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Feasibility Study Of Sustainable Material For Retrofitting-Case Study Nashik City

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Abstract—The urban population and incomes are increasing, therefore the need for primary facilities such as water, public transportation, sewage treatment, low income housing is excessively increasing five- to sevenfold in every size and type of city. In recent studies the awareness of government has lead cities that can cope with the challenges of urban living and also be the part of attraction for investment. The announcement of '100 smart cities has been seen to follow this vision. There are many problems like parking, congested traffic, adequate water supply, and improper sanitary system. And the deterioration of buildings also takes place. The strategic components of development are city betterment by modifying. These problems can be solved by proper methods of retrofitting. Need of Study is to retrofit part of Nasik city which is Kalidas Kala Mandir. Main focus of study is to improve the quality of life for Nasik with the objectives to be finding out problem, to identify the area of retrofitting in Nasik city, to study the concept of retrofitting, to study the methods & sustainable material used for retrofitting. Also heritage conservation of the city has to be preserve. To achieve these objectives a methodology is adopted towards the retrofitting management, understanding the need of retrofitting.

Index Terms— Smart city, retrofitting, heritage, sustainable, Nashik.

1. INTRODUCTION

As the urban population and incomes increase, need for every basic facility such as water, transportation, sewage treatment, housing will increases. There are many conflicts like parking, adequate water supply, improper sanitary system, light and ventilation at Kalidas Kalamandir, Nashik. These problems can be solved by proper methods of rehabilitation. To improve the quality, use of sustainable material and different methods of rehabilitation are used. As cost of retrofitting is less than the reconstruction cost, the retrofitting is adopted, this shall also require less working time and much less dislocation[1].

There is limited use of retrofitting for the preservation of heritage structure, situated in the pilgrimage city of Nashik. The Kalidas Kala Mandir situated in the heart of Nashik city for more than forty years, is deteriorated and on the verge of becoming obsolete. Little research has been done on the use of sustainable material for retrofitting for such structures. In the smart city Nasik, the Gaothan area like Panchvati, Ravivar Karanja, Yashvant Mandai, Sita Gunfa are the old area of city. There are many problems like parking, Congested traffic, adequate water supply, improper sanitary system. And the deterioration of buildings also takes place. These problems can be solved by proper methods of retrofitting.

The use of retrofitting can apply in different types of buildings, industrial structures, bridges, urban transport structures, sanitation, and water treatment[2]. The advantages of these modifications are seen through the reduction in the loss of lives and damage of the essential facilities, and functional continuity of the life line structures. For an existing structure of good condition, the cost of retrofitting tends to be smaller than the replacement cost. Thus, the retrofitting of structures is an essential component of long term disaster management than a restructuring.

2. METHODOLOGY

In India the governments launch the smart city program, in which the various sector of smart city. In this the one of sector of smart city is to preservation of heritage of given smart city. In this investigation to identify the area of retrofitting in Nashik city. Nashik city are one of historical and devotional city, therefore the various old structure are situated in city. This structure preserve in smart city are one of challenge, therefore to preserve this structure to find the solution. The retrofitting is one of best solution for preservation of this structure.

In this investigation to find one of the case studies of Nashik. The Kalidas Kala Mandir are one of this structure and to preserve this structure. In this research to find the various method of retrofitting using sustainable material. To study the Kalidas Kala Mandir tender and to developed this structure using sustainable material. In this research the various sustainable material find and to study this material properties and there environmental benefit for development of sustainable retrofitting structure.

a. Concept of Retrofitting

Retrofitting is technical interference in structural organization of a building that raise the resistance to earthquake by enhancing the strength, ductility and earthquake loads. Retrofitting is needed when the analysis of structural capacity results in insufficient capacity to resist the forces of expected intensity and acceptable limit of damages.

b. Retrofitting Process

The retrofitting of a structure involves improving its performance under loadings through one or more of these following measures:-

1. Columns
2. Beams
3. Bracings
4. Walls
5. Foundation
6. Horizontal diaphragms
7. Joints between structural elements
8. Masses
9. Period of vibrations

c. Various Techniques of Retrofitting

1. Inserting structural elements
2. Implementing horizontal and vertical belts (iron wire mesh) in masonry building
3. Jacketing of structural elements for RC elements (Beam and Column)
4. Strengthening roof trusses and roof diaphragms
5. Strengthening Concrete Diaphragm
6. Strengthening techniques for continuous or strip wall footings
7. Decreasing Demand on Existing Building
8. Retrofitting of Non-Structural Components

3. SUSTAINABLE MATERIAL AND TECHNIQUE

In this section to study the sustainable material and technique are used for Kalidas Kalamandir Nashik.

a. Sustainable Materials

i. Fly ash-

Fly ash brick (FAB) is a building material, masonry units, containing class C or class F fly ash and water. The manufacturing method of fly ash helps in saving energy, reducing mercury pollution, and costing 20% less than traditional clay brick manufacturing.

TABLE I. THE RAW MATERIALS

Sr no	Material	Mass
1	Fly ash	60%
2	Sand/stone dust	30%
3	Ordinary Portland Cement/(Lime+Gypsum)	10%
4	Total materials	100%

The strength of fly ash brick of above compositions is normally of the order of 7.5 N/mm2 to 10 N/mm2. Fly ash bricks are lighter and stronger than clay bricks.

ii. Autocleved areated concrete(AAC)

Autoclaved aerated concrete (AAC), also known as autoclaved cellular concrete (ACC), autoclaved lightweight concrete (ALC), autoclaved concrete, cellular concrete, porous concrete, Aircrete, Hebel Block. It is porous, non-toxic, reusable, renewable and recyclable. ACC blocks and panels are manufactured using fly ash mixed with cement, lime, water and an aerating agent.

Properties of AAC-

- Lightweight
- Thermal Insulation
- Fire Resistant
- Termite Resistance
- Sound Absorption
- High Strength to weight Ratio
- Earthquake resistant
- Enviro-friendly
- Green Building Material
- High dimension accuracy and uniform surface
- Water penetration
- High Workability
- Economical
- Energy Efficient.

iii. Flyoplast (Ready Mix Plaster)

FLYO PLAST is a Ready Mix Cement base plaster with high quality polymer additives. It can be used on inner and outer walls. It can also be used efficiently on brick, block, stone walls as well as concrete surface. FLYO PLAST gives even surface on which tiling also can be done faster and efficiently.

Technical Specifications-

- Color: Grayish granular powder
- Binder: Cement
- Additives: workability, bond strength improving polymers.
- Aggregates: silica confirming to IS.
- Bulk Density: 1.2 to 1.6 Kg/liter unit
- Thickness of layer: 6-12 mm
- Coverage: 15-20 sq.ft./40 kg bags.

1) Tripal glazed window

This type of window generally has three sheets of glass, and each glass is separated by a suitable air gap. The gaps between the glass provide the insulating membrane that slow down the heat loss and slower down the chance of condensation. This window is a widely acceptable solution forhome improvement and is marketed as an environmental friendly option.

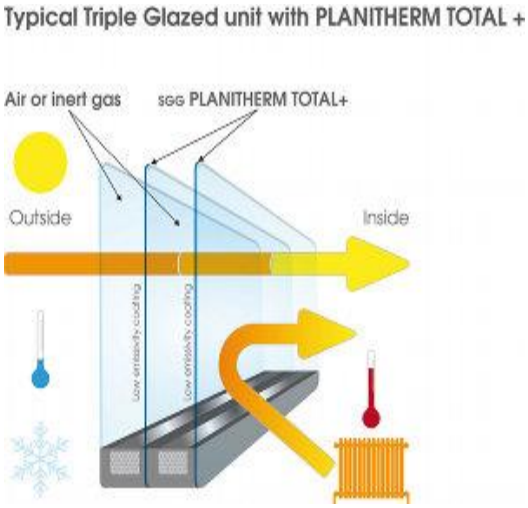

Fig. 1. Triple glazed window

This environmentally friendly product has the following advantages:

- It is energy efficient, durable and have low maintenance requirements;
- Is free of ozone-depleting chemicals, toxic compounds and that is manufactured without any toxic by-products;
- Is made from or contains recycled materials or is made from renewable or sustainable resources;
- Has been locally manufactured;
- Is biodegradable or can easily be recycled.

2) Recycle steel

Steel is one of the most durable building materials in the world. The steel industry has grasp a common sense approach that controlling its impact on the environment is not only the right way to do, but it also makes economic sense.

The steel industry has made being a green builder nearly effortless. Sustainability, that term you hear so much these days is one of the hallmarks of steel construction. Steel is the only material used in construction today that can be 100% recycled and re-used.

3) Sustainable concrete

Squander and supplementary establishing materials, for example, fly fiery remains, impact heater slag, silica rage, rice husk cinder and metakaolin can be utilized as halfway trades for Portland concrete. These materials can enhance solid sturdiness, decrease the danger of warm splitting in mass cement and are less vitality and CO2-serious than bond. The utilization of high volumes of fly fiery remains and other supplementary cementitious materials is to create more reasonable and sturdy cement. A noteworthy extent of cement delivered today contains supplementary cementitious materials (SCMs) as a feature of the aggregate cementitious segment or folio.

4) Cellulose insulation

This is plant fibre used in wall and roof cavities for insulating draught proof and reducing noise. Cellulose is the oldest types of building insulation material, including newspaper, cardboard, cotton, straw, sawdust, hemp and corncob, many other types of cellulosic materials also have been used.

b. Sustainable Technique

i. On grid solar power generation-

Solar power has been rapidly overburdened as a sustainable construction technology. It is been utilized in two ways in green construction. One as active solar power and the other as passive solar power. Active solar power is a solar systems that absorbs the sun's radiation to avail the heating and electricity provision, thus reducing the need for the use of electricity or gas.

Despite the fact that the forthright establishment costs are higher, in long haul it winds up in saving money on vitality bills and helps in decreasing ozone harming substance outflows from non-sustainable power sources like petroleum derivatives. Utilizing the sun's beams to warm homes through the key arrangement of windows and the utilization of warmth engrossing surfaces is finished by aloof sun oriented power. The windows let in vitality and the warmth assimilated decreases the requirement for warming the house amid icy periods, for example, winter.

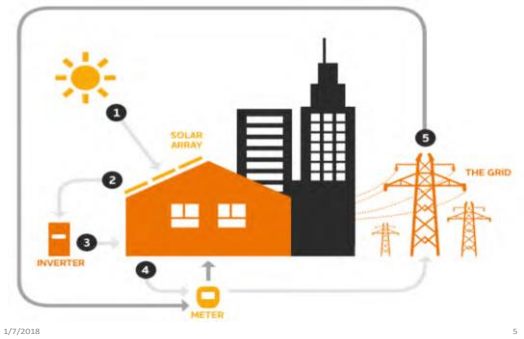

Fig. 2. System of on grid power

3. RATE ANALYSIS

In rate analysis we have to done rate analysis of above material with conventional material. In this session we can to select the tender material and to their alternative sustainable material. Selecting the various tender materials and their alternatives sustainable material to find out unit cost of each material. After find unit costs compared with tender quantity and find the total amount of each material.

TABLE II. ANALYSIS FOR BRICK WORK

Sr. No	Description of Material	Unit	Total Quantity bricks work in tender	Pre Cum Quantity	Total quantity (number)	Unit Rate	Total Amount
1	Conventional bricks	Cum	32.842	500	16421	4.50	73894
2	AAC	Cum	32.842	64	2102	47.65	100160
3	Fly ash bricks	Cum	32.842	500	16421	4.20	68968

TABLE III. ANALYSIS OF MORTAR FOR PLASTER

Sr. No	Description of Material	Unit	Total Quantity of plaster in tender	Pre Sqm Rate	Total Amount
1	Mortar	Sq m	1312.82	67	87958.94
2	Mortar with 20% of replacement of Pond ash	Sq m	1312.82	61	80082.02
3	Flyoplast	Sq m	1312.82	86	112902.52

TABLE IV. ANALYSIS OF MORTAR FOR BRICK WORK

Sr. No	Description of Material	Unit	Total Quantity bricks work in tender	Pre Cum Quantity of mortar	Total quantity of mortar	Rate per Cum	Total Amount
1	Mortar	Cum	32.842	0.3	9.8526	872	8292
2	Mortar with 20% replacement of Pond ash	Cum	32.842	0.3	9.8526	788	7764

TABLE V. ANALYSIS OF TRIPLE GLAZED WINDOW

Sr. No.	Item	Unit	Tender quantity	Rate per Sq. m.	Total amount
1	Aluminum sliding window	Sq.m.	161.4	3228	520999
2	Triple glazed window(UPVC)	Sq.m.	161.4	5380	868332

TABLE VI. ANALYSIS OF CONCRETE

Sr. No	Item	Unit	Tender Quantity	Rate per Cu. m.	Total Amount
1	Concrete	Cu M	292.6	4200	1228920
2	Concrete with 30% replacement of pozzocrete	Cu M	292.6	3360	983136

4. CONCLUSION

From the above study by using various retrofitting techniques we can preserve the historical monument and heritage structure in the city.

By studying various sustainable material used for retrofitting environmental sustainability can maintained.

From above research by using sustainable material cost can be controlled and can achieve economy of structure.

By using recycled material in construction we can control the emission of greenhouse gases in environment.

In this research by selecting the sustainable material we can save the overall cost of retrofitting and to reduce the environmental impact by reducing carbon emission.

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