New designs for smarter buildings

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After two years of design, experimentation, fund-raising and building, the University of Arizona's Solar Decathlon team has completed construction of its 800-square-foot solar-powered house on the National Mall in Washington, D.C.

The UA's team will compete with entries from 14 other states, Puerto Rico, Canada, Germany and Spain.

The Solar Decathlon effort is but one of the UA's efforts to broaden the horizon of sustainable architecture and building.

"I think what you're looking at is a college that has made a strategic decision to really focus in on sustainability," said Janice Cervelli, dean of the UA College of Architecture and Landscape Architecture. "What we specialize in is the practice of - we're not theoretical, we're not conceptual."

One of the signature features of the Decathlon house - a water-filled Trombe wall that forms a solar thermal collector - came together in a capstone class. Eddie Hall, who recently earned an architecture degree but remains with the Decathlon team, said the idea evolved from his work with Álvaro Malo, director of the UA's emerging materials technology program.

"The principle," Hall explained, "is that you put a piece of glazing over something with high density." Sunlight comes through the glass and the radiant heat is absorbed by the mass and warms the air between the glass

and the wall.

"At nighttime, when the temperature drops, that heat can't get back out through that glass. It has no direction to go but in." Warm air rises in the cavity and can be directed into the house through louvers in winter, or vented outside in summer.

With a particular interest in materials, Hall began investigating plastic packaging technology. "How do they make water bottles?" he said. "How do they make blister packaging? Why is it considered so cheap and throwaway and then it ends up in our ocean and causes all sorts of problems? Well, what if you were to take it and use it in a more permanent application?"

His vacuum-sealed panels, made of the same material as plastic water bottles, contain football-shaped cavities that are filled with water. They're recyclable. "You can literally pull it out and recycle it and turn it into a water bottle," he said.

The system holds 215 gallons of water - just over 2,000 pounds. Every cubic foot of water can hold 64 Btu's for every degree Fahrenheit of temperature change, Hall said, making the system three times more efficient than concrete. It's also much lighter to ship to Washington because the water can be added at the end of the journey.

"Just for general use in Tucson - water is so important here - it sort of becomes an ephemeral thing," Hall said, "living next to a water wall." He said it also has "some really neat optical effects and lighting effects."

"It's actually a really flexible system when you use this passive strategy in addition to some simple air-flow things - just open up a louver or turn on a fan," Hall said.

He cautions that, like many things in the experimental house, his water wall is a prototype. But he says it is a system that's been refined after a year and a half of experimentation.

"It's OK just to get a bunch of plastic and go into the shop and goof around for awhile," Hall said. "But at the end of that process you go back upstairs and say, 'All right, what about this? What about that? What have I learned? I didn't do this well; I did this great. That one caught on fire; that one exploded.'"

At the Solar Decathlon, the house will be inspected, analyzed, toured by the public and tested by required loads of laundry. And then there are the dinner parties.

"They're required to do two dinner parties and you invite your neighbors from the neighboring set of houses and then they come and score you," said Larry Medlin, a professor of architecture and a faculty adviser who will accompany the team to Washington. Medlin said that Oscar Blazquez, a lecturer in landscape architecture, had developed an Arizona-themed cuisine for the dinner.

The centerpiece of the competition, a creation of the U.S. Department of Energy, is energy efficiency and solar power.

"Using off-the-shelf technology, the teams must produce enough electricity and hot water from solar panels to run a modern home with all of the conveniences we've come to expect," U.S. Energy Secretary Steven Chu wrote in defining the objective. "Competitions like this one can lead to new solutions and inspire a new generation of problem solvers."

The roof of the UA house holds an arsenal of photovoltaic panels that can produce more than eight kilowatts of electricity - twice what would

be needed to power a much larger home. Of 10 competition categories, the one for which the most points are awarded is energy generation. The houses will be awarded points for producing as much energy as is consumed and for generating surplus power for the grid.

In addition to the dinner parties, the teams must hold a movie night for neighbors, who rate their hosts based on the quality of the home theater system, as well as "design, ambiance, and overall experience." Architecture, market viability and engineering are also graded.

Medlin said the hope is the solar homes could become a stimulus for a sustainable lifestyle. "Rather than say this is a piece of high technology that's imposed upon the landscape and often does substantial damage," he said, "it's something that steps back and responds to and attempts to put people in a position to be stewards of their interaction with nature."

Most of the houses in the three past competitions have returned to their campuses as learning centers. Cornell has sold its houses to private owners, but continues to collect data on energy efficiency. It remained to be determined what would happen with the Arizona house, named SEED [pod] for Solar Energy Efficient Dwelling.

The winner of the Solar Decathlon will be announced Oct. 16, and the UA house will return to Arizona on four trucks, the team's long journey complete.

"An experience like this," said Medlin, "of going from a moment of conceptualization, planning, making judgments about what's included and what's not included and getting it realized, encountering problems and executing and still maintaining a very high standard and level of quality - it's given them a great personal confidence to be able to lead and direct and participate in that kind of process in the future. Which is exactly what a university should be about."

More information: Video of the Solar Decathlon house: uanews.org/node/27719

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