

## Development of a Ready-to-Assemble (RTA) Tornado Safe Room Constructed from Cross-Laminated Timber

The growth of the cross-laminated timber (CLT) panel market has made available manufactured wood panels that are ideal for tornado safe rooms and shelters. The thick cross-section of the laminated panels are well suited to resist wind and impact loads produced by tornados (Fig. 1).

### Background

Over the past several decades, the market for ready-to-assemble (RTA) products has grown significantly. RTA kitchen cabinets and furniture are commonplace because they can be shipped flat and assembled on site, which has greatly reduced shipping costs associated with an otherwise voluminous product. Packaged with necessary hardware and instructions, these RTA products are typically easy to assemble and fool proof. The development of a standardized safe room using CLT that is ready to assemble, easy to ship, and quick to fabricate on site would not only increase the level of safety for our population but also increase the market opportunity for these engineered wood products. This research is an extension of research by the USDA Forest Service, Forest Products Laboratory, to develop a do-it-yourself safe room constructed from wood that can be incorporated into existing housing and that utilizes commodity wood products.

### Objective

The objective of this project is to develop a RTA tornado safe room and shelter from CLT for use in existing and new residential and commercial construction.

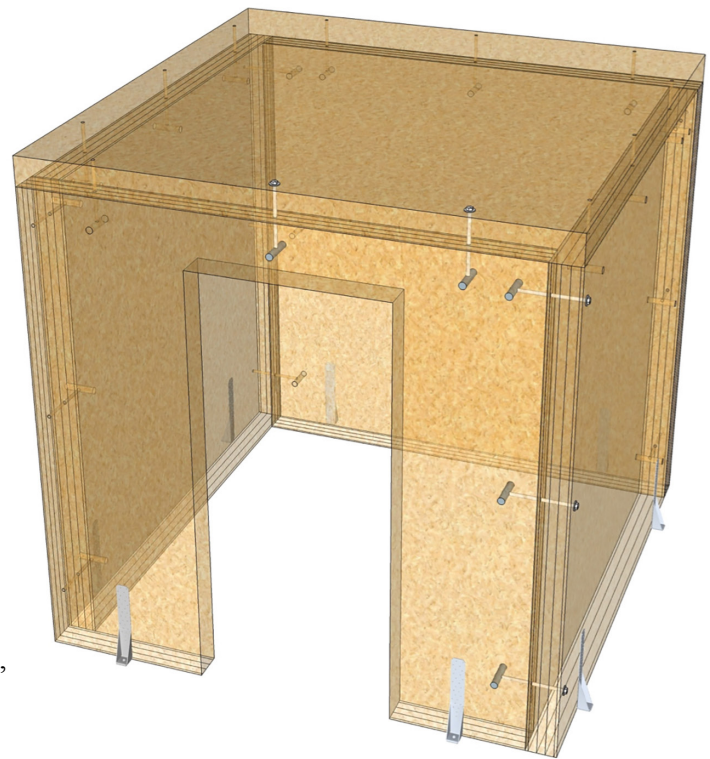


Figure 1. Proposed 8- by 8-ft CLT ready-to-assemble safe room.

### Approach

CLT panels obtained from a cooperating CLT manufacturer will be tested for impact and wind load resistance. These initial tests will confirm optimal panel thickness and layup configuration. Panels 8 by 8 ft in size will be tested because this size matches existing panel manufacturing capacity. These tests will follow the protocol of ICC-500 (2014) and the test setup used by Falk et al. (2015).



**Figure 2. Prototype panel connector.**

A panel connection system is being developed and tested that is similar in design (albeit much more heavy duty) to that used in the furniture industry (Fig. 2). These doweled fasteners would be simple to install and allow the butting of panels with little field modification. Full-size lateral load tests will be performed on an assembled safe room (8 by 8 by 8 ft in size) to verify the integrity of the developed connection system and lateral wind pressure resistance of the shelters.

### **Expected Outcomes**

A workable RTA safe room constructed from CLT will be verified to resist the forces of an EF-5 tornado and the requirements of the ICC-500 design standard.

### **Timeline**

This project will be completed by December 2017.

### **Cooperators**

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### **References**

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