UNIVERSITY OF NORTH TEXAS- MULTIFAMILY BUILDING

UNT COLLEGE OF ENGINEERING

THE EAGLE'S NEST

APARTMENT COMPLEX FOR UNT GRADUATE STUDENTS

PROJECT SUMMARY

The mission of Eagle's Nest is to reimagine the built environment, keeping sustainability at our forefront and the design of an eagle's nest as our touchstone. Eagle's Nest is a response to the high carbon emissions from residential buildings and the crucial need for on-campus graduate students housing at UNT Discovery Park. Our project goals include:

- Meet the crucial need for on-campus graduate student housing at UNT
- Tackle head-on the high carbon footprint of residential buildings by reducing emissions by 50%.
- Provide accommodation for UNT graduate students at 20% less than the market average.
- Immerse students in the cutting-edge renewable energy research at UNT.
- Create community among students that encourage innovation, social action, and excitement towards a more sustainable future.
- Facilitate relationships between university students and the Denton community through an open and green environment for community gatherings

DESIGN STRATEGY

Reduction! We plan to reduce the HVAC loading through passive ventilation with an overhanging breeze way across the door side of the units and covered patio/balcony by the rear door. Automated window treatments to minimize radiation through non occupancy hours to preserve internal temperatures and PCM (Phase Change Materials) insulation acting as a thermal resistor, reducing HVAC loading up to 20%. We will also include VRF heat pump HVAC systems for residential and VRF geothermal heat pumps for ground floors. Grid connected solar with disconnect and battery bank will be sized to insure net zero energy costs with option for power island in event of another major grid outage event.

PROJECT DATA

Location: United states, Texas, Denton, 76207 University of North Texas Discovery Park

Climate Zone: ASHRAE 3A

Lot size: 7.5 Acres

Building Size: 858 ft^2

Occupancy: 152

Construction cost: $380/ft^2

On-site EUI: 27.8KBTU/FT2/YEAR

Average Utility Cost: $892/month

TECHNICAL SPECIFICATION

Insulation Values

Wall: R-29.86

Roof: R-30

Foundation: R-10

Glass

U value: 0.262-0.444

HVAC

Radiant flooring

Geothermal

Variable Refrigerant Flow

Heat pump

Passive Ventilation (external window shading with airflow pathways near windows & walls)

Renewable Energy sources

PV Cells: Roof mounted: 523 units, 47,195 kwh

Parking Structure: 565 units, 50,985 kwh

Wind: Turbine walls: 70,460 kwh/yr

Advanced wind wall: 43800kwh/yr w/4 units

PARTNERS

EOS Labs

Gensler

Architecture: Before Air Conditioning, regional populations took more care when building houses. Particularly in North Texas, they would allow for passive breezes to cool the house, create outdoor shaded areas to linger (front porch), and utilized readily available/vernacular building materials (wood frame, wood siding, cedar shingles, white paint). In the advent of mechanical systems for heating/cooling, we have become increasingly dependent on energy production/use; which ultimately, is a major contributor to carbon emissions adversely affecting our climate. "The Eagle's Nest" is designed with this in mind. We are creating a more dense version of the vernacular – heavy timber superstructure, wood walls, ethically sourced and sustainable finish materials throughout; yet, with ultra-efficient cutting edge mechanical systems. We are not only using less energy, but we are creating it on-site. This balanced cohesive design concept allows us to move into the future while considering the lifecycle of student housing. This project aims to inspire the students/occupants by proving the difference between traditional suburban apartments and the new upgraded method to achieve carbon neutrality.

Engineering: The building utilizes a radiant heated floor slab to reduce heating load on the HVAC system and provide a more consistent temperature profile from the floor to ceiling than a traditional convection system. The walls will be built using locally sourced, bio-based building materials in conjunction with a phase change material thermal storage layer to reduce peak cooling loads during the day and heating loads at night. High R-value materials will further reduce the load on the HVAC system. A variable refrigerant flow HVAC system will allow for optimization of the airflow within the building by providing only the required amount of conditioned air to the rooms and floors based on occupant sensors. All appliances and fixtures are energy-star rated to reduce usage as much as possible. Water heating, provided in each living space, allows readily available hot water while minimizing the energy required to heat it through the smaller scale of the water heaters.

Market Analysis : This apartment complex is very affordable for UNT graduate students. The 1 bedrooms are affordably priced at $920 while the 2 bedrooms are $1320. This is 20% below market price for similar apartments. Similar apartments in Denton cost about $1300 for single bedrooms and $1600 for two bedrooms. We will be using locally sourced materials from local businesses in the DFW area. This will reduce the overall costs of construction. As stated earlier, our market for the Eagle's Nest are UNT Engineering graduate students. 69% of UNT Engineering graduate students are from India, 17% from the United States, 3.8% from China and the rest from other countries. This means, the majority of UNT Engineering graduate students are international and require living spaces that are close to campus. So, they are not dependent on public transportation. Eagle's nest is a 4min walk to the UNT Engineering campus. About 50% of students are in the age bracket of 22-23 years, with the next age bracket being 24-25 years. From our research, we saw that most graduate students are single and do not prefer to live in large apartments which causes an increase in rent, energy use and maintenance. The square feet for each Eagle's Nest apartment are strategically designed to be just the right amount of space needed for a single student. This enables us to keep the apartments at a low cost, which is a major factor for graduate students.

Durability and Resilience: This site on UNT Discovery park campus allows housing units to maintain power during grid outages with the use of battery backup systems, and multiple energy production systems utilizing solar, wind, & geothermal energy. Water catchment systems with passive solar water heating will be used in this building. Eagles nest utilizes natural light through windows, skylights, and light pipes minimizes the use of led lighting. Passive HVAC through natural convection, variable refrigerant flow cooling, geothermal heat pumps, radiant heating, and cooling; and smart ventilation systems to regulate housing unit temperatures. Our highly efficient energy star appliances and fixtures further reduce the power consumption of each housing unit to create more efficient use of stored energy. The building will utilize steel reinforcement joint, and heavy construction timber which will give support to the building and make the building more resistant to the fire incident. The material will maintain durability during harsh conditions such as storm and snow.

Embodied Environmental Impact: Material used will be locally sourced wood and concrete. Any natural materials displaced through the construction process will be up-cycled into building and landscaping materials. With the selection of naturally occurring hardwoods such as oak and Osage orange and limestone; clay from the excavation can be used for site water features that also feed into the water storage and filtration systems the site will be a transformation of its own raw materials into finished products. The wind walls on the east façade will be manufactured by UNT they can be continuously improved on without having to buy a whole new product and reducing the cost of implementation. Materials and labor are sourced locally from the Dallas Fort Worth Area. The cut in transportation needs for students living off-campus is extinguished while providing food on-site whether it is from the greenhouses or the cafeteria. There is also a DCTA bus route connecting UNT Discovery Park with the rest of UNT and Denton. The rain catchment we have on-site maximizes the use of rainwater etc for everyday use.

Integrated Performance: With each system for the Eagle's Nest, we tried to give solutions which supply benefits further than just their primary use. This can be seen in the shading the wind wall will provide to most of the south-facing units, the rainwater catchment and covered parking provided by the solar panels over parking spaces, and the removed units supply passive ventilation to the building as well as supplying more natural light to the space. All the renewable energy systems, lighting, plumbing, and HVAC will be integrated into our Smart Building Managements system which will be controlled and optimized through The Nest phone application. The inclusion of outdoor spaces will encourage residents to take time away from their living spaces, further reducing the energy usage of the building. The Eagle's Nest is meant to supply a green housing alternative to residents while also encouraging them to engage in more sustainable lifestyles through the integrated phone application, exterior exercise spaces, waste and methane capture system, and ever-changing green energy research that will be incorporated into the building.

Occupant Experience: Eagles nest is utilizing the following strategies to ensure a positive occupant experience of the building. We have exterior circulation in the apartments which shade the unit from direct solar gain. The operable glazing offers cross ventilation & natural daylight. We also offer lightweight concrete topping the finished floor for increased durability. Apartments also have LED Lighting with occupancy sensors to reduce energy consumption. All appliances in the building will be LEED-certified, while water fixtures must be WaterSense stamped to ensure we are complying with sustainable needs. Eagle's Nest also features planted handrails that add to the aesthetics of the building. Apartment will also have integrated building intelligence that utilizes the internet of things and artificial intelligence to track energy use and building systems. The system will track each occupant's habits from appliance usage to their daily schedule to give it predictive capabilities that enhance the occupant's experience.

Comfort and Environmental Quality: To ensure comfort there will be sensors and controls that will show metrics like thermal, electrical, wind, to reach comfort levels. There will be smart product integration that will automate building functions such as HVAC, lighting including blinds, light tubes, and the function of appliances to facilitate everything for the residents. The operation will be safeguarded by a battery backed-up renewable energy source that is monitored through the smart building management systems to ensure functionality and efficiency to meet our emissions goals in case an unexpected event happens. User controls of integrated smart systems will be through an app to make the process simple. The insulation, spacing, and variable refringent flow ductless systems in the building help reduce interior acoustical noise by roughly 20%.

Energy Performance: Our EUI is 27.8 kBtu/ft2. We achieved this value by reducing energy usage, increasing efficiency, and using renewable energy sources to meet energy requirements. This was done through the integration of Phase Change Materials into the walls to provide insulation. We also maximized the use of natural light through Low E glass windows, using LEED & Water Sense certified appliances and building architecture that utilized natural light. We also used LEDs to provide additional lighting. Smart Building Management systems are also used to facilitate energy efficiency in buildings. Other energy needs of our building were provided through renewable sources like solar and wind energy. All these implemented together ensured our building reached net-zero. energy.