

Verifying fire safety in residential buildings by quantifying risk

Apartment fires result in several injuries and deaths every year. To ensure that people can evacuate a building in case of fire, it is vital to verify the fire safety design of the building.

The usage of fire has been an essential part of human civilization for a long time. However, fire can also pose a risk to people's health. To enable people to evacuate safely from buildings in case of fire, building codes have been created. Depending on the building code, there can be several ways to verify the fire safety design in a building. The conducted study looked into a new type of assessment to verify fire safety for residential buildings in Australia called 'Quantitative Risk Assessment' (QRA). This type of assessment evaluates the risk level to occupants in a building. Criteria related to the risk level to occupants are proposed to soon form part of the Building Code of Australia.

Questions that were answered during the study are: what the consequences of using this new type of assessment to verify fire safety compared to existing methods used in Australia, what the disadvantages and advantages are, what difficulties arise, and what happens to robustness. I have also explored how the proposed legislation was developed, how it is being applied, and potential challenges to applying the proposed legislation. In addition, the study intended to answer how one would select a method when conducting this new type of assessment. The study included a literature review and a case study to test and illustrate the application of the proposed legislation.

So how does the result differ when using QRA to verify fire safety in a building compared to existing methods? The answer is that while most criteria are met, some specified criteria are not met. This is believed to be because of the use of conservative input values in the assessment. In addition, a sensitivity study was conducted as part of the assessment to determine how, e.g., different fire protection systems such as, e.g., sprinklers affect the calculated risk level. The sensitivity study shows that improving the reliability of certain fire protection systems reduced the risk to occupants for the analysed building.

There are several potential problems related to the evaluation of fire safety with this new type of assessment. One example is, e.g., the limited amount of available data. So, what are the consequences of using QRA as a verification tool? The conclusions made based on the conducted study are that its usage is expected to lead to a more holistic fire safety design and may lead to a more robust fire safety design for a building.

The legislation was developed through several steps, including consolidating current criteria into two different parts of the legislation related to risk levels and the spread of fire. The application was sometimes hard to interpret when applying it during the study. It was determined that an event tree approach is recommended to be used when conducting a QRA. Such an approach is based on an initial event such as a fire, followed by intermediate events based on the development of the fire and existing safety systems. Each intermediate event then leads to scenarios or endpoints. Based on the conducted literature review, the SFPE-Guideline seems to be, in general, the most appropriate framework to follow when conducting a QRA. I hope that the research will help understand the challenges and important factors to know when deciding to use a QRA.

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