surviv(AL)House

MARKET POTENTIALNarrative

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MARKET POTENTIAL Narrative

The **s u r v i v (A L)** House target market is a young professional couple who earns a combined income of $75,000 per year. The home is designed for those who want to live in a modern, attractive, manageably-sized home that guarantees low utility costs and optimized security & comfort. The design is also perfectly suited to empty-nesters, young singles, and individuals of all ages. It can also be easily adapted to neighborhood clusters that are seeking to build low-cost housing for elder groups, homeless families, or for quickly constructed housing in the aftermath of a disaster.

The overarching theme of the **s u r v i v (A L)** design embodies the irrepressible spirit of Southern communities that have pioneered, adapted, survived, and rebuilt. Inspired by the devastating impact of the 2011 tornado super outbreak on the region, **s u r v i v (A L)** House serves as a model for sustainable, resilient housing for severe weather prone communities. Our house offers "Quick Permanence," a term we use to describe a home that can be quickly rebuilt and assembled to provide comfort, security, and energy independence in the aftermath of a disaster.

The **s u r v i v (A L)** House concept was devised with three key elements in mind: heat mitigation, severe weather security, and the capacity for "Quick Permanence."

HEAT MITIGATION ORIENTATION AND HOT CLIMATE DESIGN

Americans, in general, spend about twice as much for residential heating as for cooling, but that is not the case in much of the South. Alabama is classified as humid subtropical (Cfa) under the Köppen climate classification. Summers in Alabama are some of the hottest in the United States, with high temperatures averaging more than 90 °F (32 °C) throughout the summer in many parts of

the state. Winters are mild — the average winter minimum for the entire state is 35 °F (2 °C), and the temperature falls below the freezing point fewer than 35 days each year.

The **s u r v i v (A L)** House is designed to be climate specific. To achieve a model of efficiency and cost effectiveness, the **s u r v i v (A L)** House implements a combination of careful orientation of the building, as well as a heavily insulated envelope and precise protection of glazing. With an architectural design informed by Southern Vernacular language, the building is oriented to maximize solar access and to use roof planes as shading for a majority of the year. The home is oriented with the long east-west axis, most windows face north or south, and large window areas are shaded. The large northern porch is covered with a transparent canopy for inclement weather, allowing light to wrap around corners and penetrate in the early morning and late evening, activating the living spaces. Thick, double-studed walls, a well-insulated, high-albedo roof, and an insulated crawlspace, create an efficient envelope that protects from brutal heat intrusion and leakage of valuable cooling. The sleeping zone resists daytime heat on the southern exposure and the daytime living zone benefits from a consistent northern light for most of the day.

DEHUMIDIFICATION

Team Alabama Decathletes have devised a remarkable system for beating the Alabama heat and reducing energy costs — the UAB-developed device uses a liquid desiccant system in combination with a solar collector to take water out of the air. This system dehumidifies the air inside the home at night, and recharges the material during the day, reducing the overall load on the home's air conditioning system.

ROBOTIC COOLER

Team Alabama's robotic cooler is a localized, mobile space conditioning robot that can be deployed to allow the overall energy consumption of the residence to be reduced. This robot will provide

evaporative cooling to occupants when summoned and will be abable of autonomously navigating around obstacles in the home using infrared sensors and Bluetooth signals to find occupants.

SEVERE WEATHER SECURITY

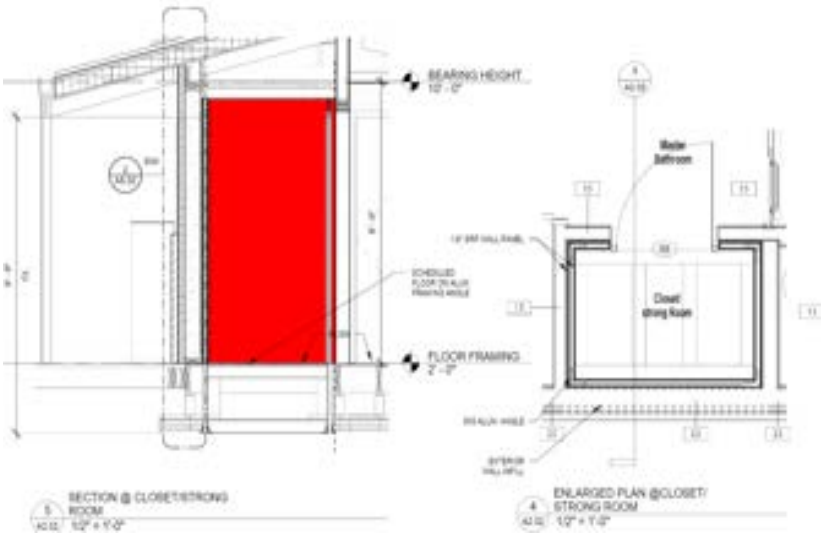
Across the southeast, populations are vulnerable to ever-increasing severe weather events such as heat waves and droughts, heavy downpours, flooding, and tornados. Catastrophic events that have taken place within the last six years have left our region's residents well aware of the damage that can occur.

Since 1966, Alabama has been struck by more tornadoes than any other state. The 2011 Super Outbreak was the largest, costliest, and one of the deadliest tornado outbreaks ever recorded, affecting the Southern, Midwestern, and Northeastern United States and leaving widespread destruction in its wake. Over three days, 349 tornadoes were spawned. Alabama was one of two states most severely affected. Of the 219 tornadoes that formed on April 27 - the most active day - 59 touched down in Alabama, resulting in more than two hundred fatalities. Countless homes, neighborhoods and cities were either partially or completely destroyed across the state, and in the days that followed, thousands of people were left without power, water, or any means of transportation or communication.

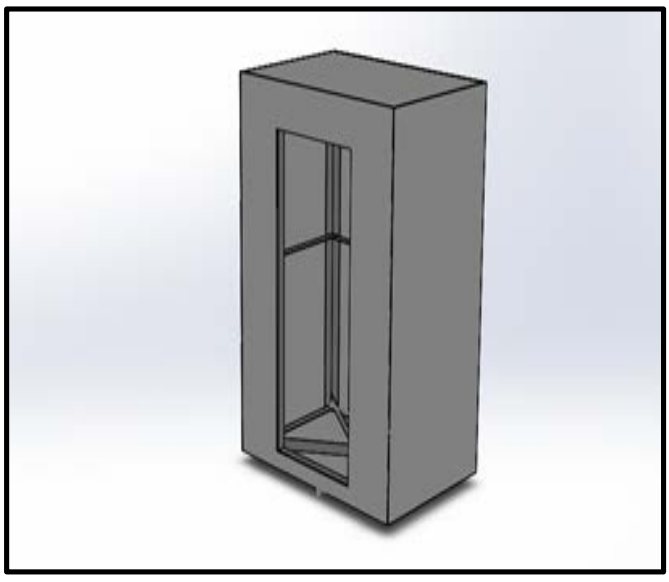
S U R V I V (A L) HOUSE : MARKET POTENTIAL

Resilience is the capacity to adapt to changing conditions and to maintain or regain functionality and vitality in the **s u r v i v (A L)** 's "safe zone," featuring a closet shielded by UAB tornado panels, a windowless core, and a water purification system combined with a net-zero PV system embodies resilient design by providing an effective and adaptable buffer against what can be tragic outcomes of extreme weather.

SAFE ROOM



With the increasing prevalence of strong storms and tornados in Alabama, interest in tornado resilience for residential and commercial buildings is proliferating. The outbreak of April 2011 prompted engineers at UAB's Materials Processing and Applications Development (MPAD) Center to create lightweight, tornado-proof composite panels. The composition of thermoplastic and fiberglass resins and fibers used in the panels are stronger per-unit density than the steel used in many current shelters and weigh 80 percent less. This makes them ideal for use in construction and retrofitting of existing structures.



Using UAB Tornado-Proof Panels as a key component, a closet within the **s u r v i v (A L)** House works as a space for both storage and safety during tornadoes. The panels are fastened from within with a student-designed steel frame, and are covered with standard flooring and drywall that hides the true protective nature of the room, leaving a visitor none the wiser.

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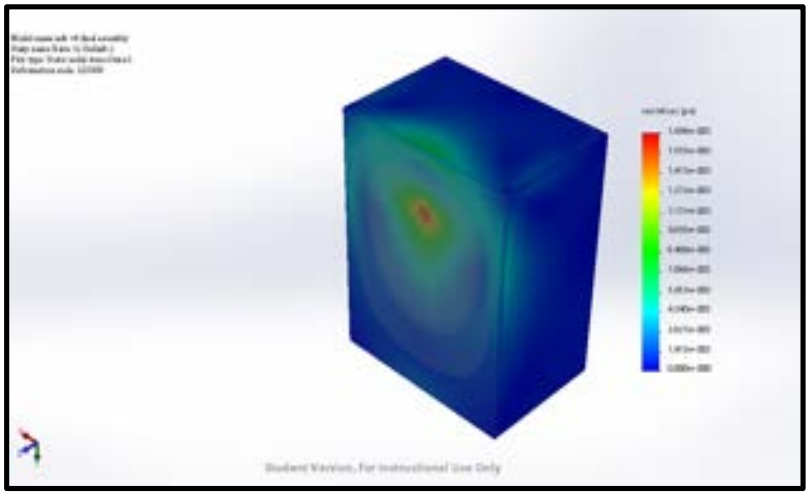
The safe room will extend below the level of the subfloor to allow permanent footings when the house is placed in its final location.

The safe room design was modeled by a UAB School of Engineering student (and Decathlete) using the computer-aided-design program SolidWorks, and tested using industry-level Finite Element Analysis (FEA) to determine if the safe room could withstand the stresses and loads experienced from flying tornado debris. The image on the right simulates the effect of debris impact during an extreme weather scenario. Per FEMA standards, the load applied to the rear wall of the safe room is 656 lbf and is distributed across an area equivalent to the cross-sectional area of a standard lumber 2x4. This loading is reflective of a four-foot-long section of lumber striking the safe room at 100 mph. The max stress experienced in the rear wall was 1696 psi, resulting in a factor of safety (FS>>10). These results illustrate the ability of the safe room to withstand an impact from flying tornado debris.



QUICK PERMANENCE

The rate of tornadoes in Alabama has been rising for over half a century. Since 1950, the average number of tornadoes every 20 years has almost doubled:

- 1950-1970: 15.05
- 1970-1990: 26.8
- In 2017 alone, there have been 39 tornado occurrences.

Although the strength of a tornado is a well-documented risk factor for injury and death, human factors also contribute to the public health outcome of such storms. After consulting existing

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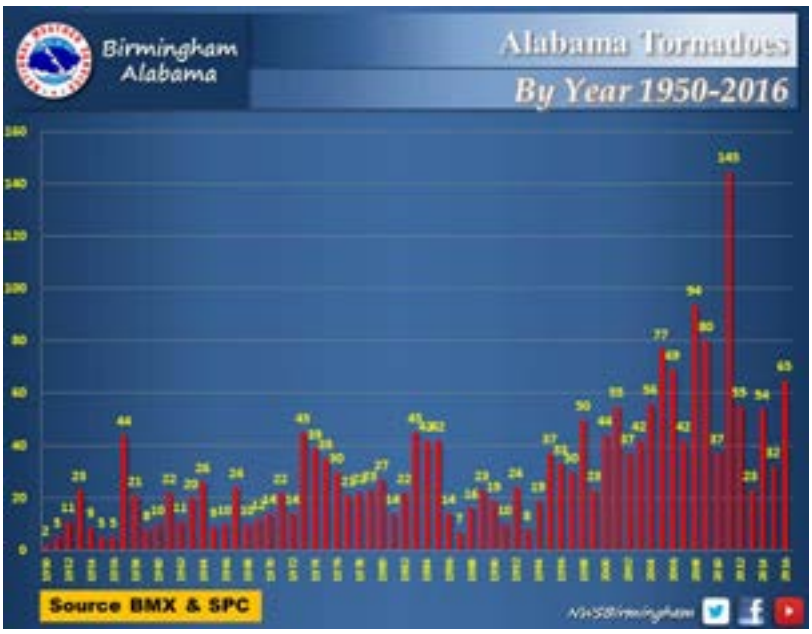
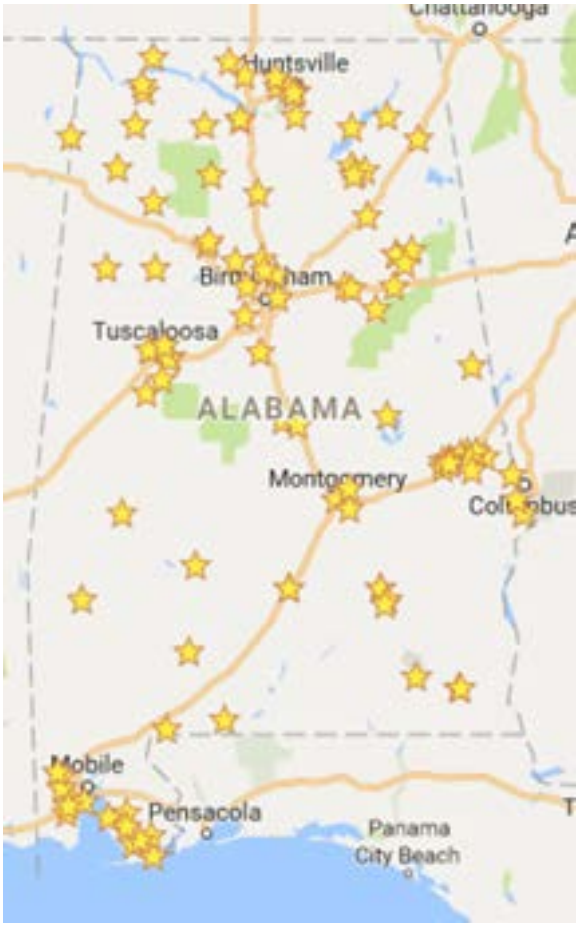
literature documenting and analyzing tornadoes in Alabama, we identified four key variables that increases the risk of tornado fatalities in Alabama:

1. Inadequate shelter: Almost half of all tornado deaths happen in mobile or manufactured homes. Mobile homes account for 14 percent of housing in Alabama.
2. Age: Existing literature finds older adults to be at increased risk for tornado-related deaths. Power outages caused during severe weather frequently leave the elderly vulnerable to extreme temperatures, decreased access to food, and improper lighting that lead to injuries.
3. Night fatalities: In the Southeast many tornadoes occur at night, when most people are in bed and are much more likely to miss out on warnings. More than half of all tornado-related night fatalities occur in the southeast.
4. Topography: The tree-filled hill and valley topography of Southern States like Alabama limits the visibility of tornadoes and leaves people vulnerable to harmful impacts from loose debris.





S U R V I V (A L) HOUSE : MARKET POTENTIAL

S u r v i v (A L) House offers an affordable housing solution that prevents these factors from becoming life-threatening issues. Team Alabama's house offers "Quick Permanence," a term we use to describe a home that can be quickly rebuilt and assembled by any contractor to provide comfort, security, and energy independence in the aftermath of a disaster. This prototype is intended to expand living options for those who would otherwise turn to unsecure mobile and commercial manufactured housing.

LIVABILITY : A PLACE TO CALL HOME

When Alabama's residents aren't dodging tornadoes and severe storms, the weather is really quite nice. Southerners spend a good deal of time outdoors, and so creating attractive outdoor spaces that connect seamlessly with the indoors is crucial.

THE SOUTHERN PORCH

Porches are a significant feature of Southern architecture and play a unique role in the character of Southern life. The South's warm climate is conducive to spending time outdoors, but the strong sun also demands a generous amount of shade. A deep shaded porch becomes a room unto itself, and invites a variety of uses. Porches are (or were) commonly a place for keeping tabs on the neighborhood, sewing, shelling peas, and folding laundry. Porches provided a place to escape the heat indoors and a safe place to send children to when they were underfoot. In the evenings adults sat on the porch and gossiped, told stories, and played music. With the advent of television, video games, and air conditioning, the porch has become less of a part of daily life, but it still holds a special place in the hearts and minds of most Southerners.

The **s u r v i v (A L)** House is designed to encourage porch traditions to return to modern life, and the home features both a front and back porch. The back porch provides full cover for sunny days, and generous front porch supports a deep transparent canopy that allows occupants to be protected from the rain but not fully shaded from the sun.

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SURVIV(AL) HOUSE

The interior of Team Alabama's home is designed to maximize use of space while providing extraordinary convenience. For instance, the home's two bathrooms feature a "shared shower" which is a single shower that can be entered from a door on each side leading to either bathroom. The open concept, high-ceilinged living area features sleek contemporary finishes and an abundance of light from the clerestory windows and windows looking out onto the partially shaded front porch.

THE SHARED SHOWER

S u r v i v (A L) House student designers placed a high priority on maximizing flexibility and use of space. The team believes that for our target customer, it was important for the home to supply two bathrooms for residents and guests. As a result of thoughtful and careful planning, the team was able to provide an innovative solution to the problem of limited space: a shared shower.

S u r v i v (A L) house a features a bathroom that is entered through the main bedroom, and an additional bathroom that is entered from the common living spaces. These rooms are bisected by a shower that can be entered from either side. Each sliding shower door is made completely opaque through the use of privacy glass.

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INTERACTIVE MIRROR

UAB's Makerspace Decathletes have devised a multi-touch interactive mirror that combines the usefulness of an integrative home hub display and crosses it with the utility of a bathroom mirror. The mirror can be used to quickly monitor the status of the house: water usage, tripped security devices, electricity usage, air quality, noise pollution, gas usage, internal and external temperatures to name a few. The mirror also has the capacity to be linked to a Bluetooth weight scale to monitor weight, and to calendars, to-do lists, and sleep monitoring data synced between smartphone and smartwatch devices to streamline self-care and self-organizing tools onto one easy to use device. In future, the team will provide further app development that will provide services for streamlining home shopping, child / pet monitoring, wardrobe management, and self-photography, and other uses.

SYSTEMS

S u r v i v (A L) House incorporates a centralized energy management system that can provide access to energy consumption data and allow control of lighting, appliances, and plug loads remotely. Temperature control will be localized based on individual room set-points that will vary according to a schedule, and based on occupancy. The hot water tank will be used as an energy storage device in order to make the house smart-grid ready.

The home's lighting is dimmable LED distributed throughout the interior and exterior of the house. Lighting intensity will be controlled by light intensity sensors to monitor available level of natural light in the room, and occupation status of the room.

Rainwater harvesting allows the house to move away from a municipal water source and use rainwater for plant watering purposes. The rainwater will be collected by using a gutter system on both ends of the house sloping towards the east side of the house.

OVERALL MARKET POTENTIAL

Alabama is located in the Sun Belt, which is the fastest growing region in the United States. The Sun Belt has seen substantial population growth since the 1960s from an influx of people seeking a warm and sunny climate, a surge in retiring baby boomers, and growing economic opportunities. Results from a 2011 study conducted by McGraw-Hill Construction indicated green homes to represent $17 billion of the overall residential construction market in 2011. This number has only increased as the cost of green building decreases.

It is Team Alabama's intention to support the growth of the sustainable housing market in our region by showcasing **s u r v i v (A L)** House at the University of Alabama at Birmingham's Sustainable Microgrid Demonstration Site. The site will be the first neighborhood of its kind in Alabama, and the only living lab of its kind at a college or university in the region. The **s u r v i v (A L)** house will be placed with four tiny homes that were recovered from an area industrial site to be repurposed as small-scale net-zero housing, in a neighborhood that will apply a whole-systems design approach to transform a high energy and water dependent area into an energy independent island. The block will feature an orchard, a community garden, and functioning solar, wind, and other renewable-sourced energy installations that will power a microgrid. The model site will be studied and managed by resident-researchers, who will conduct tours, collect data, and maintain the living spaces and gardens.