

# Resiliency Vs Reality

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This study analyzes the resilient design and construction features desired by Great Northern Services (GNS) for the design and construction of a new housing division in the City of Weed, California. This was compared to what the Cal Poly interdisciplinary student design teams were able to offer, by providing different design options. The study begins by showcasing the Boles fire and the connections that Cal Poly had made to support the City of Weed. The support was made through design and collaboration with Great Northern Services to create affordable housing. The study then discusses the needs that GNS wanted to fulfill through a resiliency plan. Each section of the resiliency plan is broken down and measured against the design work that the Cal Poly students provided. The successes and shortcomings are compared and contrasted. Lastly, the paper discusses lessons learned and how future initiatives can do more to meet more of the resiliency goals of the City of Weed.

**Key Words:** Resiliency, Passive House, Energy, Budget, Design

## Introduction

On September 15, 2014, the disastrous Boles Fire took place in Weed, California. This wildfire managed to spread across the City of Weed traveling at 40-mph, fueled by winds. The consequence of this fire was the loss of 16% of the city's collection of single-family housing. The fire also infiltrated into the City's infrastructure. According to CALFIRE, "It took 120 minutes to destroy 150 structures." Weed had a population size that was below the minimum amount needed to be given disaster relief from FEMA. The financial hardship was severe. A few years after the disaster a non-profit by the name of Great Northern Services (GNS) proposed to build new affordable housing in the area. Affordable housing would assist families in need. In fall 2017 a class of Cal Poly students had the opportunity to partner with GNS to design these affordable homes. The class included students from several majors of the Cal Poly Architecture and Environmental Design program: Construction Management, Architecture and Architectural Engineering. Using an interdisciplinary approach to design, the students separated into eight groups to compete for the best design to offer GNS. GNS believed that resilient strategies would be appropriate for the renewed community they were striving to begin. Resilient strategies include, but are not limited, to housing, economic stability, health and well-being, and disaster preparedness. The purpose of this paper is to compare and contrast the resiliency plan GNS had created with what the Cal Poly interdisciplinary student design teams delivered.

## Background

In April 2016 Thomas Bradeberry of Great Northern Services created a community inspired resilience plan. It was envisioned that this plan would identify the resources that were needed to create a more resilient community. This resiliency plan began with a general overview of the City of Weed, including its fire history. It then moved on to discuss details through the lens of different topics. It finished with a community inspired vision.

GNS stresses the term “community” throughout their plan to show the importance of its meaning when planning for the city’s needs. Community is a key term within the plan. Mr. Bradeberry defines the term resiliency as “the ability of a community to recognize and cultivate its core strengths and unique economic, social, and cultural identity so that it can function effectively prior to, during, and after a stress or shock occurs.”

Leadership, communication and planning embody the first element of resiliency. Specific to the city of Weed, there is a Planning Commission, reporting to the City Council, that implements the goals of the plan. Alongside the Commission, there is a City Administrator and a Community Economic Development Activities Committee that address management and economic health needs. All elected officials strive to create action outcomes and strategies to prepare for disasters or to respond to emergencies.

The economic stability of the community depends upon four employers: College of the Siskiyous, Roseburg Forest Products, Crystal Geysers CG Roxane, and the Weed Union School District. Weed is a small community of individuals who have struggled to find economic diversity, especially after the Boles Fire. A large, 10.8% increase in unemployment is attributable to the fire. Along with this, most of the available jobs are low wage positions. Although there are large issues at hand, there are opportunities for Weed to develop new retail businesses. The city can expand its commercial marketing and business techniques by pursuing a retail revitalization, investing in infrastructure, and otherwise stimulating economic growth. When this growth occurs there will be a corresponding need for workforce housing. The individuals finding the jobs will need affordable housing.

## **Process**

In the aftermath of the Boles fire there has been a great demand for an affordable and diversified housing stock. According to the housing section of the Resilience plan, “the housing market for Weed lists the median closing price as \$173,000, which is lower than the \$204,000 outside of the region.” There are a few types of low-income housing options offered, but the options are very minimal.

Each team faced similar issues of striving to not only meet the need to protect structures from wind, rain and fire, but to meet the resilient design and construction needs of GNS. When the class was first given the project they hoped to use passive house and green building design. With the new push for green building in America, GNS wanted to have an environmentally friendly home design. Passive house design results in high standards for energy efficiency. Together, green building and passive house design lower a home’s ecological footprint and reduce its energy consumption. Some of the passive house elements that GNS asked to be included in the designs were high R-values, Energy Star appliances, passive cooling and heating. A popular technique for green building has been Leadership in Energy and Environmental Design (LEED). LEED is a green building certification system that involves a third party to analyze and verify that the building design moves to improve performance on all scales. This certification system shows all the environmental benefits and failures building designs achieve. Passive house design is a wonderful technique that is furthering the strive for LEED construction. However, each team soon realized quickly that in order to have a passive house design there would need to be a large budget.

Each team within the cohort aimed to meet several goals of resiliency and sustainability. When first faced with the challenges of choosing the most successful way to design this home, the teams discussed what they were up against. The biggest issues to tackle were the weather in Weed and the fire danger. To battle these issues a decision was made to increase the R-value in the rigid and continuous insulation. This alteration met a new standard R-value of 26, not including other layers of the exterior wall. With a higher R-value and quality windows and doors, a home is more sustainable in the cold winter of Weed.

The second biggest challenge was fire danger, which includes wind. Wind is such a large issue because, once a fire is started the gusts can carry the fire and spread the damage dramatically. A solution was to create a strong exterior enclosure using metal (zinc) roofing and fiber cement board as siding. The roof not only is protected from fire, but there is little to no maintenance. The use of fiber cement board protects the exterior from strong winds and increases fire resistance. The cement creates a maintainable facade that only needs to be rinsed off about every year or so. As a team we came to the conclusion that passive house design was not practical due to budget constraints, but we were able to create a very resilient and sustainable exterior.

Each design evolved over the quarter. The student design teams quickly realized that what GNS was asking for was not possible within the given budget of \$140,000. Every few weeks there would be a video conference call to update them with design progress. This included material choices, design progress, floor plan layout, and budget. Each meeting seemed to have similar conclusions. Of the eight teams, the home designs with passive design were up in the \$200,000 range. Alternatively, the designs teams that made the decision to remain within the budget of \$140,000 kept to traditional housing styles. We all quickly realized that we could not deliver what was being asked for. GNS came to the conclusion that passive house design was not feasible.

When creating a budget for housing designs in the interdisciplinary class, GNS asked Cal Poly construction management students to keep the price under \$140,000. This \$140,000 was to include everything needed for a functioning home: permitting costs, grading, foundations and concrete, framing, interior utilities, finishes and so on. This presented a great challenge, because passive house design is expensive and general economic inflation has driven home prices much higher. Many of the student teams were able to meet this price goal. However, the chosen design was above that price, at \$175,613, including contractor overhead and profit. Our class was not able to meet GNS's number. The biggest concern is whether or not a low-income worker would be able to afford this housing.

## **Lessons Learned**

As the partnership with GNS began, Cal Poly students and professors were eager to meet the challenge to design and create affordable housing for GNS. With the advantages of an interdisciplinary class and an integrated project delivery approach the class was ready to create, design, and achieve. Integrated project delivery supplies an advantage, because the process involves a collaboration of all individuals on the project. Each entity, including the owner, engineer, architect, and construction manager works together from day one, allowing for more cohesive environment. A large lesson learned was that there are many hurdles to overcome in creating affordable housing. The resilience plan written by Thomas Bradeberry approaches the damaged town from all different angles. These angles of growth include, leadership, economic sustainability, housing, infrastructure and environmental impact, education, health, social and cultural, Non-disaster emergency safety, and disaster preparedness. There are many demands to meet, but our role as a design team was only to meet a portion of the housing category. Our goal included meeting the price median for homes in Weed and providing economic housing for citizens of Weed. The resilience plan outlines the previously mentioned areas of growth, moving into categories that are out of the scope of a Construction Management team.

Another lesson learned focuses more on the monetary issues seen throughout the design process. GNS wanted the designs to meet a high standard of green building and passive house design. However, as stated repeatedly within this study, the client's needs could not be met because its small budget was a roadblock. There was a gap between resiliency and reality. The expectation of meeting resilience standards existed at the beginning. In the end there was a gap between a budget of \$140,000 with a resilient design and construction that we were capable of providing. In

the end the final budget met the affordable housing standards. However, the design changed dramatically: what started out as a a push for green building became the reality of traditional building styles.

### **Further Reading**

If you are interested in reading about the other aspects that went into this study, please read the following papers:

Panelized Workforce Housing by Brock Armstrong

Material Choice and Pricing for Great Northern Services (Weed Cohort) by Ryan O’Neill

Weed Cohort Panelized Housing by John Theofanides

### **References**

City of Weed Community Inspired Resilience Plan, Thomas Brandeberry Great Northern Services Strata Research (2016).