Abstract

A knowledge of far field temperatures is valuable for Performance-Based Design structural analysis and life safety analysis, where a parametric study is needed. A fire model using multiple zones – called a multi zone (MZ) fire model – has in previous studies shown good potential as an analytical tool for predicting far field temperatures in large compartments. This thesis aims to build upon the existing state of knowledge for application of MZ fire model, as a predictive tool for far field temperatures. The research approach primarily involves designing and testing several large-scale travelling fire scenarios in MZ fire model and comparing these results to Fire Dynamic Simulator (FDS). As a further step, a comparison is made between MZ fire model predictions for two well documented large-scale travelling fire experiments: Tisova full-scale fire test and Edinburgh tall building fire test using MZ fire model.

Results of this thesis are mixed. Comparison of far field temperature values show reasonably good agreement between MZ fire model and FDS computational fluid dynamics (CFD) models (on average 11-22% differences). However, comparison of MZ fire model temperatures to the measured temperatures of the two traveling fire experiments yielded significant differences (on average 7-35 % between the models, and 37-101% between MZ fire model and the experiments). The substantial difference between analytical and experimental results indicates that MZ fire model and FDS were not successful at predicting far field temperatures for the actual experimental fires. This can be caused by a combination of parameter and model uncertainties, and a lack of reliable data from the experiments.

This research effort shows that MZ fire model has the potential to be a useful tool for predicting far field temperatures in large compartment fires; however, further research and experimentation are needed to refine modelling methods and techniques before MZ fire model is a viable engineering tool for fire safety analysis.