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# "ANALYSIS OF FIRE RISK ASPECTS AND CREATING FIRE PROTECTION STRATEGY"

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**ABSTRACT:**
Whether it's about residential, commercial, medical, entertainment, shopping or industrial building, a part of structural and architectural needs, fire safety is the most essential need as it costs a lot. Hence the assessment for the need is really a dire requirement. In India Tamil Nadu, Maharashtra, Gujarat, Uttar Pradesh, Andhra Pradesh- just five states collectively comprise of 53% of Indian industrial asset.
Also the fire risks is seen higher in Private Sector have ninth rank then in Govt/PSUs that ranks eleventh. In Pan India there is 8.04% risk of fire. The risk of fire is 7.61% in western region which is highest region wise. There were 18,450 fires reported in India, 1193 were injured and 17,700 were killed so it is an awakening call to prevent them. *Source: (NCRB's ADSI Reports)* Gujarat is the third most state having highest number of industries and among it Surat city is the second most in chemical and hazardous industry. Hence in this study industrial areas and those having past history of fire accidents are assessed different methods area applied for fire protection system.

**Keywords** – Industrial fire hazard , Active Fire Safety System, Passive Fire Safety System, industrial Buildings.

## INTRODUCTION

The United States alone has reported 1.3 billion fire incidents in the year 2020 topping the list of countries with maximum fire outbreaks, followed by Italy and France with 0.33 billion and 0.31 billion fire outbreaks respectively .The United States has also reported property damage of 33 billion USD in the year 2020 .Every year, in India, about 25,000 persons die due to fires and related causes.
Female accounts for about 66% of those killed in fire accidents However, no comprehensive data is available in India on the economic losses suffered on account of fires.According to one estimate, the major losses reported by the Indian Insurance Companies in the year 2007-2008 indicate that about 45% of the claims are due to fire losses.

Gujarat has a very wide manufacturing base including world-scale petroleum refinery and petrochemical complexes. Chemical industry occupies a pre-eminent pride position in the industrial sector of Gujarat, contributing to more than 40% of industrial output. Gujarat contributes more than 20% of the country's chemical production.The major hydrocarbon manufacturing plants are located in Vadodara, Bharuch, Surat and Jamnagar districts. More than 50% of the new investments in the state are in chemical and petrochemical sectors. Almost the entire range of chemical process industry exists in Gujarat, including hydrocarbon processing/refining

products, petrochemicals-polymers and man-made fibers, fertilizers, health care products, plant protection chemicals, dyes, pigments and intermediates, fine chemicals, surface coating products, salt and salt-based products, ceramics, glass, cement, vegetable oils, fats and detergents. Due to Vast Diversification in Industries Risk of Fire Hazard is Increased Massively, This occurs fire accident in industries which lead to major injuries to the people or sometimes it takes life Reduce the fire risk several steps are undertaken but firstly we need to understand the fire hazard to mitigate it as much as possible

In the past five years, as many as 989 workers died in accidents in industrial units in Gujarat The districts of Surat, Ahmedabad and Bharuch, located on the "Golden Corridor" from Mehsana in the north to Vapi in the south, accounted for 42 per cent of the deaths of factory workers.A large number of these workers died in the industrial units of top companies such as Reliance Industries Limited, Tata Group, Essar Group, Nirma Limited and Welspun Group account.

**Need of the Study**

India's fire safety audit lacks in legislative provisions as seen earlier there were 18,450 fires reported in India, 1193 were injured and 17,700 were killed so it is an awakening call to prevent them. It was concluded that 42.1% of deaths were due to fire accidents in residential buildings in a cause-wise analysis of fire accidents. As per India Risk Survey -2019, current fire risk is 7.12. Also, this survey states fire outbreaks continue to pose risks to business continuity and operations.

Also, the fire risk is seen higher in Private Sector have ninth rank then in Govt/PSUs that ranks eleventh. In Pan India there is 8.04% risk of fire. The risk of fire is 7.61% in western region which is highest region wise. Also, the highest risk of fire is seen in manufacturing industry.

Industrial accidents occur with depressing regularity in India. In the last year(2021), At least 6,500 employees have died on duty at factories, ports, mines and construction sites in five years, the Union labour ministry has informed Parliament. Most such incidents took place in Delhi, Maharashtra Gujarat and Rajasthan.

**Objectives**

To identify issues regarding fire risk and safety in Industrial Buildings.and performing fire audit in existing buildings for calculation of fire load calculation

**Literature Review**

At all 2021 , Mohammad A. Hassanain, Mohammed Al-Harogi and Ahmed M. Ibrahim have showed fire safety risk assessment of workplace facilities: a case study

This paper shows workplace facilities are organizational capital assets, which entail high risks of fire Occurrences. The fire risks increase based on occupants' behaviors, lack of Awareness and poor workspaces safety management. Thus, fire safety risk Assessment is vital to raise awareness about workplace fire-safety culture, and to train Employees on effective fire response requirements and methods.

This provide professional practice and Knowledge on the fire risk assessment methodology, serving safety professionals, and Facilities managers. It serves to raise awareness on the causes of fire, consequences of fire Events, and mitigation strategies in workplace facilities, for the purpose of protecting users' Lives and business properties against fires.

At all 2021 Amir Ali, Rajiv Banerjee includes Fire hazard in buildings: review, assessment and strategies for improving fire safety

This paper suggests the current fire protection measures in buildings do not account for all contemporary fire hazard issues, which has made fire safety a growing concern.

To overcome fire hazards in buildings, impact of fire hazards is also reviewed to set the context for fire protection measures.

An integrated Framework for mitigation of fire hazards is proposed. Detailed strategies on improving fire safety in buildings in these four key areas are presented, and future research and training needs are identified

At all 2019 Muhammad Masood Rafi Includes Safety assessment and risk analysis of potential fire hazards and fire development in industrial facilities

This study indicates the risk analyses of fire hazards and fire development in industrial buildings and storages - Experiments and numerical simulations fire and smoke propagation, temperature, thermal radiation, fire toxicity Ø impact of fire to the structure, stresses and strains in construction elements, load-carrying capacity of buildings determination of safety distances Evaluation: Risk from fire to humans and environment

Risk from fire to industrial structures - Design of industrial buildings and the sizing of components with respect to safety and economic efficiency

At all 2013, Eric W. Marchant includes Analysis of recovery from fire risk in industry and commerce

This analysis shows the various features of these concepts are recognized as contributors to the objective: "Efficient productivity with greater profitability"(Fletcher and Douglas, 1971(a)). Any interruption to business because of fire, or any other agency, is regarded as a failure of one, or more aspects of loss control.

This present that attempt to identify failures of loss control and it is clear that no sigle feature of a loss control system is wholly responsible for a failure although it is clear that single features can be a major causal agency.The principal factors appear to be the financial status of the fire hit company; the ability of the management team to respond to a crisis; the quality of professional advice available to the owner; and the attitude of the insurance company to they fire hit enterprise.

At all 2013 Christian Knaust includes Study on assessing the risk involved in fire hazards

This investigated to acquire an overall idea about risk and its consequences in construction field and the process required for its management in India.

The effect of risk on assessment of a project is discussed along with the tools and methods adopted to manage risk in industry.

Based on the review, underlying cause of current limitations in fire protection measures is identified as lack of a holistic framework to mitigate fire hazard.

At all 2019 Shigang Guo includes Fire risk assessment for industrial buildings based on frame method

Fire risk assessment is an important part of fire science and systemsafety engineering. "FRAME" means Fire Risk Assessment Method for Engineering. It is a widely used and comprehensive building fire risk assessment method based on a fixed index system, and compared with other methods, FRAME method can avoid artificial subjective influence, and it is more convincing.

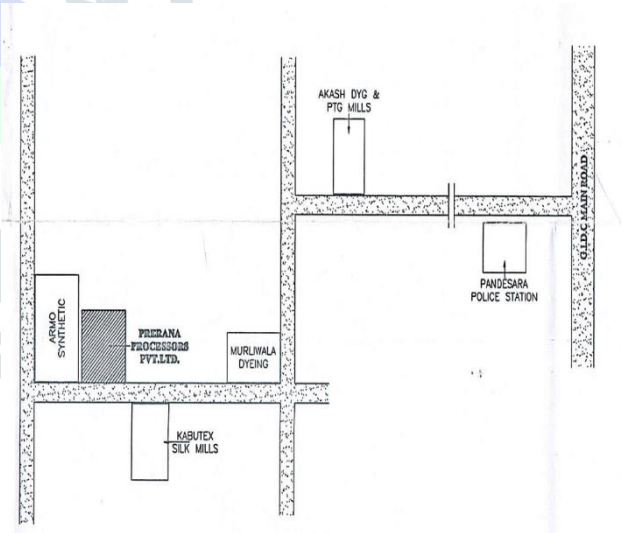
The paper discusses the advantages and calculation methods of FRAME, and takes a commercial building in Shijiazhuang as an example. By using the method, the fire risk of the building is evaluated and the strengthened fire protection measures are proposed based on the method.

**Fire safety audit of Prerana processors Pvt. Ltd, Pandesara ,surat**

**FIRE HAZARD IDENTIFICATION**

The risk falls under ordinary hazard category as per TAC (Tariff Advisory Committee) fire protection guideline.Considering the industrial activities at the facility, Fire risk Involves:

- Common fire risk due to operation, accidental happening, bad housekeeping.
- Fire risk due to electrical short circuit.
- Fire and explosion at electrical transformer area.
- Storage and Usage area of Raw material, Grey storage area & Finished goods area.
- Process areas where fabric is being dyed, transferred Etc.




Key Plan of Prena Processor

**FIRE PREVENTION ASPECT**

Following general fire prevention measures adopted:

- Entire plant area declared as no smoking zone.
- Fire hydrant and fire extinguishers are provided at conspicuous location.
- Trained person in fire fighting are available

**EXISTING FIRE PROTECTION FACILITIES**

**Source of water**

Two S.M.C. water supply pipe lines of 3” Nominal diameter are available as a source of water.

**Water storage tank**

Underground water storage tank of 425 KL

**Fire pump**

One Electrical pump of 480 Lpm discharge flow rate capacity and discharge pressure of 6 bar is provided for hydrant system

**Fire hydrant**

12 numbers of fire hydrant points are provided at various locations

**Trained person in fire fighting**

Training on firefighting are imparted to selected employees

**FIRE PROTECTION SYSTEM**

| Sr. No. | Description | Capacity | Total Qty. |
|---|---|---|---|
| **1** | Source of water | | |
| | S.M.C. Water Supply | - | 02 |
| **2** | Fire Water Storage | | |
| | Under Ground Tank | 425 kL | 01 |
| **3** | Fire Pump | 480 Lpm | 01 |
| **4** | Fire Hydrant | - | 12 |
| **5** | Foam Type | 5 kg | 02 |
| **6** | Hose Box | - | 02 |
| **7** | Fire Hose Reel | - | 10 |
| **9** | D.G. Set | 380 kV | 01 |
| **10** | Fire Extinguisher | | |
| | ABC | 10kg | 15 |
| | Co2 | 5kg | 15 |

**FIRE PROTECTION SYSTEM**

| Sr. No. | Name | Qty. |
|---|---|---|
| 1 | Helmet | 22 |
| 2 | Face Mask / Shield | 18 |
| 3 | Goggles | 45 |
| 4 | Ear Protection | 06 |
| 5 | Hand Gloves | 104 |
| 6 | Respirator | 12 |
| 7 | Boot | 32 |
| 8 | Full Body Suit | 03 |

**FIRE LOAD CALCULATION**

| | | | |
|---|---|---|---|
| 1 | Name & Address of factory | : | PRERANA PROCESSORS PVT. LTD.<br>Plot No.: 149, GIDC Estate, Opp. Jai Hanuman dyeing-2, Vadod gam jakatnaka-2, Pandesara-394221, Dist.: Surat. |
| 2 | Phone Number | : | +91 – 9376515815 |
| 3 | Name of Occupier | : | Mr. Rajeshmani Surendrmani Tiwari |
| 4 | Total Floor of the factory | : | 1) Total Floor in the factory = 04<br>2) Maximum numbers of floor in building = 04 No's Floors (Refer To Sheet No : 02/03 & 03/03 of PPPL/FIRE/APR/2021) |
| 5 | Detail of Combustible Area (In sq. Meter) | | |
| a) | Total Floor Area | : | 6501.24 $m^2$ |
| b) | Open Space Area in which Combustible Material stored | : | 6198.86 $m^2$ |
| c) | Area having more than 15 meter Height | : | NA - |
| d) | Area having Wooden material | : | 153.58 $m^2$ |
| | Total (a + b + c + d) | : | 12853.68 $m^2$ |
| 6 | $\frac{a + b + c + d}{20}$ | : | 12853.68/20 = 642.68 Lpm |
| 7 | Total Requirement of Water (based on area in sr. no-6) | : | 31234.00 Ltrs |
| 8 | Current Water storage Capacity for fire hydrant | : | 425000.00 Ltrs |

| | | | |
|---|---|---|---|
| | Under ground Tank + over head tank + On ground Tank | : | Underground Tank |

9 In case of Fire, Arrangement for water to be used in fire fighting

| | | | |
|---|---|---|---|
| a) | Is Hydrant Line available? If Yes give dimension of Pipe. | : | Yes Hydrant line is available. Diameter of main hydrant line is 15.24 cm. (Refer Sheet no - 02/03, Drawing No. PPPL/FIRE/APR/2021 |
| b) | Which type of arrangement are available for Supply water on ground or upper floor i.e. Pipe line and it's Diameter (cm); Give detail | : | Fire water Hydrant line is available for Supply of water on the Ground as well as on First Floor. Diameter of pipe line is 10.16 cm. (Refer Sheet no - 03/03, Drawing No. PPPL/FIRE/APR/2021 |
| c) | Are Fire Water Pump Available or Not? Give detail | : | Fire water Pump House is installed. (i) We have 01 no's of Main Pump in having capacity 480 Lpm. |

| | | | |
|---|---|---|---|
| 10 | If the Value of Sr. 6 is more than 550, then requirement of trailer Pump is applicable. If it applicable then what is the arrangement for the Same. Give detail | : | A+B+C+D /20= 642.68 Lpm. But the fire station is 1.6 km away from the factory (< 3 km) so the total required capacity of pump can be reduced by 25% [Rule 66A -Subrule (11)-Clause (a)], which is 482 Lpm. Value is less than 550 Lpm. Hence Trailor Driven Pump is not required. Hydrant line network is available (Details as per layout – Sheet No.: 02/03 & 03/03) |
| 11 | How many water buckets required? | : | 66 No's |
| 12 | How Many 9 Liters water type Extinguisher required?(Water Bucket/6) | : | Fire Extinguisher required 66 / 6 = 11<br>Bucket may be dispensed with provided supply of extinguisher is double than indicate above 11 + 11 = 22 |
| 13 | Requirement of 5 Kg CO2 Type Fire Extinguisher for Class - E fire. Floor wise (1 for every 15 m length) | : | 10 No's |
| | Total requirement of Fire extinguishers (5 Kg DCP). | : | 22 + 10 = 32 No's |

14 Details of installed Fire Extinguishers.

| Type | | No's |
|---|---|---|
| CO2 | : | 15 |
| ABC | : | 15 |
| Foam | : | 02 |
| TOTAL | : | 32 |

| | | | |
|---|---|---|---|
| 15 | Additional Fire Extinguisher Required | : | Nil |

| | | | |
|---|---|---|---|
| 16 | Emergency Fire Exit provided to Each Floor? Ladder Provided to Each floor? | : | 1). Evacuation Route from work location to fire exit door (Refer to drawing Sheet No: 02/03 & 03/03, Drawing No: PPPL/FIRE/APR/2021<br>2). Staircase are provided at each floor (Ground floor + 1st floor + 2nd floor) |
| 17 | Arrangement for Fire warning. i.e. Hooter / Elec. Bell / Other | : | No. |
| 18 | Water Sprinkler Provided? | : | No. |

**Major Findings**

Critical Findings from the literature and various guidelines and definitions are included below:

a.Disaster management plan and state regulations are to be considered for fire risk assessment.

b.Fire No objection certificate by state authority should be mandatory for Industrial, major fires start in storage areas and warehouses and production units

c.The Central Pollution Board issuing a circular on May 8, 2020 noting that it was the responsibility of states to undertake safety audits prior to the resumption of industrial plants, questions have been raised over whether such audits were, indeed, carried out correctly, and whether their recommendations were acted upon

d.The issue becomes even more pertinent particularly within the context of the new draft Environment Impact Assessment 2020

e.Under the Factories Act, 1948, state governments are required to appoint inspectors to enforce the requirements of the statute that is, reportedly, applicable to over 3,50,000 registered factories that include 6,000 units undertaking hazardous processes.

f. According to DISH ,34 Industries fall under MAH Category in surat including ( HCC, BPCL, GIPCL ,IOCL, NFIL, NTPC, ONGC etc )

g.The Surat city is under AA Highly Hazard category

**SUGGESTION & RECOMMENDATION**

- Fire Hydrant system to be displayed on the board near the security office/ main gate.
- Fire Extinguisher shall be inspected & serviced periodically.
- Emergency contact Number list with name & designation of person is to be displayed in security office.
- Lightening arrestor is to be provided on top of Combustible material storage area.
- Fire Fighting training and retraining to be imparted to all employees periodically.
- Earthing of all Equipments, Motors, Machinery, etc. to be checked periodically. Continuity of earthing to be checked periodically.
- Sand buckets are to be made available at the Switch yard & Transformer area.
- Prepare Emergency response plan, emergency team with its display at site.
- Safety training to all to be given for basic fundamental of fire prevention with Fire Extinguisher operation.
- Emergency evacuation route (FLUORESCENT EXIT BOARD) to be arranged.

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