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Fire Safety Design with Sprinklers

a Nordic project

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Project overview



Project overview

- Objectives
 - Develop a verification method to evaluate possible trade-offs when introducing fire sprinklers in buildings
 - Investigate and document sprinkler capabilities by examining past experience on sprinkler system performance and reliability



Project overview (cont.)

- Work packages
 - Verifying trade-offs in buildings with fire sprinklers
 - Lund university, Sweden
 - Sprinkler capabilities
 - COWI, Norway
 - Coordination and dissemination
 - SP Träteknik (Wood Technology), Sweden
- Time frame
 - Finalised in march 2010



Early findings



Early findings

- Possible trade-offs is a question of
 - Sprinkler system reliability
 - Minimum fire safety measures when sprinkler is unavailable
- Evaluation of fire safety with current building regulations cannot be applied to verify sprinkler trade-offs
 - Sprinkler performance is risk related (prob x cons)
 - Regulations are consequence-based
 - Necessary to focus on saving lives instead of containing the fire



Early findings (cont.)

- Verifying sufficient safety in sprinklered buildings is often unsuccessful as a result of
 - Design guides are too conservative on
 - Design fires
 - Life safety criteria
 - Shall robustness scenarios have the same set of criteria as base case scenarios?
 - Methods of verifications are missing or incomplete



Sprinklers in fire safety design



Sprinkler as a fire safety measure

- Fire sprinklers can be used to allow trade-offs regarding:
 - Control fire growth
 - Control smoke spread
 - Limit fire spread within building
 - Prevent structural collapse
- Fire sprinklers could not be used to:
 - Prevent ignition
 - Prevent fire spread to other buildings
 - Allow for rapid egress
 - Facilitate rescue service operations



Sprinkler trade-offs

- Fires could be allowed to grow more rapidly in the presence of sprinklers as they will be controlled or extinguished at a later stage
 - Chosen materials must not reduce the effectiveness of the sprinklers
 - A certain set of material characteristics are still required
- Smoke spread could be allowed to some extent in the presence of fire sprinklers as they will limit the quantities of smoke produced by the fire
 - The smoke should be assumed to be “harmless”



Sprinkler trade-offs (cont.)

- Sprinklers could replace other fire safety features in the “limit fire spread within building” barrier group.
 - The probability of sprinkler failure should be less than the probability of failure of the replaced features.
- From a more overall perspective, sprinklers should allow for lower ratings on fire separating and load-bearing structures.
 - The “national” level of fire damage and building collapse must be kept within the range of acceptable risk.



Sprinkler trade-offs (cont.)

- The same trade-offs should be allowed (with some exceptions) independent on type of sprinkler system installed
 - Residential or commercial sprinklers



Verification method



Available verification methods

- Qualitative risk assessment
- Testing
- Quantitative verification with
 - Scenario analysis
 - Quantitative risk assessment



Qualitative verification

- Limited deviation from prescriptive solutions
- Collect “evidence” that the proposed solution is as safe as the prescribed solution
- Verification is performed by logic arguments and references to statistics and experience, etc.



Quantitative verification – scenario analysis

- A “deterministic” analysis where the performance of the building is measured towards some kind of acceptance criteria
 - Comparative analysis or direct evaluation
- At least two scenarios are evaluated:
 - Sprinkler system operates and is successful
 - Sprinkler system is unavailable
- Building must show sufficient performance for all scenarios
- Necessary to establish design fire scenarios and life safety criteria



Quantitative verification – risk assessment

- The performance of sprinklers is a probabilistic “problem”
 - Either the system works and everything is fine, or it doesn’t work and a back-up plan is needed
- Proposed risk measures could be the probability of
 - An individual being exposed to untenable conditions
 - An escape route being blocked by smoke
 - Fire spread or collapse of structural element
- Necessary to establish
 - The probability of successful sprinkler operation
 - Acceptable levels of risk

