

Chapter 10

Extracting Fire Engineering Simulation Data from the IFC Building Information Model

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ABSTRACT

Fire engineering is a distinctive discipline within the construction industry that has its own language, design goals and analytical approaches. The use of sophisticated and computationally intensive numerical fire simulation tools is becoming more prevalent and the ability to share building-related data is getting serious consideration within the discipline. This chapter examines what fire engineers would like to achieve and how building information modelling (BIM) fits in with those goals. It discusses the types of fire simulation models that fire engineers use and gives a brief description of two particular fire growth models which use different means to represent a fire scenario. The chapter then considers how the IFC building product model can be used to transfer building geometry and property data to fire simulation models. Two commercial BIM tools have been used to create some simple test case buildings to illustrate the transfer process and highlight some of the problems encountered. Finally, the chapter describes some of the challenges involved in sharing building data with fire simulation models and provides recommendations for further work.

1 INTRODUCTION

Fire engineering is a relatively young and specialised discipline within the construction industry. The protection of people, property and the environment from the effects of fire means that fire engineers are involved in the design of everything

from super high-rise towers, large capacity sports stadia, industrial and petro-chemical facilities to major road and rail tunnel projects. The chapter describes current developments in use of BIM for fire engineering design particularly where computer simulation models are used. The chapter provides a brief background to the needs and challenges of fire engineering simulation modelling and how BIM might be integrated into this design aspect.

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Simple case study buildings are described in the chapter to illustrate some of these developments through the use of STEP files conforming to IFC Building Product Model (simply referred to here as the 'IFC Model') which have been generated by commercially available BIM applications. The contents of this chapter are predominantly based on recent work carried out by the author and co-workers which has been published in various places (Spearpoint, 2003a; Spearpoint, 2003b; Spearpoint, 2006; Spearpoint, 2007; Spearpoint and Dimyadi, 2007; Dimyadi et al., 2007; Dimyadi et al., 2009).

Fire Engineering Design

Fire engineers are involved in many aspects of a building's construction, fit-out and renovation with the objectives of providing means of escape to occupants, reducing the loss of property, preventing the spread of fire to neighbouring structures, providing protection to fire service personnel during fire and rescue operations and limiting the effects of fire on the environment. These objectives are met through the consideration of issues such as exit route design, fire and smoke spread mechanisms and structural stability. There are essentially two broad approaches to fire engineering design. The first is a prescriptive or 'deemed-to-satisfy' approach in which the design needs to follow a set of predefined rules that achieve regulatory compliance. The second approach is where specific engineering design is carried out to match a set of performance metrics that form the regulatory system.

There are many aspects of a building that are common to the fire engineering, architecture, structural engineering and building services domains. Fire engineers need to have the basic geometry and topology of a building which includes information on the size and shape of rooms, openings and hidden voids, the exits from a space and where those exits lead. In addition, fire engineers need to determine the fires that could likely

occur through an assessment of the fuels in the building. This analysis requires the fire properties of lining materials, the contents of the spaces in terms of total fuel load, the arrangement of fuel packages and the relative flammability of those packages. Fuel packages might include furniture and fittings plus wall, floor and ceiling coverings and the fuel load is the total calorific value of the fuel packages per square metre of floor area. The severity of the fire can be assessed by the rates of energy release from fuel packages, the peak rate of energy release and the products generated by fire such as toxic gases and smoke volumes. The specification and design of fire safety systems such as alarm, suppression and smoke management systems requires details of system components plus electrical wiring layouts, plumbing and pipe work, ducting networks etc. Information regarding the site of the building may also be necessary. Weather may be a factor and temperatures, wind velocities, humidity may all be required in order to specify the performance of the fire safety systems. Finally, fire engineers need to obtain details of the occupancy characteristics of the building. This may include information such as the primary use of the spaces, numbers of people, times when the building will be occupied and by whom, the physical and mental state of the occupants.

In order to carry out designs, fire engineers are likely to conduct computer simulations particularly where the building is complex and prescriptive regulations are not appropriate. The availability and accessibility of faster computer processors with larger memory capacity makes it practical for fire engineers to use sophisticated and computationally intensive numerical simulation tools to solve fire engineering problems. There are a large number of software tools available to the fire engineer that can be used to carry out distinctly different tasks (Olenick and Carpenter, 2003). However, the current fire modelling practice often uses a paper-based approach to gather basic building geometry information which contributes to high overhead costs in preparation

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