Abstract

In order to encourage innovative design and allow more design freedom for fire engineering professionals, Performance-based Fire Code has been increasingly implemented over the world. Countries like British, Australia and New Zealand have implemented it. The U.S.A. is in the process of development. Canada is working on their Objective-based Building Regulations and target to be in force in 2003. In Singapore, a Performance-based Fire Code Committee has been formed by Fire Safety Bureau in early 1999 as part of its continuing effort to optimise the local Fire Safety requirements for buildings.

Over the last decade or so, there has been a substantial use of deterministic modelling in relation to fire engineering. Computational Fluid Dynamics (CFD) modelling has been widely used in the industry for predicting smoke spread regime or evaluation of the performance of smoke control system. In particular, concern has been expressed regarding the possible use of such a modelling skill as a part of the system design process in a performance-based approach. The uncertain degree of accuracy of the computer model might cause unreliable results. This forms the background of the study.

In this research, smoke movement, temperature contour, smoke concentration contour and velocity vector of a fire in a concealed basement were studied using a commercial Computational Fluid Dynamics (CFD) package – PHOENICS (Version 3.2). Four (4) fire scenarios were simulated and the actual full-scale fire experiments were carried out on site. The experimental results obtained were compared and used to validate the CFD simulation results. On top of that, an in-depth study was carried out on the effectiveness
and suitability of using fire fan in such a fire scenario. The response of the fire to the introduction of fire fan has been critically analysed and discussed.

By comparing the CFD simulations and full-scale fire experiments results, it was shown that the CFD simulations can be used as a tool to predict the actual fire behaviour. However, the CFD prediction is generally on the conservative side. It is concluded that the differences are due to the limitations of the CFD model in modelling the real fire situation.