



1 Project Summary

United States Military Academy
Suburban Single-Family Division



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Figure 1: Front Facing Revit Rendering

1.1 Project Description

The All-American Abode (Figure 1) is a suburban single-family home to be built at Fort Bragg, North Carolina - one of the largest military bases within the Department of Defense (DoD) and home of the historic 82nd Airborne Division, colloquially known as the "All-American Division". The home fills a need for higher performance and healthier living housing at Fort Bragg and is designed for American soldiers and their families. As recently as March 7, 2019 the Secretary of the Army said himself that "the recent reports of substandard conditions in some of our military housing units are deeply troubling" and "unconscionable," and that "it is unacceptable for our families...to endure these hardships in their homes". [2] With this project, we aim to mix two crucial facets of each of the design team member's lives - engineering and the Army.

1.2 Design Strategy and Key Points

Our design strategy is to build a home that is not only net-zero energy but also cost effective and realistic for the DoD. Our strategy in designing the home centered around optimization. For every design decision and selection, we considered cost, performance, constructability, and other element specific criteria. We created dozens of decision matrices that applied these weighted criteria to all of our design decisions to ensure we selected the right product that best met our objectives. These decisions matrices are further explained in Supplemental Appendix C. We designed a home that Corvias, Fort Bragg's privatized housing contractor, could feasibly construct, while fulfilling a soldier and his or her family's needs. Additionally, we integrated relevant sustainability programs, including Leadership in Energy and Environmental Design (LEED) and the Army's Net Zero Initiative, to guide our decision making. Ultimately, we are building this home for a unique and diverse owner in a challenging climate, with limited project budgeting and investment from the average occupant. The design challenge is inherently multidimensional, and we applied multiple academic disciplines to address it.

1.3 Relevant Project Data and Cost Estimates

- Location and Climate: Fort Bragg, NC and humid sub-tropical.
- Structure and Lot: 1,456 S.F. home on 0.22 acres.
- Interior Features: 3 bedrooms, 2.5 bath, 2 stories, suitable for 2 adults and 2 to 3 children.
- HERS Score = -14, construction cost = \$194,418 and \$42 per month in utility costs.
- Other: Excess photovoltaic (PV) energy produced offsets Fort Bragg's utility bill.

1.4 Project Technical Specifications

- Envelope: SIPs walls (R = 21) and roofing (R = 21), insulated slab-on-grade (R = 7).
- Glazing: Pella windows: U-0.28 (R-3.6) with sliding glass door of U-0.3 (R-3.3).
- HVAC: Ground source heat pump, energy recovery ventilator, forced-air distribution system.
- Smart Features: Sensors and actuators to monitor and control water, air quality, etc., controlled via Mobile App.
- Environmental: 700 gallon rain water recovery system
- Energy Production: 7,440 Watt PV array



1.5 Project Relevance

The All-American Abode seeks to revolutionize the way the Army currently views sustainable living in their *Energy Security and Sustainability Strategy* by integrating methods conveyed in the Department of Energy and the Solar Decathlon Design Challenge. The Design Challenge evaluates teams "on how well they meet the nation's rapidly evolving demand for buildings that are innovative, cost-effective, quick to build, high-quality, resilient, grid-interactive, efficient, and locally responsive." Our design embodies what it means to "push the envelope," for it seeks to propel the Army in a direction of net zero housing across the force. In addition to being net-zero, our home is *smart*, allowing military families to live sustainably and comfortably while providing the Army cost and energy benefits.

1.6 Project Highlights

Established in 1918 and servicing the Army's Airborne and Special Operations communities, many consider Fort Bragg to be the home of the Army. Despite this prominence, roughly 2,700 of Fort Bragg's 6,100 homes are over 50 years old, and 1,500 contain lead-based paint. Concerningly, between 2016 and 2018 there were ten cases of children with dangerously high levels of lead on Army installations, and two of these occurred at Fort Bragg. Additionally, the DoD as a whole is in need of increased energy efficiency standards, beyond those targeted by the Energy Policy Acts of 1992 and 1999. Simply put, Fort Bragg needs a significant housing upgrade, and our design - the All-American Abode - provides a feasible, scalable option.

Our home applies innovation with the practicality required for a DoD building project. We plan to accomplish net zero energy with an optimized PV array and the use of innovative technology to minimize power usage. Specifically, our design integrates a new direct current (DC) lighting model, automatic control of housing systems, and sensing of a multitude of conditions to increase the energy efficiency and quality of life within the home. The team is utilizing Z-Wave protocol and the SmartThings Application to integrate the systems cohesively and securely. Soldiers focus on their duties and families instead of ensuring their homes are always energy efficient, and our solution allows for that without requiring major user input.

One of our most effective processes is our commitment to evidence-based, expert-informed decision making, where everything is either signed off by our industry sponsors or justified using a standardized decision matrix. Since we are designing our home for a DoD entity, cost is a primary consideration, and every technology we select for implementation is accounted for in terms of its value to the home and its impact on the budget as seen in Supplemental Appendix C.

2 Team Information

2.1 Academic Institution Profile

Our team is from the United States Military Academy (USMA) at West Point, NY. Established in 1802, USMA is a federal service academy, requiring five years of active duty service upon graduation. In order to achieve its mission to "educate, train, and inspire" its graduates and meet the needs of the Army, USMA offers a broad liberal arts core requirement complemented by 35 academic majors. With only 47 months from reception to graduation, 20 credit-hour semesters are the norm, and academics compete with myriad requirements such as mandatory military training and organized athletics.