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Residential Fall Protection Case Study: Habitat for Humanity St. Louis

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The director of construction for Habitat for Humanity St. Louis, Mr. Kyle Hunsberger, described that after OSHA rescinded the Residential Guidelines, Habitat International encouraged adherence to the new fall protection standards. Paid carpentry professionals are onsite for every build to instruct, direct, and perform specific tasks; however the majority of the homes are built by volunteers. Since most of the volunteers have no knowledge of construction, lack skills inherent in the individuals in the trade, and are most likely not as agile as seasoned construction professionals, Habitat for Humanity adheres to procedures to ensure that volunteers are safe at all times. Since there are thousands of different size volunteers, both male and female, and there are many nuances to using personal fall arrests systems (anchor, lanyard, and harness), personal fall arrest was not chosen as the preferred method of fall protection. Personal fall arrest is used for a brief period of time by the trained carpentry professional at the construction site.

Determining the type of fall protection for the various phases of the construction process was no easy feat. Mr. Hunsberger familiarized himself with the fall protection requirements described in OSHA's Construction Standards 1926. He did not attend an informational session by OSHA, but other carpentry professionals that work with him did attend these sessions. He and his staff called OSHA's compliance hotline many times with questions, which were always answered by OSHA. Mr. Hunsberger performed an extensive internet search to determine the type of fall prevention technologies and methods that would be best for the homes that they construct in the St. Louis region. He stated that, "we had to learn how to build the homes all over again." They problem-solved the best methods to protect workers during each phase of the construction process. Mr. Hunsberger described standardizing the building process around the fall protection and incorporating fall protection "into our culture." He estimated personally spending 40 hours searching for fall protection solutions.

After identifying the targeted solutions, Mr. Hunsberger collaborated closely with local businesses and professionals to implement them, including a tool rental company, engineer, and machine shop. A local tool rental company researched different types of hanging scaffold systems and assisted them in purchasing the system they had chosen. Since the walk boards for the scaffolding are large to store and need to be cleaned and maintained, the rental company provides these for each build. Mr. Hunsberger needed the assistance of an engineer to determine how to brace and lift the roof assembly, which they build on the ground, and lift into place using a crane.



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This engineer volunteered his services and consulted with the crane company to ensure that the correct spreader bar was used to lift the roof assembly. In order to fasten safety nets in place when installing floor joists and sheathing, Mr. Hunsberger worked with a machine shop to design brackets that hook over the top plate; the shop fabricated enough brackets to position the net in place.

Solutions implemented at St. Louis Habitat for Humanity to construct a 2-story home with basement are described by the phase of construction below.

Installation of first-floor joists

After the foundation is poured, the over-dig area is filled in half-way with dirt, leaving approximately 39" of the foundation exposed. This allows workers to stand in this area to set the floor joists, with the foundation wall acting as a guardrail of appropriate height to prevent the workers from falling into the basement. After the floor joists are set and fall protection is installed, the over-dig area is filled in completely. Since Habitat builds several homes in the same location, it is feasible to bring the heavy equipment out twice to fill the over-dig area. This may also be feasible for builders who are constructing several homes in a subdivision.

Installation of first-floor sheathing

After the floor joists are installed, a safety net system is installed (Figure 1). Note that their floor joists are set 2' on center, so there is a significant risk of falling between the joists. They have several size nets that match the size of home (Figure 2). Since the bracket to attach the nets was designed for commercial applications and did not allow for the floor sheathing to be installed over the top plate, they had a special L-shaped bracket designed and fabricated (Figure 3). These brackets are hooked to a 2"x4" board for ease of placement. After the brackets are in place, it takes approximately 15 minutes to set the net. The nets must be pulled snug in order to protect the volunteers and workers. Since the nets stretch throughout the day, they are regularly checked and re-stretched. At the end of the workday, the net is loosened to allow it to return to its original position. At the beginning of the day, the nets are snugly stretched into place. The nets are inspected daily. In order to protect the nets from damage when not in use, they are stored in large rubber tubs (Figure 4).



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Figure 1 – Safety nets guard workers on second floor.



Figure 2 – Safety net spans the width of the home.

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Figure 3 – Fabricated bracket for safety net.



Figure 4 - Storage tub for safety net.

First-floor wall setting

Since first floor walls can be raised from ground level, there is no need for fall protection. In order to prevent workers from having to use a ladder to install the house wrap/blue board, this is installed prior to raising the wall.

Installation of second-floor joists

Exterior hanging scaffolds are used to protect workers from falling to the exterior of the home during construction (Figure 5). Before the first floor walls are raised, the brackets for the hanging scaffold are attached to the exterior walls; sheathing is notched to allow for the scaffold brackets to be installed (Figure 6). The bracket system requires interior bracing to support the weight of individuals on the scaffold, so they are installed immediately (Figure 7). A bin was fabricated on top of a skid to store the scaffolding and transport to and from the work site (Figure 8).



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Figure 5 – Hanging scaffold system in place.



Figure 6 – Notching of wall scaffold bracket.



Figure 7 – Interior bracing supports scaffold and workers (right).



Figure 8 – Storage bin for hanging scaffold storage/transport.

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Installation of second-floor sheathing

After the second-floor joists are in place, a safety net is installed to protect workers from falling inside the home. The hanging scaffold guardrail system prevents workers from falling outside of the home; therefore workers are free to install the floor sheathing from the floor joists.

Second-floor wall setting

Workers setting the walls from the floor sheathing are protected from a fall over the edge by the hanging scaffold guardrail system.

Stair openings

Pre-built stair-covers are positioned in place over the stair openings, usually 2-3 per stair opening. These have openings cut into the top to slip the hand into to remove (Figure 9). Please note that the opening in Figure 9 should be covered as they are holes which are over 2" side. After the stairs are built, the stair-cover is lifted to allow access to the lower level prior to guardrail fabrication. Using 2-3 sections of stair-covers ensures that they are light enough to be handled by one worker, possibly two. In 2-story homes, after the first floor stair opening is railed, the stair cover is moved to the second-floor stair opening (Figure 10). The stair-covers are transported from house to house. See pictures below.



Figure 9 – Reusable sections of stair opening covers. *Note:* handle holes should be covered.



Figure 10 – Stair covers in place from below.



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Roof truss setting, roof sheathing and shingling, and soffit installation

The entire roof assembly is built on the ground next to the house, beginning with the roof trusses, which are set on a base that stays on the ground (Figure 11). A large wood-beam is built into the center of the roof system to support the weight of the roof when lifted into place by a crane; the beam is permanent. Roof sheathing and shingling are installed while the assembly is on the ground, as are soffits, plumbing stacks and flashing. Two small cut-outs in the roof are left unsheathed for the crane to hook up to the beam. Two permanent roof anchors are attached to the top of the roof. Guardrails on the end trusses protect workers from falls over either edge of the roof assembly (Figure 12). The crane company uses a spreader bar that is the size specified by the engineer to handle the weight of the roof assembly. If the crane must make a long lift, a 120 ton crane is required (Figure 13). Workers stand on ladders inside of the home to guide the assembly into place and fasten it down. After securing, one worker climbs onto the roof to patch the openings for the crane with sheathing and shingling. The roof anchors are left in place for use during maintenance operations.



Figure 11 – Roof assembly built on stationary base.



Figure 12 – Guardrail protects the gable end of truss.



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Figure 13 – Roof assembly being lifted by large spreader bar.

Installation of siding

On most one-story homes, siding can be installed from ladder jacks. If the height exceeds 12', they set up masonry scaffold as it is more “dummy proof.” They must always keep in mind the safety of the untrained and inexperienced volunteers. In urban sites, they occasionally use snorkel or scissor lift or boom.

1-min. videos: Raising the roof

See a one-minute video of a crane raising a roof in place, as shown in the photo above. The Habitat for Humanity site is in St. Louis; the action is in fast motion to see the lift and landing of the roof on the house frame quickly.

<http://www.youtube.com/watch?v=BHTnOXBn2Fs>

Another one-minute video shows a pitch roof, built on the ground, lifted into place by a crane. The house is in Old North St. Louis, another Habitat for Humanity site.

<http://www.youtube.com/watch?v=IRBa0HWCVoY>



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