Popular science summary: Evaluation of Strategies for the Integrations of Building Information Modelling with Simulation of Fires in Enclosures

For assessing the development of a fire in a building, the most advanced approach nowadays is Computational Fluid Dynamics (CFD) which allows the study of fluid flows by scenarios simulated in a computer-based environment. One of the most known CFD software used in the Fire Safety field is Fire Dynamics Simulator (FDS) which numerically solves a form of the Navier-Stokes equations for fire driven flows. This software does not have a graphical user interface; therefore, it is needed to write down the lines of input and output required for performing simulations. However, these tasks are time-consuming and make it impossible to think in creating complex geometries by writing down the location and shape of every element in the building. Pyrosim is a pre-processor of FDS which facilitates the job of creating the geometry and selecting the correct parameters and measurements required for the simulation.

Building Information Modelling (BIM) is being used in the Architecture, Engineering and Construction (AEC) field for the design, construction and maintenance of buildings. It allows creating three-dimensional representations of buildings with realistic graphics and with a high level of detail. Besides the geometry, it incorporates information such as the thermal properties of the materials that are part of every element in the building. It results relevant to use this digital information for performing fire simulation to avoid re-entering data manually in the FDS input file. This process results in a more efficient way of transferring information, for example from Architects to Fire Safety Engineers.

This thesis evaluated strategies for using the relevant information contained in a BIM model in the simulation of a fire using FDS. This process required the analysis of a data-exchange format, Industry Foundation Classes (IFC), to allow this export and import process. It was identified the relevant information contained in the BIM model and the data losses that occur when bringing this information into FDS using Pyrosim.

It was found that the IFC file contains the building geometry data and information regarding the thermal properties of materials in the BIM model. Pyrosim interprets the geometry but does not read information about material properties, which is needed for the calculation of heat transfer. A scripting tool was written in the Python programming language for enhancing the FDS input file obtained from Pyrosim with thermal data from the IFC file. Fire simulations were performed in three different building models, starting from a basic building to analyse parametric data exchange. Finally, a more complex model was used to check the overall implementation of strategies. It was confirmed that once the Python script enhances the FDS input file, this can be read by FDS and used for the calculation of heat transfer trough the boundaries.