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Publisher's version / Version de l'éditeur:

World Conference on Timber Engineering 2012 [Proceedings], 2012

Predicting the Fire Resistance of Cross-laminated Timber Assemblies

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Abstract

There is growing interest from the Canadian wood products industry to produce and use cross-laminated timber (CLT) panels in construction. These panels are typically manufactured with 3, 5 or 7 plies, where, most commonly, the plies are glued together with the grain perpendicular to the previous in each successive layer.

Because this is a new product in North America, there is a need to demonstrate that the product meets various performance attributes such as structural resistance, sound transmission and fire resistance. Massive wood members are generally known to perform well under fire conditions due to the slow rate of charring and the low thermal conductivity of the charred layer which protects the non-charred wood beneath. Understanding charring rates is important in estimating the remaining structural resistance which designers can use to calculate the fire-resistance rating for a particular load.

This research aims to address two primary objectives which will support the North American adoption of CLT. First, a generic calculation method for determining the fire-resistance of CLT assemblies is needed to enable producers to manufacture a number of different configurations of panels without the need to run a large number of full-scale fire tests. Second, the CLT assemblies chosen for testing have been identified as the most likely configurations to be used thereby providing test data to support the claims of fire-resistance to help satisfy the authority having jurisdiction.

There are several factors that may affect the performance of CLT in fire, including but not limited to: the type of adhesive used, the configuration of the panel (number of plies, ply thickness, orientation of plies), the type of fire exposure, joints between panels and any protection methods used.

Based on the work of Frangi et al. (2009), Friquin et al. (2010), Schmid et al. (2010), and work previously completed on medium-scale fire-resistance tests reported by Craft et al. (2011), a generic calculation procedure has been proposed for calculating the fire-resistance of CLT within North America. More recently, a full-scale fire resistance testing program was initiated to validate the proposed design methodology. This full-scale testing program consists of five full-scale floor assembly

tests and three full-scale wall assembly tests and is currently in progress. This paper compares predictions employing the calculation procedure to the results of the initial first wall and floor assemblies, looking specifically at the impact of gypsum protection, charring rates, performance of joints between panels and time to failure.

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