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Thesis

A Study of Smoke Movement in Multi-Storey Buildings Using Experiments and Computer Modelling

Abstract

In multi-storey building fires, smoke is the main threat to occupants; therefore it is necessary for performance-based fire safety design to be based on accurate predictions of smoke movement in multi-storey buildings using computer models. However, these computer models need to be validated against experimental data. Ten full-scale experiments including four fuel-package fires and six propane fires were conducted in the National Research Council Canada (NRCC)'s 10-storey tower to generate realistic smoke movement data for model validation. In this study, an approach is developed using propane as a fuel to reproduce the temperature distribution of various fuel-package tests in order to estimate the heat release rate of fuel-package fires when the oxygen consumption method cannot be used. A two-zone model CUsmoke is used to simulate fires with steady or linear growth heat release rates in a single-compartment and in a two-compartment building, as well as fires with non-linear heat release rates in a multi-compartment multi-storey building. The comparisons between the CUsmoke predictions and the experimental data demonstrate that the model is capable of predicting smoke movement in single and multi-compartment multi-storey buildings.

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