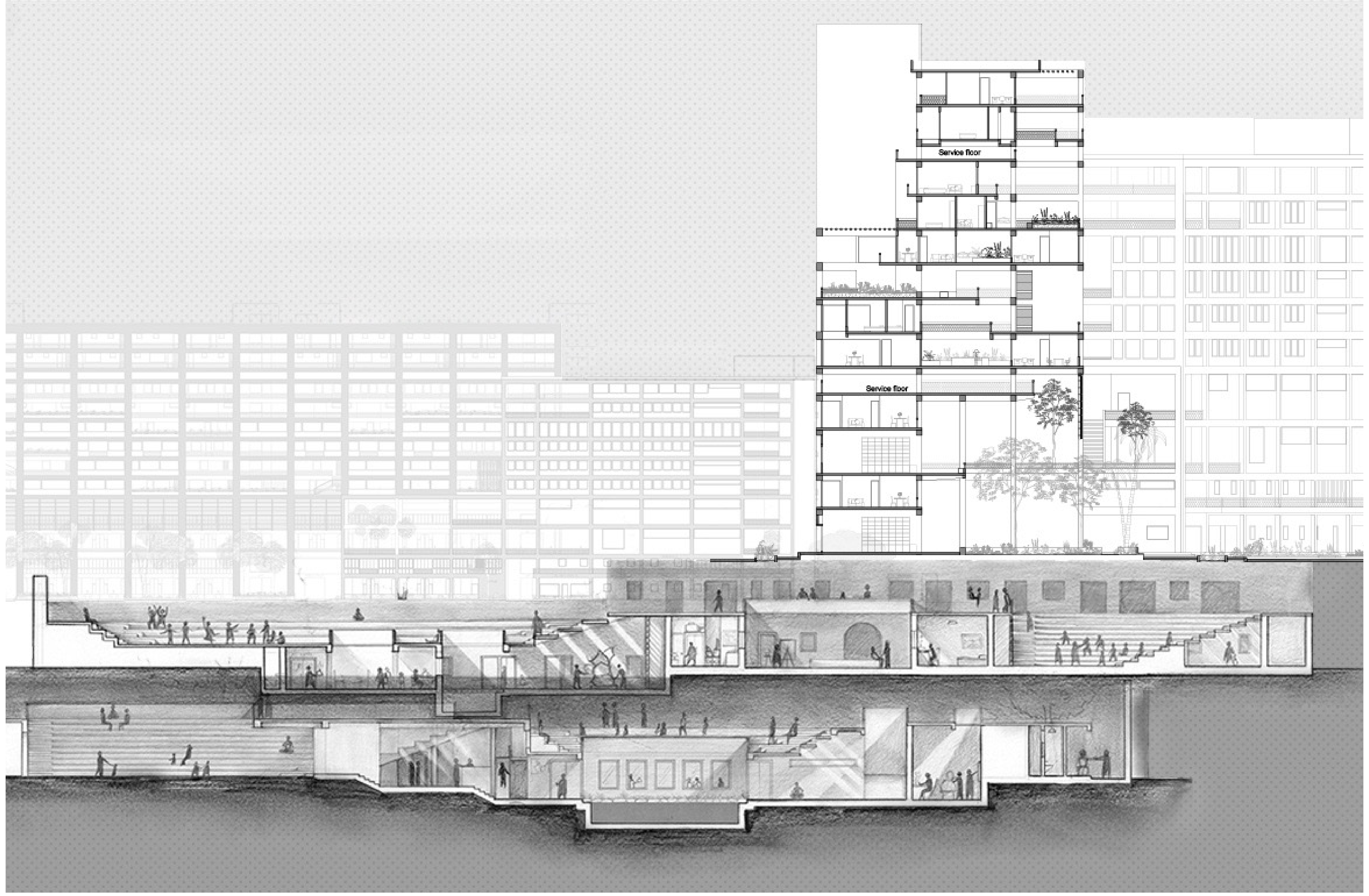


PORTFOLIO 2025

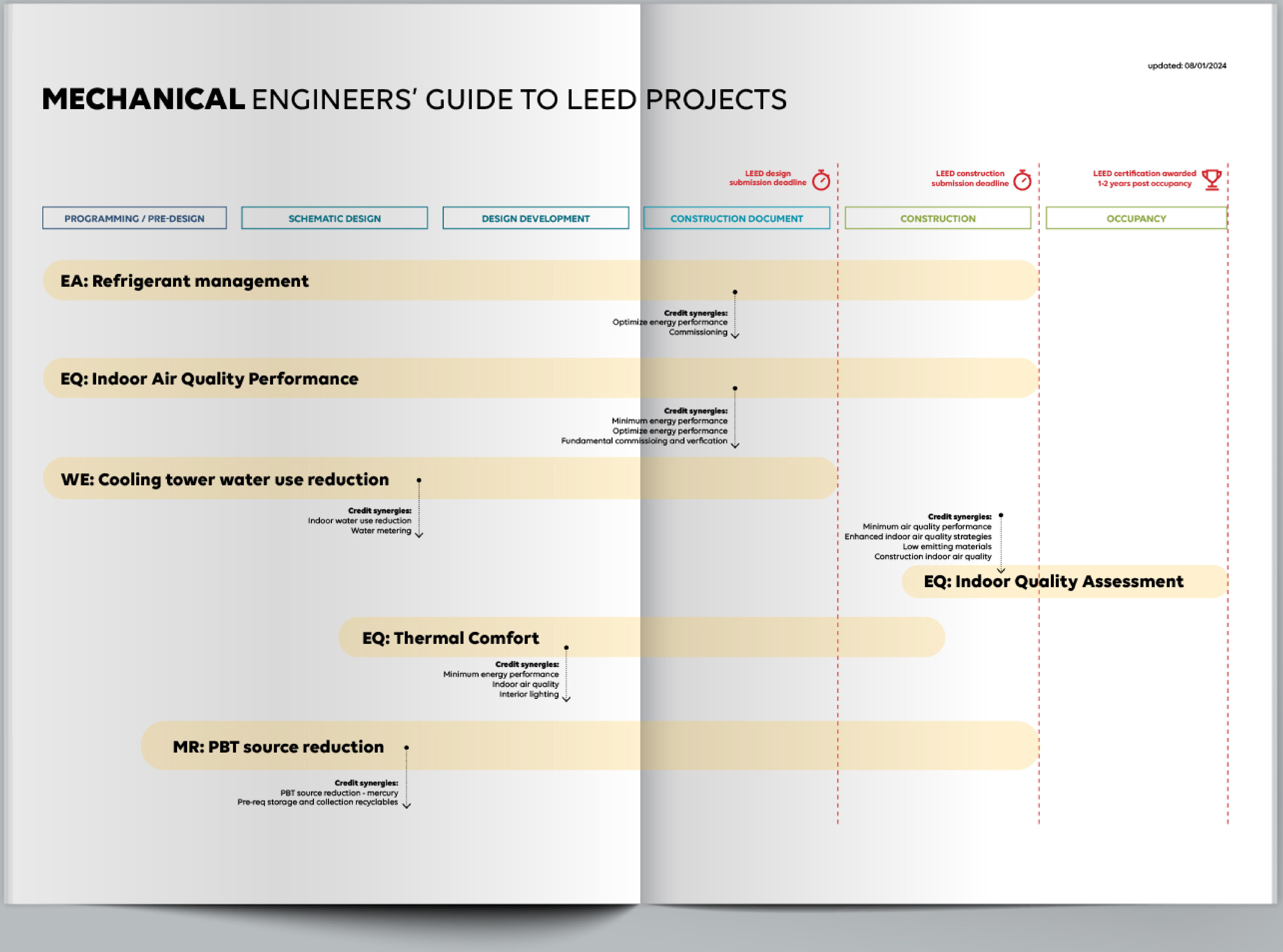
HETVI SHETH

TABLE OF

Contents

Driving design toward sustainability with innovative and practical solutions. Guiding teams to make informed, climate-conscious decisions that positively impact the environment.

environmental leadership



01

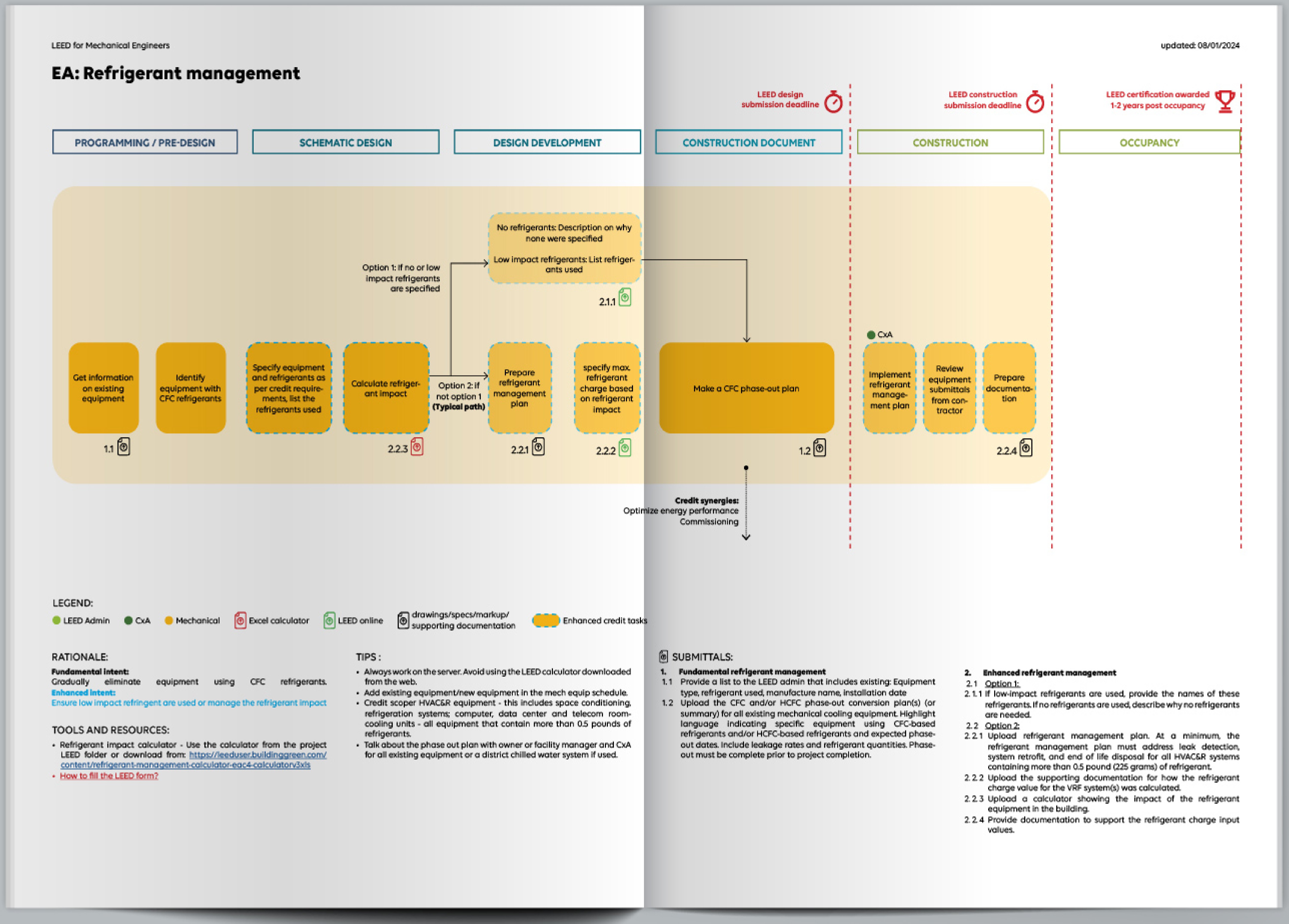
LEED Workplan Development

Enhancing Sustainability Processes at HGA

2024 | Sustainability Intern at HGA | Mentor: Maggie Pipek

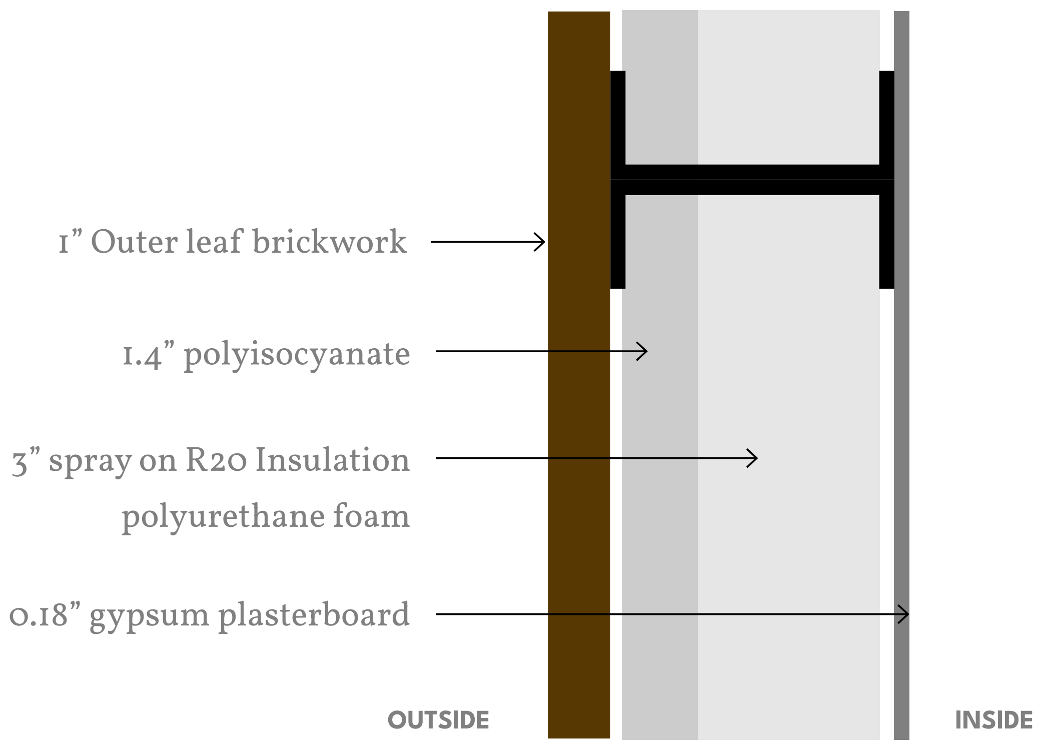
A comprehensive guidebook was developed during the internship to streamline the LEED certification process across engineering disciplines, particularly for engineers with limited LEED knowledge. The project aimed to answer common questions and guide engineers on how to collaborate effectively on LEED projects with other disciplines. By comparing LEED v4, v4.1, and v5, the guidebook identified changes and future trends, ensuring the firm's practices remained aligned with evolving standards.

The guidebook provided clear guidance on when and what actions should be taken throughout the project, which questions to ask at each stage, what to keep in mind for smooth coordination, and the specific deliverables required at each phase of the process. An analysis of previous LEED projects revealed recurring challenges, leading to proposed process improvements to enhance efficiency and effectiveness. The guidebook included step-by-step instructions for each credit, complete with timelines, required resources, and key points of contact, developed in collaboration with various disciplines. Detailed process diagrams were designed to outline the overall LEED workflow and credit-specific tasks for each discipline, enabling teams to navigate the certification process more effectively and achieve better sustainability outcomes.

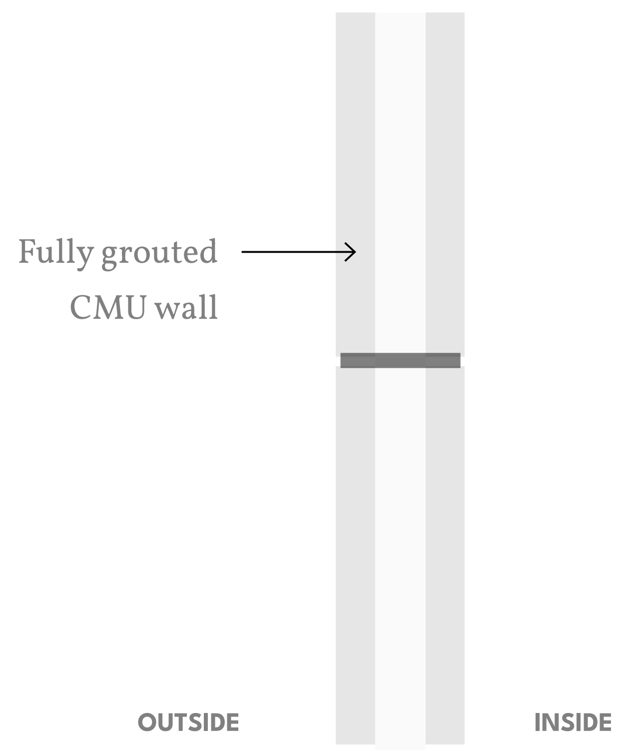


A comprehensive guidebook was developed with detailed timelines and handouts for each LEED credit assigned to specific engineering disciplines. This ensures tasks are completed efficiently and facilitates a seamless handover between teams. During the initial LEED workshop at the project's onset, pursued credits are identified, and corresponding handouts are distributed to each team to track progress. The guidebook includes timelines, deliverables checklists, and an informational guides to align efforts between the certification team and other disciplines, minimize repetitive work, and prevent slip-ups. This was an individual project under the mentorship of Maggie Pipek, Certifications team lead at HGA.

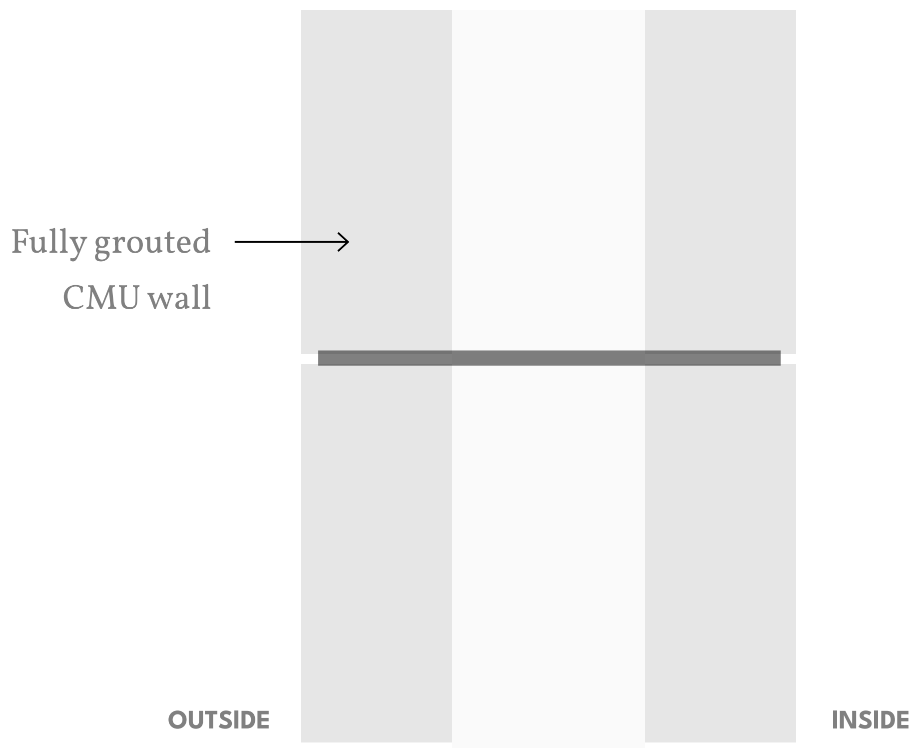
TITLE-24 PRESCRIPTIVE METAL FRAMED BUILDING
R-18.2 (U - 0.055)

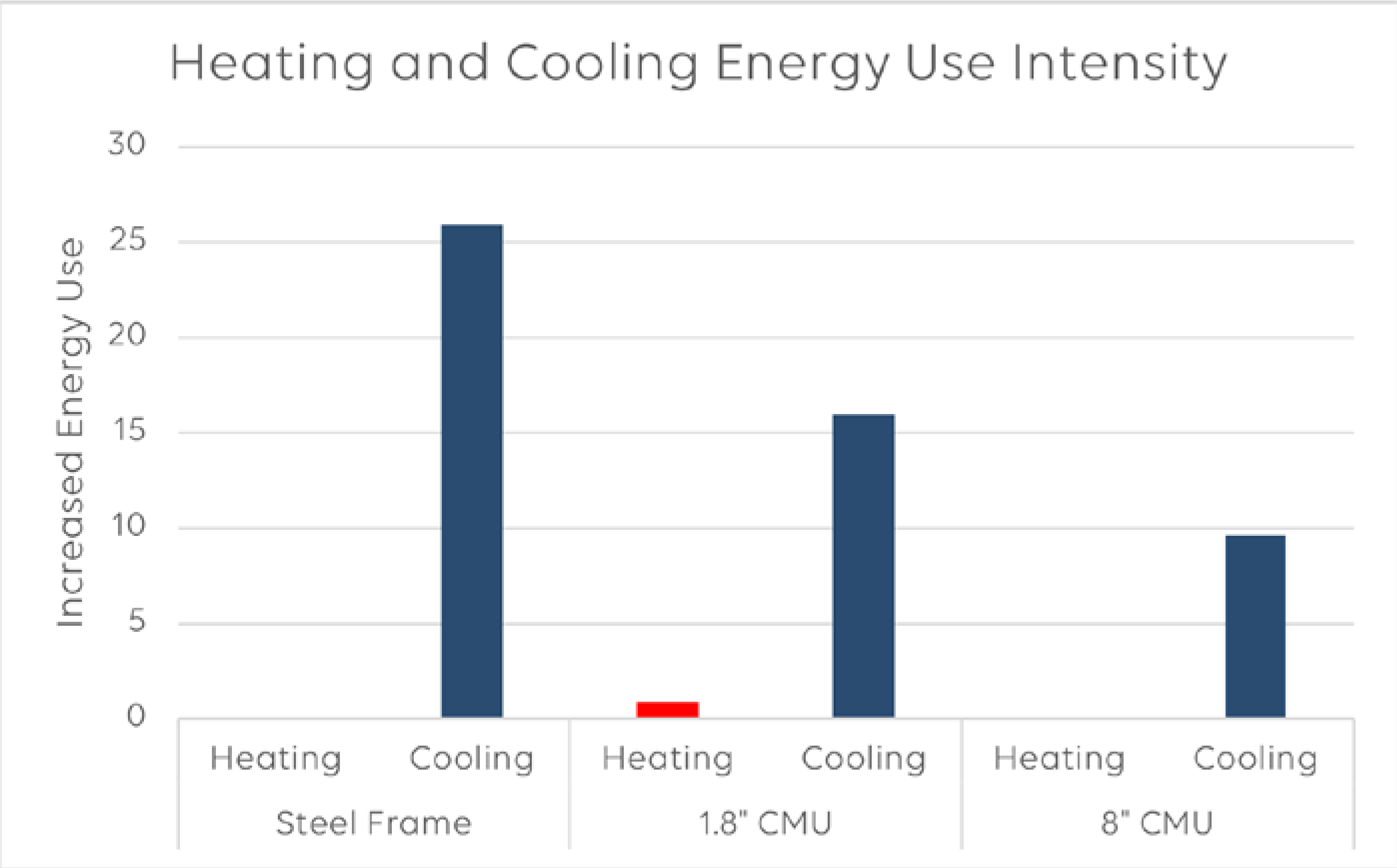


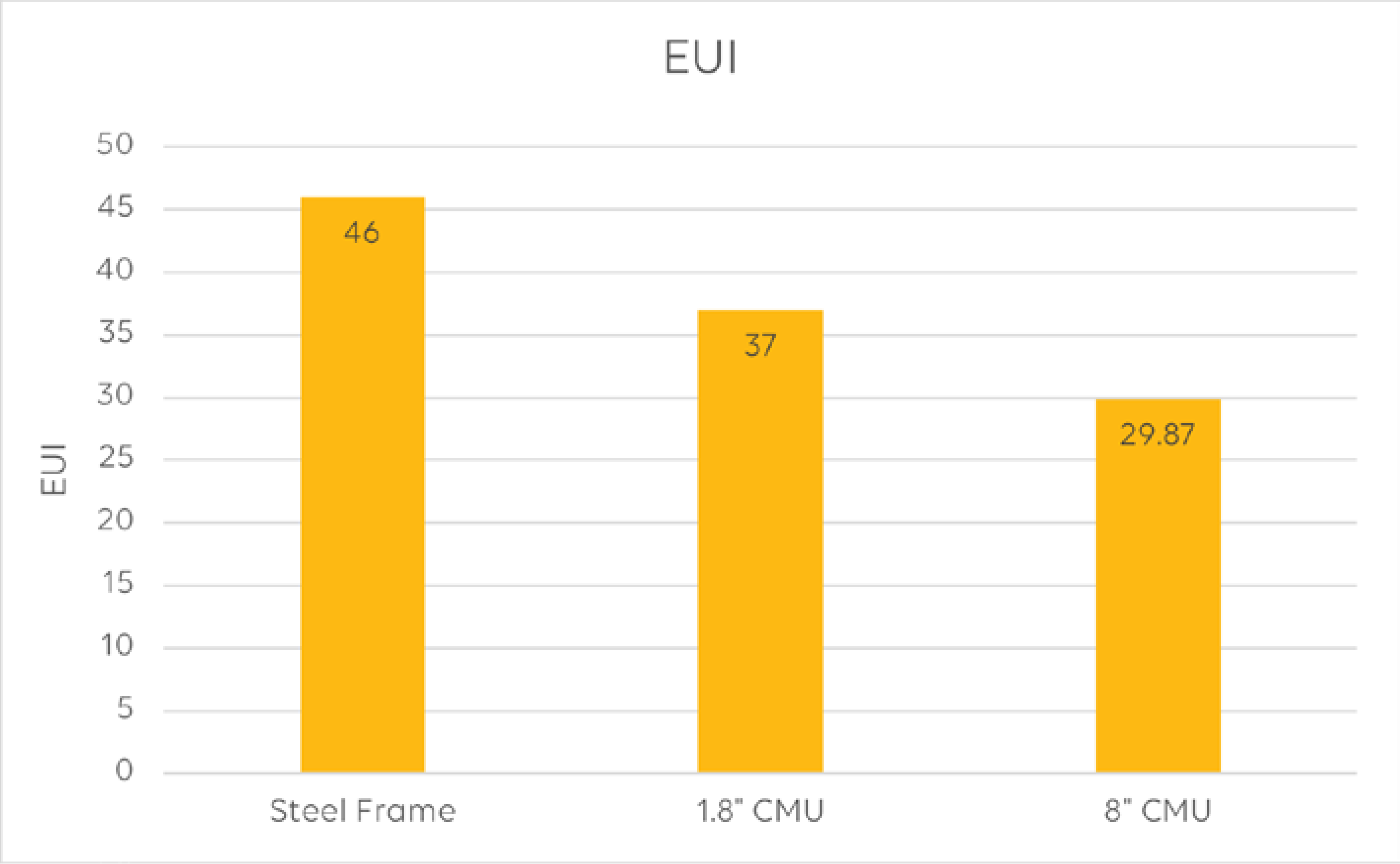
TITLE-24 PRESCRIPTIVE HEAVY MASS WALL
R-1.45 (U - 0.689)
1.8" CMU



PROPOSED HEAVY MASS WALL
R-2.58 (U - 0.386)
8" CMU







Thermal mass optimization cuts EUI by 35% and cooling demand by 50%, with 8" CMU walls outperforming steel frames in energy efficiency.

02

Thermal Mass and Building Energy Analysis

Impact of Thermal Mass on Building Energy in California

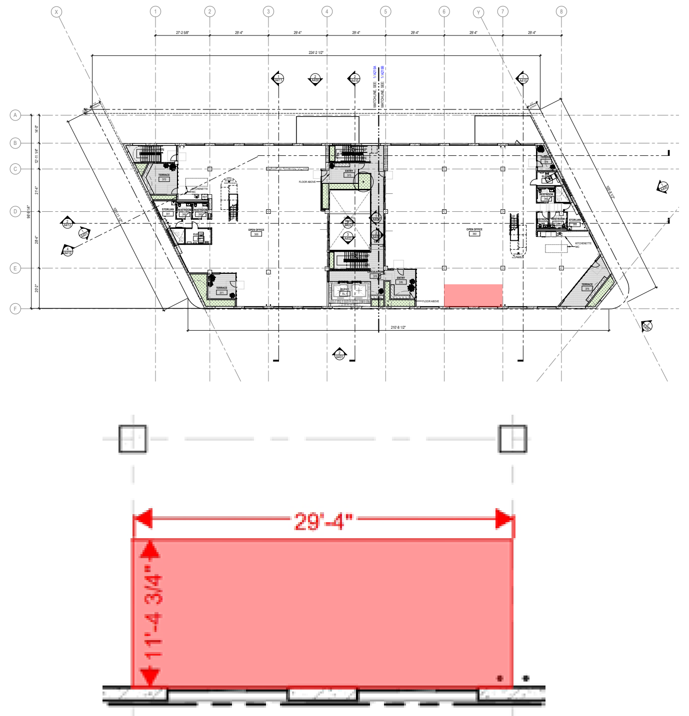
2024 | Sustainbaility Intern at HGA | Mentor: Elizabeth LeRiche

This project investigated the impact of thermal mass on building energy performance, focusing on how different wall assemblies influence cooling loads and energy consumption in California's climate. By comparing steel frame and concrete masonry unit (CMU) assemblies, the study aimed to understand how thermal mass contributes to energy efficiency.

The analysis showed that thermal mass walls, particularly 8" CMU, reduced peak cooling demand by up to 30%, offering significant energy savings. In contrast, steel frame assemblies dissipated heat faster but resulted in up to 20% higher energy consumption. The 8" CMU reduced cooling load by approximately 15% compared to the 1.8" CMU, which exhibited 25% more temperature variability and higher cooling needs.

The findings highlighted the importance of optimizing thermal mass to improve building performance, with the potential to cut overall energy consumption by 10-20%. This research demonstrates that integrating well-designed thermal mass in building envelopes can be a key strategy for achieving energy efficiency and sustainability in buildings. This project was done in collaboration with Elizabeth LeRiche, Building performance specialist at HGA.

MODEL ASSUMPTIONS



- Location: Santa Monica
- Climate zone: ASHRAE climate zone 3C
- Type: Open plan commercial building

Test Parameters

- Floor Area: ~321 ft²
- Occupant Density: 0.01 people/ft²
- Equipment Power Density: 1.09 W/ft²
- Lighting Power Density: 0.6 W/ft²

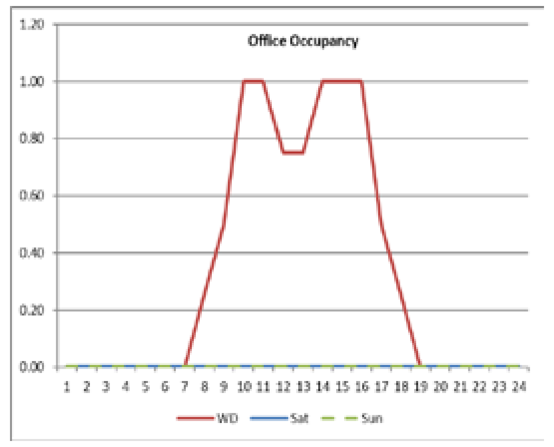
HVAC System

- Type: Fan Coil Unit (4-pipe)
- Cooling Source: Chilled water from air-cooled chiller
- Heating Source: Hot water from natural gas boiler
- Temperature Setpoints:
  - Heating: 70°F (setback: 63°F)
  - Cooling: 75°F (setback: 82°F)

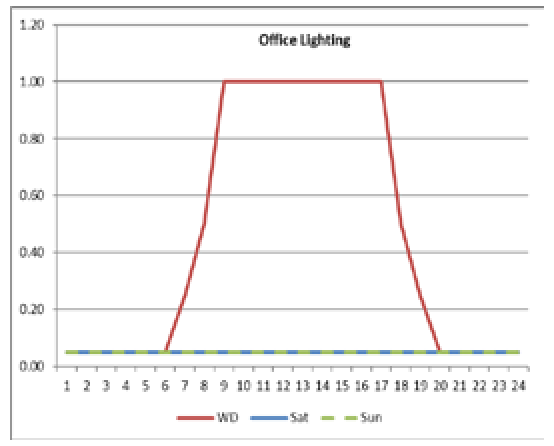
Construction Assemblies

- Roof and Floor:
  - Set to adiabatic (no heat transfer)
- Glazing:
  - Window-to-Wall Ratio: 30%
  - Solar Heat Gain Coefficient (SHGC): 0.270
  - Light Transmission: 0.64
  - U-Value: 0.24

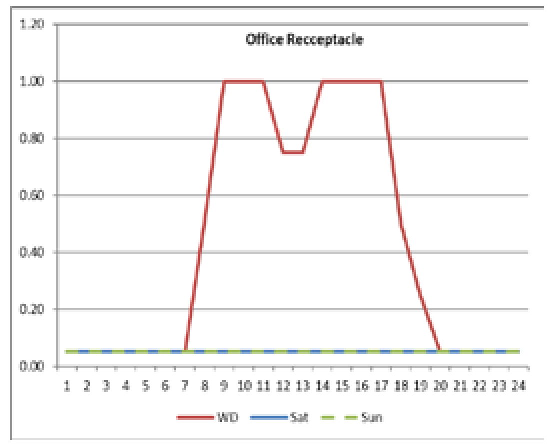
Office occupancy schedule



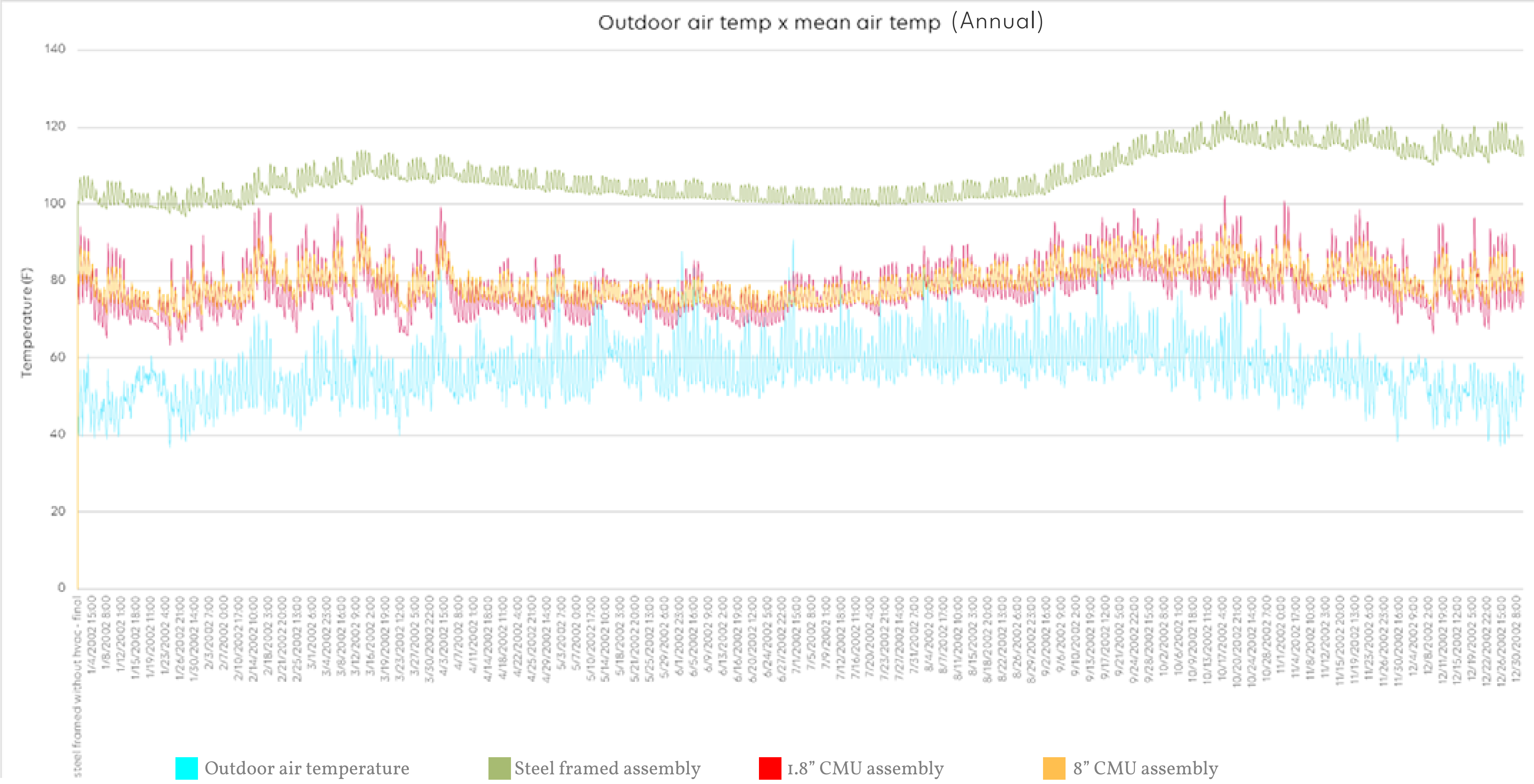
Lighting schedule



Receptacle schedule



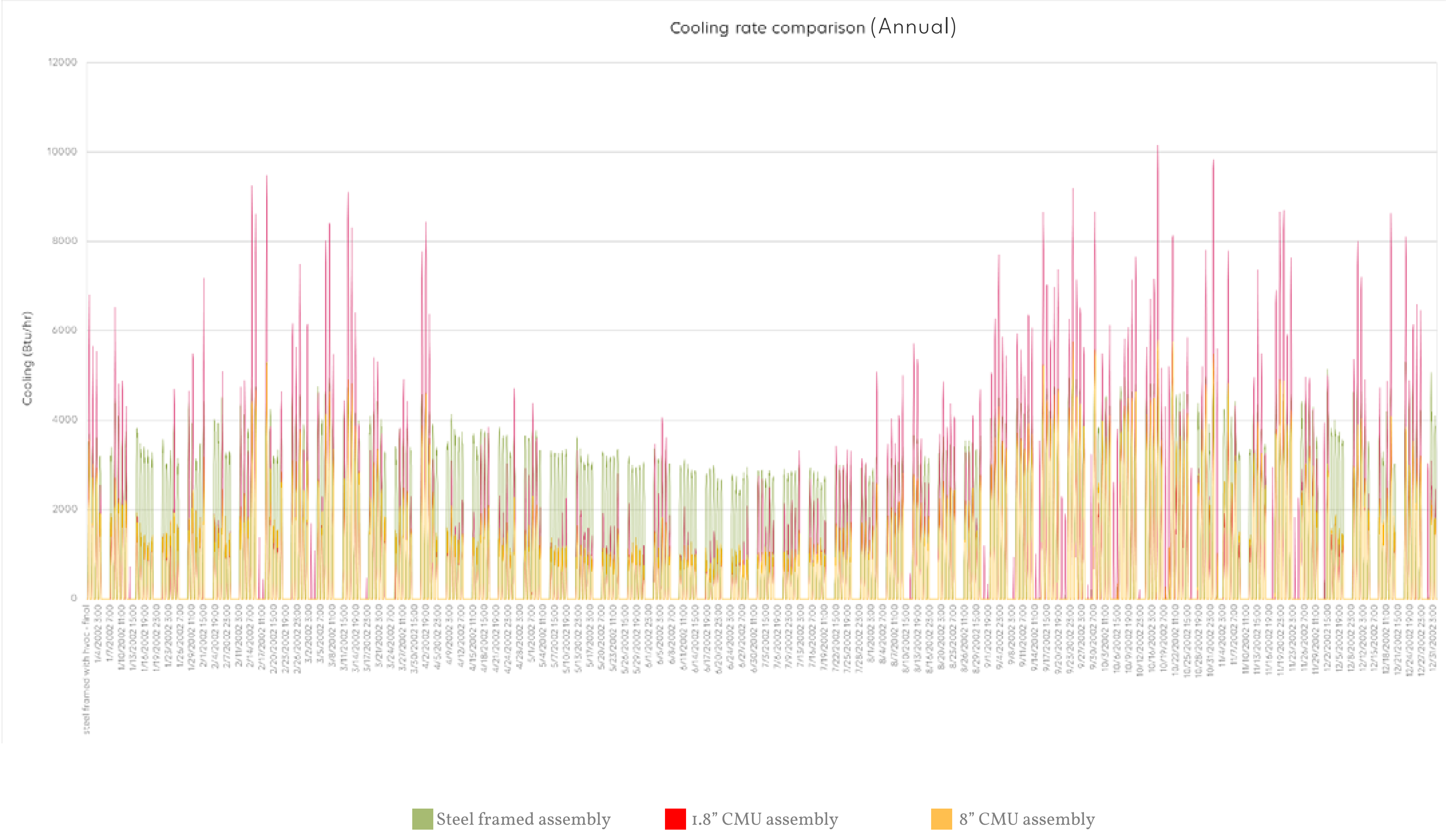
RESULTS



With HVAC off, the steel frame assembly reached the highest temperatures due to its insulation trapping heat inside. The insulation retained heat, causing the internal temperature to rise. The temperature profile closely correlated with solar radiation, with summer months seeing reduced solar transmission, which lowered temperatures, while winter's longer days and direct sunlight increased solar gain, raising internal temperatures.

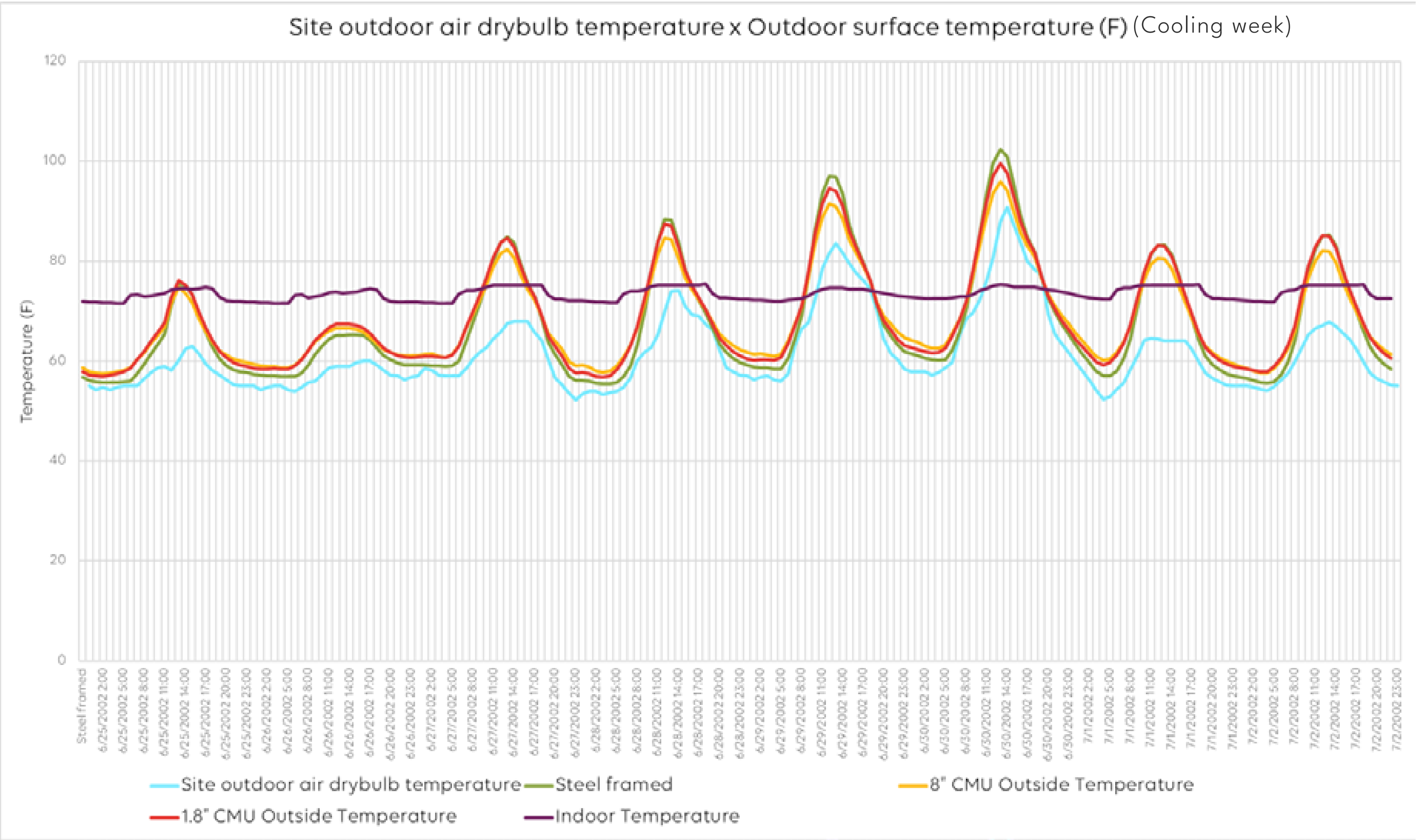
The 1.8" CMU showed the most variability in room temperature, closely following exterior temperatures due to its low R-value and heat capacity.

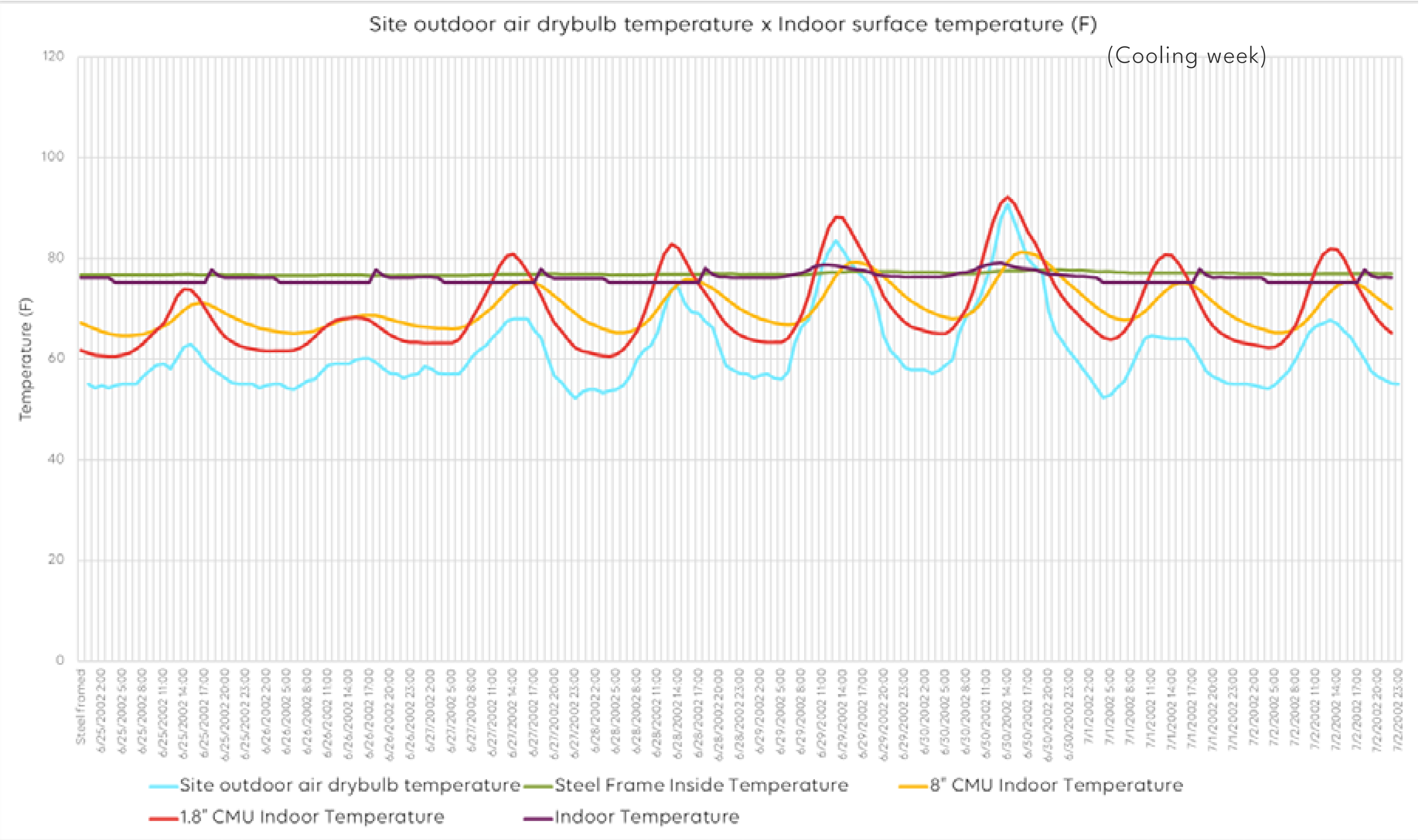
The 8" CMU exhibited a similar profile to the steel frame, but at lower temperatures, as it lacked the steel frame's insulative properties, allowing more heat transfer through the wall.



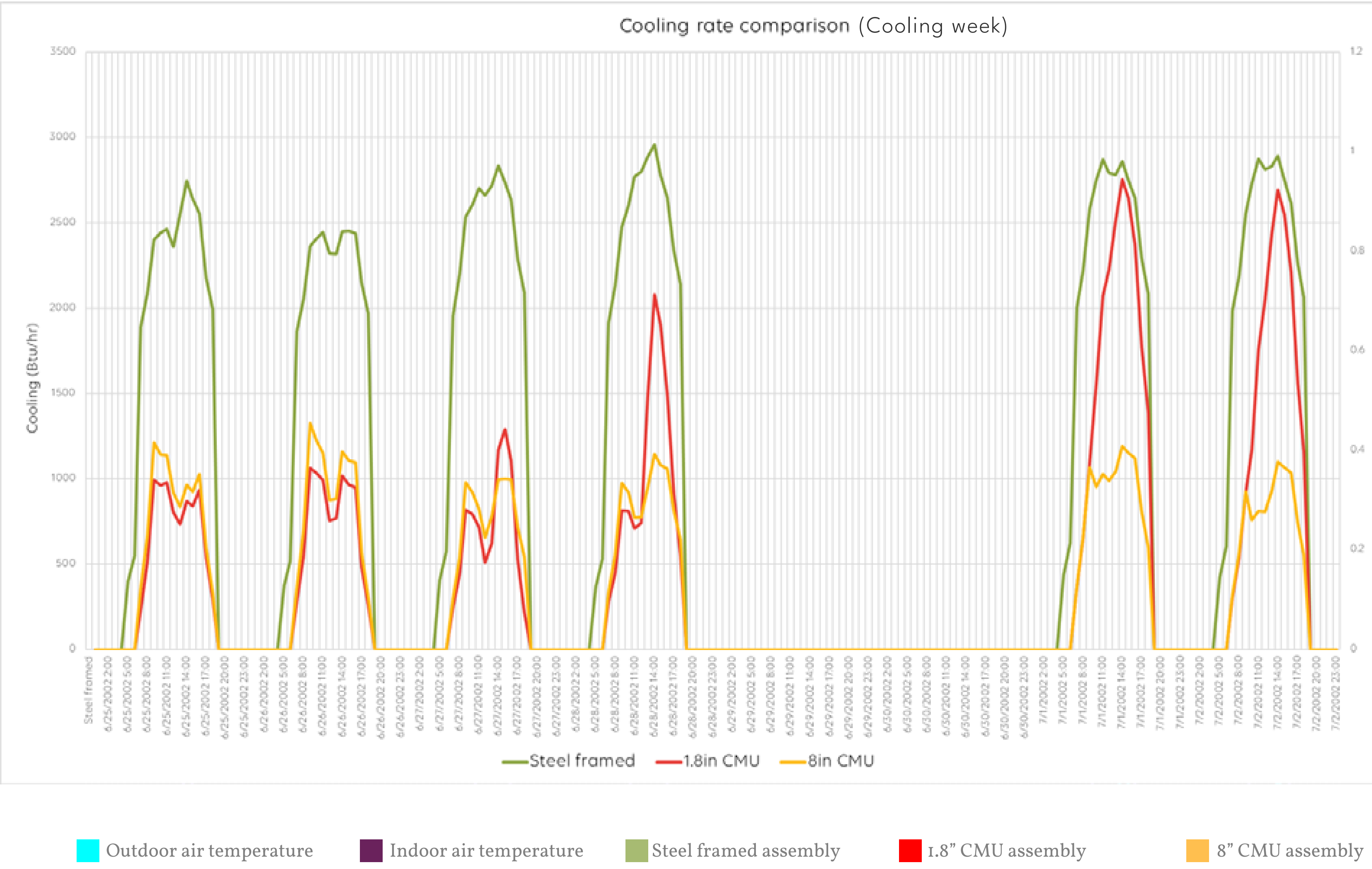
The 1.8" CMU (in red) shows the largest cooling load at certain times of the year, as it is highly responsive to exterior climate conditions. The increase in cooling load directly correlates with outdoor temperature and solar radiation.

In contrast, the steel frame (in green) assembly exhibits a more consistent cooling load throughout the year, occasionally surpassing the 1.8" CMU. The 8" CMU (in yellow) follows a similar pattern to the 1.8" CMU but to a lesser degree, with the lowest average cooling load annually among the three assemblies.





The outside surface temperature of each assembly mirrors the outdoor dry bulb temperature. However, the indoor temperature of the steel frame assembly (green) remains consistent with the indoor set point, as it lacks thermal capacity. The 1.8" CMU, while still reflecting the outdoor temperature, shows higher temperatures and more variability, indicating the influence of its thermal capacity. The 8" CMU demonstrates greater consistency and stays closer to the indoor set point, with a noticeable lag in temperature transmission. Comparing indoor and outdoor surface temperatures highlights the thermal storage capacity of the CMU assemblies, emphasizing their ability to store and release heat.

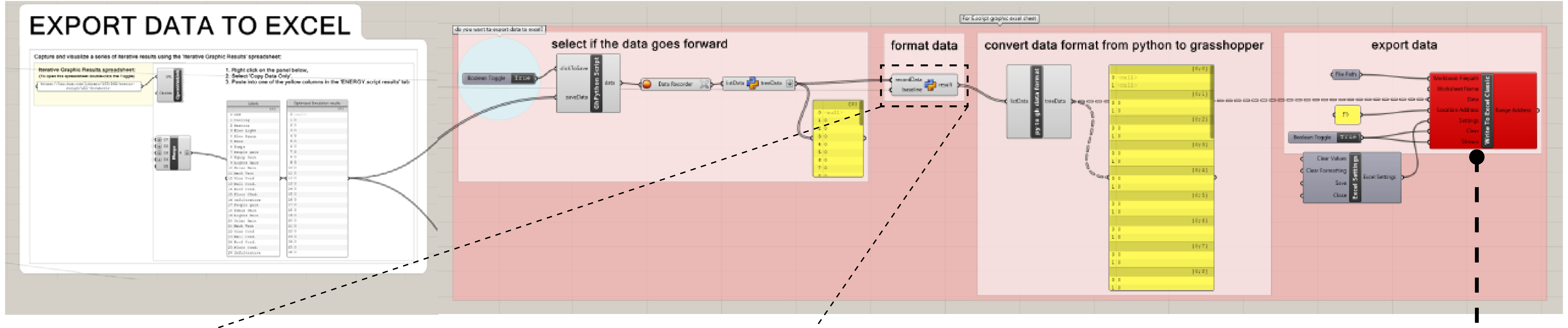


During a week in the summer, from June through July, the steel frame assembly experiences the greatest cooling load. The cooling system typically activates about 2 hours earlier than both the 8" CMU and the 1.8" CMU. As observed, the 1.8" CMU is the most variable, with its cooling load closely correlating to outdoor temperature and solar radiation. The cooling load for the 1.8" CMU increases above that of the 8" CMU during peak times when outdoor conditions intensify.

Thermal mass walls reduced peak cooling demand by up to 30%, while steel assemblies dissipated heat faster but resulted in up to 20% higher energy consumption.

The 8" CMU reduces cooling load by about 15% compared to the 1.8" CMU, which exhibits 25% more temperature variability and higher cooling demands.

Therefore, properly optimized thermal mass can lower overall energy consumption by 10-20%, enhancing building performance.




```
from ghpythonlib.componentbase import executingcomponent as component
import Grasshopper, GhPython
import System
import Rhino
import rhinoscriptsyntax as rs

class MyComponent(component):
    
    def RunScript(self, recordData, baseline):
        """Takes all the recorded data and creates a 2D list to separate it into lists for different runs.
            
            Inputs:
                x: The x script variable
                y: The y script variable
            Output:
                a: The a output variable"""
            
        __author__ = "glhetvis"
        __version__ = "2024.07.09"
            
        import rhinoscriptsyntax as rs
        #initialise the lists
        print(recordData)
        print(baseline)
        #print(labels)
        subData = []
        splitRuns = []
        result = []
        #splits the recorded data into run lists
        for i in range(0,len(recordData),27):
            #makes the sublist of 27 items
            subData = recordData[1:i+27]
            splitRuns.append(subData)
        print(splitRuns)
        print(len(splitRuns))
        
        
        
        for k in range(27):
            if len(splitRuns) == 5:
                format = [baseline[k], splitRuns[0][k], splitRuns[1][k], splitRuns[2][k], splitRuns[3][k], splitRuns[4][k]]
            elif len(splitRuns) == 4:
                format = [baseline[k], splitRuns[0][k], splitRuns[1][k], splitRuns[2][k], splitRuns[3][k]]
            elif len(splitRuns) == 3:
                format = [baseline[k], splitRuns[0][k], splitRuns[1][k], splitRuns[2][k]]
            elif len(splitRuns) == 2:
                format = [baseline[k], splitRuns[0][k], splitRuns[1][k]]
            elif len(splitRuns) == 1:
                format = [baseline[k], splitRuns[0][k]]
            result.append(format)
        print("result", result)
        print("--------------------")
        
        # return outputs if you have them; here I try it for you:
        return result
```

INSTRUCTIONS:

1 - After each simulation run, right click the results panel in the ENERGY. script, select 'Copy Data Only', Paste the data into one of the (yellow) columns. Label each iteration. -------------->

		Example Baseline [Replace with your project's data]	Example Optimized [Replace with your project's data]
GSF	GSF	120,000	120,000
Energy End Uses (kBtu)	Cooling	1,222,100	634,497
	Heating	2,753,300	107,076
	Electric Light	801,875	394,702
	Electric Equip	1,129,700	1,129,700
	Fans	198,289	116,348
	Pumps	126,775	99,058
Heat Gains	People Gain	511,297	509,483
	Equip Gain	582,557	580,078
	Lights Gain	429,255	184,812
	Solar Gain	1,000,942	315,782
	Mech Vent.	922,482	266,598
	Glaz. Cond.	146,879	183,591
	Wall Cond.	11,396	13,790
	Roof Cond.	21,243	13,151
	Floor Cond.	-	-
	Infiltration	116,812	41,404
Heat Losses	People Gain	-	-
	Equip Gain	-	-
	Lights Gain	-	-
	Solar Gain	-	-
	Mech Vent.	(1,002,081)	(103,849)
	Glaz. Cond.	(1,172,792)	(374,886)
	Wall Cond.	(120,229)	(120,762)
	Roof Cond.	(141,422)	(80,503)
	Floor Cond.	(52,289)	(47,872)
	Infiltration	(469,967)	(204,477)
	Annual Energy (kBtu/yr)	6,242,039	2,541,381
	Annual Energy (kWh/yr)	1,829,437	744,836
	EUI (kBtu/sf/yr)	52	21

2 - Select whether natural gas or electricity is used for space heating for each scenario (Refer to the Mechanical Systems you selected in ENERGY.script -----> **Natural Gas Heating** | **Electric Space Heating**

ANNUAL ENERGY COST

3 - Select the project State or City to determine utility costs

MINNESOTA				
		Natural Gas Energy Cost ($/yr)	$ 29,263.35	$ 3,860.01
Natural Gas rate ($/kWh)	$ 0.04	Electric Energy Cost ($/yr)	$ 125,405.89	$ 87,754.84
Electricity Rate ($/kWh)	$ 0.12	Total Energy Cost ($/yr)	**$ 154,669.24**	**$ 91,614.85**

OPERATIONAL CARBON EMISSIONS

4 - Select the project State to determine carbon emissions rates

MINNESOTA				
		Carbon Emissions - From Natural Gas (tCO2e/yr)	146.4	11.8
Natural gas emissions rate (tCO2e/MWh)	0.1808	Carbon Emissions - From Electric Grid (tCO2e/yr)	384.5	269.1
Electricity (grid) emissions Rate (tCO2e/MWh)	0.3771	Total Carbon Emissions (tCO2e/yr)	**530.9**	**280.9**

03

Energy script optimization

Automating Data Export for Faster Design Optimization

2024 | Sustainability Intern at HGA | Individual work | Mentor: Elizabeth LeRiche

This project focused on transforming the workflow of an in-house energy simulation script developed at HGA, designed to help architects evaluate and optimize energy efficiency in their designs. While the script offered valuable insights, its adoption was limited due to significant inefficiencies and perceived challenges, such as a steep learning curve, additional workload, and time constraints. A key bottleneck in the process was the manual transfer of simulation results to an Excel file for visualization, which added complexity and discouraged widespread use. To address this, a custom Grasshopper component was developed to automate the export of simulation data directly to a pre-configured Excel sheet. This innovation eliminated the need for manual data entry, enabling results to flow seamlessly into the visualization framework with every simulation run. The automation not only saved time but also simplified the overall workflow, making the tool more user-friendly and accessible to architects across the organization. The impacts of this optimization were significant. It reduced time spent on repetitive tasks, allowing users to focus on creative problem-solving and design improvements. By streamlining the process, the tool became more intuitive, increasing adoption rates and supporting quicker, more comprehensive energy analyses. The automated integration also enhanced collaboration, as visualized results could be easily shared among project teams, fostering better communication around energy performance. By the end of the internship, the development was completed, and the component was in the user testing phase, marking a pivotal step toward empowering architects with efficient and effective energy modeling tools. This project was done under the mentorship of Elizabeth LeRiche, Building performance specialist at HGA.

Decisions made during the design process hold the greatest potential for responsibility and climate sensitivity. By recognizing and seizing these opportunities, designers and clients can ensure that their solutions are strategic and environmentally conscious.

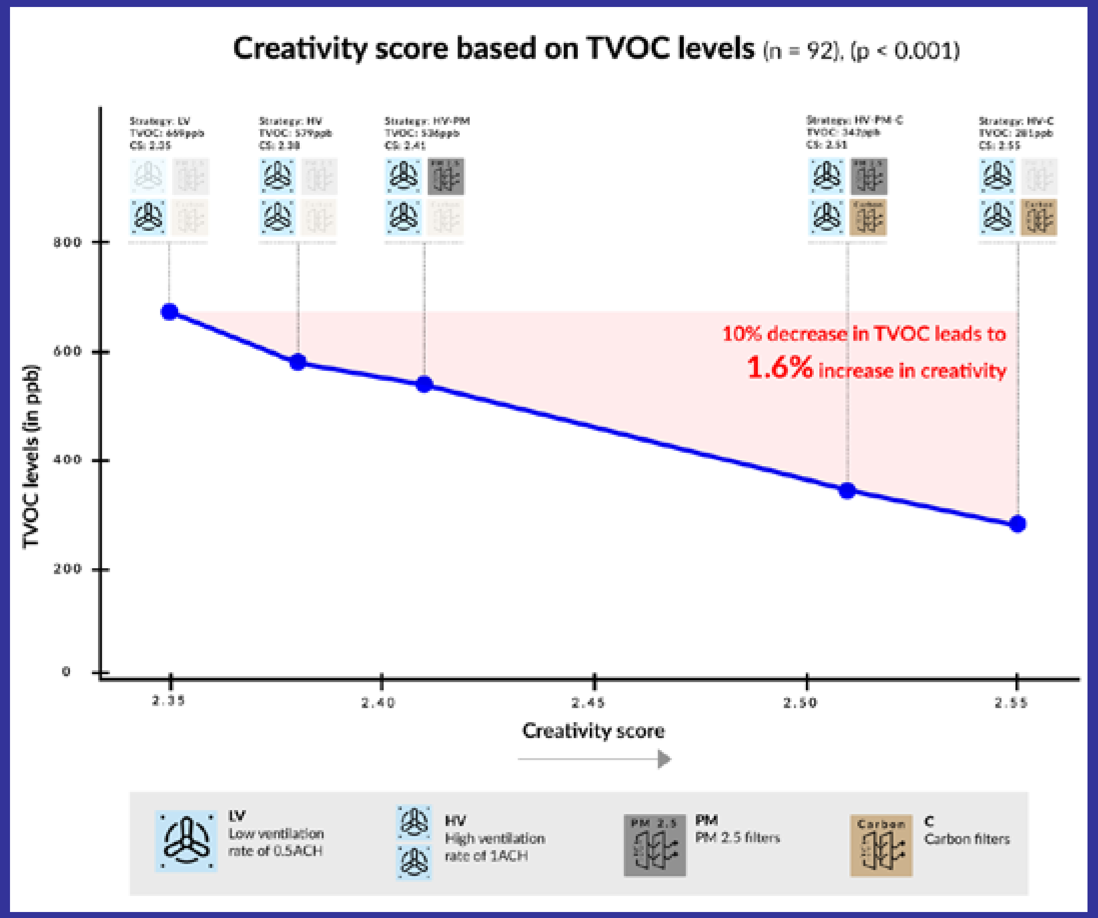
strategic decision making

Increased ventilation rate + carbon filters = Individual creativity

Arikrishnan et al.,v 2023

In a 2023 single blind lab experiment in Nanyang Technological University, Singapore, Arikrishnan et al. identified a 10% decrease in TVOC levels due to the use of increased ventilation rate (1 ACH) combined with carbon filters is associated with 1.6% increase in individual creativity as compared to low ventilation rate(0.5 ACH). ($p<0.001$) (n = 92 students, t = 1 day x 7 weeks)

First cost increase:	\$3306 / employee[2]	(Cost of system upgrades as compared to baseline + maintenance for 15 yr period)
Annual creativity benefits:	\$13422 / employee[3,4]	(3.75% increase in revenue due to idea generation + efficiency in creativity related tasks)
ROI:	**405%**	



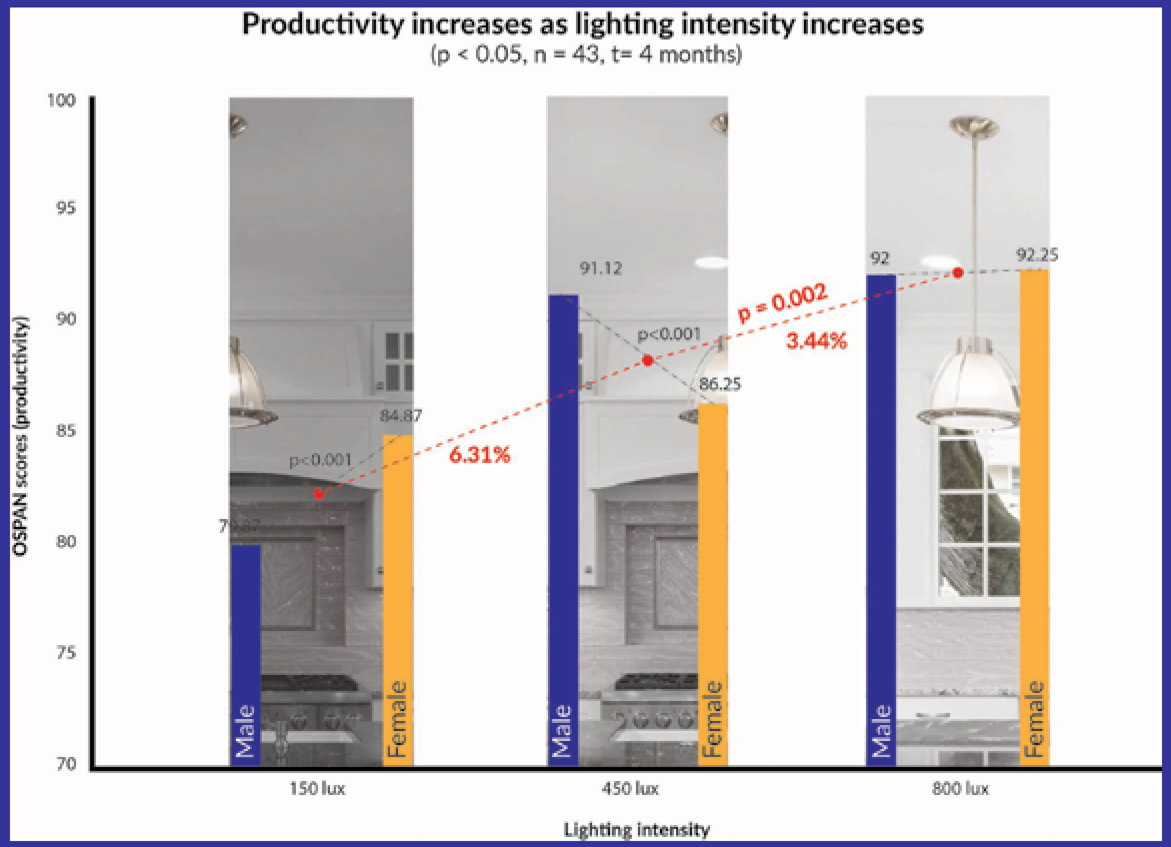
1. Arikrishnan, S., Roberts, A. C., Lau, W. S., Wan, M. P., & Ng, B. F. (2023). Experimental study on the impact of indoor air quality on creativity by Serious Brick Play method. *Scientific Reports (Nature Publisher Group)*, *13*(1), 15488. https://doi.org/10.1038/s41598-023-42355-z
2. Djukanovic, R., Wargocki, P., & Fanger, P. (2002). Cost-benefit analysis of improved air quality in an office building. *Proceedings of Indoor Air 2002*.
3. Bernoff, D. M., Paul Brook, and Josh. (2017, December 28). *Are Innovative Companies More Profitable?* MIT Sloan Management Review. https://sloanreview.mit.edu/article/are-innovative-companies-more-profitable/
4. Pagani, M., & Champion, R. (Eds.). (2023). *Artificial Intelligence for Business Creativity*. Routledge. https://doi.org/10.4324/9781003287582

Case for investing in increased ventilation rate and carbon filters. It can result in a ROI of 405% by increasing individual creativity by 1.6%.

Increased lighting intensity (800 lux) = Increased employee productivity

Kim et al., 2022

•In a 2022 lab experiment study at Arizona State University (ASU), Kim et al. identified that increased lighting levels of 800 lux are associated with a 3.44% increase in individual productivity as compared to 450 lux. Productivity reached the maximum at 800lux for both males and females. ($p < 0.05$, n = 43, t = 4 months)



First cost increase:	\$47.20 / employee	Number of bulbs per space (\$0.236/sq.ft)
Annual productivity savings:	\$1548 / employee	(Salary \$45,000 x 3.44% productivity)
ROI:	**32.79%**	

[1] Kim, T., Lim, S., Yoon, S.-G., & Yeom, D. (Jason). (2022). Pupil size and gender-driven occupant's productivity predictive model for diverse indoor lighting conditions in the office environment. Building and Environment, 226, 109673. https://doi.org/10.1016/j.buildenv.2022.109673

Case for investing in increased lighting intensity of 800 lux. It can result in a ROI of 32.79% by increasing employee productivity by 3.44% in office environments.

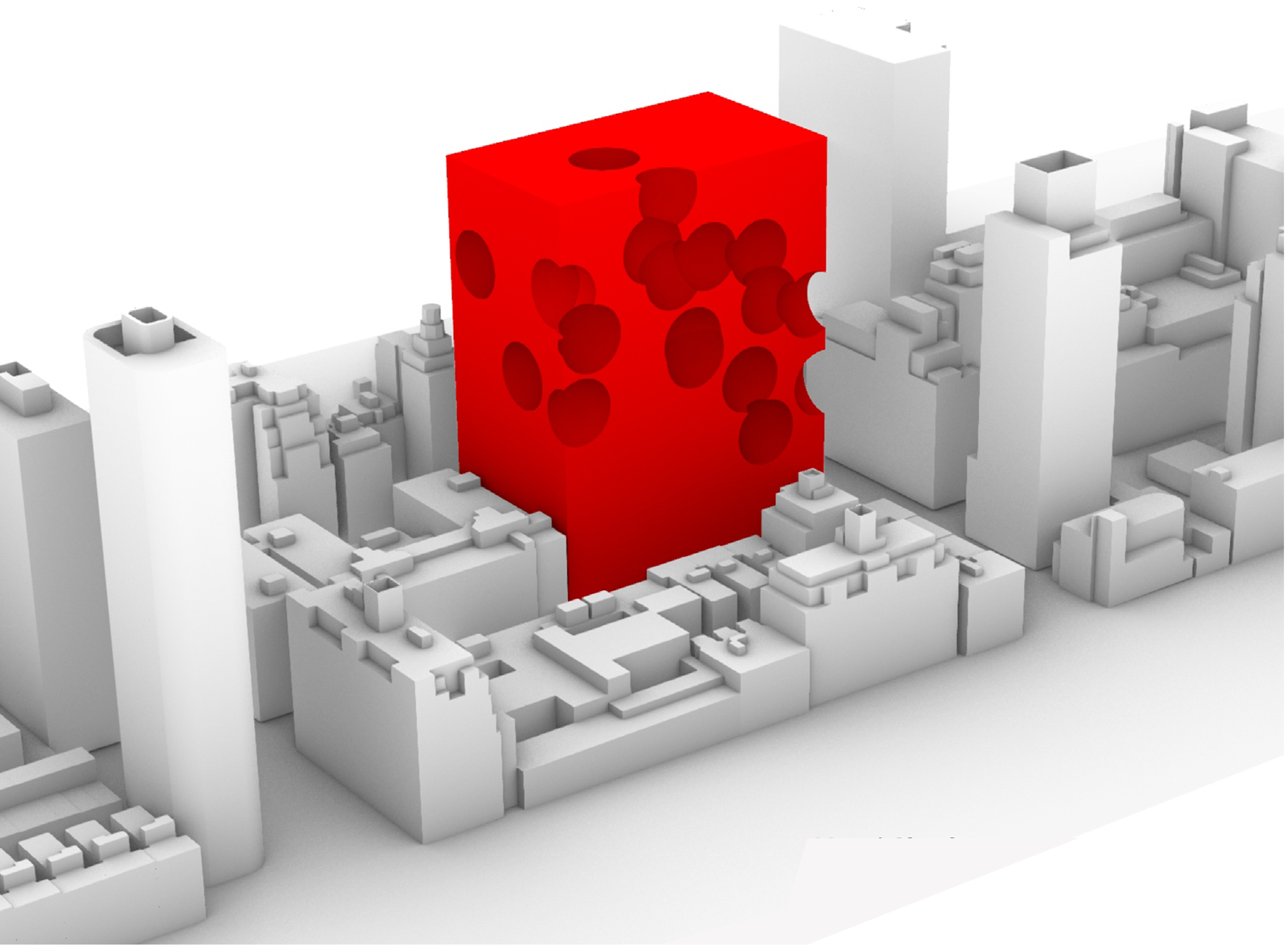
04

Building Investment Decision Support Tool

2024 | Sustainability, Health and Productivity | Individual work | Mentor: Vivian Loftness

This project explores the impact of indoor environmental quality (IEQ) factors—ventilation, thermal comfort, and lighting—on human performance metrics such as creativity, learning performance, and productivity. The research draws on multiple studies to provide actionable insights for optimizing built environments to enhance human outcomes. These findings underscore the critical relationship between environmental design parameters and individual performance. This project aims to advocate for targeted IEQ interventions, providing a framework for designers, policymakers, and facility managers to create optimized environments that enhance well-being and efficiency in educational, workplace, and other built settings.

Link to the complete report



05

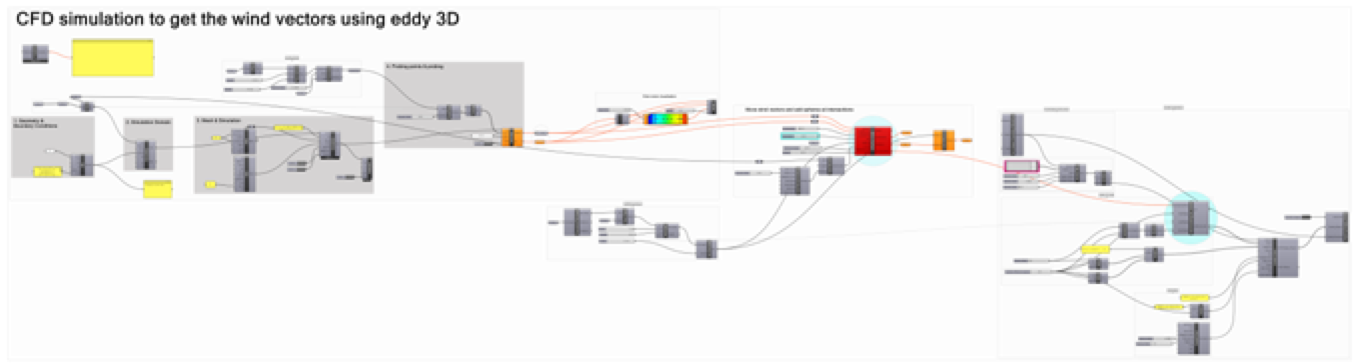
Wind Simulation for Performance-Driven Architectural Design

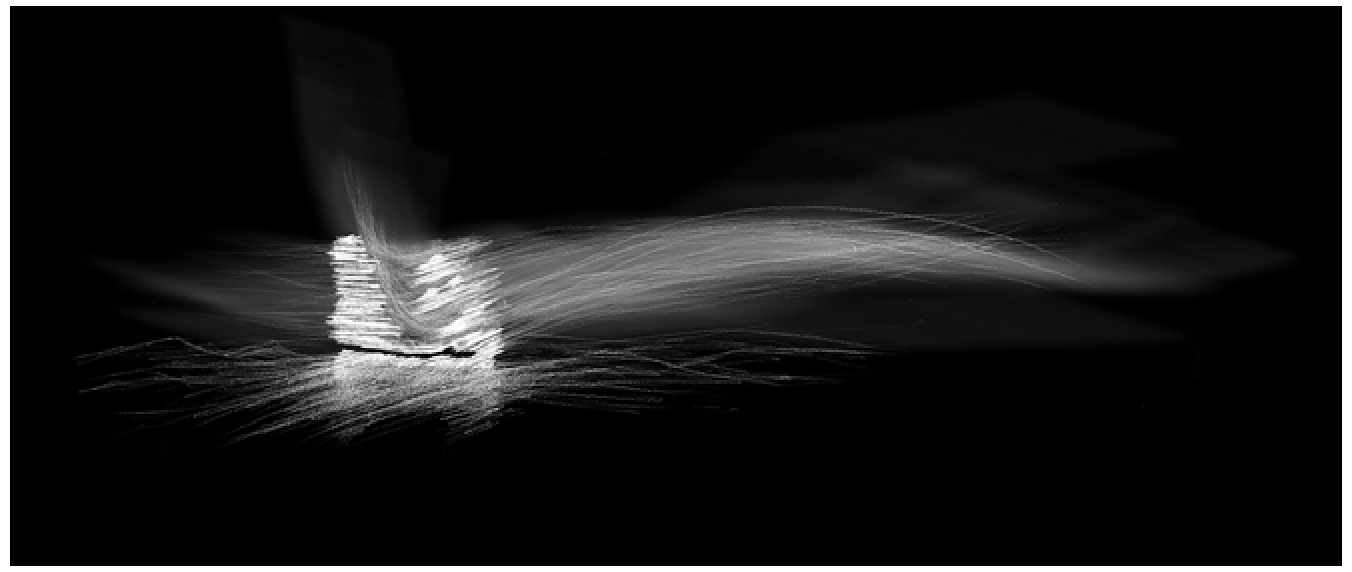
Optimizing Building Form through Wind Collision Data

2024 | Scripting and parametric design
| Individual work | Mentor: Jimmy Wei-Chun Cheng

Wind simulation has emerged as a critical tool in performance-driven architectural design, allowing for the precise analysis of wind behavior and its impact on buildings. By understanding how wind interacts with a structure, architects can develop strategies to optimize comfort, energy efficiency, and resilience while also addressing sustainability goals. The study is grounded in the principle that wind is both a challenge and an opportunity in building design. High wind impact areas may compromise structural integrity, occupant comfort, and material durability, while low wind zones offer opportunities for passive cooling and energy efficiency. By addressing these dynamics, architects can create adaptive, high-performance buildings that respond to environmental conditions.

This project focuses on generating collision distribution data from wind simulations that could inform architectural decisions like enhancing façade design, structural stability, passive heating and cooling, and integrating sustainable systems like wind energy harnessing.

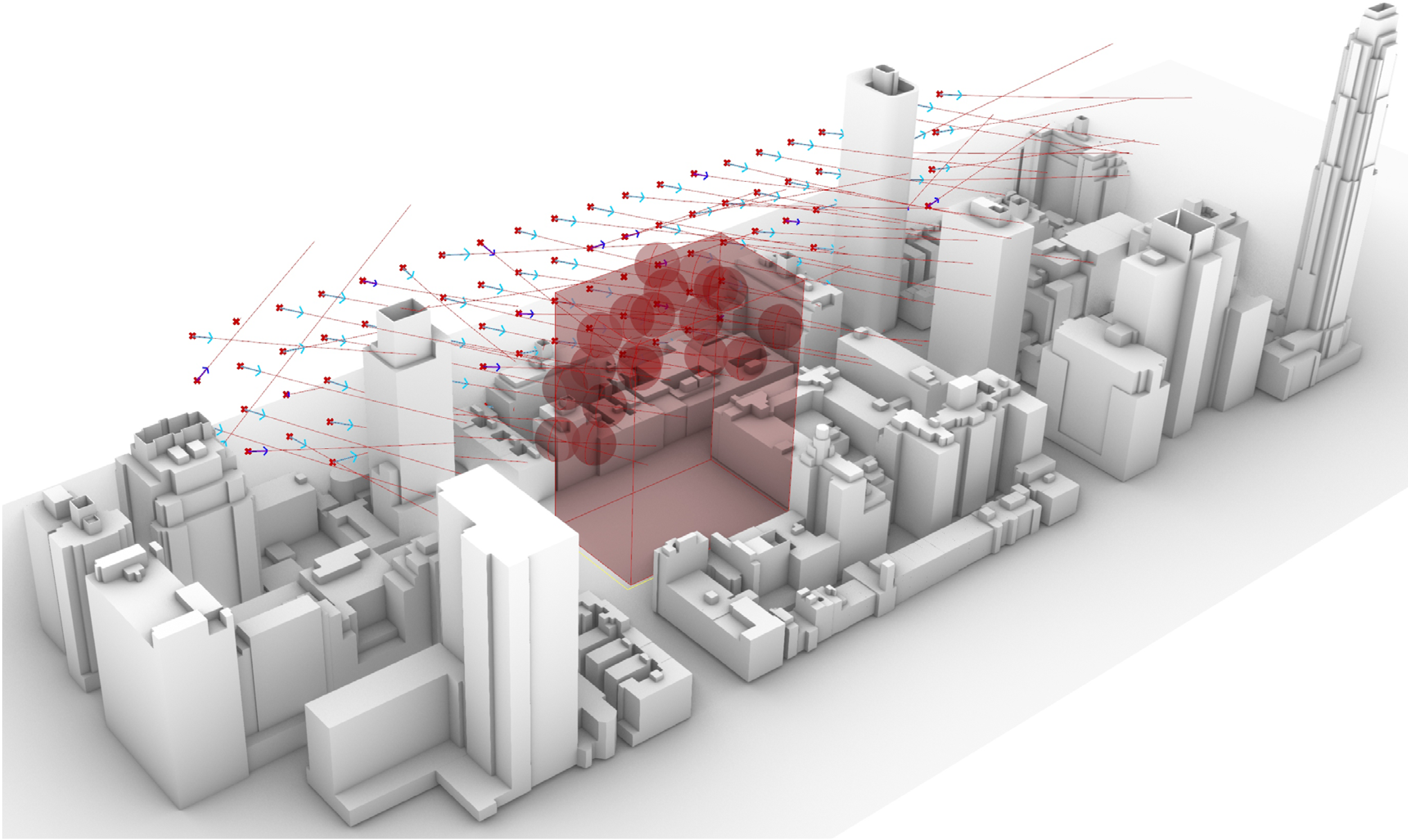




Hatching by Fernando Menis

Pseudo-code:

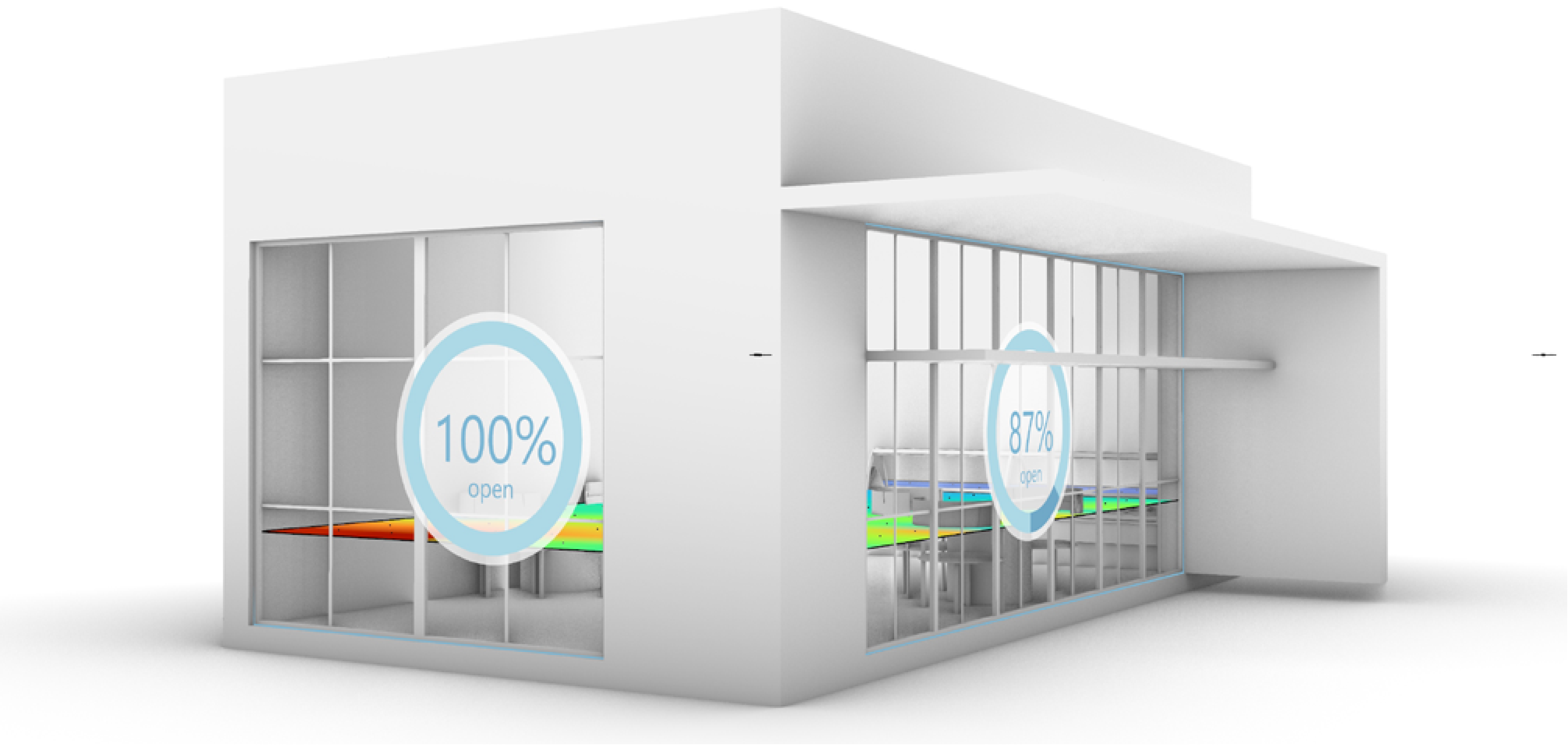
1. Use Eddy 3D to generate wind vectors.
2. Set parameters (e.g., wind vectors, site geometry) and initialize lists (boids, collisions, curves).
3. Create boids with speed, coordinates, and acceleration, and track their movement.
4. Check if a boid's path intersects with site geometry and adjust the path if a collision occurs.
5. Detect intersections between boid paths and geometry, and add spheres at collision points.
6. For each wind vector, create corresponding boid instances.
7. Update boid movement, check for collisions, join movement curves, and check for final intersections.
8. Categorize and count collision points by height.
9. Output collision count per floor using Conduit.



Link to simulation video

Balancing the pursuit of energy efficiency with the importance of human aspects lile visual comfort, health, productivity, moods and so on. Designing with humans at the center ensuring energy efficiency is achieved without compromising on overall human well-being.

human-centered design



06

Beyond Metrics

Unveiling the Essence of Space Quality

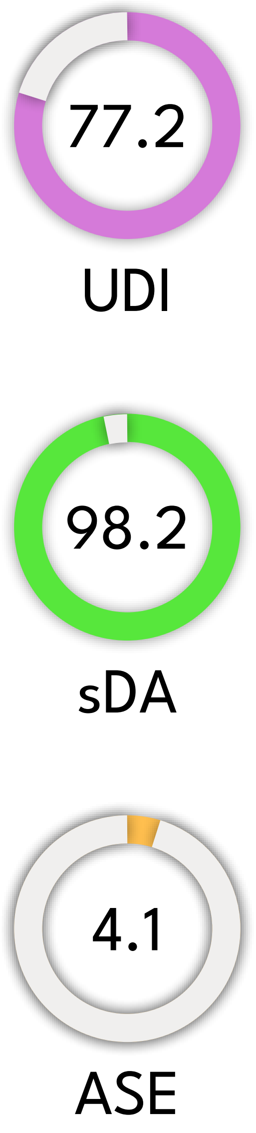
2024 | Shaping Daylight through Simulation and Virtual Reality | Individual work | Mentor: Azadeh Sawyer

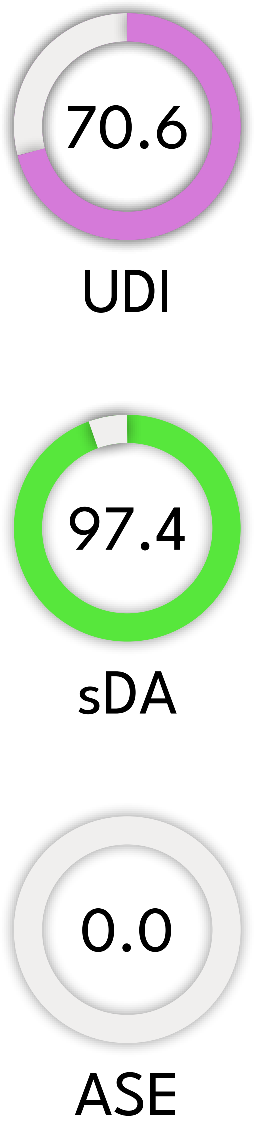
This project delves into the critical inquiry: "Does meeting daylighting metrics suffice to ensure a quality space?" It juxtaposes two spaces with identical daylighting levels or optimal daylighting metrics, yet one space exudes an inviting atmosphere while the other lacks appeal. This demonstration underscores the multifaceted nature of crafting a desirable space beyond mere daylighting metrics.

Employing a diverse toolkit, including simulations via Climate Studio to fine-tune daylighting metrics and leveraging virtual reality with Enscape to validate the hypothesis, the project navigates the intricate interplay of factors shaping space quality. By scrutinizing various elements, it illuminates the nuanced dynamics contributing to the overall ambiance and user experience within a space.


How much daylight do you think this space gets?
How does this image make you feel?


and this?

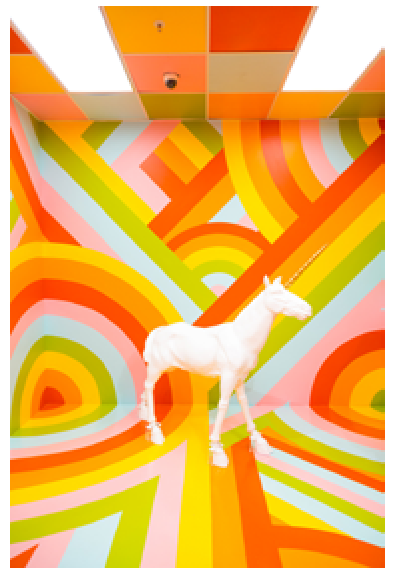
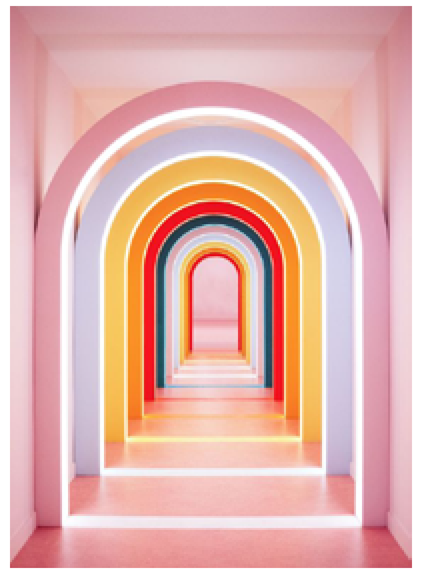
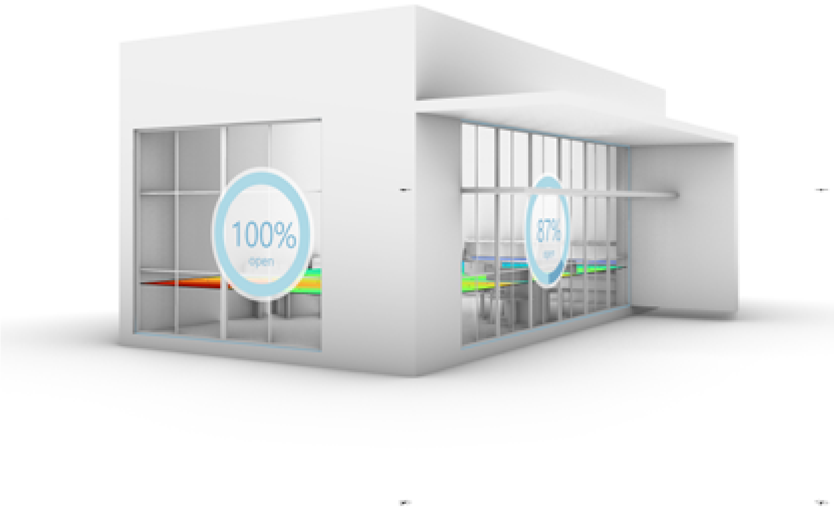

77.2
UDI
98.2
sDA
4.1
ASE

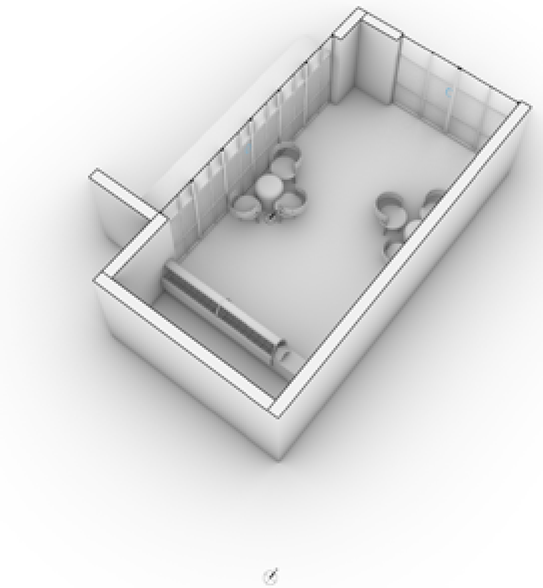
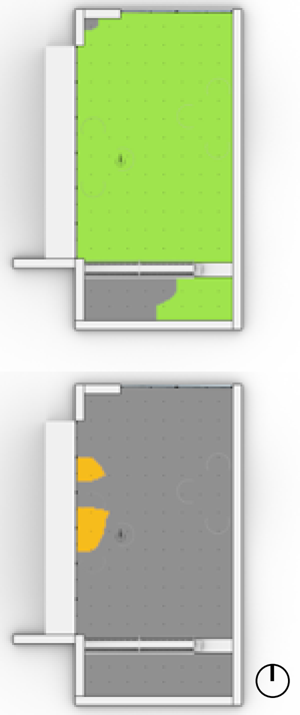

70.6
UDI
97.4
sDA
0.0
ASE

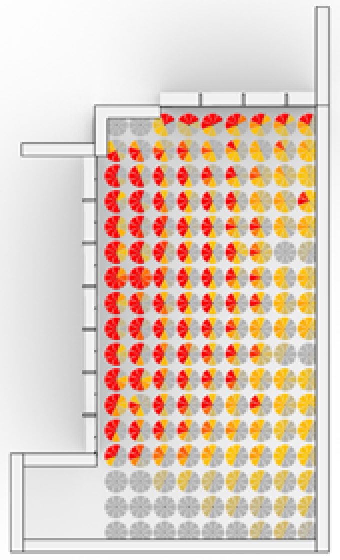
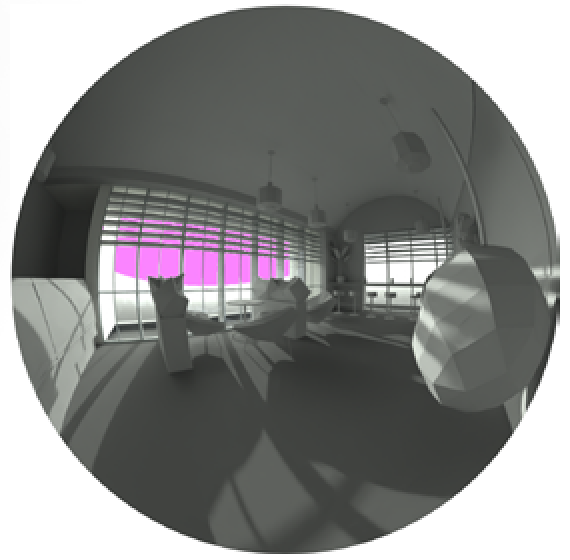
methodology

2 adjective words selected → created spaces to depict programs with those words → made the daylight levels within the spaces similar → made the spaces to describe the adjective in enscape and tested in VR → Glare analysis

joyful

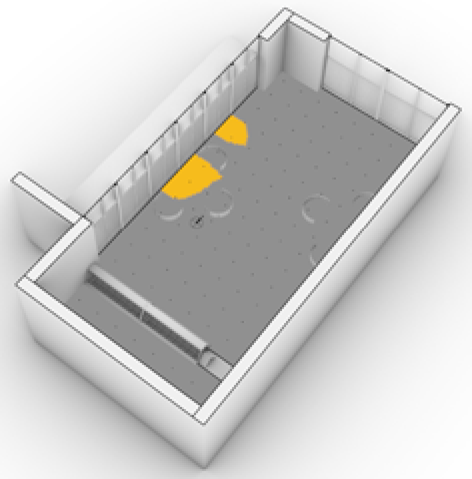
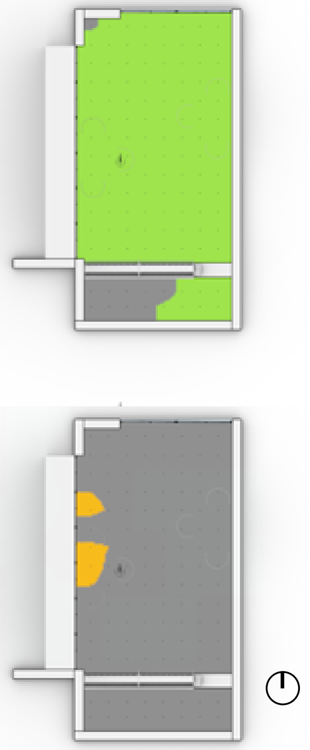




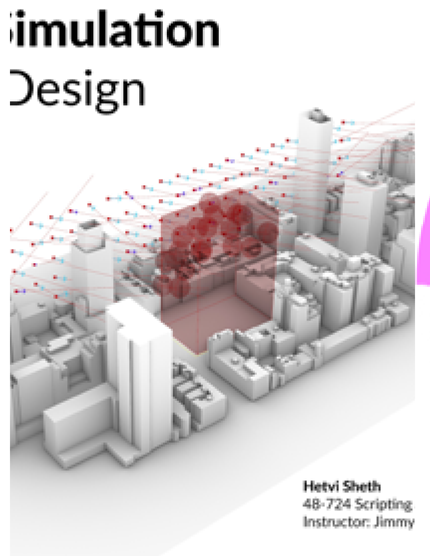



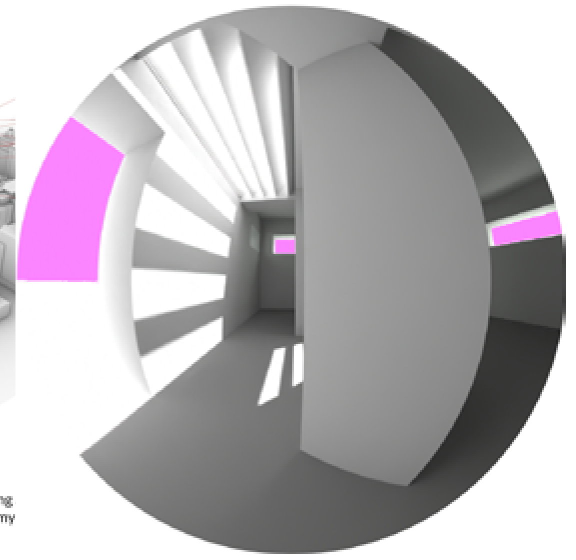



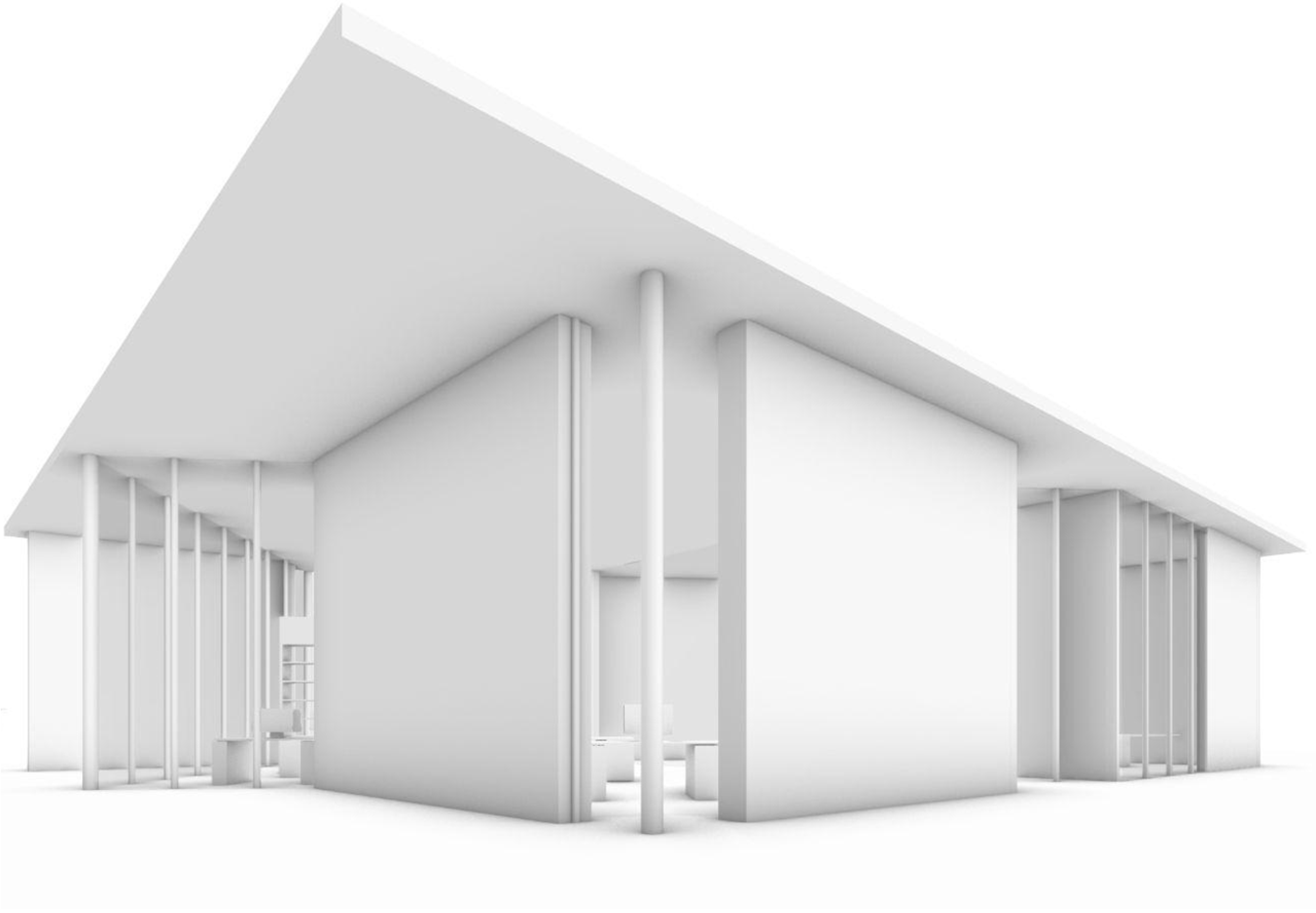
gloomy









07

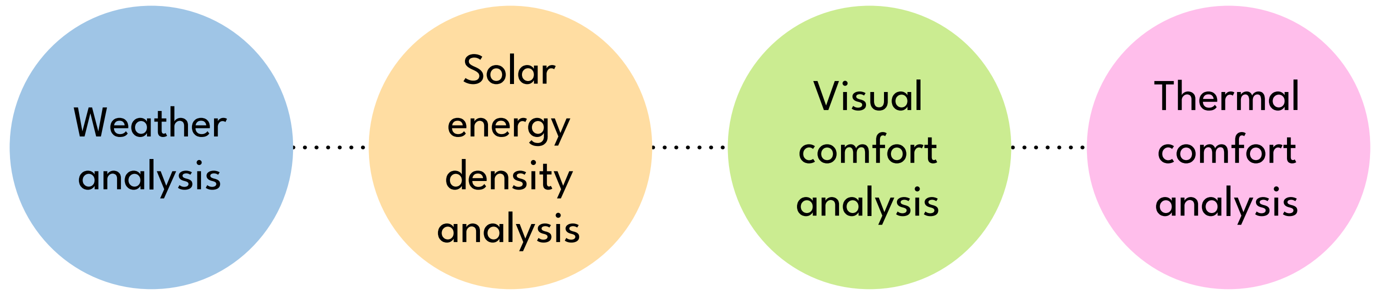
Designing for comfort and energy efficiency

commercial office building design

2023 | Environmental Performance Simulation | Group work | Mentor: Tian Li

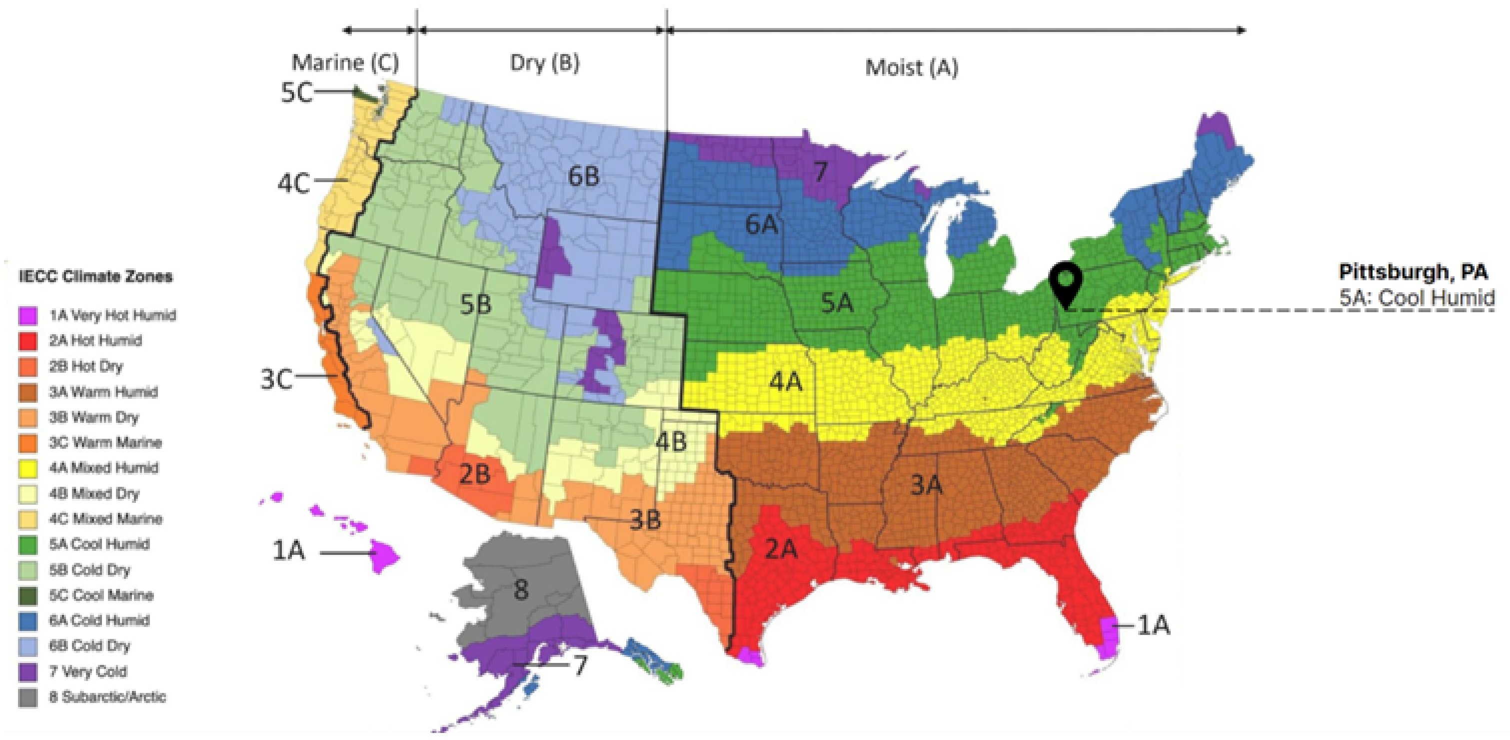
In our 2023 Environmental Performance Simulation project, guided by Mentor Tian Li, we designed a commercial mid-size office building in Pittsburgh. The process involved climate-driven considerations, optimizing orientation, landscaping, and massing for user comfort. Iterative analyses focused on solar metrics, spatial daylight autonomy, lux levels, glare, and LEED credits. Notably, the design achieved a 66% reduction in Energy Use Intensity (EUI), attaining 45.95 kWh/m²/year compared to the baseline of 283.91 kWh/m²/year, meeting AIA 2030 challenge criteria

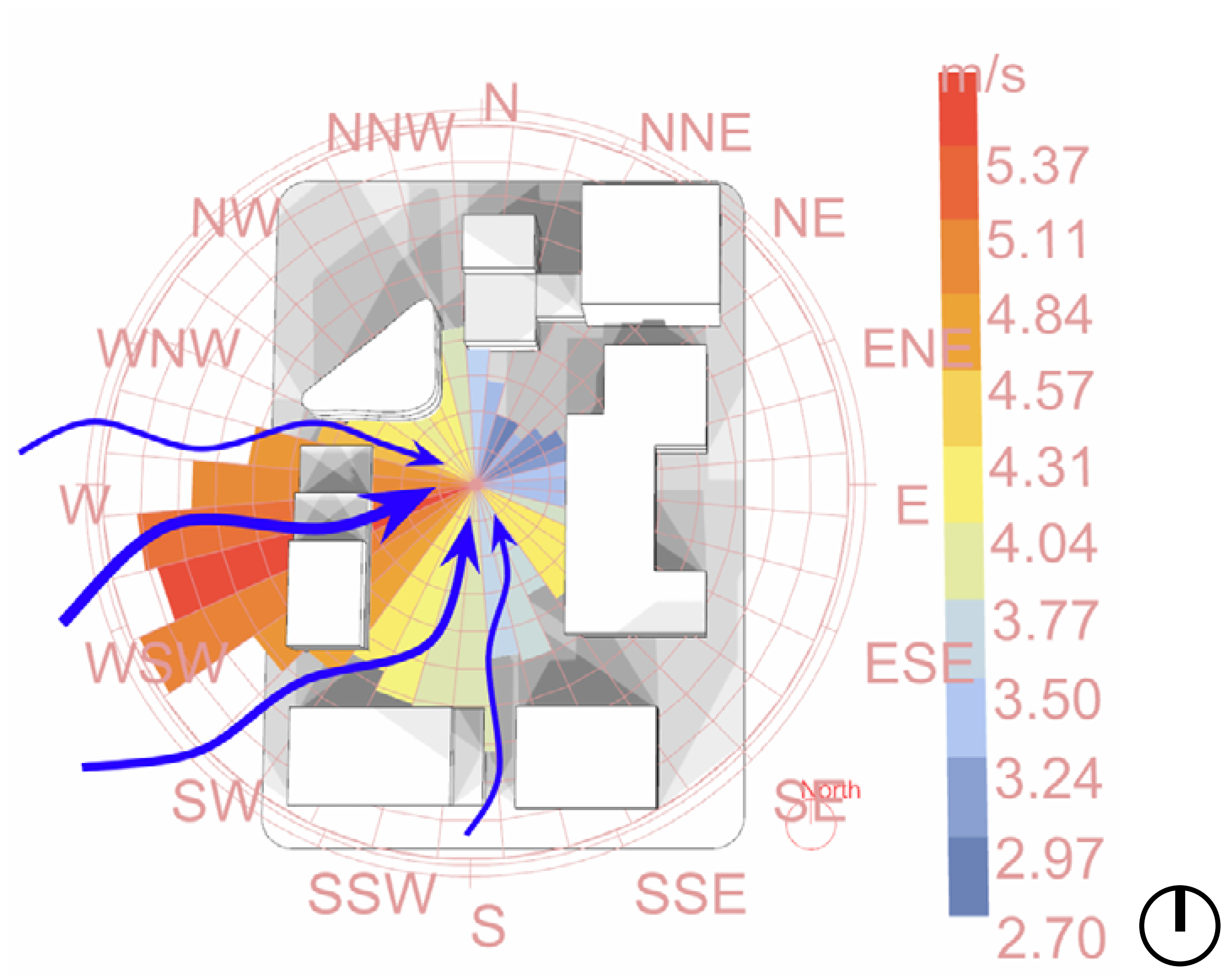
Early design form analysis methodology



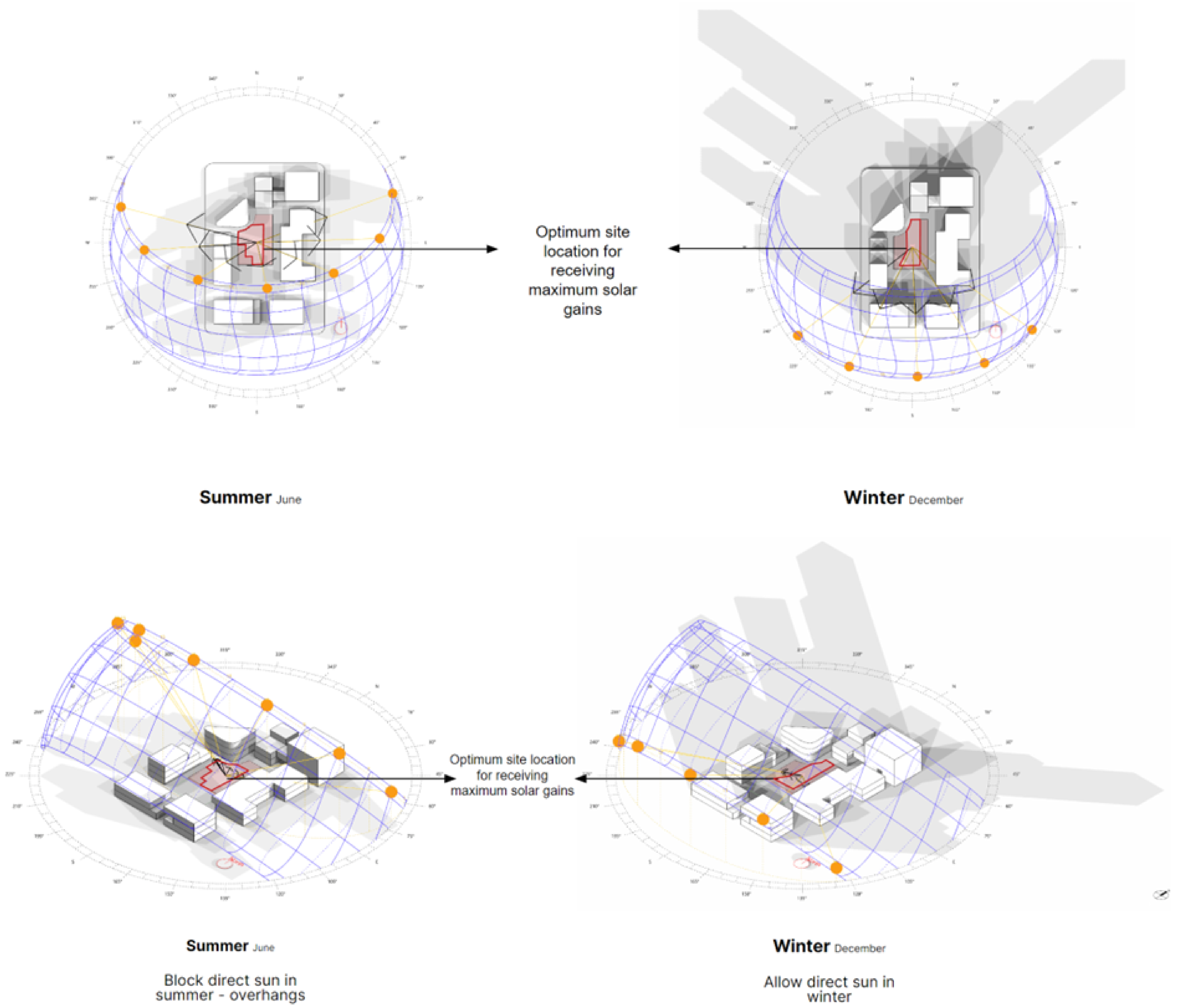
Weather data analysis

The primary objective was to design a commercial mid-size office building that seamlessly integrates with the environmental conditions, focusing on aspects such as orientation, landscaping, and massing.





site analysis



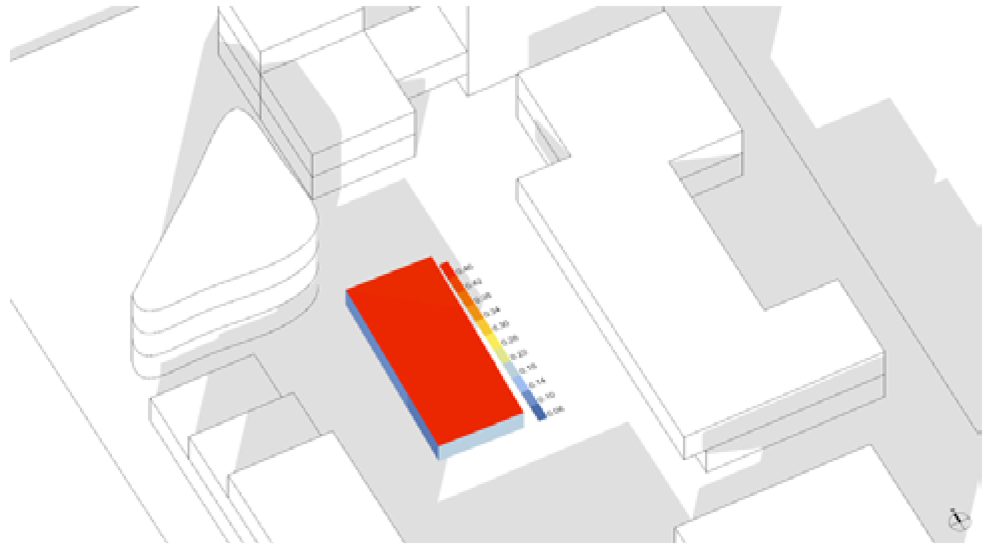
optimal locations for situating the building based on the sunpath diagram and shadow patterns

HETVI SHETH | PORTFOLIO 2025

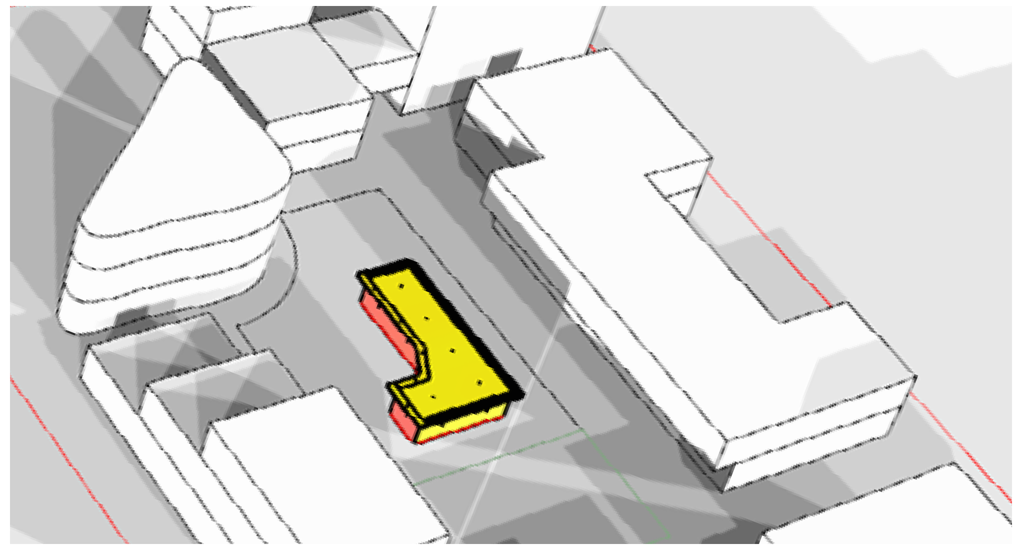
Solar energy density analysis

The project evolved through successive stages, beginning with early design elements and progressing towards user comfort considerations, encompassing both thermal and visual aspects. Climate analysis played a pivotal role in shaping the building's form, taking into account factors such as solar energy density, direct sun hours, and solar radiation on each facade.

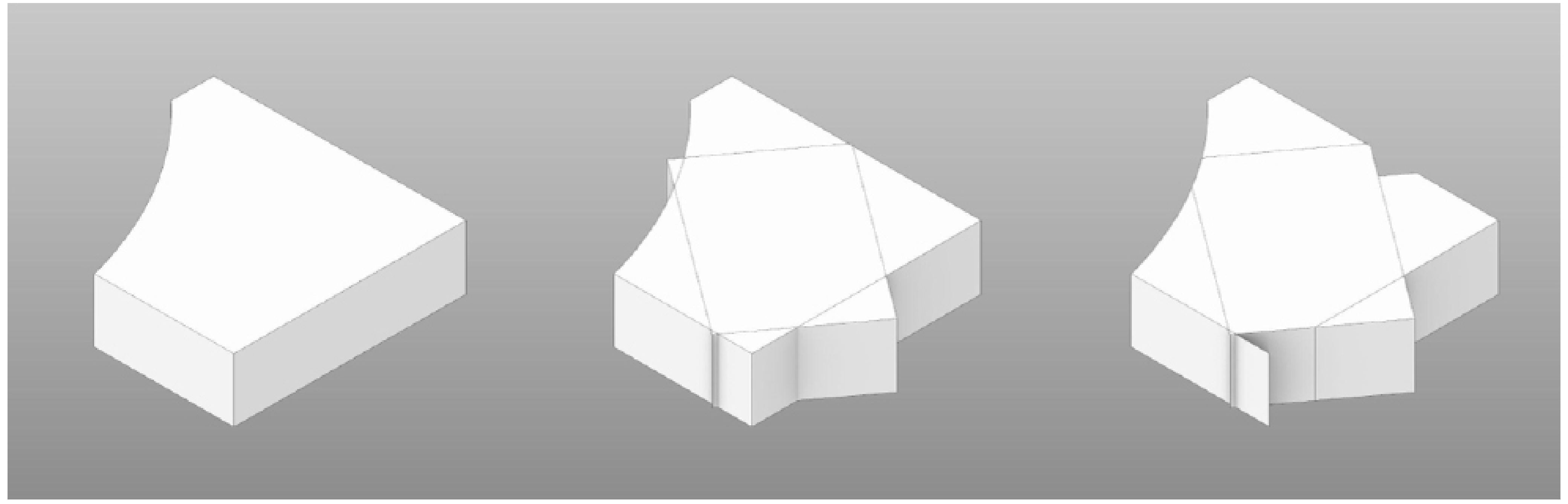
Iteration 1

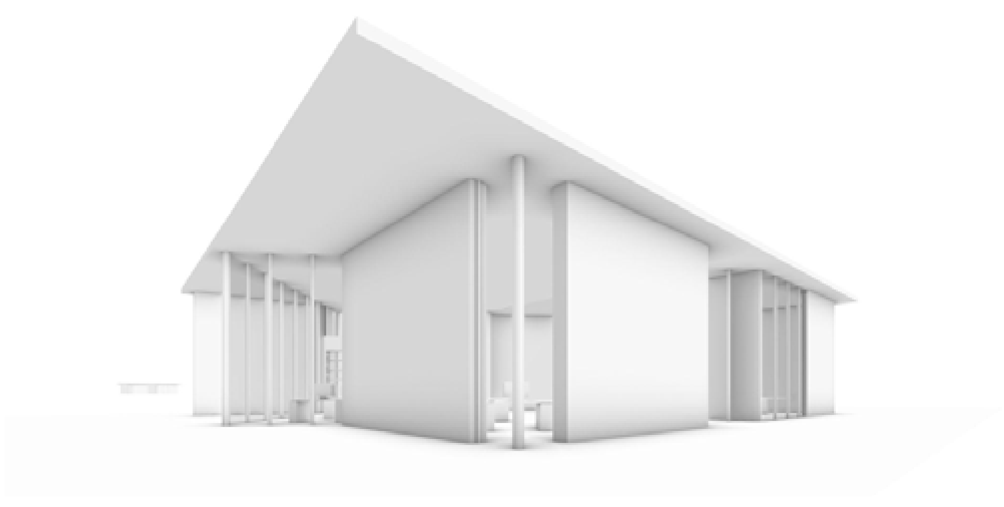


Iteration 2

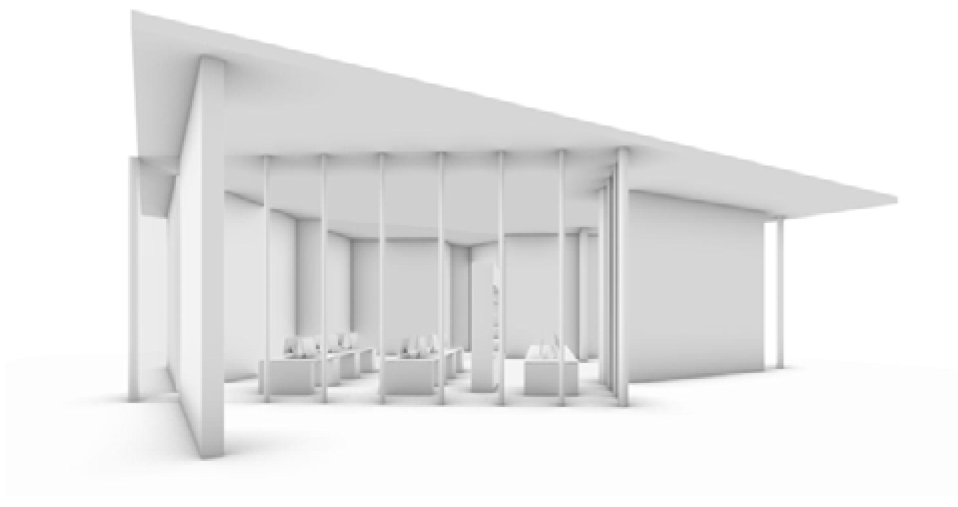


Iteration 3

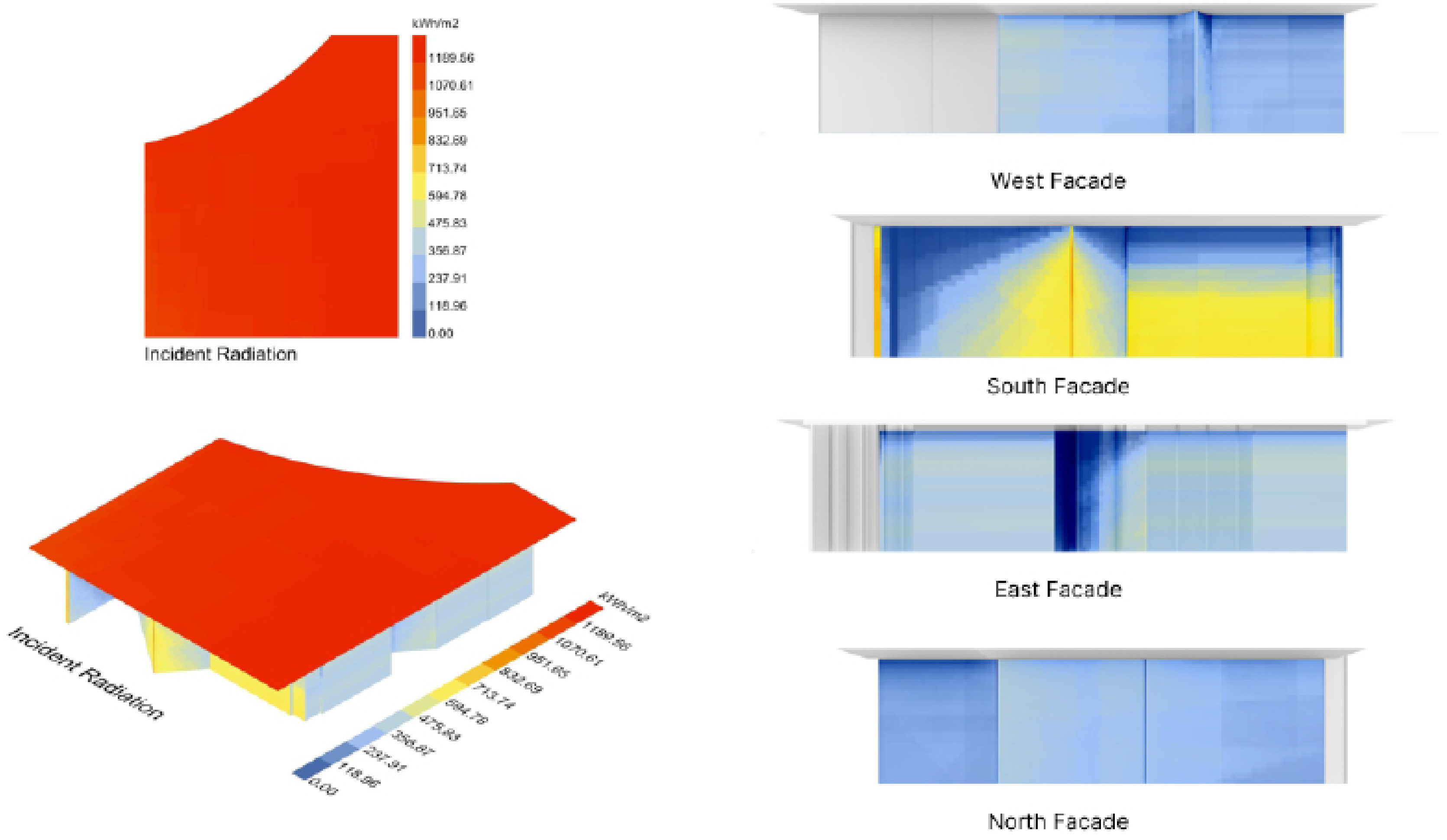




view from south-east corner of the building



view from the south-west corner of the building

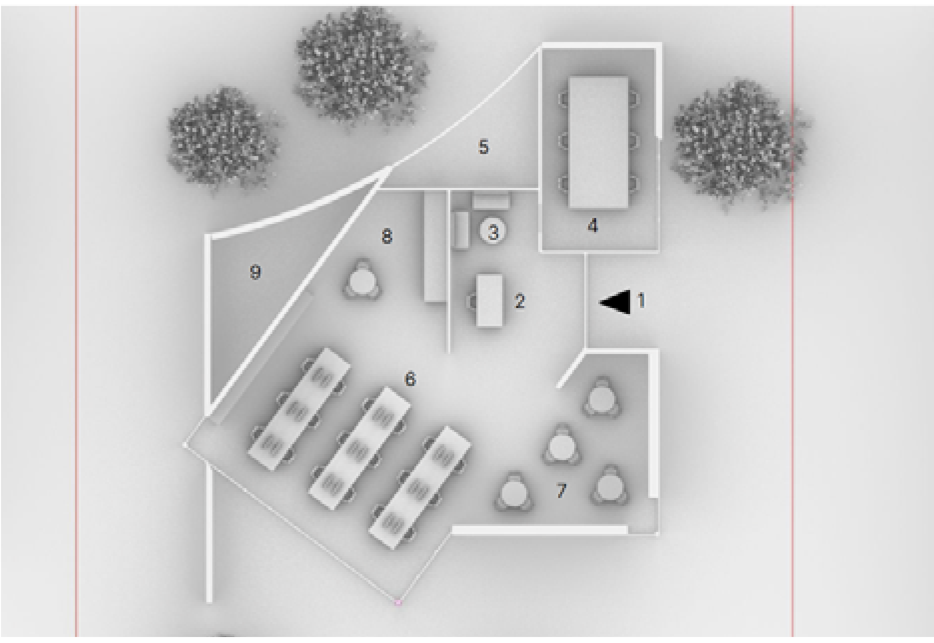


Metric	Iteration 1	Iteration 2	Iteration 3
Solar Energy Density (SED)	Roof 445 North facade 131 South facade 265 West facade 305 East facade 251	Roof 201 North facade 527 South facade 1085 West facade 944 East facade 785	Roof 619 North facade 186 South facade 149 West facade 162 East facade 140
Direct Sunlight Percentage	63% of the surface	68.86% of the surface	54% of the surface
Heat Above 300 kWH	453,878 sq. ft.	36,948.13 Sq. Ft.	6484.95 sq. ft.

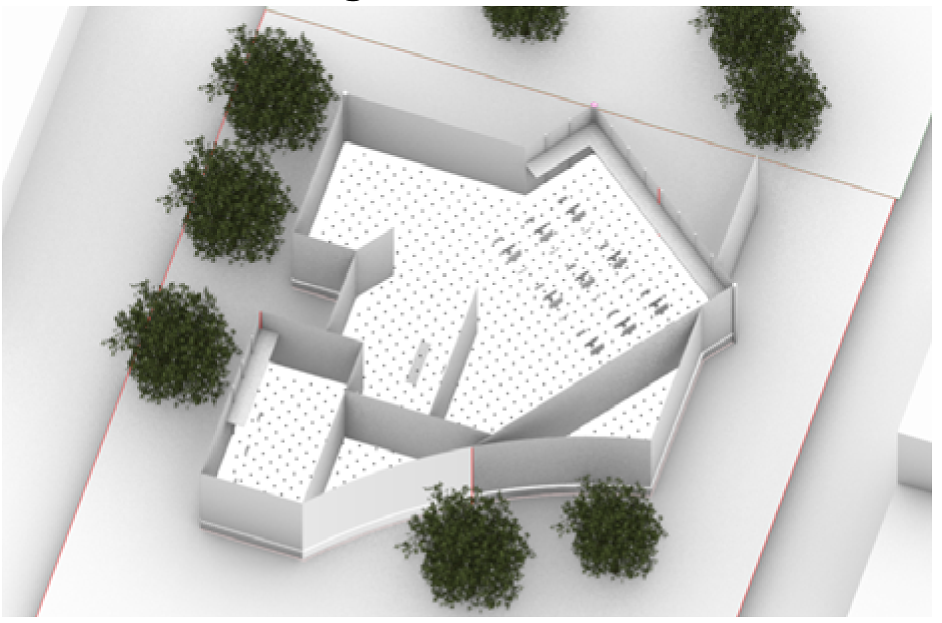
Visual comfort analysis

The design iterations were meticulously analyzed based on project goals, including spatial daylight autonomy (sDA), Annual Solar Exposure (ASE), lux levels, annual glare, and point-in-time glare. Our efforts were dedicated to optimizing these parameters, incorporating features like light shelves and vertical louvres to achieve an optimal level of visual comfort.

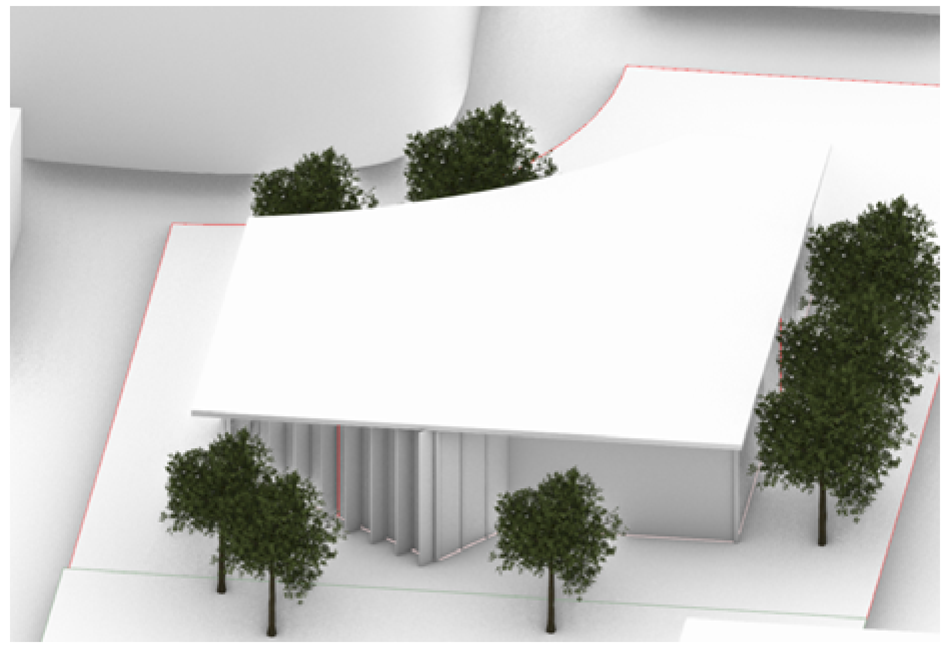
Baseline model



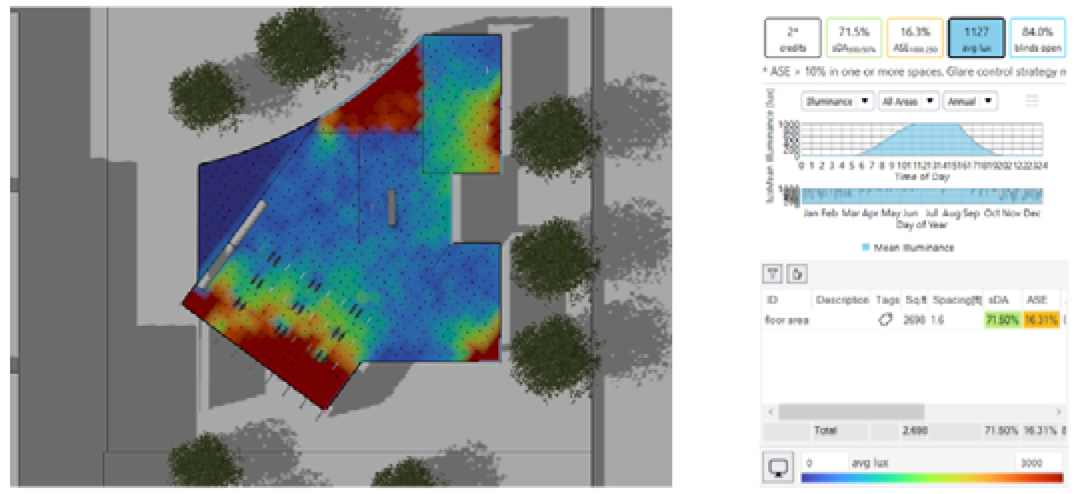
Iteration 1: Light shelf



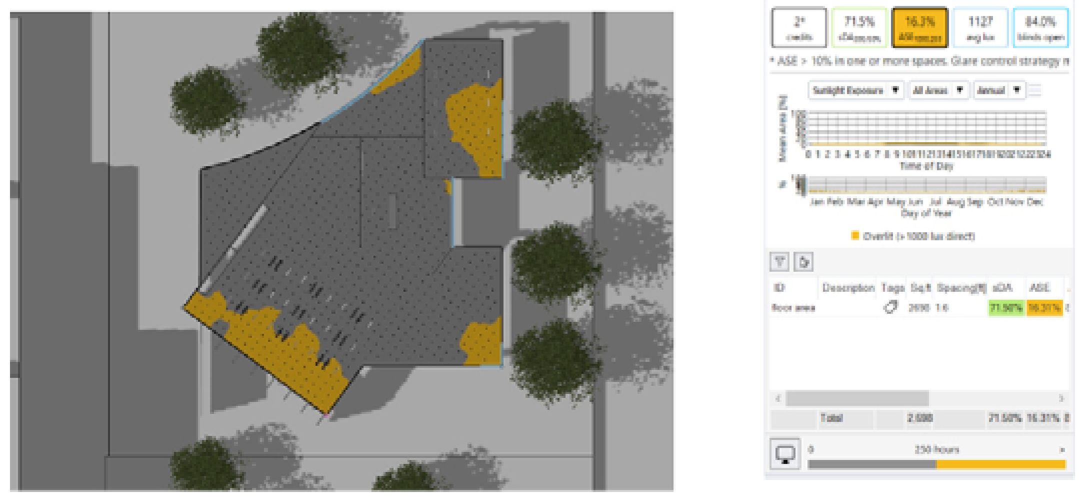
Iteration 2: Vertical fins



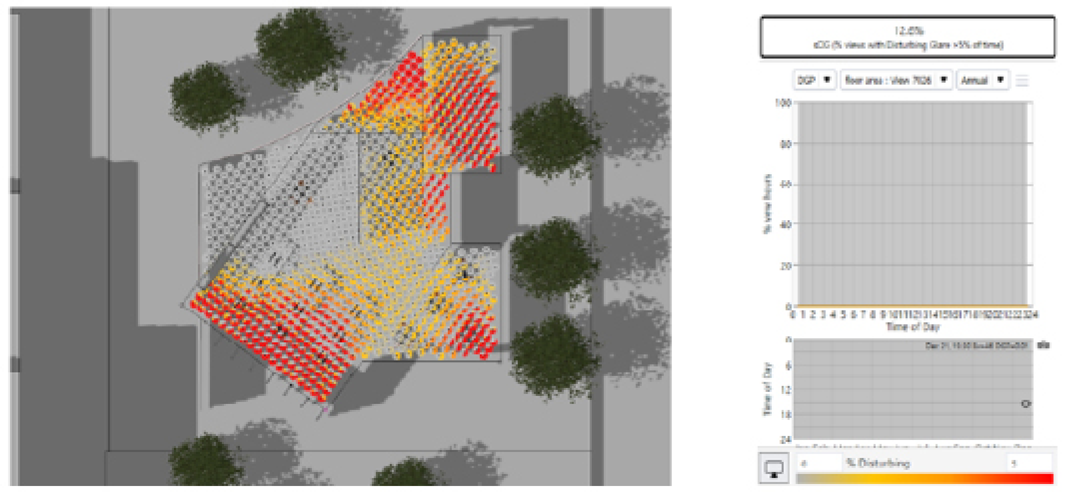
sDA simulation for iteration 3



average lux levels simulation for iteration 3



ASE simulation for iteration 3



Disturbing glare simulation for iteration 3

	Base model	Iteration 1	Iteration 2
sDA	89.8%	71.7%	71.5%
ASE	20.7%	14.7%	16.3%
Mean Lux	1186	1101	1127
LEED credits	3	2	2
sDG	25.3%	16.8%	12.6%

Comparison of visual comfort achieved through iterations

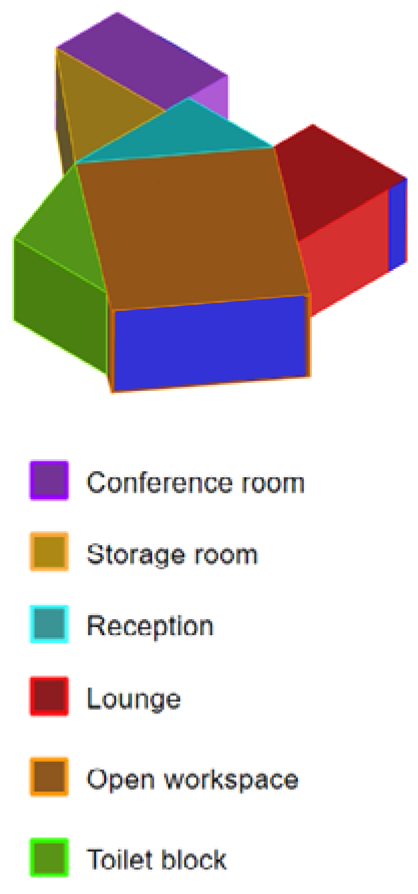
Thermal comfort analysis

In parallel, the project focused on achieving thermal comfort by significantly lowering the Energy Use Intensity (EUI) of the building. This involved a multi-faceted approach, encompassing building form optimization, utilization of high-performance construction assemblies, intelligent daylight harvesting, and the optimization of heating and cooling mechanical systems.

Iteration 1: Form optimization

		Baseline simulation	10 degree rotation	20 degree rotation	30 degree rotation	40 degree rotation	50 degree rotation	60 degree rotation	350 degree rotation
	units								
EUI	kWh/m2/yr	133.60	133.4453	133.3081	133.2048	133.1717	133.31274	133.45918	133.74034
Baseline EUI according to the AIA 2030 challenge	kWh/m2/yr	283.91	283.91	283.91	283.91	283.91	283.91	283.91	283.91
Operational carbon emissions	kgCO2/m2/yr	70.54	70.45914	70.38868	70.33211	70.31464	70.39	70.466447	70.614899
Operational energy cost	$/m2/yr	16.78	16.76074	16.74435	16.73052	16.72636	16.74408	16.762473	16.797787
Floor area	m2	273.47	273.47	273.47	273.47	273.47	273.47	273.47	273.47

Performance optimization through form optimization iterations



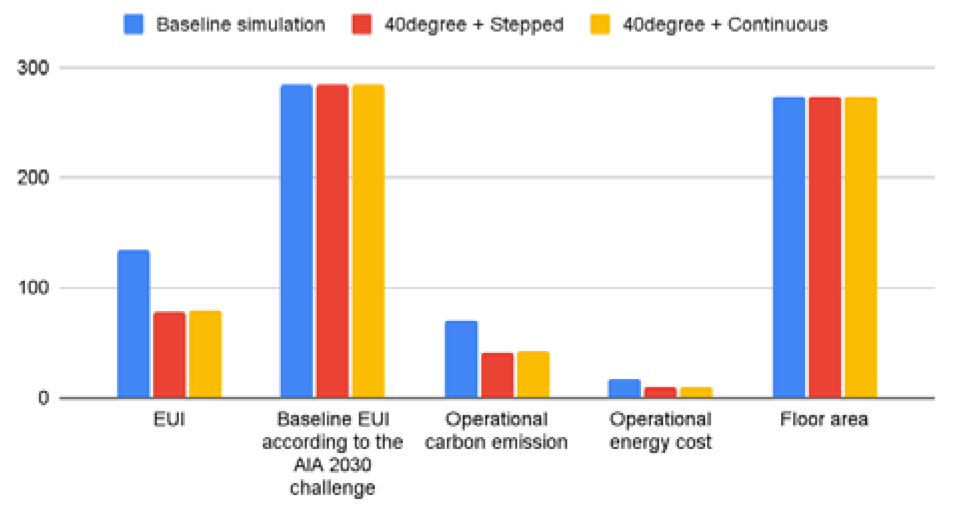
Iteration 2: Construction assemblies

	Zones	Roof Description	Roof U-value	Façade Description	Façade U-value	Partition Description	Partition U-value	Ground slab Description	Ground slab U-value	Windows Description	Windows U-value	EUI (kWh/m2/yr)	Operational carbon emissions (kgCO2/m2/yr)	Operational energy cost ($/m2/yr)
Baseline iteration	Lounge Workspace Toilet Reception Conference room Storage room	Mediumoffice - SA_IEAD Non-res roof: 0.01m roof membrane + 0.127m roof insulation + 0.002m metal decking	0.357	Mediumoffice - SA_steel frame non-res ext wall: 0.01m wood siding + 0.087m insulation + 0.013m 1/2 inch gypsum	0.472	Mediumoffice - SA_Int-walls: 0.013m gypsum + 0.013m gypsum	2.388	Mediumoffice - SA_ext-slab: 0.102m concrete + 0.01 carpet pad	1.805	Mediumoffice_SA_nonres fixed assembly window: Simple glazing model	3.236	133.1717	70.314644	16.726362
Iteration 2.1	Lounge Workspace Toilet Reception Conference room Storage room	Mediumoffice - SA_IEAD Non-res roof: 0.01m roof membrane + 0.127m roof insulation + 0.002m metal decking	0.357	Opaque wall 0.015m gypsum sheathing + 0.051m air space + 0.152m cellulose + 0.051m air cavity + 0.013m gypsum board	0.165	Mediumoffice - SA_Int-walls: 0.013m gypsum + 0.013m gypsum	2.388	Mediumoffice - SA_ext-slab: 0.102m concrete + 0.01 carpet pad	1.805	Mediumoffice_SA_nonres fixed assembly window: Simple glazing model	3.236	127.3658	67.249194	15.997157
Iteration 2.2	Lounge Workspace Toilet Reception Conference room Storage room	Mediumoffice - SA_IEAD Non-res roof: 0.01m roof membrane + 0.127m roof insulation + 0.002m metal decking	0.357	Opaque wall 0.0127m fibercement board + 0.0762m air barrier + 0.18415m cellulose insulation + 0.012575m plywood sheathing + 0.1524 mineral wool insulation + 0.0127m gypsum board	0.099	Mediumoffice - SA_Int-walls: 0.013m gypsum + 0.013m gypsum	2.388	Mediumoffice - SA_ext-slab: 0.102m concrete + 0.01 carpet pad	1.805	Mediumoffice_SA_nonres fixed assembly window: Simple glazing model	3.236	125.419	66.221472	15.752684
Iteration 2.3	Lounge Workspace Toilet Reception Conference room Storage room	Mediumoffice - SA_IEAD Non-res roof: 0.01m roof membrane + 0.127m roof insulation + 0.002m metal decking	0.357	Opaque wall 0.0127m fibercement board + 0.0762m air barrier + 0.18415m cellulose insulation + 0.012575m plywood	0.099	Mediumoffice - SA_Int-walls: 0.013m gypsum + 0.013m gypsum	2.388	Mediumoffice - SA_ext-slab: 0.102m concrete + 0.01 carpet pad	1.805	Pacifica - Solarban90 (3) (Krypton): Solar ban 60 on Pacifica 6mm + Krypton 127mm	1.21	111.416859	58.828102	13.993958
Iteration 2.4	Lounge Workspace Toilet Reception Conference room Storage room	Mediumoffice - SA_IEAD Non-res roof: 0.01m roof membrane + 0.127m roof insulation + 0.002m metal decking	0.357	Opaque wall 0.0127m fibercement board + 0.0762m air barrier + 0.18415m cellulose insulation + 0.012575m plywood	0.099	Mediumoffice - SA_Int-walls: 0.013m gypsum + 0.013m gypsum	2.388	Mediumoffice - SA_ext-slab: 0.102m concrete + 0.01 carpet pad	1.805	Pacifica - Solarban90 (3) (Krypton): Solar ban 60 on Pacifica 6mm + Krypton 127mm	1.21	107.760089	56.897327	13.534667
Iteration 2.5	Lounge Workspace Toilet Reception Conference room Storage room	NECB-2020 nonresidential office CZ8 5 exterior roof mass: 0.003m vapor permeable felt + 0.298m XPS board + 0.203m concrete +	0.11	Opaque wall 0.0127m fibercement board + 0.0762m air barrier + 0.18415m cellulose insulation + 0.012575m plywood	0.099	Mediumoffice - SA_Int-walls: 0.013m gypsum + 0.013m gypsum	2.388	Mediumoffice - SA_ext-slab: 0.102m concrete + 0.01 carpet pad	1.805	Pacifica - Solarban90 (3) (Krypton): Solar ban 60 on Pacifica 6mm + Krypton 127mm	1.21	99.653668	52.617137	12.516501

Performance optimization through high performance building envelope design iterations

Iteration 3: Intelligent daylight harvesting

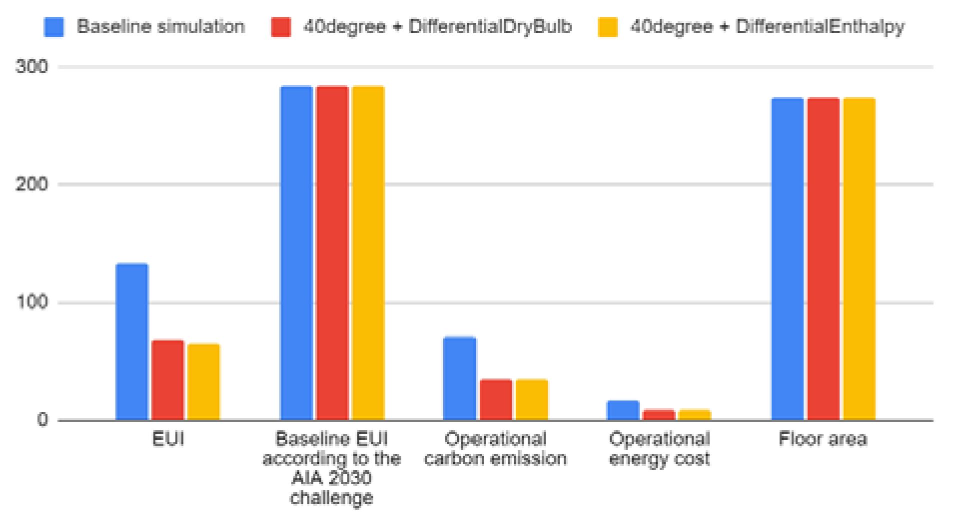
		Baseline simulation	40degree + Stepped	40degree + Continuous
	units			
EUI	kWh/m^2/yr	133.6	78.17	79.12
Baseline EUI according to the AIA 2030 challenge	kWh/m^2/yr	283.91	283.91	283.91
Operational carbon emission	kgCO^2/m^2/yr	70.54	41.27	41.77
Operational energy cost	$/m^2/yr	16.78	9.82	9.94
Floor area	m^2	273.47	273.47	273.47



Performance optimization through intelligent daylight harvesting iterations

Iteration 4: Heating-cooling mechanical system

		Baseline simulation	40degree + DifferentialDry Bulb	40degree + DifferentialEnthalpy
	units			
EUI	kWh/m^2/yr	133.6	67.66	65.86
Baseline EUI according to the AIA 2030 challenge	kWh/m^2/yr	283.91	283.91	283.91
Operational carbon emission	kgCO^2/m^2/yr	70.54	35.73	34.78
Operational energy cost	$/m^2/yr	16.78	8.5	8.27
Floor area	m^2	273.47	273.47	273.47



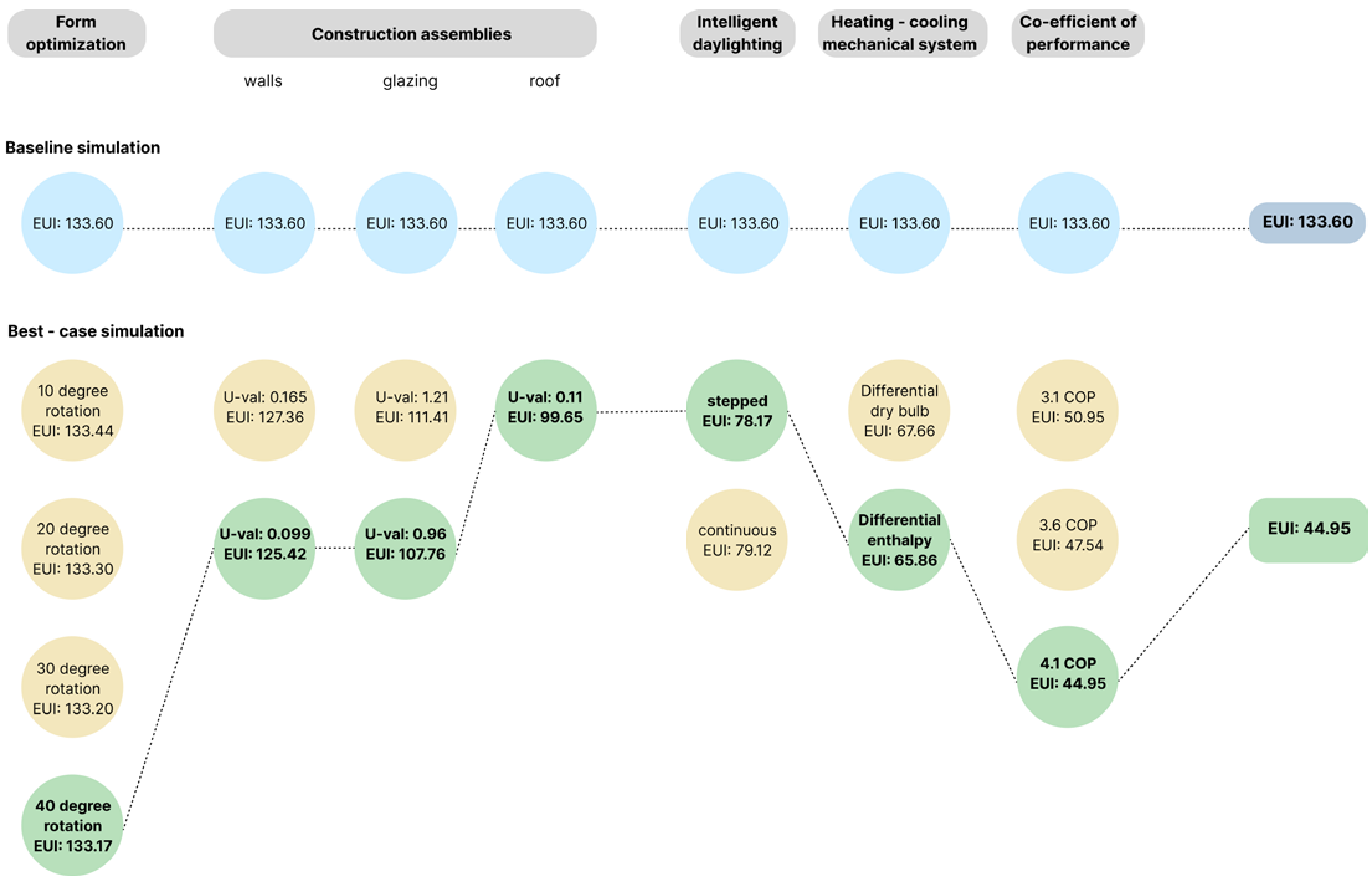
	Units	Baseline simulation	40degree + 3.1 COP + Differential Enthalpy	40degree + 3.6 COP + Differential Enthalpy	40degree + 4.1 COP+ Differential Enthalpy
EUI	kWh/m^2/yr	133.6	50.95	47.54	44.95
Baseline EUI according to the AIA 2030 challenge	kWh/m^2/yr	283.91	283.91	283.91	283.91
Operational carbon emission	kgCO^2/m^2/yr	70.54	26.9	25.1	23.74
Operational energy cost	$/m^2/yr	16.78	6.39	5.97	5.65
Floor area	m^2	273.47	273.47	273.47	273.47

Performance optimization through heating-cooling mechanical system iterations

Thermal comfort analysis

The result was a remarkable **66% reduction in EUI,** carbon emissions, and operational costs, culminating in an a**chieved EUI of 45.95 kWh/m²/year. This achievement surpasses the baseline EUI of 283.91 kWh/m²/year** and aligns with the stringent criteria of the AIA 2030 challenge.

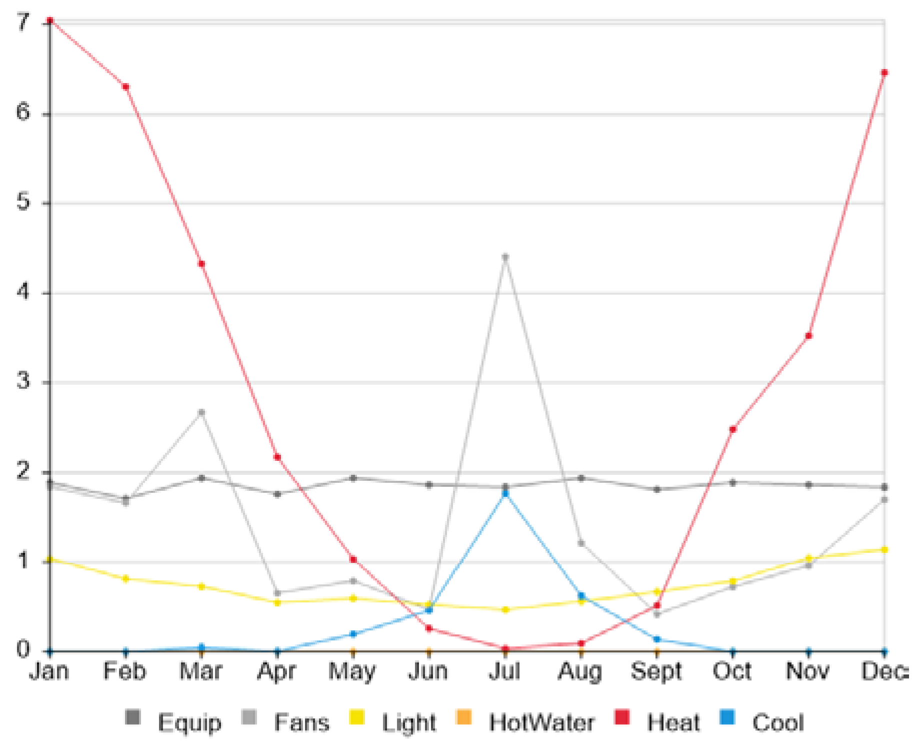
Thermal comfort analysis workflow

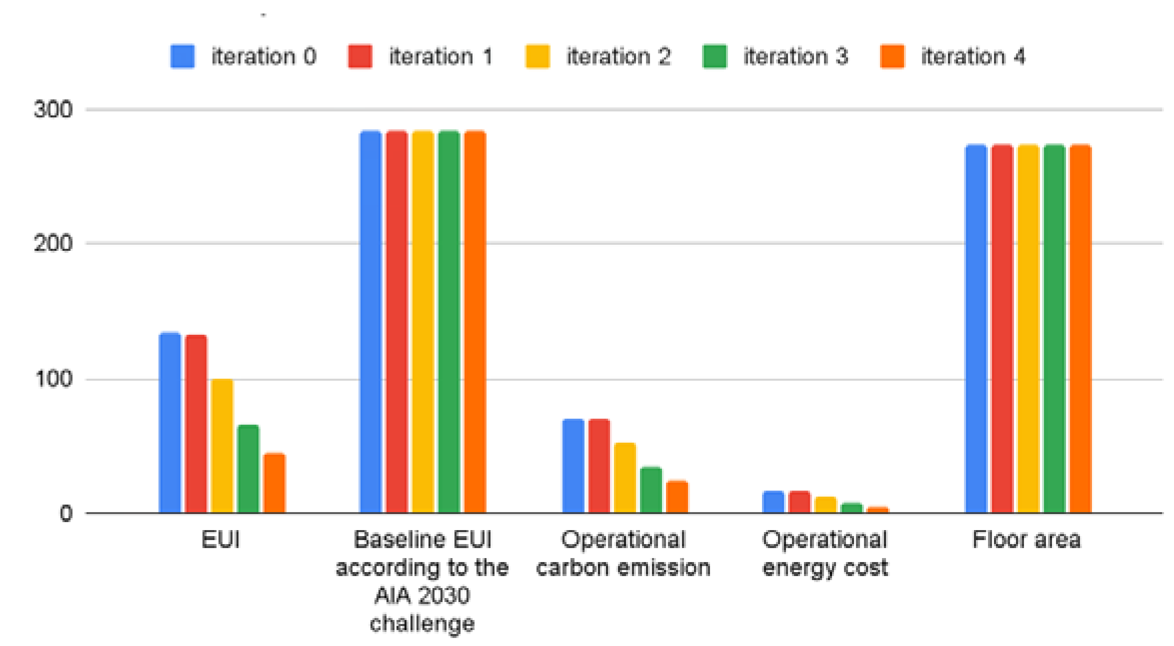


Thermal comfort analysis comparison

	Iteration 0 Baseline model	Iteration 1 form optimization	Iteration 2 Construction assembly	Iteration 3 Intelligent Lighting	Iteration 4 Heating and cooling mechanical system
EUI kWh/m2/yr	133.6	133.17	99.65	65.86	44.95
Baseline EUI according to AIA 2030 challenge kWh/m2/yr	283.91	283.91	283.91	283.91	283.91
Operational carbon emissions kgCO2/m2/yr	70.54	70.31	52.62	34.78	23.74
Operational energy cost $/m2/yr	16.78	16.73	12.52	8.27	5.65

Performance achieved through iterations achieved using one-factor-at-a-time optimization to arrive at the best case scenario





Performance optimization through best cases of all iterations

Early projects ignited my passion for sustainable design, laying the foundation for creating energy-efficient, human-centered spaces. Experiences that fostered a commitment to making a positive impact on both people and the environment.

where it all began...

08

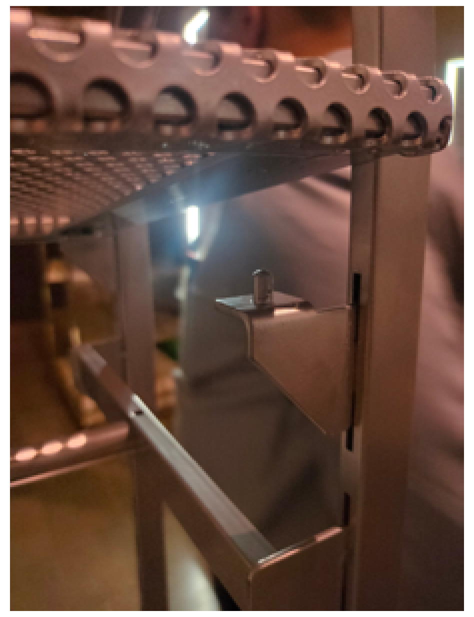
The souled store

Retail design, Bengaluru

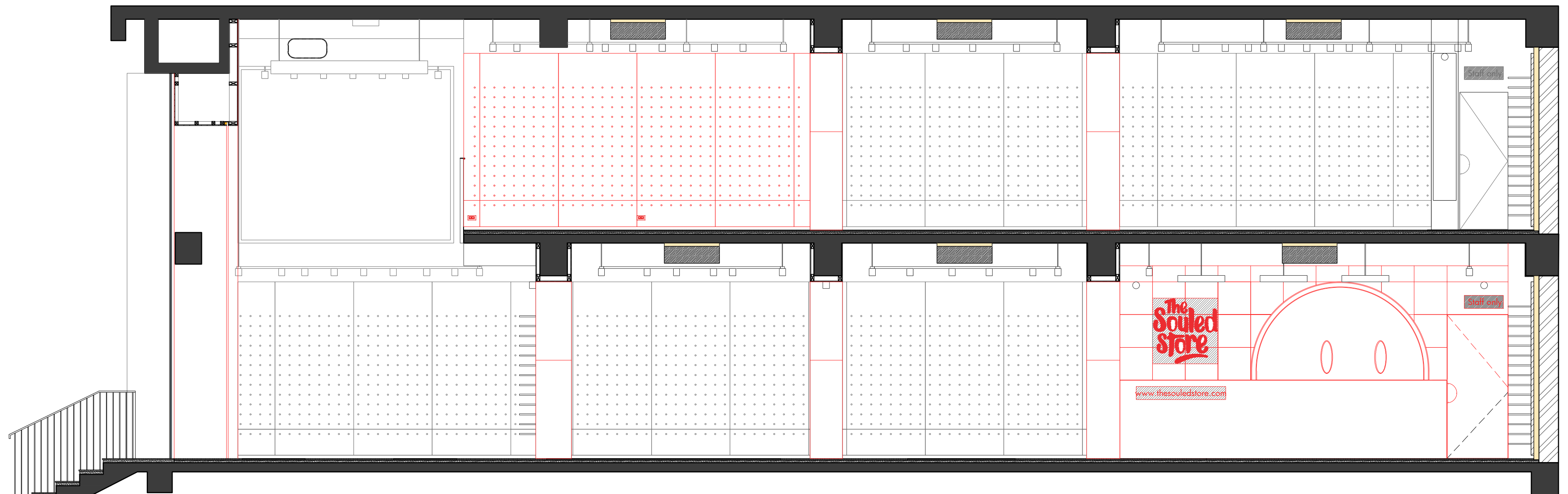
2022 | Professional work at beyonddesign | Team work
Scope: Project lead in complete design and project management

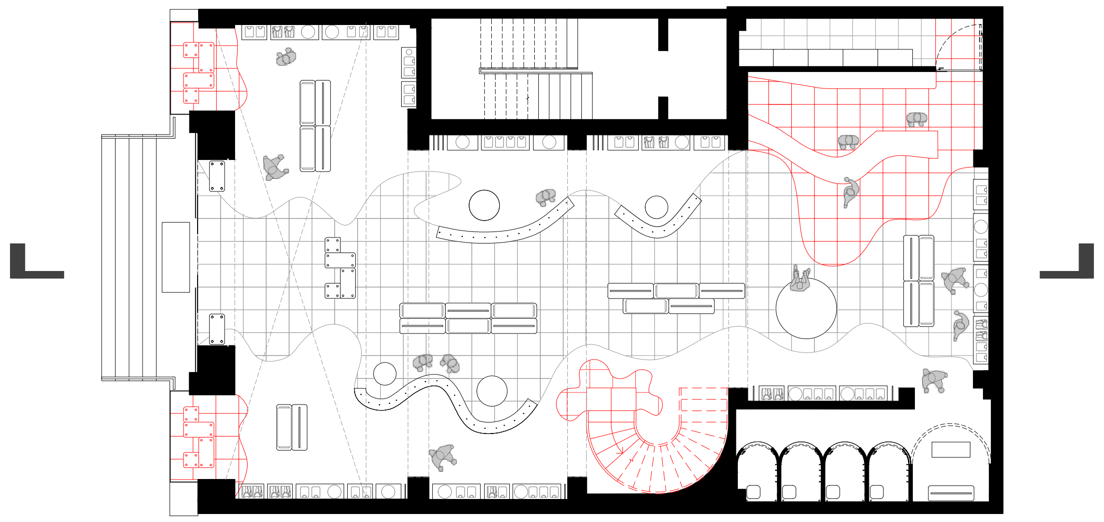
The Souled Store has thrived in their online presence over the years, and recently started expanding into the offline retail market. The objective was to create a set of high-spirited, playful stores that drove the brand's message home. The brand colour red and brand ambassador Mr. Soul, make a recurring appearance in the various elements designed for the store. Another target was to create a free-flowing and welcoming space that allowed for easy navigation and in-store experience. To meet these expectations, the form of Mr. Soul was used to divide the store into a series of spaces, each with a specific function. The transition of colours through the spaces and the flooring creates a subconscious path of navigation and is complimented by a set of eye-catching patches. The red shopfront creates a characteristic familiarity with the brand and interest for new customers. Moving into the display area, the curved white footprint of Mr. Soul on the shop floor and the grey display walls, functionally guides visitors through the store. The perforated wall system and flexibility in the modularity of the store maintains the playful nature even in the way the products are presented. The project was a prototype for the brand's future store. Also since the brand is fairly new to the retail market, each element in the store had to be modular and should allow for flexibility, in case they need to move to a new location. A peg wall system was developed after a lot of back and forth between the manufacturers and the client combining aesthetics and functionality with modularity and flexibility. *The project was done under the guidance of the principals.*



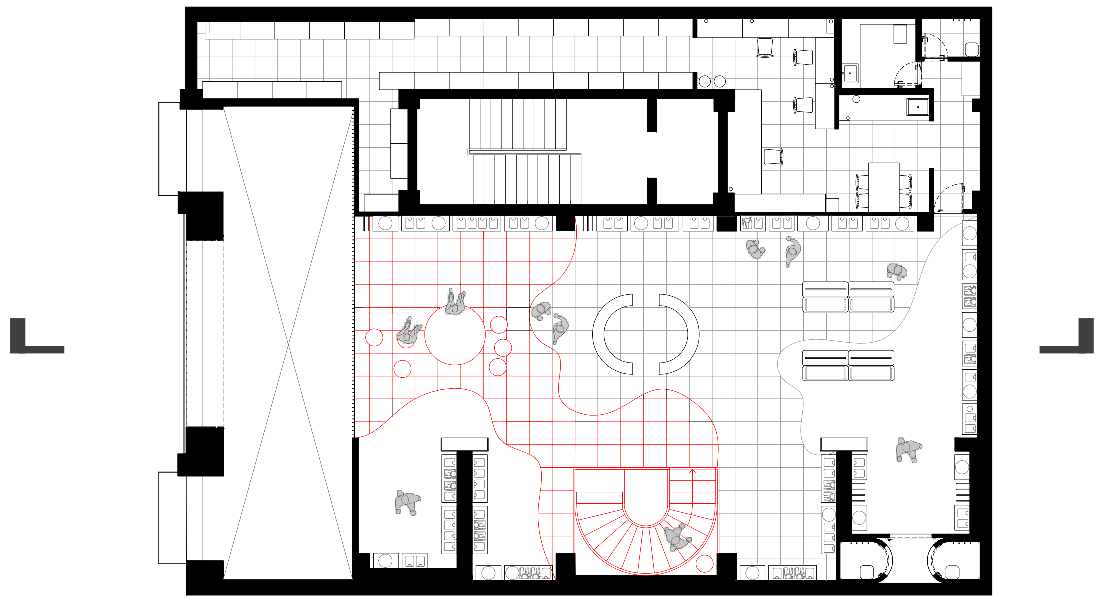


Section facing the billing desk





Ground floor plan



First floor plan

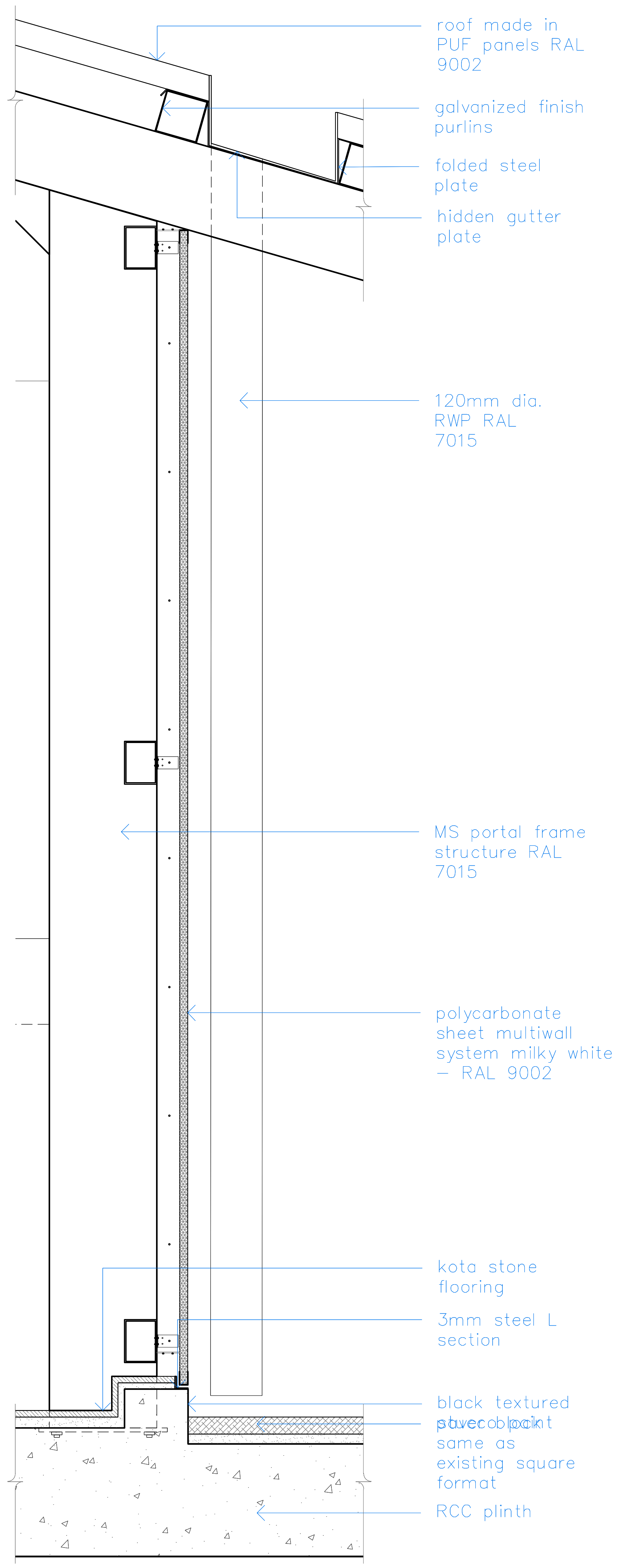
09

OLA future factory canteen

Bagrur

2022 | Professional work at beyonddesign | Team work
Project lead in complete design conceptualization and development

The project is a part of the larger OLA future factory campus. The future factory is conceptualized with a footprint of 2 million sq.ft. to be built in 4 phases while being fully operational. Currently, 0.5 million sq. ft is built and operational. To cater to the current needs, a lot of utility buildings in the campus have been built who have to be temporary in nature as they will have to move and increase in size once the factory expands. One of these is the canteen building. The building serves 580 people at a time for the employees who take breaks in shifts. The canteen mirrors the form of the factory while complimenting the factory with its materiality. It is made up of a portal frame structure, clad with a combination of PUF panels and polycarbonate sheets. The internal partition walls and roof are also made up of PUF panels. The only permanent elements were the plinth and the kota flooring. The polycarbonate sheet panels provided natural light to the space while offering a respite from work in a closed environment. All elements within the canteen also followed the brand identity and continued the language of the factory. *The project was done under the guidance of the principal.*



The building aimed to solve the current space issues and provide a better environment while offering a respite to the workers. The design intent was provided, material selection was done and samples reviewed to arrive at the building design. Co-ordination with the contractor, MEP consultants and OLA reps lead to the successful design and construction of the building. As a result, the building achieved a 68% reusable status. The materials and the structure could be reused when it had to move elsewhere. It also has a possibility to expand in the future.

Leveraging innovation and technology to combat climate change through energy-efficient, human-centered designs. Focused on creating spaces that aren't just sustainable but regenerative—contributing positively and making a tangible impact.

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