

**Universiti Teknologi Mara**

**FIRE SIMULATION PROTOCOL AND THE  
ROLE OF A CFD SOFTWARE**

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## ABSTRACT

Current trends in fire safety designs are to depart from conventional prescriptive regulations. This trend towards an engineering or performance-based approach allows for the introduction of more innovative designs. The correct modelling of fire scenarios are central to the implementations of performance-based designs, especially with rapid developments in the field of Computational Fluid Dynamics (CFD) techniques or field models as opposed to zone models which are empirically derived.

The purpose of this research is to explore the feasibilities and reliabilities of field modelling techniques in the predictions of fire behaviour and its effects. The three main objectives of this research are:

1. To identify suitable simulation protocols for safe evacuation of occupants,
2. To establish Available Safe Egress Time (ASET) using CFD Software and
3. To identify certain CFD attributes needed to satisfy the above.

In the present study a review of prescriptive and engineered system are highlighted. The role of CFD in field modelling has been identified with respect to prediction of various parameters, which affected tenability and the time taken for untenable conditions to prevail for assigned fire sizes. To test the above requirement, various fire scenarios were analysed employing zone models to initially identify input parameters required for the field model. Computation for ASET employing field model is carried out and these results are compared with the Required Safe Egress Time (RSET) computed from existing empirical equations in the literature. CFD results validated the zone models, which are empirically derived. However, it was found that zone models are limited in their applications and for complex geometries the field models can give a better description of fire behaviours.

Of interest is the discovery that the prescriptive requirement of 12 airchanges per hour is acceptable in certain instances whilst in another instance it is over prescribed depending on the fire scenario and on the physical size of the room being analysed.

CFD software attributes such as appropriateness of turbulence model selected, evidence of grid independence and convergence criteria are investigated. The relevant parameters, which should be included in any field model, are the location of the fire source, dimension and transient conditions of the fire source and its smoke concentration, outlet and inlet boundary conditions and appropriate turbulence model.

## **CHAPTER 1**

### **INTRODUCTION**

Of late, fire safety engineering is one of the most important disciplines being integrated into the planning, design and construction of a building. In fire safety design, significant fire hazard of a building is first investigated in order to come out with potential solutions to reduce the loss of life and damage to property. Over the years, there has been significant development in fire science and technology. However, there are still many inadequacies in the existing knowledge, which require continuous research and development. Perhaps the recent development in fire safety approach shall see the implementation of the more practical and versatile performance-based building codes replacing the conventional prescriptive building codes. The performance-based code allows a practice of innovative design, as long as performance and safety can be maintained. This can enhance effective use of space and materials resulting in more cost effective designs.

The Computational Fluid Dynamics (CFD) approach also known in fire research as field modelling technique is considered to be fundamental to the future development of fire models and which can provide the basis for the development of performance-based fire safety regulations. In such an approach, fire is modelled from first principles via solution of the basic conservation equations (1).