NEW YORK HARBOR SCHOOL

Renovation and Extension of New York's Maritime Secondary School

The Cooper Union for the Advancement of Science and Art | Education Building (EB) Division | April 4, 2023

Project Data

Location: Governors Island, New York City, USA
Climate Zone: ASHRAE 4A
Lot Size: 7 Acres
Building Size: Retrofit: 32,000 ft^2, 3 storeys
New Building: 60,000 ft^2, 2 storeys
Occupancy: 900 students
Construction Cost: $878/ft2 ($79 million)
Source EUI: 51 $kBtu/ft^2$/year
Site EUI w/ PV: -15 $kBtu/ft^2$/year

Technical Specifications

Thermal Performance ($ft^2 \cdot °F \cdot h/BTU$): Walls: R-20; Roof: R-40; Foundation: R-10; Window: 0.2 $Btu/h \cdot ft^2 \cdot F$
HVAC: Geothermal Heat Exchanger, Heat Pumps, Radiant Panels, Hydronic Heating/Cooling, Dedicated Outdoor Air System w/ Energy Recovery
On-Site PV: 36,993 ft^2 (350 $kBtu/ft^2$-yr @22% Effy)

Project Summary

The Urban Assembly New York Harbor School is a public high school that occupies a unique position as an institution since it is located on Governors Island. The Harbor School is dedicated to a career preparatory education built on the city's maritime experience and provides students with opportunities to learn on, in, and around the water. The school is submerged in the history of the city, with the current building housed in a renovation of a former hospital for the Coast Guard.

The NYC Mayor's Office and School Construction Authority announced plans for The Harbor School's expansion. Our proposal challenges the attitude of strict standardization to showcase the unique characteristics of the school, its site, and its students. We are designing net zero, sustainable designs for the retrofit of former military barracks and a new academic building connecting the campus to community spaces and the harbor. The unique location poses an obstacle to our design since the school is in a flood zone. To combat this, we are building above the design flood elevation designated by FEMA and working to make the building a haven for the community in times of inclement weather. Our combination of design and mechanical systems limit the amount of energy that the building uses, and photovoltaic systems fully support the energy needs of the building and supply excess power to the grid. The design responds to climate conditions absorbing floodwater, integrating structural resiliency measures, and incorporating passive ventilation, energy piles, solar and geothermal systems.

Design Strategy

The design has three overarching sections: the retrofit of Building 555 into classroom spaces, the design of a new academic building on the adjacent triangular site housing sports facilities and new lab spaces, and the landscape in between the buildings.

Our design follows five key objectives: the creation of a campus that connects the existing building to the expansion, as well as provide exterior spaces of gathering and leisure for students; the integration of the campus into the larger urban composition of the island; respecting the codes of historical preservation for the existing buildings; consideration of climate conditions and methods to collect, store, and supply renewable energy with systems and materials that allow the construction to operate at net-zero carbon emissions; and lastly the mitigation of potential flooding protecting the campus and community.

Project Highlights

1. Architecture - The New Academic Building places the program along a staggered North-South axis, creating a serrated bar that ends with the larger program volumes of the lobby, pool, and gymnasium. The West facade is a landscaped wall that acts as a thermal mass for the classrooms. The North-South axis is followed by the sawtooth roof canopy, which provides shading over a landscaped basin and skylights into the building.

2. Engineering - A geothermal heat pump effectively distributes heating and cooling throughout the spaces using radiant panels to meet the building's needs. The ground source geothermal heat exchanger loops will be integrated with the pile foundations underneath the new building. A dedicated outdoor air system (DOAS) with heat recovery provides ventilation for each space minimizing energy demands and collecting otherwise wasted heat in the exhaust air.

3. Market Analysis - The building cost is estimated to be $79,000,000 meeting cost per sq. ft. and new seat targets. Operational costs are reduced due to energy efficient systems.

4. Durability and Resilience - All mechanical systems are placed on higher levels of the buildings for resiliency in case of flooding. The PV system with battery storage serves to power the building during potential power outages.

5. Embodied Environmental Impact – Local materials sourcing and use of carbon-negative CLT superstructure reduce embodied carbon. The debris/waste from the demolition of the renovation will be used as fill for the basement of retrofit Building 555 prone to flooding.

6. Integrated Performance - Our structure is optimized to garner maximum passive heating, cooling, and ventilation to lower the building's energy consumption throughout the year. For the retrofit, acoustically protected vents allow for cross ventilation throughout the building and the solar chimney draws air through the building to maintain a comfortable climate and optimal fresh air for the occupants.

7. Occupant Experience – Security systems, LED lighting and outlets are strategically placed based on occupancy/vacancy and spatial flow/dimensions while emphasizing the effects of lighting on learning experiences and the use of AV systems in classrooms and public assembly areas. Organization of spaces and finishes will highlight the building's materiality while enhancing the classroom environment and prioritizing safety.

8. Comfort and Environmental Quality - The DOAS has a bypass valve for natural ventilation mode activated by the building management system (BMS) based on outside air conditions. The BMS will: 1) coordinate lighting and automated solar shades when usable daylight is available, and, 2) warn users to keep windows closed during mechanical cooling and will stop circulating chilled water to avoid condensation when windows are open. Rainwater will be recycled on site for use in toilets and landscape irrigation reducing water waste and runoff.

9. Energy Performance - Geothermal heat pumps with high Coefficient of Performance (COP) and radiant panels eliminate duct losses and increase efficiency. The DOAS with heat recovery recovers energy and reduces heating and cooling loads. Solar panels outputting 2,848,461 kBtu/yr are integrated on the new academic building roof for a positive-energy design.