# University of Illinois at Urbana-Champaign

The Illinois **"*elementhouse*"** features an attractive, efficient, flexible building, in which light, comfort, and utility are primary aspects of the design. The building design can be configured as a residence, as demonstrated for the Solar Decathlon, or a number of other structures, including field offices, relief structures, and summer homes. The building-block modules can be added as desired to create interesting configurations of different sizes.

**What's Different?**

- A scalable "manufacturing" plant was developed in which each of the three building modules (living room and office module, kitchen and dining room module, and bedroom and bathroom module) were sequentially constructed and rolled along a rail to a truck trailer for transport.
- The building modules are self-contained, with individual solar energy collection systems and comfort-conditioning systems. A building of any size can be automatically conditioned and powered.
- The "Z-shaped" organization of the house's three modules is used to demonstrate the flexible, interesting range of designs one can implement. More modules can similarly be "plugged" together to form a larger building with courtyards and larger room spaces.
- "Human power" is all that is required to remove the house modules from the truck and connect them, allowing ***elementhouse*** structures to be used for emergency and remote-site applications.
- A foamed exterior roof with retractable solar panel array provides a highly efficient, low-cost integration of PV into the building. The design provides excellent PV panel cooling, which is beneficial to PV efficiency, while the array design provides shading of the house roof, lowering building cooling loads.

**Architecture, Interior Comfort**

- The Illinois philosophy recognizes that the inhabitants and their internal activities are the primary aspect of an energy-efficient, comfortable, and practical building design.
- The house is designed to bring the outside inside. Detailed light-simulation studies, combined with judicious selection of windows and doors, maximize the views from the house that extend the interior to its exterior decking.
- The furniture, designed and constructed by students, demonstrates the attractiveness of renewable bamboo-based materials. Flooring is also made from bamboo.
- There is a novel integration of room lighting and radiant heating/cooling panels in the ceiling.

**Heating and Cooling Systems**

- Unique, modular heat pumps were developed for conditioning the building modules. Each module has its own heat pump, contained in a small enclosure mounted behind the parapet of the module.
- "Latent" (moisture) comfort conditioning has been separated from the "sensible" (temperature) conditioning of the building. Separate conditioning leads to greater comfort, as well as reduced power requirements.
- An energy recovery ventilator provides fresh air, as required, to the building space with cross-flow exchange of energy for efficient ventilation.
- The unique ceiling radiant-panel system eliminates air ducts and provides a quiet, comfortable conditioning of each space.
- "Ambient-powered" thermostat and humidistat can be placed anywhere within the house to provide comfort to occupants wherever they are located at the conditions they prefer.
- The heat pump water heater provides cooling to the building interior while heating the building water. This "double duty" significantly increases the building's efficiency.

**Lighting (including Daylighting)**

- Comfortable daylighting throughout the year and for a broad range of sky conditions has been achieved through detailed modeling and simulation.

- Space lighting is efficiently provided by fluorescent lights, while task-based lighting uses similarly efficient LED lights. The LED light was invented by University of Illinois graduate and current professor, Nick Holonyak.

**PV**

- The solar array, which comprises BP Solar PV panels rated at 7 kW, is tunable. It can maximize the solar energy by adjustments to the tilt of the collectors, based on location and season.
- The home is fully electric. The energy produced is used efficiently with a novel heat pump water heater that provides air-conditioning to the house while heating the domestic water. The heat pump, developed by University of Illinois students, uses carbon dioxide, a "green" refrigerant.

**Computer Systems**

- A computer monitoring system provides occupants with a detailed accounting of their activities in an easy-to-understand format. Future expansion of the system will allow other features, such as monitoring of infirm or elderly occupants, to be incorporated into the building.

**Budget**

- The total project cost is estimated to be $550,000 including house transport, student travel, and curriculum-support costs.
- Building costs (not including the PV power system) are estimated to be similar to that of standard construction ($100 per square foot) with "2 x 6" frame construction on two-foot centers and stud and ceiling/floor joist cavities filled with high-insulating urethane spray foam.
- The PV system cost is highly dependent on local and state incentives. The 7-kW system on the ***elementhouse*** costs $60,000 without incentives.

**Future Plans**

- The house will be transported to the Chicago Center for Green Technology at the conclusion of the Solar Decathlon for a month-long visit. The house will be available for tours during the Greenbuild International Conference and Expo, held in Chicago, November 7–9.
- The house will return to the University of Illinois at Urbana-Champaign for educational and research activities and will participate in the National Renewable Energy Laboratory's Solar Building Benchmarking program.

**Education**

- Visit the ***elementhouse*** in Chicago during the month of November, or in Champaign-Urbana after that.
- Visitors and Web "virtual" visitors can add comments and questions about the house to the Illinois Solar Decathlon Weblog. (See address below. Visitors Blog will be available at the start of competition.)
- More than 200 students and two dozen faculty and staff at the University of Illinois have participated in the development of the ***elementhouse***!

**Team Information**

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