Problem Statement

The purpose of this IPRO is to design an efficient, sustainable, durable, net-zero energy, net-zero carbon emissions structure. The building must be constructed according to traditional building costs.

Objectives

1. Design a durable, 300-year lifetime, structure that will have net zero carbon emissions and draw zero energy from the grid over time.
2. Do research to discover the most efficient possible route to attain net zero energy.
3. Prove that the structure created is a green, sustainable, net-zero structure.
4. The structure created should be easily done such that it can be used as the base for future projects in creating and designing a net-zero energy home.
5. Work efficiently with the group members to reach the mutual goals of the purpose of the IPRO.

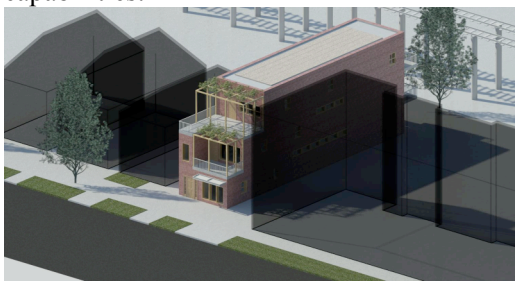
What is Net-Zero?

A net-zero structure is one that, simply, does not draw energy from the grid and does not leave a carbon footprint in the atmosphere. This project designs a structure that has extremely limited thermal emissions through exterior walls as well as the roof. The use of a ever evolving products for designing a green home, the research put into finding such products and the ability to organize these products together is incredibly important for putting together the simplest way of discerning net zero. Another important note is that this structure is a net zero carbon e-missions structure. This is made possible by eliminating the necessity of gas in the structure. Instead, all appliances are electric and the building uses radiant heat from a Geothermal System.

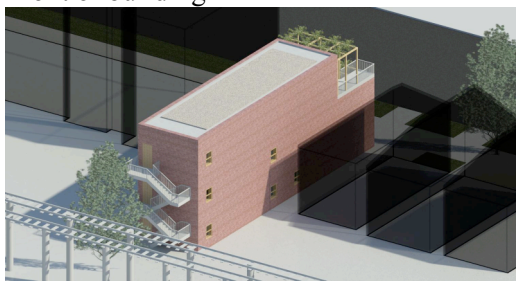
Getting to Net-Zero

The research and steps to get to net-zero are outlined below. The division and subdivision of persons into groups was incredibly important in getting to net zero. It is important to note that not all steps were going on simultaneously but often were created as a result of further inquiry.

1. **As-Built Structures**: This
2. **Solar and Wind Energy:** The main focus of this group was to keep a running tally of how much energy is necessary for the building to keep off of the grid according to the appliances used and average power consumption of a typical family.
3. **Civil and Structural:** The focus of the group was to provide structural advice for the building, soil tests for the site, benefits of below ground unit, and aid in calculating R values for the wall sections in question. Ultimately the group was very helpful laying the ground work of the project.
4. **Heating, Ventilation, and Air Conditioning:** High efficiency mechanical products can maximize the use of renewable energy and can allow any building to achieve Net Zero. These options include ground source heat pumps and radiant heating supplying our units with the best heating options today, allow for less energy usage, and keep residents happy.
5. **ICFs:** The research about Insulated Concrete Forms focused on ensuring that the use of concrete for the base wall structure would be durable and provide for resistance to heat loss through the exterior walls.
6. **Designing the Envelop:** The envelope design was important to have for E-Quest especially, but also so that the final product would show a traditional looking housing unit with very high-tech capabilities.



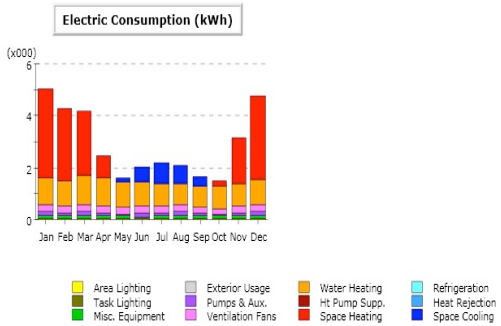
Front of building



Rear of building.

7. **E-Quest:** This is the group whose work would ultimately show that the structure designed would be a net-zero energy, net-zero carbon emissions

structure.



Challenges

The team faced several challenges throughout the course of the semester. One of the most challenging pieces of the net-zero proof were the technical challenges becoming acquainted with the E-Quest software and modeling a building within it. There were a variety of test models to become acclimated to the modeling environment before running the building created by the Designing the Envelop team given the approximated energy consumption for HVAC, lighting, appliances, et cetera.

Less technical challenges that presented themselves include the initial confusion about the goal of the IPRO. Information from the sponsor was often confusing but through furthered communication between the faculty advisor, students and sponsor, the challenges were faced by a group of people who genuinely wanted to design a better home for tomorrow.

Recommendations

Due to the nature of the project, it is recommended to review the research done and understand that this would be best approached as a two-semester project ending with the actual construction of the building. It is especially important to understand that no matter the amount of research that may or may not go into the project, the construction element may change the actual efficiency of the building due to errors during the construction process.

Also, the use of Green Technologies in mainstream design for residential applications should be more readily available to the masses for the creation of a net-zero energy structure to be more attainable.

Conclusions

This project has successfully fulfilled all requirements of the problem statement. The use of ICFs to create a durable structure that is easily sustained and will stand the test of time marks the 300-year lifetime. It was shown through E-Quest that the structure would be a net-zero home with an R-50 wall to prevent heat loss through the walls. This is, of course, an evolving technology. The roof spaced required for solar panels and wind energy over time will inevitable reduce with higher efficiency ratings but the hybrid system for this structure meets all criterion for the electricity needs based upon the average. It has also been shown that it can be done at traditional building costs based upon the cost-benefit analysis lead by the HVAC group.

Special Thanks

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IPRO 317 – High Efficiency Green Homes

netZERO

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