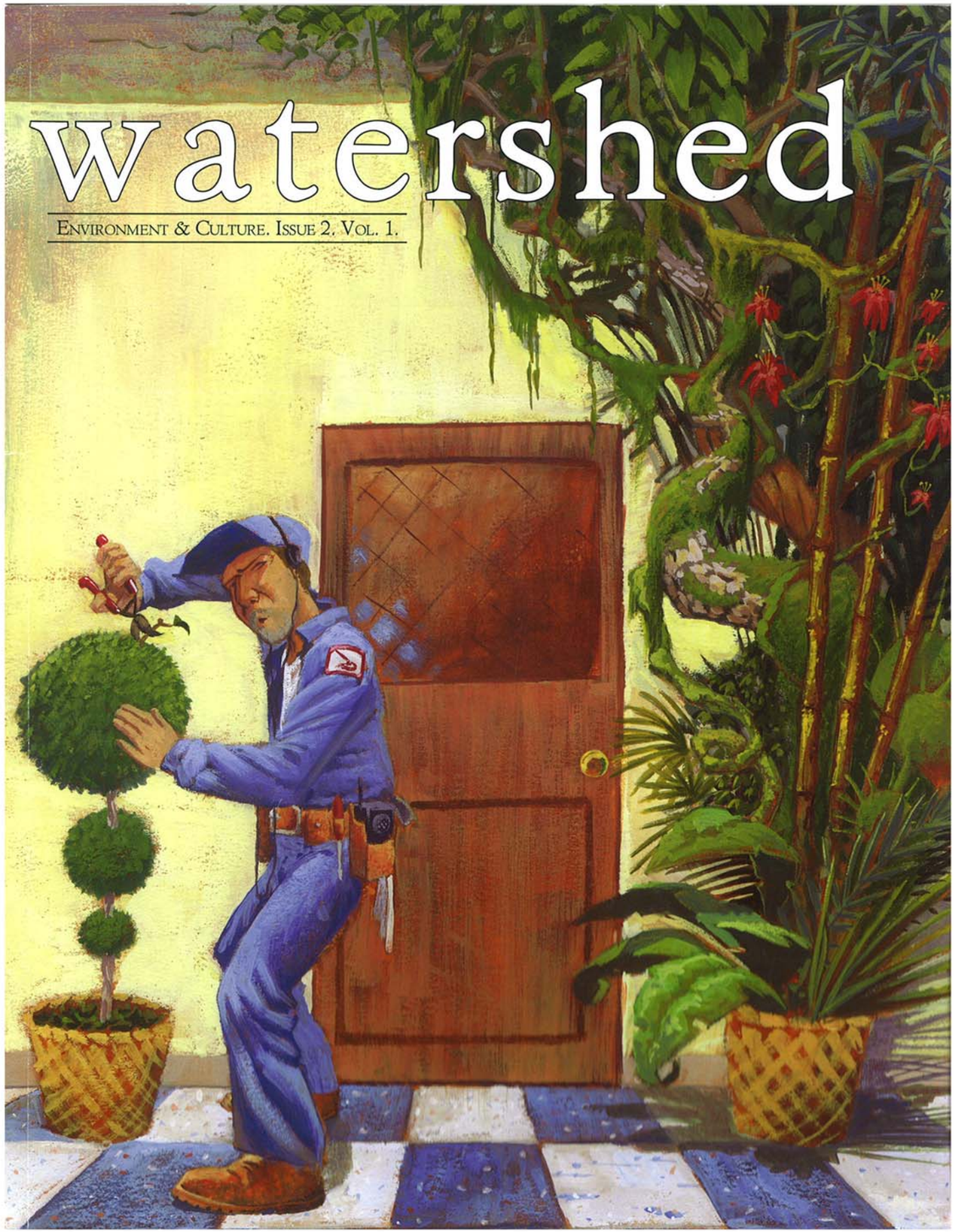

RISD's Solar Decathlon

by Jonathan Knowles

South Facade, Low Tech, Passive systems.

Rhode Island School of Design has been chosen to participate in the 2005 Solar Decathlon, a competition sponsored by the Department of Energy in which entrants will build a solar powered house on the Washington Mall in October, 2005. The National Solar Decathlon Design Committee selected RISD for participation because its members believe that RISD student and faculty researchers are ideally qualified to explore the parallel issues of conservation, sustainability and solar power for the betterment of the built environment. This competition will feature 18 colleges and universities from across the nation and the world, all of whom will compete to design, build and demonstrate the advantages of a solar lifestyle. Each of the 18 entries will be given ten days to build and display an 800 square foot solar house. This competition was held once before in 2002, at which time the event drew more than 100,000 visitors.

RISD's approach to the 2005 solar decathlon is to integrate solar energy research with art and architectural design in its solar home entry, titled RISD Solar. We aim to synthesize high-tech solar energy systems with low-tech devices for energy efficiency, primarily through innovative use of materials and products that are reclaimed and have high insulation values. RISD plans to build a house that convinces visitors of the viability of solar and sustainable design.

The research team will demonstrate that the aesthetics and utility of the solar house are as important as the operational technology. Ultimately, the house itself becomes an important educational tool, and a visible and accessible installation that can be viewed by the general public during the building phase. Paramount to the project has been balancing the need for energy efficiency with the principles of thoughtful architectural design. Through intense research and revision, RISD Solar has achieved this. Our design includes:

- A consideration of site adaptability, using our concept of an urban "Townhouse." The orientation of the building will favor the North/South axis, which allows for the potential to place these buildings side by side in a compact urban setting.
- A clear path of circulation through the house in order to accommodate the large number of expected visitors—including a roof garden that provides a unique vista onto the competition, reinforces the townhouse concept and insulates the roof.
- A compact mechanical core that will contain the elements of heating, cooling, electricity and water, providing increased efficiency in the performance of the building.
- A performative, louvered skin, which will reflect heat during the day and insulate against heat loss during the night. It also provides the opportunity for changing the visual character of the exterior through the use of super graphics and/or color.

Each of these design elements solves a complex design problem. Our goal is to utilize the potential of design in every aspect of the home to provide the inhabitant with a quality of living that is enhanced through the interaction with this space.

Townhouse

One of the overriding factors in the design of this house,

The North Facade, High Tech, Technological mechanical systems.

which has been with the project since the first semester, is a desire to design a house that encompasses the lifestyle of the urban dweller. To achieve this goal, we are proposing a design in which the various aspects of the house share a language of expression, and yet retain an individually unique demarcation of place. A dialogue exists between the interior and the exterior, between public and private, between environment and inhabitant.

While we can only build one house for the Solar Decathlon, we have been concerned with how our house might grow to become twice its current size through the aggregation of units, either identical or mirrored. This is our Townhouse concept, and one which we feel responds in a unique way to the questions proposed by the organizers of the Solar Decathlon in terms of efficiency. When these units come together, their displacement in section and in plan creates interstitial spaces that can become oases within the urban context. The idea of the solar village, while not a novel concept, becomes more energy efficient with the aggregation of more units. Uniting design with urban values, our solution addresses the issues of sustainability not only within the individual house, but also on the scale of community, improving the spaces we call home.

Circulation

The overriding concept for the interior is the architectural promenade—a clearly choreographed path through the house for the occupant and the visitor. It begins with an entry ramp into the living space and ends with an exit ramp out onto the Mall. The path winds through the living room, around the central core, through the home office and out onto an expansive deck, where visitors circle back to where they started. There are no bottlenecks. Additionally, a private stair provides access to a roof garden—a critical component in an urban environment, where space is a premium and a yard almost unheard of. The roof garden brings tranquility and a sense of place to the house and will include a series of planter boxes in which we will grow vegetables and herbs, as well as shade plants. This again reduces the solar load on the building and insulates the roof. The relationship between the deck and the roof is central to our townhouse concept and it is our goal to allow the garden to spill down the southern façade into a deck mounted planter, shielding the house from solar gain in the summer and providing it with solar gain in the winter when the plants are dormant. Above the planter and bench is a light shelf, which allows valuable light further into the building while minimizing solar gain at the façade. This transparent zone at the southern end of the house serves as a transition between the house and the environment.

Mechanical Core

The most energy and assembly efficient component of the house is the central mechanical core. The hot water heater, the bathroom fixtures, and the washer/dryer unit all sit on the platform, of the house's bathroom. The bathroom shares a wall with the kitchen, minimizing plumbing runs. The heat exchanger for the radiant heating and cooling system resides above to heat and cool the house. Since the bathroom shares walls with both the bedroom and the living/dining area, ducting is virtually eliminated. Below the bathroom floor is an ultra-compact chiller unit, consisting of a series of horizontal tubes. The compact nature of these mechanical/plumbing systems allows the 'core' of the building to be shipped as a unit, slid into position and

Representatives from the RISD Solar Team at the National Renewable Energy Lab (NREL) Conference in Orlando, January 3rd, 2005.

hooked up in relatively short time. The ADA compatibility of this aspect of the house was critical to the design, and was the subject of much of the design process. The resulting 'core' element provides light and space within the house and compactly and efficiently provides the mechanical and plumbing systems necessary for the project.

Louvers

On the exterior of the house, we have envisioned a system of heliotropic louvers, vertical fins set off from the main structure, that are used as a shading device to reduce the energy loads required of the house. These louvers utilize the same attachment points as the walls to integrate into the floor and roof. Tracking the sun in the summer to reflect its rays away from the building can mitigate a significant amount of solar gain. This enables the house to run at maximum efficiency and provides a way of perceiving the house from the outside as more than just a 'machine for living' but instead as a machine for smart living. The result is a house in constant motion, changing its character with the solar cycles. The construction method is similar to an airplane wing, with ribs and a lightweight skin, reducing the energy required for operation. Our team completed a mapping of the solar light angles throughout the year to determine the possible movements of the louvers, and the design was adjusted to simplify the movement.

The louvers would be closed at sunrise and then track the sun, with the faces of the louvers remaining normal to the sun's azimuth on the east side of the building. The louvers on the west side would be in the fully open position mirroring the louvers on the east façade. As the sun passed to the west side, the louvers would track the sun's descent into a closed position, and then reopen after nightfall. By maintaining two discrete sides to the louvers, aluminum on one side facing the sun and wood on the other facing the shell of the building, micro-convection cycles would begin to stimulate inter-louver thermal drafts. Therefore, the louvers would help to dissipate heat from the surface of the building while giving the building a variety of appearances visually depending upon perspective. We were able to corroborate our assumptions relating to their behavior with our partners at Arden Engineering. As a part of the energy system of the house, the mechanical systems will be monitored and accessible through the home computer. A subroutine of the mechanical monitoring would track and move the louvers according to the location of the house.

Conclusion

Within the pedagogy of RISD's Architecture program, a decisive part of the exploratory aspects of various studios is the investigation of the ways in which materials interact and interconnect. We are taught to examine a material's potential and properties, to transform the concept from one material to another in order to observe what is brought forward and what remains behind. The goal is to develop a logic, which can be applied to a structure to be used to solve various design problems at different scales. During the last two years, over 60 students and seven departments at RISD and Brown University have contributed to the development and testing of the logic of ten separate proposals and from this then synthesized the best ideas into the final design of our 2005 Solar Decathlon entry. The project has also been aided by the sponsorship from generous individuals and companies. The next leap forward is the actual construction of the building, which has been exhaustively planned and eagerly anticipated.

Please contact Jonathan Knowles at bkad@earthlink.net with any additional questions or if you would like to contribute to our efforts.