

# INNOVATION



## Factory Building: The Next Wave Computerizing and automating home panelization

JLC STAFF REPORT

Tedd Benson has “only a small ambition,” he told assembled guests at the grand opening of his Unity Homes factory in Keene, N.H., in 2018. “We intend to change the building industry. Dramatically.”

Benson’s roots as a builder go back to the 1970s, when he helped to kick-start the timber-framing revival in the U.S. with his classic book, *Building the Timber Frame House*. But the vision has evolved over the years, and Benson’s current venture, Unity Homes, is about much more than honing a chisel.

In July 2018, JLC toured Unity’s factory in Keene, N.H. What we saw was a state-of-the-art computerized and automated facility where comprehensive CAD plans are turned into complete

high-performance custom home packages that the company’s trained crews can erect on site in a matter of days.

In December, we went on site in Brewster, Mass., to see a crew set one of Unity’s house packages. What follows is a look at both ends of the process: the precise factory fabrication of house components in the Keene facility, and the quick erection of the home on site in the field.

The company’s goals are ambitious and broad: building in a few weeks homes that can last for hundreds of years; precisely controlling fabrication to eliminate construction defects completely; and creating a process that can scale up to become standard practice throughout the nation. Can they do it? Read on.

Photo: Roe Osborn



## Touring the Unity Homes Factory Floor

Humans have dreamed for years of a future where all the work would be done by machines. At the Keene, N.H., manufacturing plant of Unity Homes and Bensonwood, that future is one step closer to becoming a reality. The plant cranks out complete home frames, bundled for assembly on site, including walls, roofs, and floors. There's still plenty of work in the facility for people. But much of the fabrication, along with all of the heavy lifting, is done by high-precision machinery (see photos). On a tour of the facility, *JLC* got to see some of the equipment in action as Hans Porschitz, Unity's chief operations officer, explained the setup.

At the heart of the operation is a Hundegger Speed Cut SC3, a versatile robot that gets its instruction directly from a home's CAD design file. Workers load the machine with raw materials using a vacuum-lift crane. The Speed Cut can handle solid beams as fat as 7 inches by 24 inches and has no trouble with wood I-joists or glue-laminated stock. Inside the machine, a spinning saw blade makes all the necessary cuts for stud, joist, and rafter framing. Routers can hog out mortises and tenons or holes for chases. Cuts are precise to 1/16 inch. And the Speed Cut's ink-jet printer not only labels every part that's cut, it also handles layout for wall, floor, and roof panel assembly. Workers who put the components together rarely have to touch even a tape measure or pencil.

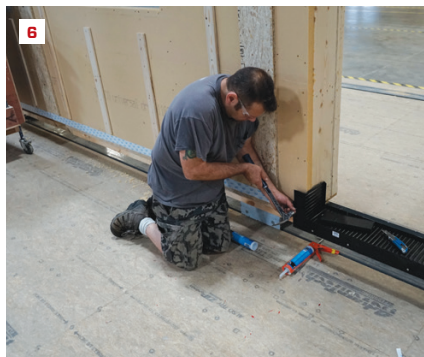
From the Hundegger, parts are bundled and carried by forklift to three parallel assembly lines: one for walls, one for roofs, and one for the "open cavity" components (interior walls and floors). During assembly work, operators don't have to bend over or lift heavy weights, because machines handle the lifting. And operators seldom touch a tool; they just place parts on the framing table. Machines nail studs to wall plates. Workers do have to tack sheathing in place (although they don't have to lift it), but automated routers handle the sheathing cuts, and rack-mounted nail guns nail the material off with precision accuracy.







(Facing page) Mortise-and-tenon joinery substitutes for steel connectors in some situations; here, Hans Porschitz demonstrates a mortised porch-roof connection **(1)**. Brad Ramsey, the Hundegger CNC equipment operator, works the controls for the machine. Also at Ramsey's fingertips is the control panel for the Joulin semi-automatic vacuum feeding system, which allows him to select and feed a variety of materials from a magazine into the cutting equipment **(2)**.



Alex Morin assembles the framing for a window rough opening. This component will then get fed into the automated framing system that will frame the other parts of the wall **(3)**.

(Facing page) The CNC bridge gantry is equipped with nailers and a router. It travels over the wall on the table, fastening the sheathing to the framing and trimming it to the final panel size as well as cutting out the sheathing for any door and window openings **(4)**.



Jason Furland places insulating fiber sheathing on the exterior of a wall panel. The gantry will nail off and trim the panel later **(5)**. Ray Zabel installs the standard sill pan detail of a doorway rough opening prior to the door install **(6)**. All doors and windows are detailed and installed before the walls are shipped, allowing the home to be blower-door tested as soon as the last panel is installed in the field. Greg Bruns preps the exterior of the rough opening for a window, using Siga tape **(7)**. All wall panels are fully airtight and watertight when they are shipped to the field. A worker manhandles parts for a custom curved roof package created by the Hundegger Speed Cut saw. The Unity Homes plant is capable of accomplishing fully panelized building shapes ranging from simple geometric forms to one-off architect-designed creations **(8)**.





## Built in a Factory, Assembled on Site

The first sign that assembly of the house was imminent was the far-off sound of a semi truck winding its way down a narrow dirt road through the woods on Cape Cod. The Unity Homes crew had arrived from New Hampshire a day earlier and set mudsills on the foundation. The crane—an absolutely essential part of the assembly operation—was set up and ready. What followed over the next five days was nothing short of incredible to observe.

**Crew coordination.** The crew of four from Unity Homes worked together like a well-oiled machine. These guys had assembled many Unity homes together. In addition, they alternated their time on assembly crews with time in the factory, so they were able to bring valuable feedback from the field to the factory floor.

Whether unstrapping a load from a trailer, rigging panels for lifting, or nestling a panel into place on the house, they worked quickly, efficiently, and methodically. Every crew member seemed to have a good idea of what was supposed to be done next.

**Safety first.** It would be easy for an experienced crew to get lax with safety on the jobsite. But these crew members always wore hard hats during crane operations, and their bright yellow shirts were much more for jobsite visibility than for promotion.

Fall protection equipment was used at all times while the roof panels were being set. The lifting-strap anchors on the roof panels worked perfectly as attachment points for the equipment. And the panels even came from the factory with toe boards attached.

**Attention to detail.** Perhaps the most impressive thing was the crew's attention to detail when it came to air-sealing the panels. Specialized gaskets were used to seal every connection between the subfloor, walls, and roof panels. They meticulously executed every detail with a complete battery of different tapes and sealants.

The photos on the following pages offer a quick look at the assembly process. To see more photos, please check out the online version of the article, at [jlconline.com](http://jlconline.com).



The parts for the house come on big flatbed trailers, shrink-wrapped, labeled, and numbered for assembly (9). After glulam carrying beams supported by posts tenoned into them are dropped into place (10), the crane sets the first-floor deck panels (11). As each floor panel is set in place, the crew draws the panels together with specialized ratchets (12). The panels are then fastened to the sills from below.







Unity Homes often have a timber-frame component, and this house was no exception. After setting the floor deck panels, the crew assembles a timber-frame bent made from glulam lumber that was cut in the factory (13). Besides adding a distinctive decorative note to the home's interior, the bent supports the main roof. Although cut on CNC machines, all the joints are pegged together in the traditional manner of a timber frame (14).



Specialized gaskets are attached to the floor panels (15) before the wall panels are dropped into place (16) to air-seal this critical joint. Note that each panel is fully insulated and comes with an interior 2x3 wall for running utilities. As each panel is set and braced, the crew attaches the gasket material to the corner of the panel where it meets the adjoining wall panel (17). After raising the timber-frame bent, the crew continues to stand the walls around the house (18).





After attaching gasket material to the top plates of the walls, the crew sets the gables (19). Roof panels have an integral lip that fits into a groove on the top of the bent beam (20). Chainfalls on the lifting straps hold the panels at the proper angle (21). After installing the intersecting roof beam (22), the crew staples gasketing to the roof in preparation for the next roof panels (23).



Even the porches are on this house are prefabricated in the factory. Supports for the inner porch walls are part of the foundation pour to avoid the need for a ledger (24). The main porch uses a timber frame to support the roof, but prebuilt gable panels sit on the frame (25). After installing the porch ridge beam, the crew installs the porch roof panels (26).





Siga Rissan tape seals the lifting holes in the walls (27), and Zip System tape seals the roof-panel seams (28). A crew member layers the various tapes and gaskets for a crucial wall-roof-deck intersection (29). At the peak, backer rod fills the gap between panels (30), followed by expanding foam (31) and Zip tape (32), which also seals roof-panel holes (33). Siga Wigluv tape air-seals the wall-panel intersections (34).

The crew's truck is packed up and ready to return home with the shrink-wrap material, extra lumber, food coolers, and luggage (35). No dumpster was needed, and no trash pile was left on site.