

NHERI TallWood

Shake Table Testing of A Full-Scale Resilient 10-Story Mass-Timber Building Newsletter Issue 3: October 24, 2022

Structural Construction Progress

Gravity framing is complete for the first seven stories of the building. Presently, preparation is underway to install the next set of rocking wall panels that will span stories 4-7. This requires completion of a major technical detail: the first set of splice joints between the rocking wall. Updates on rocking wall construction will be presented in the next newsletter.



Figure 1: (a) Gravity framing complete to 5 stories, and the safety towers are installed, (b) erecting columns for the 6th and 7th stories, (c) gravity framing complete to 7 stories

Installation of Exterior Wall Subassemblies

To reduce delay in the construction process, the installation of the exterior skin subassemblies is proceeding on the building lower levels while the construction team preparing the wall segments. The test building will include four exterior wall subassemblies that span the first 2-3 stories of the building, a unique system on each corner. The subassemblies include a 2-story glass curtain wall (northwest corner), and three 3-story cold-formed steel frame (CFS) subassemblies on the remaining corners. Each CFS-framed subassembly uses a unique approach to accommodate the drift. The CFS-framed assemblies will also include a variety of shapes and sizes of windows, and will include aluminum composite panels on the exterior finish.

The curtain wall was installed over about two and a half weeks by Long's Glazing and Door and is now complete. Scaffolding has been erected to support the construction of the CFS subassemblies (Figure 2). One tricky aspect is to avoid bearing directly over shake table moat covers or the portion of the base slab that lies directly over the shake table actuators; therefore, two sides of the scaffold have outrigger trusses to transfer this load away from the building. The

installation of the CFS walls has been made possible through a partnership with the local Southwest Carpenter's Union Training Fund (apprenticeship program). The program instructors have been leading the apprentices through the installation process (Figure 3). After two weeks, the majority of the framing on these three subassemblies is complete. Remaining installation steps include sheathing, waterproofing and flashing, windows, and exterior panels and joints.

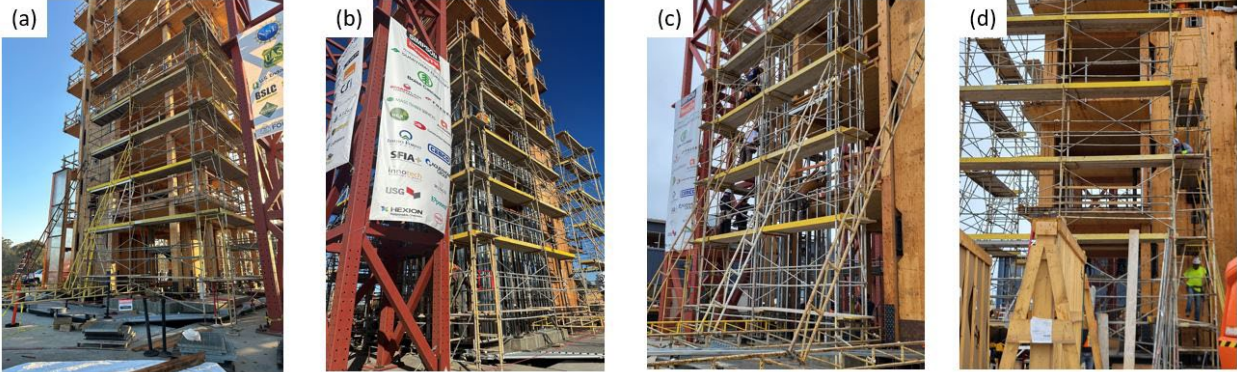


Figure 2: Scaffolding spanning around the building to support exterior wall installation: view from (a) southwest corner, (b) southeast corner, (c) northwest corner, (d) directly north. Note the outrigger trusses in some of the images.

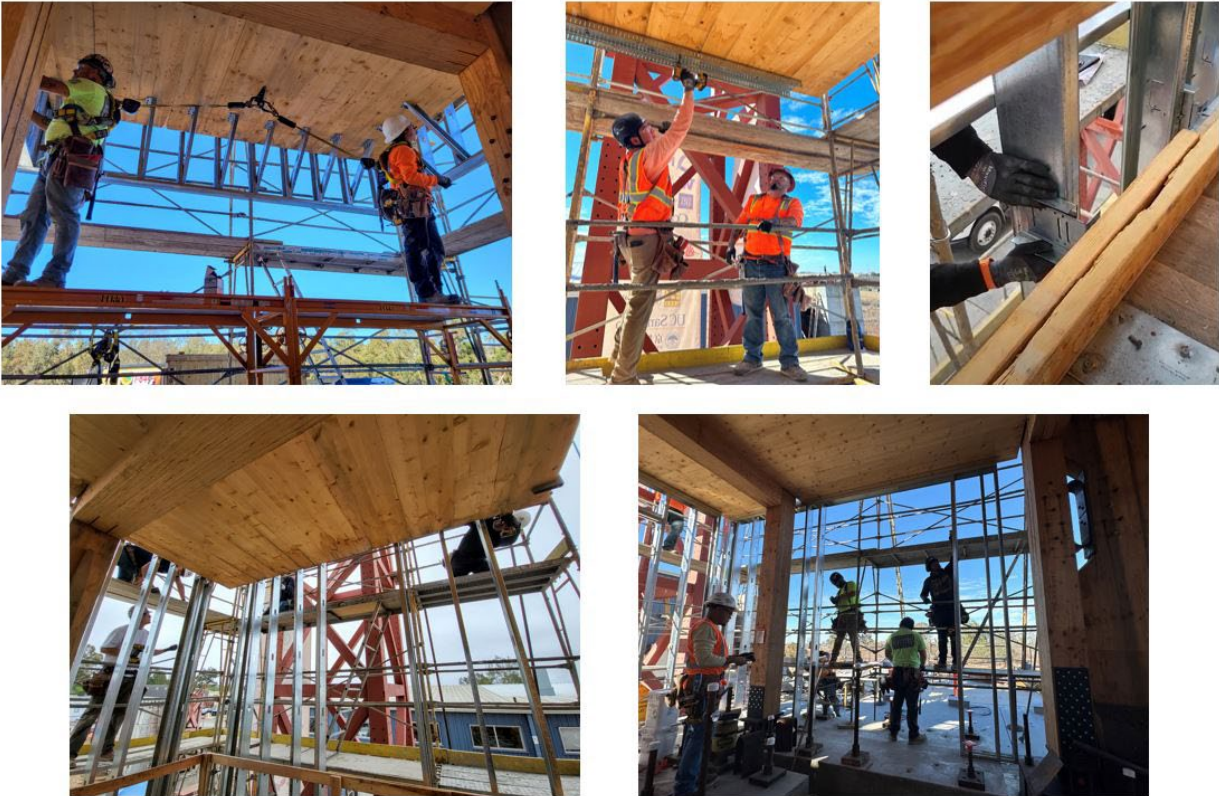


Figure 3: Images from CFS-framed exterior wall subassembly installation by Southwest Carpenters Union Training Fund (apprenticeship program)

Test Feature Highlight: Fire-rated Glass Curtain Wall

Curtain walls are framed floor to floor typically with heavy horizontal and vertical framing members (mullions) that support the glass lites. The C-shaped curtain wall subassembly that has been designed and installed for this test program was donated by Technical Glass Products, a subsidiary of Allegion. This curtain wall subassembly is stick-built with mechanically captured glazing. A gasketed pressure plate is mechanically secured to the mullions through the glazing pocket to hold the glass in place. To resist the lateral drift in an earthquake, the framing racks and the glass rotates within the framing to accommodate the movement. The clearance between the glass and the frame must be selected to prevent glass fallout at the peak drift per ASCE 7-16 Section 13.5.9. The displacement at glass fallout is determined using AAMA 501.6 racking protocol applied to a mock-up of the curtain wall system, or theoretical calculations for a mechanically captured system. Racking tests of curtain wall mock-ups indicate that they can effectively resist controlled unidirectional loading. The goal of the testing is to determine if standard racking protocols are representative of the response of a realistic curtain wall subassembly with multi-directional geometry (corner conditions), bidirectional and vertical drift/deformation, and potential high acceleration dynamic effects.

This particular curtain wall system utilizes a fire-rated specialty product with 1-1/16" glazing. The glazing is a multilayer laminate composed of thin sheets of annealed glass with intumescent layers in between for fire protection. A variety of glass panel sizes and aspect ratios are incorporated into the design to explore the effect of these variables. This fire-rated assembly also utilizes S235JR steel mullions instead of typical aluminum mullions characteristic of curtain walls.

The following images highlight the construction process for the curtain wall.



Figure 4: (a) Slotted base anchor to accommodate vertical movement, (b) slotted wind load anchors, (c) slotted head anchors, (d) intermediate horizontal and vertical mullions are partially assembled on the ground, (e) lower segment of framing is lifted into place and anchored, and perimeter sill horizontals are installed (f) upper set of framing is placed and anchored at the splice joint and the head.

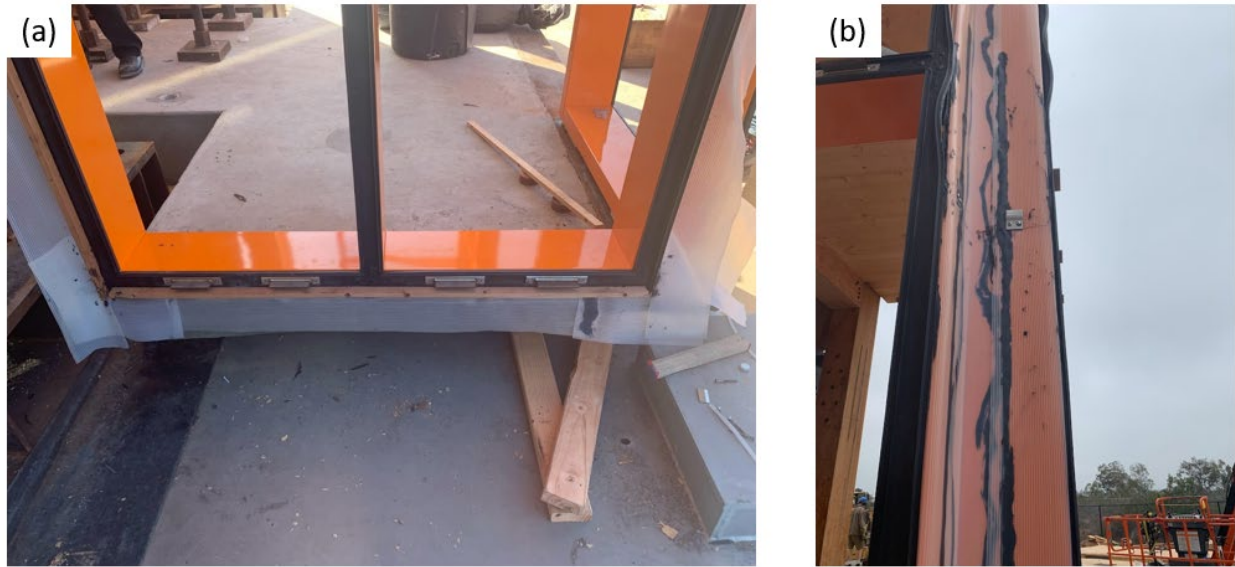


Figure 5: (a) Extruded silicone perimeter transition assemblies are attached between the mullions and adjacent construction silicone caulk to provide a water and fire-resistant corner transition around the system, (b) extruded silicone transition and caulk at the corner joint.

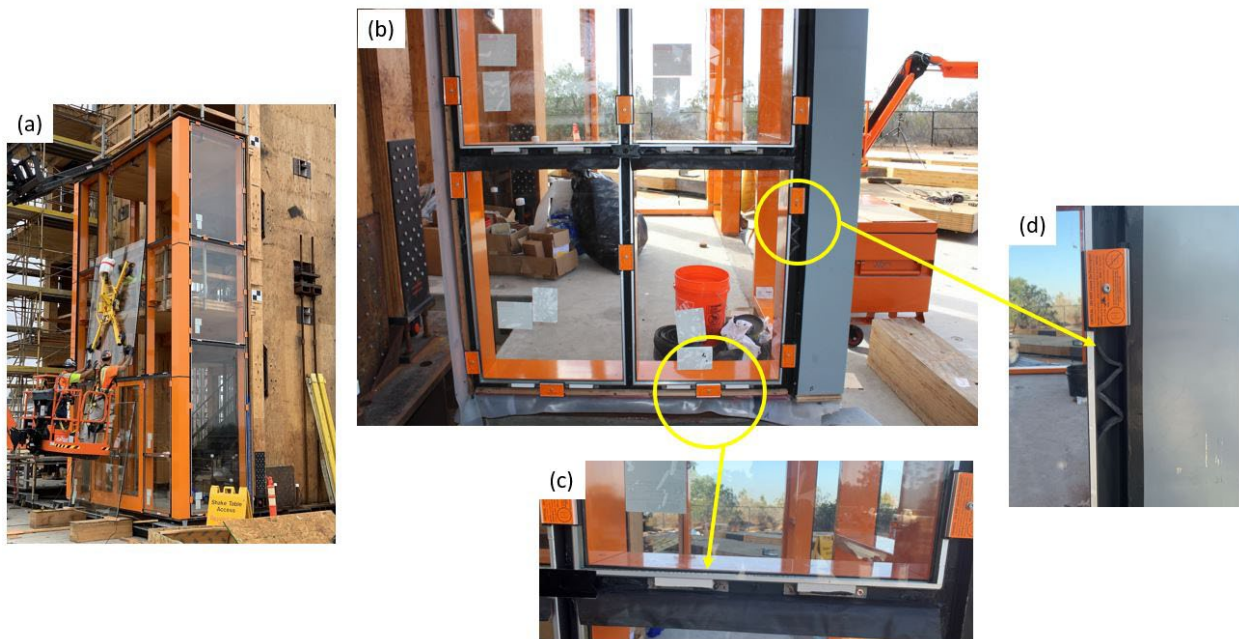


Figure 6: (a) Power cup is required for lifting larger panels weighing up to 650 lbs, (b) temporary plates hold glass in place until pressure plates are installed, (c) glass panels rest on calcium silicate setting blocks, (d) W-shaped anti-walk blocks help recenter glass curing movement.

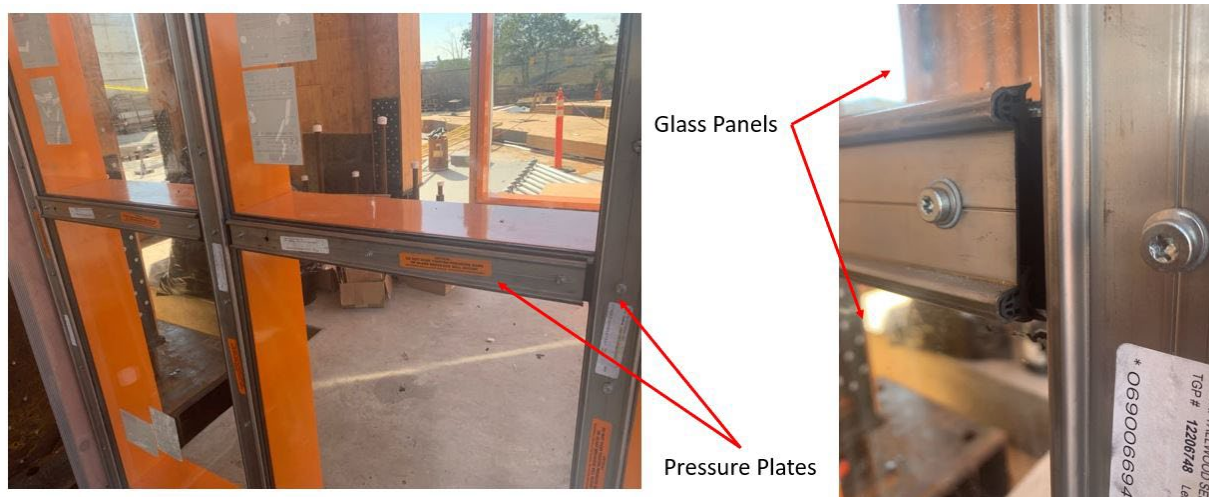


Figure 7: Pressure plates are installed after all glass panels on one side are set. Pressure plates hold glass panels in place using rubber gaskets.



Figure 8: (a) Cover caps are installed after the pressure plates have been attached, (b) sealant finish is applied, (c) finished curtain wall

Follow Construction Progress

Reminder: You can follow construction progress on your own by looking for our newsletters on the NHERI TallWood website: <http://nheritallwood.mines.edu/>, checking in with the site webcam <http://nheri.ucsd.edu/video/>, or following Ling on Twitter: @slpei.

Acknowledgements

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