## UQ Fire Project #2019.16

# FIRE MODES IN OPEN-PLAN COMPARTMENT FIRES: EFFECT OF COMPARTMENT AND FUEL CHARACTERISTICS

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### 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 (Vs) and the burnout front spread velocity (Vb): (i) a travelling mode (Vs=Vb), (ii) a growing mode (Vs>Vb), and (iii) a fully-developed mode ($Vs \rightarrow \infty$). 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.

### Research objectives

This project aims at studying the thermal conditions for different fire modes to be developed in open-floor compartment fires using a numerical modelling 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 develop a series of models using correlations from the literature and the Fire Dynamics Simulator. The thermal conditions that determine the spread of the fire and burnout fronts will be studied using different compartment geometry and characteristics and using different heat release rate per unit area representative of different fuel loads. The models will parametrise fundamental parameters and provide results to be compared with existing data from full-scale tests.

### Recommended literature

[1] Torero et al., Revisiting the Compartment Fire, Fire Safety Science 11:28-45, 2014, https://doi.org/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, https://doi.org/10.1016/j.firesaf.2017.02.002A

[3] J.P. Hidalgo, T. Goode, V. Gupta, A. Cowlard, C. Abecassis-Empis, C. Maluk, J.M. Montalvá, J. Maclean, A. Bartlett, A.F. Osorio, and J.L. Torero (2019) The Malveira Fire Test: Full-Scale Demonstration of Fire Modes in Open-Floor Plan Compartments, Fire Safety Journal, vol. 108, https://doi.org/10.1016/j.firesaf.2019.102827