PORTFOLIO

SUSTAINABLE DESIGN + INNOVATION + RESEARCH

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LinkedIn Profile

PREFACE

With a background in both architecture and sustainability, I approach design with a focus on minimizing environmental impact and maximizing resource efficiency. My work delves into the integration of material life cycles, embodied energy, and carbon-sequestering materials, aiming to develop regenerative systems. Currently pursuing a Master of Science in Sustainable Design at Carnegie Mellon University, my academic journey enriches my expertise in sustainable practices. As an Architect from CEPT University in Ahmadabad, my professional experience has given me a broad understanding of spatial design, shaped by diverse cultural and ecological contexts. Over time, I have honed strong project management and coordination skills, leading teams and ensuring successful project outcomes. My design philosophy revolves around creating performance-driven solutions that foster resilience and sustainability, addressing the needs of both people and the environment.

Energy in Motion

Simulating Solar, Thermal, and Visible Radiation for Office Building Design in New York's 4A Climate Zone

Optimizing Building Design

Comparative Analysis of Building Design and HVAC Systems

Geo-spatial Contaminant Mapping

A GIS-Based Analysis of Industrial Emissions and Their Impact on Air, Water and Soil Quality of Allegheny County

Echo-Shield

A Mycelium-Based Sound Absorption System

Women's Center in Baghere

Empowering Communities in Senegal Through Locally Sourced Materials

Urban Wellness

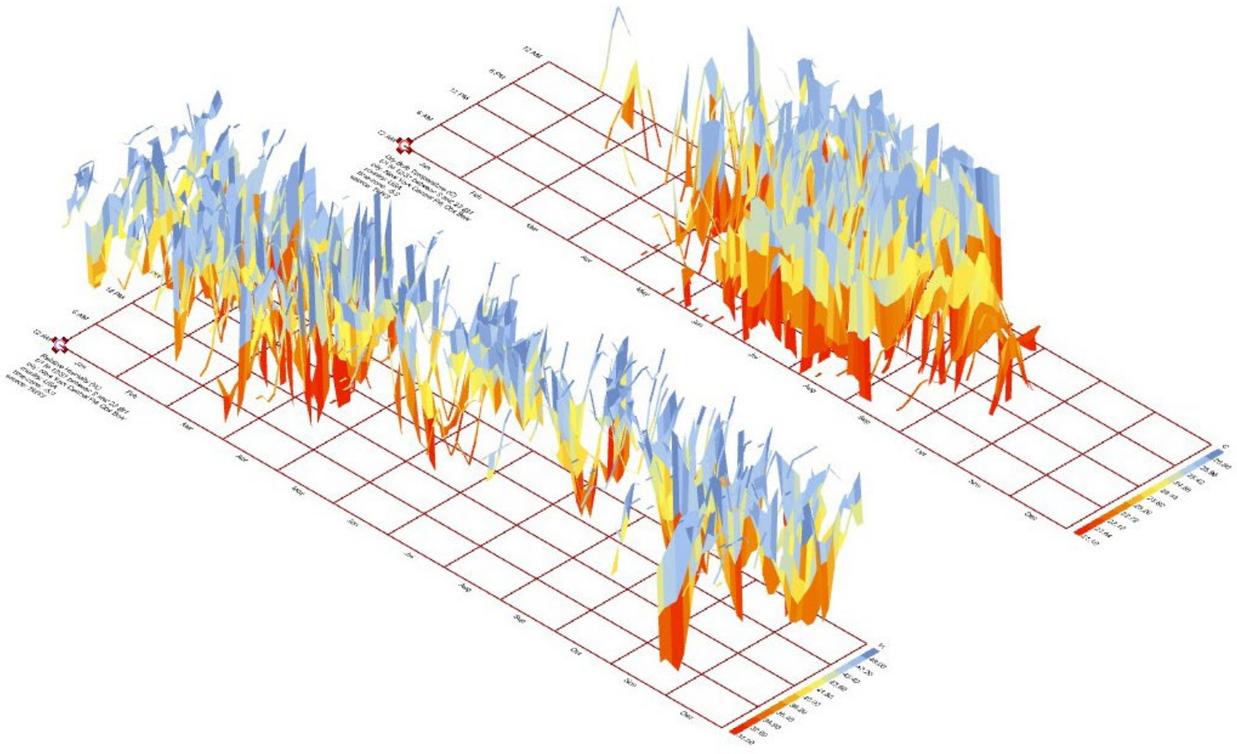
Transforming Spaces for Health and Connection

Villa in Coimbatore

Fostering Connection Between Built and Natural Environments

Energy in Motion

Simulating Solar, Thermal and Visible Radiation for Office Buildings in New York's 4A Climate Zone



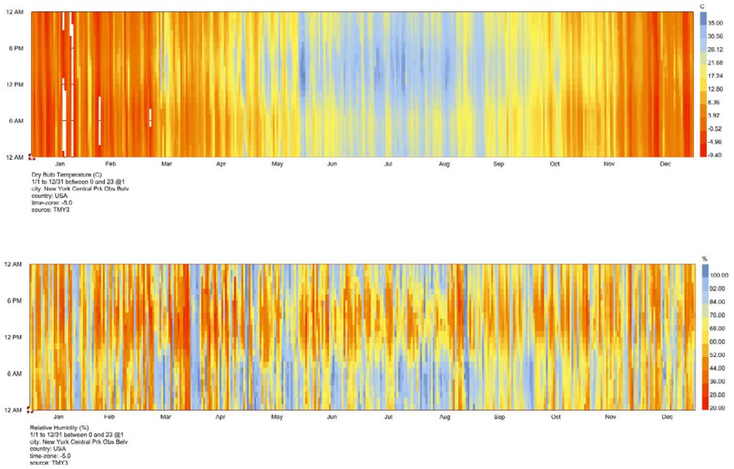
3D Visualization of Comfort Period : Dry Bulb Temperature 21C - 26.7C | Relative Humidity 30% - 50%

This project focuses on sustainable design strategies for an office building in New York, integrating climate-responsive and daylighting performance solutions. Using Rhino 3D modeling, Climate Studio, and Ladybug plugins, the study analyzes climatic data (temperature, humidity, wind, and solar radiation) to inform design decisions.

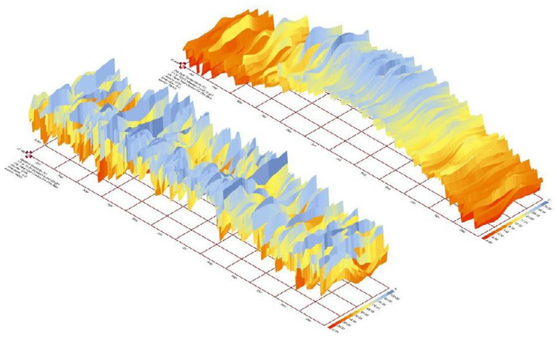
The baseline case reveals that 46.5% of the area receives less than the required 300 lux (sDA), and 27% of the area has an ASE greater than 250 hours. The base case also shows an sDG of 45.3%, indicating significant glare discomfort for occupants. Two design iterations were proposed to improve performance: in the final design, 18.4% of the space achieves sDA, 6.7% of the area receives ASE greater than 250 hours, and sDG is reduced to 9.2%. These improvements contribute to occupant comfort, energy efficiency, and adherence to LEED standards, with a focus on maximizing daylight while minimizing glare and reducing reliance on electric lighting. The final design emphasizes a balance between sustainability and user well-being, promoting a comfortable, energy-efficient, and glare-free environment. This approach underscores the importance of computational analysis in creating environmentally responsive designs.

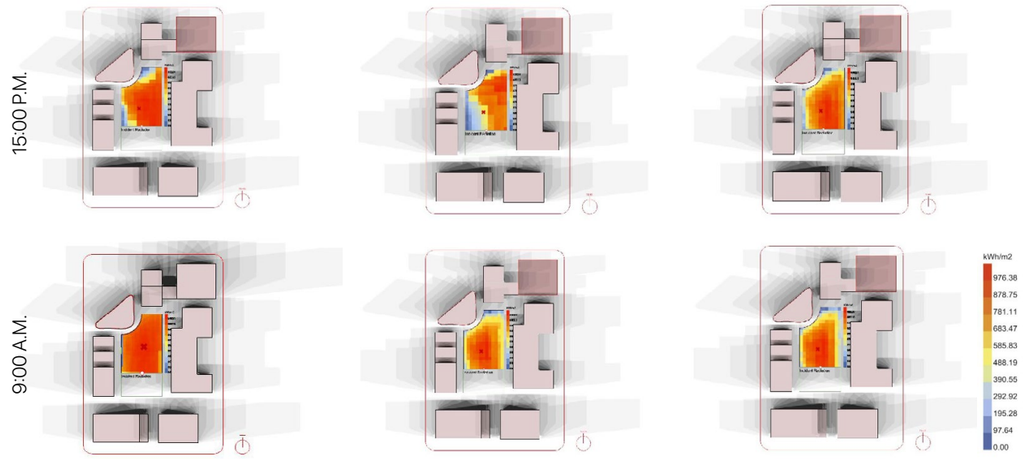
Link to Technical Reports: 01 | 02 | 03

Project Type: Academic | CMU
Course: Environmental Performance Simulation | Fall 2023
Faculty: Tian Lee
Team: Khevna, Jill and Kuyiang



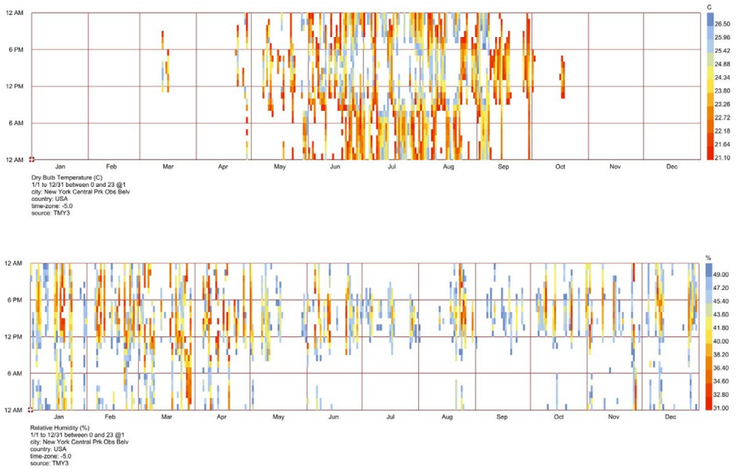
2D & 3D Visualization of Annual Period : Dry Bulb Temperature and Relative Humidity



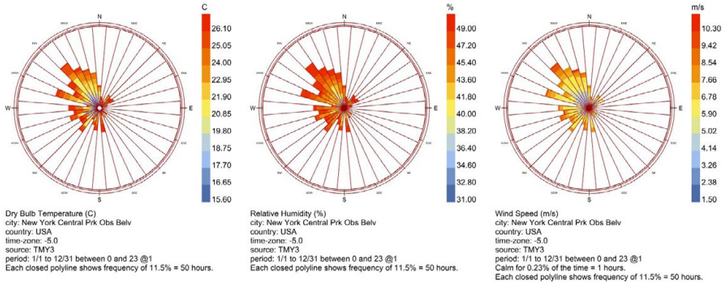


22nd June - Summer | 23rd Sept - Autumn | 22nd Dec - Winter

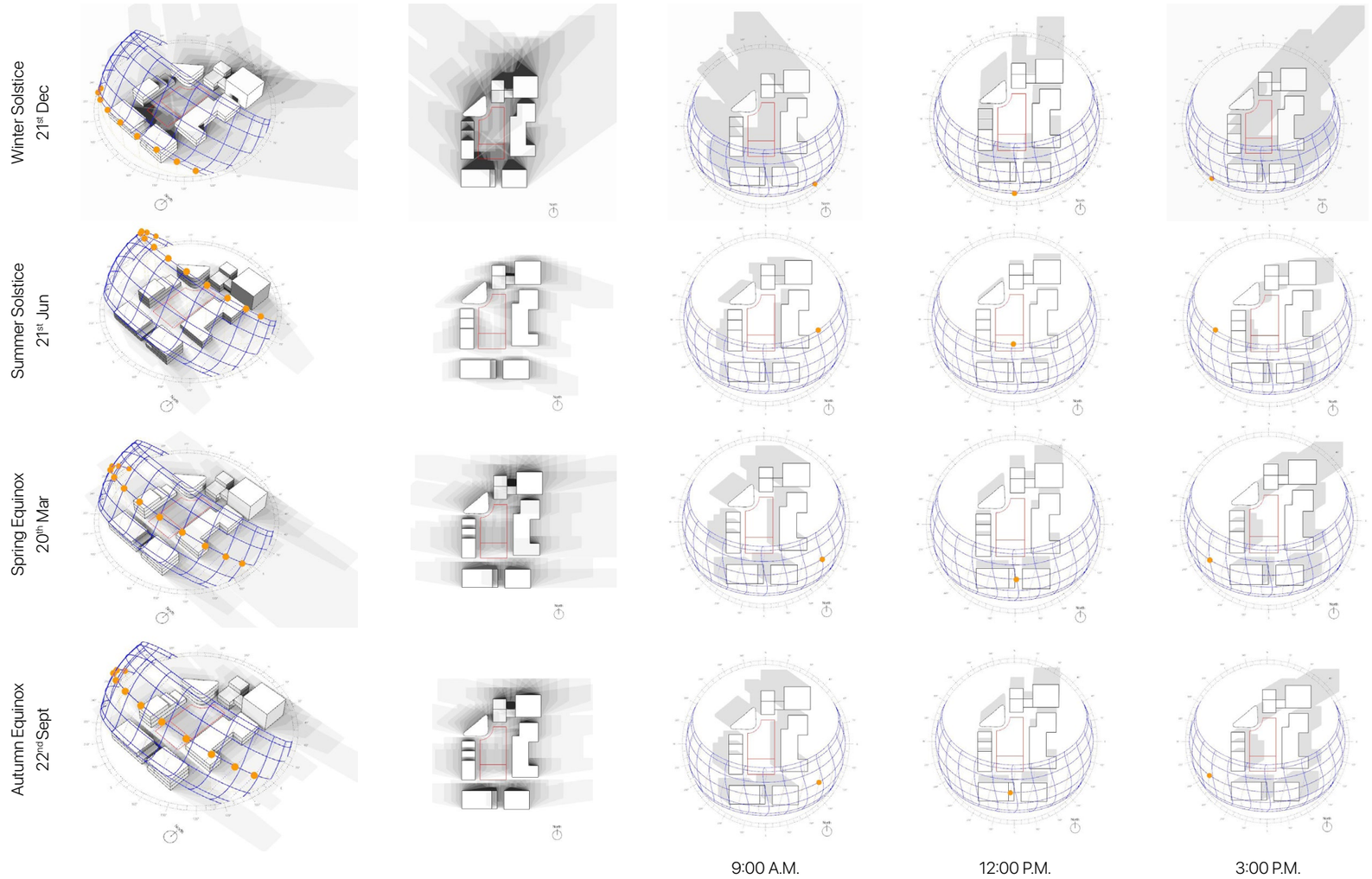
Solar Radiation Analysis - kWh/m²



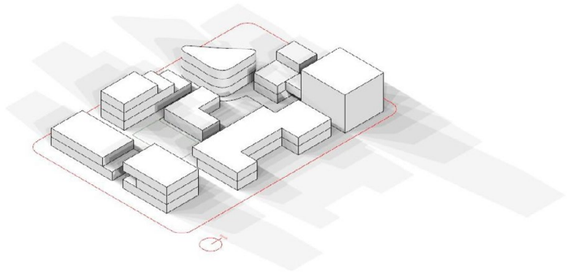
2D Visualization of Comfort Period : Dry Bulb Temperature 21C - 26.7C | Relative Humidity 30% - 50%

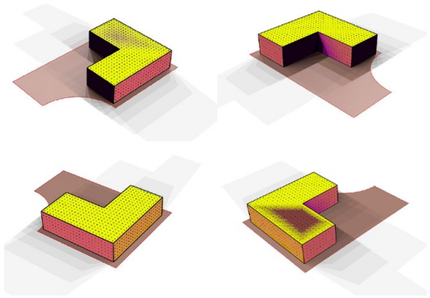


2D Visualization of Comfort Period : Wind Rose & Wind Speed Diagram

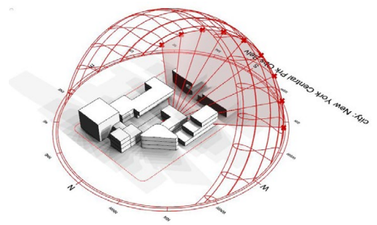


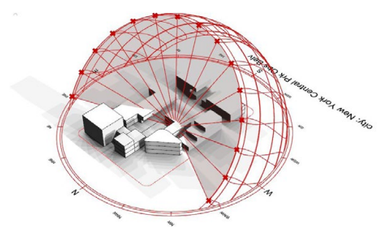
Sun-Path and Shadow Range Butterfly Diagrams - GH Ladybug



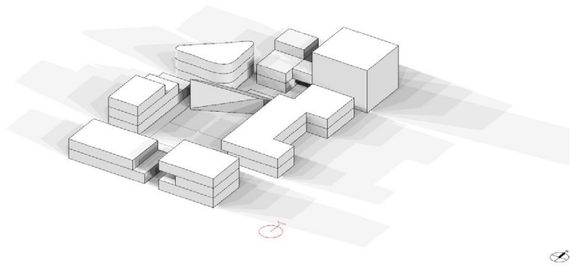


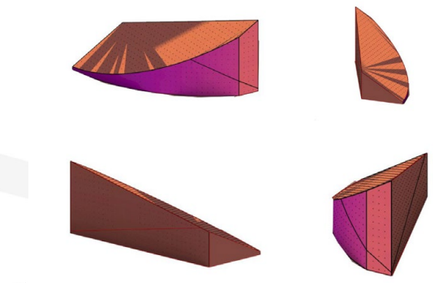
Option 1	kWh/m2/yr
South Wall	564
East Wall	694
West Wall	339
North Wall	37
Roof	765



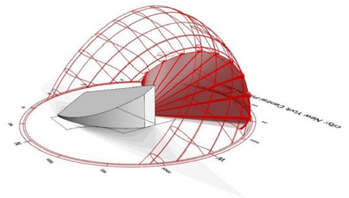


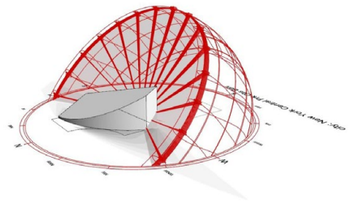
DESIGN ITERATION 1



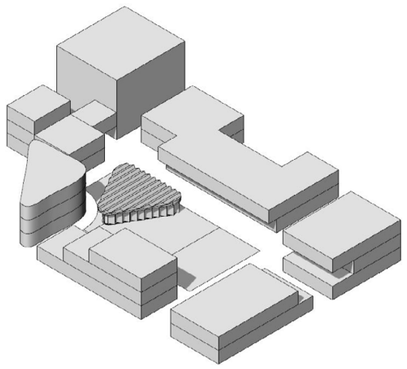


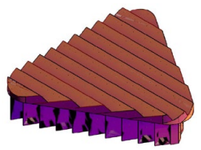
Option 2	kWh/m2/yr
South Wall	809
North Wall	350
East Wall	400
West Wall	-
Roof	2700

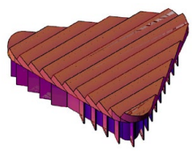




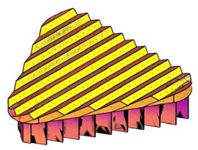
DESIGN ITERATION 2

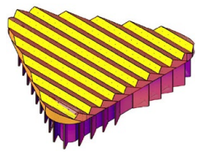


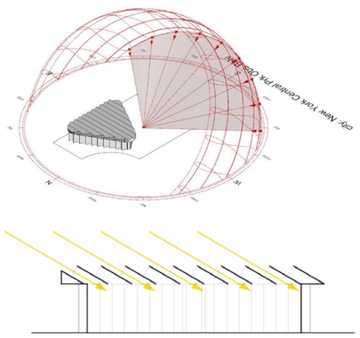


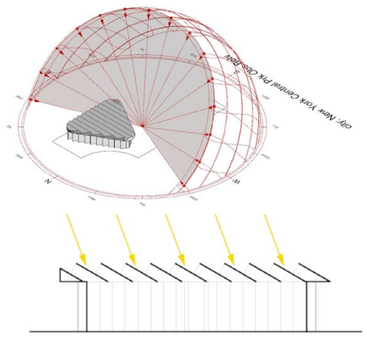


Option 3	kWh/m2/yr
South Wall	1093
North Wall	283
East Wall	420
West Wall	-
Roof	3912









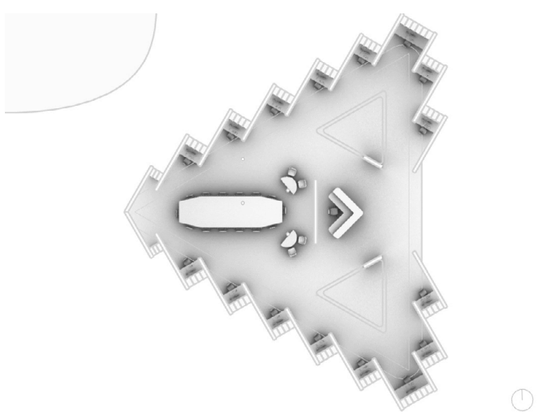
DESIGN ITERATION 3

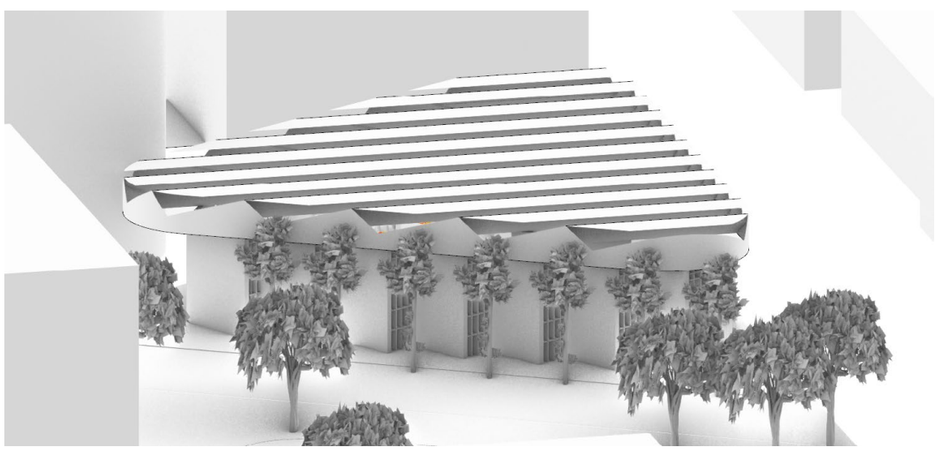
Situating on site

Solar Energy Density (kWh/m^2/year)

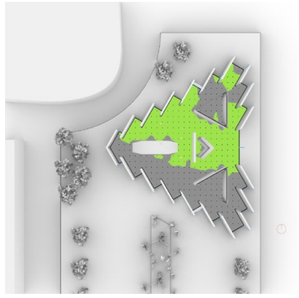
Winter Solstice (21st Dec)

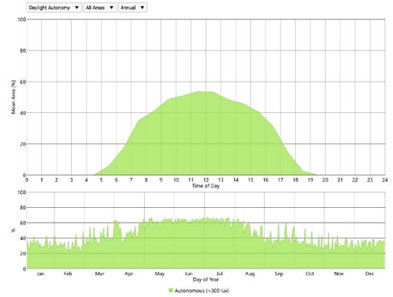
Summer Solstice (21st Jun)

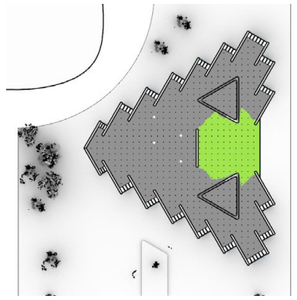


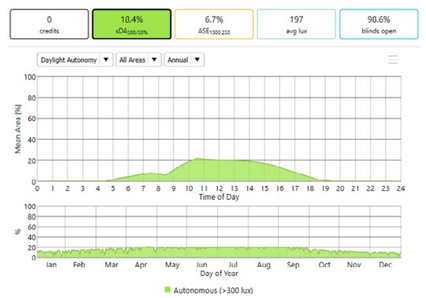


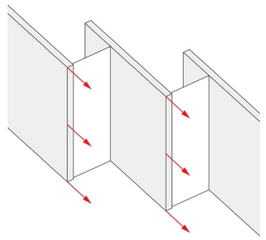
Spatial Daylight Autonomy
[%] sDA300lux-50%

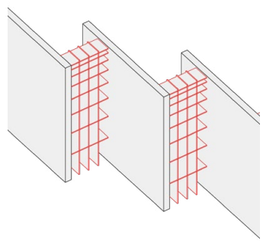


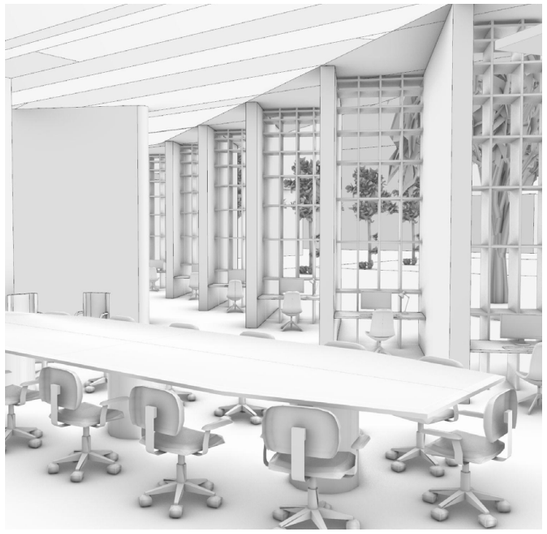




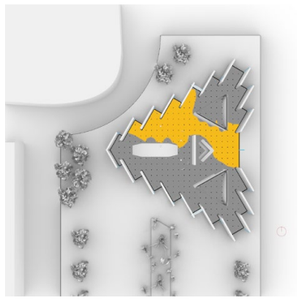


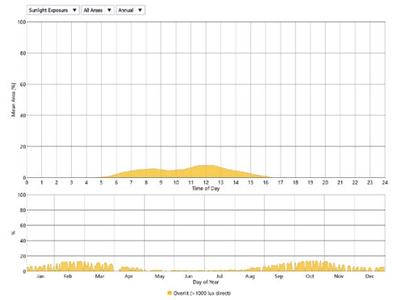


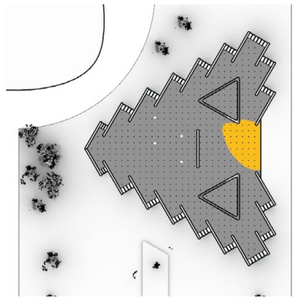


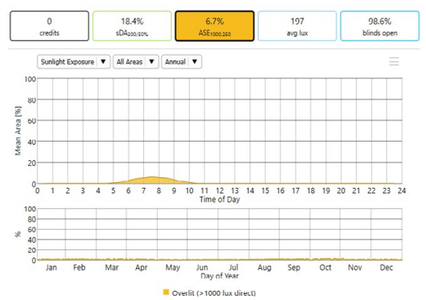


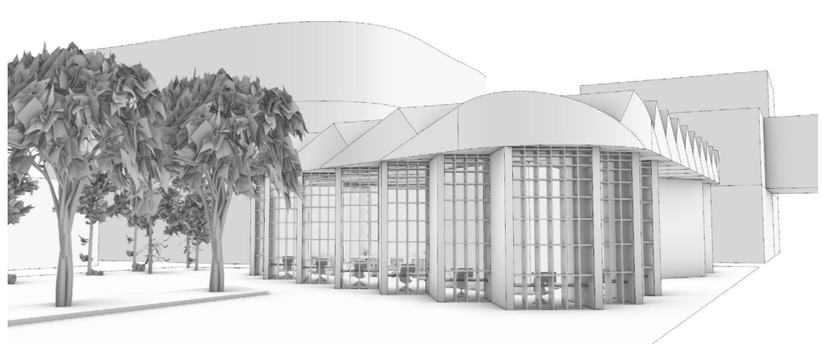
Annual Sunlight Exposure
[%] ASE1000lux-250 hrs





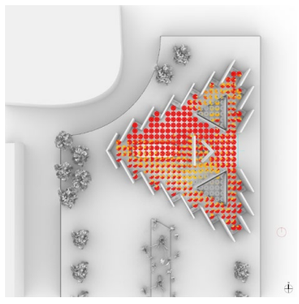


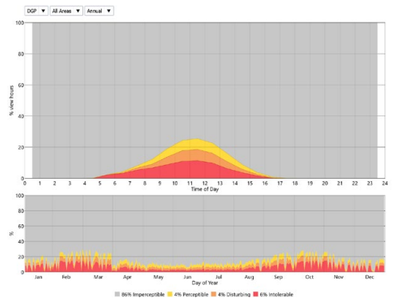


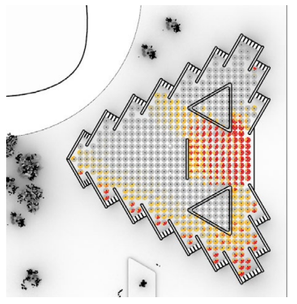


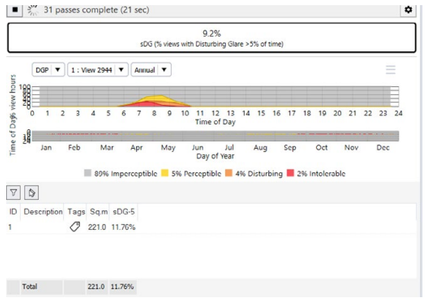
Proposed Design - Facade Iteration

Annual Glare

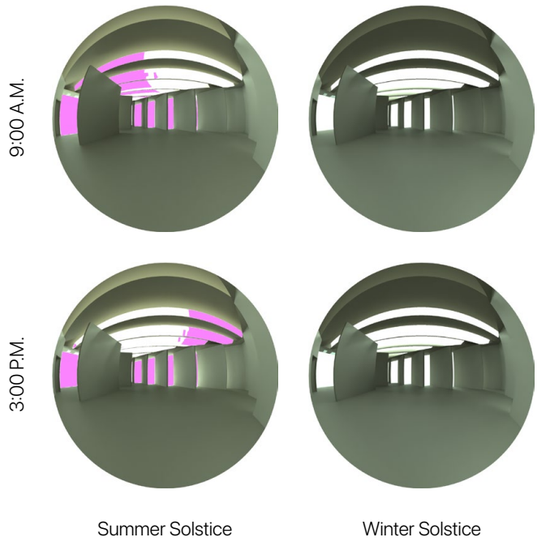




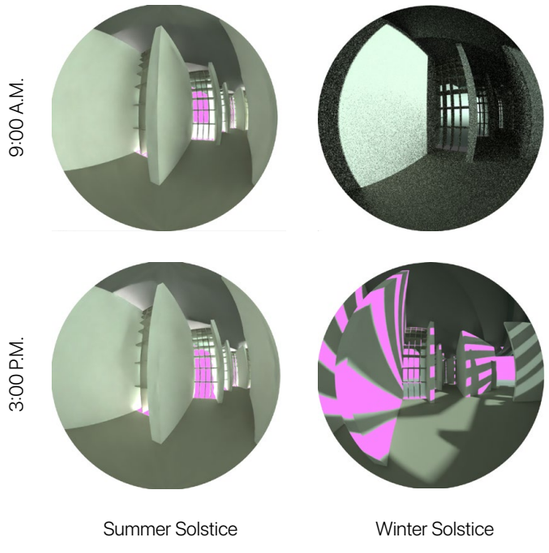




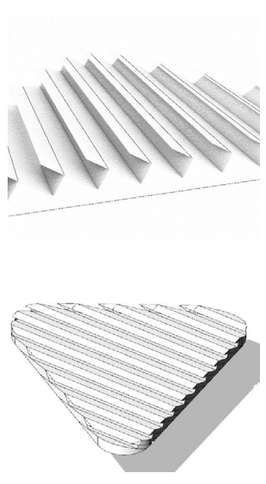
Point-in-time Glare

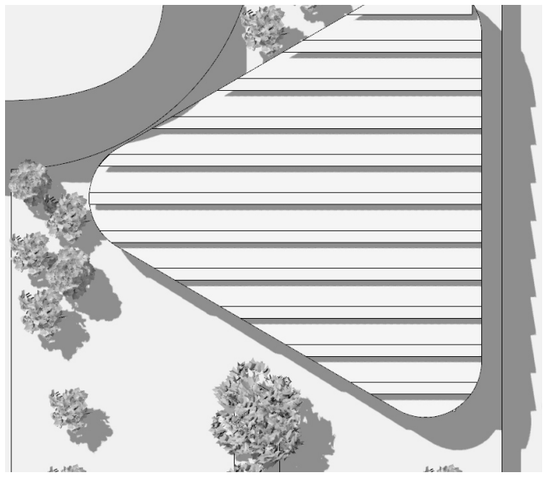


BASELINE DESIGN



PROPOSED DESIGN





Proposed Design - Roof Iteration

Optimizing Building Design

Comparative Analysis of Building Design and HVAC Systems

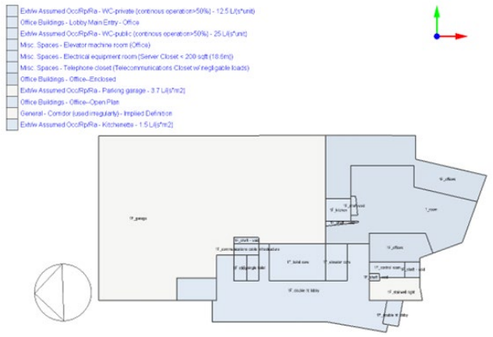
TCS Hall , Carnegie Mellon University Pittsburgh, Pennsylvania

The whole building envelope and HVAC system design are further examined in this report to improve the energy performance of the structure. As a part of Carnegie Mellon University in Pittsburgh, Pennsylvania, the project building TCS Hall is classified as an educational facility. The open-source program Energy Plus, developed by the United States Department of Energy, and the state-of-the-art building performance analysis program Design Builder were used to do the energy analysis. The baseline model was developed using ASHRAE 90.1 (2010).

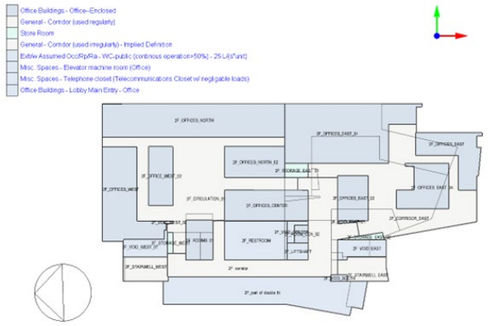
In this task, the design of the HVAC system—which stands for heating, ventilation, and air conditioning—was given special attention. The report includes a thorough design of the HVAC systems and details of the building envelope features. According to the analysis's findings, the proposed envelope + VAV with setpoint modification option will reduce the annual overall EUI from 254.53 kWh/m2/yr in the Baseline Envelope + CAV option to 143.6 kWh/m2/yr. Compared to the benchmark EUI of 195 kWh/m2/yr, the energy performance of the later design option results in a 26% increase in overall energy consumption. The accompanying report has a detailed presentation of additional findings and analysis.

Link to Technical Reports: 01 | 02 | 03

Project Type: Academic | CMU
Course: Building Performance Modeling | Spring 2024
Faculty: Wei Liang P.E.
Team: Khevna, Surabhi, Jill and Hetvi



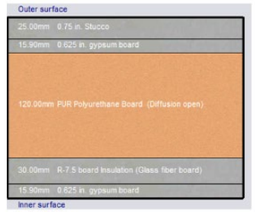
Ground Level Zoning Layout



First Level Zoning Layout

Second Level Zoning Layout

Third Level Zoning Layout

Parameter	Baseline Design	Proposed Design
Layers	5	5
Construction layers		
Thickness [m]	0.1523	0.2068
U-value [W/m^{2}K]	0.362	0.182
R-value [m^{2}K/W]	3.202	5.506

External Wall - Alternative vs Baseline Comparison

Parameter	Baseline Design	Proposed Design
Layers	2	2
Construction layers		
Thickness [m]	0.2031	0.2250
U-value [W/m^{2}K]	0.273	0.167
R-value [m^{2}K/W]	5.504	5.974

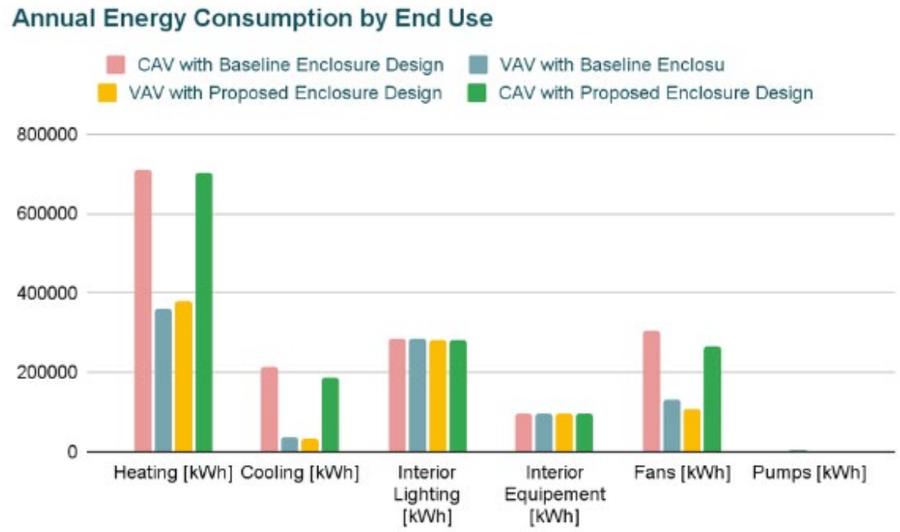
Roof - Alternative vs Baseline Comparison

Parameter	Baseline Design	Proposed Design
Construction Name	Slab-On-Grade, Unheated, Fully Insulated, R-15 for 24 in. (2.6 for 600mm), F-0.52 (0.9)	Slab-On-Grade, Unheated, Fully Insulated, R-10 for (Fully insulated slab), F-0.36 (0.6)
Layers	2	2
F-Factor [W/m-K]	0.9	0.6

Ground Floor Slab - Alternative vs Baseline Comparison

Parameter	Baseline Design	Proposed Design
Layers	2	2
SHGC	0.38	0.238
Lighting Transmission	0.418	0.362
U-value [W/m^{2}K]	2.158	2.635

External glazing - Alternative vs Baseline Comparison



Annual Energy Consumption by End-Use

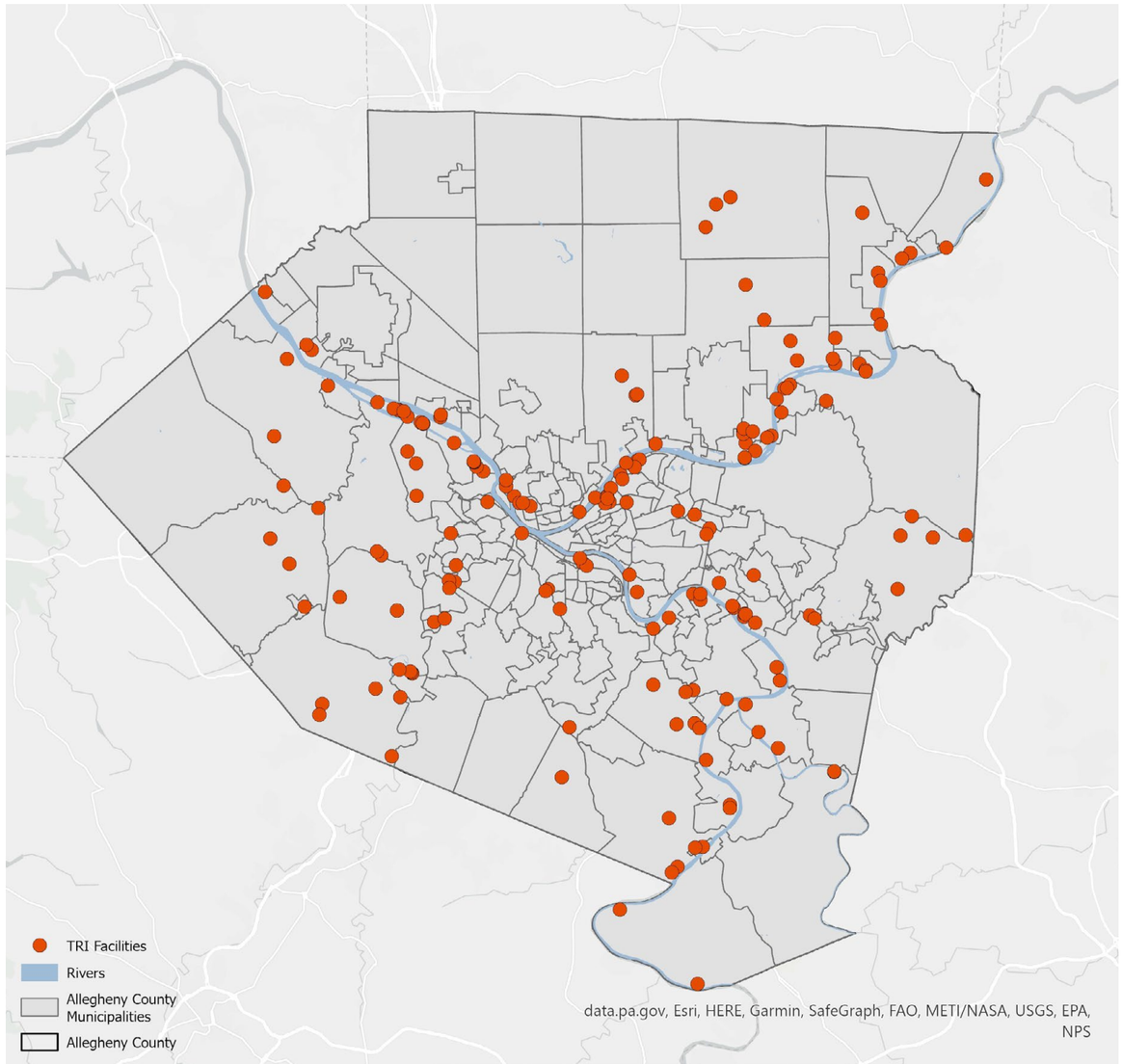
	Annual Energy Consumption [kWh]	Annual EUI [kWh/m2]
CAV with Proposed Enclosure Design	1537006.41	243.36
VAV with Proposed Enclosure Design	907019.92	143.61
Difference (in percentage)	40.99%	40.99%

Annual EUI Comparison between CAV and VAV system vs Proposed Envelope Construction

This study evaluates the energy performance of HVAC systems and building envelope designs in office buildings, highlighting the role of thermal zoning and adaptive control systems. Advanced daylight controls reduced energy consumption by 73%, although this affected heating efficiency in colder climates like Pittsburgh's. Building envelope improvements led to a 4.89% reduction in energy use intensity, while Variable Air Volume (VAV) systems showed enhanced efficiency over Constant Air Volume (CAV) systems. The study underscores the importance of integrating climate-specific strategies, adaptive systems, and optimized envelopes for better energy performance and occupant comfort.

Pollution Footprint

A GIS-Based Analysis of Industrial Emissions and Their Impact on Air, Water and Soil Quality

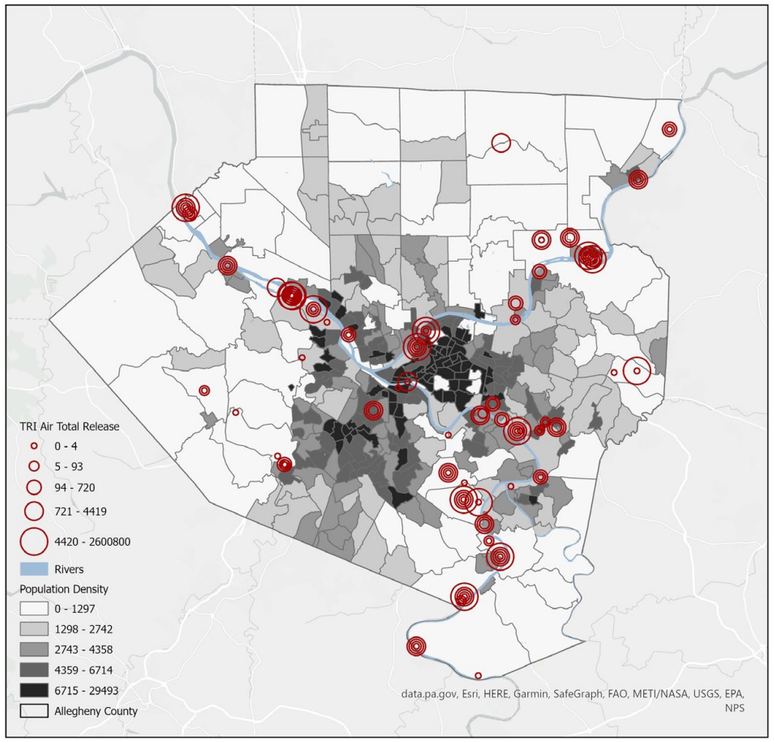


Map of Polluting Facilities in Allegheny County
Data obtained from Allegheny County Toxics Release Inventory

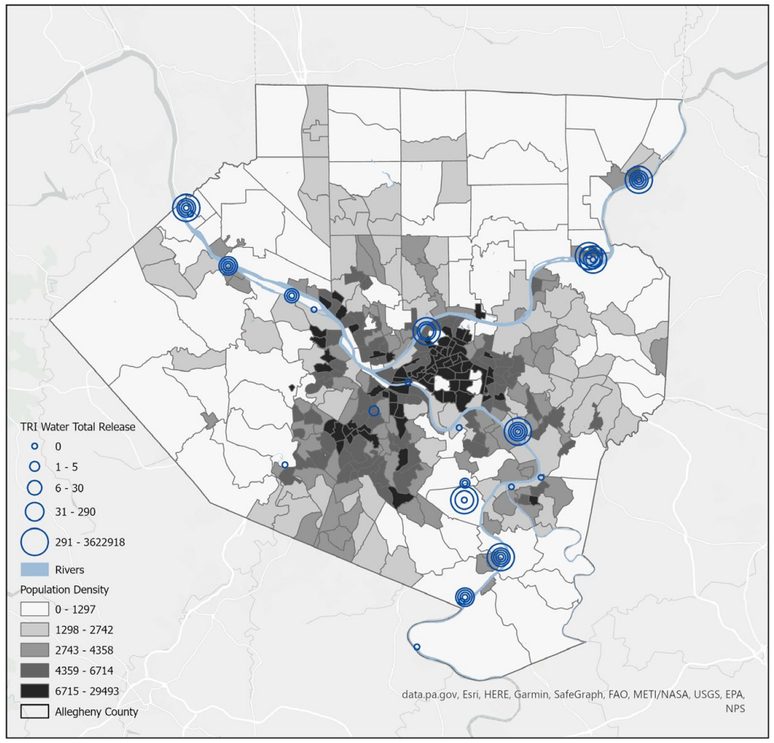
This project investigates the release of toxic pollutants into the air, water, land, and underground in Allegheny County, with a primary focus on air and water pollution. Allegheny County is among the most polluted regions in the U.S., where industrial facilities significantly contribute to hazardous air quality, affecting the health of over 1.2 million residents. Using the Toxics Release Inventory (TRI) dataset from the U.S. Environmental Protection Agency (EPA), this study analyzes pollution patterns from 2018 to 2022 to understand the environmental and health implications of industrial emissions.

The project utilizes ArcGIS Pro to map and analyze toxic releases from various facilities, assessing their impact on air quality, water contamination, and public health. Key GIS tools such as raster analysis, spatial joins, and geo-coding were employed to visualize the distribution of pollutants. Special emphasis was placed on correlating air pollution with PM2.5 concentrations and population density, as well as evaluating the effects of waterborne toxins on regional watersheds. By visualizing toxin release data, this project aims to raise awareness about industrial pollution and inform policymakers on strengthening environmental regulations. The findings highlight the urgent need for sustainable industrial practices and stricter emission controls to safeguard public health and the environment.

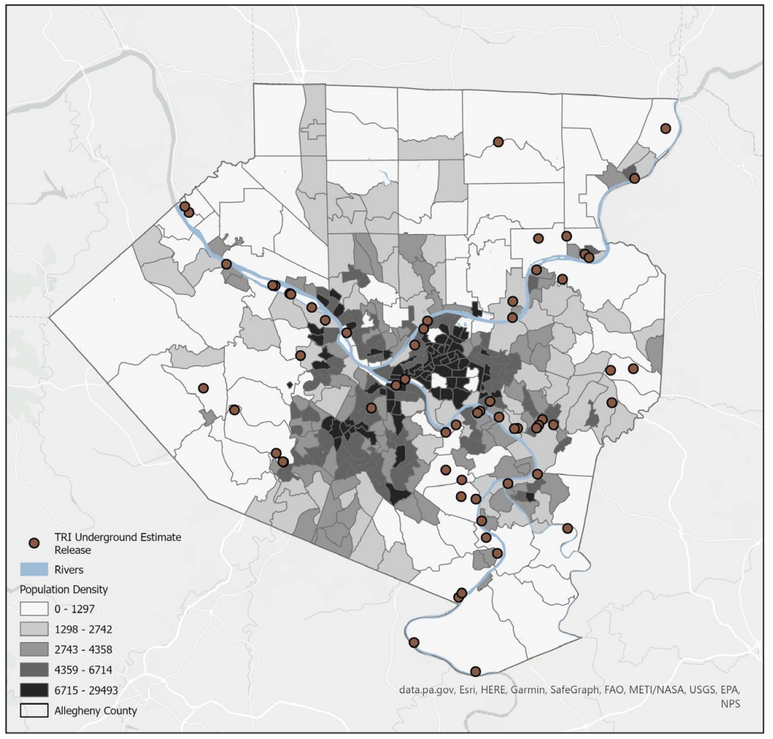
Project Type: Academic | CMU
Course: Geographic Information Systems (GIS) | Fall 2023
Faculty: Prof. Kristen Kurland
Team: Khevna and Manya



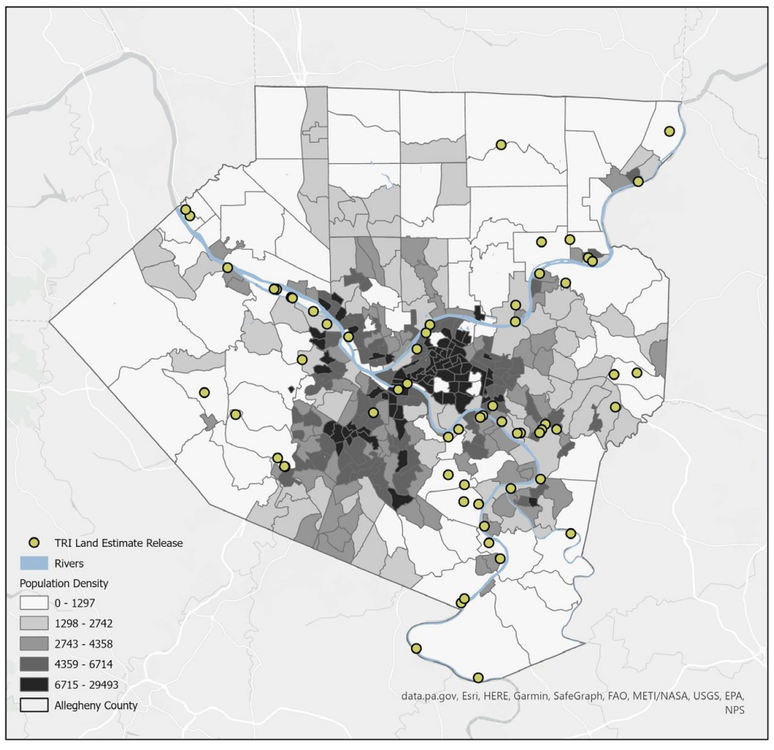
Toxins Released in Air (Total Release) from the Polluting Facilities



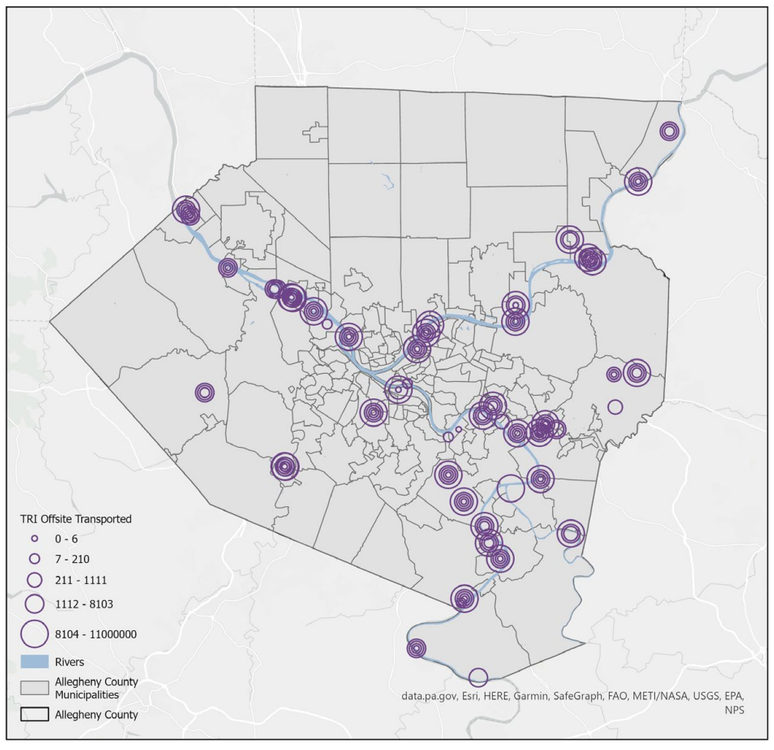
Toxins Released in Water (Total Release) from the Polluting Facilities



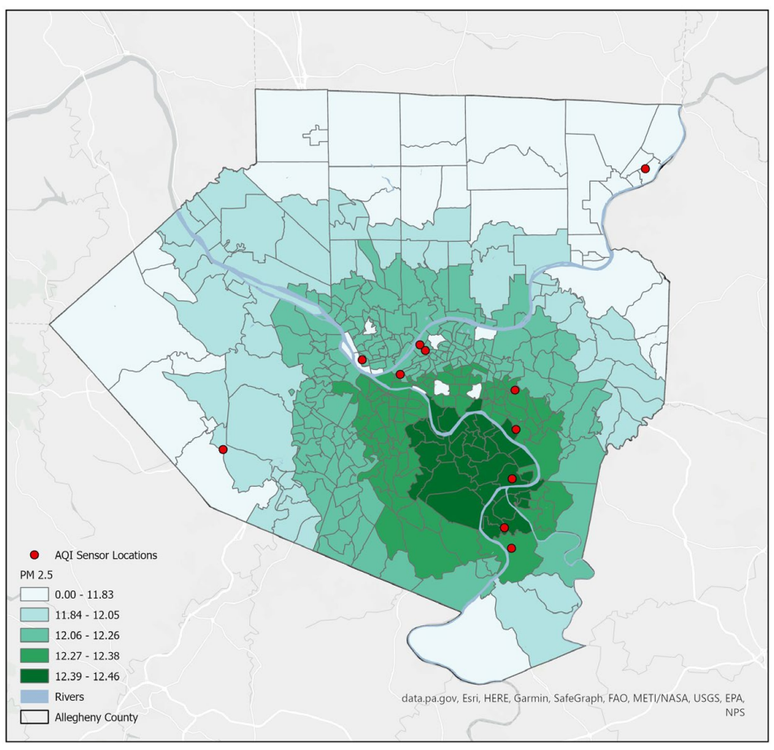
Toxins Released Underground (Estimate Release) from the Polluting Facilities



Toxins Released on Land (Estimate Release) from the Polluting Facilities

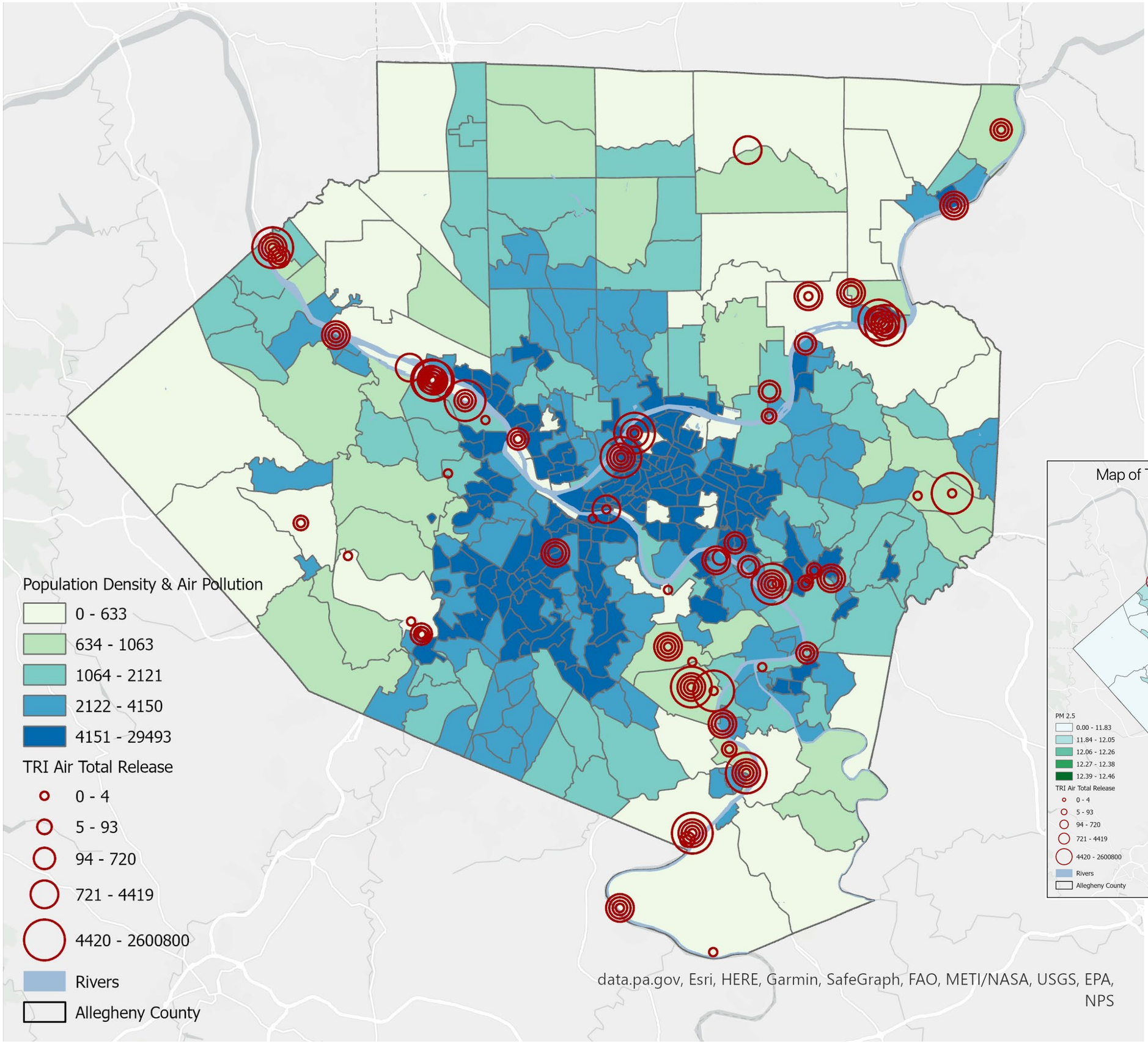


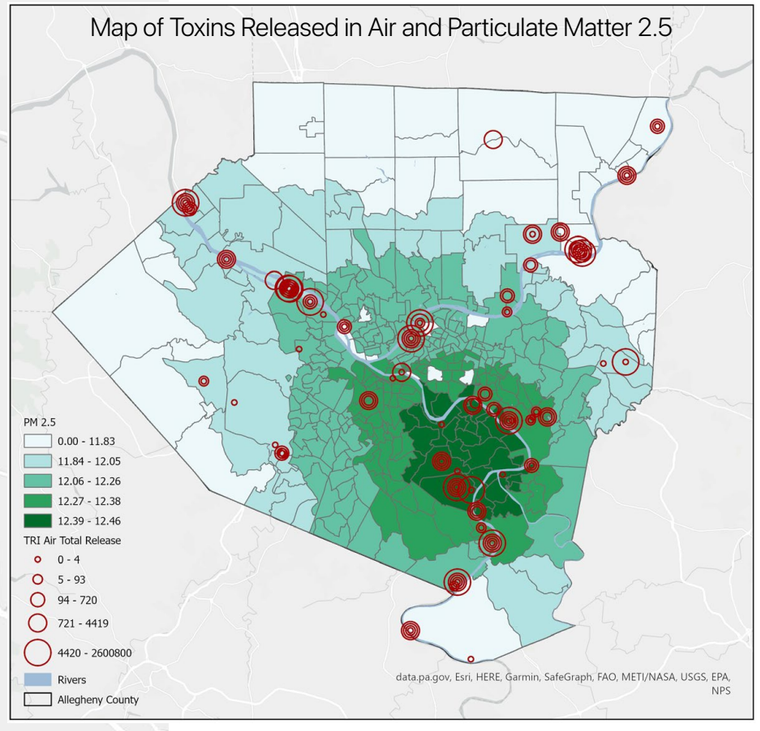
Toxins Released Offsite (Total Transported) from the Polluting Facilities



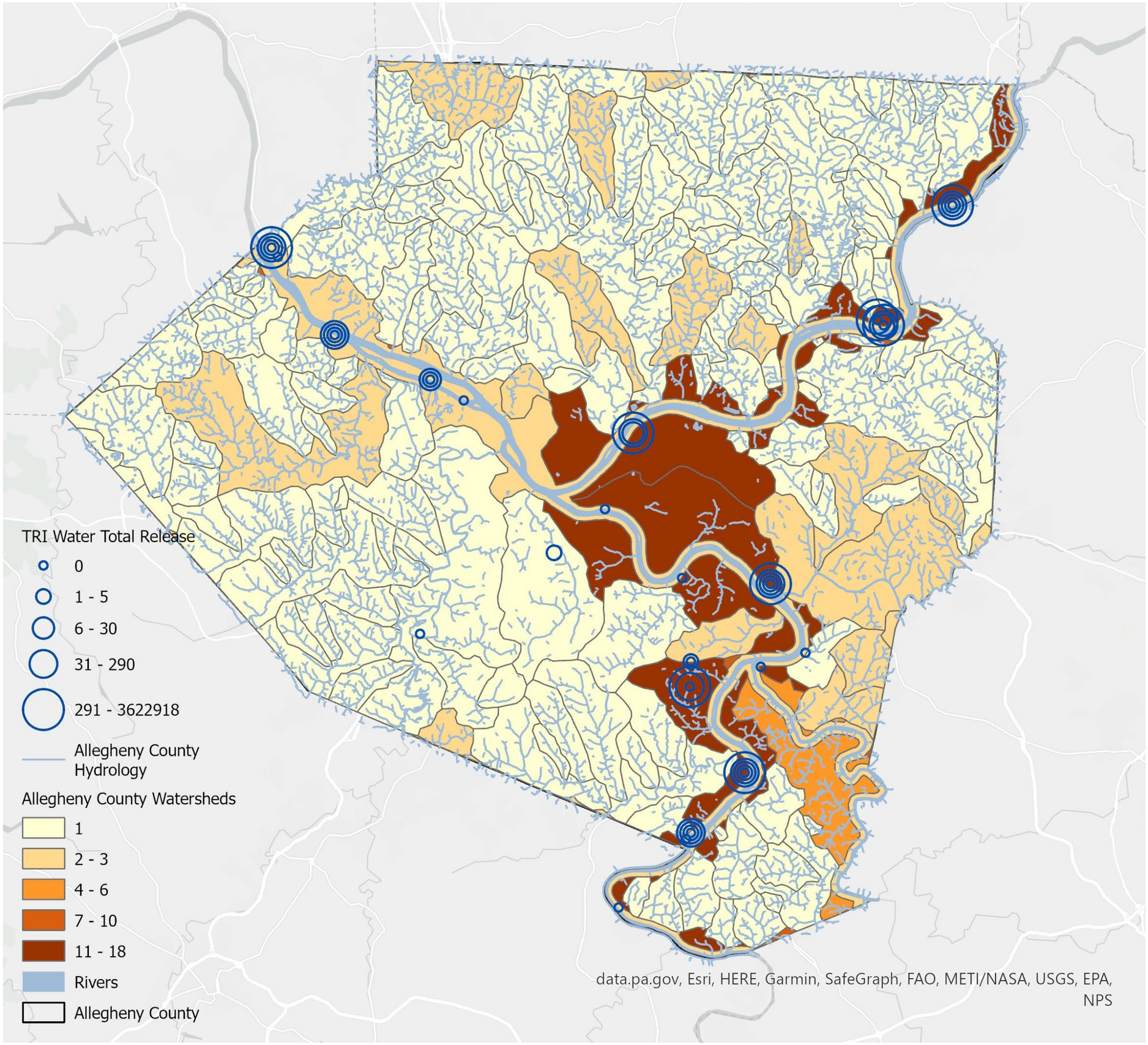
Air Quality Index sensor locations in Allegheny County

The maps highlights high population density in central and southwestern Allegheny County, where residents are exposed to harmful emissions from nearby facilities. Air pollution is especially severe in the city's southeast, with concentrated PM2.5 levels making neighborhoods unlivable, including areas near Point State Park.





Map of Polluting Facilities Affecting the Population Density in Allegheny County (left)



This map illustrates waterborne toxin release and its impact on 52 isolated sub-watersheds in Allegheny County, which drain into the main rivers. The highest-polluting facilities are primarily located along these riverbanks, significantly affecting water quality and ecosystem health.

Map of Toxins released in water affecting watersheds and hydrology in Allegheny County

Echo-Shield

A Mycelium-Based Sound Absorption System

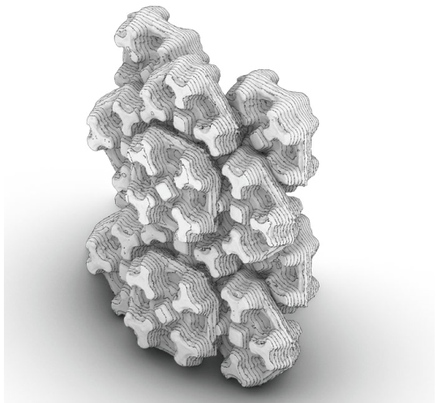
View of Sound Absorption Panels installed on the Highway

Our project aims to design a sustainable mycelium-based sound absorption system for reducing highway noise. The material combines coffee grounds, a natural nutrient source, with gravel to enhance density and compression strength. Using re purposed coffee trays as molds, we created a modular, interlocking system that ensures stability and ease of assembly. Gravel provides weight and sound-dampening properties, while coffee supports strong mycelial growth. The interlocking design incorporates wooden dowels for added stability, and the geometry optimizes sound diffusion and absorption.

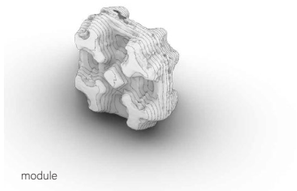
Beyond its functionality, the life cycle of this system is inherently regenerative. Mycelium sequesters carbon during growth, contributing to a net positive environmental impact. Over time, the biodegradable components naturally degrade into the soil, enriching it with nutrients. This process supports reforestation and enhances soil health, embodying a closed-loop, eco-friendly approach. Combining material efficiency, ecological restoration, and acoustic performance, this innovative system offers an ideal solution for sustainable infrastructure.

Project Type: Academic | CMU
Course: Shaping Environments - Experiments in Geometry and Waste Matter | Fall 2024
Faculty: Prof. Dana Cupkova
Team: Khevna, Ella and Vaibhav

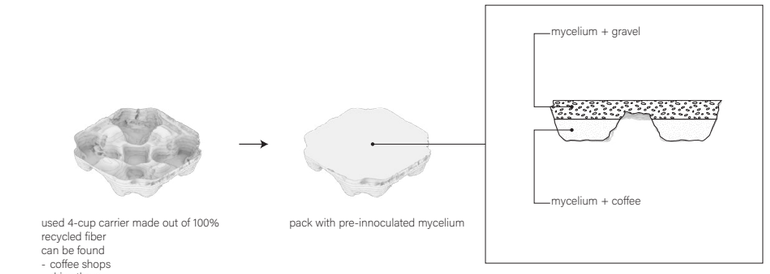
process / assembly diagram



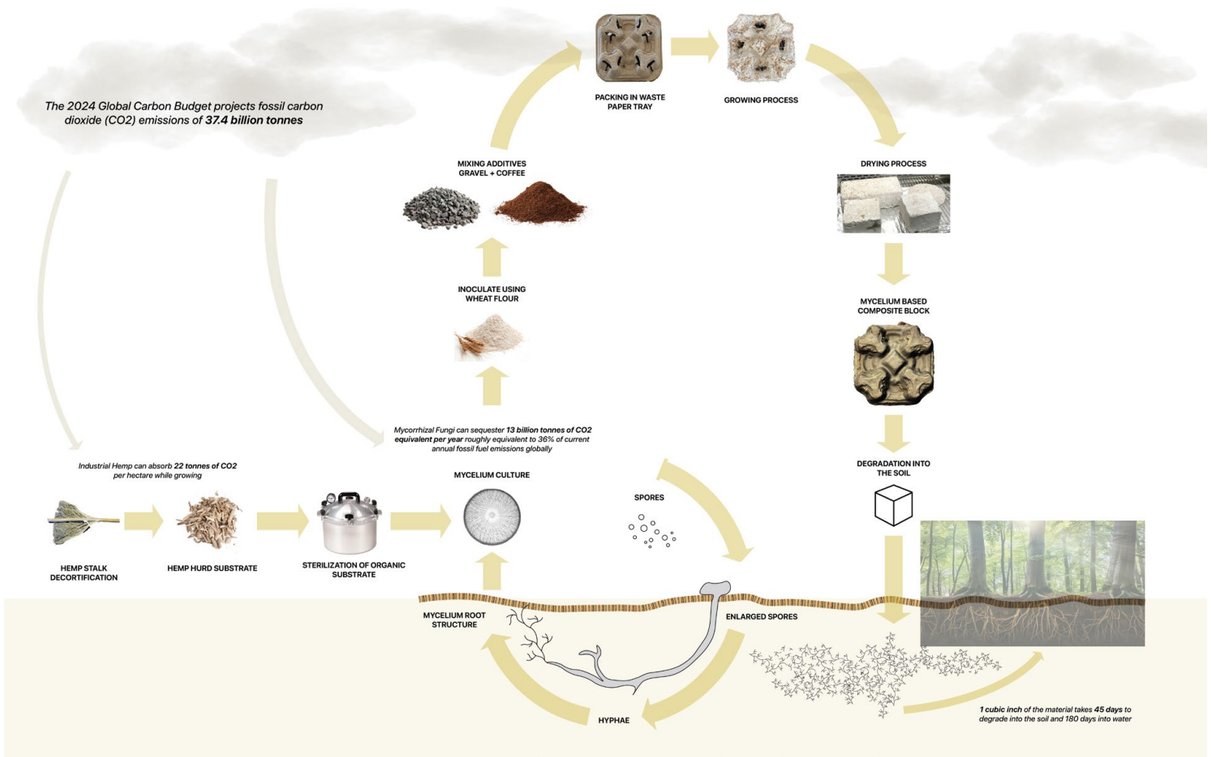
final assembly isometic view



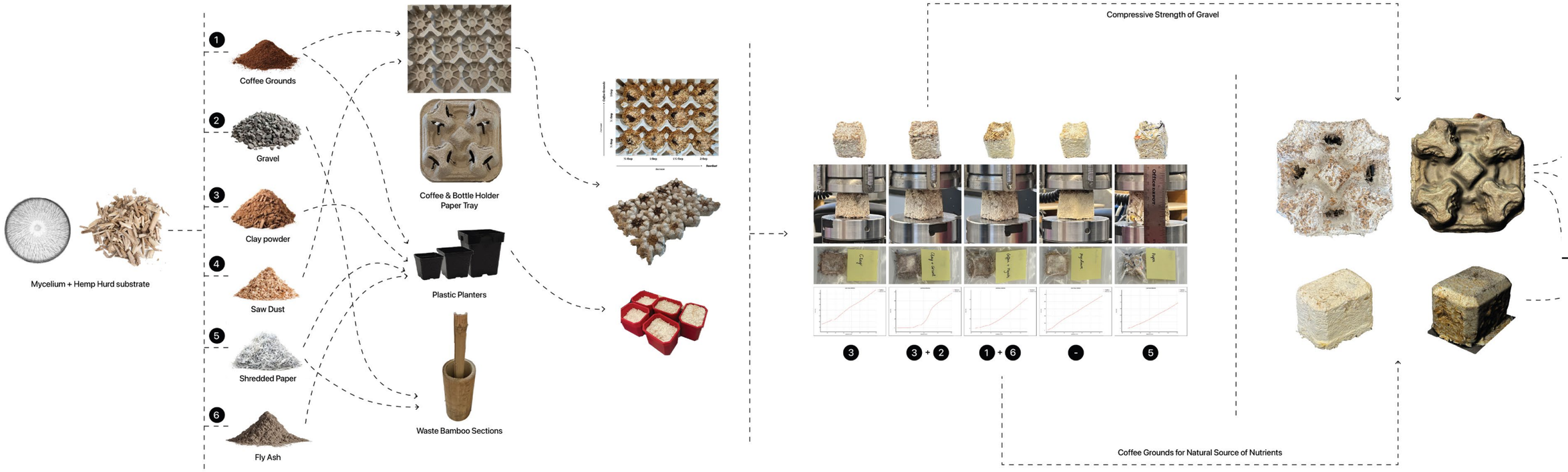
module



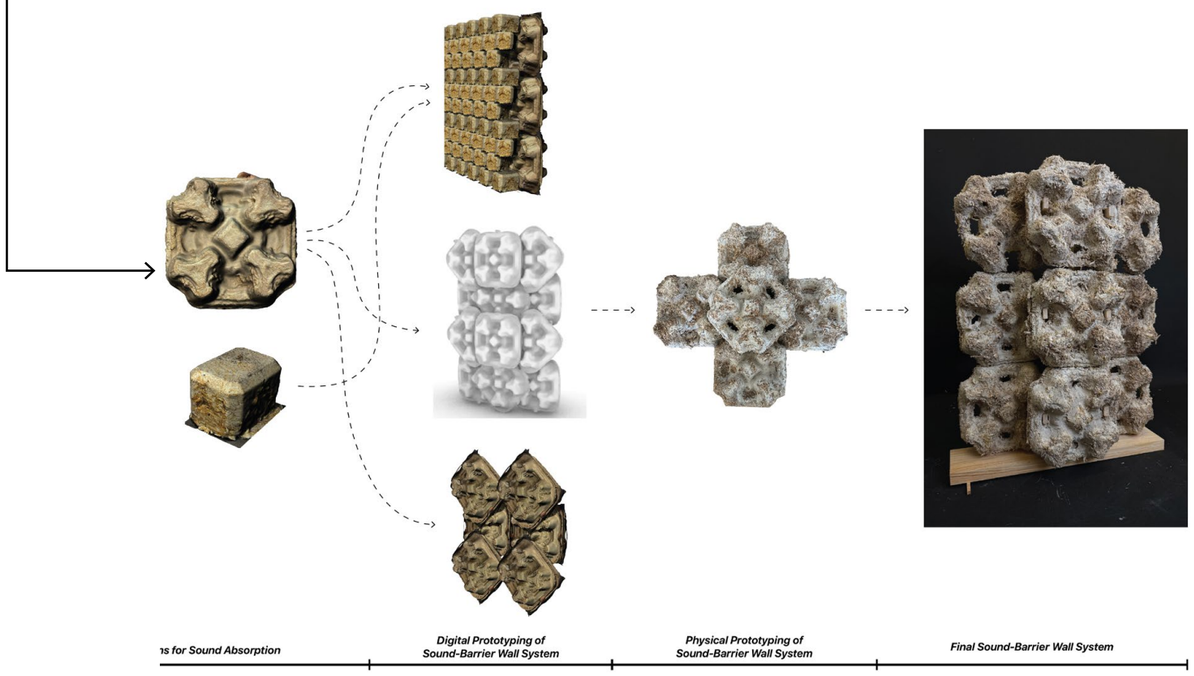
Panel Assembly Diagram



Life Cycle Diagram

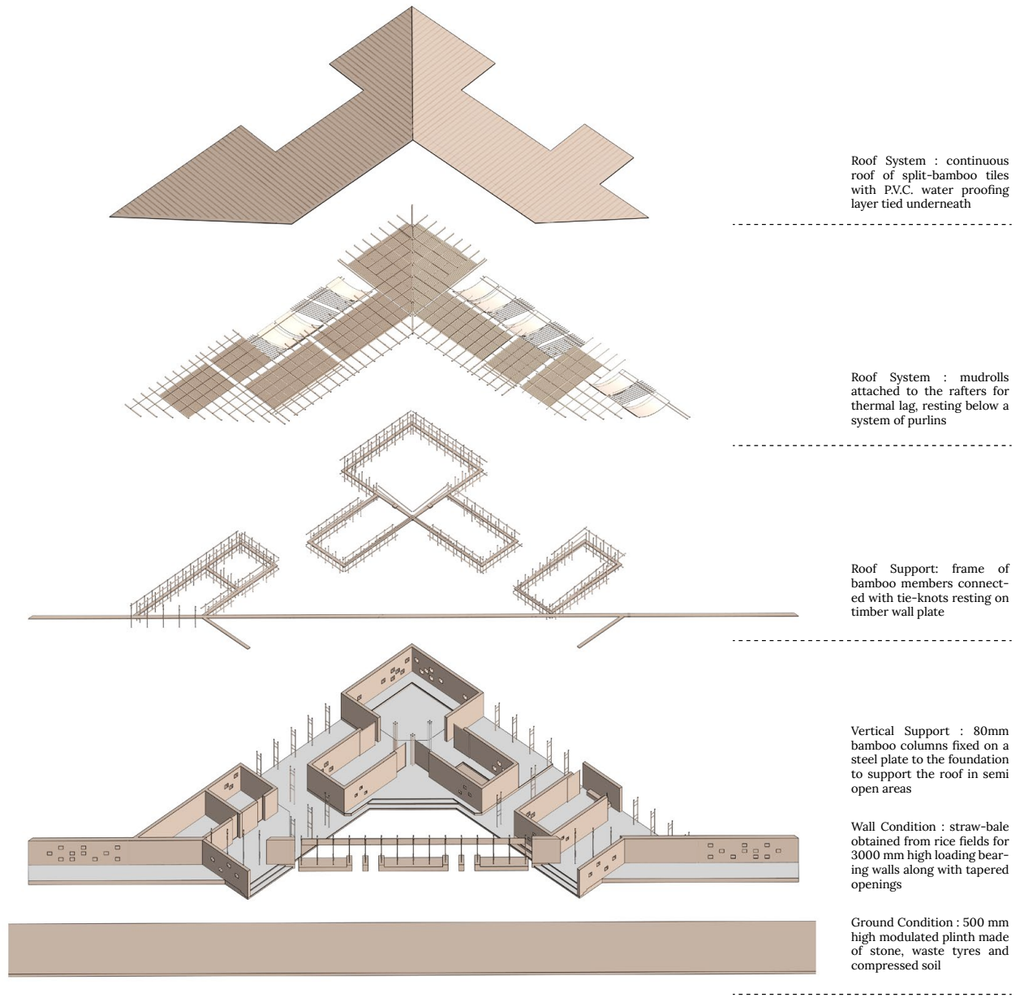


Material Explorations with Additives | *Repurposing Waste Molds for Packing* | *Distribution of Additives* | *Compression Testing - 50 MM X 50 MM X 75 MM Blocks* | *Prototype Explorations for Sound Absorption*



Women's Center in Baghere

Empowering Communities in Senegal Through Locally Sourced Materials

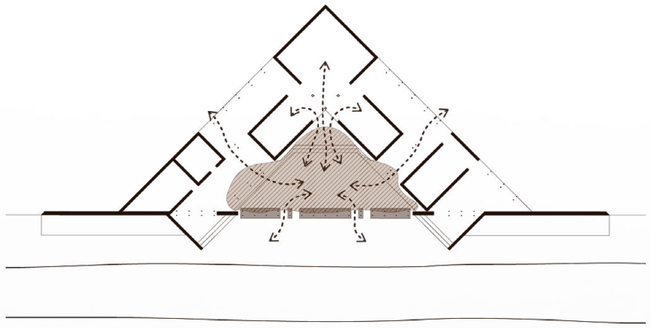


Axonometric view of the Women's Center illustrating the elements and sequence of construction

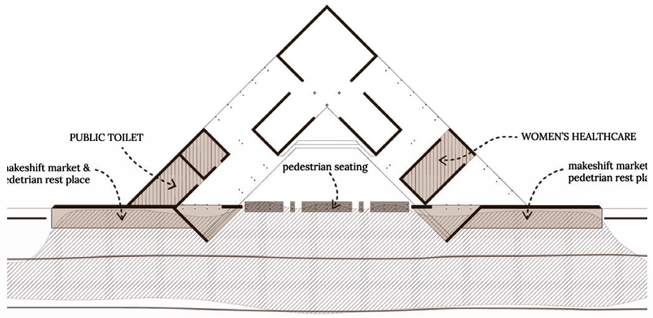
Amidst the differences in the social attributes, relationships and opportunities that are particularly associated with gender, the proposal for the Women's Center nudges the inequalities that are ingrained in our lifestyles. The design is premised on the belief that if the needs of women are consciously integrated along with the purpose of the space, gender equality is not only encouraged but also understood spatially. Thus, the project aims to accommodate the needs of women, while it also opens itself up to become a medium of dialogue between the Women's Center and the rest of the community, as gender equality is not only about women but about all the genders.

The design looks closely into the daily lives of the women of Baghere to identify the essentials that built environments require. First and foremost, it : 1. Accommodates the role of motherhood, 2. Promotes women's health and well-being, 3. Provides public sanitation facilities, in addition to the functions of meeting, gathering, discussing and performing awareness workshops around the issues of gender equality. Through the various programmatic decisions, this Center embodies the spirit of equality and brings women at par with men to be able to become an active participant of their community.

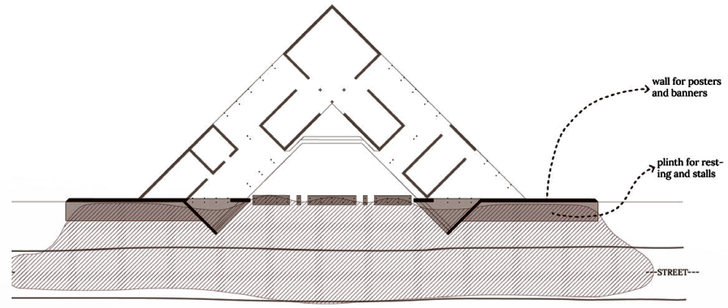
Project Type : Competition Project
Competition : Kaira Looro International Competition | 2021
Team : Khevna, Aditi and Mohit



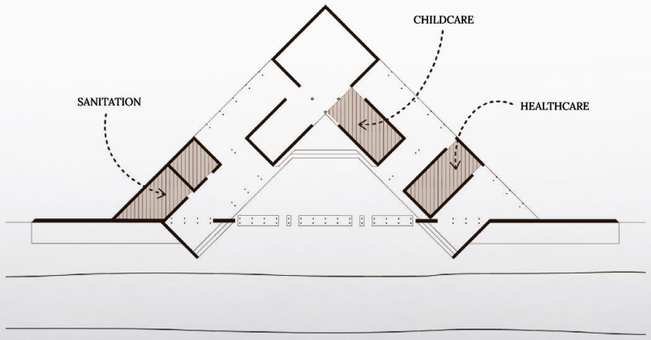
INVITING AND INCLUSIVE



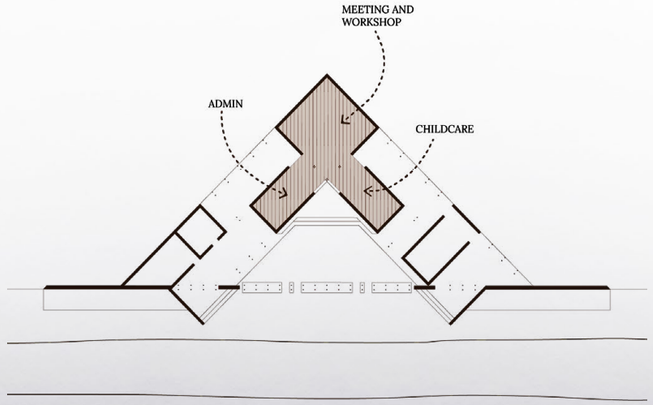
ENHANCING THE STREET



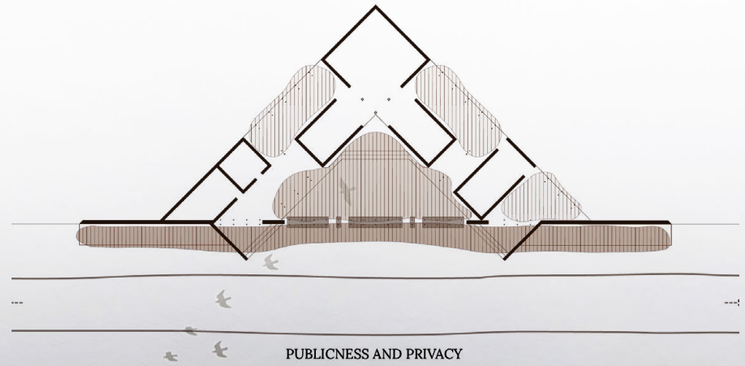
ENGAGEMENT THROUGH THE EDGE



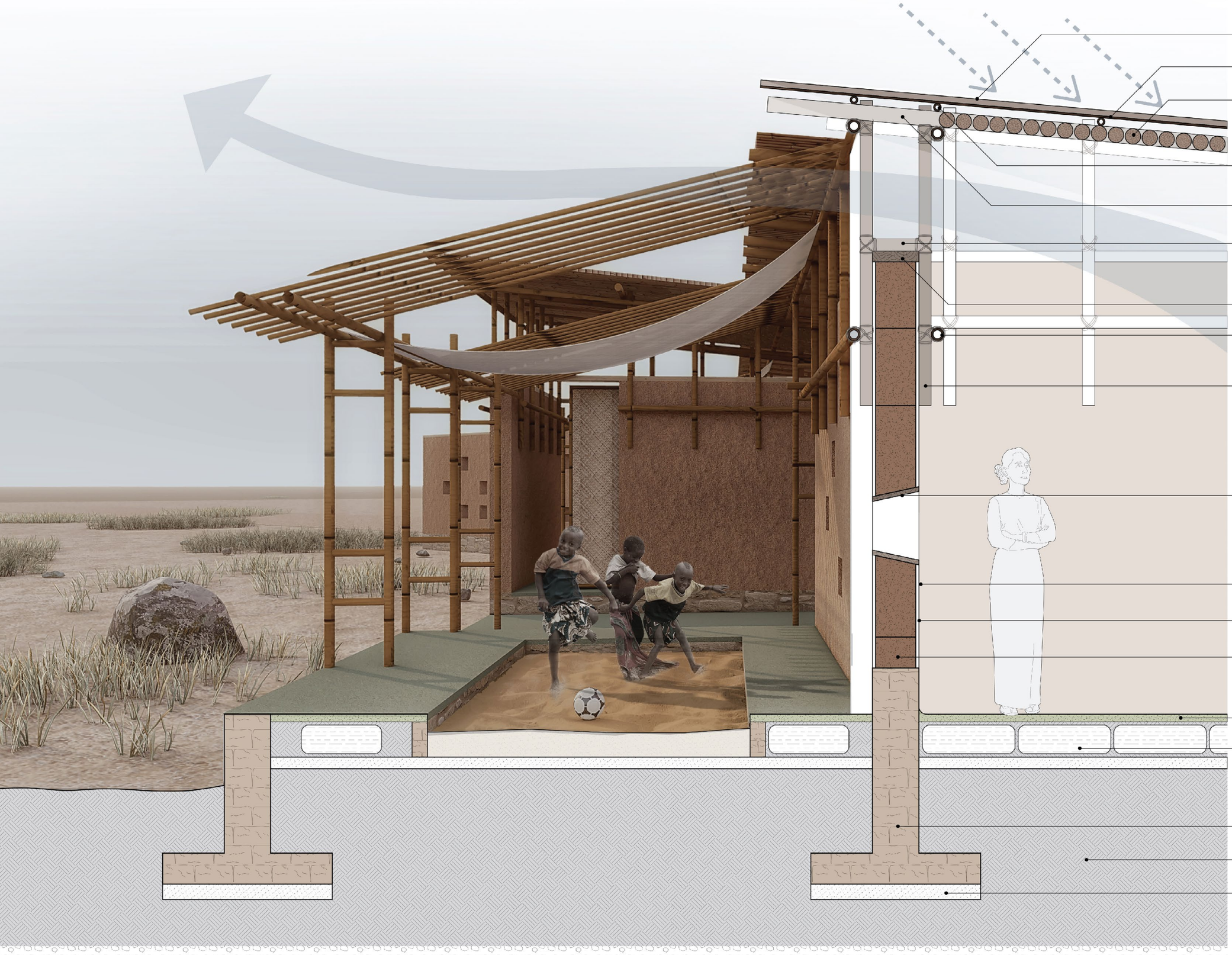
EMPOWERING THROUGH FUNCTION



FLEXIBILITY



PUBLICNESS AND PRIVACY



80 mm dia **split-bamboo tiles**

2 mm thick **PVC waterproofing** layer

120 mm dia **jute mudrolls** for thermal comfort

30-35 mm dia **solid bamboo purlins** 400 mm apart

100 mm dia **bamboo rafters** at 700 mm apart

60 mm dia **bamboo bracing member**

250 mm X 300 mm **white wood timber** wall plate

80 mm dia horizontal **bamboo tie member** running along the wall

80 mm dia vertical **bamboo supports**

100 mm X 300 mm **white wood timber** sill & lintel

15 mm thick **stucco mud plaster** with agricultural waste for binding

wire mesh for holding plaster on bale-wall

300 mm X 450 mm X 600 mm load bearing **rice straw-bale blocks**

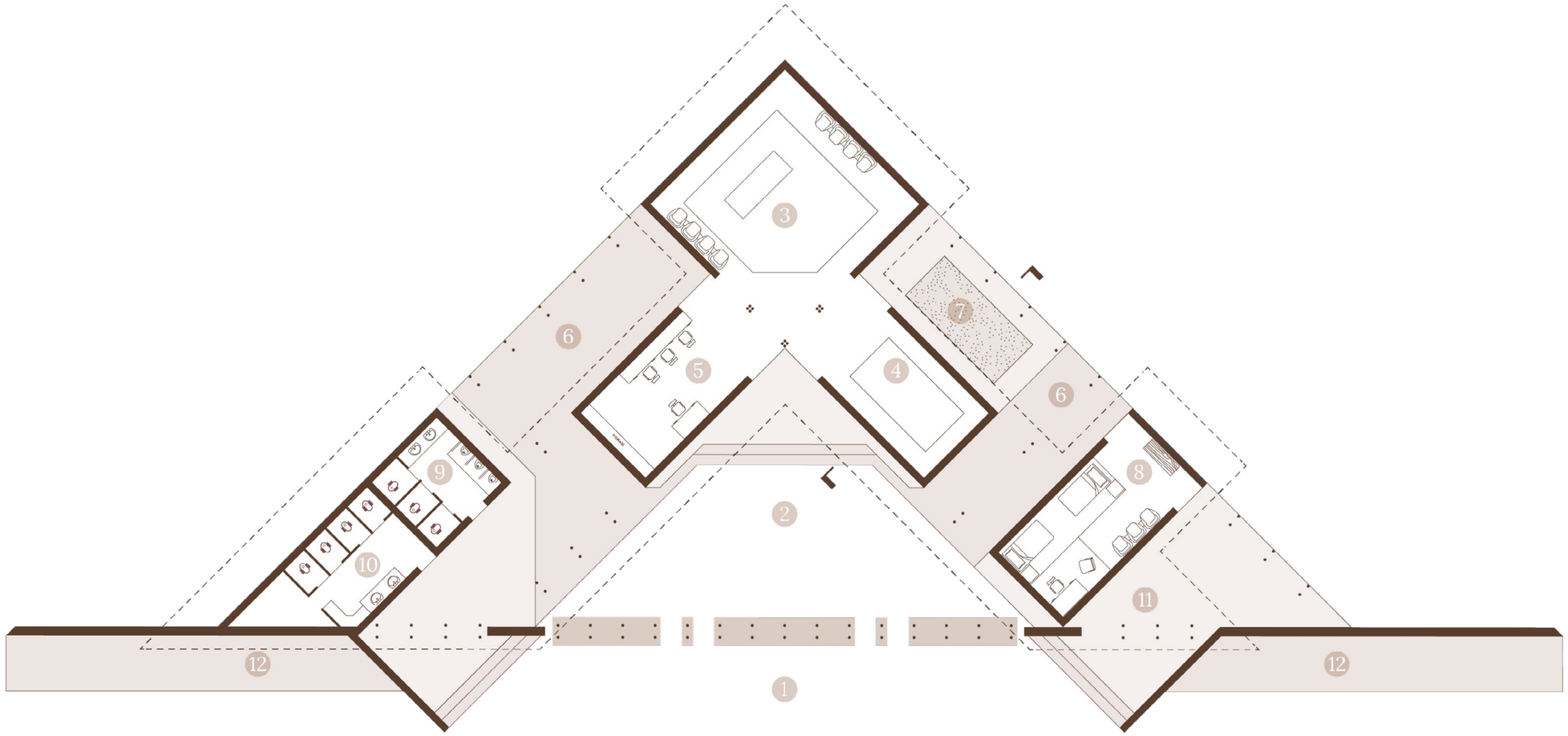
50 mm **IPS (stone-concrete) flooring** for thermal comfort

300 mm top bed : **waste tyres** tied with jute rope & soil-concrete mixture infill

450 mm X 300 mm **stone foundation** with mud mortar

Compressed Earth

75 mm thick **P.C.C. bed**



1. Street Edge
2. Public Gathering space
3. Meeting & Workshop Area
4. Childcare
5. Admin
6. Semi-private space
7. Sand-pit
8. Women's Heathcare
9. Male Public Toilet
10. Female Public Toilet
11. Liminal Space
12. Community makeshift space

Plan of the Women's Center showing the spatial interconnectedness

Urban Wellness

Transforming Spaces for Health and Connection

View of the Wrestling Court with an ongoing Wrestling Match

This project re-imagines the 780,000 sq. ft. Asarwa Park in Ahmadabad, transforming it into a vibrant wellness hub that fosters community engagement, sustainability, and urban revitalization. Despite its location near key government and service institutions, the park suffers from poor sanitation, limited green spaces, and a lack of recreational amenities. At its core, the design introduces a 28,900 sq. ft. institutional wellness center, integrating eco-friendly sanitation solutions, inclusive wellness spaces, and sustainable public infrastructure to create a healthier urban environment.

A key feature is the dry flush composting toilet system, which incorporates waste diversion, composting waste management, and air ventilation for ecological sanitation. The wellness center also includes open decks, jogging trails, gender-inclusive bathing and dry toilet facilities, and multi-use gathering spaces that support physical and mental well-being. By activating this underutilized land, the project blurs the boundaries between private infrastructure and public space, encouraging the Ahmadabad Municipal Corporation (AMC) to embrace a more inclusive, sustainable approach to city planning. This initiative not only enhances public health and accessibility but also sets a precedent for regenerative urban development in Ahmadabad.

Project Type: Academic | CEPT University
Studio: Urban Commons - A place for wellness in the city | 2019
Faculty: Prof. Shubhra Raje
Team: Individual Project

Complete erasure of the walls around the temple, shrines and warehouse to allow for a seamless exchange between the temple activities, street activities and the cafeteria of the health center

A partial access, moderated by tree edge and a designated pathway for differently abled

Merging the vicinities of government properties to carry out civic interest events/protests/awareness camps and enabling a direct access to the peaceful forest for a tired citizen

Openning the back end of the Matabhawani Vav vicinity to the Asarwa park for more engagement

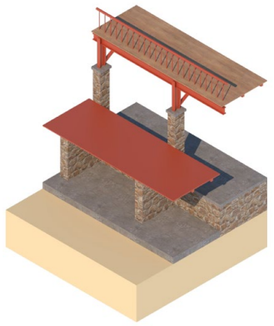
Controlled access from the school to the park for holistic growth and developement at a young age

Unregulated access from the territory of Water Treatment Plant and opening the roof of the underground water tank to host events

1. North approach
2. Vehicular Parking
3. Sanitation Core
4. Wrestling Courts
5. Cleansing Edge
6. Experiential space
7. Forest
8. Service Road
9. South approach
10. Fitness trail
11. Pedestrians trail
12. Vehicular road
13. Retaining Wall
14. Catchement Area

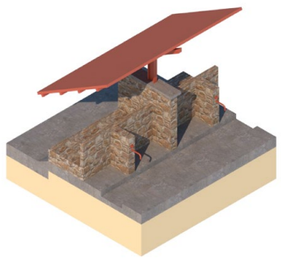
N

1



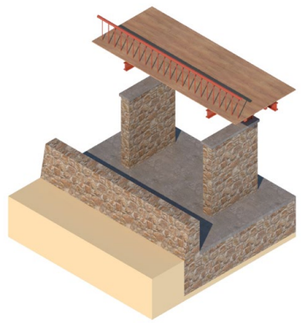
The shaded and separated resting space adjoining the court for Female members.

2



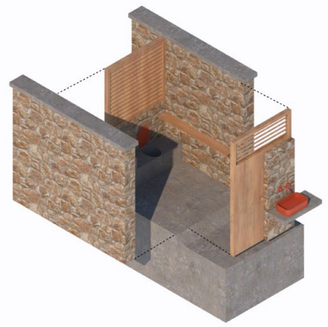
The cleansing edges on both sides of the courts also provide seating for fitness trail users.

3



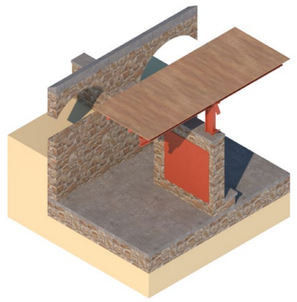
The shaded resting and preparatory space adjoining the court for Male members.

4



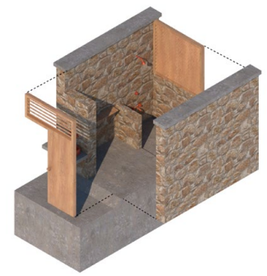
Dry Toilets are lined accessible from inside while the dry pit remains accessed from outside. The design provides ample space to place sanitaries and a dry flush mixture.

5



The resting space, partly open on the Northern edge, adjoining the cleansing bay indoors and alongside locker shelves to store.

6



One of the bathing space, equipped with shower and tap, divided into wet and dry zones and provided with hangers & ledge to store.

Roof system : MS hollow box sections, I-section column and gutter-beam along with rafter and puffed tin roof panels.

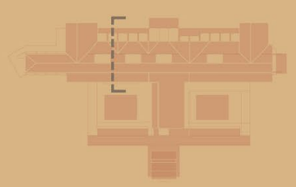
Floor system : 7 M wide truss with 4 M wide I-section beam along with hollow box sections and wooden planks.

Wall system : 300 mm & 500 mm thick stone walls on either sides capped with RCC coping.

Openning system : Teak wood doors and louvred windows.

Plinth system : Stone walls laid below 180 mm thick PCC slab. Pre-cast RCC dry toilet pit.

1. Dry flush mixture : Saw dust & dry leaves
2. Dry Toilet seat with urine diverter
3. First Level : composting waste
4. Second Level : finished compost
5. Air Vent extending through first level roof
6. Urine collection Tank
7. Maintainence door
8. Manure transferred to wheel barrow



0 0.5 1 2 4 M

Villa in Coimbatore

Fostering Connection Between Built and Natural Environments

Aerial Perspective revealing the villa's spatial layout with a central courtyard

This conscious villa design prioritizes the preservation of the site's existing trees, integrating them into the architecture to enhance both the aesthetic and environmental quality of the space. The ground floor features a main entrance that separates private and guest areas, with the living and dining spaces opening onto a covered patio that connects seamlessly to the pool area, where one of the trees becomes part of the veranda. The service areas, including the kitchen, utility spaces, and staff rooms, are placed at the southern end, while the garage and other facilities are arranged to create a private courtyard, shielding the pool from neighboring buildings.

On the first floor, the den and terrace overlook the pool and adjacent tree, while bedrooms maximize views of the surrounding greenery. The total built-up area is 10,828 sq ft, with the ground floor comprising 2,572 sq ft of built-up space, 1,442 sq ft of outdoor covered area, 2,872 sq ft of ancillary built-up area, and 377 sq ft of ancillary outdoor covered area. The first floor has 3,337 sq ft of built-up space, with an outdoor covered area of 226 sq ft

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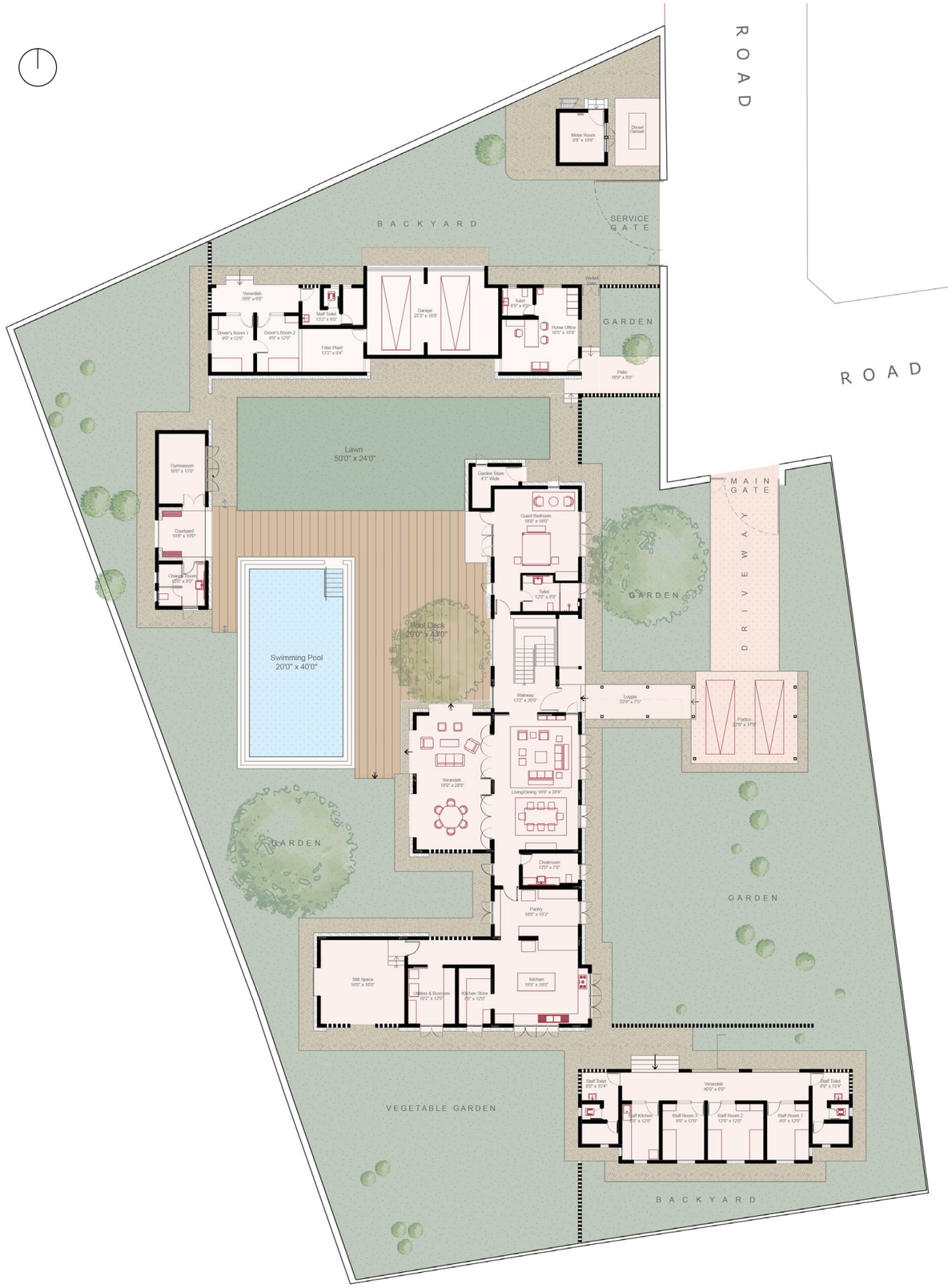
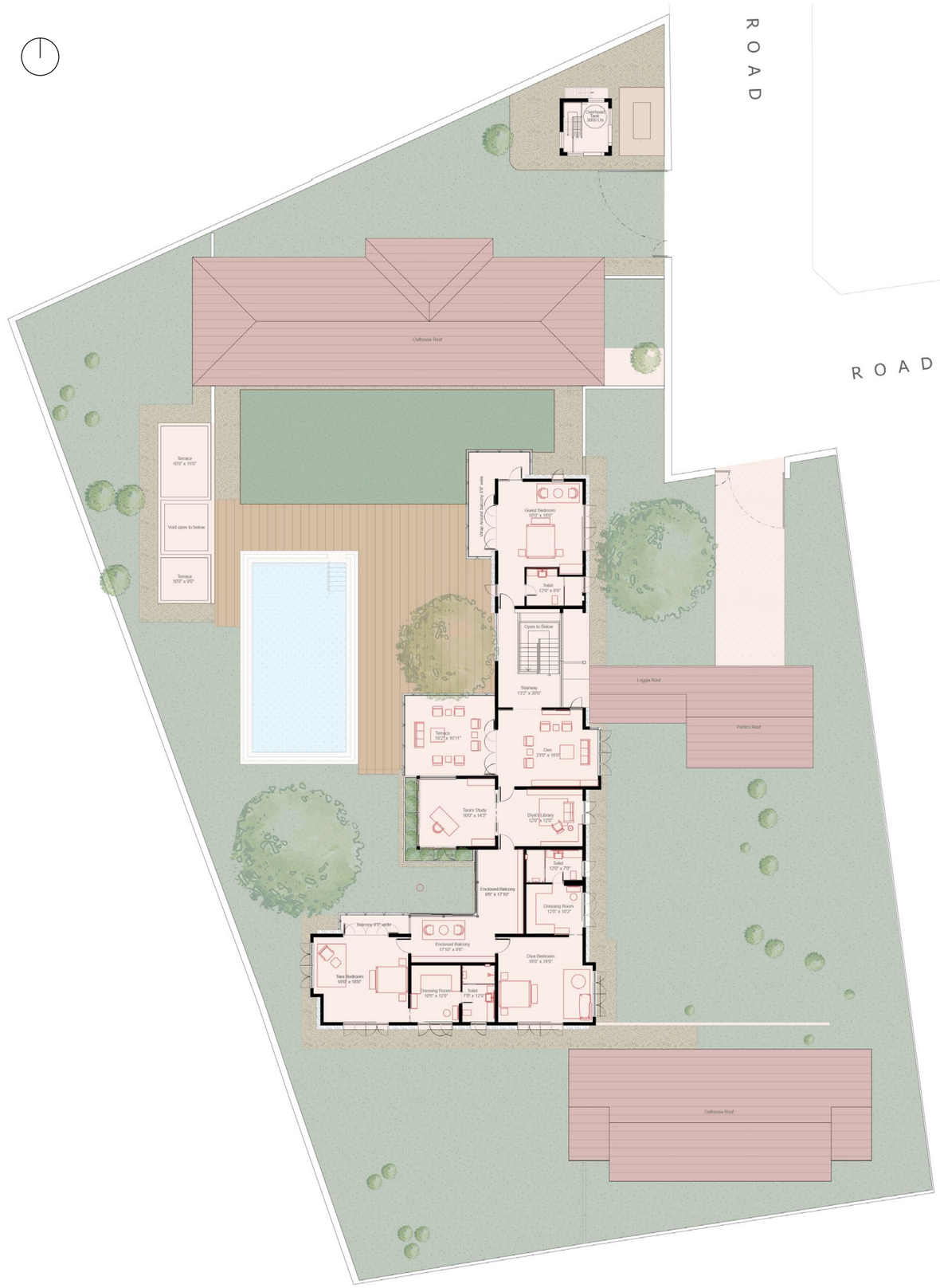
Project Type: Professional Residential
Firm: Ranjit Sinh Associates Architects | 2022
Principals: Vandana Ranjit Sinh and Ranjit Sinh
Team: Khevna, Ranjit Sinh



Ground Floor Plan - Main House, Pool Room, Adjoining Quarters, Parking & Water Tank



First Floor Plan - Main House and Water Tank

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