

Section 6: Cycle Time, Crews, and Onsite Construction Issues

Cycle Time for Framing Operations

The cycle time to complete the framing phase of a home at Radford Terrace typically took 5 to 7 days under the old approach where one framing crew started a home and stuck with it through completion of the framing and installation of the windows. However the even-flow work schedule now being employed was developed to avoid down times and to absorb construction delays. The current work flow process has a cycle time from foundation to finish framing, including installation of windows, of 30 days. During a typical 30 day period, Worthington will frame 28 homes.

Under the old approach, a crew could do between 4 to 5 homes per month. Thus it would take slightly over six crews of five workers (30 to 35 workers) to frame the same 28 homes currently completed each month with about 22 full time equivalent employees under the task oriented approach.

The time to complete homes is based on the crews operating a single shift each day, starting at 7:00 am and ending at 3:30. A thirty-minute lunch break and two fifteen-minute breaks are required under the terms of the agreement between Hunt and the local union. More detailed information on the tasks and responsibilities of those involved in the process are contained in the following sections.

Framing Crew Work Task Format

This section addresses the tasks that make up the framing process at Radford Terrace, the crew size and time required for each task, and provides a description of the work each crew conducts for the task.

First Story Wall Panels

Crew size	Four
Completion time per home	Three hours

The first floor framing crew is responsible for installing and bracing the first floor wall panels. The crew initially applies the foam and protective barrier (sill sealer) to separate the concrete slab from the steel panels. After this process is completed, two of the crew members unscrew the connecting straps needed for transportation and begin laying out the panels in their correct area. Then they stand up the first floor panels and connect them together. The other two crew members apply the support bracing and temporary foundation connections using power-driven nails. Pictured here are panels laid out ready to be stood up.



This crew works at other construction sites as needed, so they are not on the Radford Terrace job full time. The crew leader also works on exterior sheathing when the rest of the crew goes to another job site.

Anchoring

Crew Size	One
Completion time per home	Four hours



The anchoring task involves installing the permanent foundation tie downs and brackets for high wind resistance and traditional anchor bolts for the first floor wall panels. The crew first attaches brackets to the wall panels. Then they drill holes through the steel panels into the concrete slab. Next air is blown into the holes to remove dust so the epoxy will adhere to the slab and bolt. The bolt and

bracket connections are used at critical locations as dictated by the structural design.

Anchor bolts are drilled directly into the foundation through the steel. Pictured above is a bracket bolt with epoxy at a corner stud.

Floor Joist and Beams

Crew Size	Two
Completion time per home	Two to three hours

This two-person crew is responsible for installing the floor joists and their supporting beams in preparation for the second floor decking. Brackets are applied to the support beams prior to being lifted on top of the first floor wall panels. Beams and joists are set on the wall panels by an all-terrain forklift. During



down time the crew preps beams for future installation and helps other crews as needed. Pictured to the left is a beam with brackets waiting for the forklift to place it on the wall panels and a forklift (above) placing floor



joists on wall panels. Notice the placement of the beam on wood blocks to facilitate use of the forklift.

Second Floor Decking

Crew Size	Two
Completion time per home	Four hours

The main responsibility of the decking crew is to apply the second story floor sheathing. Plywood stacks are placed on the joists by a forklift. Once the decking is applied a forklift will drop off the second floor panels for the next crew. This crew requires tie-off training. Pictured here is a crew member carrying floor sheathing.



Second Story Wall Panels

Crew Size	Three
Completion time per home	Three to four hours



This crew is responsible for applying the sheathing to second floor shear walls and erecting and bracing them with the non-sheathed second story walls. Just like the first floor panel crew, they place the panels in their appropriate locations first. Then they apply the exterior sheathing on the necessary panels. The panels are then stood up, attached to the decking, and braced. This crew requires tie-off training. Pictured (above-left) is a completed second floor wall panel job and (right) a worker screwing sheathing onto a wall panel before tilting it up. Notice the extension attachment on the screw gun to facilitate screwing into a wall panel from the standing position.



First Floor Exterior Sheathing

Crew Size	Two
Completion time per home	Three to four hours



The exterior sheathing installers are responsible for affixing sheathing to the first story exterior walls. The crew also applies brackets to connect first story wall sheathing to second story wall sheathing. Walls that don't require shear resistance are left open. Pictured here is a completed sheathing job.

Trusses

Crew Size	Five
Completion time per home	Five to six hours

The truss crew is the biggest crew at the job site. Longer trusses are placed on top of the second floor by a forklift. Smaller trusses and pieces are inserted through a window on the second floor. The crew then begins spacing out the trusses and standing them up. As a home approaches completion, some of the truss crew moves over to the next house and begins prep work. This crew requires tie-off training. Pictured here are trusses being installed on a home.



Fascia

Crew Size	Two
Completion time per home	Five to six hours



This crew is responsible for attaching the fascia board to the end of trusses. Most of the fascia arrives pre-cut but some modifications are necessary on site. This crew requires tie-off training. Pictured here is the fascia on the truss tails.

Soffit (perimeter roof sheathing)

Crew Size	Two
Completion time per home	Five to six hours

Soffits in Hawaii are different than in many other parts of the United States. It is common practice to have an open soffit where the roof sheathing and truss tails are visible from the underside of the roof overhang. Therefore the soffit material is not a traditional soffit designed to cover the trusses and roof sheathing, but rather it is a special section of plywood that covers the roof at the overhang. The soffit, or perimeter sheathing, is a high end, paintable plywood instead of traditional plywood. The plywood is installed around the perimeter of the building and then painted so it can remain exposed. Standard roof sheathing is then applied (by a different crew) to the rest of the roof.

The soffit material (plywood) arrives in sheets and is cut to size onsite. This crew requires tie-off training.

Roofing

Crew Size	Four
Completion time per home	Five to six hours



The roofing crew installs the roof sheathing (plywood) after the soffit previously discussed. The crew places a few sheets of plywood that serves as a stand for the rest

of plywood to be dropped off. This crew requires tie-off training. Pictured above is the roofing crew installing plywood. Notice the plywood stand and different shade of the soffit perimeter plywood in the photograph.

Interior Partitions

Crew Size	Two
Completion time per home	Five to six hours

The interior partition crew is responsible for constructing and installing the interior partitions. These walls are stick built in much the same way as in commercial buildings. The studs arrive in a standard length but the crew does have to cut some studs and almost all the track to length in the field. Also, they only need to screw one-side of non-load bearing walls to the track, whereas load bearing walls need both sides of the stud attached to the track. When the drywall crew comes through, they secure the second side as they attach the drywall.

Supervisors

There is one site supervisor and assistant supervisor on site who oversee the process. The assistant is basically on site full time and the supervisor about half time.

Safety Supervisor

There is one safety supervisor on site who monitors the construction process and handles safety related incidents. This person is responsible for tie off training of specific crews.

Forklift Operators

There are two forklift operators at the job-site. They are responsible for prepping the construction crews by placing heavy materials in the appropriate locations. The forklift operators are critical in maintaining the work flow.

Transportation

The trucks used to transport the panels from the fabrication plant to the construction site are owned and operated by Worthington. Worthington Industries gains efficiencies and a cost advantage by owning trucks because of the all the activities they are engaged in. If Worthington was a smaller company focused solely on panel fabrication, leasing or renting flatbed trucks would most likely be more cost effective.

Call Backs

Hunt reports a steep reduction in call backs, especially related to framing members, when using steel. They attribute this reduction to the uniform quality found in steel studs and tracks, and to steel's ability not to pop nails and twist with moisture changes. The majority of their stud replacement is a consequence of transportation damage. Hunt estimates that over 20% of the studs in a wood home need to be replaced or repaired. Only one wall panel needed repair and two studs were twisted in the 15 homes observed during this study.

Site Issues

Over the weekend prior to our observations, high winds racked one home's first floor wall panels. The panels had been left unbraced on the previous Friday because the panel erection crew had run out of bracing material. On their return to the site the following week, the crew straightened the panels. This took about an hour before the crew was able to move on to other work. No other on-site modifications were required.

Efficiency Improvements

The main efficiency improvement reported by the framer was the implementation of the task orientated even-flow construction schedule. After a home has been built four or five times the framing crew begins to demonstrate real efficiency and reduce construction time. Over time, each crew began to understand the amount of supplies and inventories they need and they helped the site supervisor maintain adequate supplies.



In addition, the framer noted two other improvements they have adopted over time. The exterior sheathing crew screws plywood to the steel panels and then goes back and cuts out the window openings. This process eliminates the need to pre-measure the window and cut-out the openings in hopes they line up correctly. Also the exterior sheathing for the second floor is attached to the panel before being erected. This prevents sheathing damage that can occur during transportation and limits the amount of work done and waste generated at the fabrication facility. Scaffolding is also unnecessary if this sheathing strategy is employed. The second floor panels are laid out in their place on the second floor and the sheathing is attached by the crew before raising them.



The electrician also noted two products that have improved their efficiency in preventing wires from being damaged as they pull them through steel members. The first one is a plastic grommet that snaps together around the openings in steel studs. These grommets are hard to move and take little time to install. The second product is a

thin plastic strip with adhesive inside. The plastic is cut to length, usually enough to cover the bottom of the hole in the stud.