Session No. 777

Implementing Effective Fall Protection Practices In Residential Construction

Thomas Trauger, ARM
Winchester Homes
Bethseda, MD

Introduction

In 2010, OSHA rescinded the *Interim Fall Protection Compliance Guidelines for Residential Construction* (STD 03-00-001). All tasks 6 ft and above conducted on a residential construction site fall under 29 CFR 1926 Subpart M. OSHA states that over 40 workers' lives will be saved annually by following this compliance directive (OSHA 2010). OSHA analysis of insurance claims for 38 states indicated that the average cost for a roofer falling is $103,000 (OSHA 2012), and the average cost of a claim for a framer falling is $93,000 (OSHA 2012). Residential construction contractors and subcontractors will have to evaluate fall hazards and implement new safe practices that will comply with Subpart M. The following paper will briefly review the process Winchester Homes followed to evaluate and control fall hazards encountered at its home building operations. It will focus on specific work practices by task and trade and subcontractor involvement. A brief discussion of issues with anchor points attached to wood trusses will be included.

Background

Winchester Homes is one of five companies that is part of the Weyerhaeuser Real Estate Companies (WRECO), which builds homes in Maryland and Virginia. Winchester Homes both develops land and buys finished lots to build single-family homes and town homes. Using the "Your Home Your Way" process, buyers can modify the home at will. Therefore, Winchester seldom builds the same house twice. Besides options and finishes, major structural changes are commonly conducted on base-type homes. Over 100 subcontractors are used to complete over 100 building phases. In 2007, the WRECO management team started the implementation of fall protection practices that met or exceeded Subpart M, phasing out practices that met the OSHA interim fall protection guidelines (OSHA STD 03-00-001). Permanent roof anchor points have been installed on all Winchester Homes sites for over eight years (shown in Exhibit 1).

Exhibit 1. Permanent roof anchors installed for trades to use.

Assessment of Fall Hazards

The first item was to identify fall hazards above 6 ft by construction phase and affected trade contractor. This was conducted by onsite observations, input from site project managers, conversations with workers conducting the task, and meetings with trade contractor owners or managers. Trades identified with fall hazards above 6 ft were: concrete, framers, HVAC, plumbers, electricians, drywall installers, painters, siding installers, and brick layers. Exhibit 2 lists specific tasks conducted by the trades.

Identification and Evaluation of Possible Safe Work Practices

Once the affected trade contractors and hazards were identified, possible solutions were researched and evaluated. A meeting with principals of the affected trades was conducted to review our fall protection initiative. During the meetings, we asked contractor principals for their fall protection ideas, practices and solutions. Very few recommended any practice or solution. We clearly communicated our expectations that new fall protection practices would be implemented to build our homes, and they had the option of cooperating or would lose the work. We continued with our plan, and identified and evaluated solutions with feedback from of our contractors and subcontractors.

Task	Hazard	Trade	Safe Practice	Cost
Pouring basement walls	8 ft fall from top of form	Concrete	Attach brackets to forms and install two 2x10 planks	L
Install sill plate	8-9 ft fall into basement	Framer	Partial backfill, work from ladders	M
Install first floor joists	8-9 ft fall into basement	Framer	Partial backfill, work from ladders	M
Sheath first floor	8-9 ft fall into basement or edge	Framer	PFAS, work from ladders	L
Raise first floor walls	8-9 ft fall from edge	Framer	PFAS	L
Install second floor joists	8-10 ft fall between joists and higher falls from edge	Framer	Work from ladders, PFAS	L
Sheath second floor	8-10 ft fall between joists and higher falls from edge	Framer	PFAS, work from ladders	L
Raise second floor walls	10 ft and higher falls from edge	Framer	PFAS	L
Install trusses	8-10 ft fall from inside wall top plate and higher falls from outside wall top plate	Framer	Assemble trusses on ground install anchor point lift and place, work from ladders	L
Sheath roof	8 ft and higher falls from edge	Framer	PFAS	L
Framing of porches, bump outs	8 ft and higher falls from walls and trusses	Framer	PFAS	L
Installing roof	>8 ft falls from edge	Roofer	PFAS	L
Installing vent pipes	8 ft and higher falls from attic	Plumber	Relocated vent, PFAS, work from ladders	L
Installing HVAC ducts and vents	8 ft and higher falls from attic	HVAC	Work from ladders, PFAS	L
Installing electrical	8 ft and higher falls from attic	Electrician	Work from ladders, PFAS	L
Installing drywall	8 ft and higher falls in two story foyers and family rooms	Drywall installer	Scaffold, ladders, PFAS	L
Outside paint	8 ft and higher falls from ladders and roof	Painter	PFAS, work from ladders	L

Exhibit 2. List of some fall hazards, task, affected trades and fall protection work practices, arranged by building phase from start to finish.

The use of ladders and scaffolds were evaluated as the first safe practices. Other solutions included changes in work practices and scheduling. If the previous two solutions were not feasible, the use of conventional fall protection systems was evaluated.

Most contractors use step and extension ladders of different heights. This was the most economical and easily implemented solution. The use of different types of scaffolds was evaluated. Horse scaffold, mobile scaffold, ladder jack scaffold, carpenter brackets and pump jack scaffolds were evaluated by subcontractors. However, most subcontractors chose to use ladders and PFAS.

Some trades changed their work practices. The electricians stated that they had no need to climb up into the attic to conduct work. They could conduct all tasks from ladders. The plumber stated that he could move the location of the vent pipes to the rear of the house instead of the peak and use a ladder to do the work. The boots for the vent pipes were installed by the roofer using PFAS, eliminating the need for the plumber to access the roof.

Cost Analysis of Possible Solutions

The safe work practices were evaluated for ease of implementation, time to install and remove protective equipment, and costs of materials and/or equipment. The tasks were classified as low (L), medium (M) and high (H), based on costs of labor and equipment. Low indicates less than $200, M indicates costs between $200 and $1000, and H indicates costs above $1000 per house. For cost estimating purposes, materials and equipment were pro-rated over 100 homes. Current labor rates for the trade were used to estimate this cost.

Examples of Tasks Evaluated

The following are examples of the tasks that were evaluated.

Concrete Form Work

Most contractors doing this type of work for residential construction also do it for commercial construction. This made it easy to implement a safety practice on home-building sites. The practice of walking the top of the form walls (shown in Exhibit 3) was eliminated by installing scaffold brackets on the forms and planks (shown in Exhibit 4). Installing and removing the brackets and planks require at least two workers and two to three hours of work, depending on the size of the basement. The bracket and planks can be reused and prorated over 100 homes, making the cost an overall low expenditure.

Exhibit 3. Concrete worker walking forms while pouring basement walls.

Exhibit 4. Concrete workers working off of bracket scaffold while pouring basement walls.

Setting Sill Plate, Floor Joists, Sheathing Floor and Raising Walls

The practice of walking basement walls and setting the sill plate and floor joists was eliminated. Framers can work from ladders or scaffolds to complete this task (shown in Exhibit 5 and 6).

Exhibit 5. Workers setting sill plate on basement walls from ladders and mobile scaffold

Exhibit 6. Framer working off of a ladder installing first floor joists.

Exhibit 7. Framers installing floor joists from backfilled ground 39 inches from top of basement wall to ground and ladders.

Another practice that was evaluated was partial backfilling, leaving 39 inches from the top of the basement walls to the ground (shown in Exhibit 7). The basement wall acts as a guard rail, preventing falls into the basement. This protects framers installing the sill plate, floor joists, and sheathing. The excavator would come back after the house was framed to complete the backfill.

Exhibit 8. Worker using PFAS during installation of floor sheathing.

When a walk-out basement condition exists, there will be a fall hazard greater than six feet from the edge of the first floor; a retractable line, harness and anchor point installed on the floor protects the worker from falling over the edge and falling between floor joists while sheathing the floors (shown in Exhibit 8).

Exhibit 9. Framer working off of carpenter bracket scaffold installing second floor joists.

Installation of second floor joists can be conducted from a carpenter bracket attached to the first floor walls (shown in Exhibit 9), horse scaffold (shown in Exhibit 10) or ladders (shown in Exhibit 11). Framers chose the use of ladders because of availability, ease of use, and cost.

Walls can be raised using a self-retracting line and harness with anchor points installed at the feet (shown in Exhibit 12). Materials need to be properly staged to facilitate moving the walls to the proper location. Additional anchor points may be needed in order to facilitate material handling issues.

Exhibit 10. Framer working off of horse scaffold tying first floor walls together.

Exhibit 11. Framers installing second floor walls using self retracting lines and anchor points installed on floor.

Exhibit 12. Framers installing second floor joists from ladders.

Setting Trusses and Sheathing Roof

In order to install an anchor point on the trusses that would meet the load requirements listed in Subpart M and ANSI Z359, the manufacturer's bracing recommendations, listed in BCSI-2 and BCSI-11 (BCSI 2011), need to be followed. Five trusses are braced on the ground and an anchor point spanning at least two trusses is installed (shown in Exhibit 13). A self-retracting line is attached to it, and then the braced trusses are lifted with a crane and set in place (shown in Exhibit 14). Once the five braced trusses are set on the walls, a framer can climb up a ladder and hook his harness to the self-retracting line, then climb up on the top plate of an inside wall or the web of the trusses and continue to set the additional trusses (shown in Exhibit 15). Workers at the tails working from ladders will secure the trusses to the top of the wall (shown in Exhibit 16). The bracing of the trusses on the ground was conducted prior to the crane arriving on the jobsite. In approximately one hour, 3 to 4 framers working from ladders can have the five trusses braced and ready to be lifted. Additional lifting bars and bracing are needed to ensure the braced trusses would stay together during the lift. An engineer from our integrator who fabricates and installs all of the wood components for the home was onsite the first couple of times to ensure the proper bracing was being installed and the installation went smoothly.

Exhibit 13. Braced trusses with temporary anchor point installed and self-retracting line.

Exhibit 14. Braced trusses lifted by crane.

Exhibit 15. Worker working off of ladder while installing trusses.

Exhibit 16. Worker using self-retracting line and anchor point installed in trusses to set trusses.

Once all of the trusses are set and braced, the roof sheathing process starts. Permanent anchor points are then installed in each roof plane. Depending on the size of the home, more than one anchor point may be installed on the roof plane (shown in Exhibit 1). The worker hooks in to the permanent points with a retractable line and harness and continues sheathing the roof (shown in Exhibit 17). Any additional work conducted on the roof can be done using the permanent anchor points and PFAS.

Exhibit 17. Worker sheathing roof using PFAS.

Issues with Anchor points

Many of the tasks conducted are done when there is no overhead structure to install an anchor point. If no other alternative is feasible, such as working off of a ladder or scaffold, then PFAS is necessary. Not having a structure above the worker requires the installation of an anchor point at the feet. During building of the structure, many of the structural elements being installed will not meet the anchor point requirements from Subpart M and ANSI Z359. Many of the tasks are conducted at heights between 8 and 10 feet. PFAS manufacturers recommend having proper fall clearance unless fall restraint is used (Guardian). Concerns about having the proper clearance distance raised issues with what type of PFAS equipment should be used and location of anchor points. The following were concerns raised during the research and evaluation phase related to specific tasks:

Installation of Anchor Points on the Floor System

The manufacturer's installation instructions (truss joist) for our floor system require all floor joists and band boards to be installed and fully sheathed prior to applying any loads on it. The manufacturer, Weyerhaeuser (our parent company) was contacted and they provided guidance on how much sheathing is needed on the floor joists to provide structural strength on the floor system and be able to use an anchor point that meets the Subpart M requirements. A recommendation of installing 3 to 4 pieces of 8x4 floor sheathing, preferably in a corner, and spanning as many floor joists as possible, and then installing the anchor point was suggested. Sheathing of the floor is conducted with anchor points installed at the feet (shown in Exhibits 8

and 10) because there is no overhead location to install them. ANSI A10.32 contains best practices for the installation of anchor points.

Anchor Points on Trusses

For the past several years, Winchester Homes has been installing anchor points at the framing stage between two trusses, and then sheathing over them and leaving them in place until the house is completed (shown in Exhibit 1). These anchor points are used by several trades working on the roof. Using anchor points on fully sheathed roofs meets the truss manufacturer's recommendations and complies with Subpart M and ANSI Z359 requirements. A fall protection solution for framers working off of inside walls while installing trusses and then sheathing the roof was needed (shown in Exhibit 16). In the past, they would follow the interim fall protection guidelines, and framers installed the first three trusses from a ladder and then temporarily braced them. Then the worker installing trusses in the middle of the house would climb into the web of the braced trusses and continue installing trusses. Sheathing was conducted by installing the first few boards from ladders and the web of the trusses, then installing slide guards and continuing to sheath the roof (shown in Exhibit 17). During this task, they would install the anchor point.

The truss manufacturer's instructions recommended not using the anchor point until a section of the roof was fully sheathed. The BCSI-B11 2008 edition recommendations were followed (BCSI 2008). Additional research was conducted into when an anchor point could be installed on unsheathed, braced trusses and meet the requirements of Subpart M and ANSI Z359. Our parent company, Weyerhaeuser, conducted several drop tests on trusses and floor joists. A total of 14 drop tests were conducted with different bracing.

Our integrator brought up liability issues related to the installation of anchors on the structure and their use by other contractors. Contractually, they are required to provide and install the anchor points per our instructions. For additional information on bracing trusses, refer to the BCSI. In 2011, the SBCA updated the BCSI-11 (BCSI 2011) safety recommendations with additional guidance on the installation of anchor points on trusses. Presently, these recommendations are followed (shown in Exhibits 13 and 14).

Implementation

After evaluation and conducting tests of the different tasks, we met with the trade partners and presented them with more than one option on how to do the work and comply with our fall protection initiative. During the evaluation and testing phases, constant communication was in place with affected contractors. We had separate group meetings with concrete, framers, painters and drywall installers, and HVAC, plumbing and electricians. We asked each contractor to provide a written fall protection plan. This plan listed how they would conduct the different tasks above 6 ft and what means of protection they would use. The use of alternative or safety monitor plans was discouraged, and the contractor needed to meet the infeasibility and greater hazard conditions in order for us to consider this plan. Our project managers conducted frequent site inspections, focusing in fall protection practices. If agreed upon fall protection practices were not being followed, work was stopped and items were corrected prior to work starting again.

Conclusion

By being proactive prior to OSHA issuing Directive *STD 03-11-002*, many fall hazards were eliminated or mitigated and many safety best practices implemented. Teaming with contractor trade partners allowed for detailed evaluation of hazards and safety best practices. Although at the beginning of the process many trade contractors were skeptical of changes, many safety practices were implemented, eliminating most of the hazards. By implementing these fall protection safe practices, our trade contractors are complying with OSHA regulations and preventing their employees' exposure to fall hazards.

Bibliography

American National Standards Institute/American Society of Safety Engineers (ANSI/ASSE). 2007. *Fall Protection Code* (Z359). Des Plaines, IL: American Society of Safety Engineers.

American National Standards Institute/American Society of Safety Engineers (ANSI/ASSE). 2004. *Fall Protection Systems for Construction and Demolitions* **(**ANSI/ASSE A10.32-2004). Des Plaines, IL: American Society of Safety Engineers.

Guardian Fall Protection. "Product Instructions, Protection Cable Retractable Lifeline #4728" (retrieved January 12, 2012) (http://www.guardianfall.com/index.php?option=com_productinstruction&view=productinstruction&Itemid=92)

Occupational Safety and Health Administration (OSHA) 1999. *Instruction STD 03-00-001, Plain Language Revision of OSHA Instruction STD 3.1, Interim Fall Protection Compliance Guidelines for Residential Construction.* Washington, D.C.: OSHA.

Occupational Safety and Health Administration (OSHA). 2010. *Compliance Guidance for Residential Construction (STD 03-11-002).* (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=4755)

Occupational Safety and Health Administration (OSHA). 2010 News Release Number: 10-1753-NAT, Dec. 22, 2010. "U.S. Labor Department's OSHA acts to protect residential roofing workers. Agency rescinds Clinton-era directive and gives workers more safeguards against falls." (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=19005)

Occupational Safety and Health Administration (OSHA) 29 CFR 1926.501(b)(13). *Duty to have fall protection* (retrieved February 21, 2012) (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10757)

Occupational Safety and Health Administration (OSHA) 29 CFR 1926.502(k). *Fall protection systems criteria and practices* (retrieved February 21, 2012) (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10758)

Occupational Safety and Health Administration (OSHA). 2012. *Workers' Compensation Costs of Falls in Construction* (retrieved February 21, 2012) (http://www.osha.gov/doc/topics/residentialprotection/index.html)

Structural Building Component Association. *Building Component Safety Information (BCSI) Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses*. 2006 Edition, updated June 2011. Madison, WI: BCSI-B2 and BCSI-B11.

Structural Building Component Association. *Building Component Safety Information (BCSI) Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses*. 2008 Edition, Published May 2008. Madison, WI: BCSI-B2 and BCSI-B11.

Weyerhaeuser. "Truss Joist*:* Framing Details for Floor and Roof, Structural Framer's Pocket Guide" (retrieved January 21, 2012) (http://www.woodbywy.com/top_literature.aspx)

Weyerhaeuser. "Truss Test" (retrieved February 21, 2012) (http://www.youtube.com/watch?v=8P_5sMjjEZQ&feature=related