Georgia Institute of Technology

Georgia Tech's Solar Decathlon House harnesses and celebrates the sun's power. As in the Greek tale of the architect Daedalus and his son Icarus who embarked on a flight to the sun, so too the modern fascination with building "lighter" and more "transparent" buildings is presumed to be at odds with energy conservation. And yet, at no other time in the history of construction have advances in materials technology and energy systems design rendered Icarus' vision more realizable. Exploring the paradox of “lightness” and “energy conservation” is the inspiration that guides the design and construction of Georgia Tech's Solar Decathlon House.

What’s Different?

- The key message of this team is "Sustaining Life with > Light."
- The roof is translucent, made possible by Aerogel insulation and ETFE (ethylene-tetrafluoraethylene), a translucent film with high corrosion and temperature resistance. ETFE has been used in large-scale buildings including the Eden Project, an environmental science center in England, and the Aquatics Center for the 2008 Olympics in Beijing. The ETFE used in the roof of the Georgia Tech house represents its first residential application in the United States.
- LEDs are integrated into the walls of the bedroom, producing a luminous effect that can be continuously dimmed to suit one’s visual comfort.

Architecture, Interior Comfort

- The high-bay, open plan of the house has the capacity to easily expand, adding bedrooms, bathrooms, and storage space to the west or a larger kitchen, dining, or living room to the east. This built-in flexibility will attract younger couples who decide to have children or active retirees who decide to board a college student to raise their monthly income.
- The house incorporates universal design principles that accommodate a wider range of users than the typical house, including lower than normal countertop heights, a roll-in shower, adjustable shelving, accessibility under work areas, wayfinding lighting at night, and a high level of evenly distributed natural daylight.
- The roof is composed of a double translucent membrane, which allows diffused light to pass through. Made from ETFE film, the membrane is inflated like a pillow and filled with Aerogel insulation, a lightweight substance. This roof lets in sunlight while being thermally efficient.
- Aerogel insulation has been incorporated into the translucent roof and polycarbonate walls. Nicknamed frozen smoke, Aerogel is low-density insulation derived from gel that is translucent, durable, and known for the way light scatters within the material.
- The east and south walls of the house incorporate cellular polycarbonate panels that let in sunlight while being thermally efficient. “Nanogel” is temperature resistant, thermally efficient, and 1/100th the weight of glass.
- The solid walls of the house incorporate structural insulated panels; the west and north walls are finished with aluminum composite materials.
- The entire floor of the house is insulated with bio-based insulation (spray foam derived from soybeans), which has excellent insular properties and provides a tight seal to keep air and moisture out.
- The solar panels on the roof are supported by a light-frame, adjustable-rack system that allows the panels to pivot and optimizes their solar orientation angle while shading the roof from direct sunlight. Shading minimizes unwanted heat gain and provides UV protection, resulting in longer-lasting materials and reduced maintenance.
- Rainscreens are used on the roof and on the south wall for deterring rainwater.
- Rainwater is collected from the roof, and grey water is collected from the sinks and air-conditioning; this water is then channeled to a cistern in the garden for use in the house’s energy systems and to water the indigenous plants around the deck.

Heating and Cooling Systems

- A mini-split heat pump provides individual control of air-conditioning without ductwork. It is very quiet, efficient, and cycles quickly between heating and cooling modes. Its slow cooling mode also allows one to control the humidity in the house.
- An energy recovery ventilator recycles the air in the house, reducing the amount of energy needed for air-conditioning. This easy-to-install, off-the-shelf technology recovers conditioned air that would otherwise be wasted.
- The house uses the rainwater collected in 20" PVC pipes under the deck to spray water on the machines that need cooling to improve energy performance.

Lighting (including Daylighting)

- A clerestory wraps the entire perimeter of the house, providing abundant daylight while offering panoramic views of the sky from inside the house. Clerestory is an architectural term that originated in the temples of Egypt.
- LEDs (light-emitting diodes) are integrated into the walls of the bedroom, producing a luminous effect that can be continuously dimmed to suit one's visual comfort. LEDs are essentially tiny light bulbs that fit easily into an electrical circuit. They are extremely energy efficient, lasting up to 25 times longer than traditional incandescent light bulbs.
- Fluorescent lighting is used because it's more energy efficient than incandescent lighting (based on a greater proportion of the energy being converted to usable light). The living areas of the house are individually zoned and modulated by separate light circuits.
- Efficient use and control of lighting can significantly reduce the energy required in the house. To maintain control, photo sensors are placed in each functional area of the house and linked to the optimal controller. Lighting performance can be monitored and regulated by the homeowner over the Internet to improve efficiency and visual comfort.
- Solar technology is also showcased in the house at night. Small, self-sufficient solar lights are charged by the sun during the day to provide outdoor deck lighting at night.

PV and Solar Thermal

- The roof design integrates 27 solar modules providing 6.5 kW of electricity to power the energy systems and appliances of the house. The design of the south-facing wall integrates 12 solar modules, providing an additional 2 kW to help power the house and an electric vehicle.
- The house is controlled and operated by software that continuously assesses the solar power available against the energy demands of the house. In this manner, the house becomes a dynamic living environment that can be continuously adjusted or balanced under varying uses and weather conditions.
- A set of 20 evacuated-glass tubes provides all the domestic hot water needed for the house. The tubes are easy to install and may be part of the building skin or, as in this house, part of the outdoor landscape.

Budget

- The estimated market cost of the house is $300,000.
- The cost of participating in this competition was $700,000.

Future Plans

- The house will return to Georgia Tech for a year for research (monitoring, evaluation, assessment, and publishing results), education (various courses in the College of Architecture and College of Engineering), and outreach (K-12, non-profits, industry, and the team's sponsors).
- This mission is supported by a team sponsor, who will then move the house off campus nearby with the aim of continuing the involvement with the Georgia Tech students.

Team Information

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