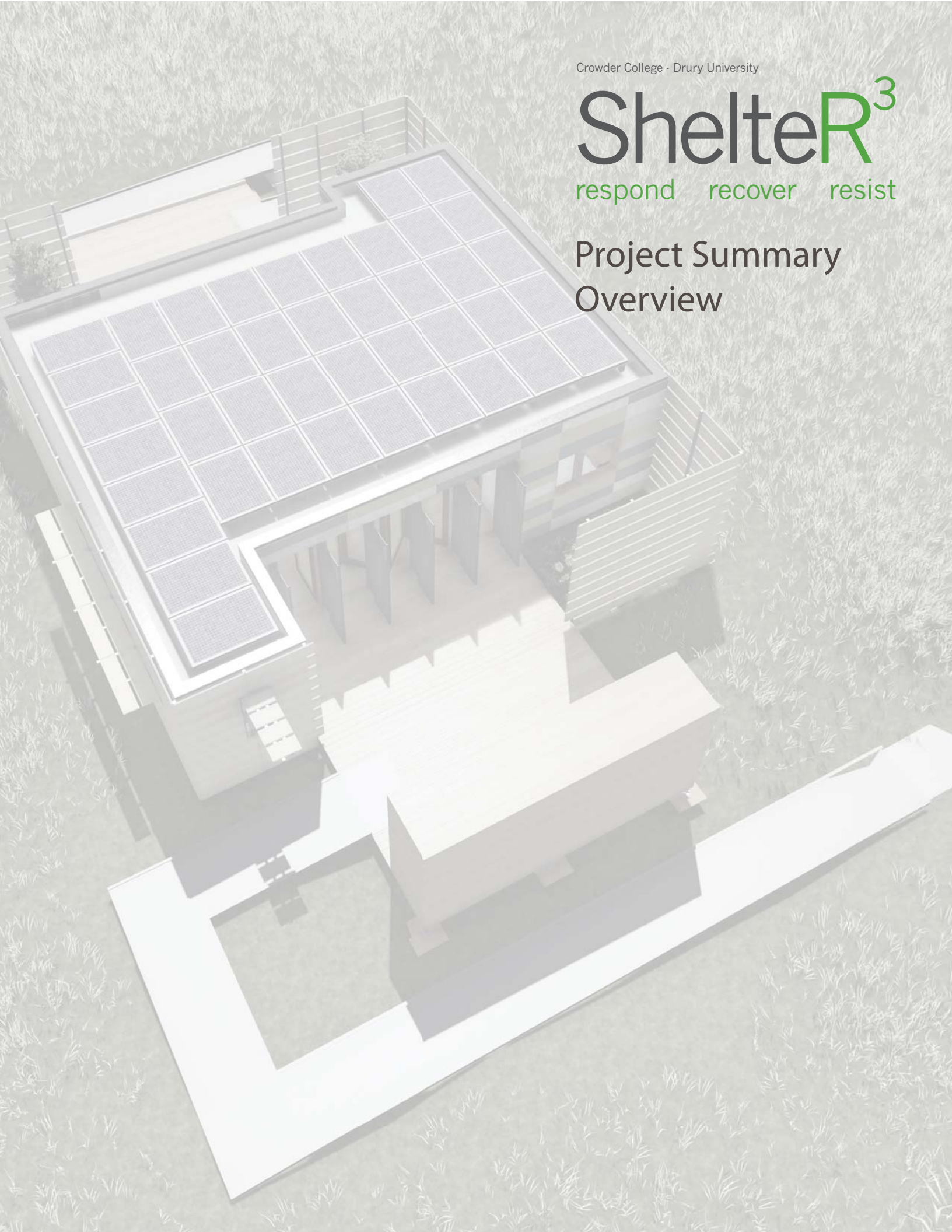
Crowder College · Drury University

ShelteR^3

respond recover resist

Project Summary Overview



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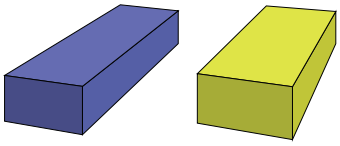
House Description

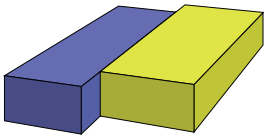
A product of state-of-the-art technology and design, ShelteR³ is a solar-powered, disaster resilient home designed for style, simplicity, and security. The name alludes to the most fundamental purpose of homes—to provide shelter. R³ stands for the three components of the design philosophy of the house: Respond, Recover, and Resist. ShelteR³ will not only accelerate the recovery of those affected by tornadoes but also enable families to maintain high living standards while providing redundant systems to counter the effects of future disasters.

Design Philosophy and House Design

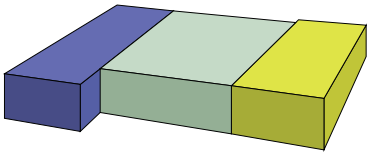
ShelteR³ epitomizes the potential of modern engineering and forward thinking. R³—Respond, Recover, Resist—is its guiding design philosophy. In the event of a tornadic disaster, ShelteR³ can accelerate the recovery of the region in an affordable manner. As the diagram demonstrates, the house can be quickly transported to the affected site in two modules (fig. 1). Fully equipped with amenities like kitchen, bath, living spaces, and independent power facilities for heating and lighting, it can be conveniently assembled to function either as disaster response command center or disaster relief housing (fig. 2). Once the ambient conditions ameliorate, the two modules of the house can be expanded to form a spacious, sustainable, permanent residence that is prepared to resist future disasters (fig. 3). The house can thus serve three purposes.



① SHIPPING



② DISASTER RESPONSE



③ PERMANENT HOME

ShelteR^3 offers style, simplicity and security. The house will have an open, light-filled living area that expands out to the spacious front porch and semiprivate rear deck. The minimal window opening in the bedrooms, kitchen and bath areas secure privacy and protection. The Resource Furniture, which blends with the interiors to afford openness for our family of three, can easily accommodate 8-12 people in the disaster response configuration. The rooftop solar power system and energy-efficient appliances will ensure the availability of an independent energy source and maintain perfect energy balance in the house at all times. Finally, the ultra-strong core of the house, strengthened by a multiple-layered wall assembly is further enveloped by an unyielding encompassing fence to bolster the safety of those inside the house.

Unique House Features

ShelteR^3 has several unique features. The house is perfect for quick and reliable deployment in the event of a tornadic disaster. The two modules of the house can be quickly transported to the site, and with minimal effort, converted into an independent and robust disaster response command center. ShelteR^3 can provide the basic necessities of housing and energy to those in need, even in the absence of power in the surrounding regions. In its complete form, the house will be able to withstand substantial impacts and wind loads, allowing it to resist future disasters.

Every aspect of the house is sustainable and disaster resilient. The house uses a multi-layered wall assembly of Zipwall sheathing, Lexan polycarbonate and Swisspearl fiber cement cladding, and an enveloping Alcoa Reynobond composite aluminum panel with Ecoclean fence. This combination makes the house formidably strong and smartly elegant.

The frames and glass of the doors and windows of ShelteR^3 are hurricane rated. The shield doors close down in high winds to protect life and property in the living room area. The roof uses disaster resilient 2001 Company WindVented Roof systems and advanced Canadian Solar polycrystalline solar panels to meet the energy requirements of the house reliably at all times.

The landscape is designed to support the family before and after a storm. Edible, useful and medicinal plants such as quinoa, cauliflower and soap plant provide an aesthetic addition and a practical function to the home and family.

Technological Advances

The multi layered, super-resistant shear wall assembly of ShelteR³ is one of the biggest technological innovations of the house. The innermost Zipwall layer is strengthened by a Lexan Polycarbonate Layer, which is enveloped by Swisspearl fiber cement cladding. This is further surrounded by Reynobond with Ecoclean composite aluminum fence which provides another additional layer of protection. Additionally, the house has an ultra-strong core. ShelteR³ uses 2x6 wood studs spaced at 12" on center instead of standard 2x4 wood studs spaced at 16" on center, making the skeletal frame of the house much stronger than that of traditional houses made from similar materials. A steel chassis and vertical rods 4' on center aid in wind load resistance. Each individual part contributes to the greater whole.

WALLS: The 5/8" Zipwall wall and floor sheathing creates a weather-tight water barrier. Every 4 feet 1/2" steel rods connect the steel floor chassis to the walls and the roof. In addition, the house also uses a 1/4" Lexan polycarbonate layer and Swisspearl fiber cement cladding on its walls which make it resistant to large projectiles.

FLOOR: The Zipwall floor and wall sheathing is glued and screwed to wood studs at every 3". Double rim wood joist floor framing in the modules is bolted to a steel channel chassis every 1 foot on center to create a very strong and rigid floor.

FENCE: The multi-layered walls of ShelteR³ are surrounded by Reynobond with Ecoclean composite aluminum fence. The material is not only extremely strong but also very easy to maintain. The fence contains self-cleaning material that eliminates the need for homeowners to spend time and effort on cleaning.

ROOF: ShelteR³ mechanically bolts the roof to the walls and uses a WindVented Roof System. The roof has a disaster resilient membrane that can withstand high winds and impact of debris. The 2001 Company air-seal substrate design ensures that wind-generated vacuum pressures pull out air and moisture from underneath the roof membrane through strategically placed equalizer valves in a way that the membrane sticks closer to the roof. As a result, during high speed wind conditions, unlike traditional roofs that get torn off by updraft, the roof of ShelteR³ stays intact.

SOLAR ENERGY SYSTEM: The 9.18 kW solar energy system of the house uses an array of 36 Canadian Solar photovoltaic panels wired in 4 strings of 9 panels each. Every panel is a 255 watt polycrystalline module. 2 SMA Sunnyboy 5 kW inverters convert the direct current (DC) thus generated into alternating current (AC) which is used by the home appliances. Because these state-of-the-art inverters do not have transformers, they allow a DC input voltage which is lower than that of inverters with transformers. This system will meet the energy requirements of the house and the electric car.

Target Client

Our target client is a young family of two adults and a child living in tornado-prone areas. The house is optimally designed to meet all their needs. This will enable the families to lead elegant, affordable and sustainable lives. There are two bedrooms, a kitchen, a bath, and a spacious living area. The house exhibits exceptional design with beautiful and spacious interiors. The durable, energy-efficient appliances and electric car obtain the necessary energy from the solar power generation system installed in the house. Finally, all features of the house are easy to use, so the family will not have any difficulty in using the safety features in the event of a tornado. ShelteR³, therefore, accommodates all the needs of the clients through style, simplicity and security.

Team Organization

Project Leads
Russ Hopper-Crowder College
Traci D. Sooter-Drury University

Project Manager
Nancy A. Chikaraishi-Drury University

Student Project Managers
Mat Stockstill-Drury University
Alaa Alradwan-Drury University
Jarren Welch-Crowder College

Arcitecture Lead
Marshall Arne-Drury University

Student Architecture Leads
Jonas Gassmann-Drury University
Brian Vanne-Drury University

Structural Engineer
Scott Ragan

Structural Consultant
Keith E. Hedges-Drury University

Communications Leads
Dr. Regina Waters-Drury University
Dr. Steve Mullins-Drury University
Dr. Peter Meidlinger-Drury University

Student Communication Leads
Vikas Jagwani-Drury University
Swapnaneel Nath-Drury University
Evan Melgren-Drury University
Cody Stepp-Drury University

Affordability Lead
Dr. Kelley Still-Drury University

Student Affordability Leads
Travis Bond-Drury University
Ray Horner-Drury University

Sponsorship Leads
Traci D. Sooter-Drury University
Dianne S. Johnson-Drury University

Home Life Student Lead
Emma Reynolds-Drury University

Market Appeal Student Leads
Lukas Kriem-Drury University
Avery Smith-Drury University

Student Sponsorship Leads
Evan Johnson-Drury University
Vikas Jagwani-Drury University

Solar and Electrical Engineering Leads
Joel Lamson-Crowder College
Andy Wilson-Crowder College
Andy McClain-Crowder College

Grant Manager
Kathy Collier-Crowder College

Construction Leads
Terry Clarkson-Crowder College
Kevin Newby-Crowder College

Construction Testing
Chris Catron-Crowder College

Student Construction Lead
Matthew Keaton-Crowder College

Health & Safety Lead
Bill Moss-Crowder College

Student Health & Safety Lead
Matthew Lawson-Crowder College

Systems Mentor
Art Boyt-Crowder Consultant

Architecture Team
15 Students-Drury University

Communication Team
12 Students-Drury University

Affordability Team
2 Students-Drury University

Construction Team
12 Students-Crowder College

A key factor in the success of this project is the selfless cooperation and clear communication between Crowder College and Drury University. The various tasks of the competition have been divided between the two institutions based on available campus resources, established fields of academic concentration and community interaction. Crowder College leads solar engineering and construction based tasks while Drury University focuses on architectural design and communication objectives.

Future Plans

Since Joplin, Missouri, played a key role in inspiring us to embark upon the project, we hope that ShelteR^3 is able to serve Joplin directly. We are presently working with the City of Joplin so that ShelteR^3 can be used as a demonstration home, exemplifying sustainable living and embodying disaster resilience, in their new green neighborhood. We also encourage private purchase of our home by displaced residents of Joplin. In the ideal scenario, we would want influential organizations like AmeriCorps, American Red Cross, and FEMA to embrace our design and use it for building disaster response command centers or enable mass production of similar homes for disaster relief housing.