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Wood Truss Components "Made" Homes Affordable by NAHB Research Center Staff

The NAHB Research Center, PATH and WTCA worked together on a project to demonstrate that through innovative design, affordable yet durable housing is possible.

In 2000, on behalf of the national Partnership for Advancing Technology in Housing (PATH), the NAHB Research Center began designing the Marketable, Affordable, Durable, Entry-level (MADE) Homes project. The project team worked with WTCA on the structural component aspects of the project with assistance from WTCA's Capital Area Chapter members. The four detached, single-family homes, each approximately 2,000 square feet, were built in the NAHB Research Center's National Research Home Park in Bowie, MD, as a demonstration to builders for making value-added decisions that promote durability, contain costs, and increase curb appeal. Wood truss components played a key role in achieving all of those goals.

The project team designed the building envelope around a 30' x 40' foundation for modular efficiency. Homes feature varied elevations, layouts, garage sizes and sites. MADE planners chose open web floor trusses as support members to facilitate duct placement and ensure that mechanical trade installers would not compromise structural members.

TOP CHORD BEARING

MADE PHASE I: THE USEFULNESS OF OPEN WEB FLOOR TRUSSES

The first two homes built were constructed with 12-inch deep open web first floor trusses. The 40-foot dimension of the foundation was spanned with three even lengths of trusses that were spaced at 24 inches on center. This spacing was specified to minimize cost, labor and complexity, while maximizing resource efficiency and system performance (floors were designed for a minimum deflection of L/480).

One WTCA Capital Area Chapter component manufacturer, Shelter Systems of Westminster, MD, assisted in optimizing assembly performance by engineering a bearing detail that allowed succeeding runs of trusses to lay out in line as opposed to offsetting them at the four-inch bearing beneath. The truss length was designed as the clear span plus the bearings at each end. Where one truss would abut an-other, a three-inch notch was held in the double end verticals that rested on the bearing below. The next truss was similarly designed with a top chord bearing detail at the end that would connect to the first truss and the same three-inch double end vertical at the opposite end. Being able to keep three spans of trusses aligned allowed for continuous layout of deck sheathing and mechanical systems. (See photo of top chord bearing above.)

MADE PHASE II: INNOVATIVE ROOF TRUSS DESIGN, ENERGY EFFICIENCY & MARKETABILITY

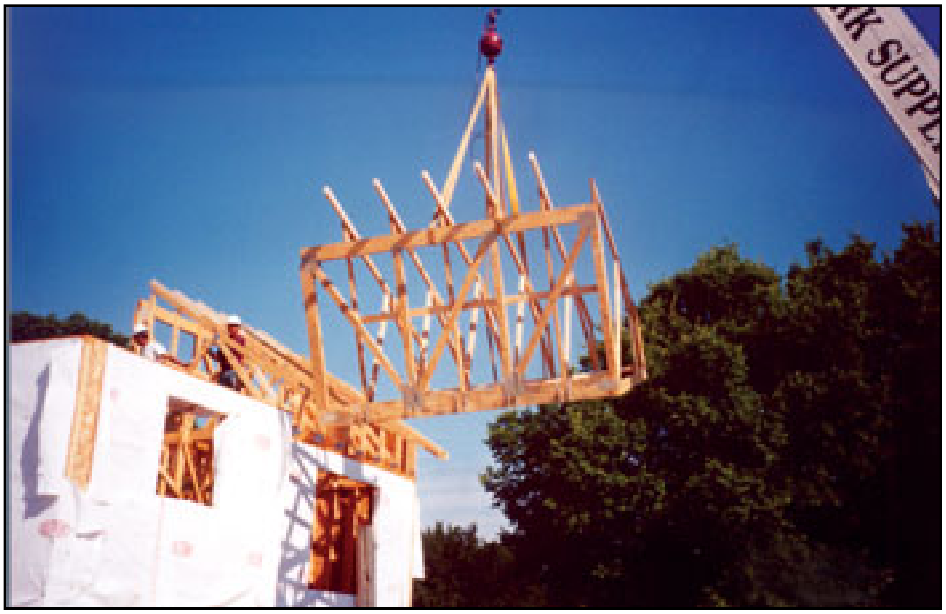

GIRDERS CARRY THE LOAD IMPOSED BY THE SECOND FLOOR AND ROOF ASSEMBLIES

When the next two homes were in the design stage, attic trusses were considered as a method of framing the second floor and roof. The 8/12 pitch and 40-foot clear span would require a piggyback design, allow an approximately 14-foot room maximum dimension, call for special engineering for the girder at the stairwell that would parallel the span, and utilize wide dimension lumber. However, the rooms' size limitations, two-piece truss design, weight of each component, and inability to design for the desired floor deflection at 24 inches on center spacing, weighed the odds against specifying attic trusses.

Working with WTCA Capital Area Chapter member engineers from MiTek, Inc., of Charlottesville, VA, the second floor and roof frame for Phase II was designed as several 7'2" flat girders carrying 16-inch deep floor trusses from one side of the bottom chord and 8'2" mono trusses from the opposite side. The flat girders define the walls of the second story rooms while the floor trusses accommodate a spacious 23'4" room dimension. Scissors trusses complete the ceiling and roof of the second levels, bearing on the top chord of the flat girders. This design allows more flexibility in first floor ceiling profiles than an attic truss might, and truss spans were reduced enough to design with 2 x 4 members in all components other than the girders. The 7'2" depth of the two-ply girders were easily engineered to carry the loads imposed by the second floor and roof assemblies. This design provided three functions for the trusses: wall members, roof headers and floor headers. (See photo.)

The Phase II design used approximately 60 components, or twice that of a piggyback attic truss system. It was also half as costly as a piggyback system, due to the quantity of similar profiles produced and smaller chord sizes. Component designs met all of the project criteria for performance, dimension and profile. In addition, the mono truss heels that were raised to 1'4" to maintain headroom in the second floor rooms provided two uncalculated, but desirable effects. The first was the creation of taller walls at the exterior front and rear elevations. The taller walls, clad with smooth horizontal lapped fiber-cement siding, lent a prominent appearance to these facades that blended well with the adjacent two-story colonial architecture in the existing neighborhood. The raised heel also served as an energy heel, allowing insulation to be installed over the exterior walls to the full depth (and R-value) that was specified for flat ceilings of the project.

One facet of the Phase II design that was not fully exploited is its potential to be assembled in sections on the ground. These modules could then be craned into place upon the structure, secured, and used to provide a fall arrest harness attachment location and platform from which contractors could continue working at the higher level.


WOOD TRUSSES ARE CRANED INTO A MADE HOME

Each of the four two-ply girders presented the opportunity to pre-assemble the components abutting one face and pre-install the hangers on its opposing face. Our carpentry team chose to connect the mono trusses to the girders and preinstall the floor truss hangers while on the ground. This option enhanced worksite safety. The "shed" roof modules were moved into place with a crane and proved to be temporarily self-bracing. Floor trusses were then hoisted into place from stepladders set up on the first deck. The process was safer than having a carpenter walk a wall plate line to position and fasten truss tails. In a production environment, this installation process could be honed even further.

Components for the MADE project enhanced durability by facilitating duct placement and sheathing layout. Incorporating engineered floors and roofs promoted resource efficiency while maximizing design flexibility. During recent tours of the homes, visitors have commented on the innovative and practical use of space.

The NAHB Research Center's National Research Home Park, in which all four MADE Homes are located, and its accredited laboratory, are two of the NAHB Research Center's unique assets. The Park provides a location for testing and evaluating the real world application of innovative building products and practices first designed in the laboratory. These capabilities, in addition to the NAHB Research Center's strict adherence to objective research and its affiliation with the National Association of Home Builders, allow the NAHB Research Center to direct the home building industry to the leading edge of technology, and enhance the quality and affordability of housing for all Americans.

The MADE project is just one of many field evaluation projects that the NAHB Research Center has completed. For more information on the use of wood trusses in the MADE Homes, visit the NAHB Research Center's ToolBase Services website at www.toolbase.org/MADE, or contact Lisa Gibson at lgibson@nahbrc.org or 800/638-8556 ext. 6269. The NAHB Research Center is the research arm of the National Association of Home Builders, and is located in Upper Marlboro, MD. In its nearly 40 years of service to the home building industry, the NAHB Research Center has provided product research and building process improvements that have been widely adopted by home builders in the United States. Through testing and certification services, the NAHB Research Center seal is recognized throughout the world as a mark of product quality and an assurance of product performance.

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