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Study on probability distribution of fire scenarios in risk assessment to emergency evacuation

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Abstract

Event tree analysis (ETA) is a frequently-used technique to analyze the probability of probable fire scenario. The event probability is usually characterized by definite value. It is not appropriate to use definite value as these estimates may be the result of poor quality statistics and limited knowledge. Without addressing uncertainties, ETA will give imprecise results. The credibility of risk assessment will be undermined. This paper presents an approach to address event probability uncertainties and analyze probability distribution of probable fire scenario. ETA is performed to construct probable fire scenarios. The activation time of every event is characterized as stochastic variable by considering uncertainties of fire growth rate and other input variables. To obtain probability distribution of probable fire scenario, Markov Chain is proposed to combine with ETA. To demonstrate the approach, a case study is presented.

Keywords

Risk assessment; Fire scenario; Event tree; Monte Carlo simulation; Evacuation

Figures and tables from this article:

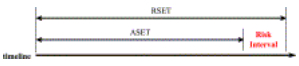

Fig. 1. ASET/RSET timeline.

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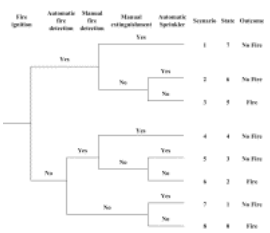
Fig. 2. Event tree analysis on probable fire scenarios.

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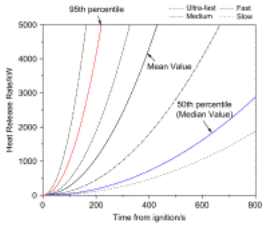

Fig. 3. Heat Release Rate curves of t^2 fire with time from ignition.

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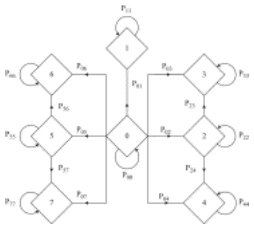

Fig. 4. Transition diagram of every state.

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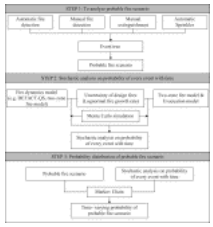

Fig. 5. The schematic framework of analyzing probability distribution of probable fire scenario.

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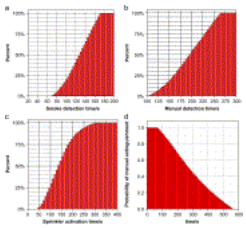

Fig. 6. The histogram of smoke detection time (a), manual detection time (b) sprinkler activation time (c) and manual extinguishment time (d).

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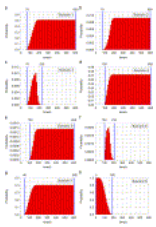

Fig. 7. Probability distribution of probable fire scenario.

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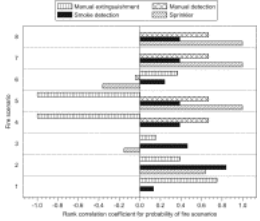

Fig. 8. The sensitivity of event probability to probability of probable fire scenario.

Figure options

Table 1. The activation probability/time of every event.

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Table 2. A list of random variables used in fire models.

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Table 3. Statistical operational reliability of fire protection system.

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