

# Cold-Formed Steel Wall Panels in a Production Setting: A Case Study of Navy Housing at Radford Terrace on Oahu, Hawaii



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And

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## **Background and Acknowledgements**

The objective of this project is to gather state-of-the-art information to enable builders and framers to better integrate steel-framed wall panelization methods and processes into their construction systems, designs and business models. This stage of the project consists of a series of case studies on builders and framers who are successfully using panelized construction in concert with cold-formed steel. This report addresses a case study conducted on the use of cold-formed steel panels in a production setting in Hawaii.

Residential steel framing has been used extensively in Hawaii for at least the past ten years. Builders in Hawaii face many of the same issues as those in the gulf coast region of the United States, especially in regard to termite infestation and climate issues. Thus, the experience gained in Hawaii is important to transfer to other locations to minimize false starts and shorten the learning curve of builders who are looking for sustainable and efficient alternatives to current practices.

Observations and interviews were conducted with personnel from Hunt Building Company (Hunt) and Worthington Military Construction, LLC (Worthington). The builder, Hunt, is using steel panels fabricated and installed by Worthington. The construction site was observed for four consecutive days to document site-specific practices. We also visited the fabrication facility to document their operations. One-on-one interviews were conducted with management representatives from both companies and with construction site workers and sub-contractors regarding their impressions on working with steel in general and steel panels specifically.

This case study and report were prepared by Matt Hawkins and Mark Nowak of Newport Partners LLC. We extend special thanks to Stu Britt of Worthington Military Construction LLC and Ralph Valentino of Hunt Building Company for their assistance throughout the project. Funding for the project was provided through a cooperative agreement between the Steel Framing Alliance and the U.S. Department of Housing and Urban Development, Office of Policy Development and Research.

## Section 1 –General site information and participants

Forest City Military Communities was selected by the U.S. Department of the Navy to build and manage Navy Housing in the Hawaii region under the Navy's PPV (Public-Private Venture) program. PPV was initiated by the U.S. Congress and the Department of Defense in response to a need to rapidly increase the quantity and quality of military family housing.

Under this particular PPV project, Forest City retains a 50 year lease on the homes and surrounding property. They assume responsibility for management, construction, renovation, and maintenance of the homes during the lease period. Military personnel rent the units using their housing allowance. The program relies on private sector financing and management to more efficiently do what was formerly the sole responsibility of the government.

This case study was conducted on Navy housing at Radford Terrace, located just outside the Honolulu International Airport. Radford Terrace is a large, multi-year project that consists primarily of the demolition and replacement of homes originally built prior to 1960. The project is situated within an existing urban/suburban neighborhood. In all, 741 new homes will be built over several years time.



Completed homes in Radford Terrace neighborhood

Forrest City manages the homes but they subcontract out all construction. Thus, this case study focuses on the activities and business models of the framer and the builder who are more closely connected to the use of steel framed wall panels at this project.

Forest City has subcontracted the demolition and construction to Hunt Building Company. Hunt has constructed thousands of homes for the U.S military over the years under both conventional turnkey contracts and more recently under the DOD privatization program. Contact information for Hunt is as follows:

Ralph Valentino, Project engineer  
Hunt Building Company  
5555 Cormorant Ave.  
Ewa Beach, HI 96706

Hunt in turn, has entered into a contractual relationship with Worthington Military Construction LLC for the framing operations. The two companies work closely on the design and scheduling of the homes. Worthington is responsible for the entire house framing and also supplies steel-framed wall panels for the project. Contact information for Worthington is as follows:

Stuart C. Britt, vice-president  
Worthington Military Construction  
94-216 Farrington Hwy B-208  
Waipahu, HI 96797

### **Housing characteristics**

The homes under construction at Radford Terrace range between 1,750 and 2,000 square feet. They are all two-story, with three bedrooms and an attached garage. The foundation is a concrete slab. There is a mix of attached and detached units.



Cold-formed steel panels are used for the first and second floor walls. Load bearing walls typically are 43 mil (18 gauge) cold-formed steel. The floor trusses and roof framing are wood.

Formosan termites are a threat to untreated wood throughout Hawaii. Thus, the market and building codes have moved toward building with treated wood, concrete, steel and other termite resistant members.

At Radford Terrace, the HVAC ducts were too large to be run in a floor system framed with steel joists. The builder thus designed the homes with treated wood trusses to provide flexibility in the duct system layout.

### **Framing innovations**

There are two innovative aspects of the production process designed to ensure that steel is used in the most efficient manner on this project. First is the use of a steady and predictable construction process at the housing site. Second is the off-site panelization of walls.

The production process was initially similar to most construction in the United States, with a single crew responsible for framing a home from start to finish

before moving on to the next home. Recently, the framer switched to a process similar to “even-flow” production often used in a manufacturing setting.

Under the even-flow approach, Worthington’s crews are organized according to specific tasks or phases of construction as opposed to one crew doing the entire house frame. The goal is to construct seven homes each week following a predictable schedule for each day for each crew.

The first crew prepares the foundation and stands up the first floor wall panels. Another individual follows them and installs the anchor bolts. A third crew installs the floor joists and support beams. Another crew then installs sheathing on the second floor joists.

Second floor wall panels are sheathed and stood up by one crew while the first floor walls are sheathed by another crew. Next the truss crew installs the main roof trusses. The fascia is then attached by one crew followed by the soffit material. Last, the roof decking is applied by yet another crew. Worthington is also responsible for interior partitions and window installation.



Floor joists supported by steel wall panels. Note that the trusses are each directly located over a stud (inline framing). Further, in order to avoid unusual connection details between the floor trusses and the steel walls, a wood top plate is installed on the panels during fabrication at the panel plant.

Each phase is completed in less than a day but an entire home takes about four weeks from foundation until the framing is complete. A home is finished in roughly sixty days after foundation, including painting and carpeting.



Off-site panel plant

Hunt and Worthington prefer to fabricate panels from pre-cut studs and track sections. Pre-cut studs and tracks reduce fabrication times.

Fabrication at the construction site reduces transportation costs and enables the panels to be stored at their respective building site. However, space constraints at this project required Worthington to build the walls at an off-site plant and transport them to the site for installation.

Employees are paid roughly \$20 an hour at an offsite plant while employees in the field are governed by union requirements and received upwards of \$50 an hour. In this case, off-site panel production resulted in more use of lower cost labor.

The plant and site framing personnel are different crews – the site crews stay on site and the plant crew works only at the plant. Site crews service multiple builders around Oahu, whereas the specific panel fabrication crew for this project only services the Radford Terrace project.

### **Surrounding Housing Market**

The surrounding area (Aiea and Pearl City) consists of modest-priced homes relative to housing costs in Hawaii. Existing homes in this area range from \$500,000 to \$650,000 while new construction starts at \$600,000 and up. In high cost locations new construction starts around \$1 million. The median home price for the island of Oahu is just above \$600,000.

Radford Terrace is a not a for-sale project so comparable sales data is not available. Total construction costs of the homes are just above \$200,000 per unit not including land and utility costs. As with other homes on the island, land costs are high and lot sizes are small.

## **Selection factors for steel**

Cold-formed steel framing is used in Hawaii primarily due to the aggressiveness of Formosan termites. The termite infestation problem forced the U.S. military services to specify steel or other termite-resistant materials over a decade ago. Building codes that govern the private sector have adopted similar practices.

## **Summary of process**

Hunt was constructing military homes in Hawaii well before steel use was mandated. The conversion process at the design and construction level wasn't difficult compared to finding a business arrangement that worked. Hunt contracts out all panel fabrication and installation to Worthington, who also does the majority of panel design with Hunt oversight. This arrangement provides Hunt with one contractor in charge of the entire structural system. Worthington has an incentive under this system to improve efficiency since they will save money, whereas with multiple contractors the desire to improve efficiency is lessened when the resulting savings go to another contractor.

Worthington employs an even-flow or task construction process. Instead of building a complete home at a time, a crew is dedicated to a specific construction task. This results in multiple homes being constructed at the same time and in different stages of construction. This limits the number of people in a home at a given time. Trades are scheduled to follow each other through the construction site resulting in only one trade contractor in a home at time.

## **Success to date**

The approach used for incorporating steel panels into the homes at Radford Terrace has evolved over time, with efficiencies incorporated along the way. The switch from building one home at a time to building a group of homes at the same time using crews who are dedicated to specific tasks is the latest evolution in the approach.

The task-oriented building approach initially resulted in slower construction times. Over the life of the project the workers become familiar with their tasks and efficiency improved dramatically. The builder recommends this construction process for projects over 100 units.

The approach used by Hunt and Worthington at Radford Terrace has been successful for all parties involved. They have averaged about 150 homes per year over the past three years and have 300 more planned for the next two years. The same arrangement is being planned for a second project on Oahu.