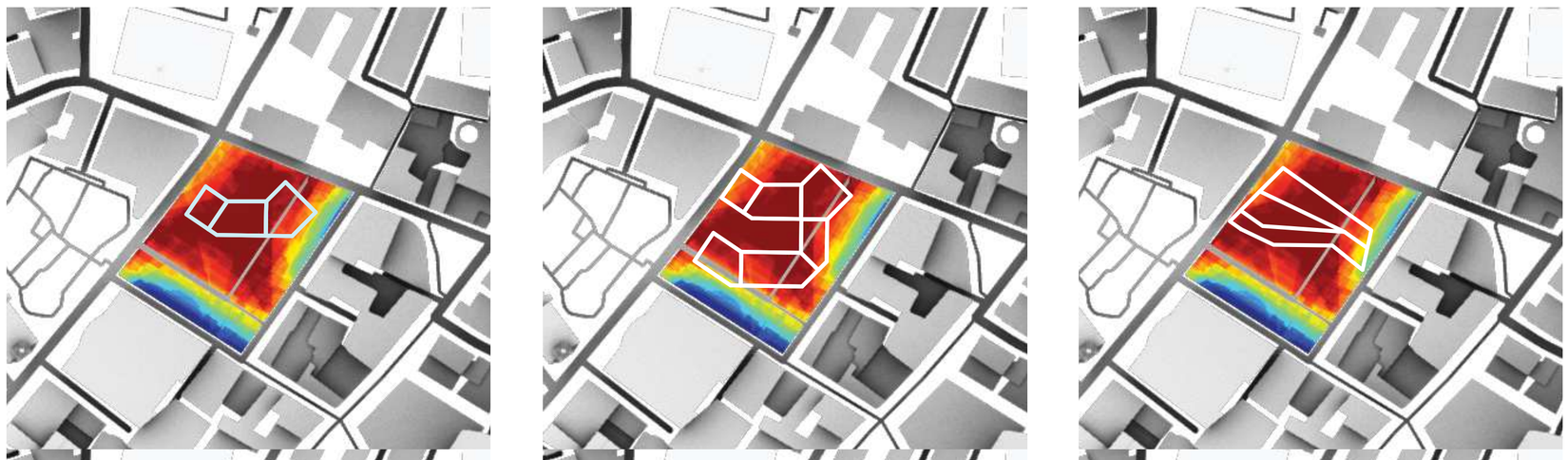
2
Duplicating the previous massing to increase building footprint while trying to maitain the same ratio of surfaces recieving high solar radiation. Terracing them to ensure the masses are not self shading.

3
Terracing a large mass as this operation seemed to optimize the solar radiation gains of the buiding. Exposing a larger amount of south facing surfaces.

Massing Operations



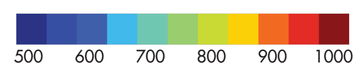
Radiation Analysis (0m)



Radiation Analysis (20m)

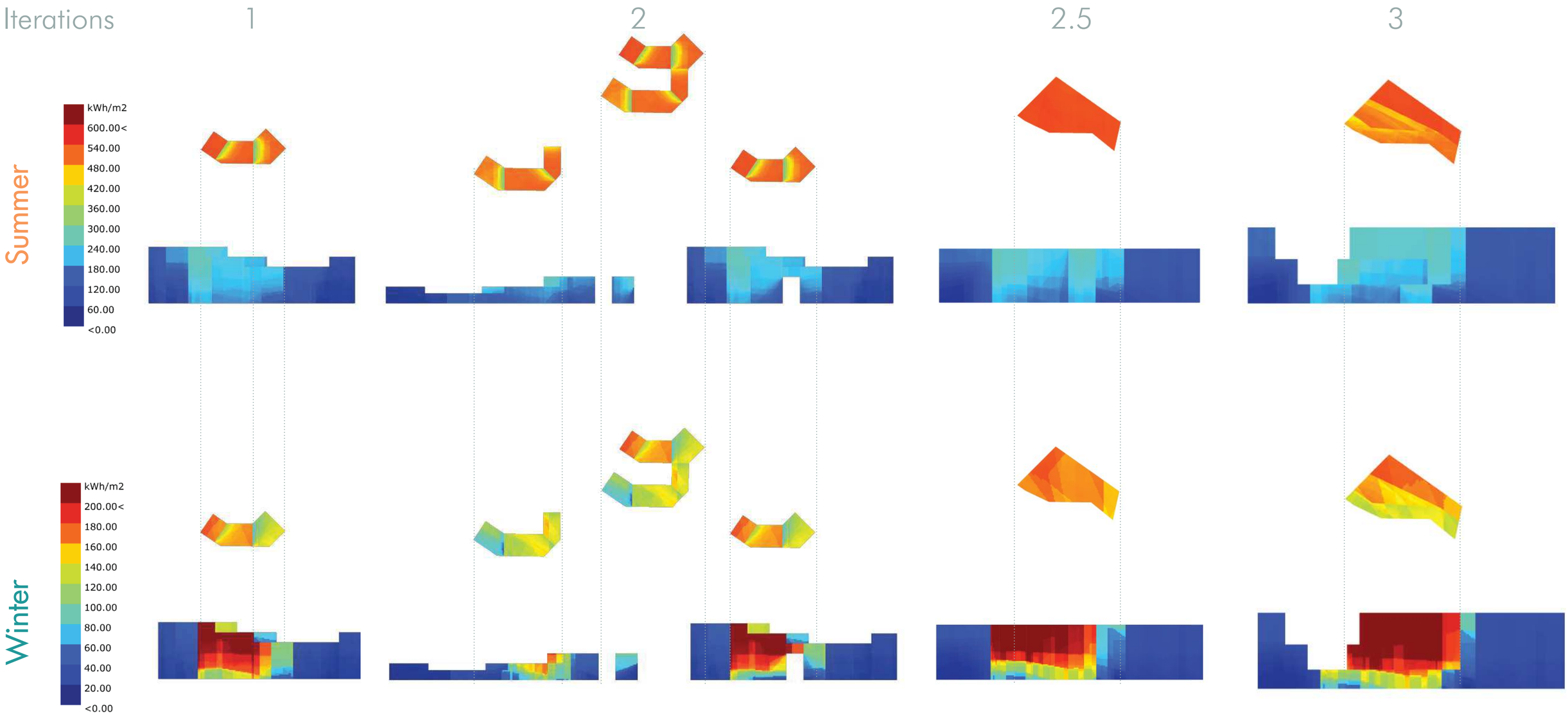
Identifying the areas that receives the largest amounts of solar radiation and aligning our massing to maximize those areas.

kWh/



Boston, MA
101 Tremont St
42°21’27.0”N

Radiation Analysis

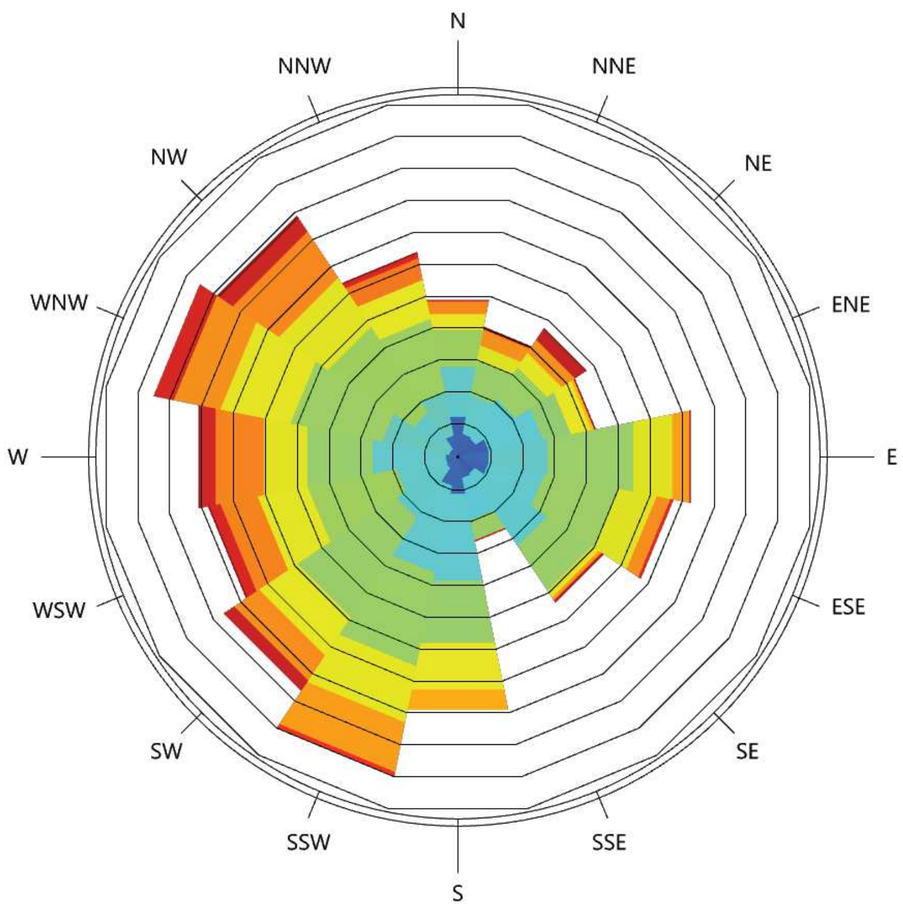


Percentage of facade area receiving high solar radiation with according to their respective scales per season (%):

	1	2	2.5	3
Summer	36.5	25.0	36.5	39.1
Winter	63.5	75.0	63.5	60.9
		Deprovement from initial massing	No improvement from initial massing	Iteration used for further analysis

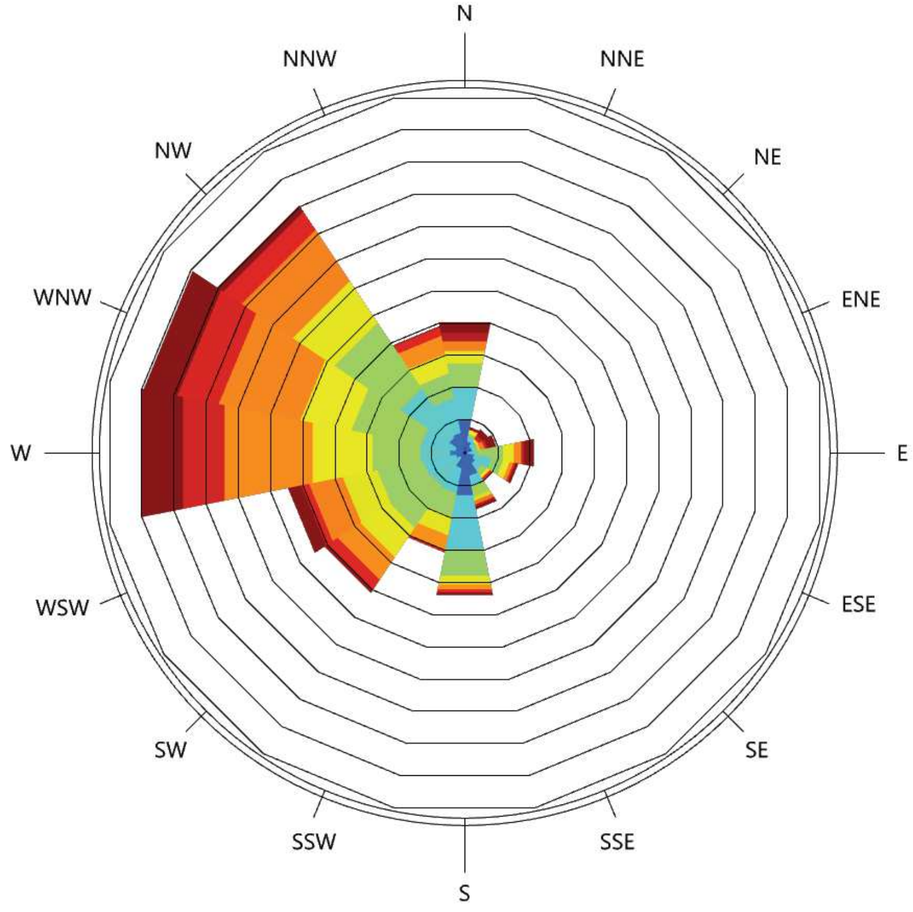
Wind Analysis

Summer

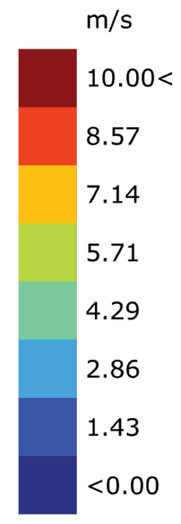


Wind Speed: 5.4m/s
Direction: SW

Winter



Wind Speed: 7.2m/s
Direction: NW



Taking wind speed values and prominent wind directions from previous site analysis on wind.

Boston, MA
101 Tremont St
42°21’27.0”N

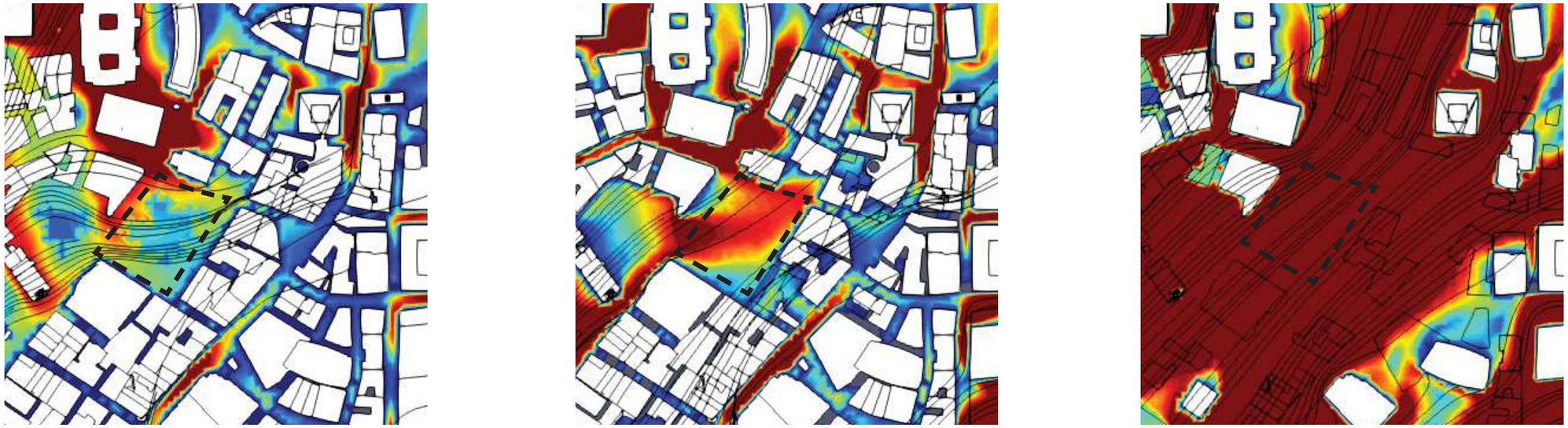
Wind Speed Simulation - **SITE ONLY**

5m

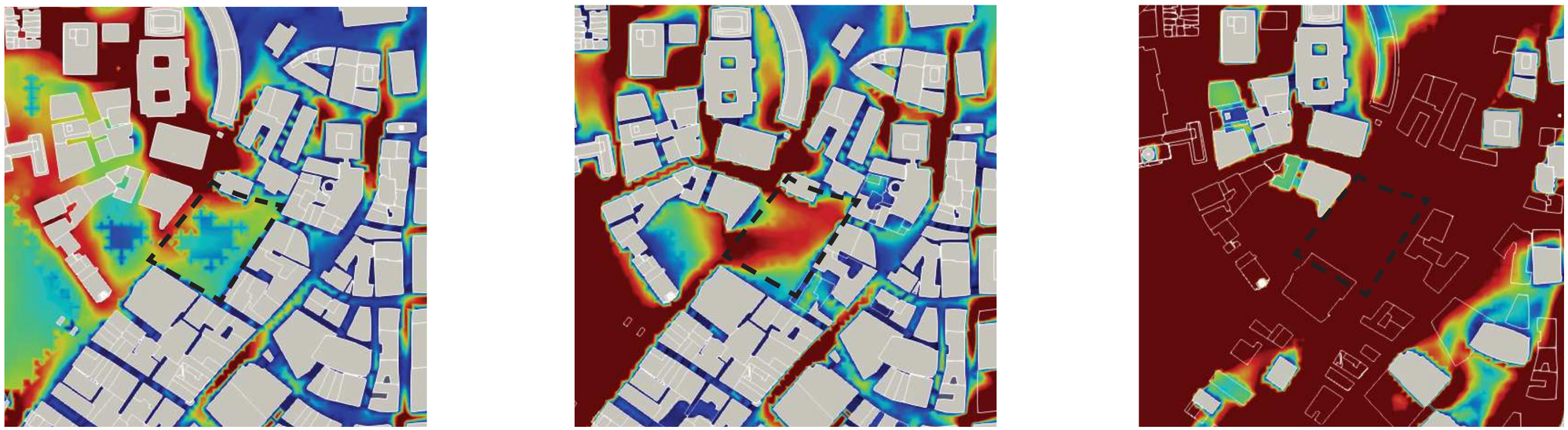
20m

50m

Summer

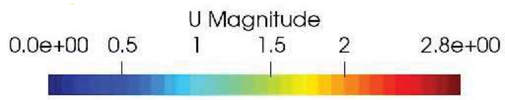


Winter



- Open site allows wind to pass through the site easily, hence its lower wind speeds on the ground level
- Naturally, higher wind speeds are obtained at a higher level as the surrounding buildings are mostly short with a few exceptions.

- Generally low winds speeds on the site.
- Even at higher elevations wind speeds remain low as taller building around the site help to shield the site from in coming north-west winds.

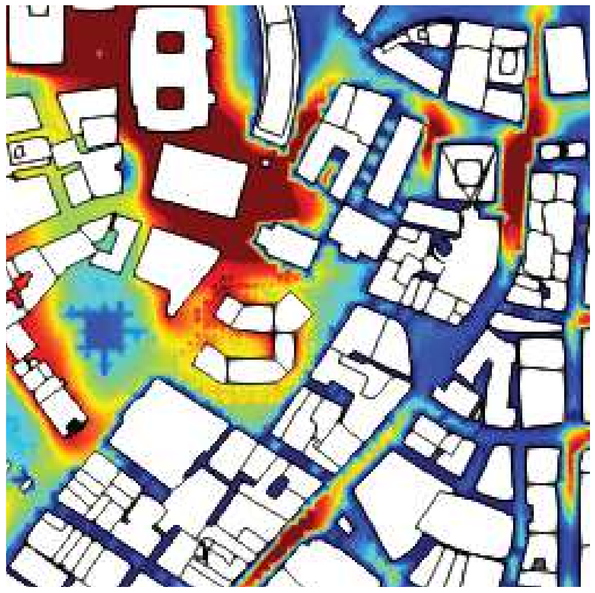


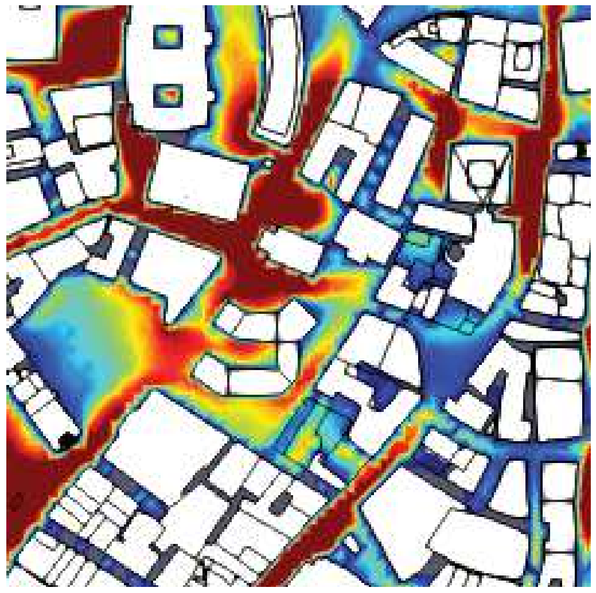
Boston, MA
101 Tremont St
42°21’27.0”N

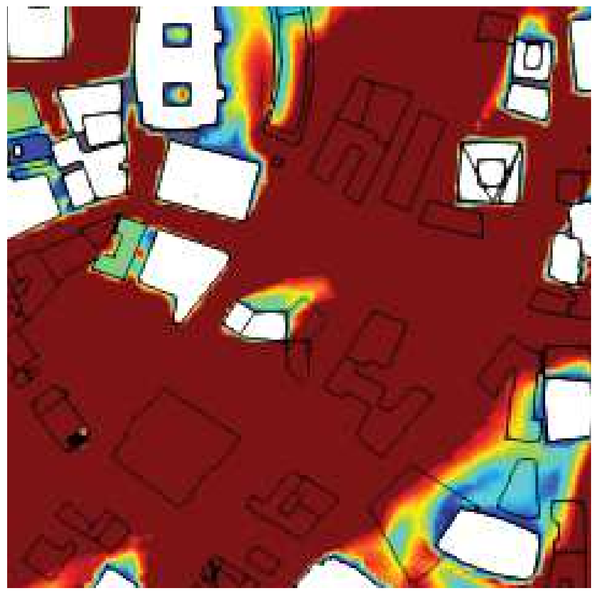
Wind Speed Simulation
(SUMMER)

5m | 20m | 50m

Iteration 2

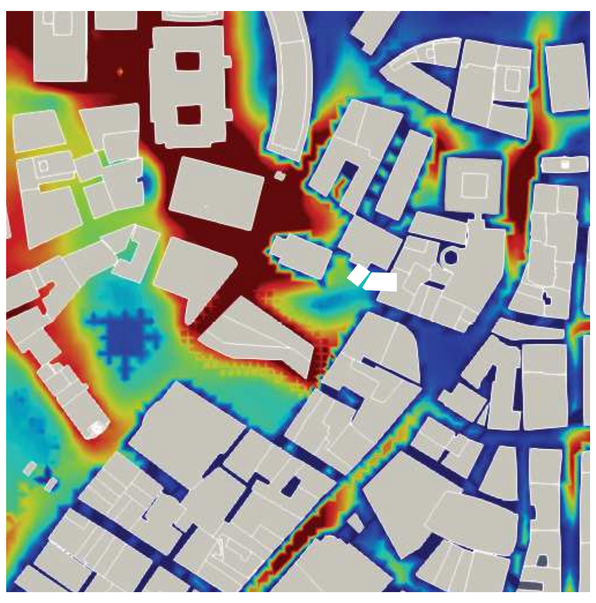


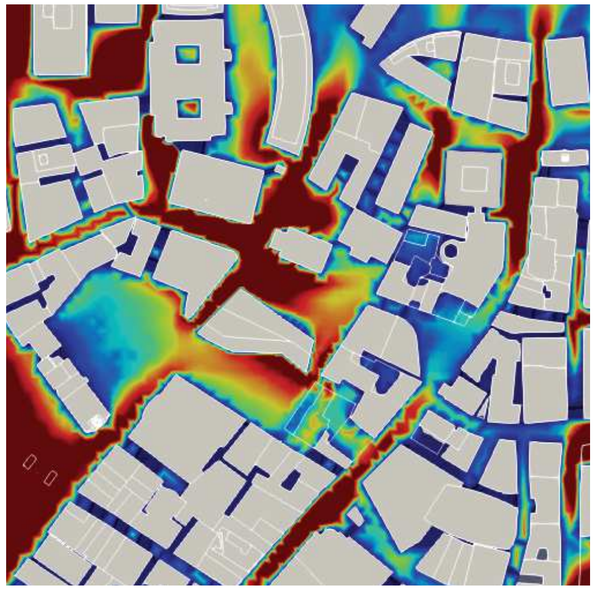


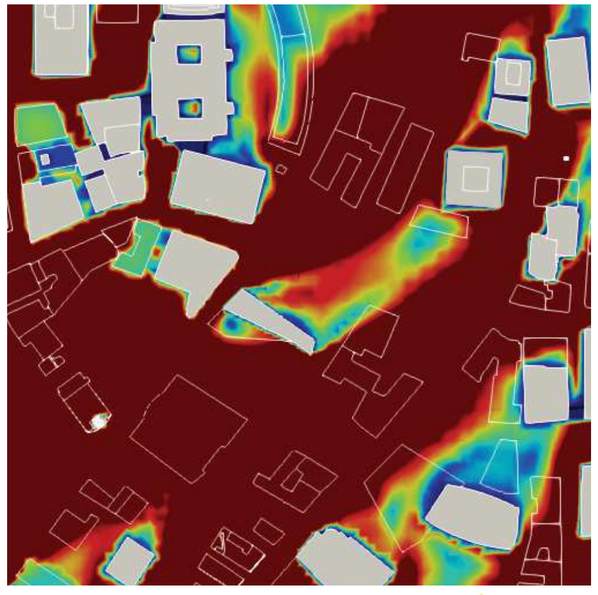


- Compared to the open site, public spaces within our massing achieved higher wind speeds which is desirable for summer.
- 20m above, high wind speeds are achieved but less prevalent than before.

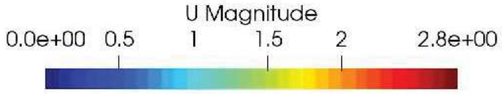
Iteration 3







- Overall, high wind speeds all around the building at the multiple levels which indicates good ventilation in the area. Good vetilation is required in summer to offset the excessive solar gains of the building
- Even at ground level, the area of high speed winds are more prevalent than the previous massing.

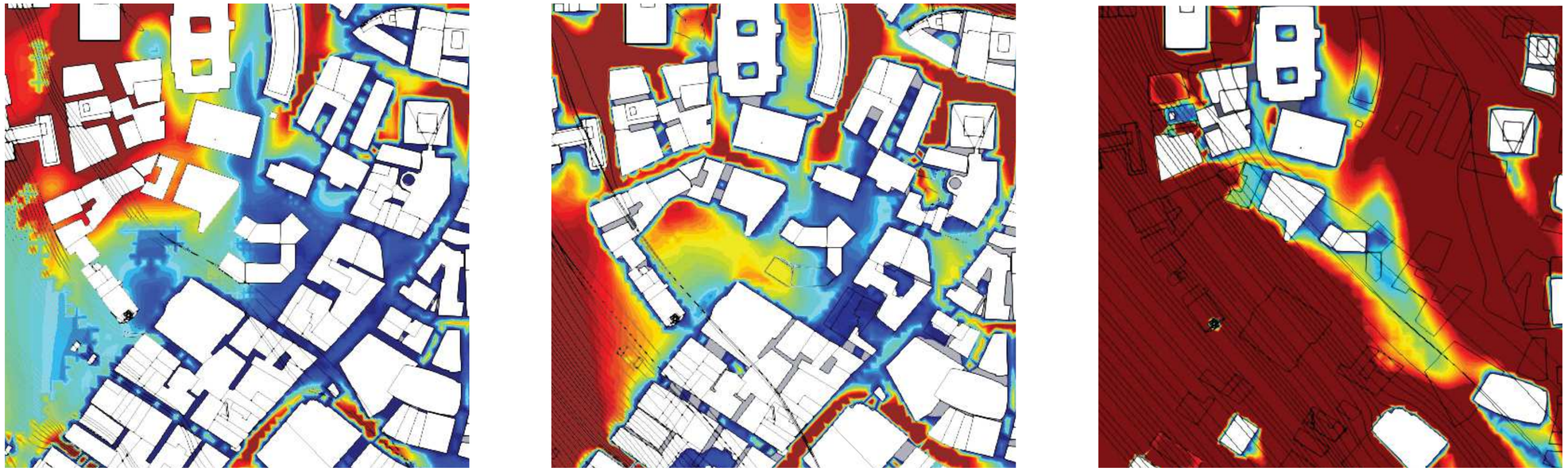


Boston, MA
101 Tremont St
42°21’27.0”N

Wind Speed Simulation
(WINTER)

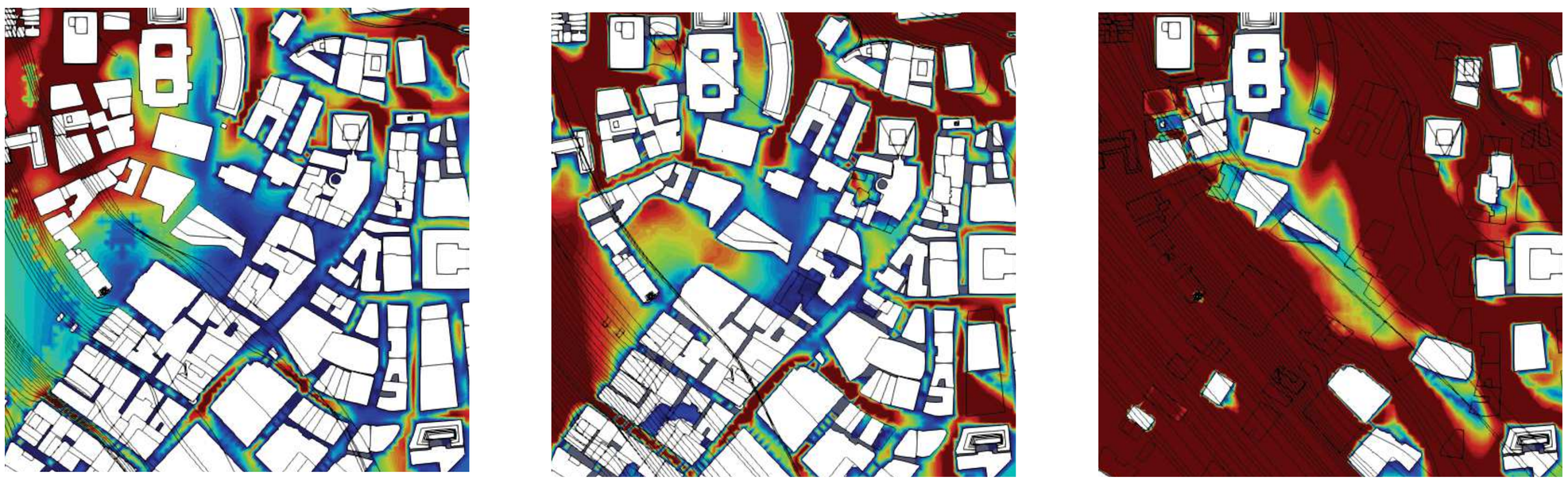
5m | 20m | 50m

Iteration 2



- Overall low wind speeds, especially in the public space framed by the massing. This is ideal as the massing shields users from winter winds.
- At higher levels, the massing still sits within the areas of lower wind speeds.

Iteration 3



- The massing sits in areas with low wind speeds.
- With the exception of 20m elevation, the south-west side shows an area with medium to high wind speed. However, the direction of the wind (from north-west to south-east) does not pass through the building. Hence, building users will not be so affected by the winds.

Boston, MA
101 Tremont St
42°21’27.0”N

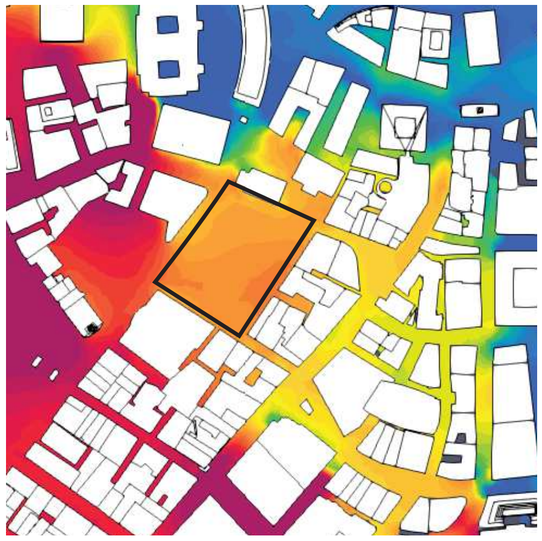
Wind Pressure Simulation - **SITE ONLY**

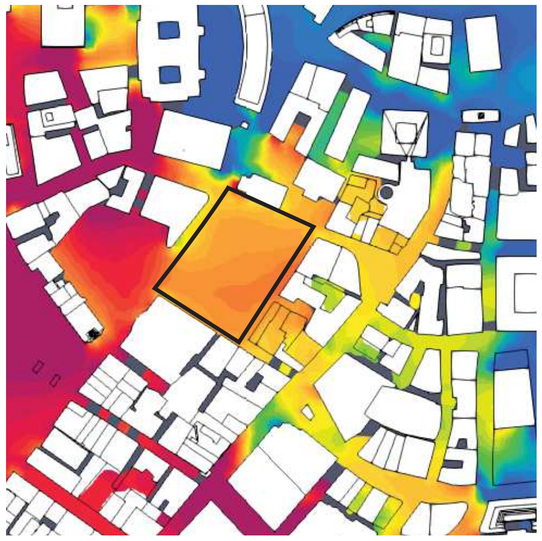
5m

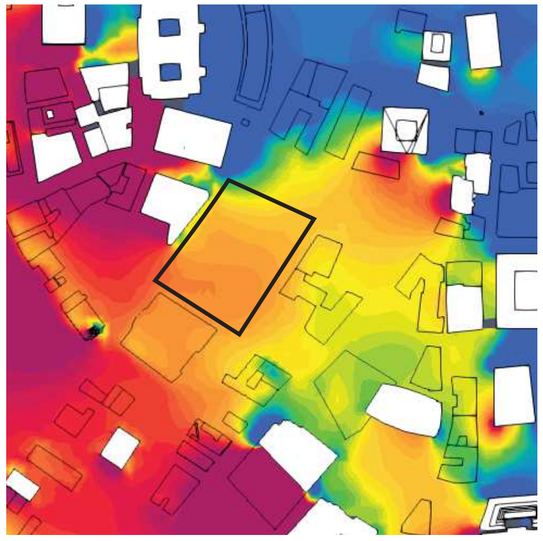
20m

50m

Summer

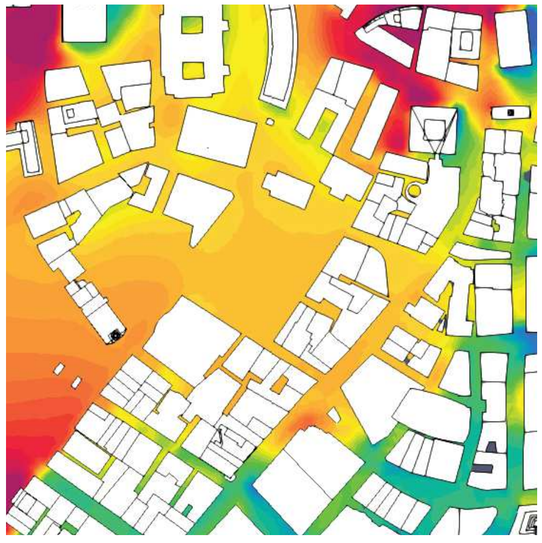


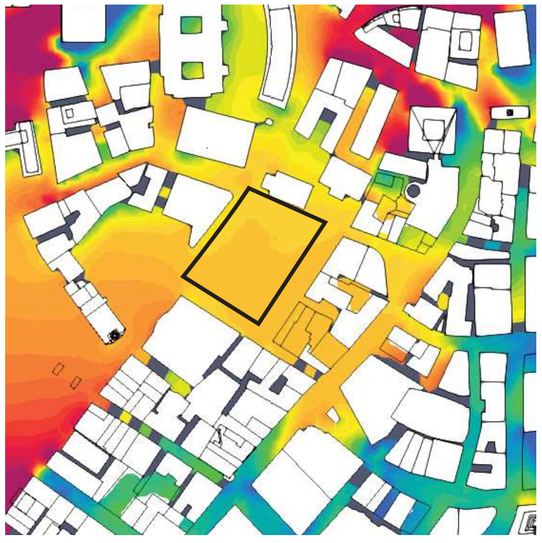


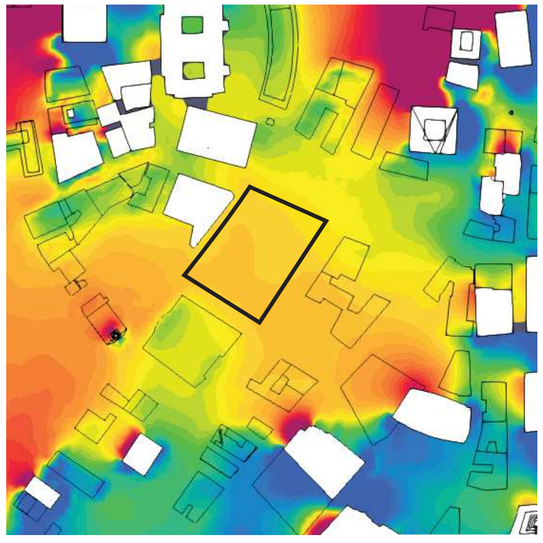


- The site’s pressure is slightly above 0 and is constant through out the site.

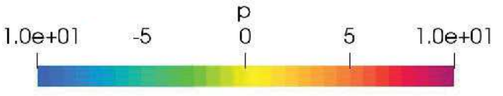
Winter







- The site’s pressure is slightly above 0 and is constant through out the site.

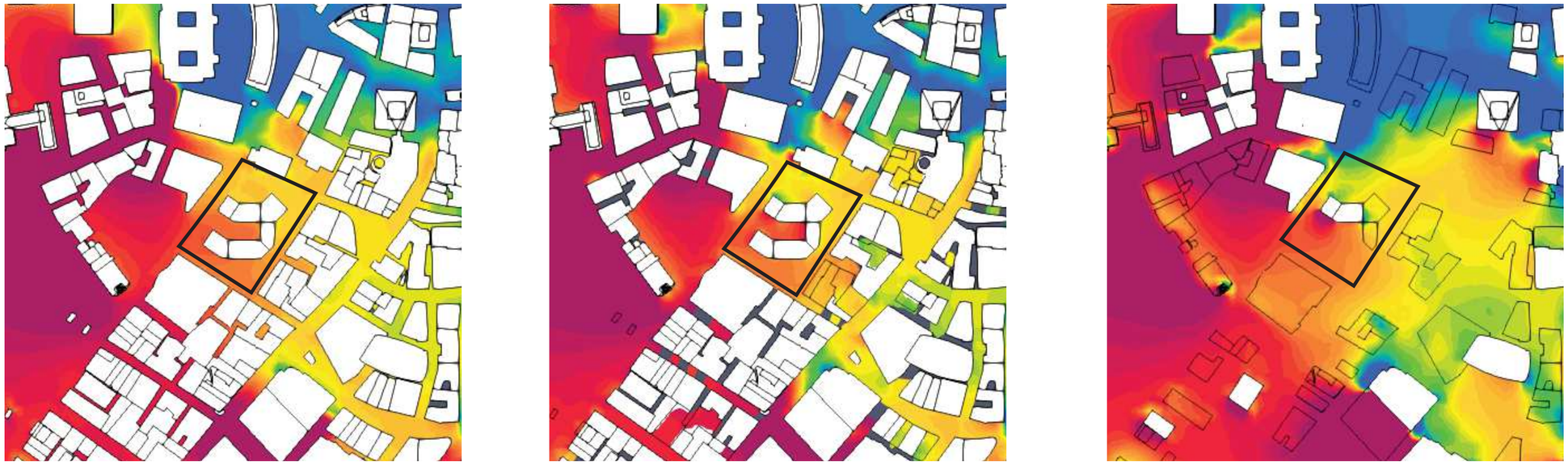


Boston, MA
101 Tremont St
42°21'27.0"N

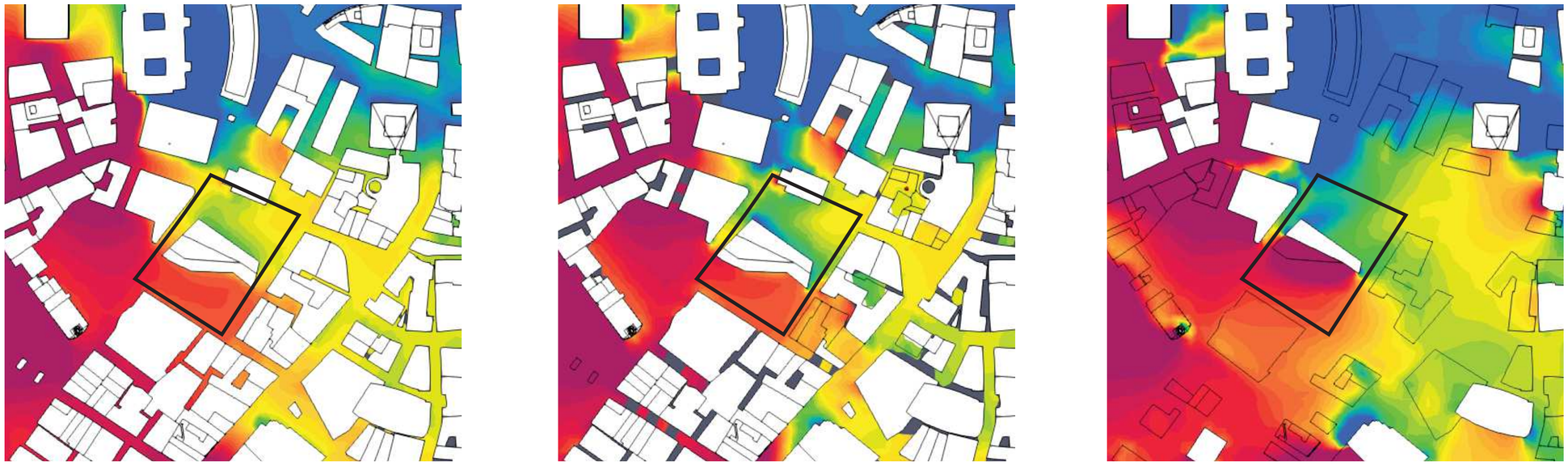
Wind Pressure Simulation
(SUMMER)

5m | 20m | 50m

Iteration 2

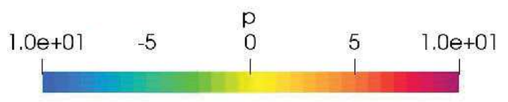


Iteration 3



- The higher pressure on the south-west side of the massing and lower pressure towards the north-east of the massing indicates that there is a movement of air that can possibly pass through the building. This encourages ventilation in the summer which is one of our goals. the heat gained from the summer sun can excessive and having ventilation allows the building to be cooled when needed.

- The massing creates a larger pressure difference between the south-west and north-east of it. This thus allows for stronger cross-breezes during the summer. This makes iteration 3 more ideal than the previous massing.



Boston, MA
101 Tremont St
42°21’27.0”N

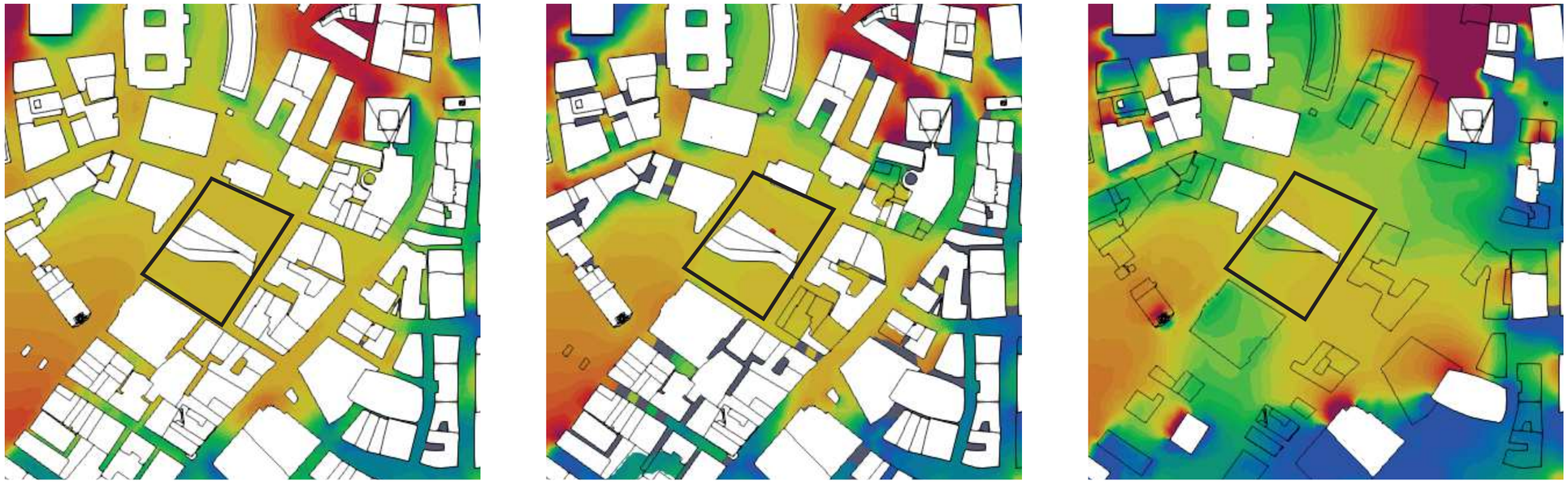
Wind Pressure Simulation
(WINTER)

5m | 20m | 50m

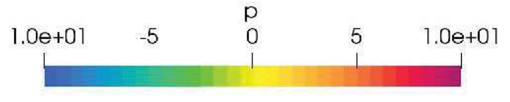
Iteration 2

- Even with the massing, pressure still remains quite uniform around the building.
- This is good in a winter condition as there would not be much air moving and creating wind.

Iteration 3



- For this massing, the building is in an area where the pressure is mostly 0. This is ideal as the air around it will be still and winds will not be generated in the winter cold.
- This, along with the the large solar gains from summer, shows that the building is suited for both summer and winter conditions.



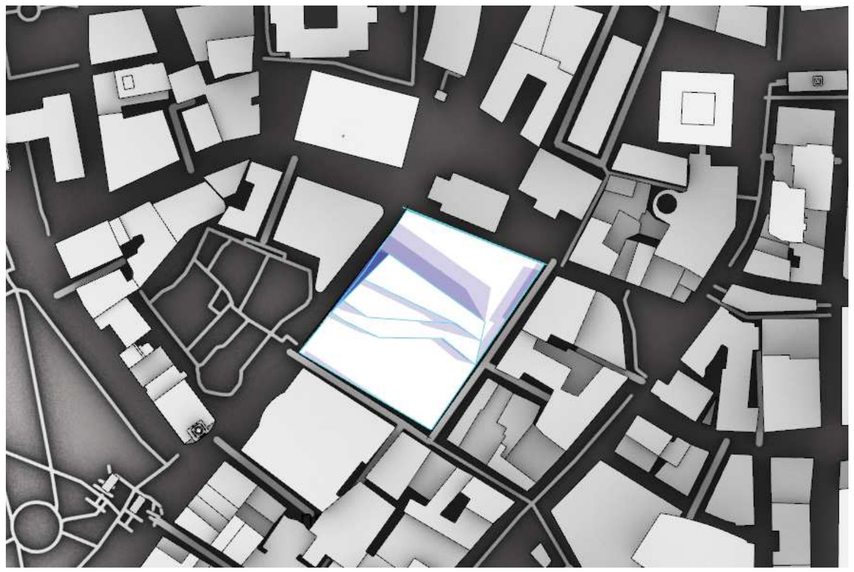
Boston, MA
101 Tremont St
42°21’27.0”N

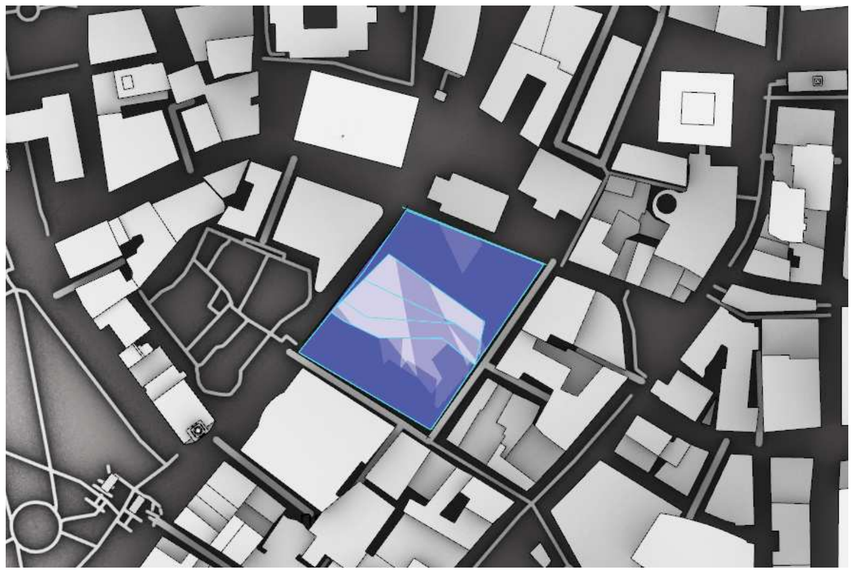
Shadow Analysis (Iteration 3)

Summer

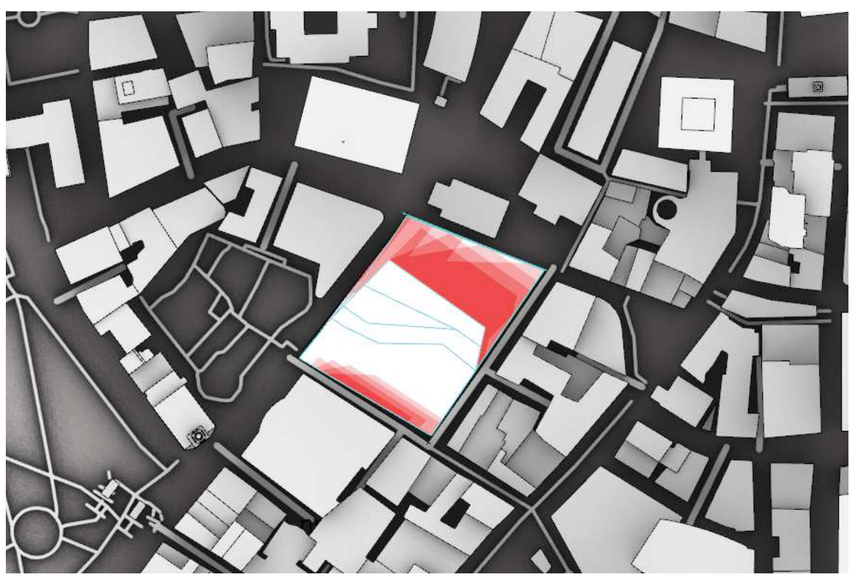
Winter

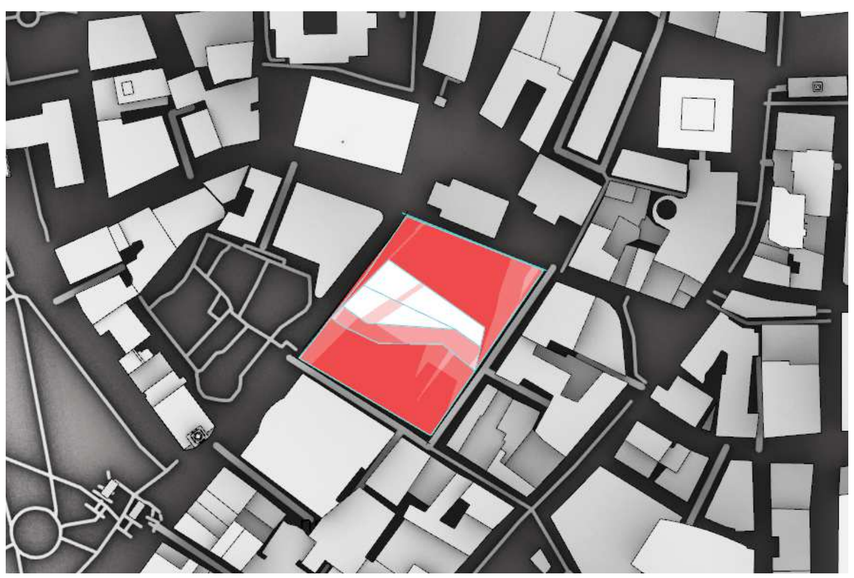
Morning

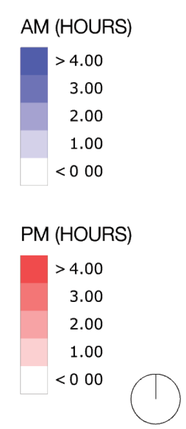




Afternoon





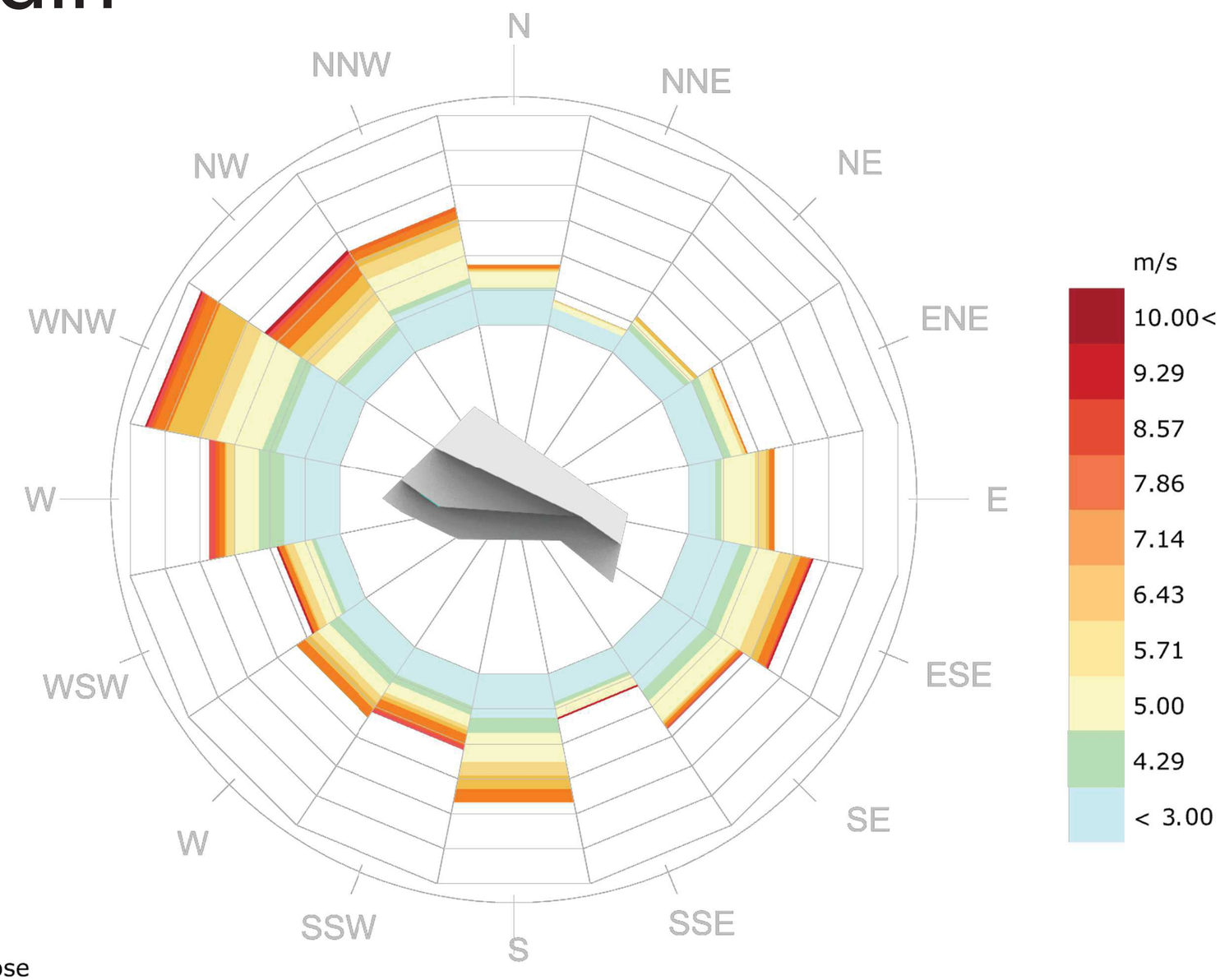


Boston, MA
101 Tremont St
42°21’27.0”N

Wind Driven Rain

JULY Windrose

Highest windspeed: 8.4 m/s
Beaufort Scale: 5 (Fresh Breeze)
Small trees in leaf begin to sway; crested wavelets form on inland waters.
Prominent Wind Direction: WNW
Direction of Massing Openings: SW



Wind-Rose
Boston-Logan Intl AP_MA_USA
1 JUL 1:00 - 31 JUL 24:00
Hourly Data: Wind Speed (m/s)
Calm for 0.00% of the time = 0 hours.
Each closed polyline shows frequency of 1.3%. = 10 hours.

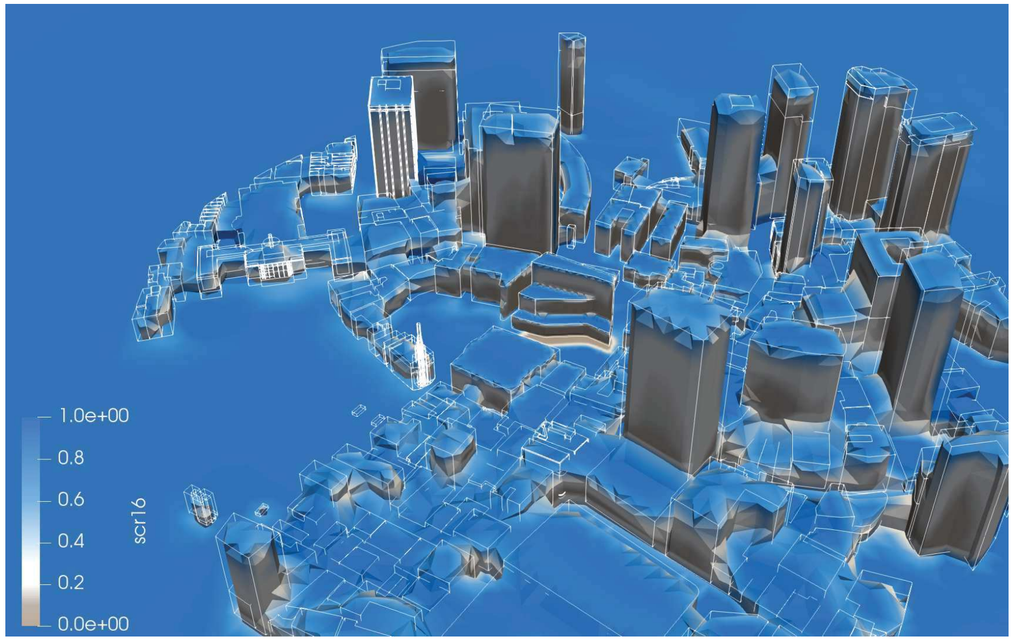
Wind Driven Rain Simulation (Massing Only - Iteration 3)

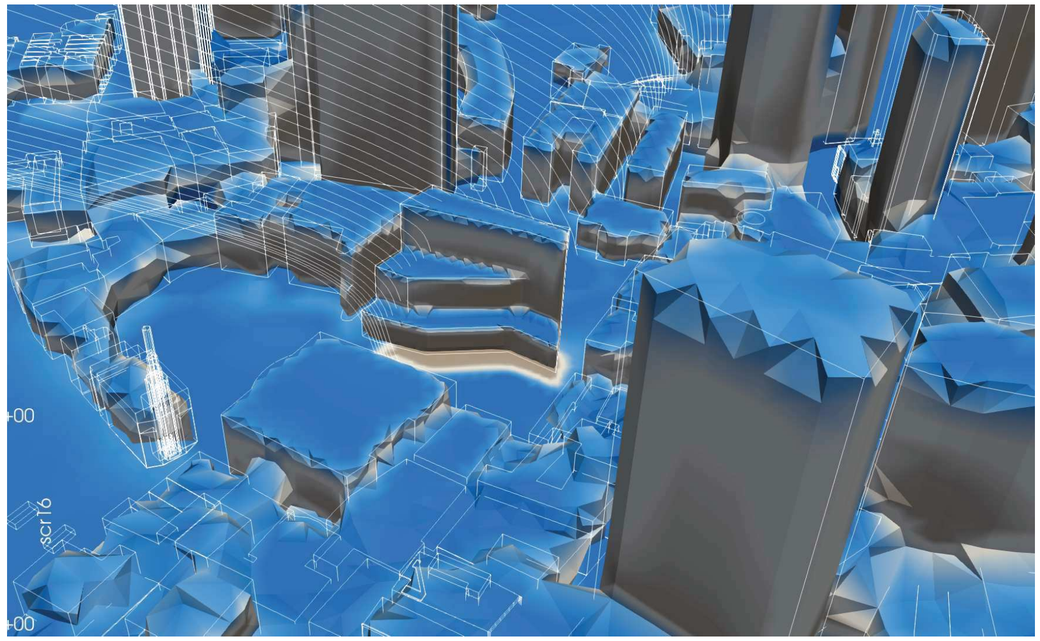
Overall Site

With Stream Tracers

5mm raindrops

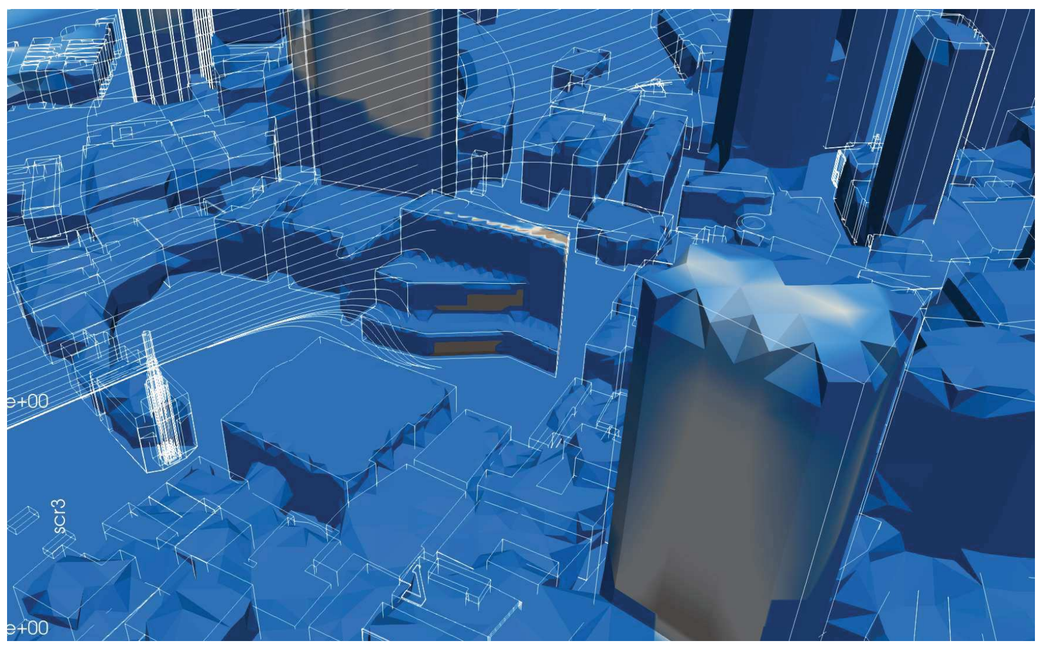
Only our roof terraces experience majority of the injected rain, with the dryest still experiencing at least 20% of the rain. However, surprisingly the highest amount of rainfall hitting the windows of the residential units is around 20% to 30%.





0.5mm raindrops

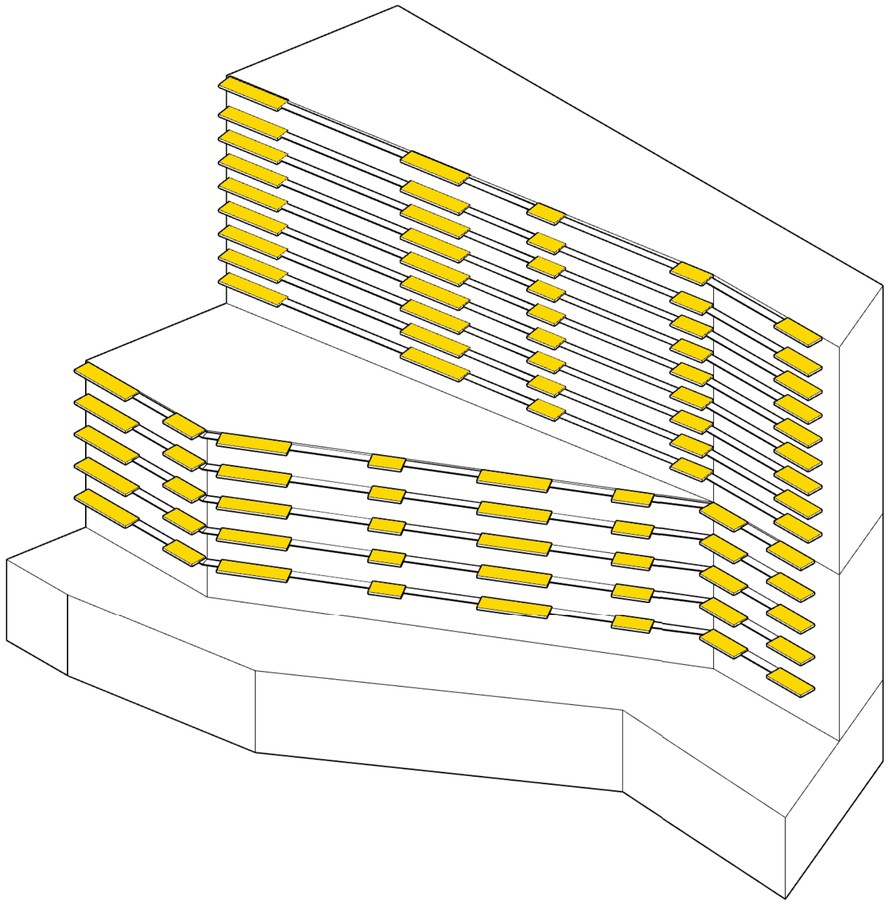
Most faces on our massing exprience more than 80% of the injected rain, which includes both the roof terraces and the windows of the residential units.



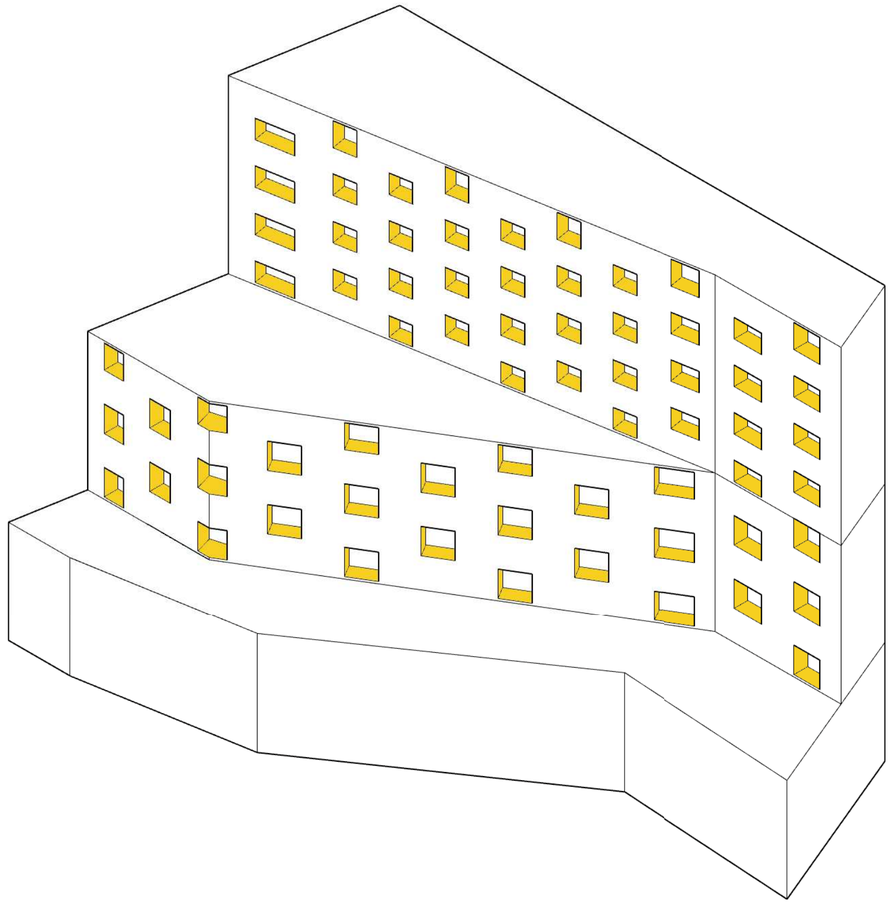
Boston, MA
101 Tremont St
42°21’27.0”N

New Iterations

Massing with
Balcony and
Louvres



Massing with
Balcony and
Louvres

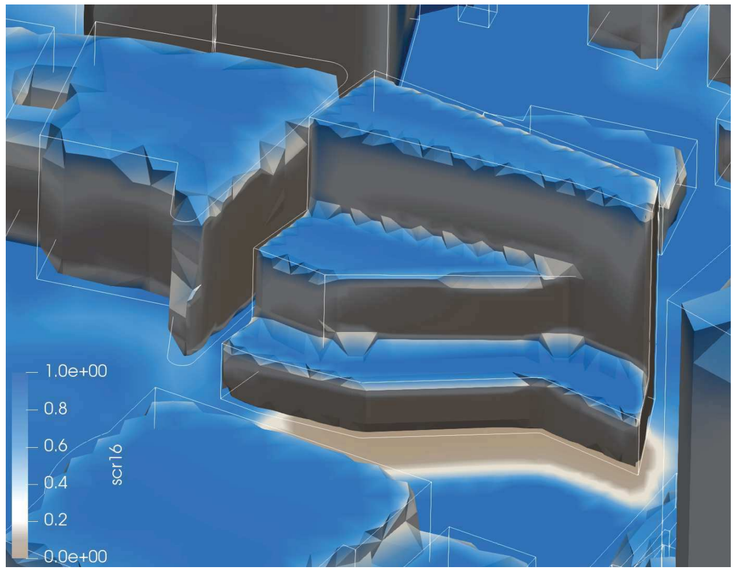


Wind Driven Rain Simulation

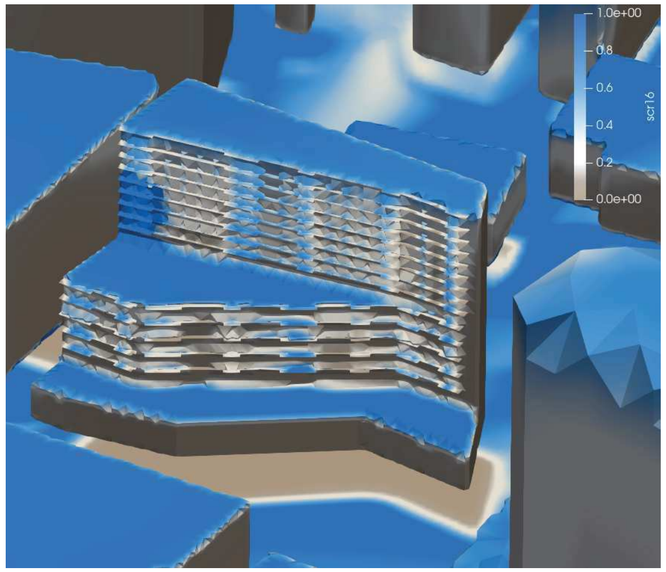
5mm raindrops

as we made minimal changes to the original massing (iteration 3), our results for this week expected as the the vertical faces are receiving about 20% of rain with the roof and terraces capturing the main bulk of rain. This shows a certain stability and consistency in the wind driven rain on the different massings for this rain droplet size.

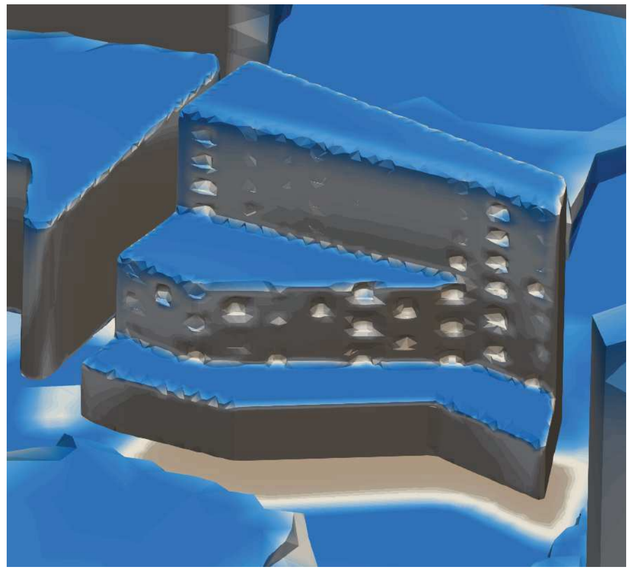
Massing Only
(Iteration 3)



Massing with
Balcony and Louvres
(Iteration 4.1)

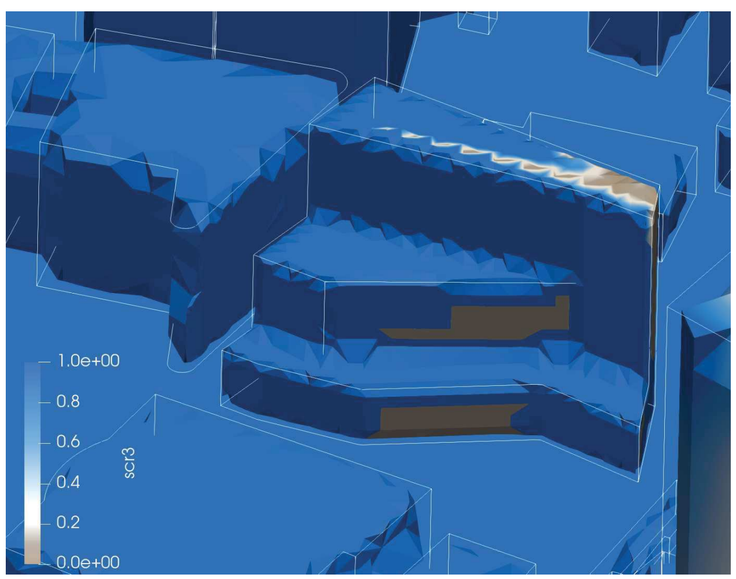


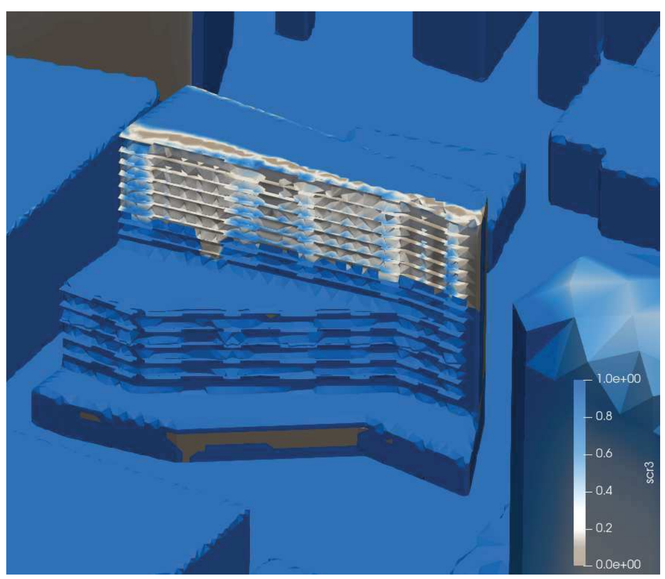
Massing with
Balcony and Louvres
(Iteration 4.2)

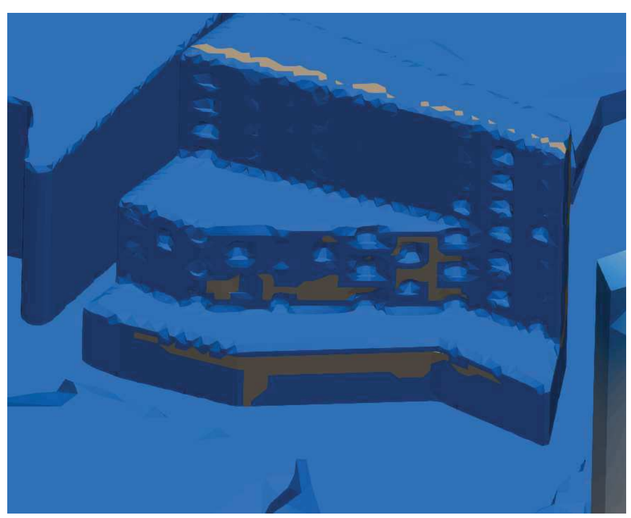


0.5mm raindrops

However, for a smaller size of rain droplets, the is a significant differents on both the vertical faces and the balconies itself. Iteration 4.1 shows a significant decrease in rain capture on the higher levels while the lower levels are still receiving high levels of rain. As for iteration 4.2, as expected, is receiving high levels of rain on the vertical faces but when analysed further we will realised that the balconies are significantly dryer than the ones from iteration 4.1.

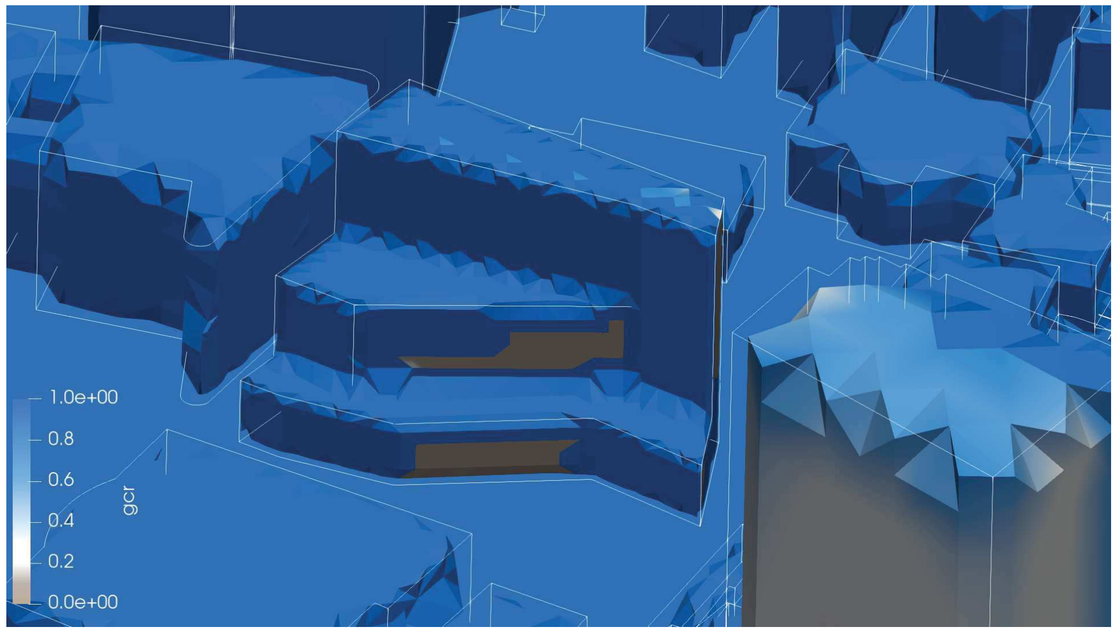




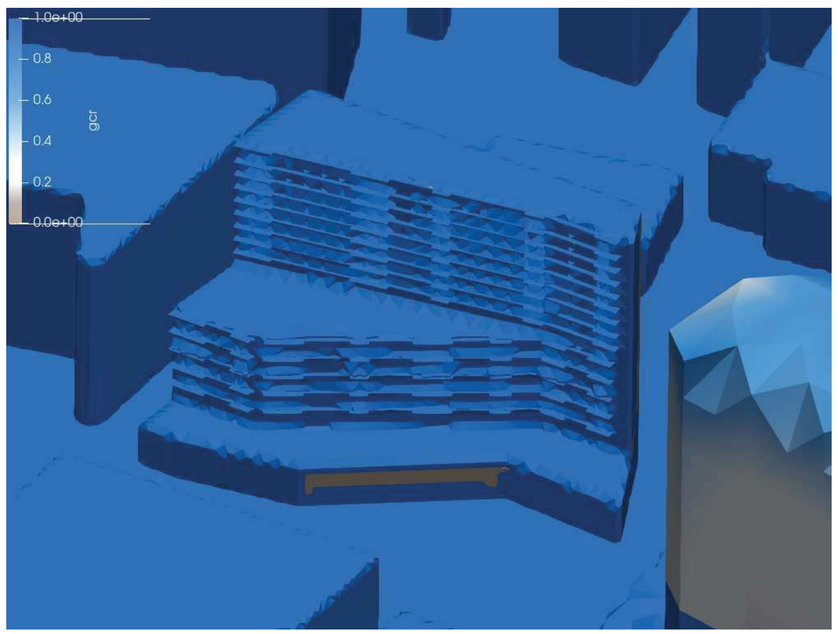


Wind Driven Rain Simulation (GCR)

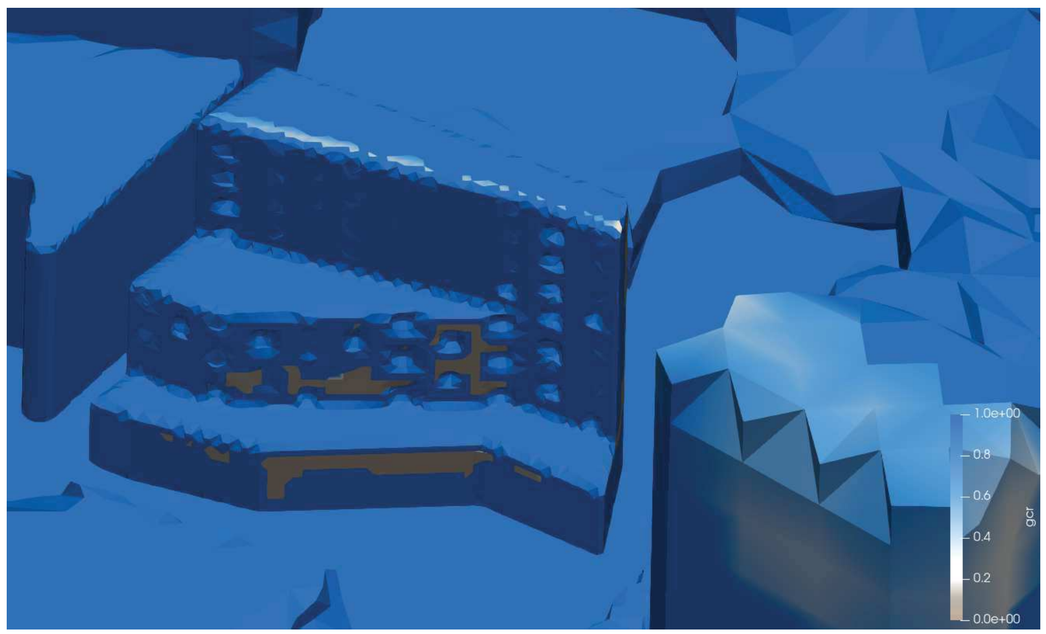
Massing Only
(Iteration 3)



Massing with
Balcony and Louvres
(Iteration 4.1)



Massing with
Balcony
(Iteration 4.2)



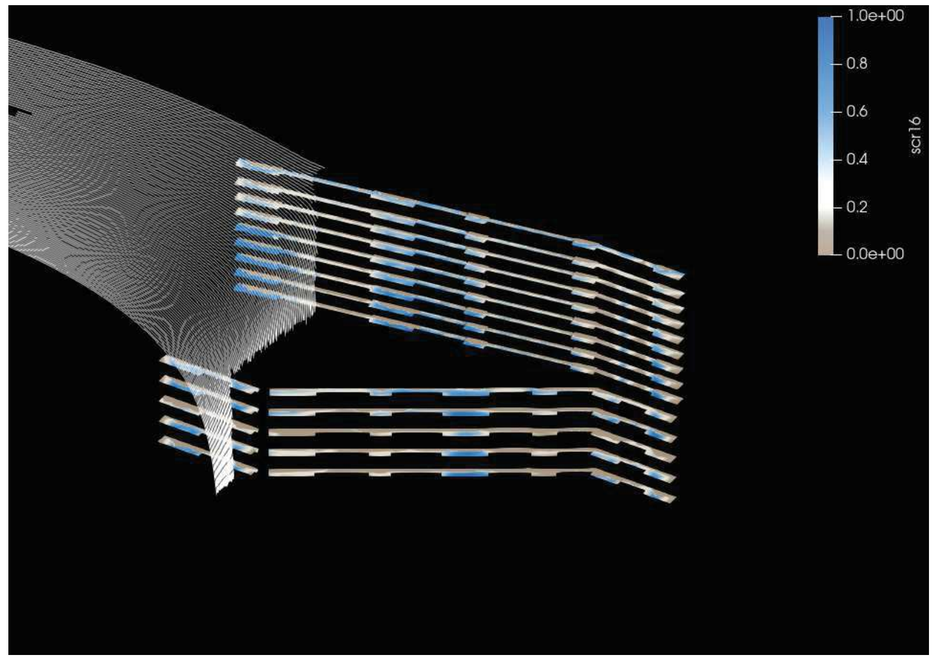
Stream Tracers (Iteration 4.1)

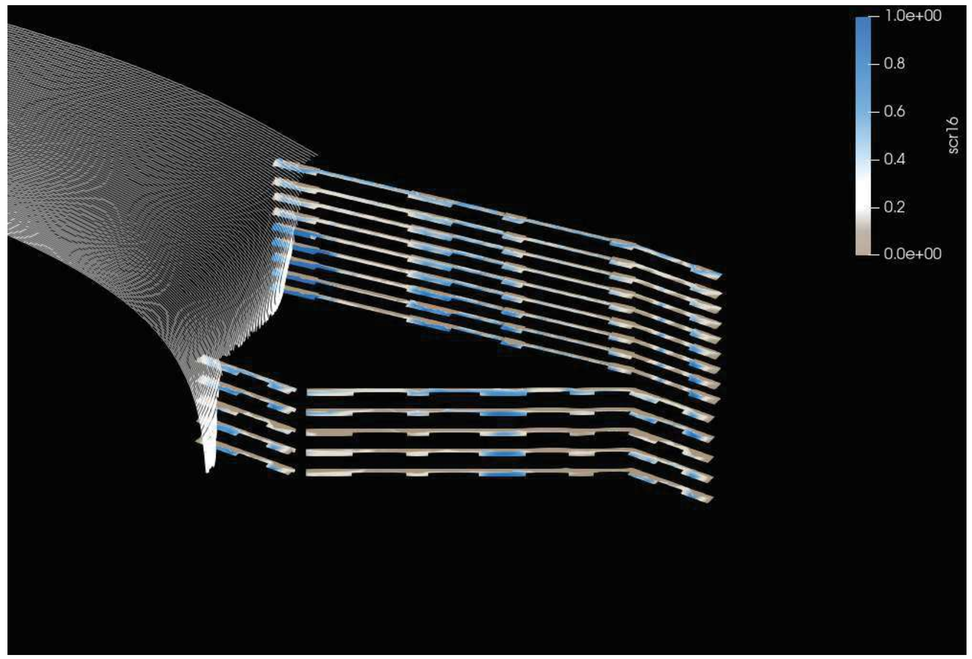
As mentioned, this massing was effective in decreasing the rain capture on the vertical faces of the higher residential levels. However, there is still a degree of rain capture (80-100%) on these levels along most balconies and some windows. This would require certain adjustments to length of canteliever of the louvres and additional louvres for the balconies as well. As for the lower level, these mitigation methods have to be enhanced further to tackle the wetter areas.

Windows

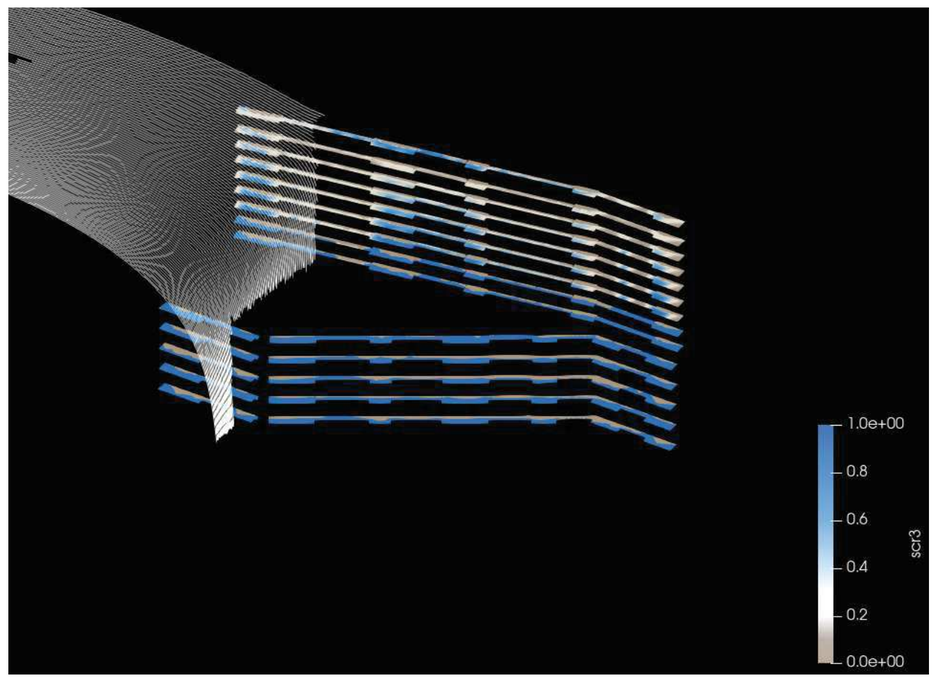
Balcony

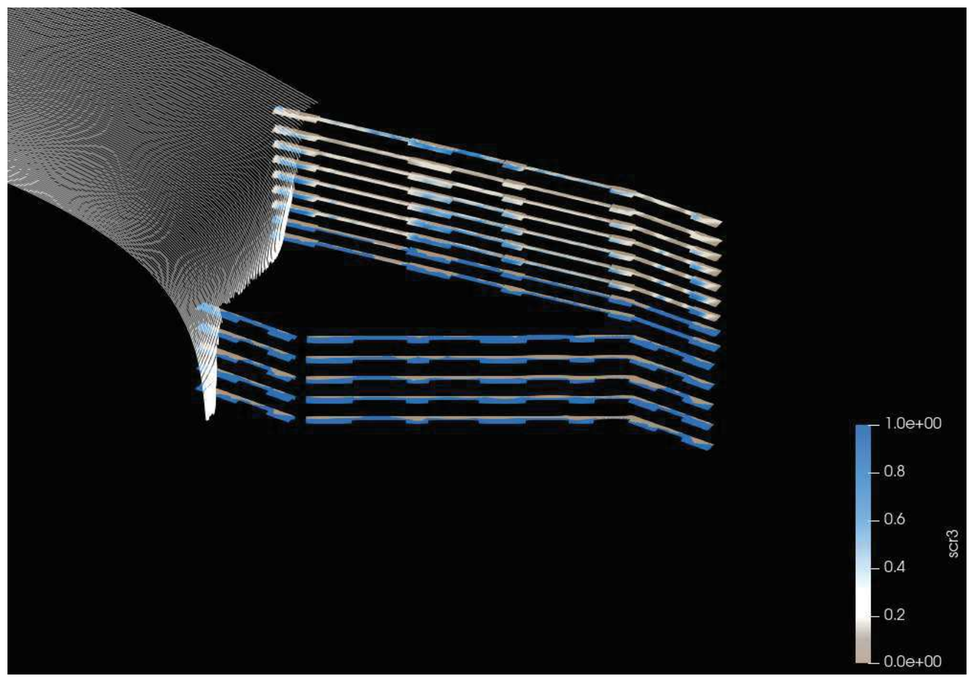
5mm raindrops





0.5mm raindrops





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101 Tremont St
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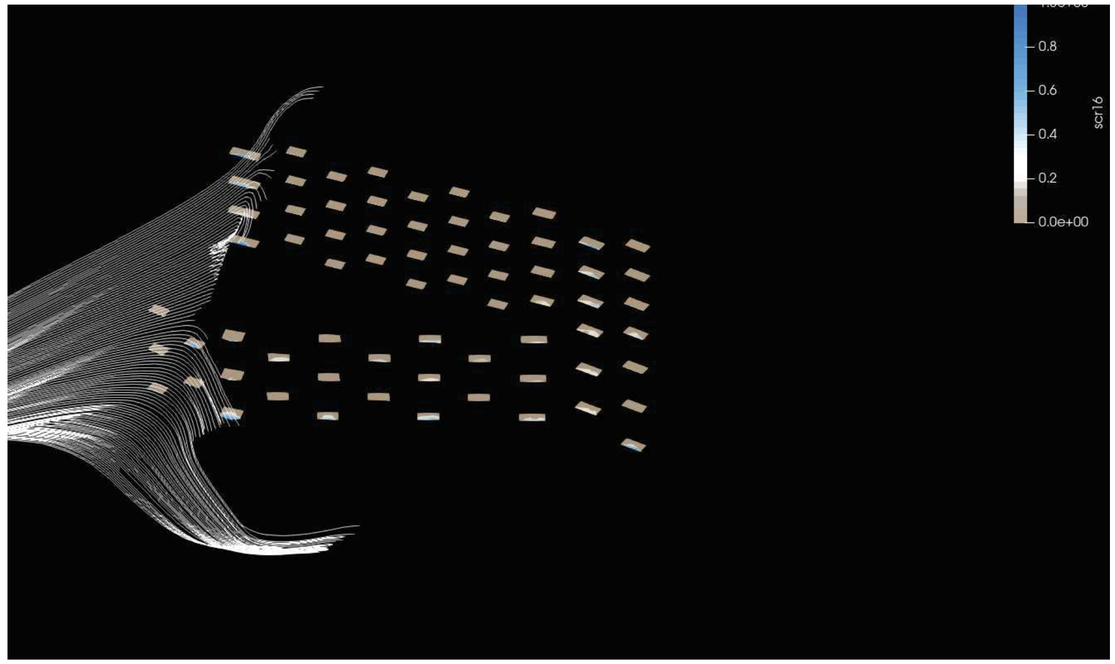
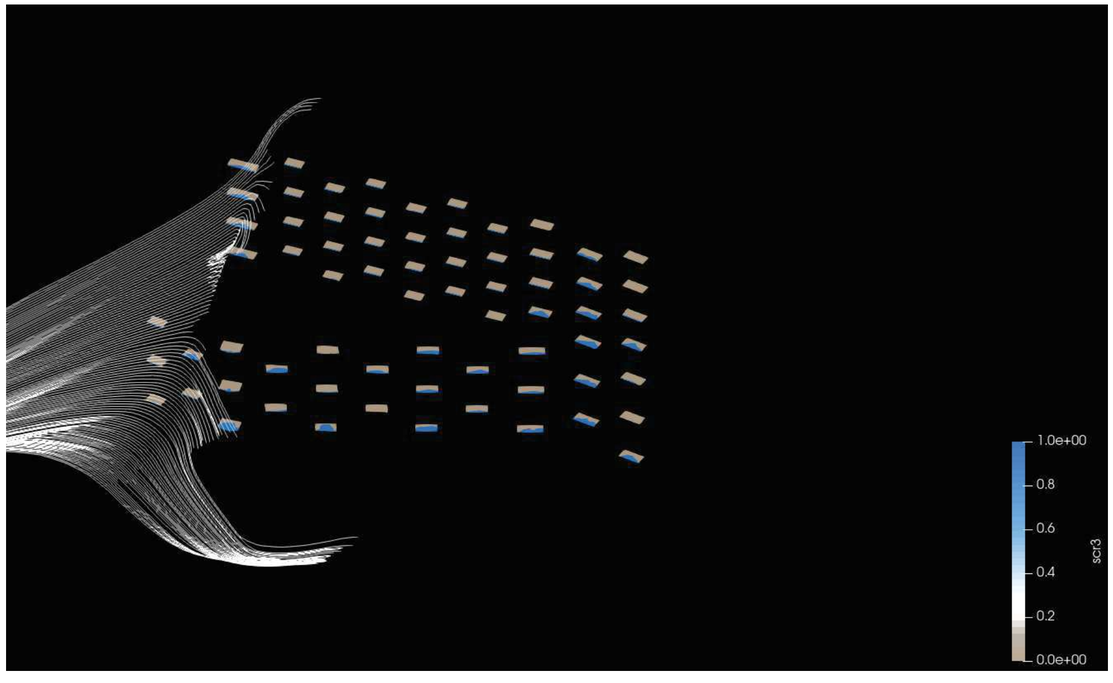
Stream Tracers (Iteration 4.2)

Recessed Balcony

5mm raindrops



0.5mm raindrops



Although the main massing faces seems to receive a significant amount of rain especially for 0.5mm droplets, when we look at the recessed balconies, they are surprisingly dry. For SCR16, most balconies only receive 0-30% of rain and for SCR3, most balconies are experiencing the same with about only about 25% of the balconies partially experiencing 80-100% rain capture. This is very useful in understanding which faces has balconies which experience more rain capture and we can be more careful into mitigating those standouts.

Boston, MA
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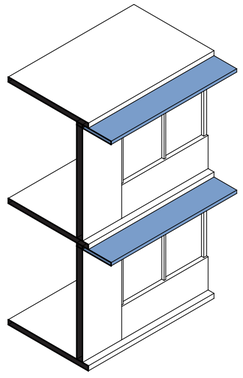
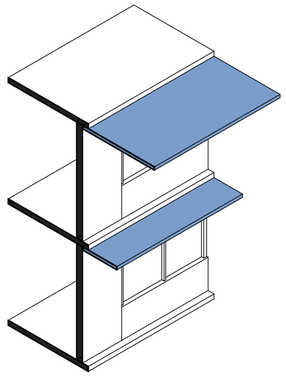
Strategies Moving Forward

Windows (Louvres)

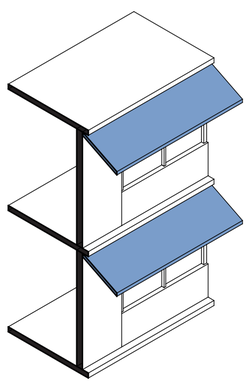
Louvers over windows (current implementation) W1



Extending louvers over more heavily affected windows to shield them W2

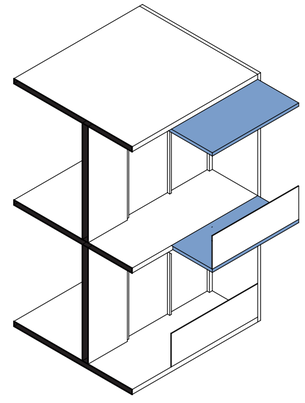


Tilting louvres to shield windows from WDR W3

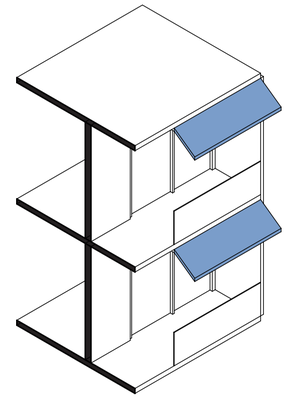


Balcony

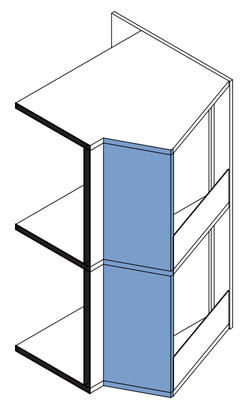
Extending Balconies over heavily affected ones to shield them from WDR B1



Tilting louvres to shield balconies from WDR B2



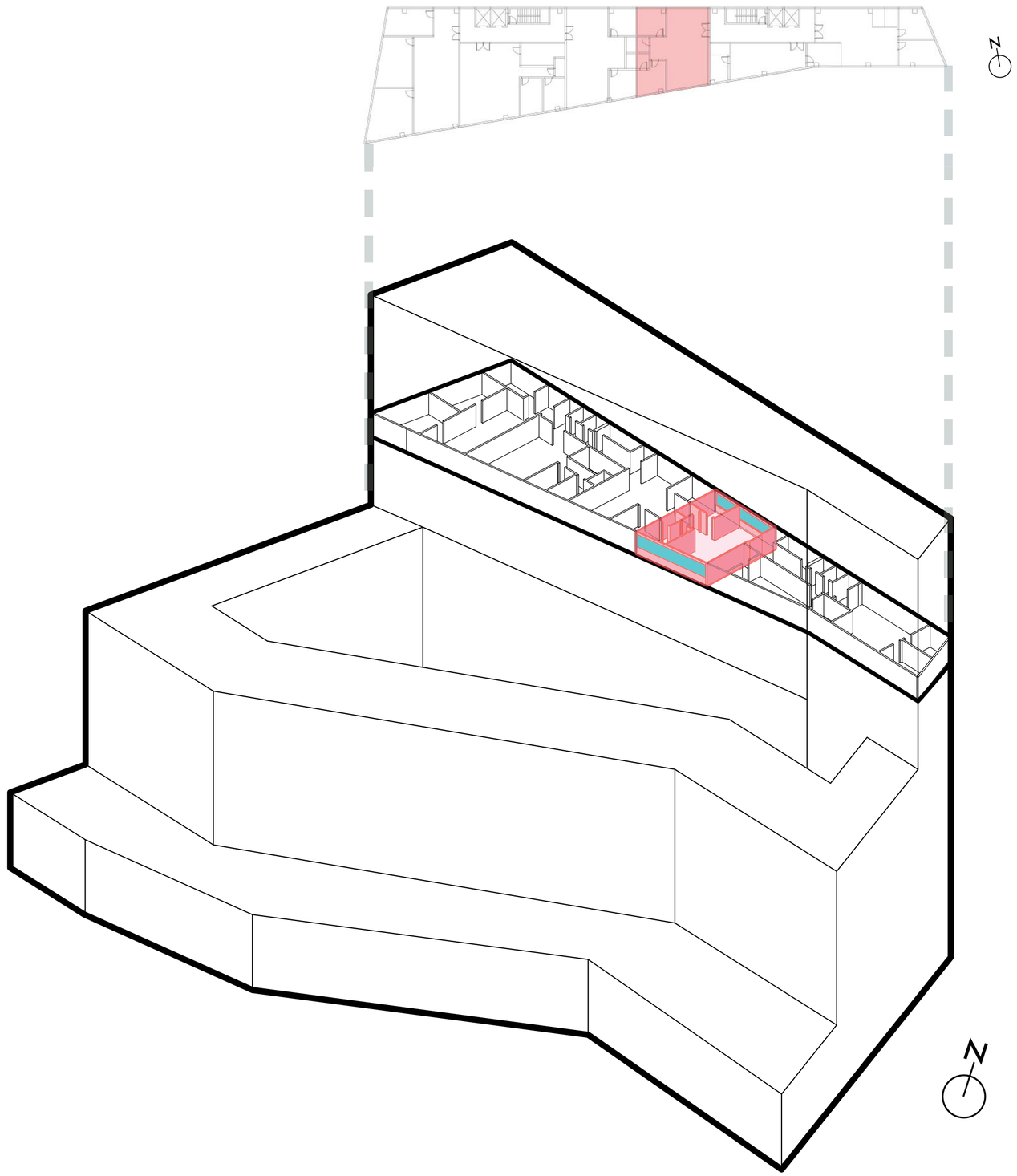
Rotating balconies with a wall to shield against South-West-WDR B3



Boston, MA
101 Tremont St
42°21’27.0”N

Daylight Analysis

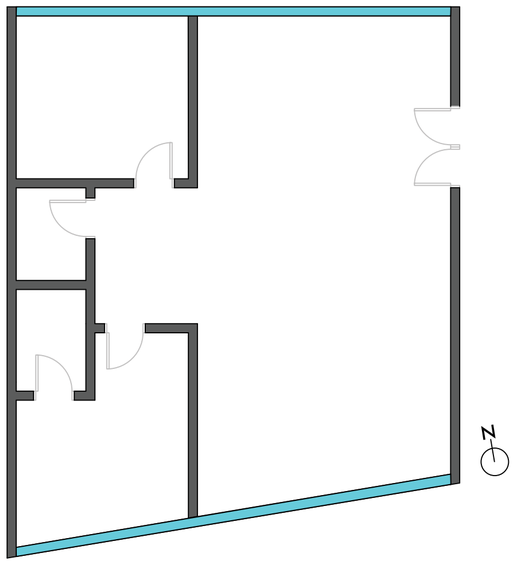
Floorplan



Boston, MA
101 Tremont St
42°21’27.0”N

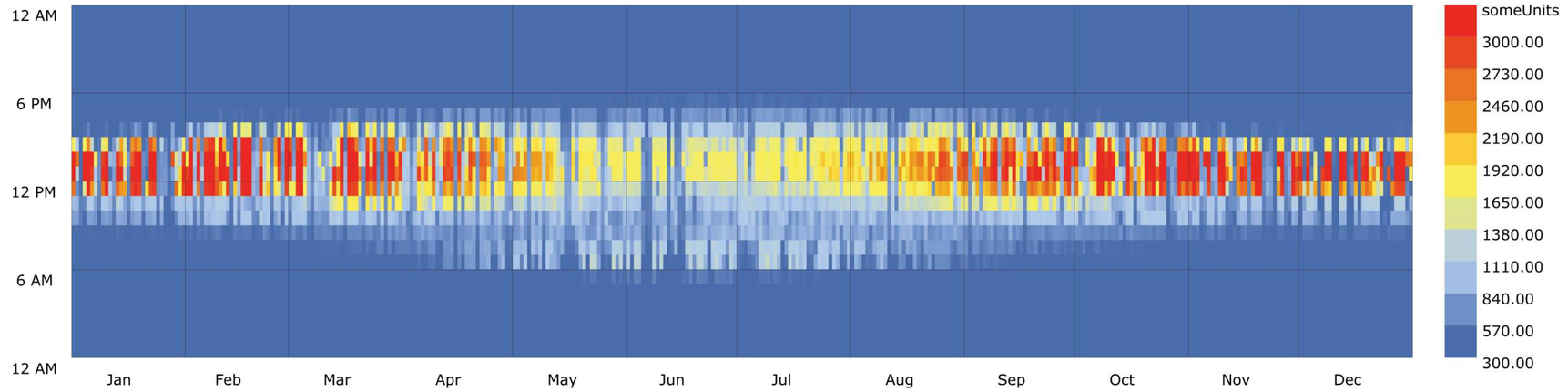
Annual Illuminance and Glare
Iteration 3 - No Façade

Unit Plan

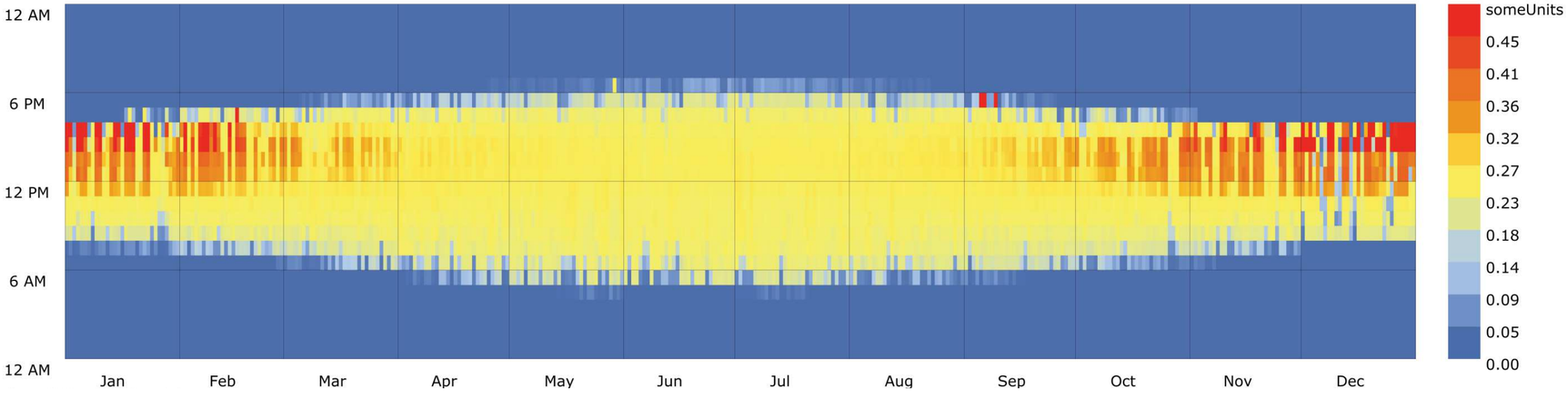


Overall, the unit is quite well lit, as reflected by the annual illuminance. Even though there are period of extremely high radiation, it is during the winter months where solar gains would be the most necessary.

Annual Daylight (lux)



Annual Daylight Glare Potential (%)

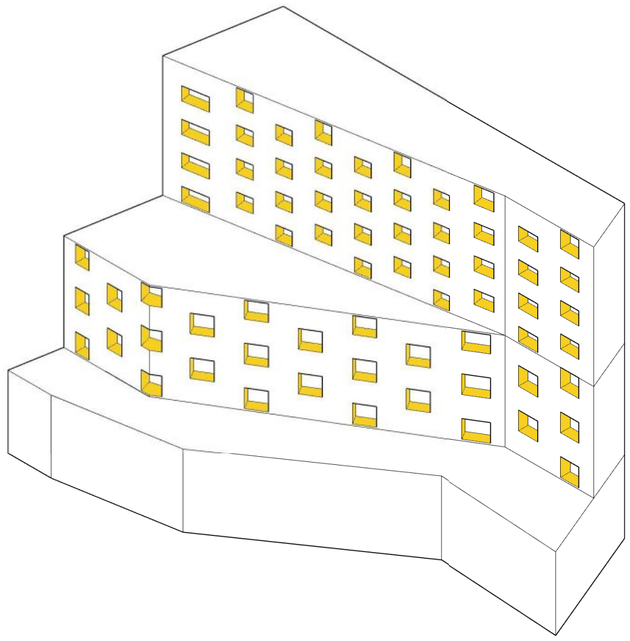


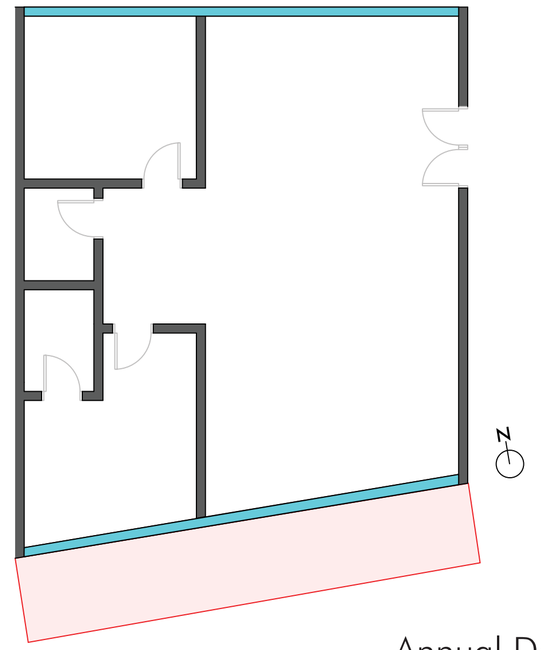
Boston, MA
101 Tremont St
42°21’27.0”N

After adjustments for WDR
Iteration 4.2 - Recessed Balcony Facade

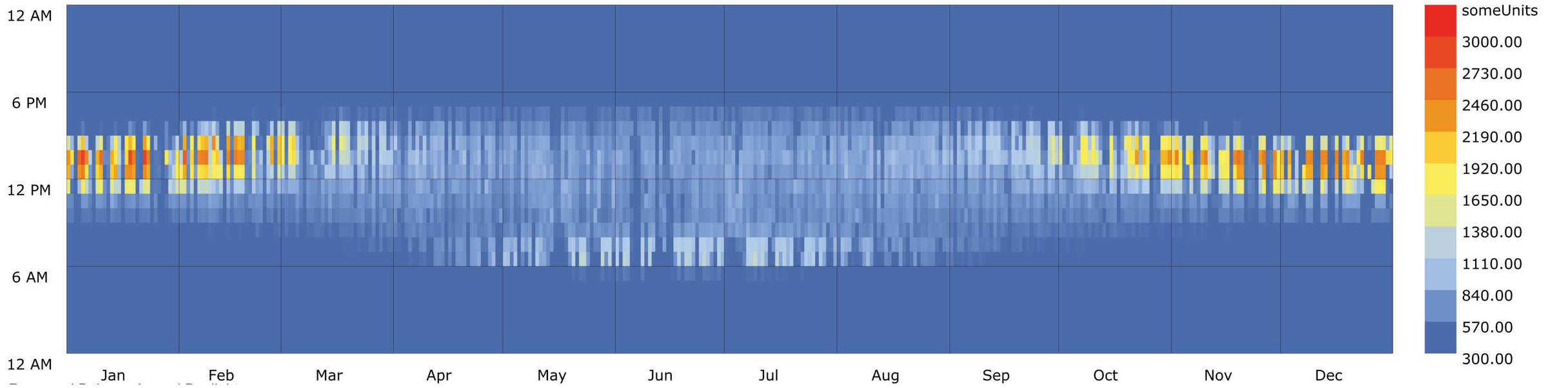
Massing with Balcony and Louvres
(Iteration 4.2)

Based on the previous assignment, we tested the model that best suited the wind driven rain conditions, with daylighting and found that Iteration 4.2 causes the unit to be not well lit. Since the site is in a temperate country, the priority would be to achieve solar gains rather than mitigate wind and rain, as the building for most parts of the year will require active heating.





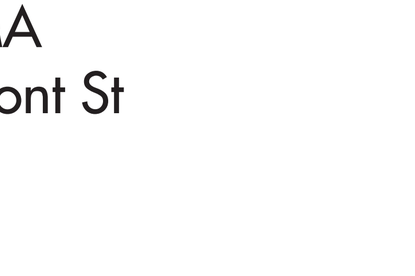
Annual Daylight (lux)



Iterations

New Iterations for the facade were designed to reduce the glare while trying to maintain high annual illuminance.

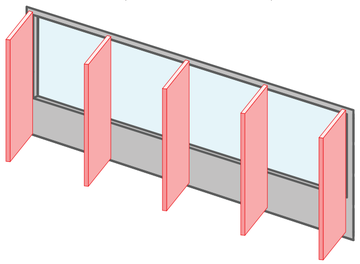
Iteration 4.2



Derived from WDR

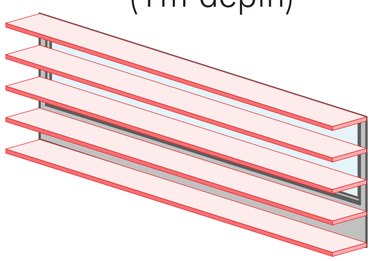
Iteration 5

Vertical louvers
(2m width)



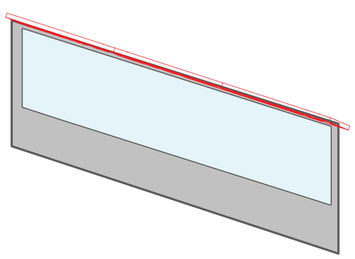
Iteration 6

Horizontal louvers
(1m depth)



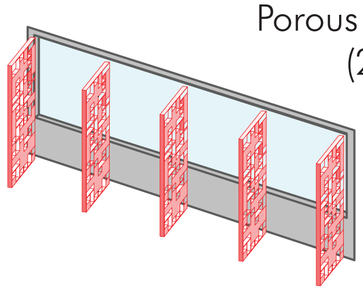
Iteration 7

Canopy
(0.75m depth, angled upwards)



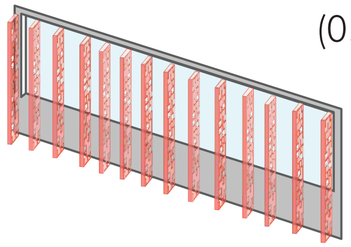
Iteration 5.1

Porous vertical louvers
(2m width)



Iteration 5.2

Porous vertical louvers of higher porosity
(0.6m width)



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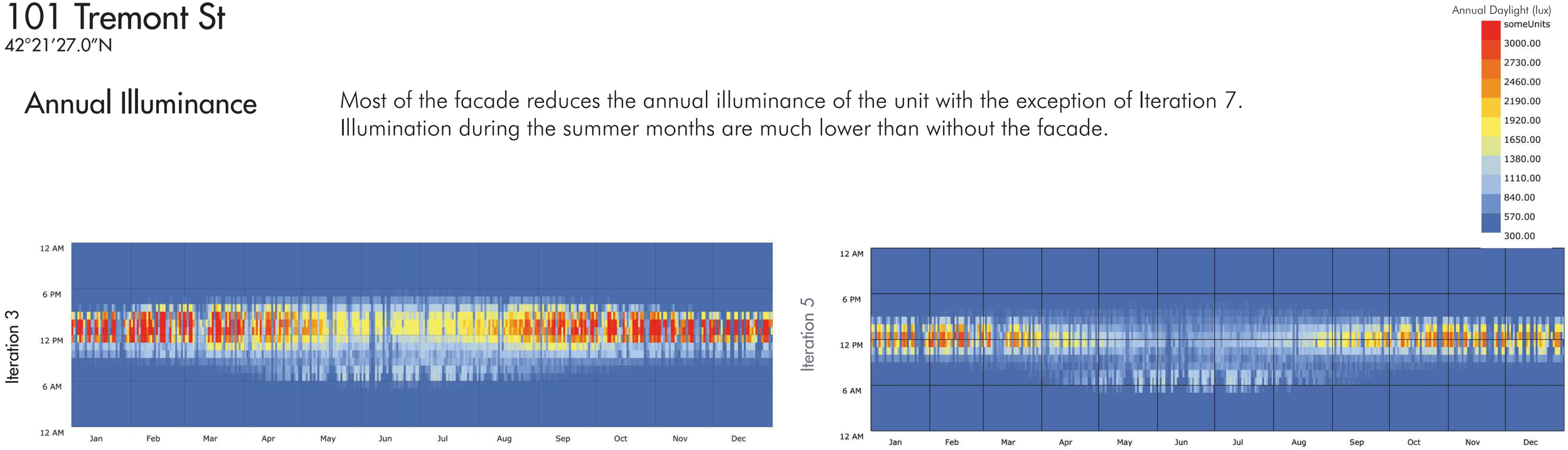
Annual Illuminance

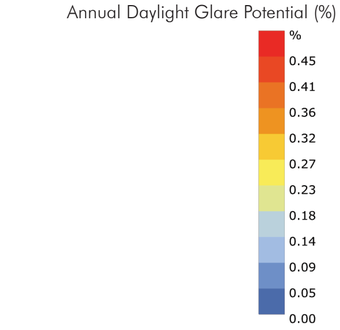
Most of the facade reduces the annual illuminance of the unit with the exception of Iteration 7. Illumination during the summer months are much lower than without the facade.

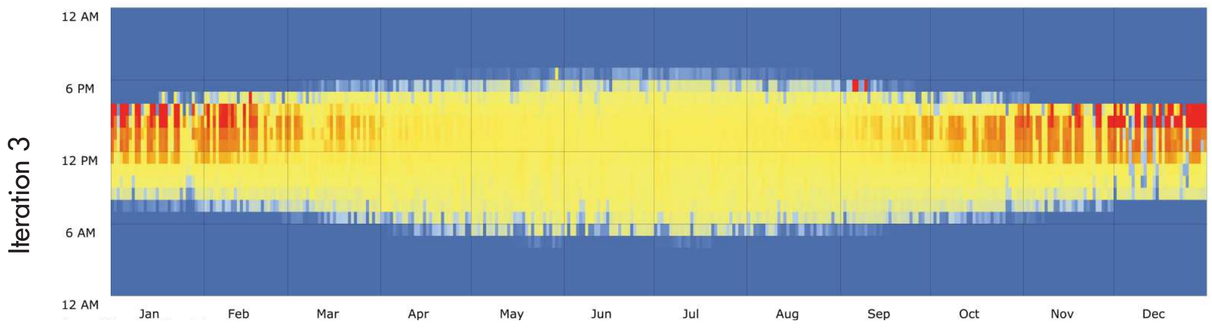


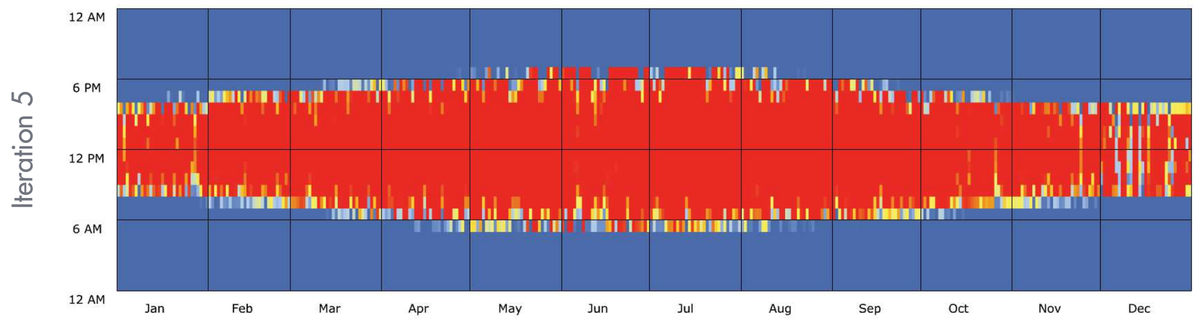
Boston, MA
101 Tremont St
42°21’27.0”N

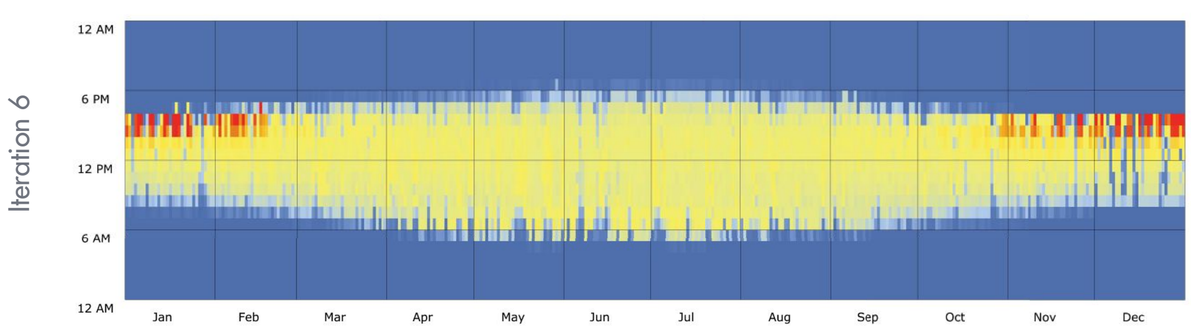
Annual Glare

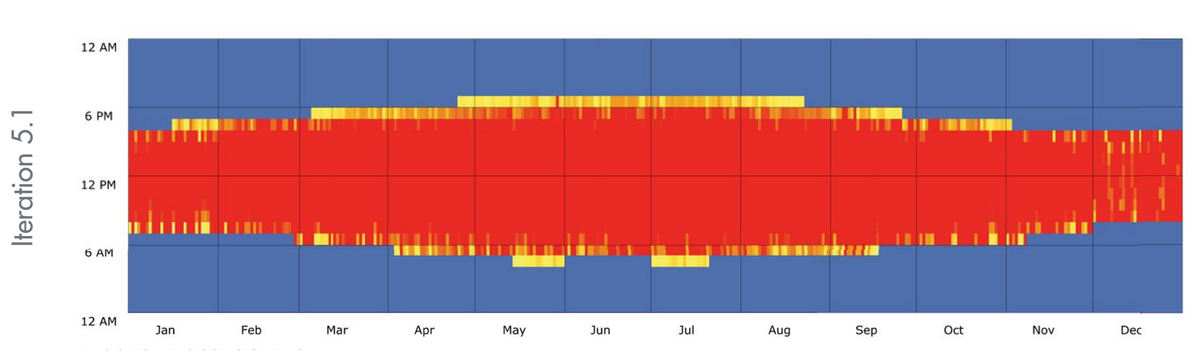
Most the the annual glare also increased with the addition of the facade, with the exception of Iteration 5.2. However, Iteration 5.2 also has the lowest annual illuminance, making it less favourable than the control (iteration 3).

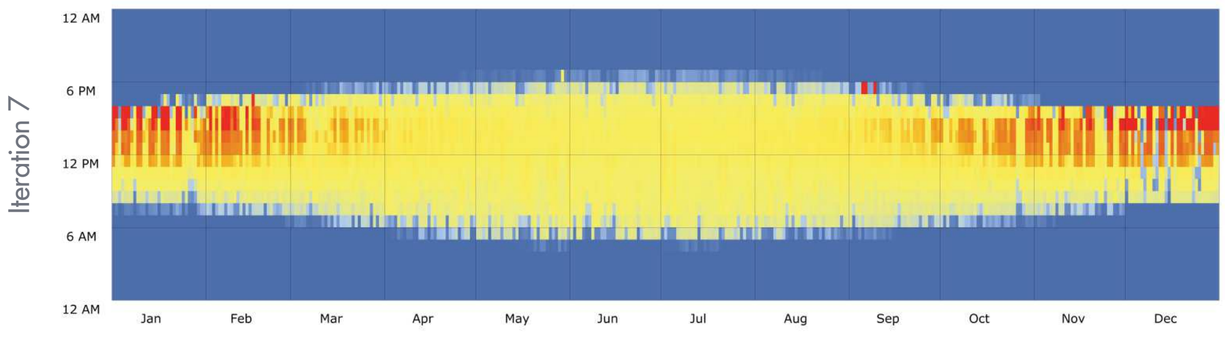


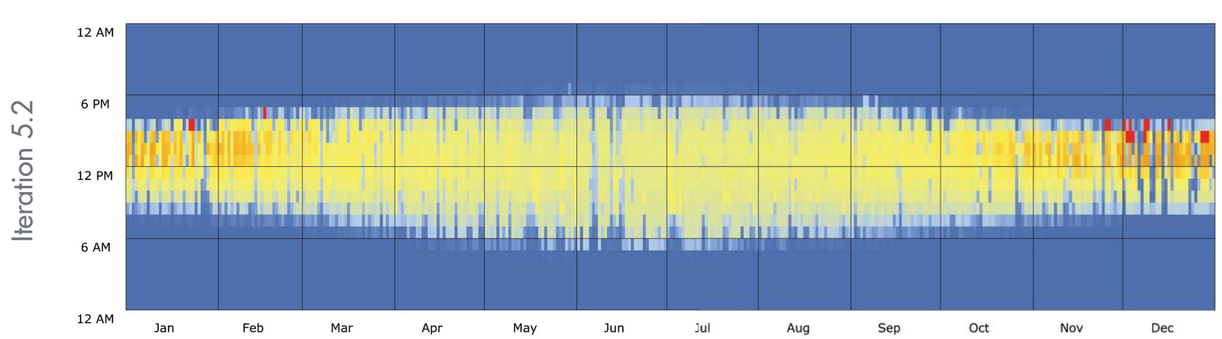












Boston, MA
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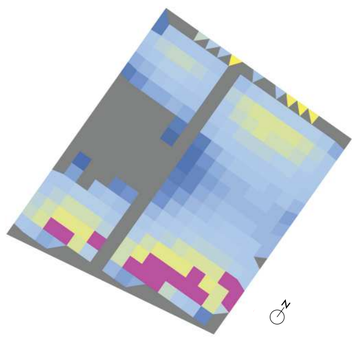
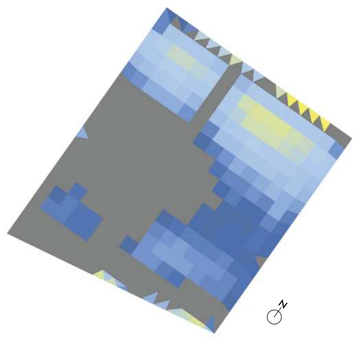
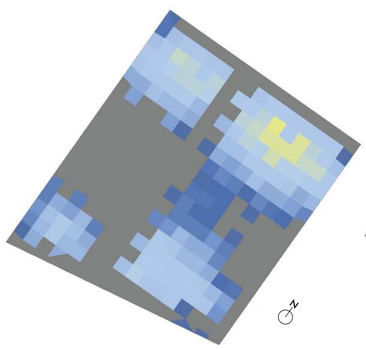
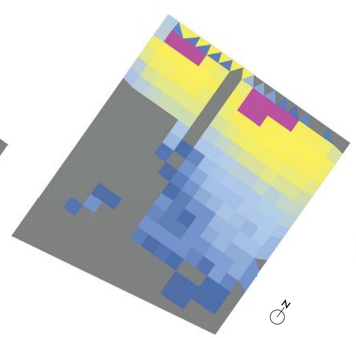
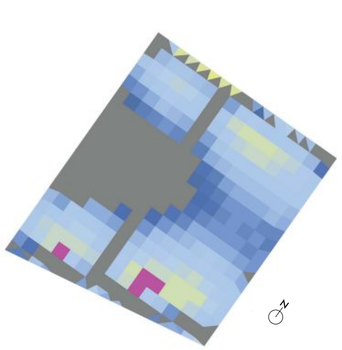
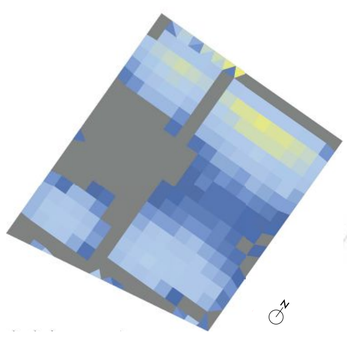
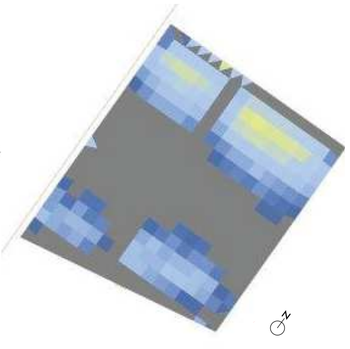
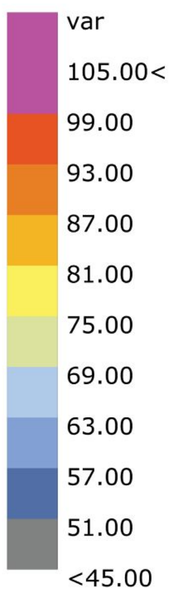
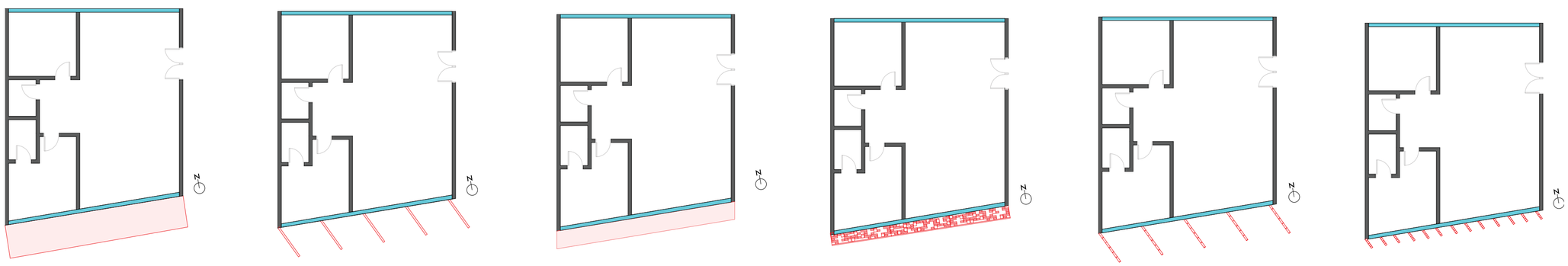
Daylit Area

xxxxxx

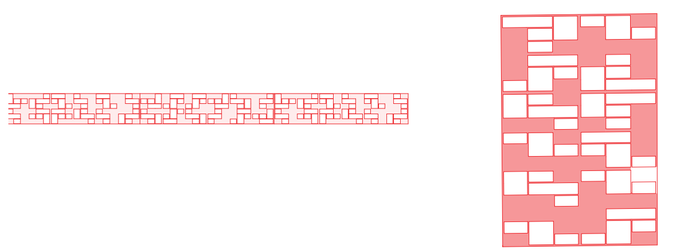
Iteration 3 (No Facade)	Iteration 4.2	Iteration 5	Iteration 6	Iteration 7	Iteration 5.1	Iteration 5.2
						
61.91%	56.85%	56.83%	56.25%	66.37%	65.77%	47.92%



Unit Floorplan

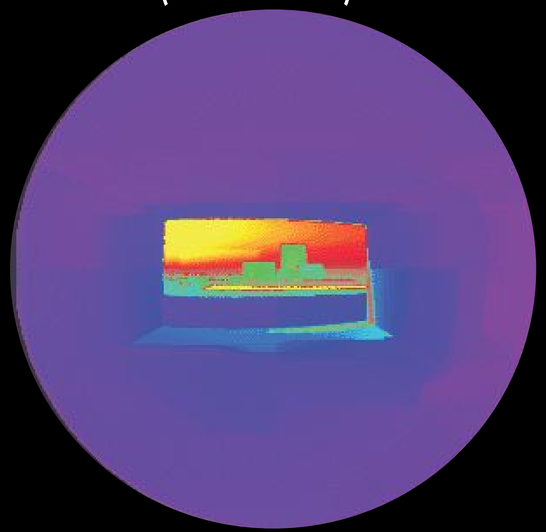


Facade Detail



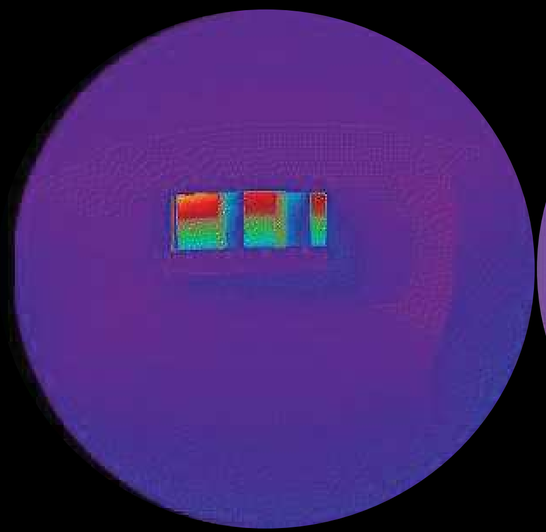
Illuminance False Colour Image

Iteration 3
(No Facade)



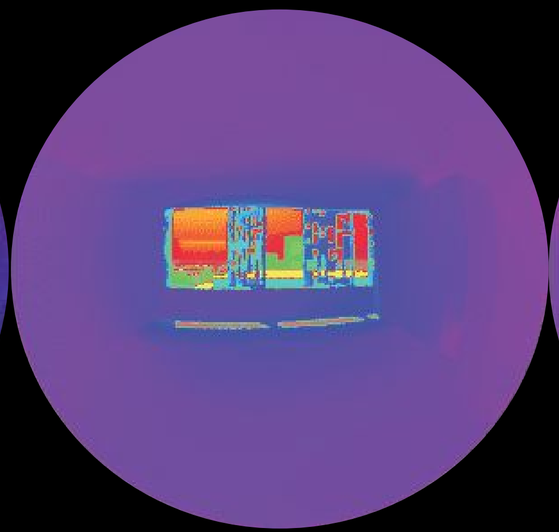
DGP Value **0.300**

Iteration 5



0.271

Iteration 5.1



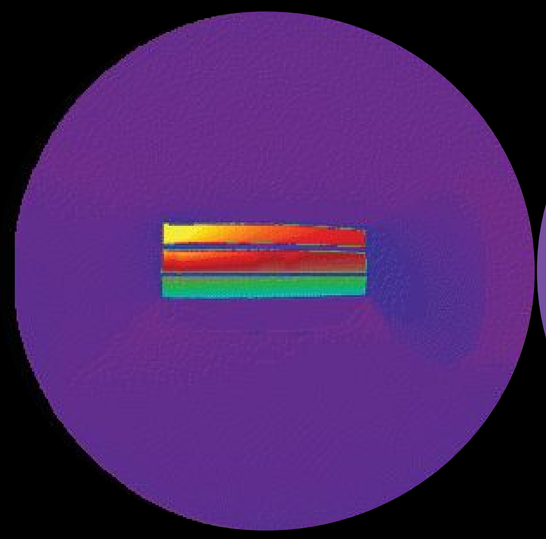
0.283

Iteration 5.2

0.303

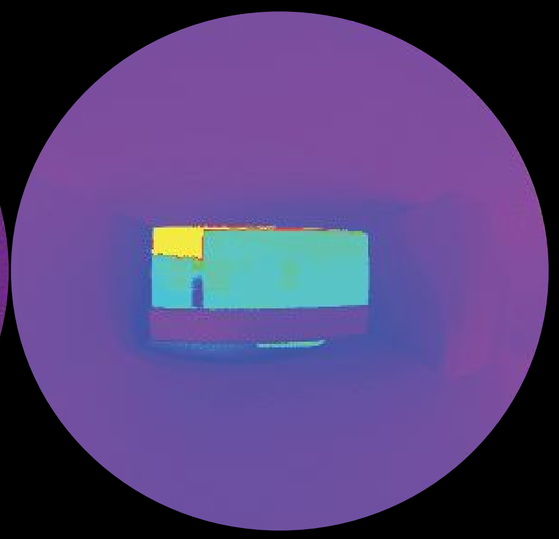
Iteration 3 has the lowest probability of glare even in comparison with Iteration 3. Hence, this **might** be more ideal as the daylit area for Iteration 7 in the previous analysis was also proven to have improve daylight within the unit.

Iteration 6



DGP Value **0.282**

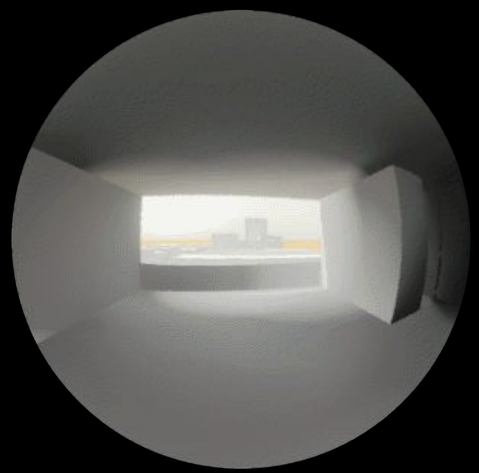
Iteration 7



0.255

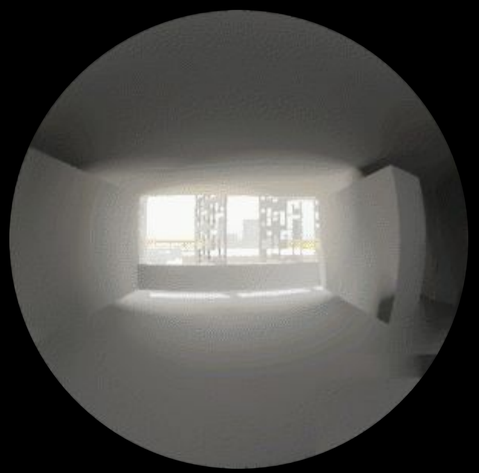
Glare Render

Iteration 3
(No Facade)



Iteration 5

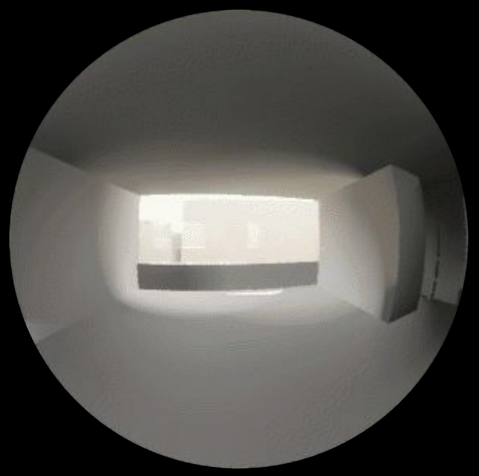
Iteration 5.1



Iteration 5.2

Iteration 6

Iteration 7



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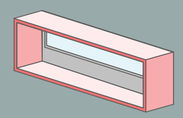
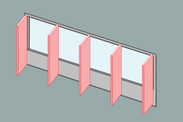
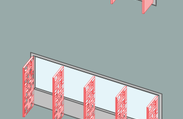
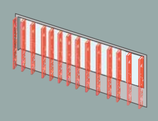
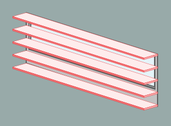
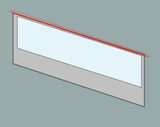
101 Tremont St
42°21’27.0”N

Summary

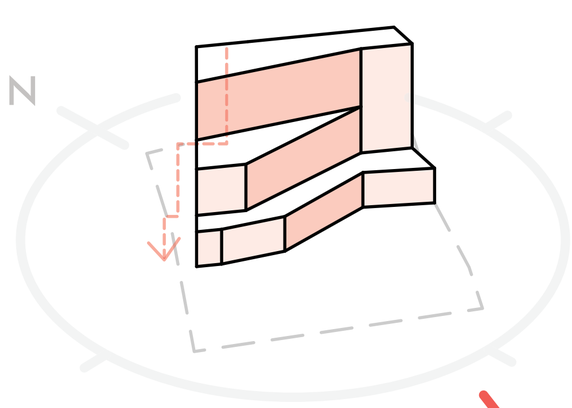
Facade Design		Daylit Area (%)	DGP Value
	Iteration 3 (No Facade)	61.91	0.300
	Iteration 4.2	56.85	-
	Iteration 5	56.83	0.271
	Iteration 5.1	65.77	0.283
	Iteration 5.2	47.92	0.303
	Iteration 6	56.25	0.282
	Iteration 7	66.37	0.255

Overall, Iteration 3 which is our control, and Iteration 7 are the closest contenders. Although Iteration 7 has a lower DGP and better daylit area than Iteration 3. There will be too much illuminance during the summer. As we want to avoid excess solar gains during the summer, we believe that Iteration 3 will provide a better compromise based on the annual results. Hence we propose to sticking with our control, Iteration 3.

Further Improvements

Improving on public space by re analyzing WDR

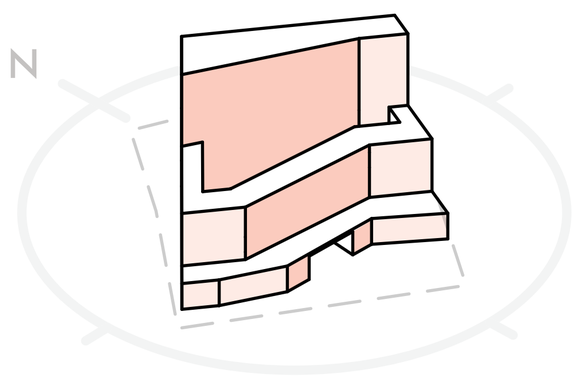
Iteration 3



Massings for Daylighting: Iterations 4-7

Concluded that no facade was the best

Iteration 3.1

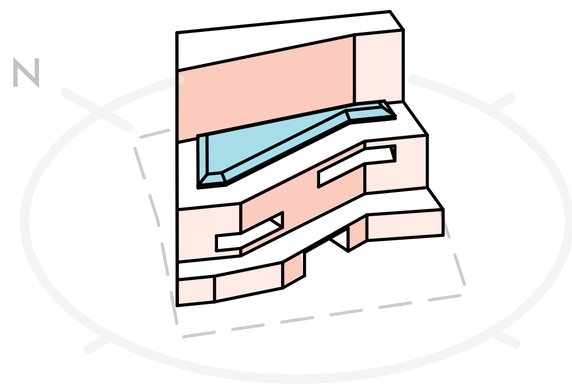


Increased building footprint and GFA.

Building Footprint: 4,573m²
(45.7% of site)

GFA: 36,806 m²
Residential: 23,090 m²
Commercial: 13,719 m²

Iteration 3.2 (Final)



Added atrium roof to shelter public space below.
Added voids in the massing to allow for better nautral ventilation through the courtyard and building.

Boston, MA
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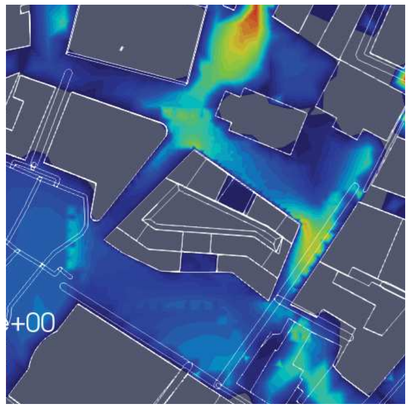
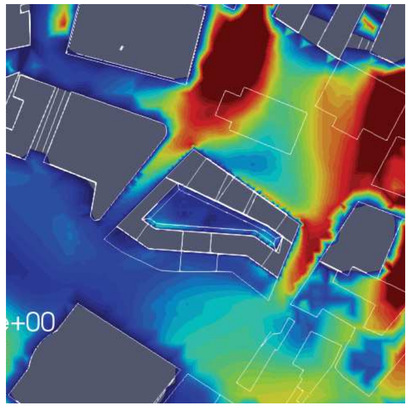
42°21’27.0”N

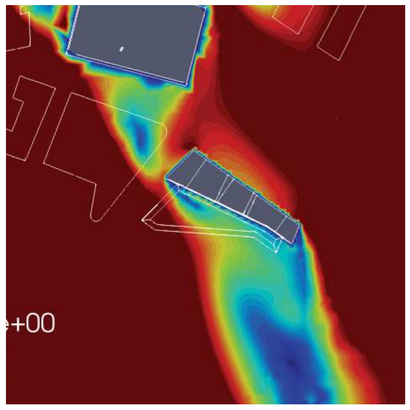
Wind Speed

SW Wind

Iteration 3.2

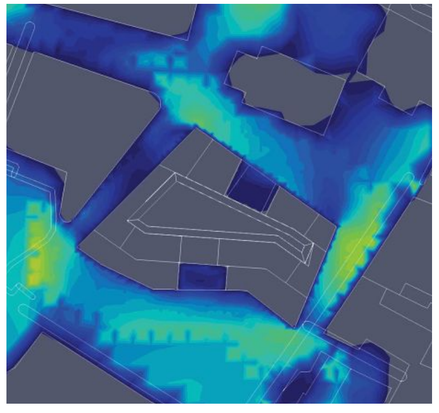


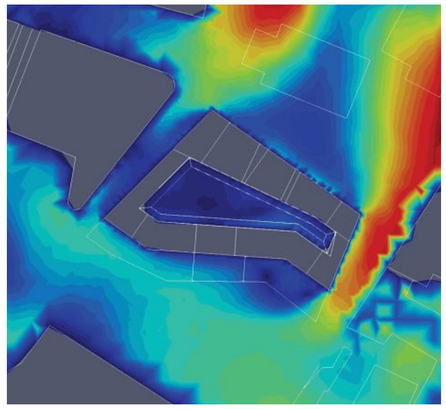


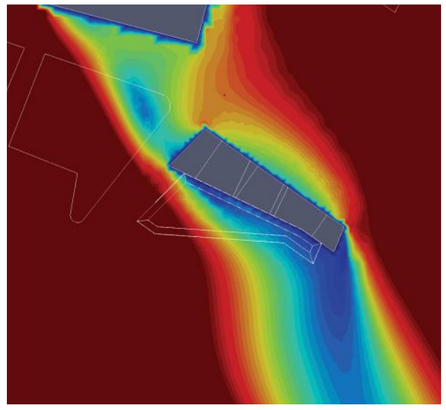


NW Wind

Iteration 3.2



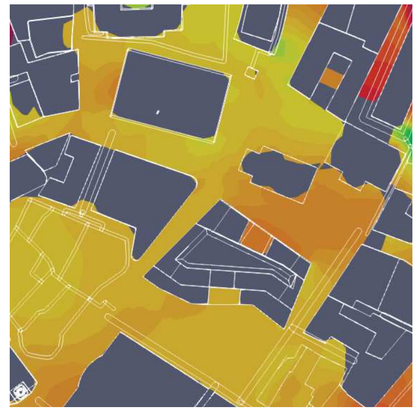


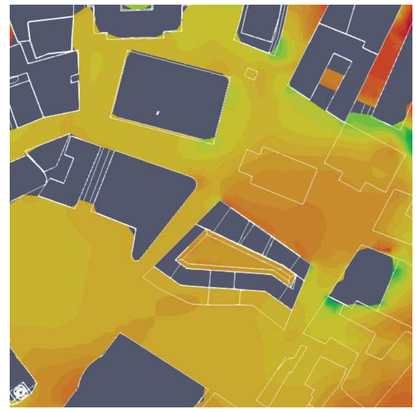


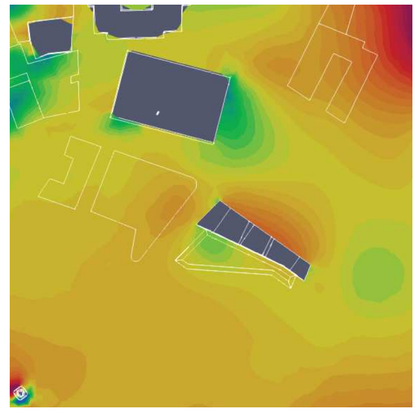
Wind Pressure

SW Wind

Iteration 3.2

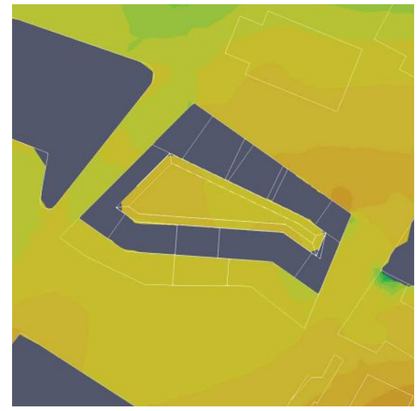


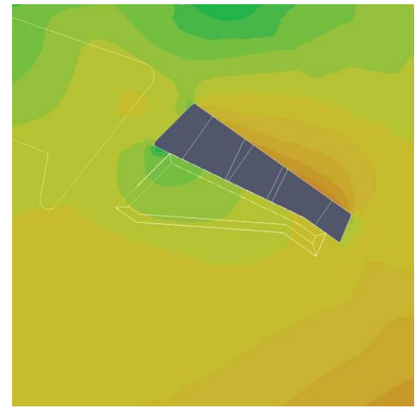




NW Wind

Iteration 3.2



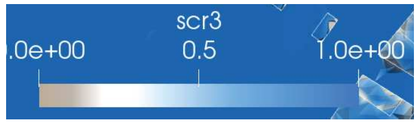


5m

20m

50m

Boston, MA
101 Tremont St
42°21’27.0”N



Public Space

Wind Driven Rain Simulation - **South West Wind**

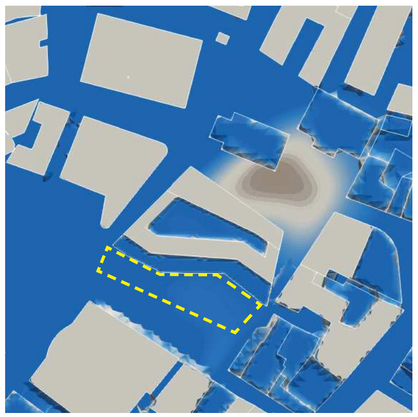
From our massing, most of the openings are south-west facing, hence by simulating wind from this direction, we are able to test how the rain may enter our massing.

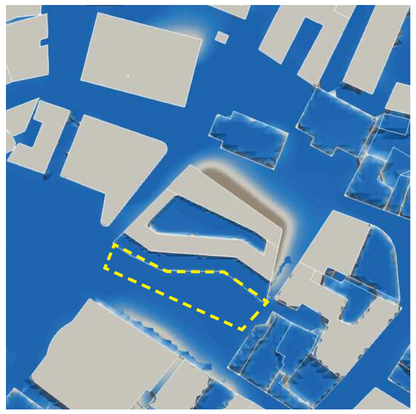
Iteration 3.1

0.5 mm Raindrops

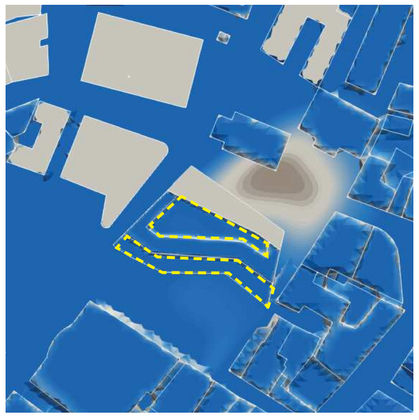
5 mm Raindrops

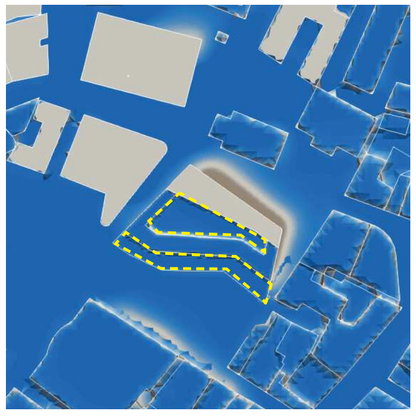
5m



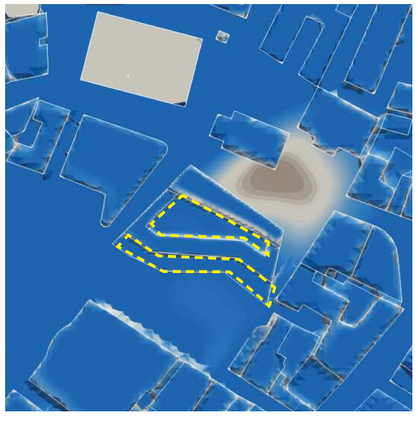


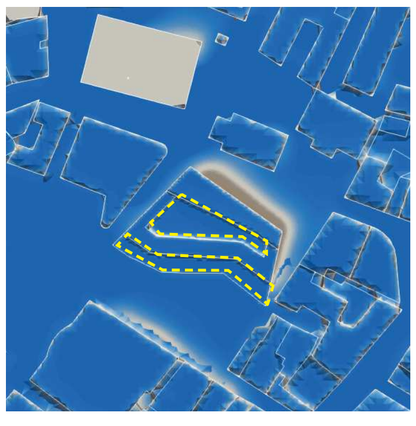
20m





50m

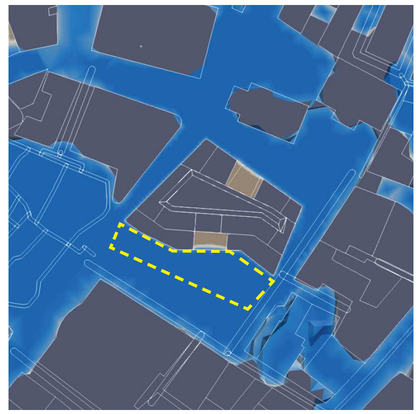


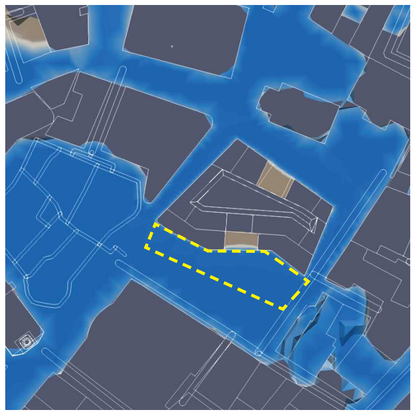


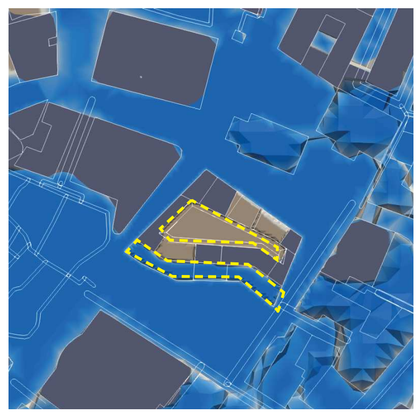
Iteration 3.2

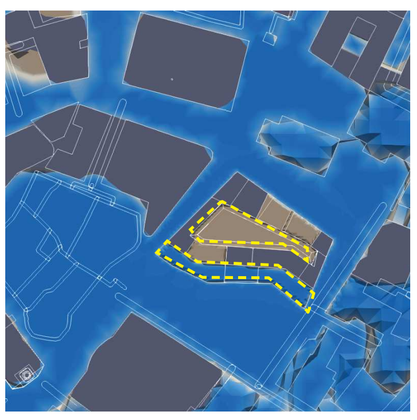
0.5 mm Raindrops

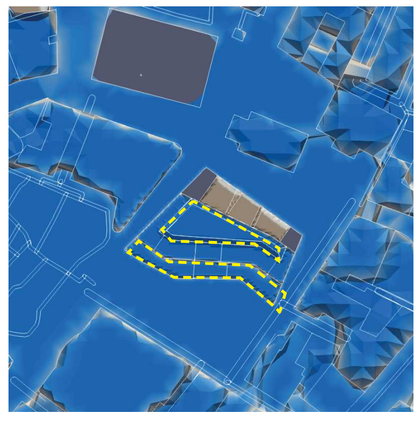
5 mm Raindrops

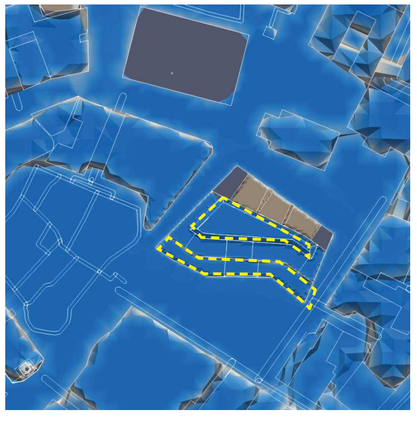












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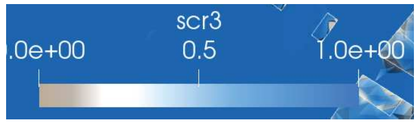
Wind Driven Rain Simulation - **North West Wind**

From our previous climate analysis, the strongest and most predominant winds are from the north-west. Hence, with these simulations, we are able understand how extreme weather conditions can have an impact on our spaces.

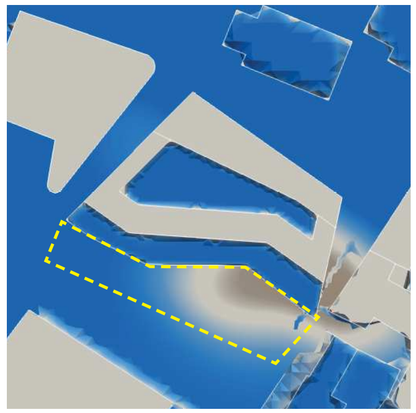
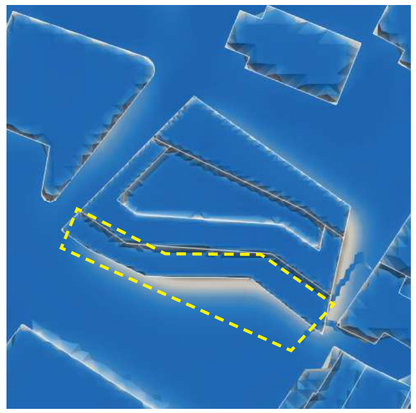


Public Space

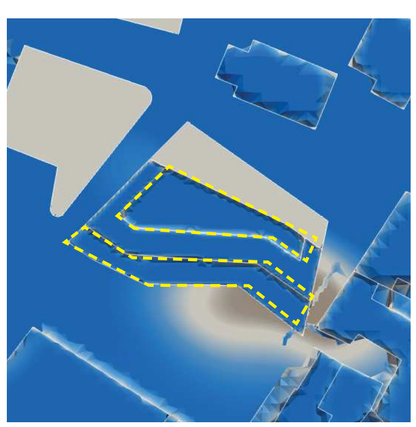
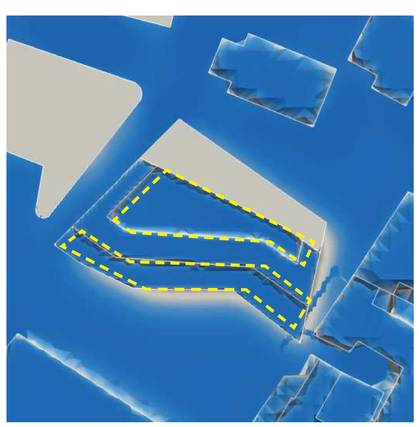
Iteration 3.1

0.5 mm Raindrops | 5 mm Raindrops

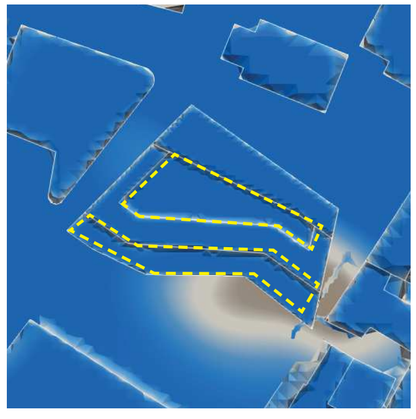
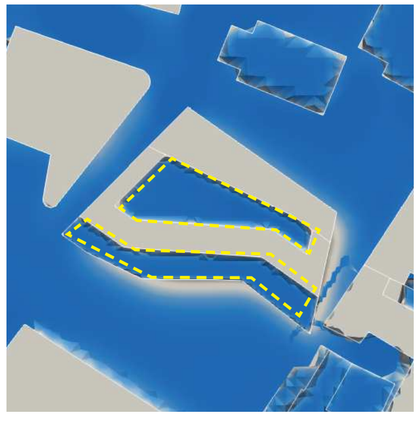
5m

20m

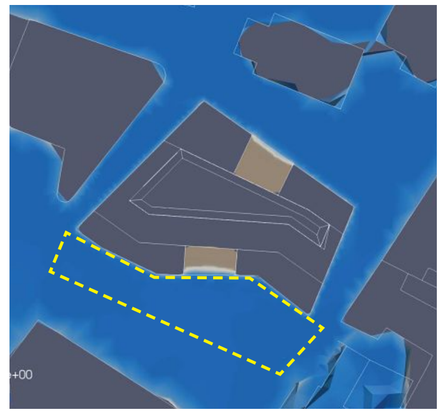
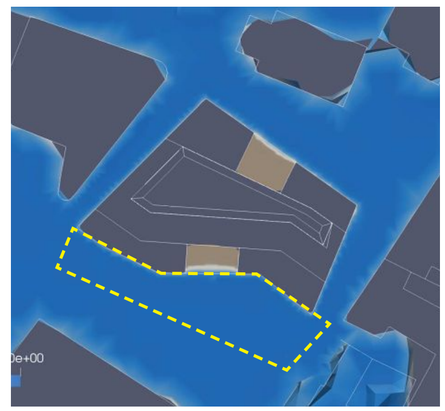



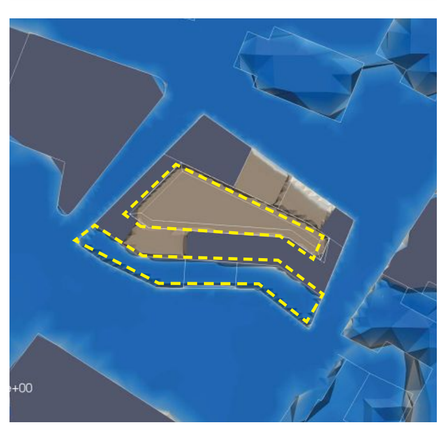
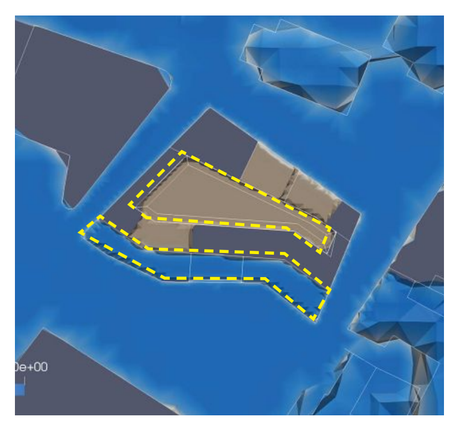
50m

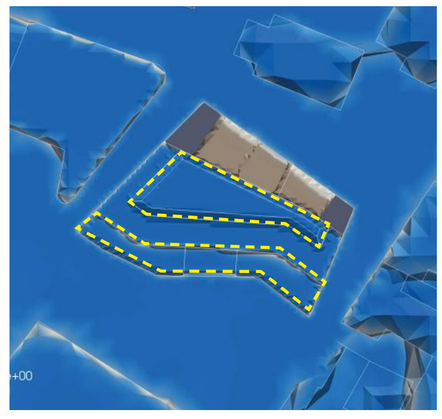
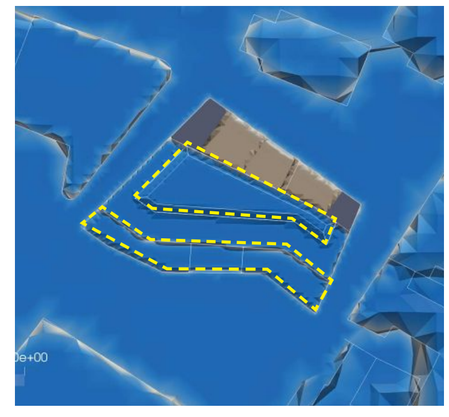



Iteration 3.2

0.5 mm Raindrops | 5 mm Raindrops

Boston, MA
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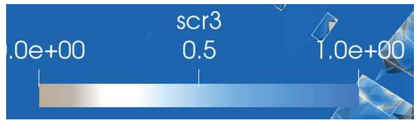


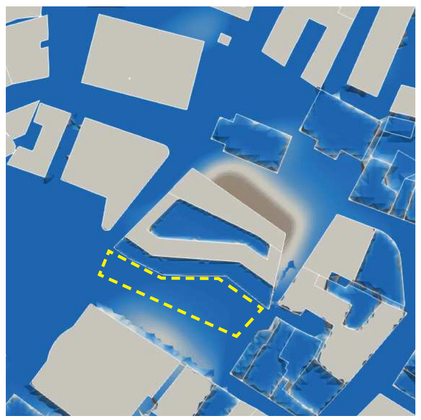
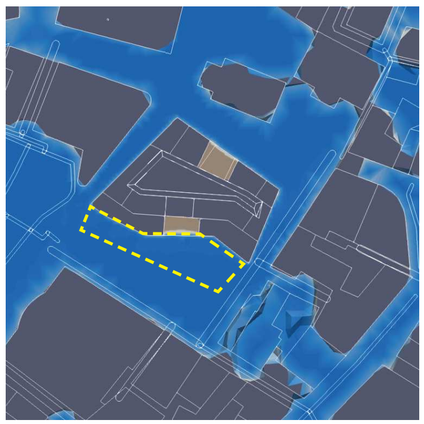
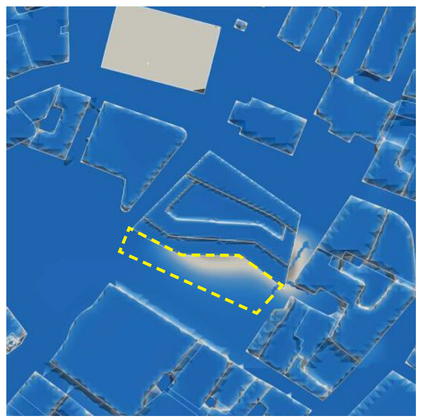
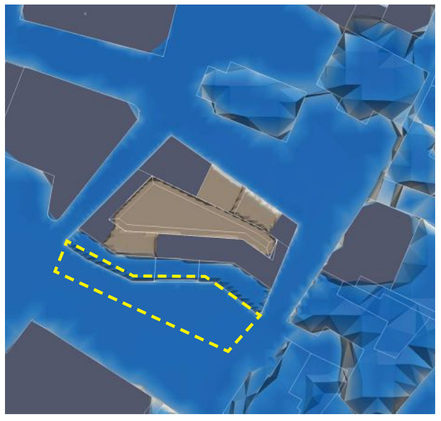
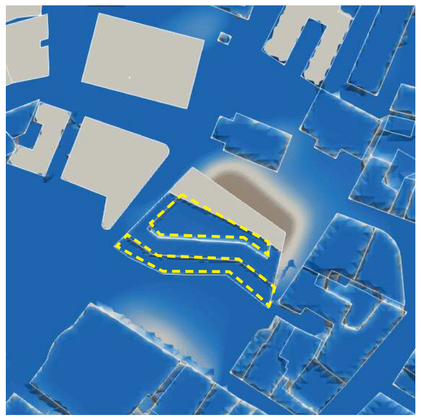
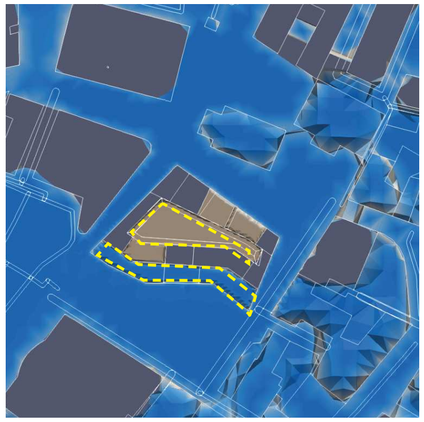
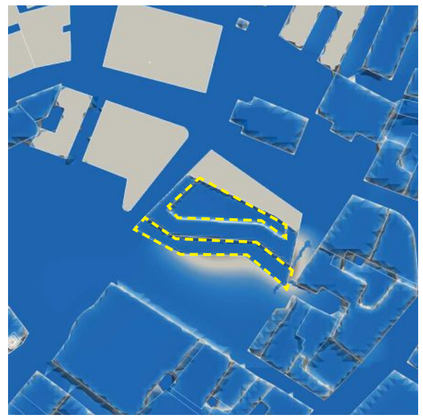
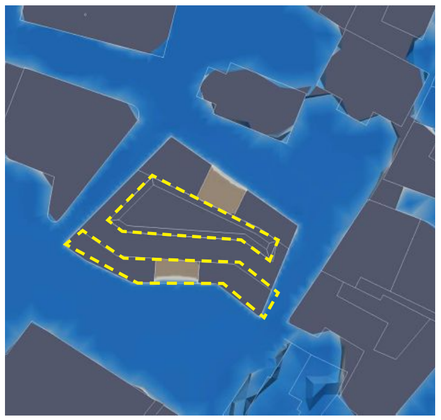
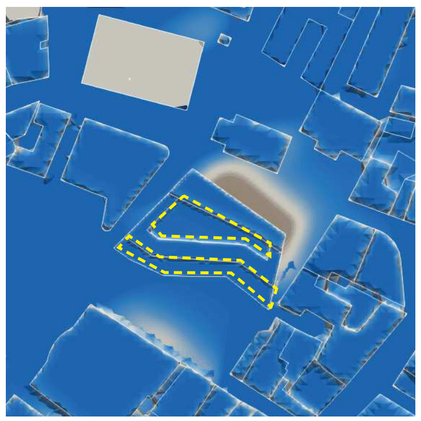
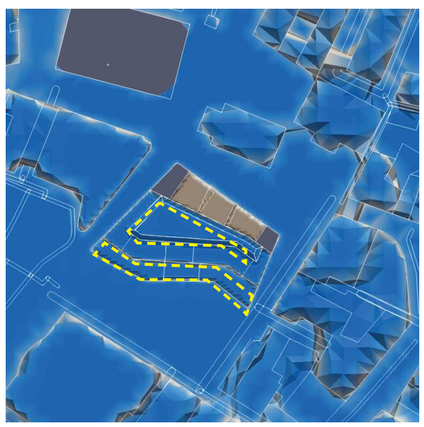
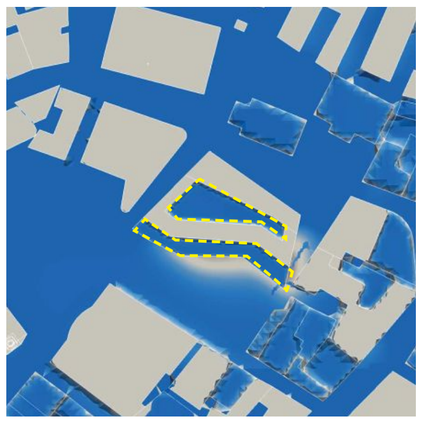
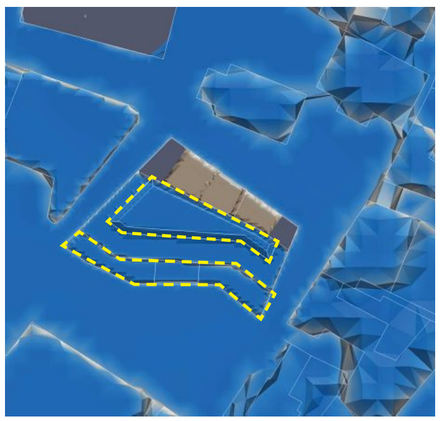
Public Space

Wind Driven Rain Simulation Summary
GCR

Comparing all iterations with simulations of wind from the 2 main directions and effects on our public spaces.

SW Wind

NW Wind

	SW Wind		NW Wind	
	Iteration 3.1	Iteration 3.2	Iteration 3.1	Iteration 3.2
5m				
20m				
50m				

With the introduction of the atrium roof, despite it being slightly elevated to allow for better air ventilation, the streamtracers show that no rain is able to affect the atrium space and it remains well sheltered from both types of raindrop sizes.

Boston, MA
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42°21’27.0”N

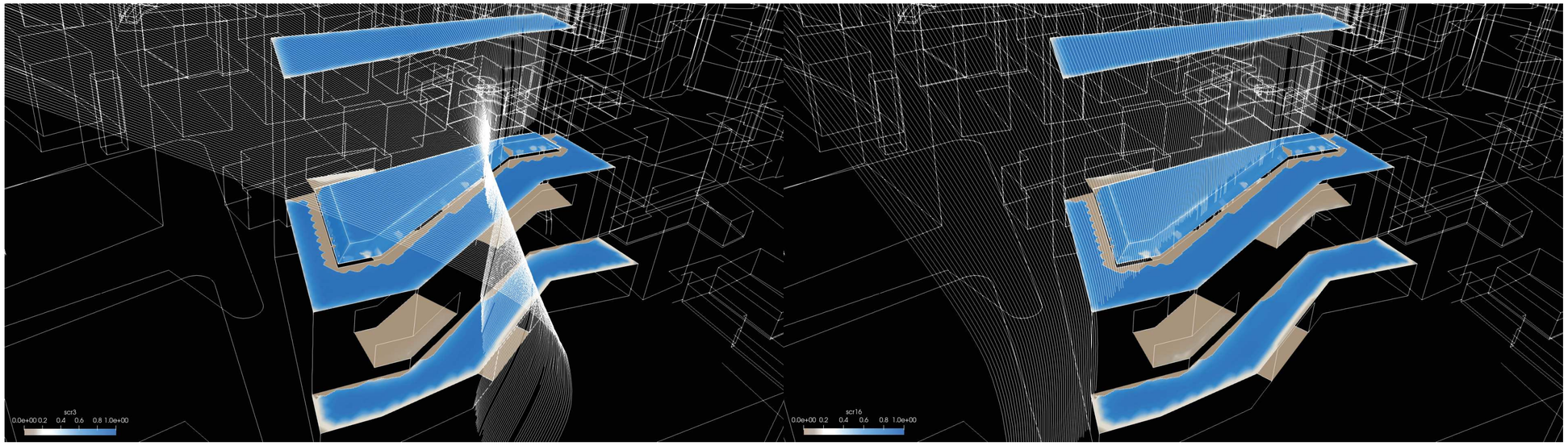
Wind Driven Rain Simulation - **North West Wind**
Streamtracer

We have 3 main public spaces: the Atrium, the Rooftop and the building entrance. The rooftop spaces have been eliminated from more detailed analysis as it always open to sky. The other 2 spaces would have a more detailed resampling.

0.5 mm Raindrops

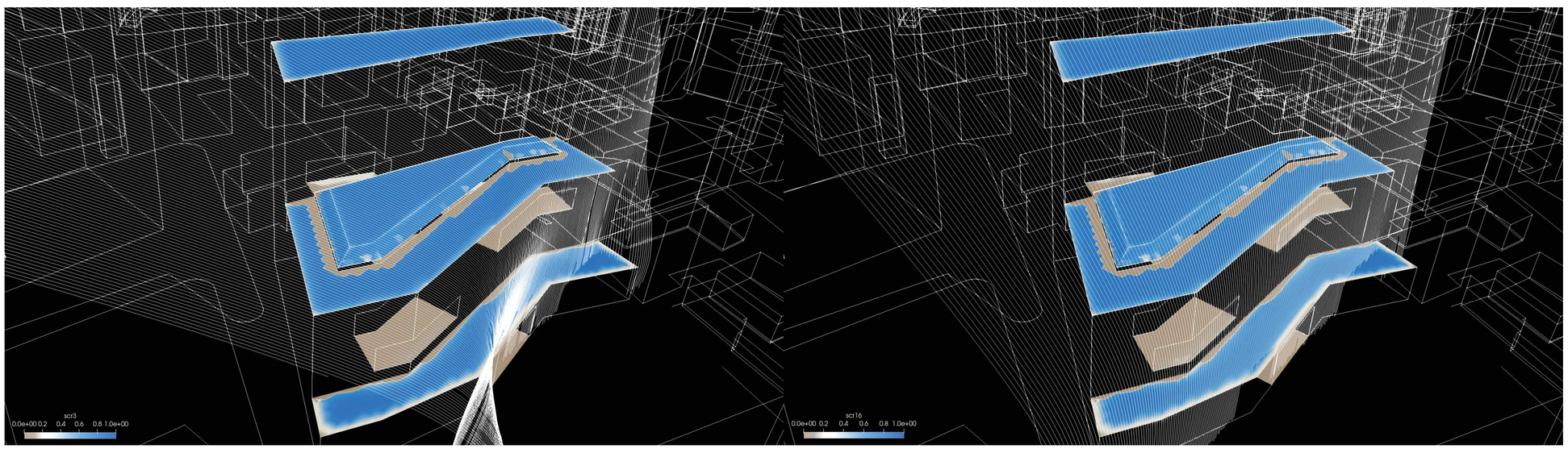
5 mm Raindrops

Atrium



With the introduction of the atrium roof, despite it being slightly elevated to allow for better air ventilation, the streamtracers show that no rain is able to affect the atrium space and it remains well sheltered from both types of raindrop sizes.

Building Entrance



The entrance of the building, indicated by the grey area on the bottom most floor, is reflected as a dry area since it is recessed into the building massing. However, for the 0.5mm raindrops, the streamtracers indicate a possibility that small amounts of rain may enter the area.

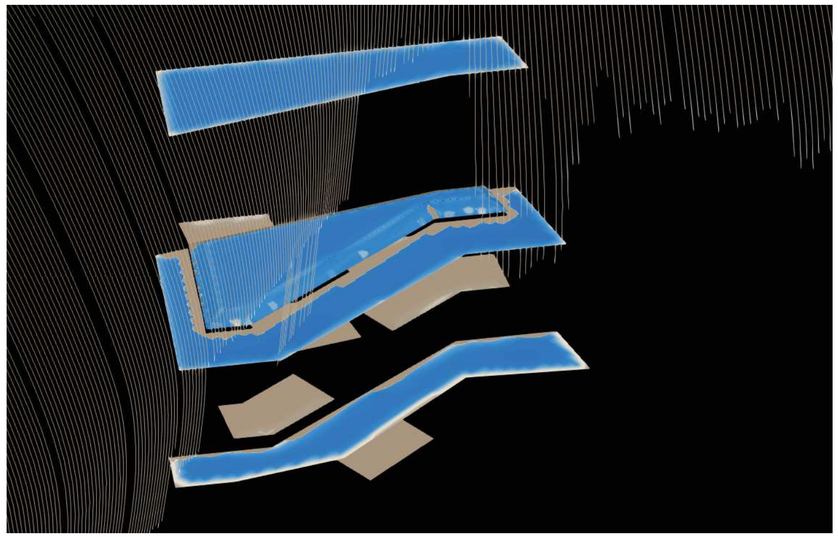
Boston, MA
101 Tremont St
42°21’27.0”N

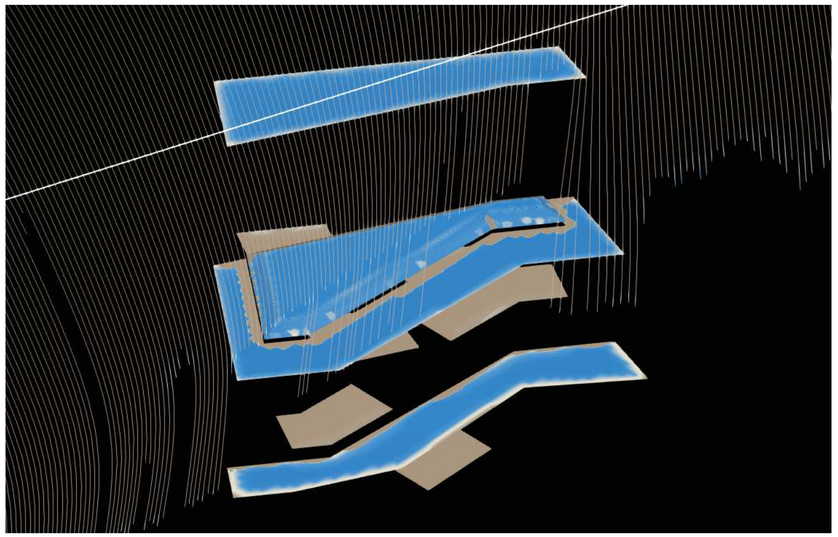
Wind Driven Rain Simulation - **South West Wind**
Streamtracer

0.5 mm Raindrops

5 mm Raindrops

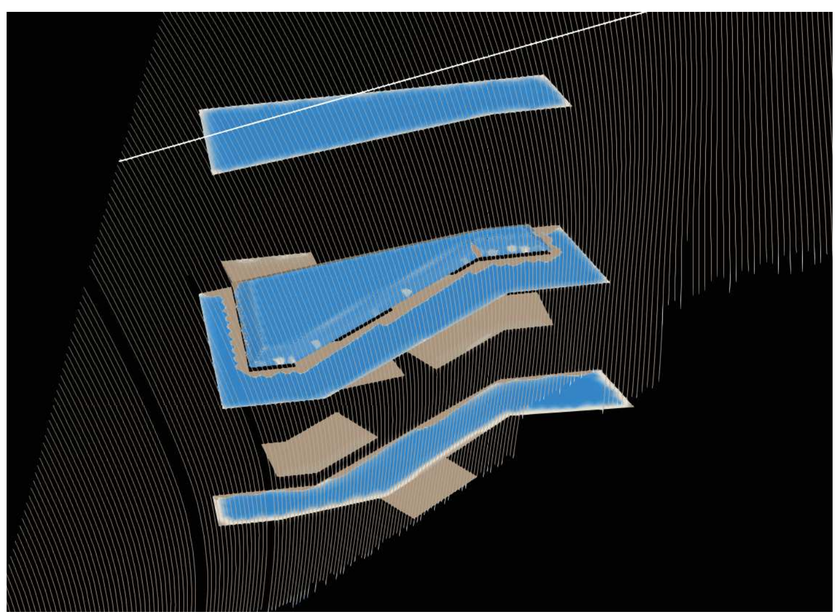
Atrium

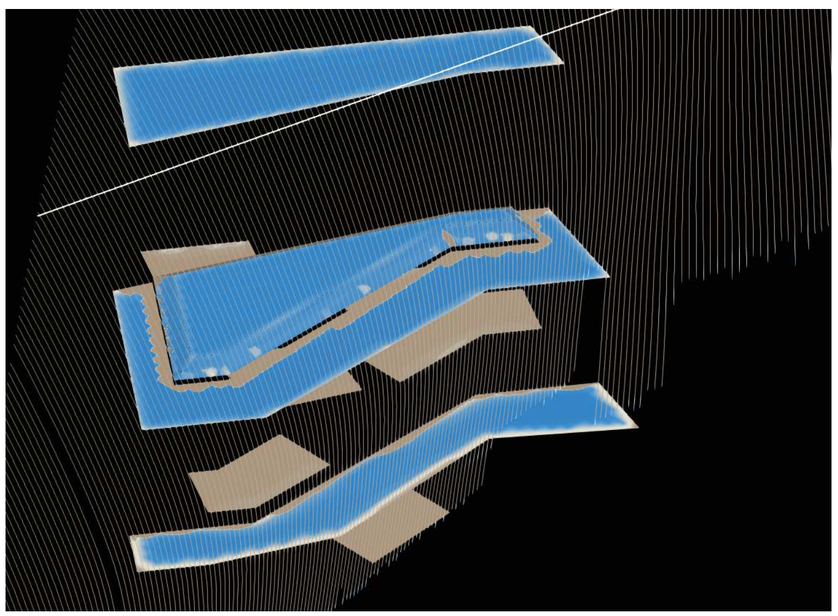




The slight elevation of the atrium roof show may allow some smaller rain particles to enter the massing, but remain mostly dry.

Building Entrance





As the wind is blown parallel to the massing of the building and its entrance, the streamtracers show that the entrance area would remain properly shielded from the rain.

Appendix

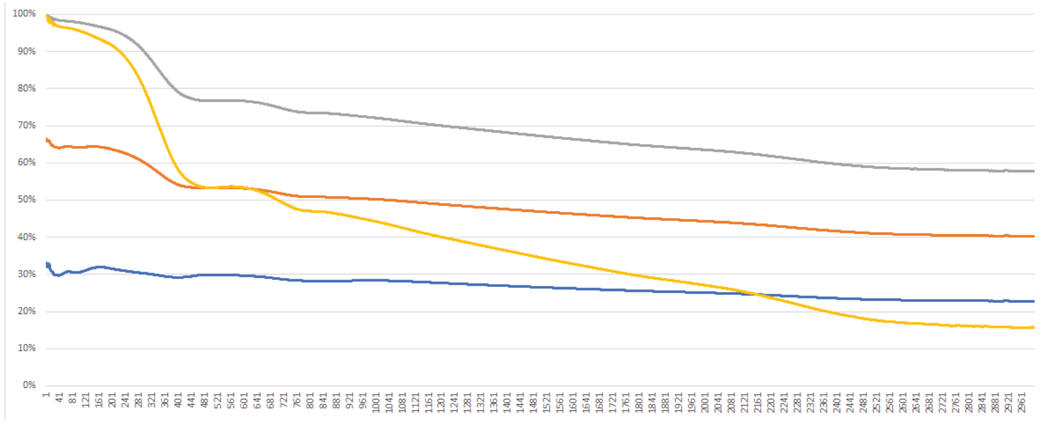
Boston, MA
101 Tremont St
42°21’27.0”N

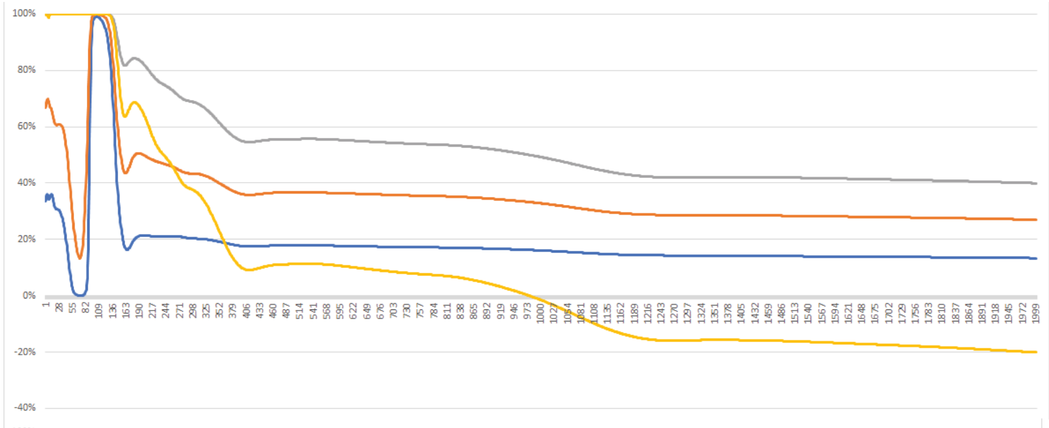
Residual Graphs - Wind for Mid Term

Summer

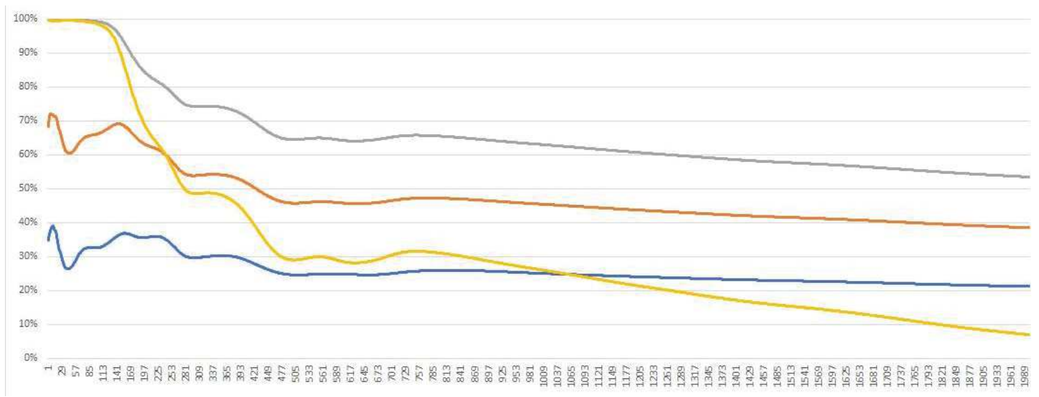
Winter

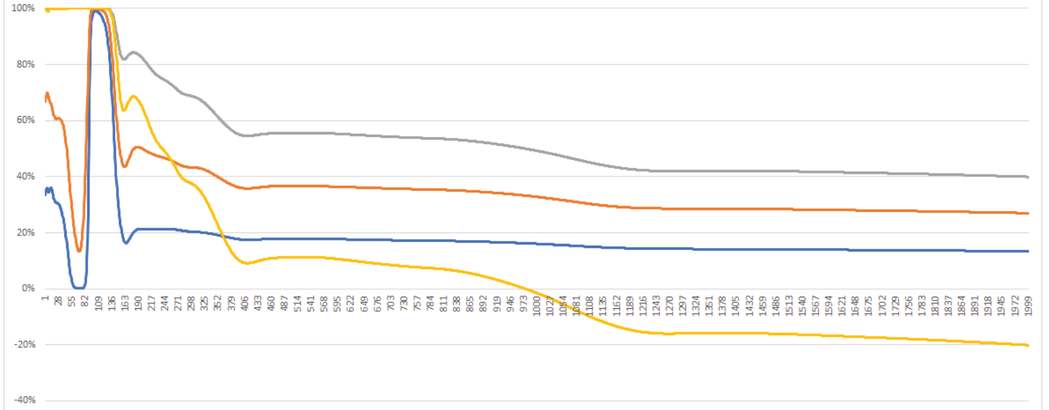
Site Only



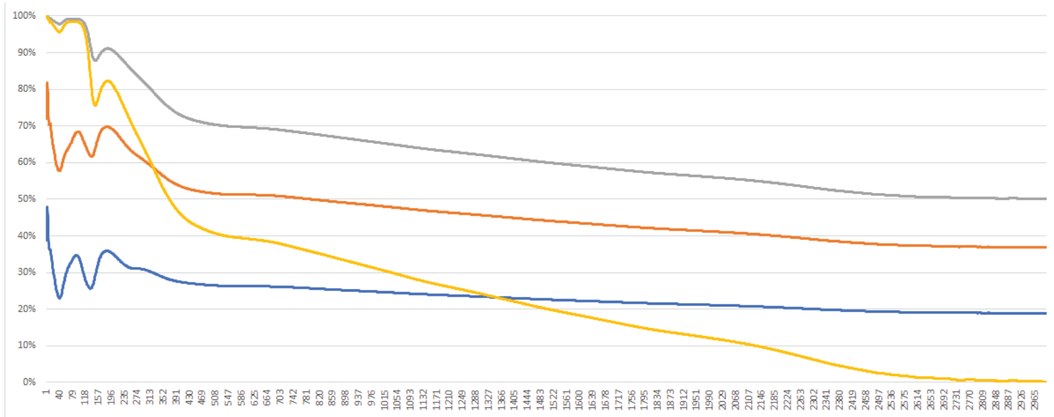


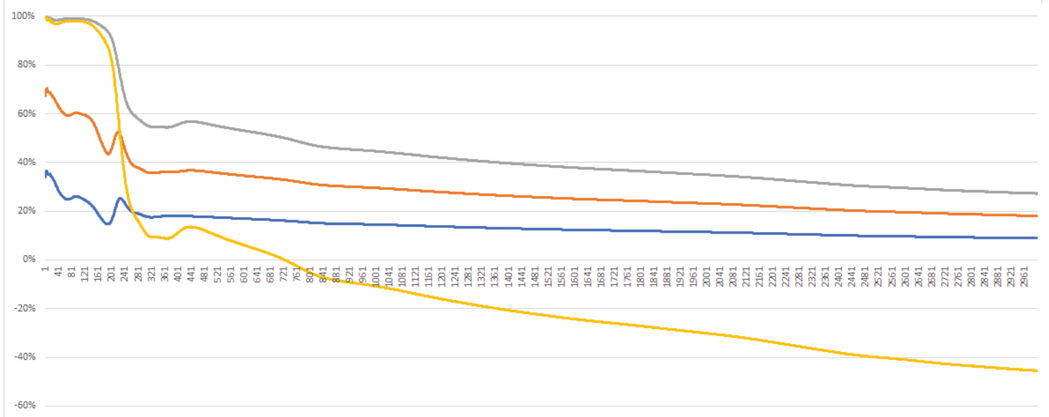
Iteration 2





Iteration 3





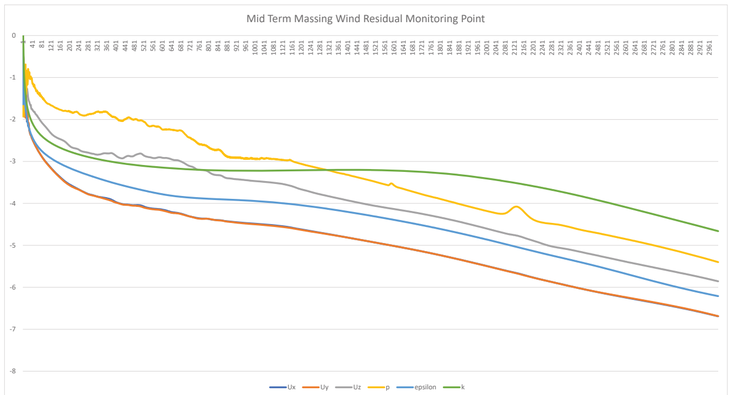
U1 U2 U3 Txt File

Boston, MA
101 Tremont St
42°21’27.0”N

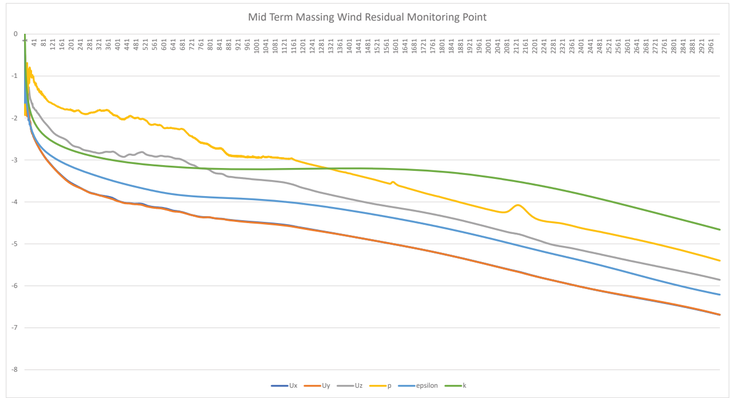
Residual Grpahs for A03

Wind

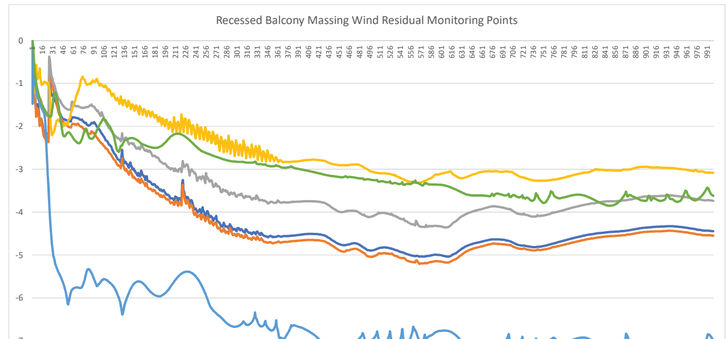
Massing Only
(Iteration 3)



Massing with
Balcony and Louvres
(Iteration 4.1)

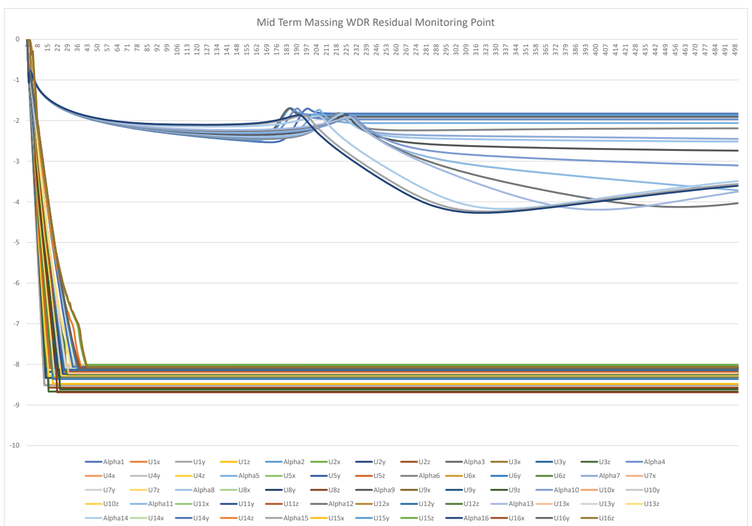


Massing with
Balcony and Louvres
(Iteration 4.2)

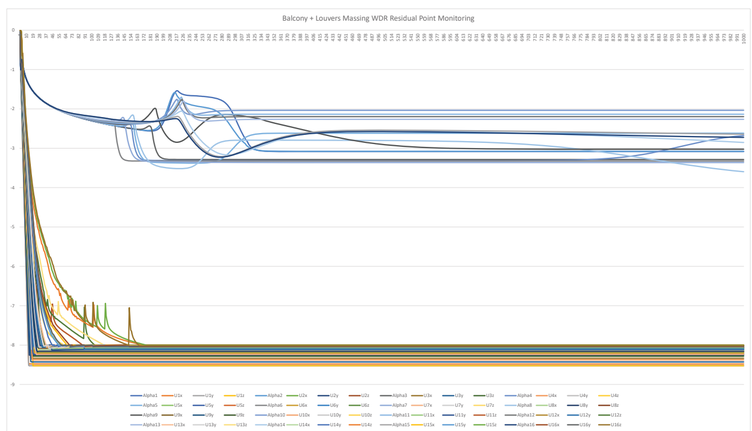


Rain

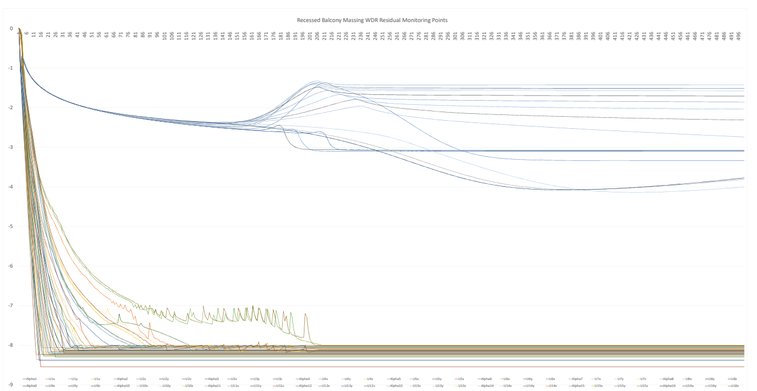
Massing Only
(Iteration 3)



Massing with
Balcony and Louvres
(Iteration 4.1)



Massing with
Balcony and Louvres
(Iteration 4.2)

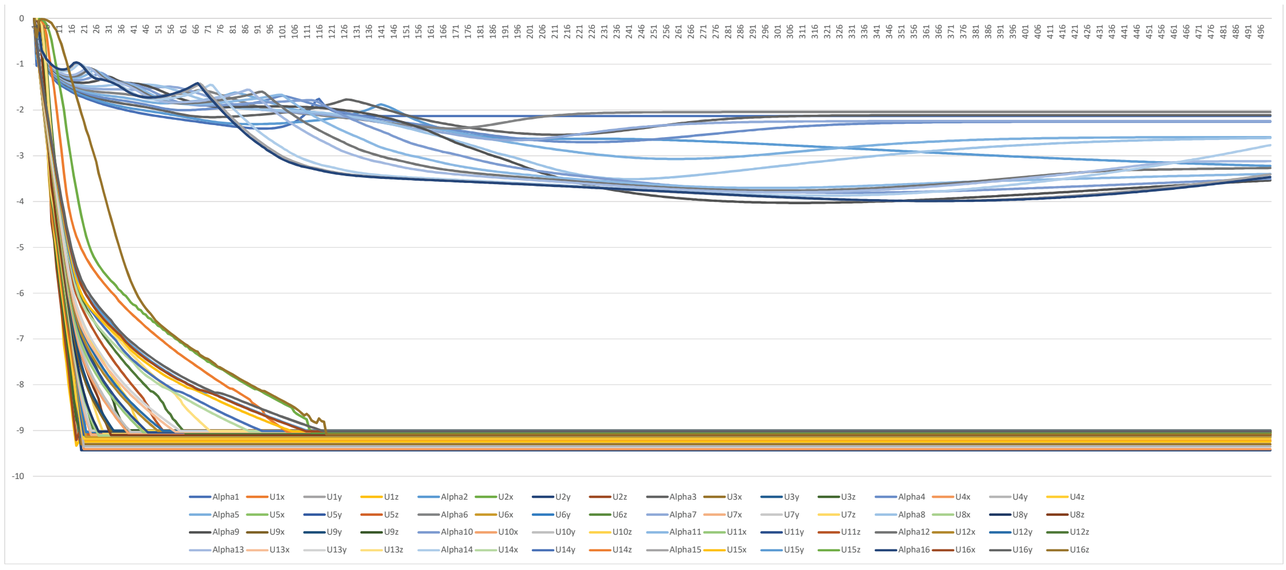


Boston, MA
101 Tremont St
42°21’27.0”N

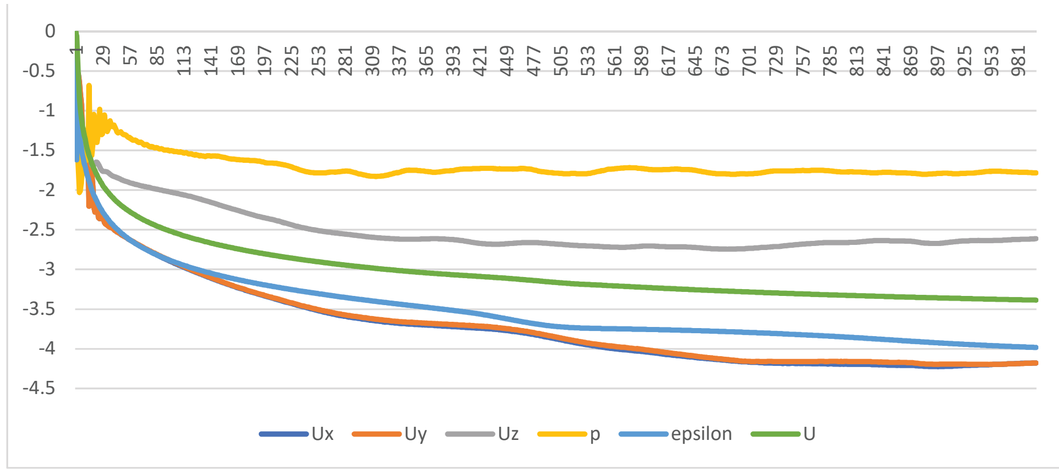
Residual Grpahs - **South West Wind**

Wind

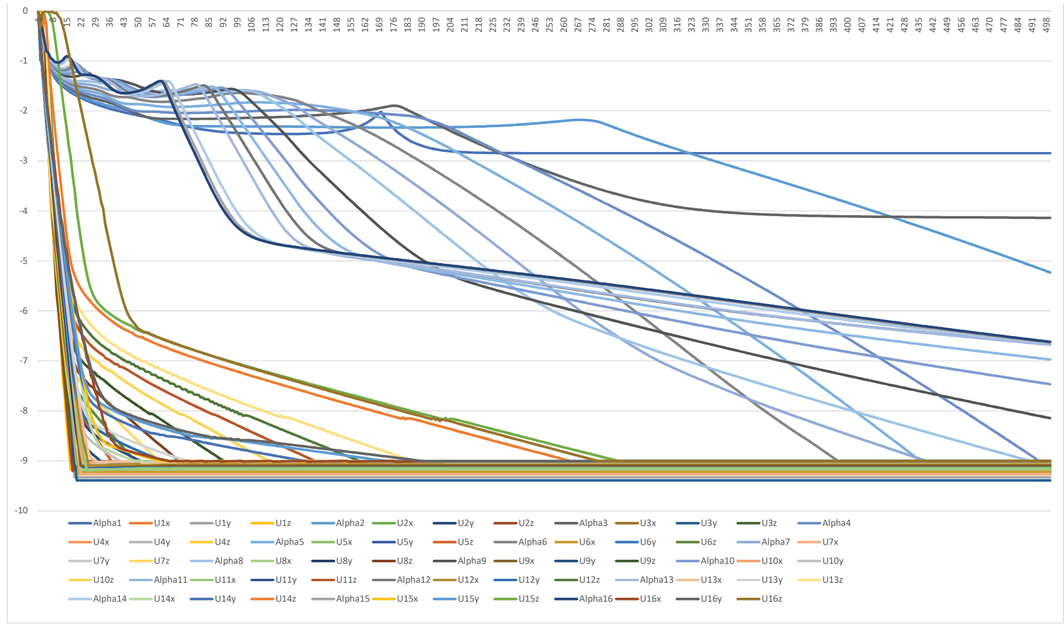
Iteration 3.1



Iteration 3.2



Rain

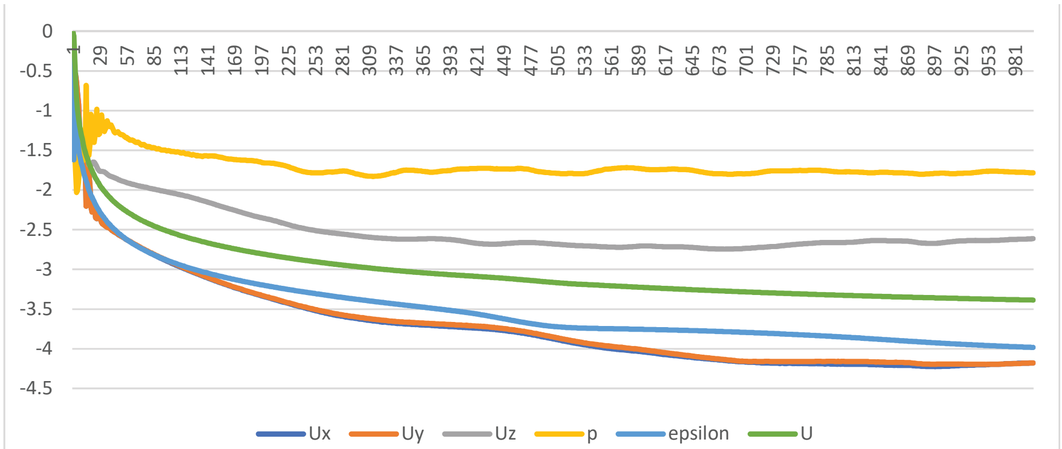


Boston, MA
101 Tremont St
42°21’27.0”N

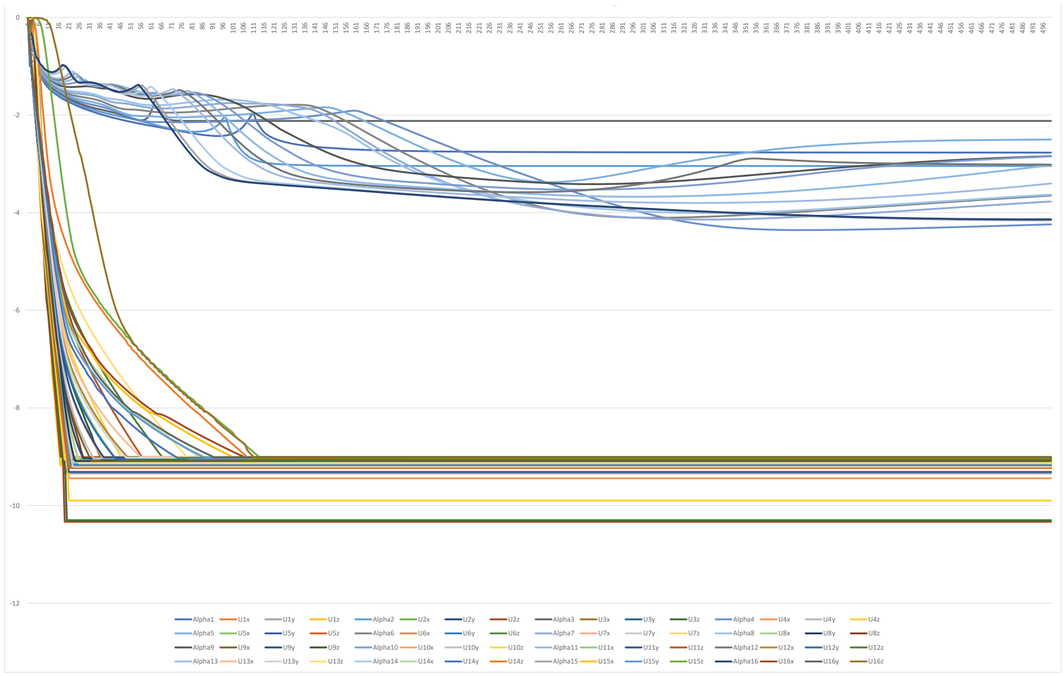
Residual Grpahs - **North West Wind**

Iteration 3.1

Wind



Rain



Iteration 3.2