Case Studies on the Verification of Fire Safety Design in Sprinklered Buildings

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***Abstract*: This project work aims to study the risk assessment at the non sprinklered building site. A fully sprinklered building design, as in the name, is a building design that is fully armed with sprinkler systems as fire suppression systems against any possible fire outbreak. Partially sprinklered building designs are self-explanatory. That is, there are not fully sprinklered. The other part is unsprinklered mainly due to the absence of hazardous materials stored while the storage for hazardous materials is sprinklered. If any industry fire incident takes place then information passes to everyone it is so difficulty, if sprinklered system is available any building within seconds alarm will activated information passes to every one like hooters and alarm.**

Keywords: Fire Hydrant Line, Fire Safety, Sprinkler System, Fire Calculations

Introduction

1.1. Background

A Nordic research initiative on fire safety design in buildings with sprinklers were finalised in 2011 and documented in Nystedt (2011). That project had the objective of exploring different fire safety design methods and to give guidance on how to choose a relevant method for a given situation. The work was focused on verifying design alternatives in buildings with fire sprinkler systems aiming at developing a more consequent and uniform performance-based design process, which is a result of a specification of methods, performance criteria and design scenarios.

The report also contained a few brief examples of applications. However, these examples did not provide any deep understanding of the required steps necessary to verify fire safety in buildings. The lack of detailed examples urged the need for an additional initiative on case studies where both practitioners and officials could find information on the use of the proposed verification methods for a number of design situations.

1.2 Method

The report uses the following methods (Nystedt, 2011) to verify fire safety in five different design situations (case studies):

- Qualitative risk assessment
- Quantitative assessment with deterministic analysis
- Quantitative assessment with probabilistic analysis

The design situations that are represented in the case studies are:

1. Combustible linings in an apartment building
2. Extended travel distance to exits in a retail store
3. Reduced fire rating on windows in an office building
4. Combustible façade materials in an apartment building
5. Combining trade-offs in an office building

The verification of the particular design situation in each case study is carried out by following the procedure described by Nystedt (2011).

2. Type of fire sprinkler systems.

The majority of sprinkler systems are designed to control a fire by cooling fire gases, the fire surface and pre-wetting surrounding material to stop it spreading. The design intent is that the fire is finally extinguished by the fire service or staff using portable equipment. In reality, in many cases, the design intent is exceeded, and the fire is actually extinguished by the sprinkler system.

This report considers two different types of sprinkler systems namely conventional and residential fire sprinkler systems. Conventional sprinklers could be used in various locations such as offices, retail stores, hospitals etc. Residential sprinklers are to be used in family houses, apartment buildings, nursing homes, hotels etc. Conventional fire sprinkler systems are built with a higher degree of robustness than residential fire sprinkler system. These increased requirements on the system are necessary to cope with the diverse fire scenarios that could take place in these buildings. On the other hand, residential fire scenarios are well defined and occur in rooms with smaller geometry.

3. Fire hazards and other factors

There are several issues to be addressed in the building:

- A high occupant load results in a potential large consequence in the event of fire.
- Furnishing could result in decreased visibility and people are not familiar with the building.
- The large opening between the floors is unfavourable for fires initiated on the entrance level as it results in larger spill plumes.

Spill plumes will increase the volume of the smoke and decrease the available safe egress time on the upper level.
□□A large part of the escape capacity is located in the entrance level resulting in relative long escape times from the upper level.

4. Fire development calculations

The fire development have been calculated by the use of a computational fluid dynamics model – Fire Dynamics Simulator (FDS, version 5.5.3) developed by NIST (McGrattan et. al., 2010). The software quantifies the transportation of smoke and heat in the building. The building (i.e. the domain in the fire simulation) is divided into app. 750,000 cells (0.2 x 0.2 x 0.2 m). The dimensionless heat release rate Q* is 1.2 and the resolution of the fire D*/δx is 12. Reference value on Q* is 0.3 to 2.5 and 10 to 20 on D*/δx is 12 (Nystedtet. al., 2011). An illustration of the model is shown in Figure 1

Figure 1 Model of building used in the fire simulation.

Classification of Buildings

Group A	Residential	Group B	Educational
Group C	Institutional	Group D	Assembly
Group E	Business	Group F	Mercantile
Group G	Industrial	Group H	Storage
Group J	HazardouS		

Past Experience put into the Code

Upahar Cinema Fire :- Resulted in Exclusion of Oil filled electrical equipment in the Basement

Dabwalli Fire :- Provided inputs with respect to Exit difficulties and Passive provisions (Meerut fire which took place subsequent to the NBC 2005 is also an eye opener in this regard

Underground shopping complex fires in Mumbai and Bangalore :- Derived useful inputs with regard to fire separations (For every 750M^2 area, Blank wall to be provided OR for Every 40M linear length if the it is a long building)

IGI Airport fire :- How dangerous buildings are when huge concealed spaces are left unattended or not protected by detectors. Some useful provisions have been made in NBC for this purpose. (and so on)

ACCIDENT PREVENTION:

- Safety Audits
- Routine Safety Inspection
- Safe Working Practices
- Performance Assessment
- Interaction
- Education and Training
- Following Safety Standards.

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