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A study on fire safety systems in commercial buildings

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Abstract: **Fire accidents in commercial buildings is a threatening one now a days. These accidents create heavy lives and property losses. Therefore a proper attention must be paid to minimize fire loss. This project is a study of fire safety systems in commercial buildings (typically textile shops), the type of equipment and tools, also this study involves the cost estimation for implementation and maintenance of fire safety systems for a textile shop.**

Keyword: fire accident, heavy loss, fire safety systems, cost estimation.

I. INTRODUCTION

Fire is the rapid oxidation of a material in the exothermic chemical process of combustion, releasing heat, light, and various reaction products. Fire is a very good servant, but, a very bad master. As long as fire is under our control, it serves a lot of useful purposes for us but once it goes out of our control, it can create a lot of destruction. However, despite the presence of fire safety measures, the occurrence of accidents is oftentimes inevitable.

II. METHODOLOGY

Four things must be present at the same time in order to produce fire they are enough oxygen to sustain combustion, enough heat to raise the material to its ignition temperature, some sort of fuel or combustible material and the chemical, exothermic reaction that is fire. A fire can be prevented or extinguished by removing any one of the elements in the fire triangle.

1.2 CLASSES OF FIRE

Class A	Ordinary combustibles
Class B	Flammable liquids
Class C	Gas fire
Class D	Combustible metals
Class E	Electrical equipments

1.3 FIRE HAZARDS

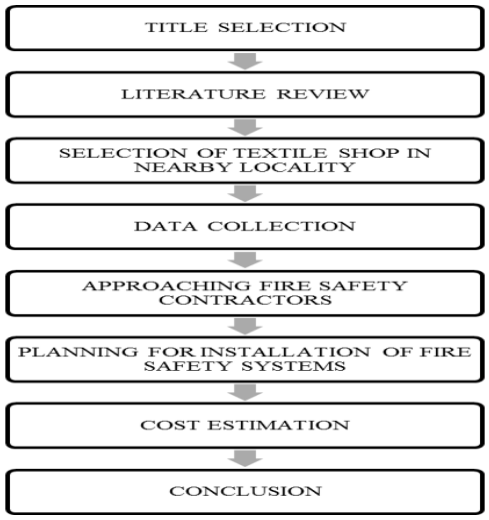
Fire safety of buildings should be considered from three aspects and protection should accordingly be provided against the following three types of fire hazards.

- Possibility of loss or damage to life, referred to as personal hazard.
- Possibility of fire occurring and spreading inside the building itself, referred to as internal hazard.

III. FIRE SAFETY PROVISIONS

Fire safety is the set of practices intended to reduce the destruction caused by fire. Fire safety measures include those that are intended to prevent ignition of an uncontrolled fire, and those that are used to limit the development and effects of fire after it starts. The two types of fire safety provisions are as follows

- Passive provisions
- Active provisions



3.1 PASSIVE PROVISIONS

Passive means it is building plan and design oriented. Any deficiency in the planning and the design will affect the architecture and construction value of the building during fire. It doesn't require any energy activation. If the type of construction and the use of construction materials are proper, the building itself or by virtue of its design with construction materials will react with the fire in such a way that it will not allow to spreading of fire and its other products of heat, smoke toxic substances and fumes

from the origination point to adjacent room or other floors or to the adjacent buildings.

3.1.1 Objectives of passive provisions

- Accessibility and reach ability
- To give insulation effects against the fire, heat penetration
- To provide sufficient number of means of exits
- To enhance the integrity and stability of the building
- To provide protected means of escape
- To maximize time of safety, actual time required for evacuation

3.1.2 Components of passive provisions

- **Building access**

Approach road to the building premises its main entrance gate and its width. Open space around the building to use emergency vehicles such as special ladder and rescue vehicles.

- **Building material selection and construction**

Use of non combustible materials, fire resistant treatment by coating or dipping and use less smoke emitting materials.

- **Building design**

Well ventilated, provision of explosion vents, designing and dividing big floor area in to small area by providing effective fire barriers walls, so that fire may be contained in the place of origin, which is known as compartmentation, providing enough exits for easy evacuation and natural smoke ventilation provisions.

- **Building construction fire rating**

Using of materials for construction should have the fire rating of minimum from two hours to maximum four hours.

- **Building maintenance**

Building should be maintained with good working condition of fire fighting equipments, liberal space provision of life safety requirements and integration of passive safety measure with automatic active fires safety measures.

3.2 ACTIVE PROVISIONS

These are the external components either temporary or permanently attached with the building and are activated by external sources of energy at the time of fire in the building.

3.2.1 Objectives of active provisions

- To provide immediate detection and give alarm of fire on its occurrence
- To provide immediate suppression effect on fire either automatically or manually on its notice
- To prevent the fire spread as well as to extinguish the fire at the incipient stage
- To reduce the destruction and loss due to fire
- To minimize time to hazard time required for reaching the maximum level of fire hazard

3.2.2 Components of active provisions

The components of active fire safety provisions are as follows

- First aid extinguishers
- Fire hydrant system
- Wet riser system
- Automatic fire detection and fire alarm systems
- Sprinkler systems

IV.ACTIVE PROVISIONS

4.1 EXTINGUISHERS

A fire extinguisher is an active fire protection device used to extinguish or control small fires, often in emergency situations. It is not intended for use on an out-of-control fire, such as one which has reached the ceiling, endangers the user (i.e., no escape route, smoke, explosion hazard, etc.,) or otherwise requires the expertise of a fire department.

Selection of fire extinguishers

Various types of fire extinguishers are available but all are not equally effective on all types of fire. For this reason , the nature of contents of building, the processes carried out therein and the types of fire which may occur shall taken into consideration while selecting the extinguishers.

CLASS OF FIRE	TYPE OF EXTINGUISHER
Class A fires	Water extinguishers
Class B fires	Foam extinguishers
Class C fires	Co_2 extinguishers
Class D fires	Special dry powder extinguishers
Class E fires	Co_2 and ABC dry powder extinguishers

TYPE	SIZE	VALIDITY
WATER	9 lit	1 year
	50 lit	
FOAM	9 lit	1 year
	50 lit	
DRY POWDER	500 g	3 years
	1 kg	
	2 kg	
	4 kg	
	6 kg	
	9 kg	
	25 kg	
CO_2	2 kg	1 year
	4.5 kg	
	9 kg	
	25 kg	

Figure 1 Types of Extinguishers

Normally, extinguishers should be provided for every 625sq.ft. It can be mounted to the wall at a maximum height of 5ft.There are two main types of fire extinguishers: stored-pressure and cartridge-operated.

In stored pressure units, the expellant is stored in the same chamber as the fire fighting agent itself. Depending on the agent used, different propellants are used. With dry chemical extinguishers, nitrogen is typically used; water and foam extinguishers typically use air.

Stored pressure fire extinguishers are the most common type. Cartridge-operated extinguishers contain the expellant gas in a separate cartridge that is punctured prior to discharge, exposing the propellant to the extinguishing agent.

Available sizes and refilling of extinguishers:

4.2 FIRE ALARMS AND DETECTORS

A fire alarm system has a number of devices working together to detect and warn people through visual and audio appliances when smoke, fire, carbon monoxide or other emergencies are present. This system consists of detector, ½ mile siren, manual call point, panel (4 zoom) with 12V battery.

These alarms may be activated automatically from smoke detectors and heat detectors or may also be activated via manual fire alarm activation devices such as manual call points or pull stations. Alarms can be either motorized bells or wall mountable sounders or horns. They can also be speaker strobes which sound an alarm, followed by a voice evacuation message which warns people inside the building. The fire detectors are of two types namely, heat detectors and smoke detectors.

Heat detectors should be so installed that the sensing element is not less than 25mm and not more than 150 mm below the ceiling/roof level. For smoke detectors, the sensing element should not be less than 25 mm and not more than 600 mm below the ceiling/ roof level.

Heat Detectors

Heat detectors are the oldest type of automatic fire detection device. Heat detectors feature a detecting element inside the unit that activates when it reaches a predetermined fixed temperature or when a specific increase in temperature has occurred. Heat detectors are best suited for applications where detection speed is not a prime consideration or where ambient conditions would not allow the use of smoke detector fire detection in small, confined spaces where rapidly burning, high heat fires are anticipated. Heat detectors have a lower false alarm rate, but they are also slower than smoke detectors in detecting fires.

Figure 2 Heat detectors

Smoke Alarms

Smoke alarms will detect most fires more rapidly than heat detectors. There are currently three types of smoke alarms on the market, they are ionization, photoelectric and combination ionization/photoelectric.

An ionization smoke alarm contains a small amount of radioactive material. The radiation passes through an ionization chamber which is an air-filled space between two electrodes and permits a small, constant current between the electrodes. Any smoke that enters the chamber absorbs the alpha particles, which reduces the ionization and interrupts this current, setting off the alarm. This type of alarm responds best to fast raging fires.

Photoelectric smoke alarms operate using a light source, a light beam collimating system and a photoelectric sensor. When smoke enters the optical chamber and crosses the path of the light beam, some light is scattered by the smoke particles, directing it at the sensor and thus activating the alarm. This type of alarm responds best to slow smouldering fires.

Figure 3 Smoke alarms

Detectors require periodic cleaning to remove dust or dirt that has accumulated. The frequency of cleaning depends upon the type of detector and local ambient conditions. In any case, the interval should not exceed a period of 3 months. For each detector, the cleaning, checking, operating and sensitivity adjustment should be attempted only after consulting manufacturer's instructions. These instructions should detail methods such as creating vacuum to remove loose dust and insects, and cleaning heavy greasy deposits, following partial disassembly or the cleaning or the washing of detectors to remove contamination, the sensitivity test requirements in accordance with the relevant clauses should be performed.

4.4 FIRE HYDRANTS AND HOSE REELS SYSTEM

A fire hydrant, also called a fireplug or simply a plug, is a connection point by which fire fighters can tap into a water supply. It

is a component of active fire protection. These fire hydrants are provided on a ring main of 150mm dia. in the ground around the building periphery. The ring main gets water from underground tank with pressure so that available pressure at each hydrant is of order of about 3.5 to 4 kg/cm^2.

This system consists of a hydrant valve (single or double),branch pipe, hose of lengths either 15m or 30m and a hose box(single door or double door).

V. COST ESTIMATION FOR INSTALLING FIRE SAFETY SYSTEM IN A TEXTILE SHOP

I have estimated the cost for installation of fire safety systems in a textile shop of 3500 sq.ft. with G+2 floors. Incase of textile shop it requires a powder type extinguishers of 9 litres for every 625 sq.ft. and a hose reel drum at each floor. Based on its requirements the cost for installation was estimated to be Rs.34,500 which was 5.75% of its asset value.

VI. CONCLUSION

- To avoid the fire accidents in building the passive way of safety design, life safety provisions and the active way of fixing fire fighting appurtenances in the building cannot assure full safety.
- If we adopt these parameters in the buildings, we can avoid the fire accidents and assure the absolute safety of the buildings in future.

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