The Effect of Fuel Load Nature on the Self-Extinction of Mass Timber

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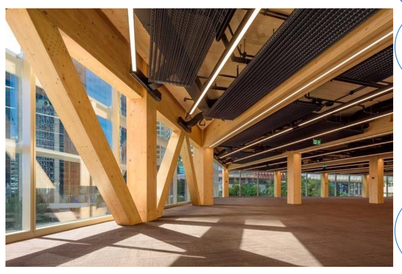
INTRODUCTION

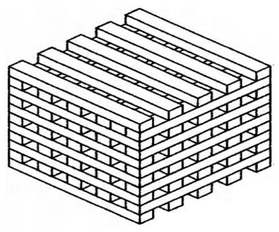
The major concern surrounding the use of mass timber construction is whether an exposed assembly may continue to burn after the initial fuel load is exhausted. In order to understand the entirety of the self-extinction potential of mass timber construction throughout contemporary architecture the problem involves understanding the existing compartment fire framework, the present fuel loads and natures within buildings and the conditions required for self-extinction.



- Compartment Fire Framework
- Building Fuel Loads and Fuel Natures
- Self-Extinction of Timber

COMPARTMENT FIRE FRAMEWORK

The fire tests that have devolved into what is known as the compartment fire framework have been undertaken using predominantly wooden cribs.



Kawagoe: $R \propto A_w\sqrt{H}$

Thomas: $T \propto \frac{A_T}{A_w\sqrt{H}}$

Time Equivalence

Parametric Fire Curves

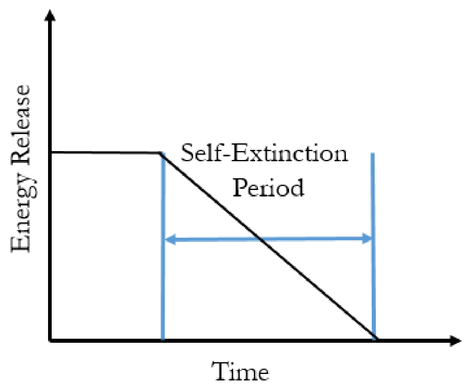
BUILDING FUEL LOADS

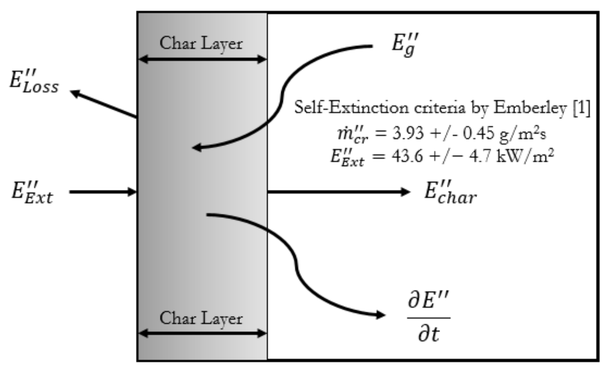
Contemporary building landscapes have resulted in outdated fuel survey data.

- Eurocode 1 – Fuel loads based on 1986 surveys.
- NFPA 557 – Fuel loads based on 1975 surveys.

SELF-EXTINCTION OF TIMBER

Self-extinction of mass timber within compartments is related to the thermal conditions throughout the decay phase of a fire scenario.

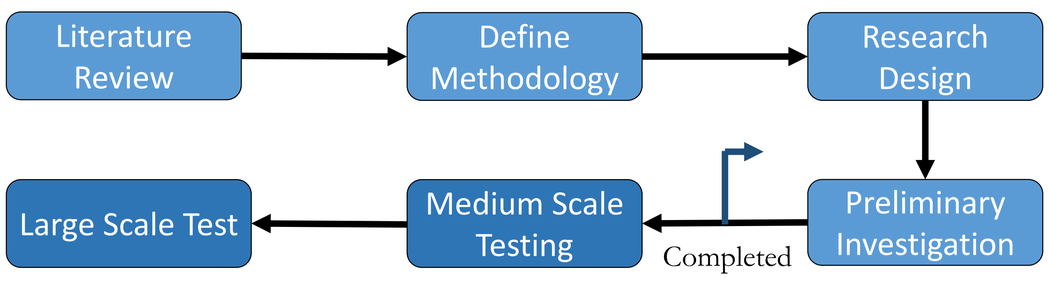




RESEARCH AIMS

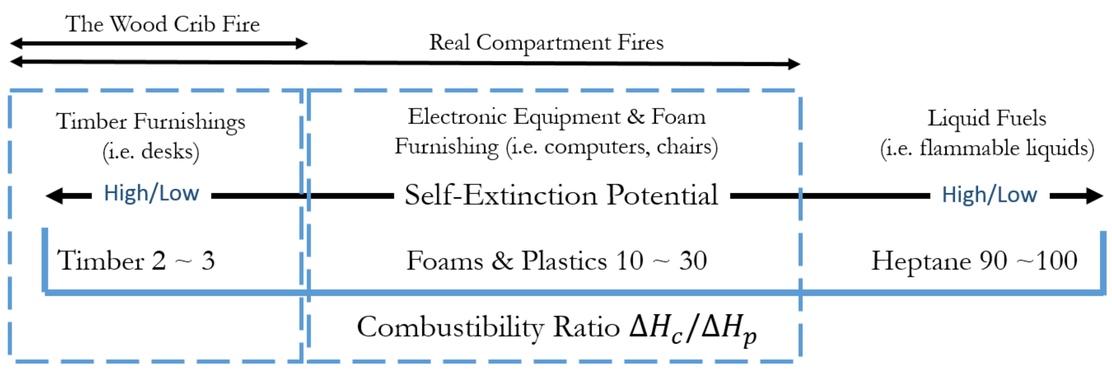
The main objective of the research is to identify the heat feedback on compartment boundaries for a variety of design fire scenarios and the associated burn-out times for variable fuel loads, natures and densities. The outcomes from this work are expected to provide an appropriate design fire scenario for which self-extinction of mass timber in modern building compartments shall be tested.

RESEARCH PLAN



EXPERIMENTAL METHODOLOGY

1. Review and analysis of typical fuel loads in contemporary buildings.
2. Medium scale testing of a variety of fuels with variable combustibility ratios.
   i. Compartment (~ 0.5 m x 0.5 m x 0.5 m)
   ii. Testing combination of fuels as per matrix hereunder.
   iii. Vary fuels to replicate a compartment fuel load (see Figure 1).
3. Large scale test dependent upon results achieved throughout Stage 2 and 3.



PRELIMINARY INVESTIGATION RESULTS

Figure 1, shows the results of a fuel nature study established from the review of a contemporary office compartment.

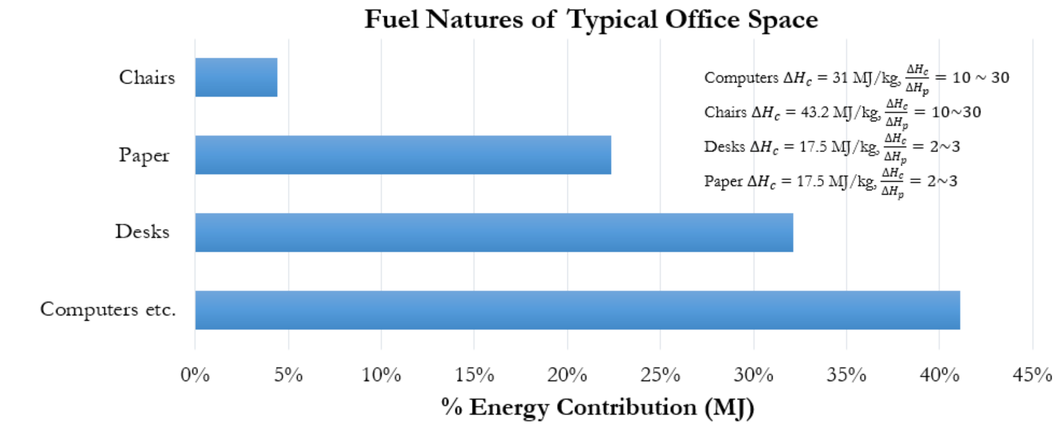


Figure 1: Contribution of specific materials to fuel loads with a typical office space with fuel load density of 220 MJ/m²

Figure 2, demonstrates the comparison throughout the decay period of a fire for kerosene and wooden cribs and the variable fuel load densities (FLED's) of which were required to establish the same fully developed fire duration.

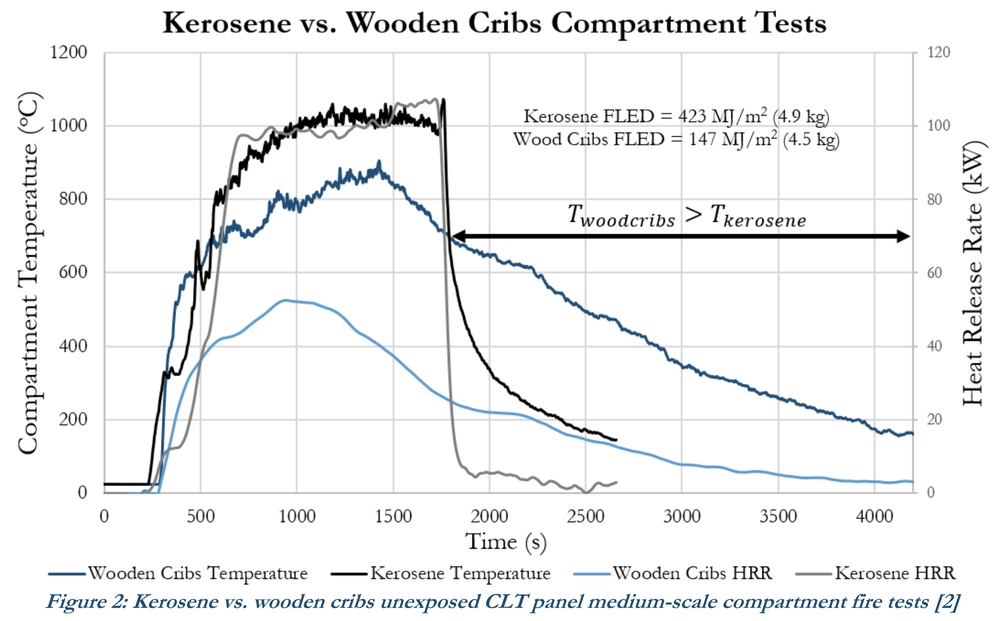


Figure 2: Kerosene vs. wooden cribs unexposed CLT panel medium-scale compartment fire tests [2]

CONCLUDING REMARKS

Preliminary investigation suggests there is a difference in the fire behaviour between different fuel natures and that a wooden crib may not be the most appropriate design fire for evaluating the self-extinction of mass timber.

REFERENCES

1. R. Emberley, "Fundamentals for the Fire Safety Design of Cross-laminated Timber Buildings," The University of Queensland, School of Civil Engineering, 2017.
2. C. Gorska, *et.al*, An experimental study of medium-scale compartment fire tests with exposed cross laminated timber, 2nd International Fire Safety Symposium, 7 - 9 June 2017, Naples, Italy.