UQ Fire Project #2020.08

NUMERICAL STUDIES ON THE SELF-EXTINCTION OF CROSS-LAMINATED TIMBER IN COMPARTMENT FIRES

Advisory Team

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Keywords

compartment fires, timber, FDS, modelling, heat transfer

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 based on the surface area of exposed timber if char fall-off and encapsulation are controlled. Additionally, studies using different types of fuel and fuel load have shown the importance of the decay phase conditions on the self-extinction.

Research objectives

This project aims at developing a series of numerical studies to investigate the effect that compartment characteristics (ventilation, number of exposed surfaces, fuel residue, etc.) have on the self-extinction of cross-laminated timber compartments. The objective of the project is to validate analysis tools (models) to be included in design guidelines for the fire-safe design of timber construction.

Methodology

This project will use numerical models (e.g. FDS) and other simplified models to analyse the heating conditions during the decay phase of compartment fires with exposed CLT. The models will be used to develop parametric studies of key phenomena governing the decay phase. The model will be validated against experimental data from medium and full-scale compartment experiments with exposed CLT as part of the ARC Future Timber Hub project 'Exploring the self-extinguishment mechanism of engineered timber in full-scale compartment fires'. The student will be invited to be involved in full-scale experiments taking place in 2020.

Recommended literature

[1] C. Gorska et al., An experimental study of medium-scale compartment fire tests with exposed cross laminated timber, iFireSS 2017, 2nd International Fire Safety Symposium, Naples, Italy, June 7-9, 2017

[2] R. Emberley et al., Description of small and large-scale cross laminated timber fire tests, Fire Safety Journal 91:327–335, 2017, doi:10.1016/j.firesaf.2017.03.024

[3] A. Browning, The effect of fuel load nature on the self-extinction of mass timber, BEME Thesis, 2018