

## UQ Fire Project #2020.07

# STUDY OF THE CHAR FALL-OFF PHENOMENON IN CROSS-LAMINATED TIMBER UNDER FIRE CONDITIONS

### Advisory Team

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### Keywords

engineered timber products, fire, timber, numerical, experimental

### Background and motivation

At present, the use of mass timber construction in buildings is experiencing significant growth. As a structural material, timber presents a series of advantageous features against common structural materials – sustainability, aesthetics, manufacturing and construction speeds are among these features. However, the combustible nature of timber is one of the main challenges due to the lack of a robust design framework. Self-extinction of timber is required during the decay phase of the fire such that compartmentation and structural stability can be guaranteed.

Recent research developed at The University of Queensland has demonstrated that Cross-Laminated Timber (CLT) can self-extinguish under specific conditions. At a bench-scale, it has been demonstrated that below critical conditions of heat exposure, CLT can self-extinguish. At a medium-scale and full-scale, it has been demonstrated that this may be obtained under specific conditions such as a limited exposure of timber surfaces. However, the char fall-off of the first lamella due to thermal decomposition of the glue adhesive can prevent self-extinguishment.

The fall-off of the charred timber is believed to be a complex thermo-mechanical phenomenon, which may depend on the scaling conditions. Once heated to elevated temperatures, the timber and glue experience different thermal degradation mechanisms that lead to the loss of strength and adhesion. To date, there are no explicit methods to describe and quantify this phenomenon.

### Research objectives

This project aims at studying the conditions under which char fall-off is experienced in CLT panels when exposed to severe conditions of heat exposure. The project objective is to deliver an understanding of this phenomenon and establish engineering criteria for describing char fall-off so that eventually a comprehensive self-extinguishment framework can be enabled.

### Methodology

This project will develop numerical or experimental work. The experimental approach may consist of a series of medium-scale fire tests on cross-laminated timber panels in the fire laboratory at The University of Queensland. The numerical approach may consist of modelling used instead to provide an understanding of the phenomena governing based on existing data.

### Recommended literature

- [1] P. Chowdhury (2019). Master thesis, The University of Queensland.
- [2] R. Emberley, Z. Yu, D. Fernando, and J.L. Torero (2016). Delamination occurrence in engineered mass timber products at elevated temperature, WCTE 2016 - World Conference on Timber Engineering, Vienna, Austria.