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# Safety & fire Strategy requirements for (High Rise Buildings)

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***Abstract:*** **Fire inspectors play an indispensable role in protecting life and property from catastrophic fires before them begin. They work with city code enforcement agencies, fire departments and other organizations that work with the construction trades and government to ensure that building safety codes are met or exceeded. As a fire inspector, I worked with my team to encourage all fire department team to know state and federal building codes and fire safety regulations. But first, you'll need to know the conditions under which fires originate and spread. You'll need to know about firefighting tactics and equipment as well as the materials and designs that go into residential, commercial and industrial structures. My study mainly focus on Improving Firefighting Strategies and Practices through this paper and a common way of handling structural fire protection and design is using the so called standard fire as basis for prescriptive design. For this, a wide experimental research with also a large amount of numerical simulations has been carried out in Sudan to gather experience of using automatic water extinguishers as a protective method against fire.**

***Keywords:*** **catastrophic fires, firefighting tactics, Fire inspectors, etc.**

## 1. INTRODUCTION

**The main Objectives of this paper:**

- State the role that (FIRE ENGINEERING SCIENCE) play in Fire Risk Assessment.
- List the characteristics of Fire Risk Assessment.
- Discuss the Legal framework for( FIRE ENGINEERING SCIENCE)
- Understand the( FUNDAMENTALS OF FIRE ENGINEERING SCIENCE )Concept
- Discuss the involvement of( FIRE SAFETY SYSTEM in FIRE ENGINEERING SCIENCE)
- Understand the (FIRE ACCIDENT INVESTGATION).
- Outline major (FUNDANTALS OF FIRE ENGINEERING SCIENCE) objectives.

## 2. HOW DO YOU CARRY OUT A FIRE RISK ASSESSMENT?

A fire risk assessment will help you determine the chances of a fire starting and the dangers from fire that your premises present for the people who use them and any person in the immediate vicinity.

**The main Objective of a fire Risk Assessment.**

The principles contained in the fire safety order is to use a risk assessment approach, which is goal based and flexible. The RP generates the risks in the workplace, therefore, to safeguard the safety of employees, the RP must:

- Identify fire hazards and people at risk and to remove or reduce the risk of those hazards causing harm to as low as is reasonably practicable; and
- to determine what fire safety measures and management policies are necessary to ensure the safety of people in the building should fire occur; by

- Reducing the probability of a fire starting.
- Ensuring that all occupants are alerted and can leave the premises safely it's the event of a fire.
- Limiting the effects should a fire occur.

Providing the premises have been built and maintained in accordance with building regulations and is of normal risk or lower, this should be a simple matter without significant expenditure. However if the premises are not in accordance with the building regulations, further guidance and action will be necessary, depending on the complexity, size, occupancy and consequential risks.

The RP can enlist the help of other persons who have the necessary experience or skills to assist him and is known as a competent person. The competent person does not have to be an expert to assist the RP, but he/she needs to have sufficient experience or training with regard to the problems they are assisting with. However a risk assessment on a small premises like the news agent shown in the following example, may be undertaken by the R P following the simple guidance in this document. Free fire risk assessment forms are readily available on the internet.

A single lined scaled drawing of the premises is highly desirable and drawn to a scale of 1:50 or 1:100 would be considered ideal. Super impose, using a colored pencil, any fire safety features and take notes of any relevant information useful to the risk assessment.

Basic information and data should be collected in your premises to help you for a fire Risk Assessment. :

1. Type of building (strength of construction materials- Skelton ok building rater or not rated ) :

(A) First glass – full fire rated (b) second class- 50% fire rated (c) third class – not fire rated

2. Height of building

(A): Ground (maxim 6meters)

(b) Media (ground + 5floors)

(c) High rise (above 5 floors).

Evaluation time (ref NFPA101)

(A) 3 min (for First glass)

(b) 2.5 min (for second glass)

(c) 2 min. (for third glass)

3. Buildings activities: Industrial (b) residential (c) commercial.
4. Location of building: to identify the Closed hazard (b) find out safety distance.
5. Content of building :Fire classification (A ,B ,C ,D )
6. Building classification (types and quantity of hazard): Separate (b) complex.
7. Hazard categories (NFPA): Light (low) (b) Ordinary (moderate) (c) Extra (high).

**Design for fire Safety**

The "design for safety" concept can be addressed in two ways.

1. On one hand there is the use of standards, codes and guidelines
2. And on the other hand there are detailed safety analyses.

**Fire Safety Analysis**

Safety analysis starts usually with a hazard and risk analysis.

The objective of a hazard and risk analysis is to identify all hazards and their associated risk. It identifies what can go wrong and how it can be prevented or controlled.

As result of this analysis it is possible to reduce the associated risk to an acceptable level by either changing the design or adding safety measures to the design**.**

**Protection philosophy (General Fire Defense lines)**

Main line fire prevention.

Second line portable extinguishers.

Third line hose reels.

Fourth line landing valves.

Fifth line Automatic sprinklers system.

**Essential Stages to implement Fire safety requirements**

1 - Liabilities of Fire safety in the planning phase.

2 - Liabilities of Fire safety in the design phase.

3 – Liabilities of Fire safety in the implementation phase.

4 - Liabilities of Fire safety in the operation phase.

Liabilities of Fire safety in the planning phase

1**.** Spread in providing civil defense services through centers (rescue-ambulance-firefighting), so as to reach the event sites in a period of 3 minutes according to international standards.

2. Find special streets and routes for emergency which help in quick arrived of civil defense equipments and machines to carry out evacuation and firefighting operations.

3. Separate the military, industrial and trading areas from residential areas according to safety distances pinpointed by civil defense.

4. Place the pipelines carrying hazardous liquids and gases far away from residential areas according to safety distances pinpointed by civil defense.

5. Place electrical high tension lines far away from city centers according to safety distances pinpointed by civil defense.

6. Specify suitable and large areas around high buildings for evacuation and firefighting operations.

7. Establish hostages and safe places (underground) in all cities.

8. Establish bridges and passages that accommodate the loads of fire engines, machines and rescue equipments and allow its constant passage.

**Liabilities of Fire safety in the design phase**

1-Natural ventilation + Natural light.

2-Routes of escape.

3-Emergency light + smoke exhausts fans, Pressurized fans.

4-Emergency exit signs.

5-Emergency stair case.

6-E emergency exit.

7-An assembly area +first aids boxes.

8-Public alarm -flash +sounder, loud speaker, fire telephone-etc.

9-Fire men elevator.

10-Lightning protection.

11-Emergency landing zone.

11-Firefighting system (wet riser pipe, dry riser, and portable extinguisher.

12-Clean Agents (gas suppression – inert gas, Aragonite, FM200, etc.

- **liabilities of Fire safety in the implementation phase.(5)**
- **liabilities of Fire safety in the operation phase.( 7)**

## 3. CODES & STANDARDS

| | |
|---|---|
| 1. An addressable fire alarm system | NFPA 72 |
| 2. Automatic fire pumps set | NFPA 13 &NFPA 14 |
| 3. sprinkler system | NFPA 13 |
| 4. Landing valve | NFPA 13 &NFPA 14 |
| 5. Dry riser system | NFPA 14 |
| 6. Portable extinguishers | NFPA 10 |
| 7. Emergency Exit &Emergency light Signs | BS 5266-1-1988 |
| 8. Gas suppression system | NFPA 2001 |
| 9. Lightning protection | BS 5266-1-1988,NFPA 780 |
| 10. Catholic &mechanical protection | NFPA 101 |

Class A (Fires in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics.

Class B (Fires in flammable liquids, oils, greases, tars, oil-base paints, lacquers, and flammable gases.

Class C (Fires that involve energized electrical equipment where the electrical non conductivity of the extinguishing media is of importance. (When electrical equipment is de-energized, fire extinguishers for Class A or B fires may be used safely.)

Class D (Fires in combustible metals, such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

## 4. FIRE HAZARD CATEGORIES

Establishments are classified in terms of the seriousness of its contents into the following fire categories 1-Light hazard?

2- Ordinary (Moderate) Hazard?

3-Extra high hazard?

1 Light (Low) Hazard.

Light hazard occupancies are locations where the total amount of Class A combustible materials, including furnishings, decorations, and contents, is of minor quantity. This may include some buildings or rooms occupied as offices, classrooms, churches, assembly halls, guest room areas of hotels/motels, etc. This classification anticipates that the majority of content items are either noncombustible or so arranged that a fire is not likely to spread rapidly. Small amounts of Class B flammables used for duplicating machines, art departments, etc., are included provided that they are kept in closed containers and safely stored.

2 Ordinary (Moderate) Hazard

Ordinary hazard occupancies are locations where the total amount of Class A combustibles and Class B flammables are present in greater amounts than expected under light (low) hazard occupancies. These occupancies could consist of dining areas, mercantile shops, and allied storage, light manufacturing, research operations, auto showrooms, parking garages, workshop or support service areas of light (low) hazard occupancies, and warehouses containing Class I or Class II commodities as defined by NFPA 231, Standard for General Storage.

3 Extra (High) Hazard.

Extra hazard occupancies are locations where the total amount of Class A combustibles and Class B flammables present, in storage, production, use, and/or finished product is over and above those expected in occupancies classed as ordinary (moderate) hazard. These occupancies could consist of woodworking, vehicle repair, aircraft and boat servicing, cooking areas, individual product display showrooms, product convention center displays, and storage and manufacturing processes such as painting, dipping, and coating, including flammable liquid handling. Also included is warehousing of or in-process storage of other than Class I and Class II commodities.

We can answer following question from FIRE HAZARD CATEGORIES

1- Content of building?

2- Early stage of the fire?

3- Fire product proprietors?

4- Evacuation scenario?

5- Examples for this category?

6- Prevention and control?

**Special Agent for Specific Area**

- Foam System
- Total flooding
- Water mist
- Auto-Dry chemical powder
- Gas suppression system
- Protection philosophy selection & operation Design References (main issue for selection).
- Main function of Agents or system.
- Location of Agents or system.
- Operation ( Auto or manual )
- Obstacles ( failure of Agents or system sys )
- Maintained and Repair of system

**General Fire Defense lines:**

Main line fire prevention. ASS-NO 1 Fire alarm system

**Scope:**

To detect fire at an early stage and identify its location

**Purpose:**

- Fire easy control and its extinguishing.
- To prevent fire from growing to an uncontrollable stage.
- To minimize losses and damages in the building and its occupancies

## 5. WHAT IS THE COMPOINED OF ALARM SYSTEM

1- Detection System:

1-1 –Smoke, Heat, Flame, Gas, combined…etc.

2- Manual Call points: Break glass, Push putt on, switches ….etc.

3- Electrical siren: Electronic fire sounder, flash with siren, loud speaker

4-Control panel: Addressable control panel, conventional control panel, combined control panel.

5- Network cables & fittings, accessories.

**Special DETECTORS for Specific Area**

For special location the following detectors type shall be used:

1. Linear heat detectors to protect cable path.
2. Beam detectors at conference room.
3. Flame detectors for generator room
4. Fire telephone used for commutation between fire team members

- The fire alarm system shall be integrated with the air conditioning system, and elevators (BMS) to allow for automatic shut down of both the air conditioning and closing of the elevators.
- The system will be programmed to sound the alarm for all the building in case of fire.
- Complete vertical evacuation shall be instructed by the public address system as indicated in the emergency plan.

**Firefighting system (water system) or (Wet- pipe)**

**Scope:**

To provide the required water flow at the recommended pressure to each floor or points of the building.

**Purposes:**

- Controlling fire and its extinguishing.
- Fighting fire at the further location.
- This shall include the whole water system without discrimination.
- To prevent fire from growing to an uncontrollable stage.

**To minimize losses and damages in the building and its occupancies System Construction:**

The system is constructed from the following items:

1. Automatic fire pumps set.

2. Fire tank (Underground or overhead tank or sharing sys with domestic services….etc.

3. Supplying riser pipe ended with an air release valve at the top or vertical pipe as network system.

4. Sprinkler – cover whole building, garage, store…..etc.

5. Hose - reel point at each floor included in a cabinet.

6. Landing valve inside or outside building.

7 Hydrants –External point outside the building –for feeding & cover garage

8. Water mist system.

**(Water system) or (Wet- pipe) System out let:**

- Hose reels – nozzles – flow with high pressure.
- Landing valves – valves (high flow rate with pressure).
- Sprinkles system – heads – spray.
- Total flooding – valves- jet with pressure.

- Water mist -heads of sprinklers –fog shape.
- Foam generators- blanket of foam .
- A FIRE RISK ASSESSMENT

**The designer should provide for approval:-**

1-schemtic drawings, hydraulic calculation, diagrams, catalog, and layout for:-

1-1- Fire alarm system (Detection) +Evacuation system (public alarm -flash +sounder, loud speaker, fire telephone-etc).

1-2-1 Fire pump set (electrical +jokey +diesel) hydro calculation accepted according to NFPA13.

1-2-2Hose reel cabinet (F.H.C) double size +landing valve +extinguisher set.

1-3- sprinkler system (Automatic).

1-4- location 0f external hydrant points.

1-5-Gas suppression (clean agents) +total flooding (Co2-Auto system)

1-6 Fire connection (double head branches due to local authority, civil defense).

1-7- Types of portable extinguishers (inside double F.H.C)

Fire protection (details) for the flowing area:-

1-A/C duct +Rise floor + above ceiling +kitchens...etc.

2-Electrical room +generator room+ transformer, data center, &similar area…etc.

3- Stores…etc.

**Note:**

- The designer should provide report about safety &fire philosophy for buildings
- Design, implementations', maintenances, testing &commissioning according to above codes and local authority recommendations.
- All specifications should be confirmed with (BS recommended).
- All items above should be shown in main plan lay out.
- Installation only by a company has licensee from civil defense & under care of this end...
- Testing & commissioning only by civil defense administration- safety &fire protection department.
- The contractor shall provide a final copy of his schematic drawings, hydraulics calculations, catalogs to the safety & fire strategy department –civil defense for final approval before installation.
- Any items mentioned & accepted in the primary approval should be clear in finals stage of design with full details (diagrams +plan lay out +schematic drawings catalog…etc.).

## 6. EMERGENCY ACTION PLAN

- Emergency action plan
- An emergency plan is a plan that identifies actions and measures to be followed when an event occurs that changes the expected or banned outcome and is often part of a risk management plan is carried out at an exceptional risk which results in catastrophic consequences

This plan shall be developed and shall include, at minimum, the following:

- Safety sings safe your life in case of fire explain it?
- who support civil defense in case of emergencies?
- What is priorities of (EAP) explain the sequence of operations ?

## REFERENCES

[1] BS (British standards 1988)

[2] NFPA (National Fire Protection Associations). Update.

[3] Industrial safety –south Asia University 2007

[4] Fire hazard and control - south Asia University 2007

[5] OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION).