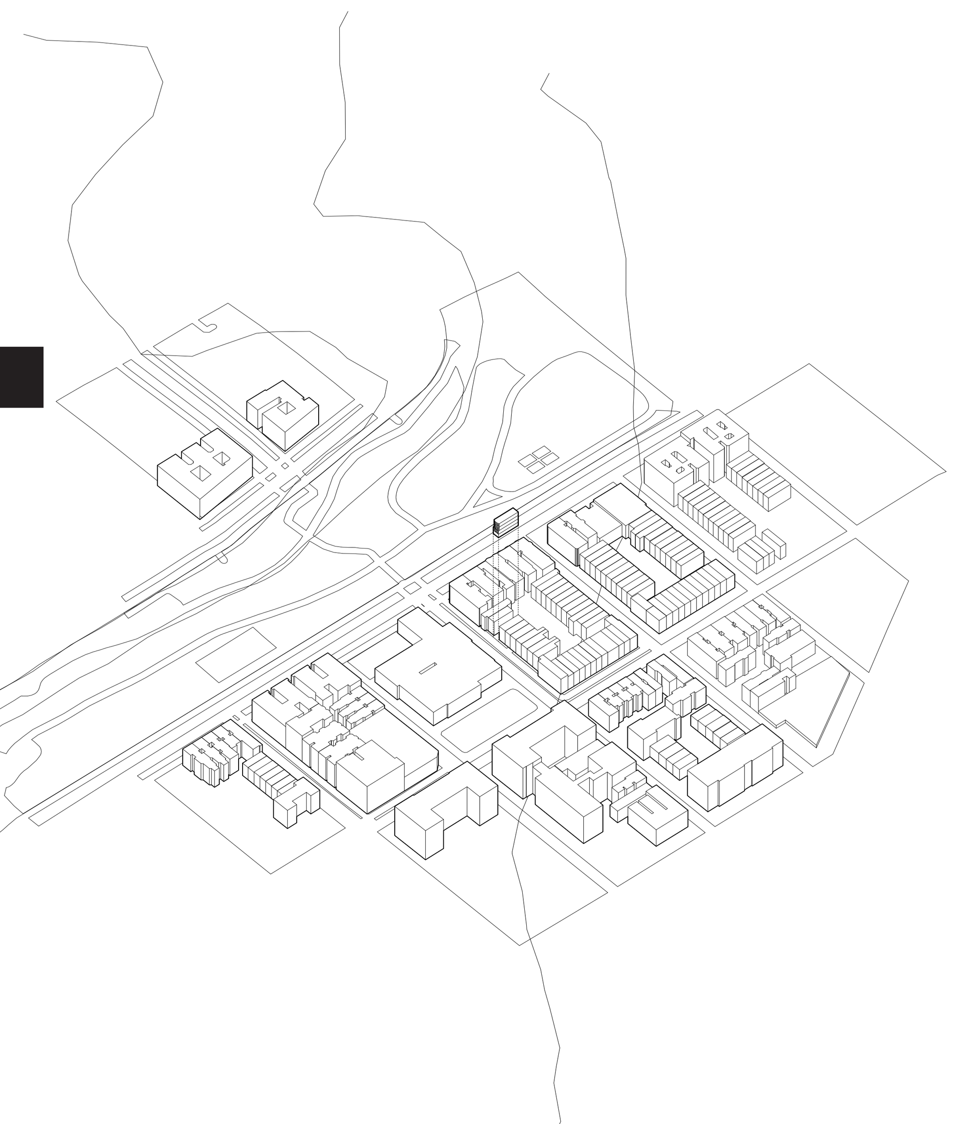
Overall Site Analysis

Harlem, New York

Ali Kamal, Eric Hagerman, Meghan Jones



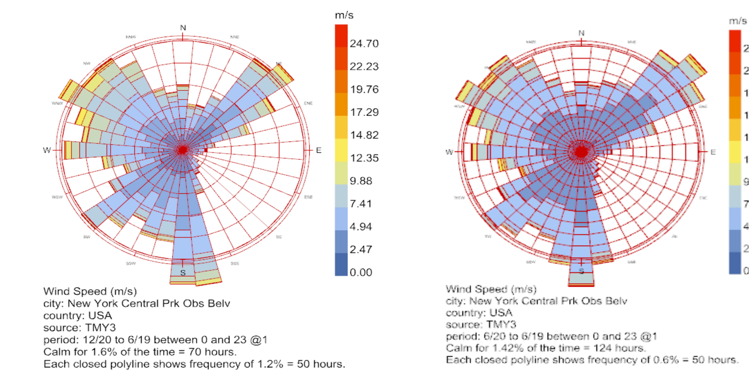
7 Design Strategy

1. Evaporative Cooling
2. Mass + Night Ventilation
3. Occupant Use of Fans
4. Passive Solar Heating
5. Capture Solar Heat

1 Weather Data Visualization

Location: Lat: 40.78, Long: -73.97
Elevation: 40
Time Zone: -5.0
Average Dry Bulb Temperature: 12.48
Average Relative Humidity: 64.85
Average Wind Speed: 5.355
Average Wind Direction: 194
Solar Radiation Intensity: 151 avg
Annual Heating Degree Days: 113
Annual Cooling Degree Days: 29
Min/Max/Ave Dry Bulb Temperature: -15/35/12.48
Min/Max/Ave Relative Humidity: 20/100/64.85
Min/Max/Ave Solar Radiation: 0/975/151.18
# of hours in a year when outdoor temperature are below freezing level: 705
#of hours in a year when temperatures are within acceptable levels: 2719

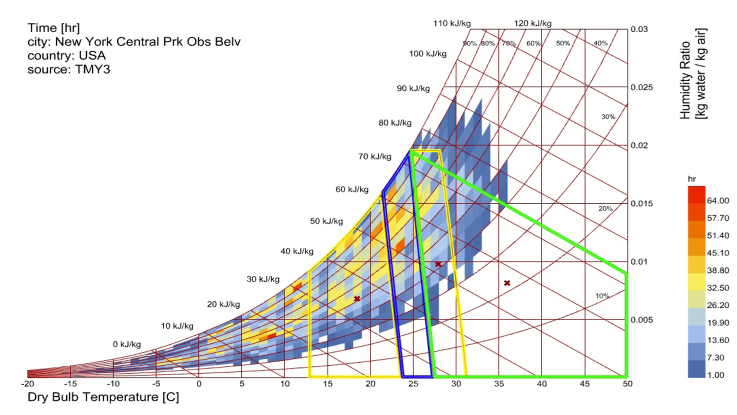
5 Annual Wind Rose Diagram



Winter Solstice | Summer Solstice

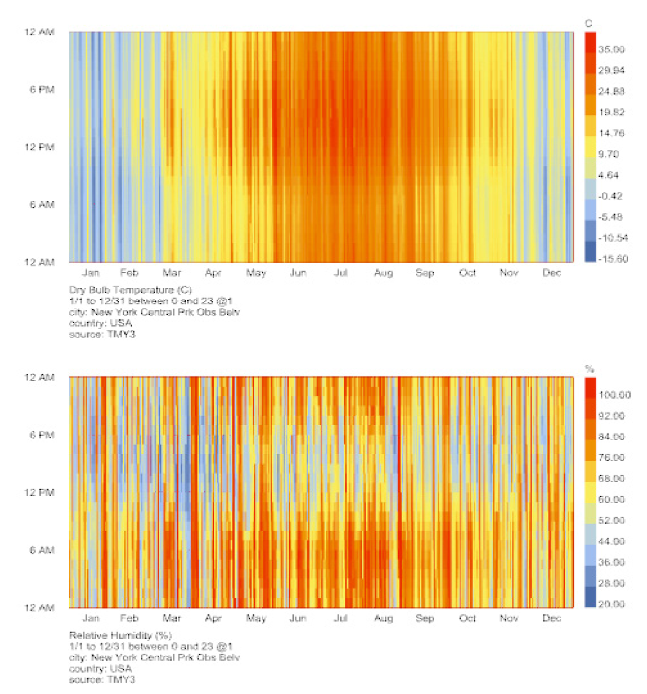
After analysis run on the city of New York City near central park we have concluded that their is an increase of wind speed over the winter months. During the summer months there is no wind 1.6% of time (124 hours) versus the for the winter months where there is no wind for only 1.42% of the time (70 hours).

6 Psychrometric Chart with Comfort Polygons



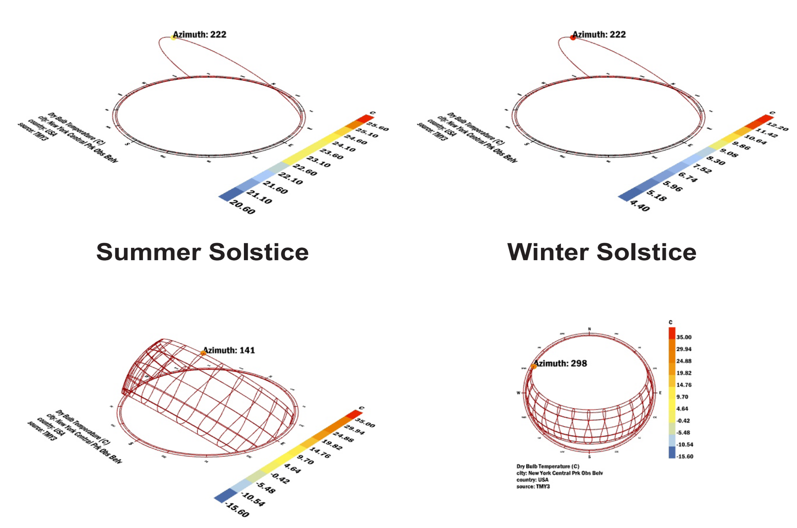
The Psychrometric chart can be an extremely useful tool in examining comfort levels in an environment. It plots dry bulb temperatures and relative humidity for each hour of the year, and uses color to represent comfort levels for each of these hours. Polygons representing design strategies are then mapped over this information, resulting in an illustration of the most effective strategies for increasing thermal comfort in a space. The most effective design strategy for this building is evaporative cooling, represented by the green polygon, which covers the most area on the chart.

1 Weather Data Visualization



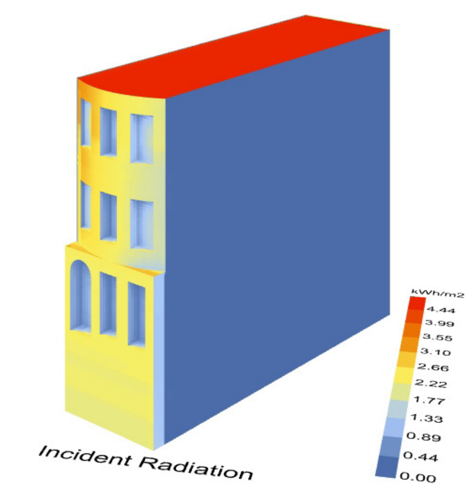
2 Sun Path Visualization

This building's large windows contribute to the solar radiation at the site. The south facing orientation of the windows is ideal for solar radiation in the winter. Additionally, the building is well shaded in the late afternoon by the large buildings to the west and elevation of the nearby Morningside Park.



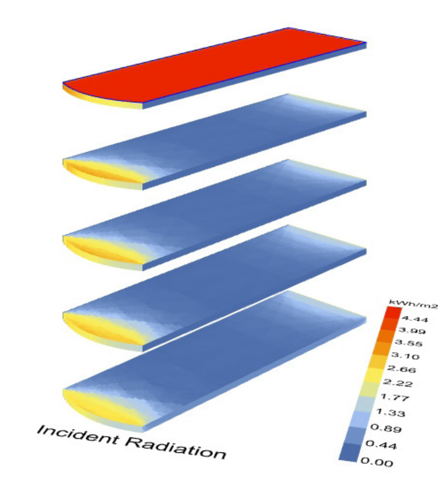
Summer Solstice | Winter Solstice
Year Round | Sun Path

3 Annual Solar Radiation Mapping Envelope



The radiation map for the envelope illustrates severe heat exchange through the building's roof. The facade walls to the northwest and southeast are directly adjacent with those of neighboring buildings, resulting in complete shade and no openings on those two sides of the building. Thus, radiation is minimal compared to that of the front and rear facade walls, which have openings.

4 Annual Solar Radiation Mapping Floor



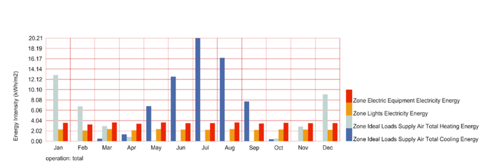
Mapping radiation across floor plates of the building reveals minimal heat transfer on lower levels of the building. However, the upper level experiences severe transfer via radiation, as it is largely unshaded. In urban settings, shading of upper levels can be difficult to accomplish without altering the envelope itself.

Assignment 3

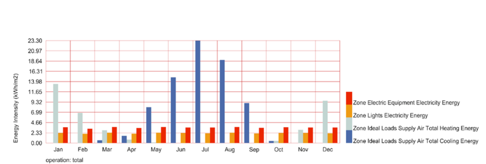
Analyze Massing

Ali Kamal, Eric Hagerman, Meghan Jones

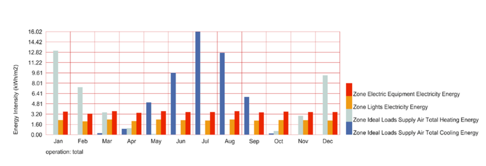
EUI Break Down Graphs



Results Simulation 1
WWR: 0.36
EUI: 162.765

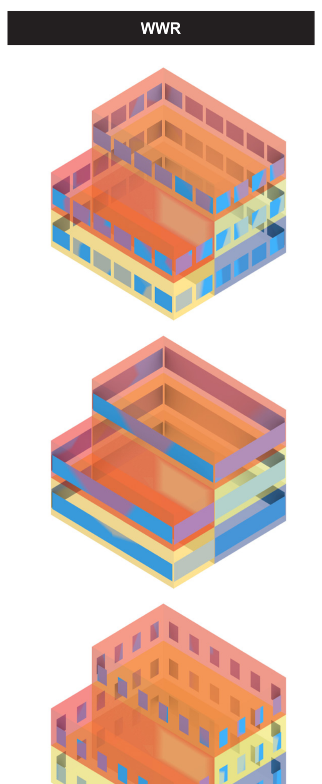


Results Simulation 2
WWR: 0.52
EUI: 183.559

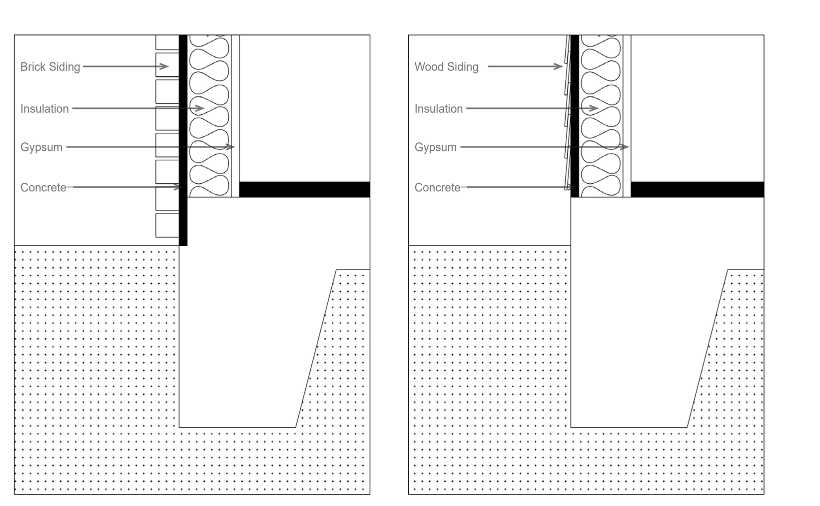


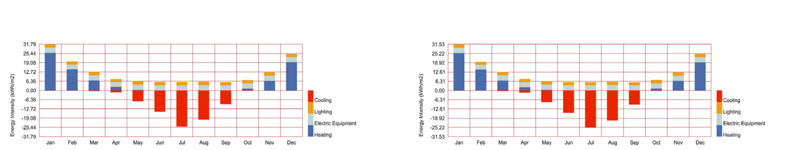
Results Simulation 3
WWR: 0.2
EUI: 157.636

WWR



Construction Set Studies





Brick Siding
R-Value: .111

Wood Siding
R-Value: .0907

Comprehensive Conclusion

We tested two unique siding materials for our building envelope: brick siding (R-value: 0.1111) and wood siding (R-value: 0.907). We kept concrete walls, gypsum lining, and typical insulation the same between the two iterations. As the two graphs show, there was not a major difference between the two siding materials. This is due to the similar R-values of the two materials. The maximum energy intensity for both construction sets is for heating in January and 25.44 kWh/m2 for brick and 25.22 kWh/m2 for the wood siding.

Comprehensive Conclusion

The results from the three simulations reflect that as window to wall ratio (WWR) increases so does end use intensity (EUI). Simulation 2 had the highest WWR (0.52) and therefore the highest EUI (183.559). This is especially clear in the summer months of May through September where the energy intensity for total air cooling is as high as 23.30 kWh/m2. This is due to the fact that the increased WWR allows more summer light in and as a result necessitates more cooling of the space. Simulation 1 has the second highest WWR (0.36) and EUI (162.765). The maximum energy intensity for total air cooling for Simulation 1 is 20.21 kWh/m2 which is less than that of Simulation 2 because of the decrease in the ratio of aperture to wall. Finally, Simulation 3 has the lowest WWR (0.2) and EUI (157.636).

Assignment 4

Analyze Massing

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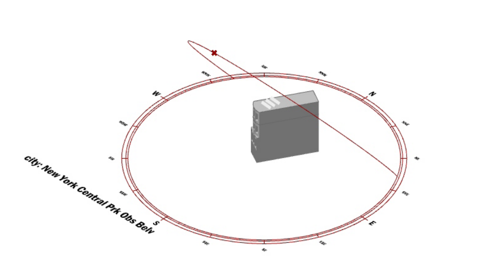
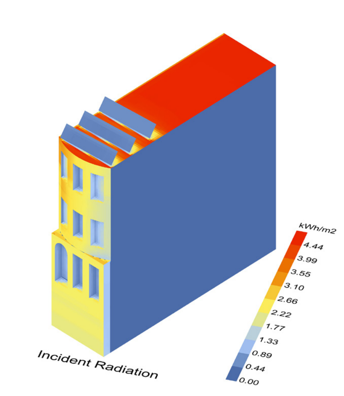
Sun Path Diagram

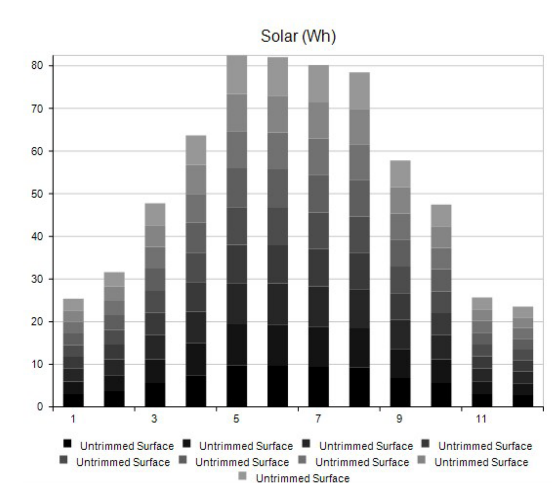
An image of your building model with WWR and construction set assembly materials indicated
- Monthly EUI graph
- The solar incident radiation mapping used to determine PV panel orientation
- The sun path diagrams used to determine the tilt angle of your PV systems
- An image of your chosen PV system model with efficiency and losses indicated
- An image of your building with your modeled PV system included
- Monthly solar energy output graph
- Discussion paragraph over-viewing analysis results



Solar Incident Radiation Mapping



Monthly Solar Energy Output



Monthly EUI graph

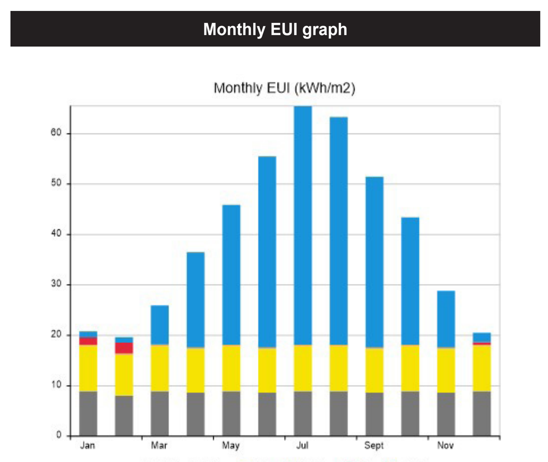
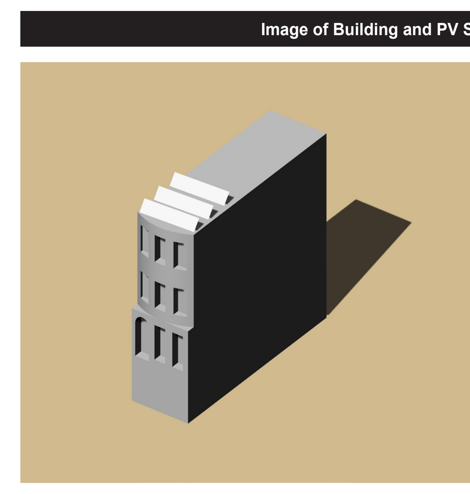
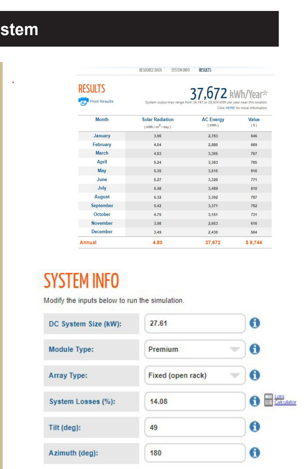


Image of Building and PV System





Comprehensive Conclusion:

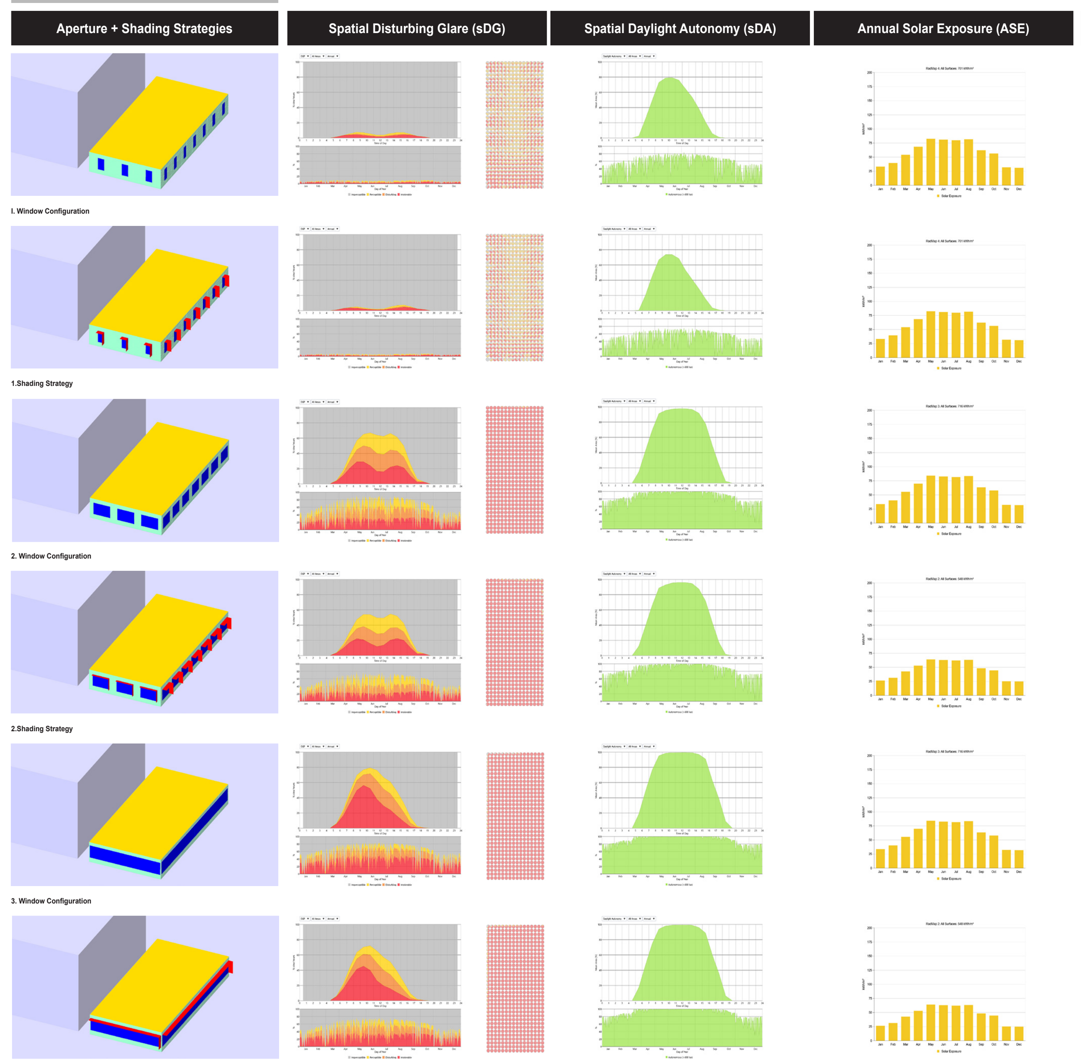
In order to maximize solar input year round, we modelled our PV system at the spring solstice. The PV tilt angle is 49 degrees and because it's oriented south, the azimuth angle is 180 degrees. Our PV system utilizes a premium model type with a nominal efficiency of 19%.The system size (kW) is 145.31 m2 (array area)*1 kW/m2*0.19 (module efficiency)=27.61 kW. The system loses percentage is 14.08%. Using the PVWatts Calculator, we were able to determine that our expected system output would be 37,672 kWh/year. However, our ClimateStudio results indicated an annual output of 64,581 kWh/year.

Assignment 5

Daylight Study

Ali Kamal, Eric Hagerman, Meghan Jones

Aperture + Shading Strategies	Spatial Disturbing Glare (sDG)	Spatial Daylight Autonomy (sDA)	Annual Solar Exposure (ASE)	EUI	Conclusion



EUI: 422.15 Btu/sq.ft

EUI: 474.73 Btu/sq.ft

EUI: 515.56 Btu/sq.ft

Conclusion

As previously determined, altering aperture size can have drastic effects on the EUI of a given building. It can also have drastic effects on glare and solar exposure, and by extension the shading configurations necessary.

Our analysis looked at one room and with three different window to wall ratios with three different shading configurations. As expected, configuration 1 with the largest window to wall to ratio also had the highest percentage of disturbing glare (sDG), annual solar exposure (ASE), and energy use intensity (EUI). As we respectively lowered the window to wall ratio for configurations 2 and 3 we also noted lower sDG, ASE, and EUI values.

With the addition of shading configurations, sDG and ASE were both lowered except in the case of the first shading configuration. The most drastic change in sDG and ASE was the third configuration which consisted of individual shading on each window.

Assignment 6:
PARAMETRIC FACADE DESIGN

Architecture Technology I
02 November 2021
Meghan Jones, Eric Hagerman, Ali Kamal

Conclusion: Our building is located on the east end of Morningside Park, for our design strartegy we parametrically optimized the solar radiation strategy by twisting the paneled system in a spiral vertically. This optimization of glass can be seen in figure 7 and 8 during the winter and summer solastce and lastly at its most optimized form in figure 9.

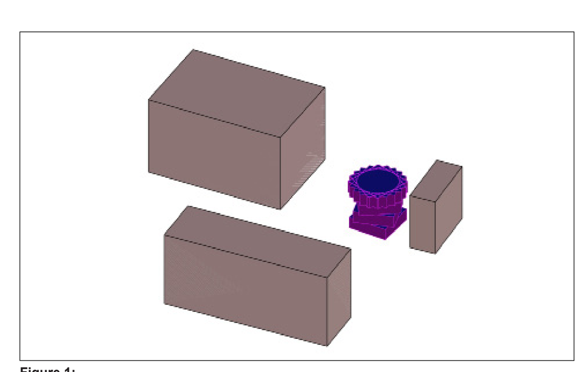


Figure 1:
Context Model

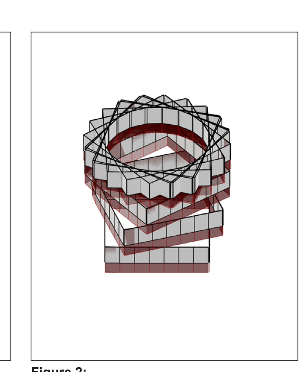


Figure 2:
Base Panels

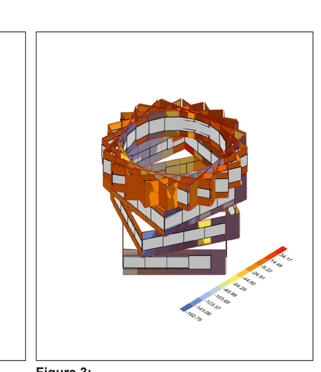


Figure 3:
Skin Generator Panel Output

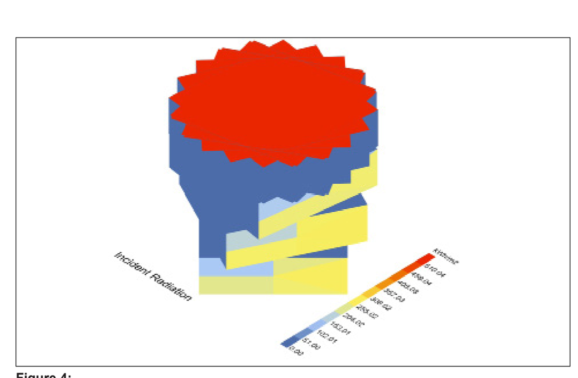


Figure 4:
Summer Solar Radiation

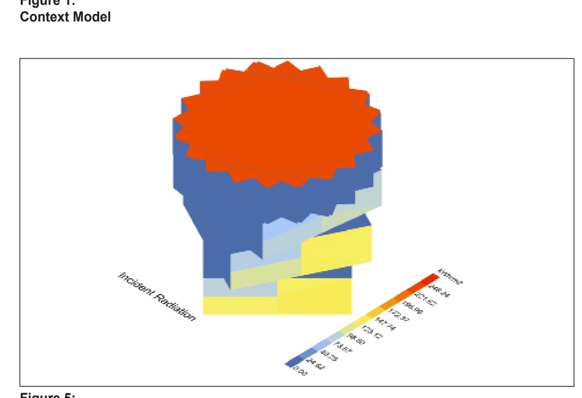


Figure 5:
Winter Solar Radiation

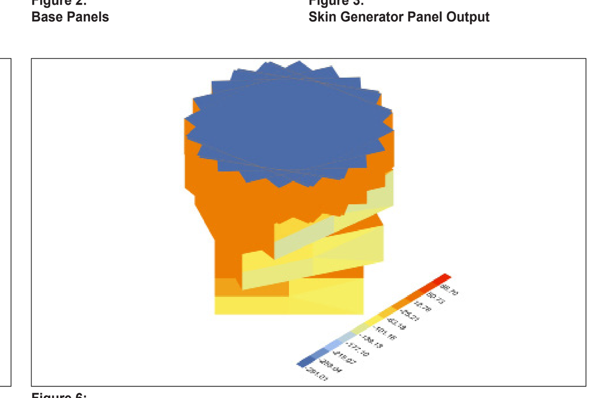


Figure 6:
Optimal Solar Radiation

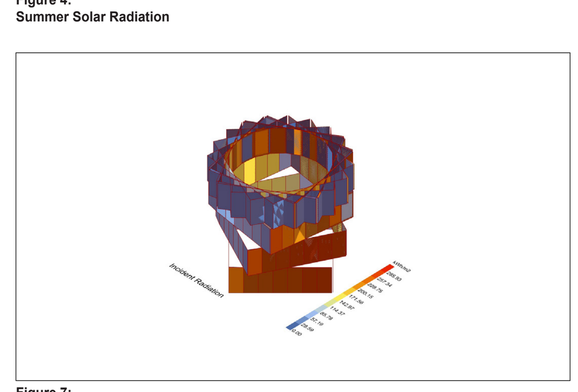


Figure 7:
Part II - Summer Solar Radiation

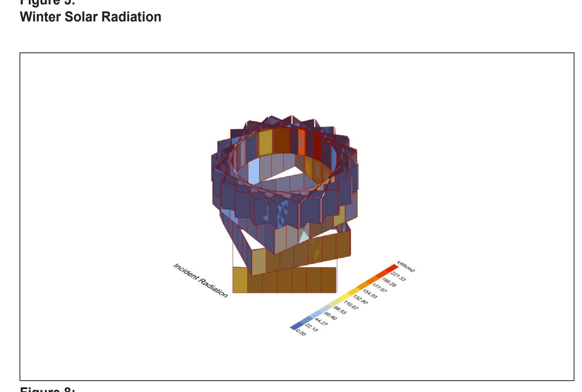


Figure 8:
Part II - Winter Solar Radiation

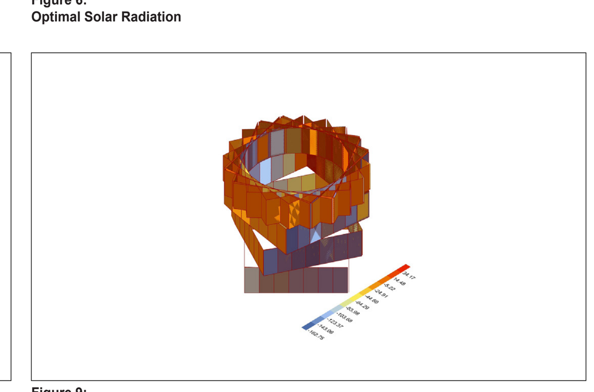


Figure 9:
Part II - Optimal Solar Radiation