ABSTRACT

As open-plan compartments become increasingly common in the built environment, it is important to question whether the assumptions embedded in fire standards remain valid. In contrast to a typical room, where a homogenous temperature distribution may be expected post-flashover, travelling fires are characterised by a flame front that progressively spreads across the room, leading to regions of high and low temperatures, at different points in time and space.

This study uses the Fire Dynamics Simulator (FDS) to investigate travelling fires, highlighting the main parameters influencing the temperature profile within the enclosure. Several simulations with different geometries, Heat Release Rate per Unit Area (HRRPUA), and ventilation configurations are explored. It is observed that the fire behaviour and the temperature profile are highly sensitive to the ventilation conditions. The location and size of the openings have a large impact on the flow field causing peak temperatures ranging from 600 to 1300^{o}C to develop. A transition from travelling fire behaviour to localised flashover is identified in compartments with closed recesses. Significant non-axisymmetric ceiling jets are recorded in some simulations causing increased thermal exposure to certain sections of the ceiling.

Next, the Travelling Fire Methodology (TFM) is implemented and the results are compared with the numerical simulation output. A time-offset linked to the fixed fire spread rate assumption of the TFM is observed upon comparison of the results. The flame spread rates derived from the simulation data reveal a non-constant value during the fire event. It is also noted that the far-field temperatures are consistently underpredicted by the TFM.

The research concludes that accurate representation of the fire spread rate is critical in achieving reasonable results from the methodology. The inability to incorporate the effects of ventilation on the temperature profile is identified as being a major shortcoming of the TFM.

Keywords: *Travelling fires, Fire Dynamics Simulator (FDS), Travelling Fire Methodology (TFM), Large compartments, fire spread rate*

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