

UQ Fire Project #2019.05

IDENTIFICATION OF FIRE MODES IN OPEN-FLOOR COMPARTMENT FIRES WITH A MEDIUM-SCALE EXPERIMENTAL APPROACH

Advisory Team

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Compartment fires, open-floor plan, timber, experimental, medium-scale

Background and motivation

The study of fire dynamics in compartments is an area of research key to the analysis of the structures under fire conditions. To date, most research in fire dynamics has focused on small, cubic compartments generally characterised as Regime I (ventilation-controlled) fires. A theoretical framework has been revised, which led to the development of well-established design tools to address this type of fires.

Open-floor plan compartments are, however, the norm in modern infrastructure, with large open spaces and increased ventilation which are extensively used in tall buildings. The research of fire dynamics in this type of compartments has grown significantly in the last two decades, leading to the development of methodologies yet to be validated and various full-scale compartment fires in large compartments. The Real Fires for the Safe Design of Tall Buildings identified three distinctive modes that can be observed in open-floor plan compartments as a function of the fire front spread velocity (V_s) and the burnout front spread velocity (V_b): (i) a travelling mode ($V_s=V_b$), (ii) a growing mode ($V_s>V_b$), and (iii) a fully-developed mode ($V_s\rightarrow\infty$). The Malveira Fire Test has shown that these modes are governed by the energy balance within the compartment, dominated by the heat losses or generation from materials used for compartment boundaries.

In addition, the extensive use of exposed mass timber structures in open-floor plan compartments raises a series of concerns regarding the lack of understanding of the behaviour of fires in these compartments, especially when extensive timber ceilings are used.

Research objectives

This project aims at studying the conditions for different fire modes to be developed in open-floor compartment fires using a medium-scale experimental approach. The project will analyse these conditions and provide a comparative study with data provided by other full-scale fire tests.

Methodology

This project will be largely desk based, with one experiment to be carried out towards the end of the project.

Recommended literature

- [1] Torero et al., Revisiting the Compartment Fire, Fire Safety Science 11:28-45, 2014, doi:10.3801/IAFSS.FSS.11-28
- [2] Hidalgo et al., An experimental study of full-scale open floor plan enclosure fires, Fire Safety Journal 89:22-40, 2017, doi:10.1016/j.firesaf.2017.02.002A