Chapter 12
Virtual Reality for Fire Safety Engineering

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ABSTRACT

The international fire safety framework defines the characteristics of an escape system that can communicate information to allow occupants to make the optimal decision to reach a safe place. Fire safety engineering is the subject that helps the designer to carry out analyses for the study of fire through the use of CFD (computational fluid dynamics) tools and escape modelling. The interaction between the escape system and the occupants is a factor that controls the effectiveness of the design solution. This factor is difficult to assess in the absence of specific tools. An analysis methodology based on numerical simulation models, aided by virtual reality tools, improves the interpretation of results. The authors set out to develop a method capable of exporting fire simulation in a virtual environment and visualising the results within a virtual reality environment. The methodology is able to improve the knowledge of the emergency dynamics within the fire scenario.

INTRODUCTION

Technological developments in the field of engineering and design have contributed to buildings with complex geometries. It is complicated to comply with the technical regulations for fire prevention when applied to very complex buildings. The development path in the field of research has also involved many innovations in fire prevention methods and approaches. There is a gradual transition from predominantly prescriptive methods to performance-based approaches. The performance approach includes a first decision-making phase regarding the fire safety measures to be adopted for the project. A second phase is the demonstration of the performance of the solution, using Fire Safety Engineering tools. The Fire

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Safety Engineering approach is therefore the most common design path to date. Often this approach is the only one that can be applied in order to comply with architectural and functional requirements.

Fire Safety Engineering

Fire safety engineering (FSE) is a discipline whose characteristics and definitions were first presented in the technical report ISO/TR 13387 of 1999. There are various synonyms for this terminology, depending on the document in which it is discussed. The following are some of them: Engineering Approach, Performance Based Approach, Fire Safety Engineering. It can be defined as the subject that guides the designer, through scientific methods, in the choice of the most appropriate safety measures aimed at protecting people, material and the environment from the effects of fire. The technical report ISO/TR13387 provides the following statement to describe the performance methodology:

"The application of engineering principles, rules and expert judgement based on a scientific appreciation of the fire phenomena, of the effects of fire, and the reaction and behavior of people, in order to: save life, protect property and preserve the environment and heritage; quantify the hazards and risk of fire and its effects; evaluate analytically the optimum protective and preventative measures necessary to limit, within prescribed levels, the consequences of fire".

Most countries have reference legislation that includes fire safety engineering. FSE methods consider the totality of fire prevention and protection measures. The method provides a more fitting solution than traditional methods. In some cases, the approach is the only means of achieving a successful level of fire protection. International FSE standards consider the interaction between fire, buildings and occupants, and provide for the evaluation of fire scenarios. International FSE standards consider the interaction between fire, buildings and occupants, and provide for the evaluation of fire scenarios. ISO/TR 13387, provide a flexible framework in order to create a fire safety design that can be easily evaluated by the competent authorities. British Standard 7974 and the NFPA standards, together with ISO/TR 13387, provide a frame for an engineering approach to the achievement of fire safety in buildings. They contain advice and guidelines on the application of scientific and engineering principles for the protection of occupants, objects and the environment from fire. During the fire design process, a great deal of effort is required. At this stage, it is essential to identify the boundary conditions and scenarios that may interact and modify the evolution of fire and escape dynamics. Within the context, it is necessary to examine aspects such as the escape system and how it communicates with the occupants. The solution must be able to provide the right information to allow occupants to make the best decision and reach a safe location. The method is based on a careful design 'dressed' to the specific needs of the activity and the characteristics of the building. In the design phase, the fundamental requirement is to be able to predict, quantify and evaluate the elements that characterise the fire scenario. The prescriptive approach does not examine or require the in-depth examination of a number of aspects, which the fire safety engineering approach requires.

One example is the fire alarm system, whose purpose is to communicate an emergency to the occupants. The same performance required of the system can be guaranteed in different ways. Fire safety engineering requires, in this case, knowledge of the signalling and alarm times. The same performance required of the system can be guaranteed in different ways. Fire safety engineering requires, in this case,