Sun, X. Q.; **Hu, L. H.**; **Chow, W. K.**; **Xu, Y.**; **Li, F.**

A theoretical model to predict plume rise in shaft generated by growing compartment fire.
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Int. J. Heat Mass Transfer 54, No. 4, 910-920 (2011).

Summary: A theoretical model for predicting the one-dimensional transient buoyant plume rise in a vertical shaft is developed, with convective heat transfer from hot up-rising flow to the side walls considered. The rising plume is induced by a t-square growing fire in a compartment adjacent to the vertical shaft. The initial plume characteristics at the bottom of shaft nearing the compartment are described using a virtual point source model. The afterward rising of the plume is then solved by considering the conservation law of the mass and energy. Experiments and corresponding CFD simulations are carried out in a 1/8 scale vertical shaft to validate the theoretical model. The measured values are compared with the model proposed in this paper and that of Tanaka. Results show that the Tanaka model somewhat overestimates the up-rising speed of the buoyant flow, while the predictions by the model proposed here agree well with the CFD simulation and measured values.

MSC:

80A20 Heat and mass transfer, heat flow (MSC2010)
76R10 Free convection
76-05 Experimental work for problems pertaining to fluid mechanics

Keywords:

buoyant plume; vertical shaft; compartment fire; scale model; experiment

Software:

Fire Dynamics Simulator

Full Text: DOI

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paper as accurately as possible without claiming the completeness or perfect precision of the matching.