How long does it take to disassemble a house, transport it halfway across the country, and reconstruct it to exact specifications?

For traditional homes, the answer might be months or even years. Thanks to the Interlock House’s unique design, the Iowa State University Solar Decathlon Team will accomplish this feat in the span of about three weeks, in time for the Oct. 8 start of the Solar Decathlon competition on the National Mall in Washington, D.C.

The team will begin deconstructing the Interlock House during the week of Sept. 14, when four trailer trucks used for transporting the house to Washington will arrive at the construction site. Among the first tasks will be packing up the house’s energy-efficient appliances and specially designed wooden furniture, much of which will be placed into crates.

After that, the real fun begins.

The team, led by Project Manager Aaron Brncich, will then commence strategically—and carefully—taking apart the house itself. In order to reduce the risk of fracturing, the team will remove the majority of the house’s windows—along with the adjustable, paneled glass Nanawall surrounding the sun porch. Team members will also disconnect and store the roof’s photovoltaic panels and evacuated-tube thermal energy collectors to ensure that they are not damaged during transport.

The team will remove the house’s roof and siding before detaching the dwelling’s walls from the ceilings, floors, and one another. The Interlock House’s forward-thinking, modular design will allow many demarcated segments of the house to be separated using nothing more than a simple utility knife.

Though Principal Investigator Ulrike Passe anticipates that surprises will inevitably arise during these final stages before the competition, she believes the team will clear any hurdles in stride. “It will be a very interesting and challenging process, because none of us have ever had to tackle an assignment like this,” Passe said. “But I think we are well prepared, and the students who are doing this have always, while they were building the house, thought about how to take it apart.”

Throughout the week of Sept. 21, a crane will lift each of the Interlock House’s three primary modules—essentially the left, middle, and right sections of the structure—onto separate trailers. Each of the modules measures between 13 and 14 feet wide and will overhang the eight-by-six-foot trailers, meaning that the drivers must exercise caution while navigating the thousand-mile trek to the nation’s capital. The modules will be strapped down and wrapped in water-proof tarps to prevent movement and damage, and the house’s decking will be loaded onto the final trailer.

On or around Friday, Sept. 25, the four trucks will depart Ames on what is expected to be a three-day journey to Washington. The team will be given a week to rebuild the Interlock House on the National Mall, where it will compete against 19 other homes and be viewed by thousands of spectators and media from across the United States and the globe.
During the U.S. Department of Energy’s Solar Decathlon, Iowa State’s Interlock House will be put to the test in 10 separate contests that will determine the overall Decathlon winner. Juries of professionals in architecture, homebuilding, engineering, lighting, web site design, and public relations will judge the competitions. Iowa State’s team is more than ready to take on their 19 competitors! Following is a summary of how the Interlock House addresses each contest.

1. Architecture
_Evaluated on architectural elements, holistic design, and inspiration._

The Interlock House shows how passive solar design (e.g., a sun porch, louvers, clerestory windows, natural ventilation) working with energy collection devices (e.g., photovoltaics and evacuated tubes) can reduce—even eliminate—a house’s energy demands. The house also boasts energy-efficient construction techniques, including R-12 windows, R-48 wall and roof insulation, and airtight construction. The sun porch, a semi-private, indoor/outdoor space with southern exposure, is the central component of the house. The name “Interlock” refers to the interlocking of the house with its seasonal environment, neighborhood, and occupants.

2. Market Viability
_Examines livability, buildability, and marketability to determine the potential of the house for the target market._

By 2019, Baby Boomers will make up 20 percent of the U.S. population. The Interlock House caters to older adults who want to “age in place.” They prefer to live independently, economically, and sustainably in their own house and garden, with the security of being part of an established neighborhood and support network. The Interlock House features universal design concepts and is ADA accessible. It uses conventional and green construction methods, and readily available mechanical systems. Cladding and interior finishes are durable, easy to maintain, and minimize environmental impact.

3. Engineering
_Evaluates how functional, efficient, innovative, and reliable the house is._

The Interlock House uses a combination of standard and innovative systems: rooftop solar panels that generate electricity to power all electrical devices inside the house; a solar thermal evacuated tube system used to heat and cool the interior space and provide domestic hot water; radiant floor heating; a liquid desiccant dehumidifier; and a high-efficiency traditional air conditioning system.

4. Lighting Design
_Judged on electric lighting quality, daylighting quality, ease of operation, flexibility, and energy efficiency._

South-, east-, and north-facing windows, which fill the space with natural light, help ensure that artificial lighting is not required during the day. Adjustable louvers enable occupants to control the natural light. A layered approach is used for electric lighting. A combination of compact fluorescent (CFL), halogen, and LED devices allow occupants to modify lighting levels according to task and season. CFLs are used for ambient lighting. Task lighting is placed near the bed, at the desk, and on kitchen counters. Suspended pendants and small, low-voltage fixtures provide a range of light levels in the bathroom. Stand-alone, solar-powered LEDs light outdoor paths.

5. Communications
_How well the team communicates information about the house using a web site, communication plans, and student-led house tours._

During the past 18 months, the team has developed a comprehensive communications plan and a strong brand identity, held open houses, published newsletters and brochures, managed a web site with a construction webcam and photo journal/blog, distributed news releases, and given many presentations and media interviews. Educational signage and scripts for student tour guides are being developed for the National Mall display.
6. **Comfort Zone**

*Determines how well a team can maintain narrow temperature (72-76°F) and relative humidity (40-50 percent) ranges inside the house.*

Airtight construction with reduced thermal bridging and closed-cell foam insulation eliminate differences between the ambient room temperature and the wall surface temperature. A desiccant dehumidifier handles the latent cooling load and lessens the load on the air conditioning system. The dehumidifier is primarily driven by solar-heated water, reducing the need for electric-powered air conditioning. These decoupled systems will handle the two parts of the comfort zone competition individually, without favoring either temperature or humidity levels.

7. **Hot Water**

*Demonstrates that the solar hot water system can supply all the hot water that households use daily.*

The team’s goal is to utilize solar-heated hot water for as many end uses as possible. Two 30-tube evacuated tube collectors are employed. A 120-gallon tank serves as thermal storage and an 80-gallon tank serves as the domestic hot water (DHW) source. The DHW tank is heated by a heat exchanger loop from the thermal storage tank, which is kept at a higher temperature (about 200°F) than the DHW tank (about 130°F). The water from the thermal storage tank is fed through a radiant floor system for space heating. The thermal storage water is also used to recharge the desiccant dehumidifier system in the summer.

8. **Appliances**

*Determines how much energy is saved while mimicking the appliance use of the average American home.*

The appliances were chosen for efficiency. In some cases, they use less electricity simply because they are smaller. All appliances except the dishwasher are Energy Star compliant. The induction cook top uses less energy because it more efficiently transfers heat to the pots, cooking food in about half the time as a conventional, electric-resistance cook top. The washer and dryer are combined into a single unit, which removes the need to transfer clothes between machines and allows start-to-finish washing and drying control from one dial. Sensors turn off power when clothes are dry. The unit reduces water usage and vents directly to the drain, eliminating the need to penetrate the building envelope.

9. **Home Entertainment**

*Demonstrates the functionality and comfort of the house during two dinner parties, a movie night, and the operation of computers, TVs, lights, etc., during specified times.*

The Interlock House has all the comforts of home, including a flat-screen TV and a computer. During the Decathlon, the team will host a movie night and two dinner parties for eight that will feature food grown and raised in Iowa. The team will serve quality food that does not require energy-intensive preparation.

10. **Net Metering**

*Determines how much energy is used by the house during the competition and if more energy is produced than consumed.*

The solar electric system is expected to produce more energy than the Interlock House will consume. Calculations using actual solar and weather data show that the main photovoltaic array will generate a surplus of electricity at the competition, and will produce about twice as much energy as the house requires over the course of a year. Because of this, the public touring the Interlock House on the National Mall will see the energy meter spinning in reverse.
Since its formation in 1987, the Institute for Physical Research and Technology (IPRT) at Iowa State University has pioneered and supported world-class, multidisciplinary research aimed at developing new technologies and fostering economic growth throughout the state of Iowa. The ISU Solar Decathlon Team’s similar aspirations have inspired IPRT to support the team with more than $45,000 in grants over the past 18 months.

“The Solar Decathlon is just such a natural fit for IPRT that we jumped at the chance to be a supporter and a sponsor,” said George Kraus, director of IPRT. “It requires multidisciplinary research, involves working closely with industry, and gives students a hands-on education. These are all areas in which IPRT excels. Besides, we don’t think you could find a better way to demonstrate to the rest of the country, and the world, that Iowa is a leader in sustainable energy.”

Though it is the second-largest monetary sponsor of the Interlock House, IPRT has contributed far more than dollars to the cause. Its vast network of research organizations includes the Center for Building Energy Research, which is directed by Ulrike Passe, assistant professor of architecture. Passe serves as principal investigator for the ISU Solar Decathlon Team and has overseen every detail of the Interlock House’s design and construction.

“Building this innovative house and moving it across the country is such a huge challenge, so I can’t say enough about the job that Ulrike is doing,” Kraus said.

The director of IPRT’s Microelectronics Research Center, Vikram Dalal, has also offered the team his considerable expertise in the materials science and plasma engineering crucial to making solar power more efficient. Finally, IPRT administrative assistant Tami Wicks has filled a parallel position with the Solar Decathlon Team. From coordinating team meetings to ordering building materials, Wicks has helped keep the project moving forward throughout its long gestation.

IPRT’s financial generosity and hands-on efforts have contributed immensely to the completion of the Interlock House, which Kraus believes is an important component of the movement toward environmental sustainability.

“The Interlock House really opens your eyes to all the things that can be done to reduce energy consumption without sacrificing comfort and convenience,” said Kraus. “It’s more than an academic exercise; it’s truly a prototype for houses of the future. Indeed, the whole effort gets our researchers and students excited about making a real and lasting contribution to sustainable energy technology. IPRT is committed to helping the team succeed, and hopefully, start a new tradition for years to come.”
What are your primary responsibilities with the Solar Decathlon Team?

My official title is IT Coordinator, but I have worked on almost every aspect of the project. My responsibilities include keeping our web site up-to-date and answering e-mails from the general public. I have also compiled and revised construction documents, responded to requests for information, and been a member of the build crew. Last summer, I worked in a laboratory helping to develop bio-composite material for the house. Finally, this summer I was the team’s spokesperson and media relations officer, responsible for arranging interviews and distributing information about the project.

Why did you become interested in Solar Decathlon?

I’m originally from the D.C. suburbs, near the University of Maryland. Three years ago, my daily commute took me by the construction site for the University of Maryland’s Leaf House (which eventually finished second in the 2007 competition). It was fascinating to watch the house take shape, from the framing to the photovoltaic installation. I often thought that it was a project I would like to take part in. One year later, when I found out that Iowa State was accepted into the 2009 competition, I jumped at the chance to participate.

What has been your biggest contribution to the Solar Decathlon project?

My biggest contribution would probably be my flexibility and willingness to go where help is needed. I have worked on, and was responsible for, compiling all of the documents for every Department of Energy deliverable thus far. The contribution I am most proud of is the Interlock House web site. I am a self-taught web developer, and the Interlock House web site is the largest and most comprehensive use of my knowledge to date.

What have you gained from Solar Decathlon?

The Solar Decathlon project has given me real-world experience in both architecture and construction. As an architecture student, I spend most of my time working on studio projects that deal with real-world issues but are never seen through to construction. The Interlock House has given me the opportunity to take part in a project from design development to completion. It has taught me the advantages and potential pitfalls of working in large teams, given me a wealth of knowledge about passive design principles, and heightened my awareness of how mechanical systems work to balance energy consumption and comfort in buildings. I’m glad I’ve had the opportunity to participate.

What motivates you to be “green”?

The Industrial Revolution occurred just over 200 years ago, but only in the last 30 years have we become aware of the impact that it has had on the environment. For the first time, we have become aware that the Earth’s resources are, in fact, limited. At this point, it is not enough to merely reduce the impact we have on society—we must begin to repair the damages done by previous generations. It is this understanding that today’s actions will affect the quality of life for not only myself, but also future generations, which motivates me to be green.
As an international manufacturer of electrical equipment and control products that are integral to the functioning of many Interlock House systems, Schneider Electric has proven itself an invaluable contributor to the project.

Several of Schneider Electric’s brands have provided donations and discounts to the Solar Decathlon Team. Xantrex supplied an inverter, which converts the direct current electricity produced by the house’s photovoltaic panels into the alternating current electricity required to power its appliances. Other branches of Schneider Electric, including Square D and TAC, have provided electrical and environmental control equipment.

Gary Scott, a senior staff engineer at Schneider Electric, said that the company feels a connection with Iowa State because many of its employees are alumni of the university. He also noted that the Interlock House and Solar Decathlon fit nicely with Schneider Electric’s philosophy of sustainability.

“Our company CEO has stated that our mission is to solve the energy equation of the world,” Scott said. “The Interlock House is a good example of balancing energy use, solar energy utilization, and comfortable, sustainable housing.”

The company is also donating the design, equipment, and on-site engineering services for a micro-grid that will allow each of the 2009 Solar Decathlon’s 20 solar homes to connect their electrical systems to the Washington, D.C., power grid.

STAY UPDATED ON THE COMPETITION!

Want to know how the Iowa State Solar Decathlon Team is faring in Washington, D.C.? Keep in touch with the team’s progress at our web site: www.solard.iastate.edu. In addition to daily scoring updates and feedback straight from public visitors to the Interlock House, the site features a blog that will give direct insight into team members’ thoughts on the Solar Decathlon experience.
2009 Solar Decathlon Timeline

**October 1-7**

Several rotating shifts of team members reassemble the Interlock House on the National Mall.

**October 8-16**

After an opening ceremony on Oct. 8, the Interlock House competes against its 19 counterparts in the 10 Decathlon contests.

The homes are officially opened to the public, with team members serving as tour guides to explain the various features of the Interlock House.

On Oct. 16, individual contest and overall winners are announced.

**October 9-13, 15-18**

The teams disassemble their houses and load them up for transport off the National Mall.
DID YOU KNOW?
Some fun facts about the Solar Decathlon:

Each Solar Decathlon team will have the chance to earn a total of 1000 points during the competition. The Net Metering contest is the most valuable, counting for 150 of those points.

The 2009 Solar Decathlon features teams from four countries: 16 from the United States (including one from Puerto Rico), two from Canada, and one each from Spain and Germany.

More than 30 Iowa State students will travel to Washington, D.C., to assemble and disassemble the Interlock House, direct the team’s participation in the competition, and communicate with the public.

The three highest-scoring teams in the overall competition receive trophies and the opportunity to give acceptance speeches. The top three teams in each individual contest also receive recognition.

WANT TO HELP?

The ISU Solar Decathlon Team greatly appreciates all the support it has received from corporate sponsors and private donors alike. That support has transformed the Interlock House from a conceptual design to a free-standing structure that demonstrates how the intelligent application of technology can help achieve environmental and social sustainability. Though the team has raised more than 80 percent of its financial goal, every additional gift puts us that much closer to officially completing the project. Please consider making a contribution to the ISU Solar Decathlon Team, which can be done via a quick visit to our web site: www.solard.iastate.edu/sponsors.