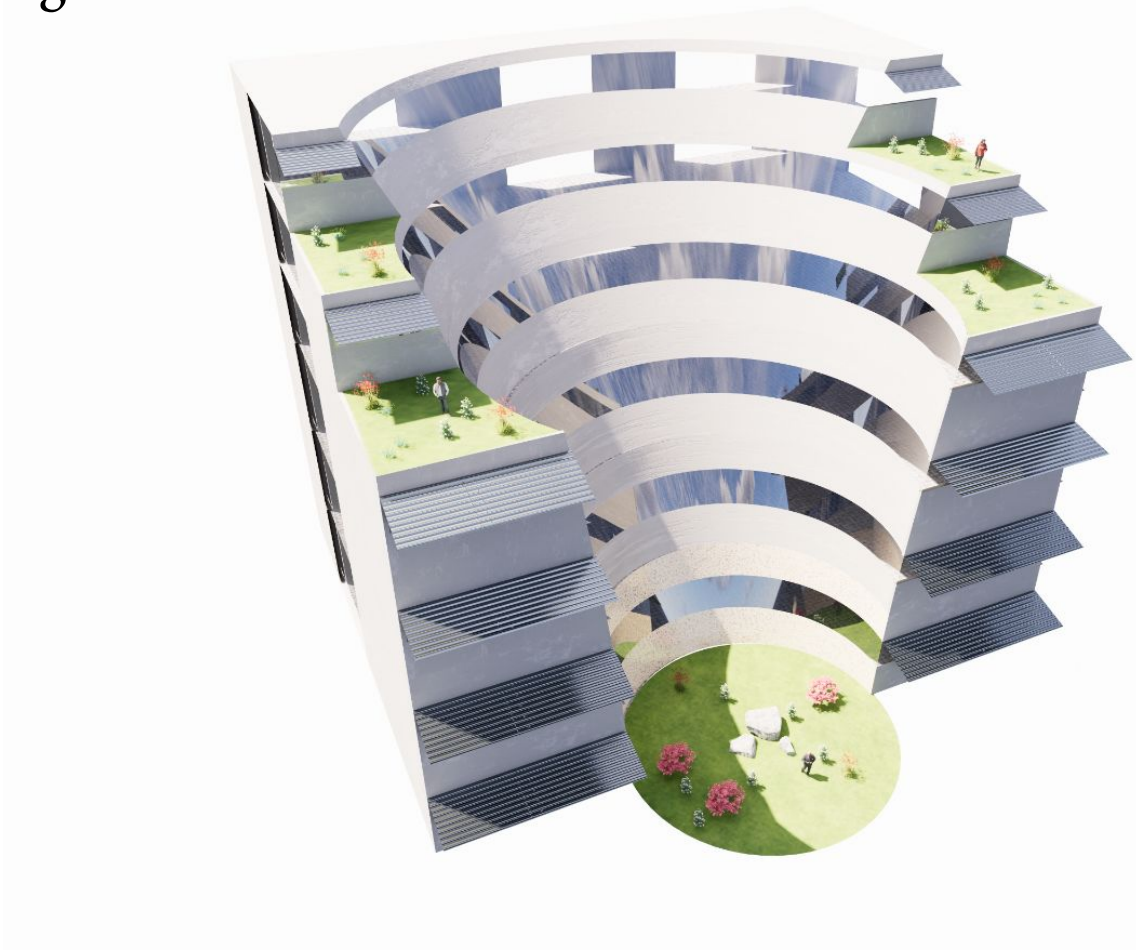
Back Bay Office

McKinley Keel-Atkins / Colin Kim / Amee Savjani

4.401 Fall 2024

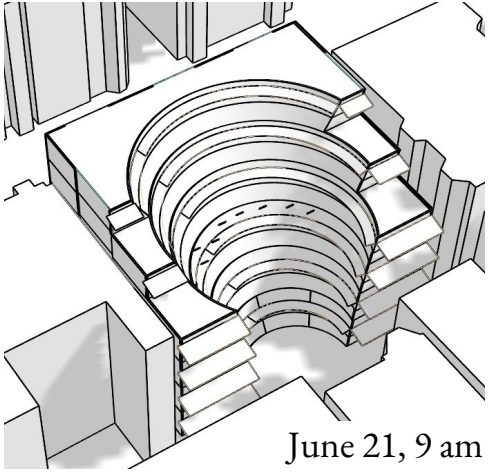
Our Building

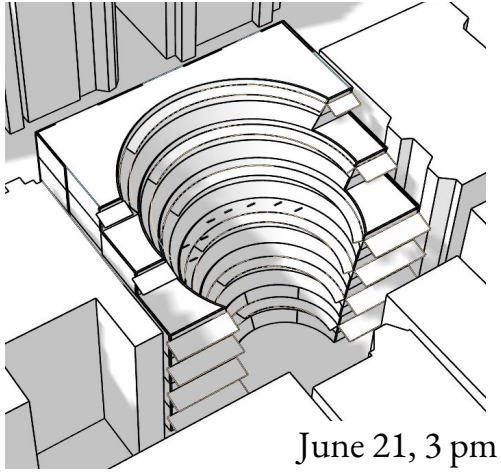


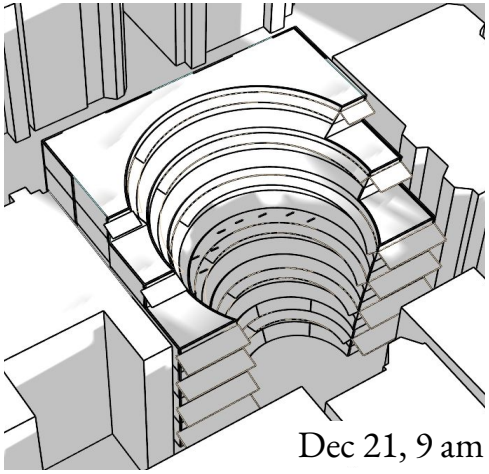
Location

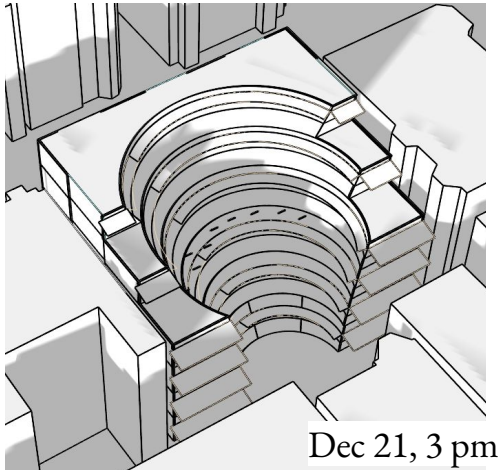
Residential area in Back Bay

Shading


June 21, 9 am


June 21, 3 pm

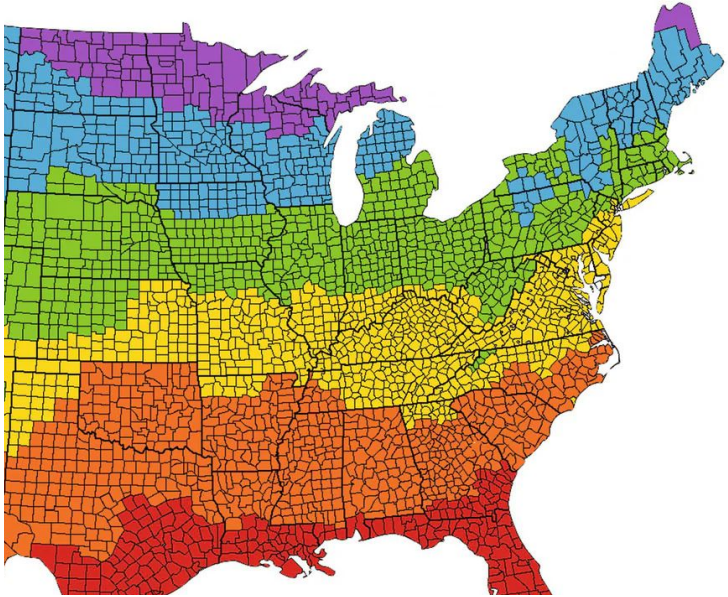

Dec 21, 9 am

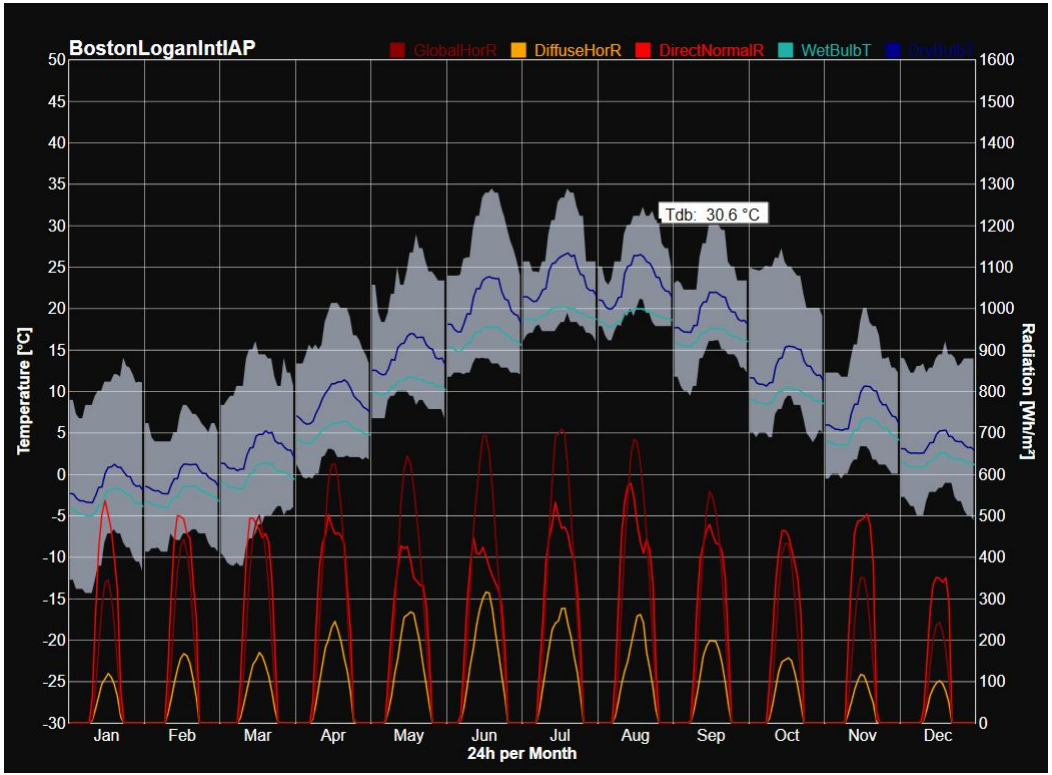

Dec 21, 3 pm

Climate

4A - mixed

- Hot & humid summers
- Cold & dry winters

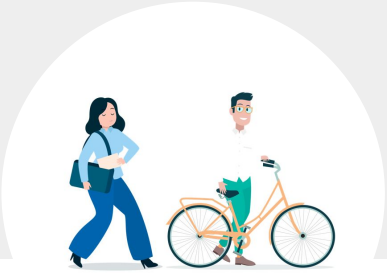




Guiding Principles

EUI Goal

A site EUI that is at least 15% less than the average comparable office building in Boston (68 kBtu/sqft)

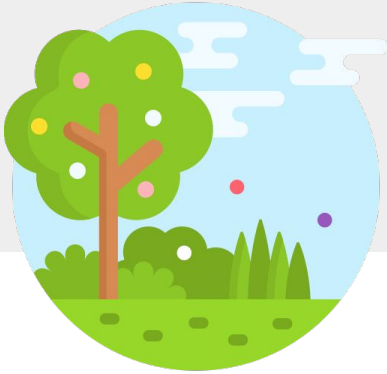


Accessibility

Conveniently located in a residential area for ease of commute

Community

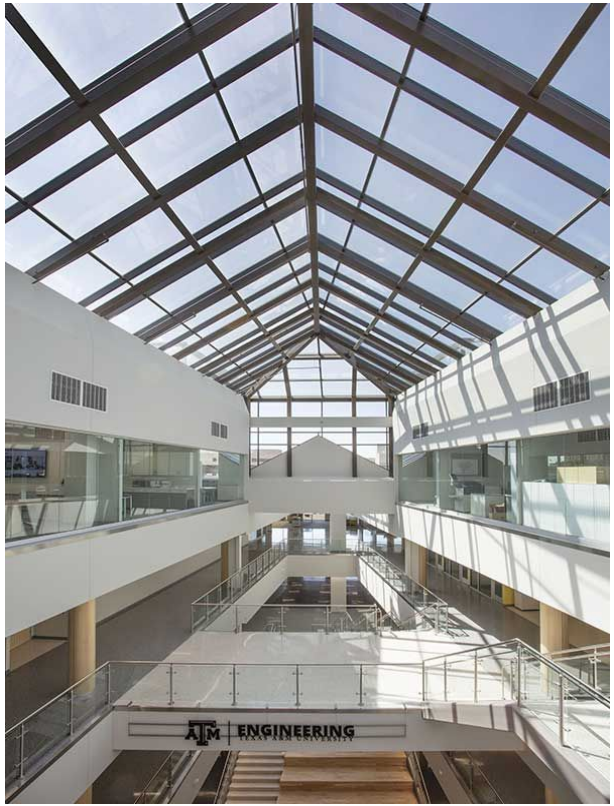
Open floor plans encourage collaboration and discussion



Greenspace

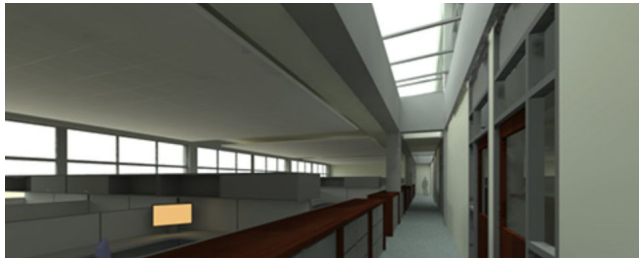
Promotes aesthetics and wellbeing through communal spaces

Precedents



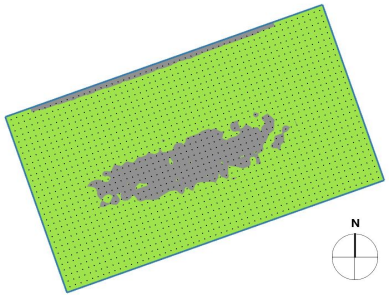
Texas A&M Zachry Engineering Building

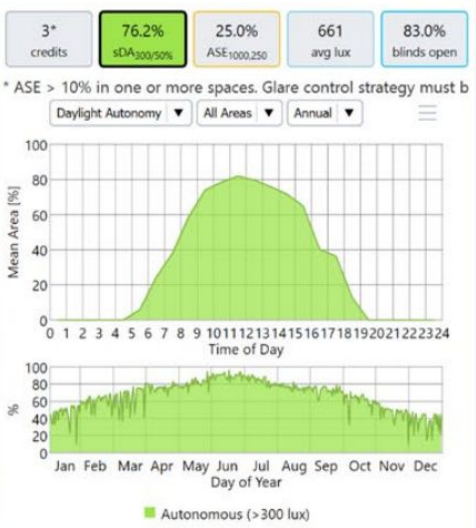
Westwood Hills Nature Center



Top + Side daylight pattern

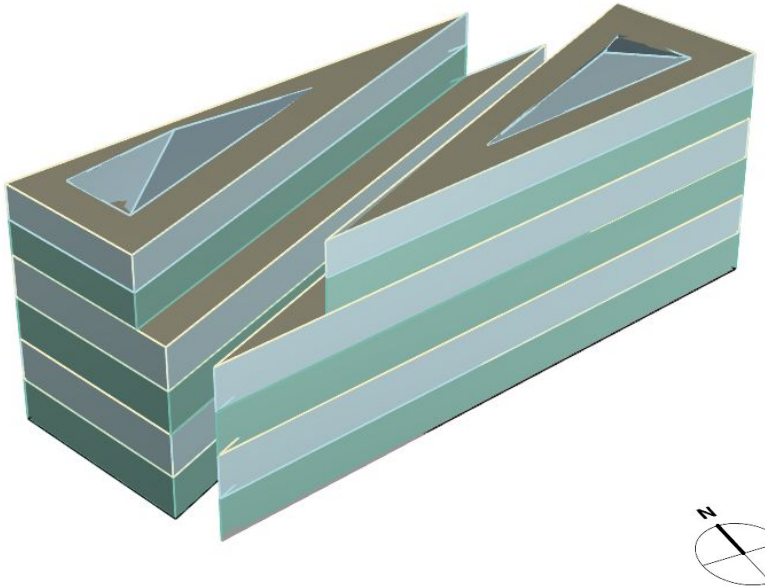
Daylighting - Massings

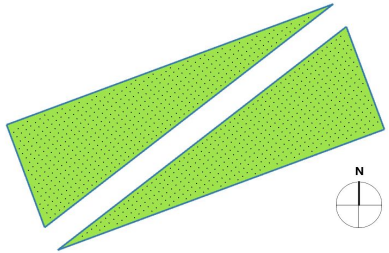


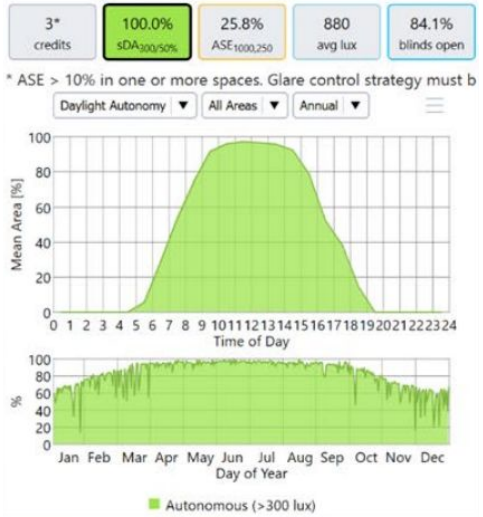


Overhanging Roofs
sDA = 76%, ASE = 25%

Daylighting - Massings

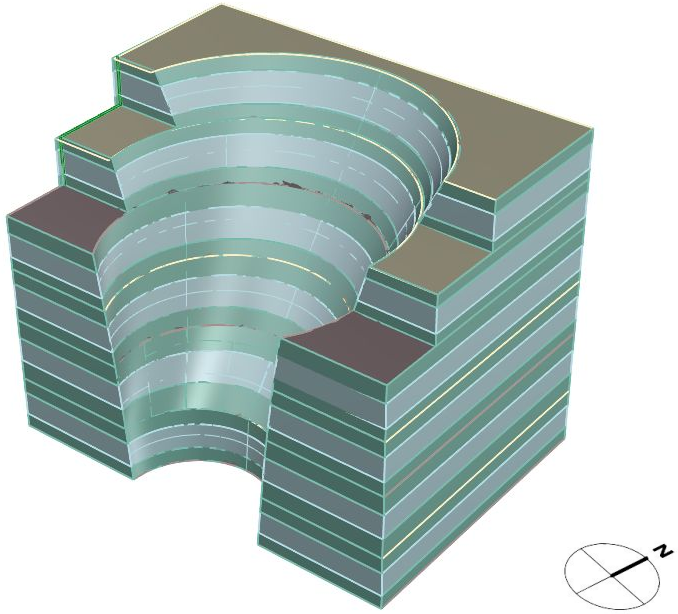


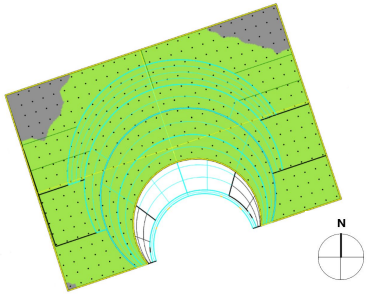


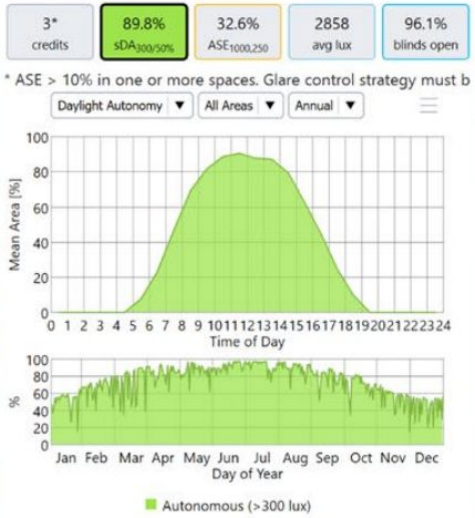


Skylights & Separation
sDA = 100%, ASE = 26%

Daylighting - Massings

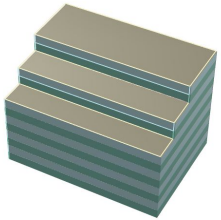


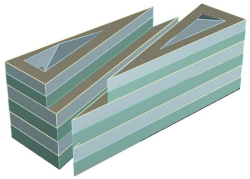


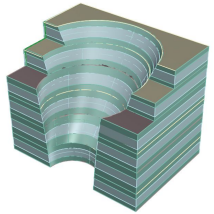


Atrium & Greenspace
sDA = 90%, ASE = 33%

Daylighting - Massings

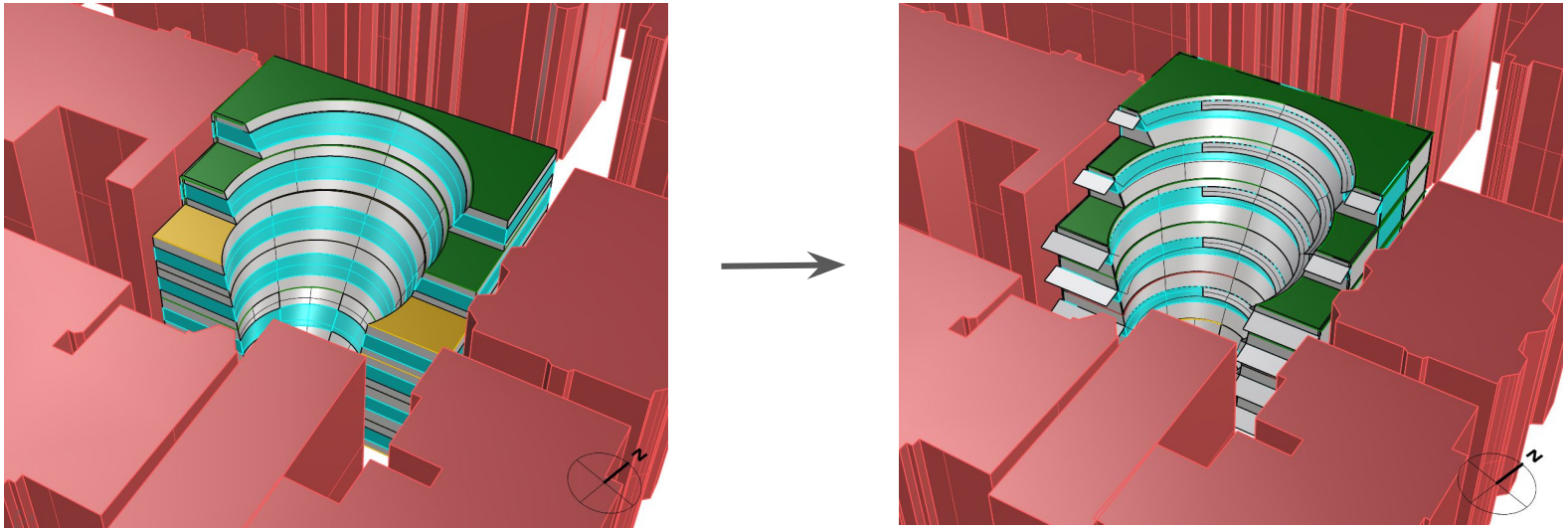






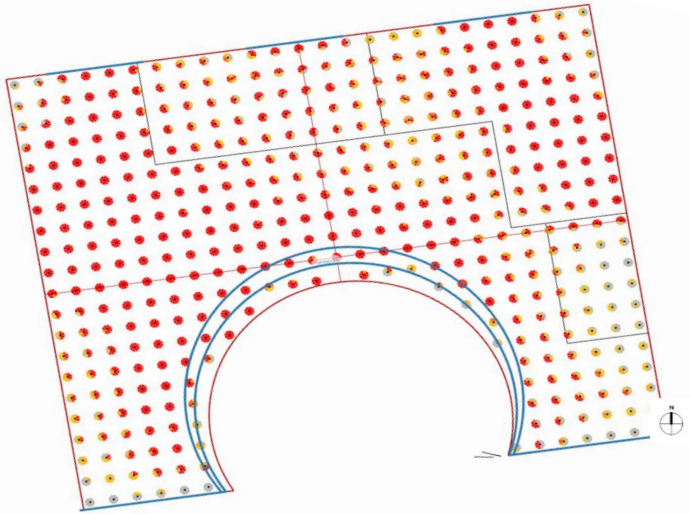
Massing Model	sDA	ASE	Notes
Overhanging Roofs	76%	25%	- Most room for solar panels - Uninspired design
Skylights & Separation	100%	26%	- Most efficient sDA - Little room for modification
Atrium & Greenspace	90%	33%	- Almost as good sDA & ASE - Open design for indoors and outdoors modification

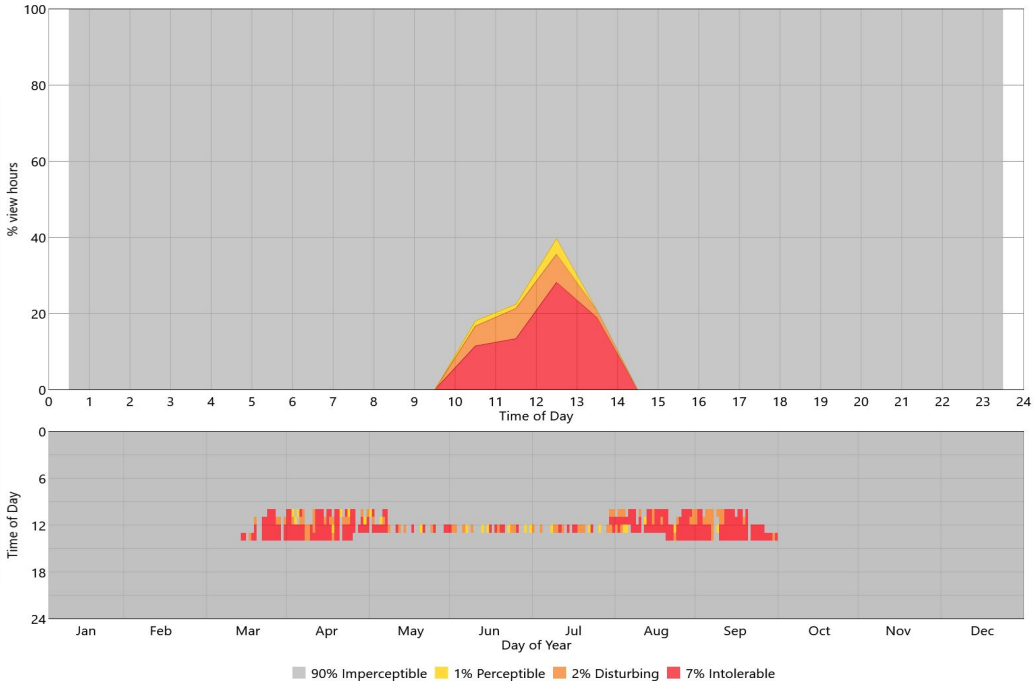
Daylighting - Massings



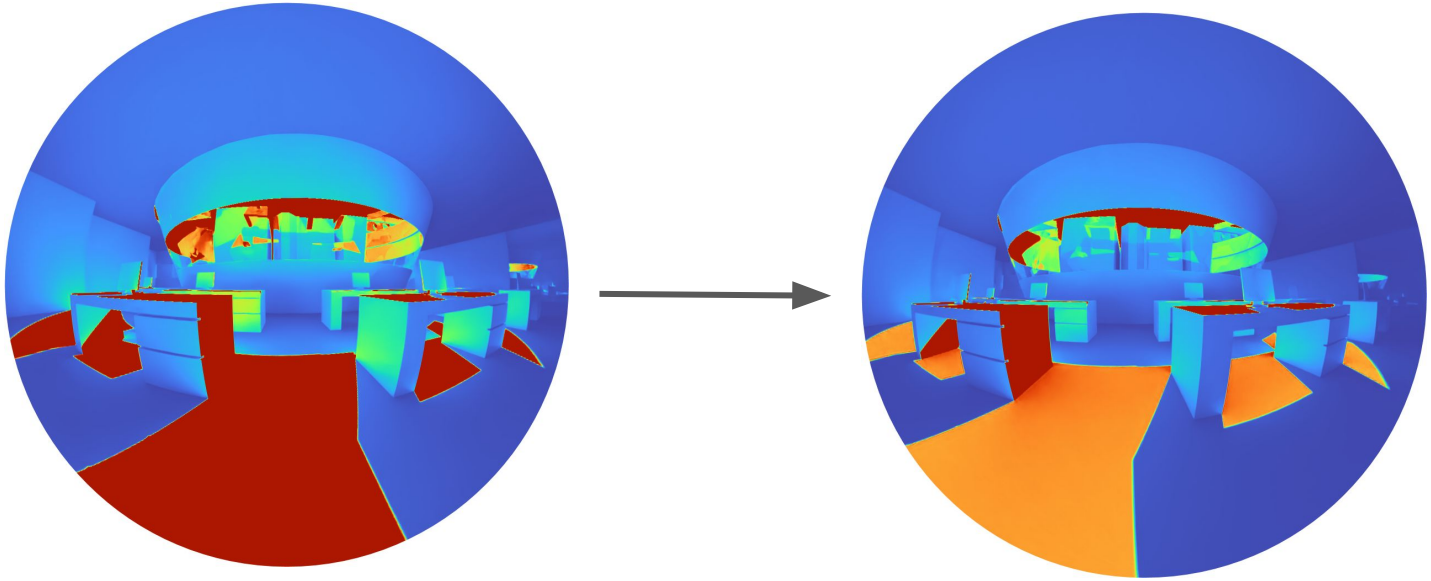
Shading and window placement improved sDA = 89%, ASE = 23%

Visual Comfort





Visual Comfort



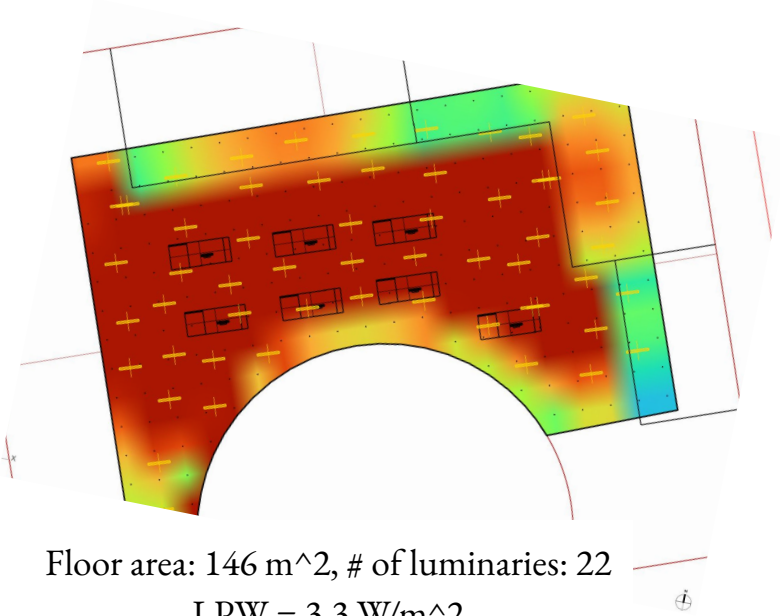
Clear Glass (77.4% VLT)

Solarban z50 (50.1% VLT)

After modification, sDA = 87%, ASE = 4%.

Electric Lighting

Philips CoreLine surface-mounted
22 W, 3100 lm (140 lm/W), 4000 K



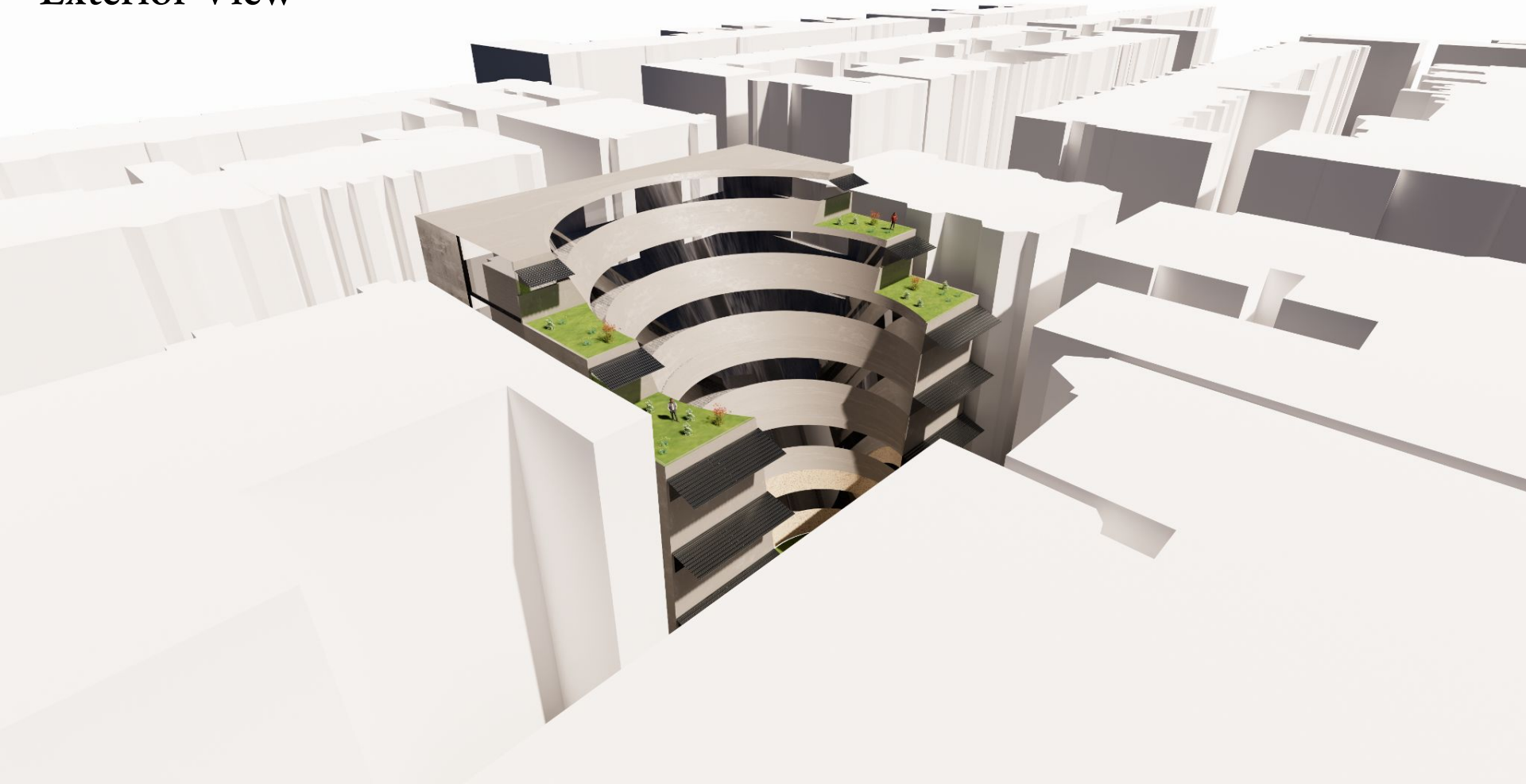
Floor area: 146 m^2, # of luminaries: 22
LPW = 3.3 W/m^2

Electric Lighting

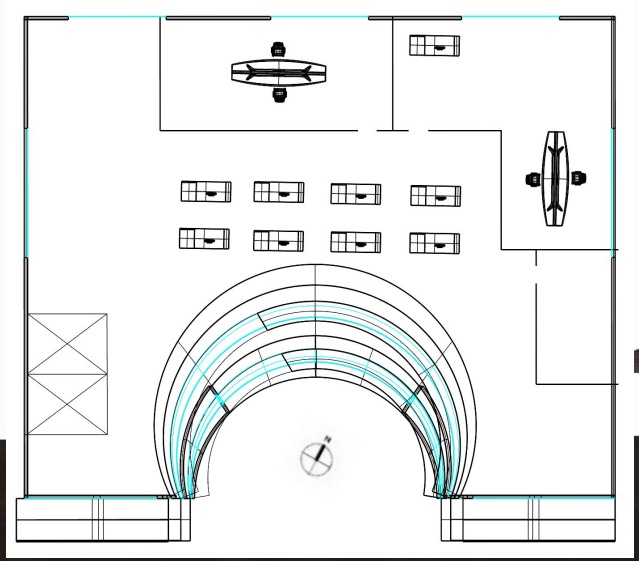
4000 CCT

7000 CCT

Exterior View

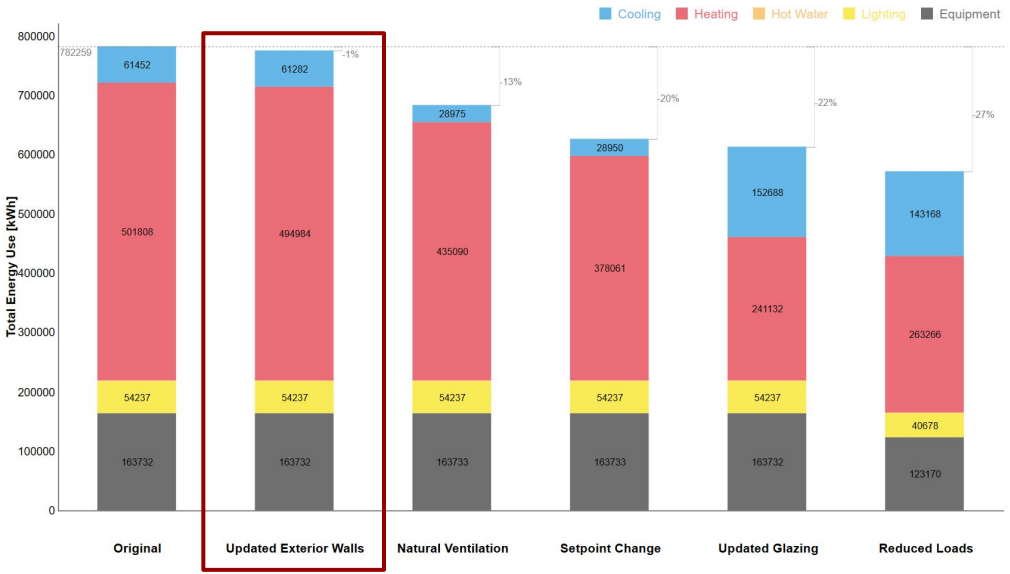


Interior View

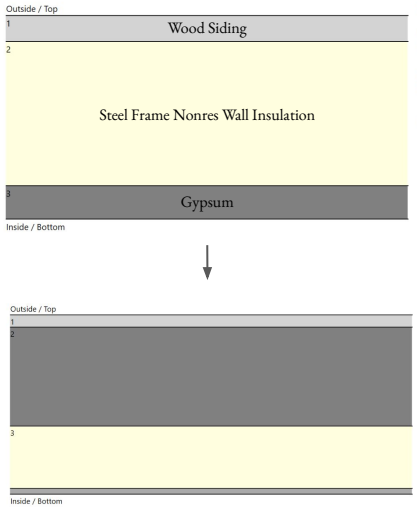


Improving EUI

Improving EUI

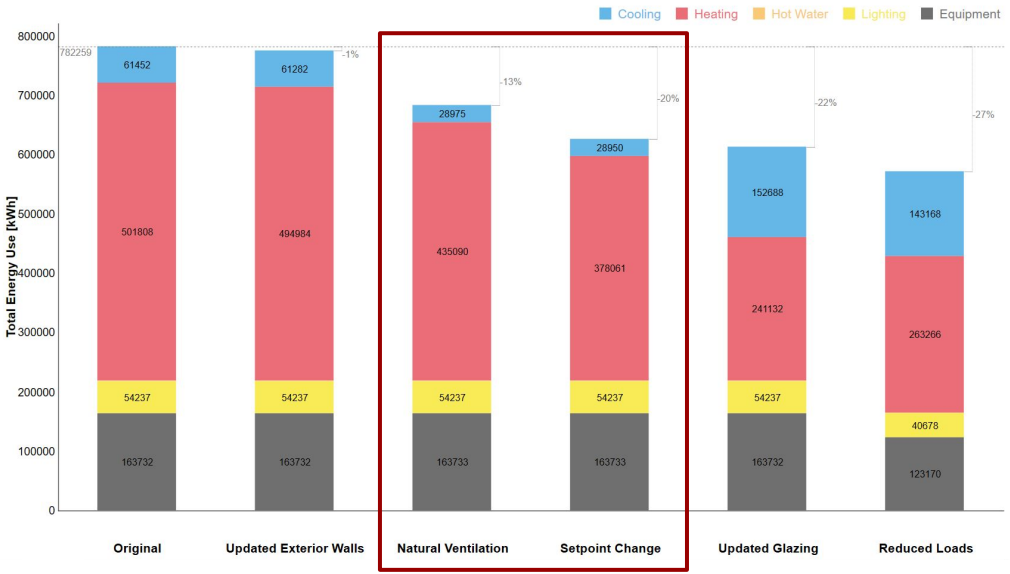


- **Updated Materials**
  Exterior walls and glazing materials were changed to have better insulating properties.



We maximized the amount of gypsum insulation, which had a minimal effect on total energy usage.

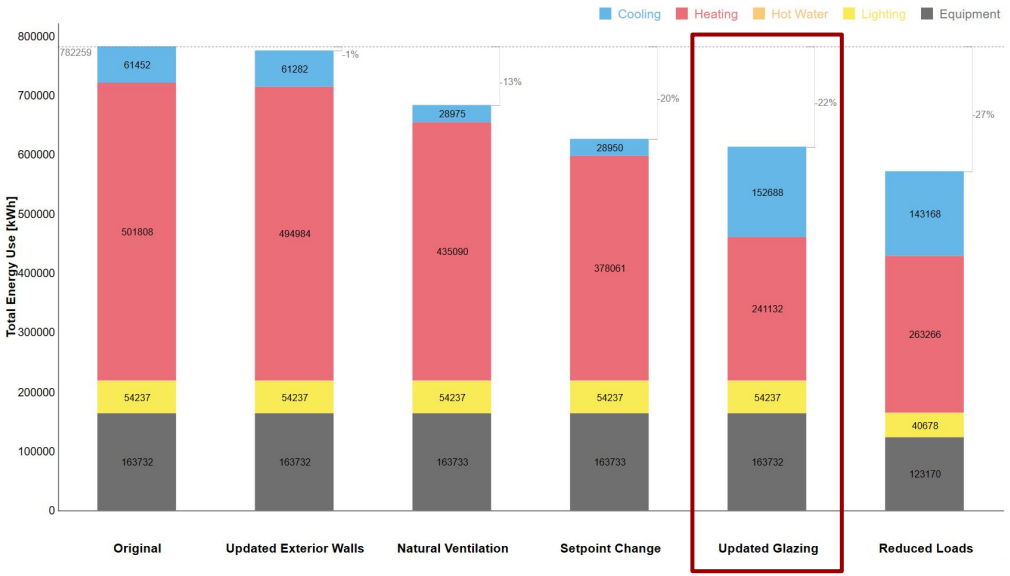
Improving EUI



- **Natural Ventilation**
  We allowed natural ventilation between the months of April and August, reducing the cooling and heating loads during those summer months.

- **Setpoint Change**
  We further lowered the energy use by updating the temperature thresholds for heating and cooling; the threshold for heating was lowered from 20° C to 18° C, and the threshold for cooling was increased from 26° C to 28° C.

Improving EUI

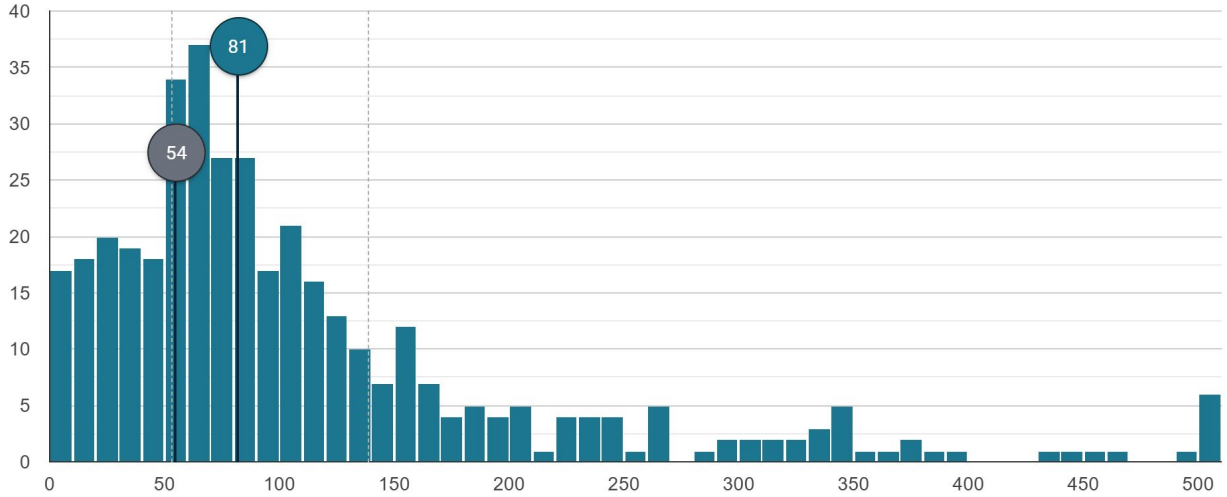


- **Updated Glazing**
  We updated our window properties as following:

  Fixed Assembly Window:
  U-Value = 3.236 W/(m^2K)
  SHGC = 0.39
  TVIS = 0.898
  Embodied Energy = 0 MJ/m^2
  Embodied Carbon = 0 kgCO2/m^2

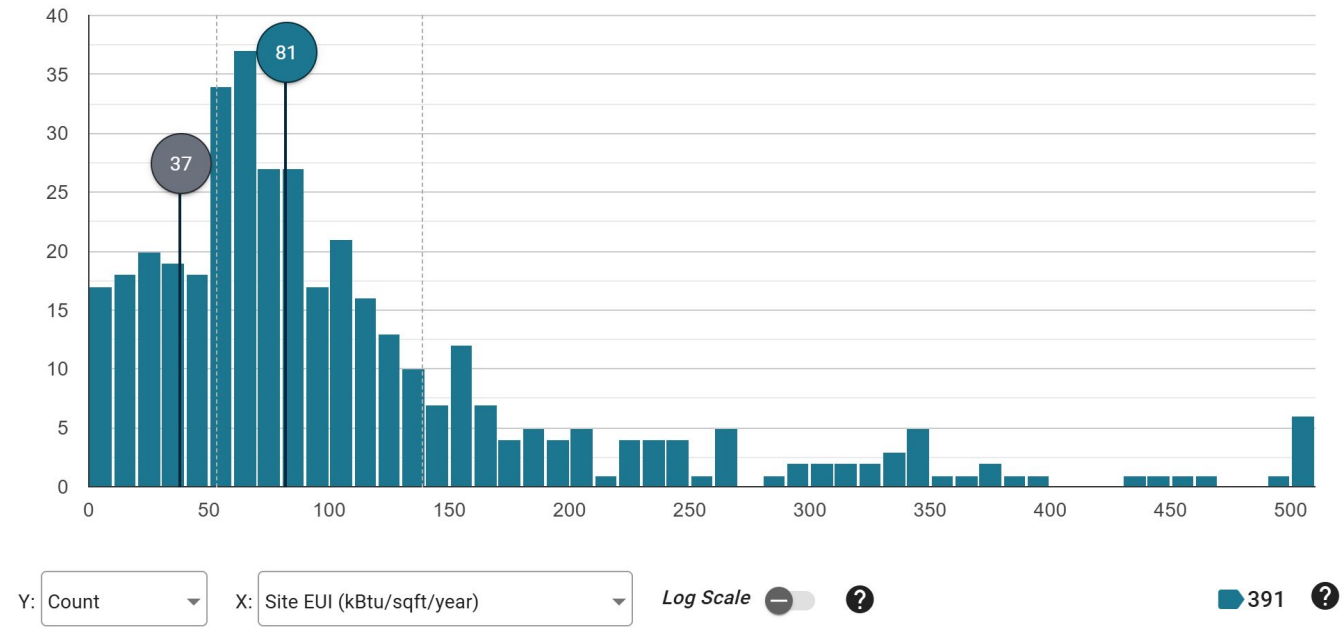
  NECB-2020 Non-residential Office CZ 4:
  U-Value = 1.9 W/(m^2K)
  SHGC = 0.84
  TVIS = 0.924
  Embodied Energy = 8 MJ/m^2
  Embodied Carbon = 46.284 kgCO2/m^2

Baseline Energy Usage

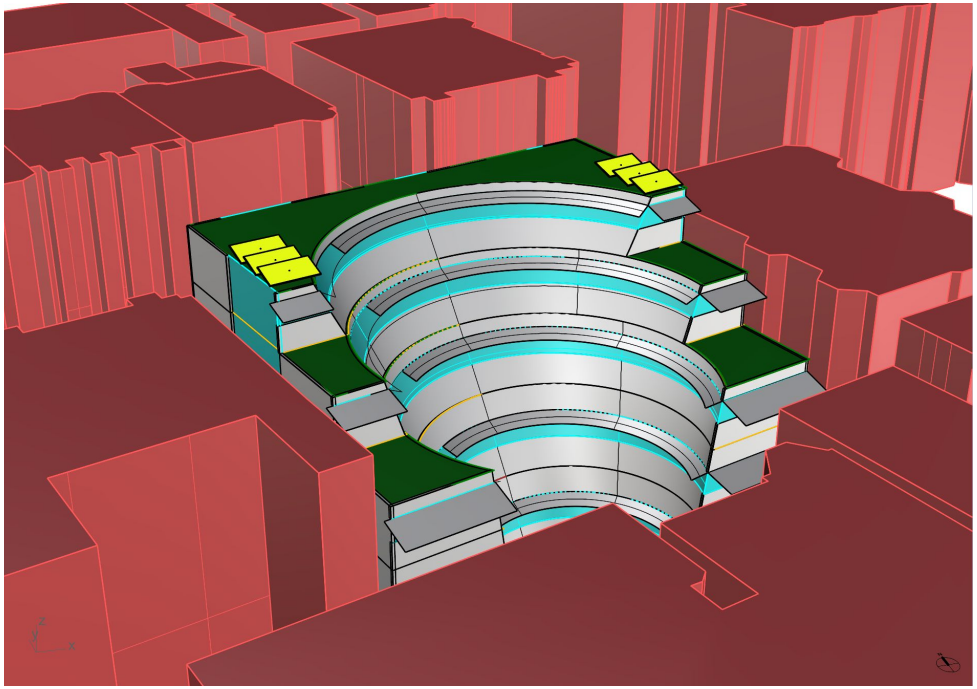


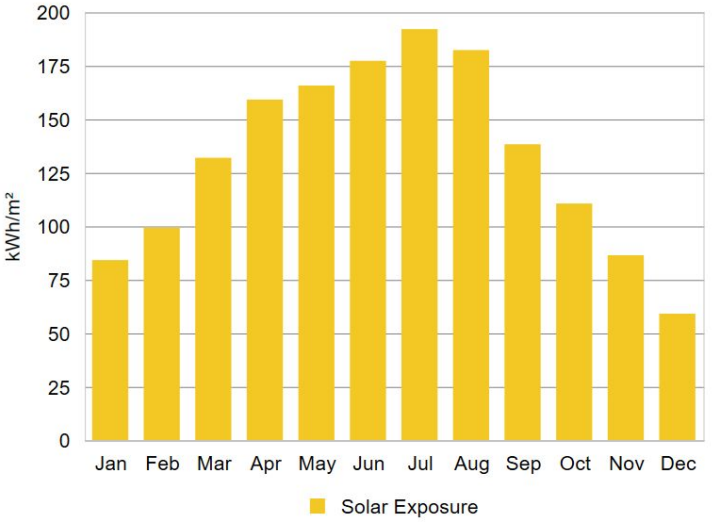
Y: Count X: Site EUI (kBtu/sqft/year) *Log Scale* 391

Combined Final Energy Usage



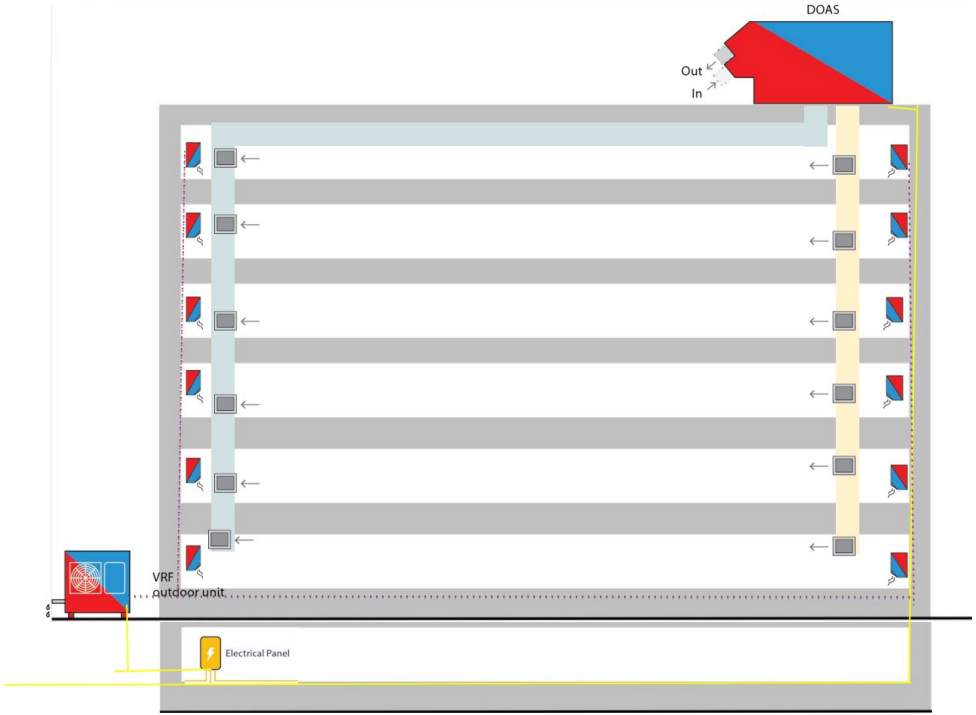
Solar Panels





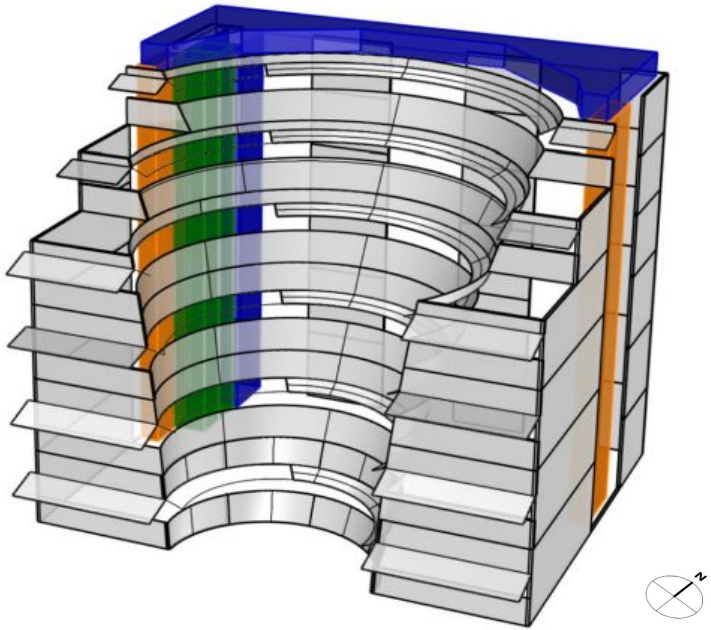
The 6 solar panels reduce site EUI by .3 kBtu/sf

HVAC



Minimum required outside air is supplied via a dedicated outdoor air system (DOAS), while heating and cooling is managed by a variable refrigerant flow system (VRF).

HVAC



We implemented a variable duct size, as our floor area varies due to our cascading floor design.

For the 6th floor, due to the limited floor space available, we eliminated an elevator shaft and repurposed the floor to lead exclusively to the outdoor greenspaces.

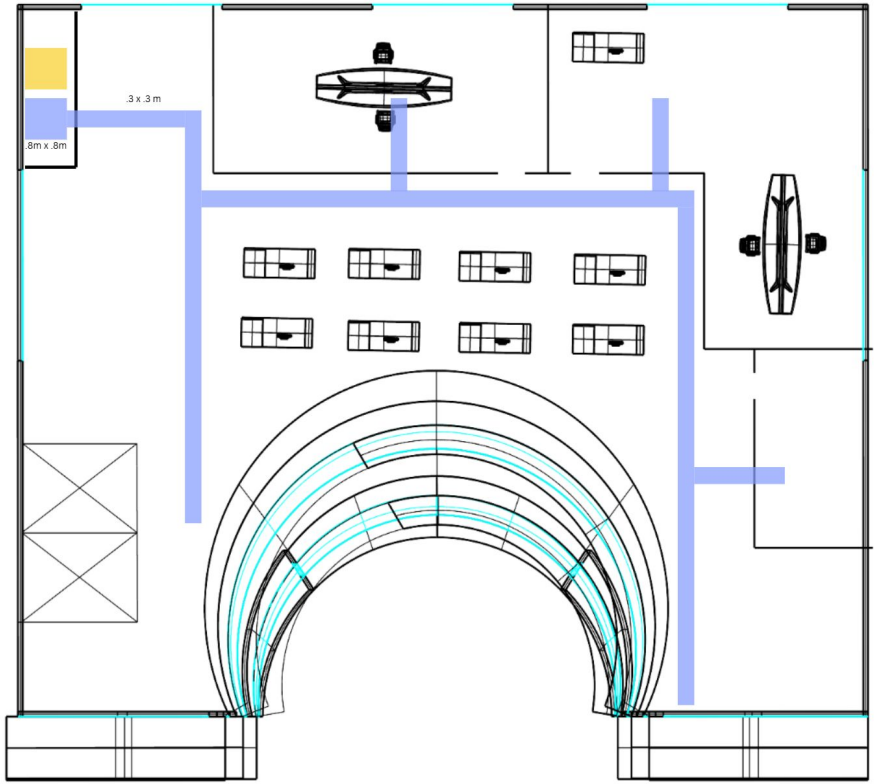
All-Air System:
Supply Cross section: .63m^2
Return Cross section: .63m^2

Floors 1-3: 1100 m^2 = 11/52 total area
Floor 4: 800 m^2 = 2/13 total area
Floor 5: 600 m^2 = 3/26 total area
Floor 6: 500 m^2 = 5/52 total area

Floors 1-3: .13 m^2, .4 m x .4 m
Floor 4: .09 m^2, .3 m x .3 m
Floor 5: .07 m^2, .27 m x .27 m
Floor 6: .06 m^2, .25 m x .25 m

Vertical Shaft Cross Section: .8 m x .8 m

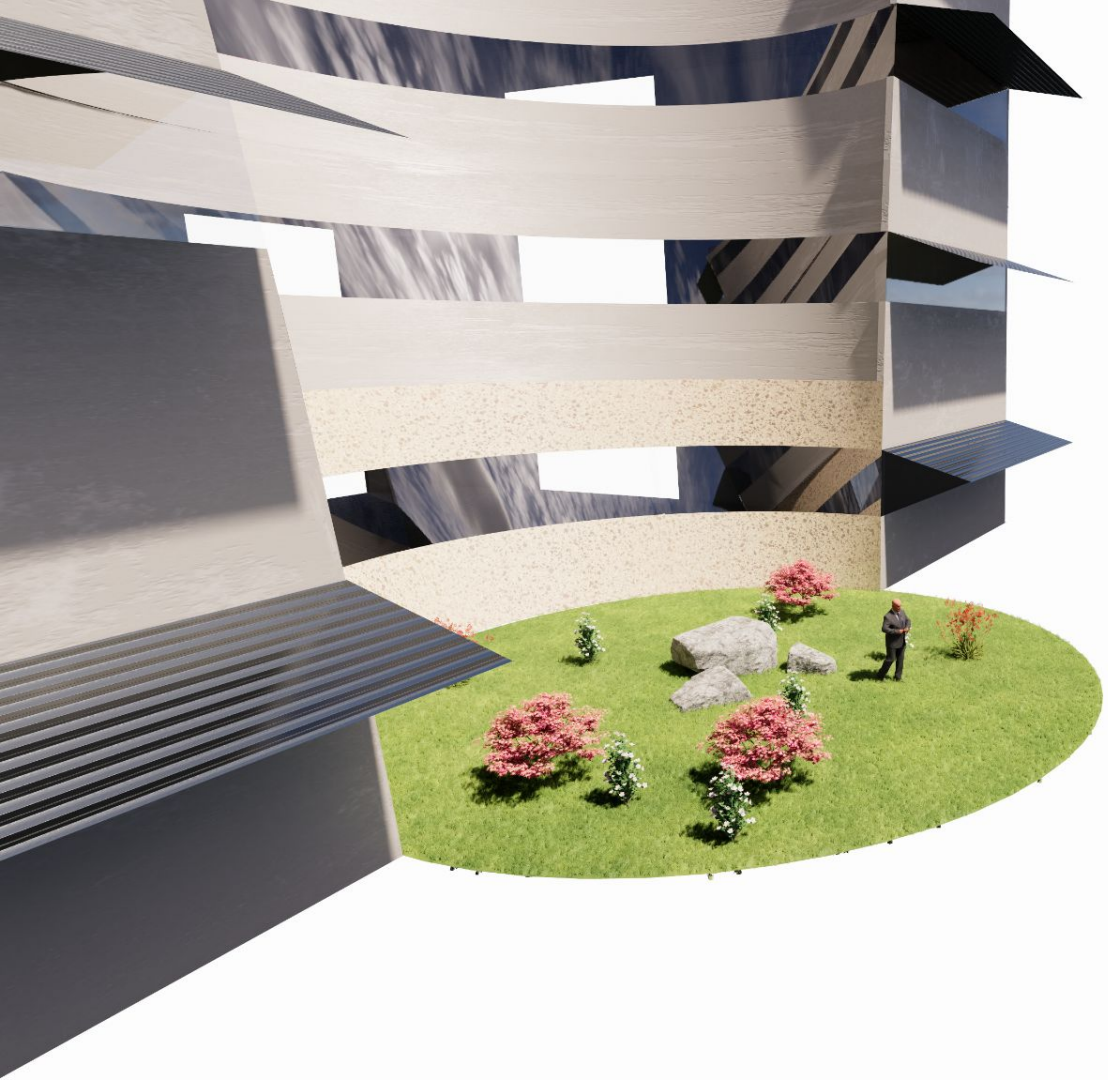
HVAC



Choosing a DOAS system greatly reduced our required duct size which was crucial, as the ducts needed to fit in the tight space allocated to HVAC.

Final Thoughts

- Construction
  - Geometry
  - Noise
- Productivity
- Repurposing
  - Hybrid months



Thank you!
Any questions?

Citations

- https://www.flaticon.com/free-icon/garden_2592043
- https://www.istockphoto.com/illustrations/open-office
- https://pngtree.com/freepng/business-company-office-work-commuter-character-material_4714475.html
- https://brainboxai.com/en/articles/energy-use-intensity-eui-the-measure-of-a-buildings-efficiency
- https://hydrostopsupply.com/pages/product-approvals-noa
- https://www.aia.org/design-excellence/award-winners/westwood-hills-nature-center
- https://www.youtube.com/watch?v=KuvkEHX3SCg
- https://patternguide.advancedbuildings.net/patterns/pattern-15-daylight-from-top-and-side-office-building.html