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Uncertainty and Risk Analysis in Fire Safety Engineering

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Keywords: Risk analysis, uncertainty analysis, Monte Carlo simulation, FOSM, reliability index, fire engineering design, event tree, response surface.

Abstract: Two Quantitative Risk Analysis (QRA) methods are presented which can be used to quantify the risk to occupants in, for example, a building in which a fire has broken out. The extended QRA considers the inherent uncertainty in the variables explicitly. The standard QRA does not consider the uncertainties in the variables and must be complemented by a sensitivity analysis or an uncertainty analysis. Both methods provide risk measures, such as individual risk and FN curves. In the extended QRA these are presented in terms of statistical distributions. The standard QRA is more simple to perform and has been used extensively in many engineering fields. Both QRA methods have been applied to an example, structured with the event tree technique, to determine the risk to patients on a hospital ward.

In addition to the two risk analysis methods, separate uncertainty analysis methods are also presented. Both stochastic uncertainty and knowledge uncertainty are considered in the analysis, separately and combined. The importance of the variables is also investigated.

As both QRA methods are rather complex to use, a more simple method using design values in deterministic equations would be preferable for fire safety design purposes. A method of deriving these design values, based on quantified risk, is presented and complemented with an example which provides design values for a class of buildings. When these design values are known, so-called partial coefficients can be derived.

Front page photo: Typical societal risks (hospital, shopping centre and transportation of hazardous goods). S-I Granemark and H Frantzich.

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