Techstyle Haus:
Weaving Elegance with Innovation

By Gussie Fauntleroy

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HIGH PERFORMANCE WOVEN FABRICS are used to cover sports stadiums around the world. Yet it took a group of university students to borrow the concept of architectural textiles and apply it, for the first time, to a much smaller, more universal structure: the house. Techstyle Haus is an 800-square-foot solar-powered house whose woven textile walls and roof consist of a single, elegantly curved form. It was created as an entry in Solar Decathlon Europe 2014, an international competition challenging twenty collegiate teams from sixteen countries to design and build sustainable homes powered exclusively by solar energy.

Techstyle Haus is the first-ever Solar Decathlon entry to incorporate fabric in its structural design. It was conceived, designed, engineered, and constructed over a two-year period by a highly creative team of students and faculty advisors from the Rhode Island School of Design and Brown University, both in Providence, Rhode Island, and the University of Applied Sciences in Erfurt, Germany, with sponsorship

and collaboration by corporate partners. Among the competition's criteria were the following requirements: each team's house must be technologically innovative, comfortable, and marketable, and must consist of sustainable architecture and design. Techstyle Haus was designed to be 90% more energy efficient than the typical home.

Solar Decathlon Europe 2014 was held in July on the grounds of the Palace of Versailles outside Paris. Because Techstyle Haus was constructed and tested in Providence, it had to be completely disassembled, its components packed into shipping containers and sent to Paris, and reassembled in ten days at Versailles. It was a marathon of intense, highly choreographed activity, with groups of team members working eight-hour shifts, 24/7, during the deconstruction and reassembly process. All entries were then monitored, evaluated, and judged over a 25-day period. Out of twenty teams, Techstyle Haus placed 3rd in Comfort Conditions, which considered interior comfort through the control of temperature, humidity, acoustics, lighting, and air quality. The team also earned 6th place in Communications & Social Awareness, 6th in House Functioning, and 10th in Energy Efficiency.

Techstyle Haus was built to German Passivhaus energy standards, the highest in the world. (The German school's architecture department specializes in Passivhaus design, which achieves exceptionally high energy efficiency through solar gain, extreme insulation, and an airtight envelope with a fresh air exchange system). The house's walls and roof consist of layers of lightweight, high performance textiles and insulation over curved steel ribs, with floor-to-ceiling gas-injected, triple-pane windows on the north and south. Electricity is generated by flexible photovoltaic cells and solar thermal units integrated into the textile roof, whose curves provide optimum angles to the sun. Inside the flexible-use, open floor plan space is a central core, prefabricated by the team and installed on assembly. It contains all mechanical, electrical, and plumbing components, as well as a bathroom, kitchen area, and storage. On top of the core is a small loft space.

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For team members from the Rhode Island School of Design (RISD), an important element in the project was the expression of its fluid form, since it emerged in part from an arts institution, notes Anais Missakian, head of the school's Textile Department. Missakian served as a key advisor, joining the team as soon as it was determined that the structure would be textile related. The genesis of Techstyle Haus began with student-designed proposals that were evaluated by a faculty team headed by RISD Associate Professor of Architecture Jonathan Knowles. Knowles then served as lead faculty advisor for the project.

Once the selected proposal was accepted into the Solar Decathlon, participating students from all three schools were involved in a series of design studios, independent studies, and internships in such areas as textiles, architecture, furniture design, engineering, and information technology. Along with meeting and exceeding competition requirements, the team's goals revolved around innovation, playfulness,

more energy efficient than the typical home.

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and transforming the conventional concept of a house into something new. Over the two-year process, the Techstyle Haus team included more than 300 students divided into specialized sub-teams, with a core group of forty students from the three schools. Along with coming up with the proposal, the students did all the research, sought out and engaged in collaboration and partnerships with relevant businesses, and managed budgets, schedules, and communications. They designed and experimented, tested and re-designed, constructed, disassembled, and reassembled the structure, juggling daunting logistics over months and then down-to-the-wire exhausting, exhilarating days and nights. They did everything, from start to finish. "The whole team has been awesome," Knowles says.

Fabric was chosen as a central design element because of its lightweight durability and strength, flexibility in form, breathability, ease of installation, and acoustic qualities, Knowles explains. "High performance textiles are being used more and more in building, so it dawned on us that you don't need concrete, wood, and solid walls," he says. The structure's exterior surface is Sheerfill®, a white, Teflon-coated fiberglass composite membrane from Saint-Gobain Performance Plastics, used most often as roofing for athletic stadiums. Techstyle Haus represents the first time this material has been applied in a residential design.

Inside the house, the upper walls and ceiling are industrial polyester knit, while the knitted fabric of the lower walls has a softer, more textural feel. This imbues the space with visual warmth, interesting qualities of light, and a sense of play. "We wanted something with more of the feel of a sweater," Missakian says. RISD textile majors Carmel Dunlap and Eric Whiting (who both graduated this spring) designed the interior textiles and worked closely with Stoll New York to produce the fabric, since RISD's flatbed knitting machine was neither large enough nor able to produce a fine-enough gauge knit. The soft-white fabric was structurally pixilated to mimic patterns and textures from the landscape in which it sat during the competition, the formal gardens of Versailles. "This sounds cheesy, but I think it looks like heaven," says student team leader and RISD architecture and fine art major Kim Dupont-Madinier.

The quality of the visual and human experience within the space was especially important because Techstyle Haus will be used to house art students in Lessac, France, following the Solar Decathlon. The structure once again will be disassembled, crated, moved, and reconstructed as part of the Domaine de Boisbuchet campus for art and design workshops, where it will continue to be monitored and studied for livability and energy use. Just as critical as aesthetics, however, were practical considerations. The interior fabric was made with 100% Nomex, a flame resistant fiber that meets stringent French M-1 standards for fire

safety and is widely used in firefighters' garments. In addition, Dunlap notes, the students took a cue from Nike's Flyknit shoes and designed the interior fabric to be cut on a curve to eliminate fabric waste.

As Missakian worked with team members in small group studios and independent study, she encouraged reflection on the role textiles have played in human culture over time. "For example, it's the first thing selected when a child is born, and a special cloth is often the last thing selected when someone dies," she says. "In that sense, textiles are sustainable as a concept, as well as functionally sustainable. Cloth is ancient, yet the team has been dealing with it in the most modern and innovative way." Dunlap says she also found herself drawn to the idea of ethnographic connections between Techstyle Haus and the use of textiles as shelter in other times and cultures, including the nomadic desert-dwelling Bedouin of the Middle East.

Among the countless challenges the Techstyle Haus team faced during the two-year project was the interface between team members specializing in three very different fields. "Having an innovative idea and translating that into a manufactured reality by a team whose members don't necessarily all speak the same 'language' got intense," Dunlap remembers. "Textiles, engineering, and architecture are different worlds that, in an academic context, usually don't mix." Adding to the intensity were daily feats of logistics, budget management, and the learning and coordination of numerous real-world skills. "No one in architecture or textiles had the expertise to know, step by step, how to build, so we had incredible collaborators to bring it all together," Missakian says.

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In the end the project paid off in ways that will continue to bear fruit well beyond the competition. As a prototype and learning tool, Techstyle Haus will be studied and improved over the years, with future potential as affordable housing in either urban or rural settings, team members say. Because it was initially constructed on the Northeast coast where it had to be able to withstand hurricane-force winds, it was built with a heavy-duty steel frame. In other settings, lighter steel could be used, Knowles notes. "We want to gradually optimize all of its systems to be less expensive and more efficient," he says.

For the students who poured their considerable talents, vision, energy, time, and excitement into the project, the ripples of their experience will continue to fan out. "I'm definitely interested in continuing to make fabric architecture," says Dupont-Madinier. Dunlap adds that for young aspiring professionals who are still students to be given such creative design liberty, along with the resources and support to translate innovative ideas into reality, was an extraordinary opportunity. "It's definitely been a rich learning experience, with so many hands, opinions, and cultural intersections," she says. "It made us all step the game up to a professional level. It pushed us somewhere we never thought we'd go."

Gussie Fauntleroy is a southern Colorado-based writer who contributes to national and regional publications, primarily on the topics of art, architecture, and design.

All photos courtesy of the Rhode Island School of Design, Kristen Pelou, Photographer.