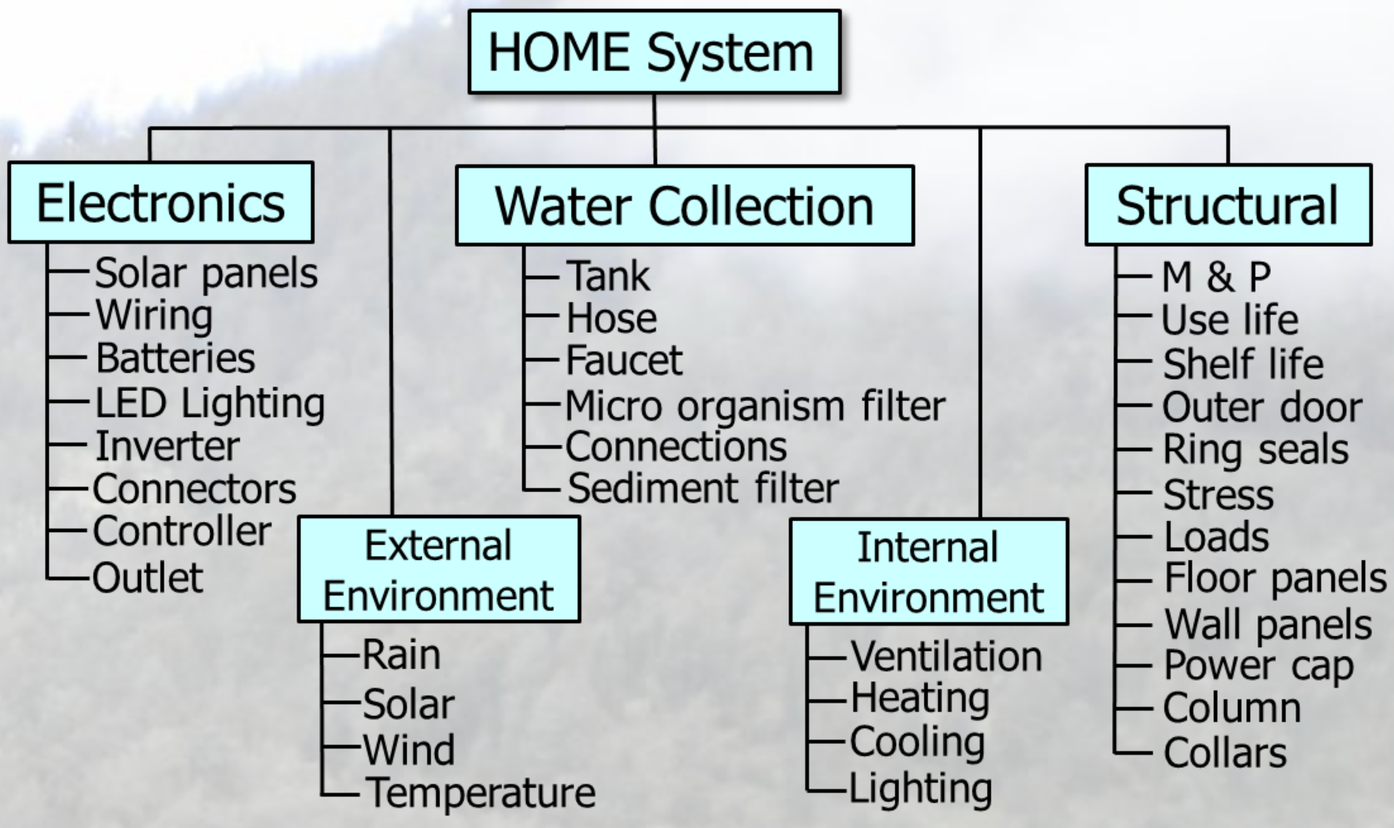
Human Occupied Modular Environment (HOME)

Problem Statement

The ultimate goal of HOME is to provide an alternative to the disaster relief housing currently available on the market. Design specifications from the client included requirements for simplicity in setup, space to house three to four people, and modular in nature such that units may be combined to accommodate larger families. The shelter also incorporates systems to address human needs such as water and electricity. The HOME design was completed using a systems engineering approach that included the capstone design team members simultaneously working on the structural, water and electrical systems as well as their interfaces.



Above: *Diagram of subsystems and initial design requirements as provided by the client.*

Electrical System

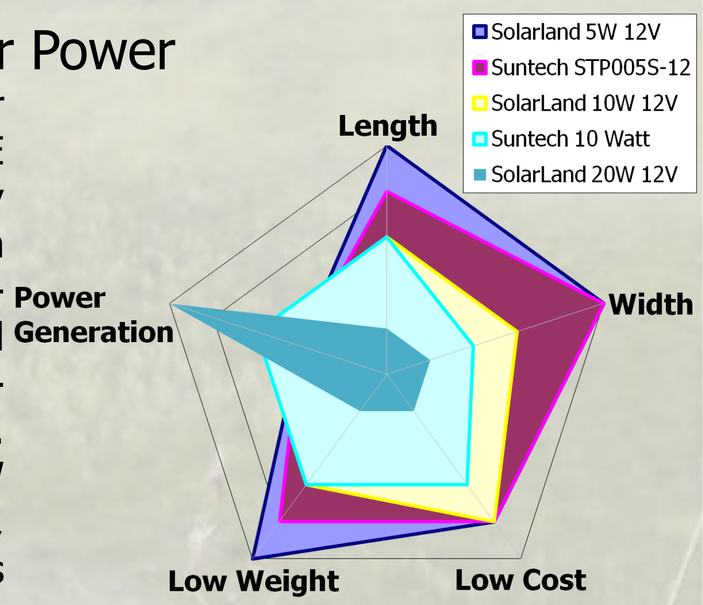
Human Power

A requirement requested by the client was to use human power, allowing users to provide their own energy. Considering human power generation research, it was determined that a crank would be optimal and provide 75 - 100 Watts/hour. Testing was completed to confirm this research as well as to design for the ergonomics and human factors. This testing was conducted by having four participants crank with one hand, two hands, and pedal from both a seated and standing position. Each trial lasted 1-2 minutes.

Above*: Human Power Generator purchased from WindStream Power and used for the purpose of our experiments.*

Solar Power

The other renewable power source selected for the HOME design was solar, specifically photovoltaic arrays. Research provided 5 polycrystalline options for comparison, based on desired dimensions, power output, weight and cost. Using 18 of the Solarland 5W 12V panels costs $630, weighs 29.7 lbs, and provides 90 Watts of power.



Above: *Radar chart used to select solar panels.*

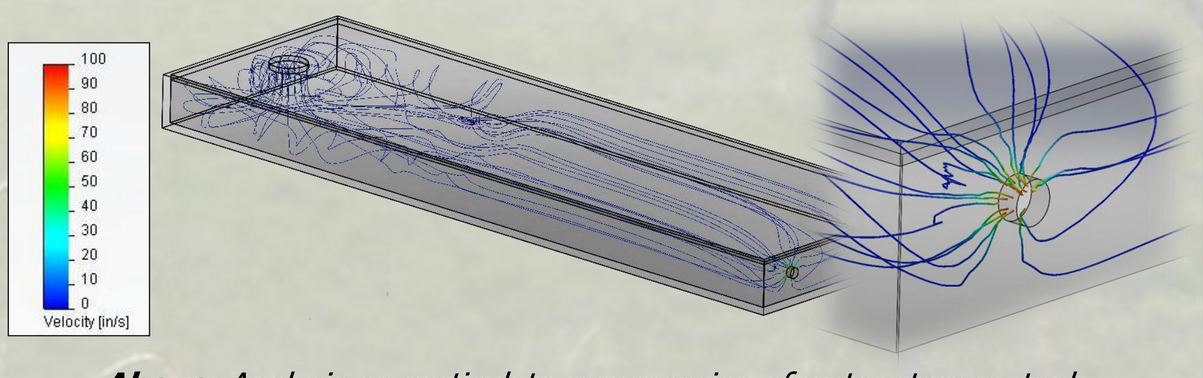
Water Systems

Above: *Scaled roof panel test.*

Collection An external water system allows for rainwater collection over the entire roof panel. To maximize collection, the roof panel design included a specification to funnel the water to one collection point. Two initial designs were created: one contoured panel and one implementing angled glides. Both designs were tested using rain simulations. It was determined that the glide design collected the most water, would be less expensive to manufacture, and would weigh less.

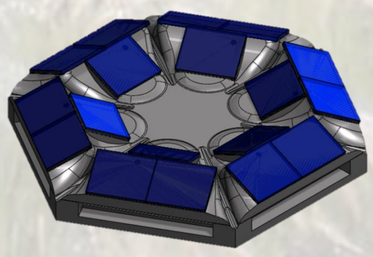
Storage Analysis

FloXpress® analysis was completed to determine if the water velocity at the outlet of the water storage tank would result in the resuspension of settled particulates. This was completed by assuming a 5 inch water depth. It was found that the velocity of the water does not exceed 10 in/s, which would not be enough to resuspend a significant amount of particles.

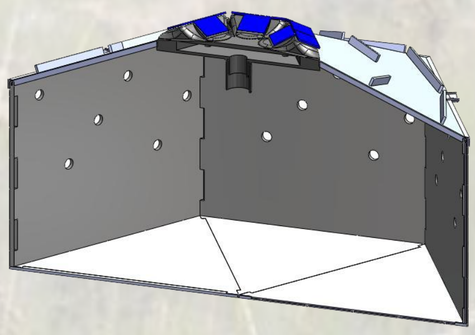


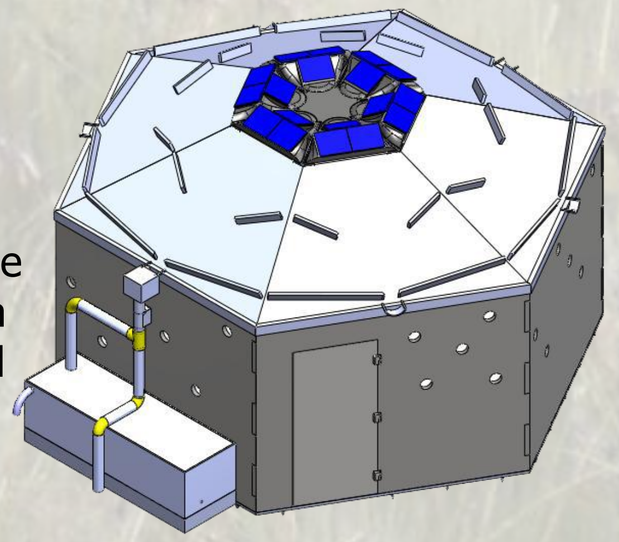
Above: *Analysis on particulate resuspension of water storage tank.*

Integrated Design



Power Cap:
- House wiring and interior lighting
- Location of solar panels





Water Storage:
- Water collected off the roof, passed through a first-flush diverter, and stored in an 80 gallon tank.

Structure:
- Hexagonal shape including 138 sq. in floor plan
- Over 6 feet of head room
- Made of HPDE plastic
- Minimal parts to simplify assembly

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