Use of Leading Edge Technology for Planning and Design of Fire Resistance Construction

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***Abstract*:** *After the 9-11 attack on the World Trade Center, interest in the design of structures for fire resistance greatly increased. Some engineers have promoted the use of advanced analytical models to determine fire growth within a compartment. This project provides engineers with a summary of the simplified techniques which have been used successfully in recent times by developed countries to design concrete structures to resist the effects of severe fires. This project also proves that fire resistance the cost by using latest technology is quiet low as compared to the cost of fire resistance by using conventional (old) methods of fire resistance construction.*

Keywords: innovative ,leading edge techniques, fire resistant .

1. INTRODUCTION

FIRE RESISTANT-to use latest technologies and develop resistance for a certain period of time against the fire to prevent loss of life and serious injuries caused due to fire also minimize the economical losses caused loss of interiors of the buildings**.**

SOME IMPORTANT DEFINATIONS

Building codes and test standards have provided definitions for some terms commonly used to describe how a given material or assembly will perform in a fire. Terms that have been defined include:

- Combustible
- Noncombustible
- Fire-resistant or Fire-resistance
- Ignition-resistant
- Fire-Resistance Rating

1. Combustible

Combustible materials are those that readily ignite and burn. Many common construction materials are combustible, including wood and wood-plastic composite and plastic products.

2. **Noncombustible**

A noncombustible material is one that is not capable of undergoing combustion under specified conditions.

3. Fire Resistant

Fire resistance ratings and tests provide guidance on fire safety issues. They are designed to evaluate the capability of a material or assembly to contain a fire within a compartment or building, or continue to provide a structural function in the event of an (internal) fire.

4. Ignition Resistant

Materials which do not catch fire in the event of fire and hence do not support or help in increasing flames are called ignition resistant materials.

5. Fire-Resistance Rating: The period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on The Purpose of "Fire-Resistance Ratings"

A fire resistance rating is a method or means to restrict the effects from the products of combustion for a predetermined period of time. Fire-resistance ratings can apply to and protect structural and non-structural elements of a building such as beams, columns, walls, floors and roof construction.

Restricting the spread of fire and resulting smoke, gases, etc. and/or extending the period of time before a building element or elements fails by having a fire- resistance rating should allow time for building occupants to safely egress the structure. It should also permit emergency fire personnel time to address the event.

2. OBJECTIVES

- To study the new Municipal Corporation building in detail about existing fire resistance features.
- To study various components of fire resistance in the newly designed fire resistance system at N.D.M.V.P.S Karmaveer Baburao Ganpatrao Thakare Collage of Engineering,Nashik (conventional or old method).
- To study various components of fire resistance in the newly designed fire resistance system under installation at Gilani Foods pvt.ltd, Mumbai Agra National Highway, Nashik (using innovative technology).
- To design the new Municipal Corporation building for fire resistance using innovative technology used successfully in recent times by developed countries such as Japan ,United States of America etc.
- To compare the estimated cost of material of fire resistance using innovative technology to the cost of material of fire resistance using conventional or old method
- To study the actual site for better understanding the fire resistance planning.
- To have the detailed information regarding each and every component of the fire resistance installed in the building.

3. LITERATURE REVIEW

Following are the literature papers referred for this thesis:

1.G.B.Menon, J.N.Vakil, "Handbook on Building Fire Codes , IITK-GSDMA-Fire 05-V3.0 , 2005.

Building, whether used for living, working, entertainment or for other purposes, forms an integral and major constituent of human habitat. As a sequel to the all round socio-economic progress, and the steady urbanization processes gathering momentum all over our country for the past few decades, there has been enormous increase in the number of buildings of all classifications, including high-rise and special buildings, especially in the urban and surrounding areas.

2. Jane I. Lataille, " Fire Protection Engineering in Building Design", Los Alamos National Laboratory, 2003

In this book, Jane Lataille, a well known fire protection engineer with over 27 years of experience in the field, explains in an easy to understand, straight forward fashion, what fire protection engineering involves and what issues need to be considered in integrating fire protection into the overall building design process.

This book provides excellent guidance to the non-fire protection engineer on the coordination necessary during the design process to make sure that the fire protection design provides a level of safety acceptable to building owners, insurers, and code enforcers that does not impose unnecessary constraints on the overall building design or operation. Fire protection is an integral part of building design and must be integrated into the overall design process from the very beginning of the project. It is vitally important for everyone involved in the building design process architects; structural, mechanical, and process engineers; interior designers, and other design professionals to be aware of the fire protection engineering issues that need to be considered at each step in the process.

4. METHODOLOGY

Step 1: Visit to New Municipal Corporation Building Dhule and getting information from fire officer Mr. R. G. Dhake Sir.

Step 2: Acquiring the approved plan of the Municipal Corporation Building Dhule.

Step 3: Organized visit to Karmaveer Baburao Ganpatrao Thakare Collage of engineering, Nasik to study the fire resistance work which has been recently done.

Step 4: Visit to Gilani Foods (4 star restaurant), Mumbai Agra National Highway, Nasik which is under construction to study the leading edge technologies used.

Step 5: Gathered information about leading edge technologies which have been rarely used to achieve greater fire resistance.

Step 6: Taking out dimensions of the elements such as ceiling radiation dampers, smoke dampers etc.

Step 7: Determining the places of their installation.

Step 8: Prepared plans showing installation of each element separately.

Eg: a) A plan showing the places of installation of smoke dampers.

b) Then plan showing the places of installation of ceiling radiation dampers..

Step 9: Designd a water storage tank and pump house unit.

Step 10: Prepared an estimate showing cost of the modern elements used for fire resistant design.

Step 11: Prepared an estimate showing the cost of elements by old fire resistant design method**.**

Step 12: Comparing both the above estimates to get final results and conclusion**.**

5. DETAILS OF IMPLEMENTATION (CASE STUDY-NEW MUNCIPAL CORPORATION BUILDING, DHULE)

- Water tank and pump house unit **:**
- Details of water tank and pump house unit required for water supply for Automatic Water Sprinklers.
- It consist of 2 water tanks one on either side of building as shown in the automatic fire sprinkler plan.
- Quantity of water required for water sprinklers 10000 lit
- Size of water tank -3x2x2m
- Volume of water =12m3=12000 liter
- Each tank consist of 1 electric pump connected to generator unit.
- Cost of each pump=45000/-Rs
- Total cost of 2 pumps=90000/- Rs

ESTIMATE

1.USING MODERN TECHNIQUES

- **Ceiling Radiation Dampers**

Total no of units on first floor-45

Total no of units on second floor-45

Total no of units on -89

Mrp per unit-1800/-rs

Total cost-160000/-rs

- **Combination of smoke and fire Dampers**

Total no of units on first floor-15

Total no of units on second floor-15

Total no of units on -30

Mrp per unit-850/-rs

Total cost-25500/-rs

- **Duct for Ceiling Radiation Dampers**

Length on first floor -244m

Length on second floor -244m

Total Length-488m

MRP per meter length- 1396/-Rs

Total cost-681248/-

- **Automatic Water Sprinkler**

Total no of units on first floor-45

Total no of units on second floor-45

- **Total no of units on -89**

MRP per unit-105/-Rs

Total cost-9345/-Rs

- **Pipe for water sprinklers**

Length on first floor -244m

Length on second floor -244m

Total Length-488m

MRP per meter length- 789/-Rs

Total cost-347160/-Rs

- **Draft Stop**

Density-48 kg/m3

Thickness -50 mm

Panel 1- 6.34x0.6x3=11.412m2

Panel 2-5.0x0.6x6=18m2

area required – 58.824m2

MRP per m2-95/-Rs

Total cost-5588/-Rs

- **2 Hour Rated Fire Partitions**

Density-48 kg/m3

Thickness -50 mm

Panel 1- 2.42x2.9x6=42.108m2

Panel 2-1.75x2.39x10=50.75m2

Panel 3- 1.70x2.9x1.0=4.93m2

Panel 2-1.79x2.9x1.0=5.191m2

Total area required for first floor -102.979m2

Total area required for second floor-102.979m2

Total area required –205.958m2

MRP per m2-120/-Rs

Total cost-24712/-Rs

- **Fire doors**

No of units-6

MRP per unit-15000/-Rs

Total cost-90000/-Rs

SR.NO	Component	Cost in Rupees
1	Ceiling Radiation Dampers	160000
2	Combination of smoke and fire Dampers	25500
3	Duct for Ceiling Radiation Dampers	681248
4	Automatic Water Sprinkler	9345
5	Pipe for water sprinklers	347160
6	Draft Stop	5588
7	2 Hour Rated Fire Partitions	24712
8	Fire doors	90000
9	Electric pump	90000
	TOTAL COST	**1433553**

TOTAL ESTIMATED COST-1433553/-Rs

In words-fourteen lakh thirty three thousand five hundred and fifty three.

2.ESTIMATE (USING CONVENTIONAL TECHNIQUES)

(Prepared as pre information obtained from Mr.Tushar Dhake(Fire Officer Municipal Corporation,Dhule)

- **Cast Iron Pipes**

Length on first floor -295m

Length on second floor -295m

Total Length-590m

MRP per meter length- 1300/-Rs

Total cost-767000/-Rs

- **Fire Hydrants**

Total no of units-4, 2 no for each floor

MRP per unit-100000/-Rs

Total cost-400000/-

- **Fire Hydrant Pumps**

Diesel pump, MRP-365000 /-Rs

Electric pump, MRP-45000 /-Rs

Total cost-410000/-Rs

- **Fire extinguishing unit consisting of hose reel,valves,cloth pipe with steel cabinet**

Total no of units-2

MRP per unit-45000/-Rs

Total cost-90000/-Rs

SR.NO	Component	Cost in Rupees
1	Cast Iron Pipes	767000
2	Fire Hydrants	400000
3	Fire Hydrant Pumps	410000
4	Fire extinguishing unit consisting of hose reel,valves,cloth pipe with steel cabinet	90000
	TOTAL COST	**1667000**

TOTAL ESTIMATED COST-1667000/-Rs

In words-sixteen lakh sixty seven tousand

5. RESULTS AND DISCUSSION

ESTIMATE (USING MODERN TECHNIQUES)

Total Estimated Cost=1433553/-Rs

In words- fourteen lakh thirty three thousand five hundred and fifty three.

ESTIMATE (USING CONVENTIONAL TECHNIQUES)

Total Estimated Cost-16,67,000/-Rs

In words-sixteen lakh sixty seven tousand

Total profit in using modern techniques-*2,33,477* /-Rs

In words- ***Two lakh thirty three thousand four hundred and seventy seven*****.**

6. CONCLUSION

- The modern system of fire resistant design of building is **more reliable** than the old conventional system
- The modern system of fire resistant design of building is more **cost effective** and money saving than the old conventional system
- The modern system of fire resistant design of building is successfully and more effectively used in recent times by developed countries.

- This system has a major advantage over the old system that no manual procedure such as taking the hose pipe and then opening valves to sprinkle water over the fire.
- Less wastage of water that is effectively extinguishing the fire in small amount of water as compared to the large amount of water wasted in the conventional system.
- Due to decreased reaction time to fire breakout, hazard to humans is very effectively controlled and also can help in saving many lives to a great extent.

7. REFERENCES

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15. **Codes and Standards**

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- Code of Practice for Fire Safety in Buildings 2011
- International Building Code- FIRE SAFETY