U.S. DEPARTMENT OF ENERGY
Solar Decathlon
2023 DESIGN CHALLENGE
OFFICE BUILDING
WENTWORTH INSTITUTE OF TECHNOLOGY

PROJECT SUMMARY

The Habitat is a mixed-use commercial office building that focuses on creating a complete environment and utilizes the need to adaptively reuse previously developed sites. The project reaches beyond the site's borders to combat issues such as climate change and the decline of local ecosystems. We have strived to create a design that takes into account not only the users of the building but all of the community's stakeholders. Our team, faculty advisors, and industry partner, New England Development, envision a place that is resilient for the present as well as the future, energy efficient, and a place people desire to be. Overall, we transform a site that is home to obsolete grocery store into a fully integrated and educational one that provides a glimpse into the future of building standards.

DESIGN STRATEGY

The focal point for The Habitat was to create a building that was as close to carbon neutral as possible as well as transform the site so that it can thrive for the future. This goal was achieved by implementing a combination of passive and active design strategies at the initial stage of the project. For starters, the building's structure consists of mass timber. With the site bordering the Charles River, the team assessed the existing restraints and responded by mitigating the effects of water surges through the use of a rain garden and rainwater collection system. An optimized building form maximizes solar gain in terms of daylight availability, renewable energy strategies, and interior vegetation incorporation. Combining these features with other smart design choices, The Habitat is a living building that works with its surrounding environment, not against it.

PROJECT DATA

Location: Watertown, MA, United States
ASHRAE Climate Zone: 5a
Lot Size: 10.54 Acres
Building Size: 234,000 sq. ft.
Occupancy: 4,074 People (394 ft2/person)
Construction Cost: $126,916,418
- $542 / sq. ft.

Energy Performance:
- 12.05 kBtu/ft2/yr (w/o PVs)
- 3.59 kBtu/ft2/yr (with PVs)

Monthy Average Building Utility Cost: $8,962
Embodied Carbon: -625,700,000 kgC02e/sq. ft
Annual Carbon Emissions : 268 tons C02/yr

TECHNICAL SPECIFICATIONS

R-Value:
- Wall: 39 h-ft^2-F/Btu
- Roof: 48 h-ft^2-F/Btu
- Windows: 5.97 h-ft^2-F/Btu

U-Value:
- Windows: 0.167 Btu/ft^2-F

HVAC:
GSHP (5.3 Cooling Cop, 4.8 Heating COP)
Water Storage Capacity: 486,000 gal/yr
On-Site PVs: 1,331,000 kWh/yr

PROJECT HIGHLIGHTS

ARCHITECTURE

- BUILDING ORIENTATION

Building form utilizes site to maximize solar gain along the south facade.

- DOUBLE SKIN FACADE

Farmer's market and greenhouse along southern facade embodies a living environment that provides vegetation and purified air to the occupants of the building.

ENGINEERING

- MASS TIMBER STRUCTURE

Utilize new structural techniques that are more beneficial to the environment, lighter than typical construction structures, and are aesthetically pleasing.

- RETAINING WALL

Concrete retaining wall adjacent to the northern facade of the building allows for an activated retail level along Pleasant street.

DURABILITY & RESILIENCY

- RAINWATER HARVESTING

Rainwater management recycled into grey / black water for the building.

- RAIN GARDEN

Acts as a habitat for local vegetation and wildlife while at the same mitigating the effects of rain / flood water surges.

ENVIRONMENTAL IMPACT

- CARBON SEQUESTRATION

Mass timber structure sequesters carbon meaning it has a negative embodied carbon.

- REUSE OF MATERIALS

Materials from existing building are sorted on site and recycled off site.

- BIKE STORAGE / PUBLIC TRANSIT

Reduces CO2 emissions.

- POLLINATORS

Providing a safe habitat for pollinators that help the local ecosystem.

MARKET ANALYSIS

- CHARLES RIVER GREEN WAY

Site borders a walking / bike path creating a far-reaching connection with the surrounding communities

- DEMOGRAPHICS

The building's program opens the door for all demographic types to work / access the building.

- PROXIMITY TO BOSTON

Watertown is a short distance away from Massachusetts capital, Boston.

INTEGRATED PERFORMANCE

- AI AUTOMATION

Optimizes the use of passive as well as active systems to maximize energy savings.

- RADIANT FLOOR HEATING

Provides thermal comfort at the appropriate time.

OCCUPANT EXPERIENCE

- INTERIOR ATRIUM

Brings in natural sunlight and acts as stacked ventilation that redistributes rising air back into the MEP Penthouse.

- TERRACES

Provides attractive views and shading for office users.

- GREEN WALLS

Enhances air quality and provides a connection to nature.

- EDUCATIONAL NODES

Curated stops that educate visitors about the importance of habitats.

COMFORT & ENVIRONMENTAL QUALITY

- PASSIVE SOLAR SHADING

Horizontal shading devices along the east and west facades reduce glare from the rising and setting sun.

- BALCONIES

Provide shading from the southern sun and visually enhance user experience.

- OPERABLE WINDOWS

Operable windows ensure a controllable environment to the user's needs.

- GREENHOUSE / INTERIOR ATRIUM

Purifies air and passively sequesters CO2 enhancing the occupant experience.

ENERGY PERFORMANCE

- GEOTHERMAL HEAT PUMP

Efficient HVAC system with a better COP efficiency compared to a typical HVAC system.

- PV PANELS

Solar photo-voltaic panels on the roof and building-integrated glass solar cells on the southern slanted facade generate a considerable portion of the building's power.