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Retrofitting of Institutional Building into Green Building

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Abstract – Retrofitting can be defined as changing, modifying certain parts, aspects of a structure with new or better parts which will prove to be beneficial for the user of the building & building itself. In a similar sense, Green Retrofit can be done by changing certain parts of building that damage the environment and changing it with sustainable alternatives which will increase the life of the building and reduce the life-cycle cost of the same. This can also be achieved by undertaking many practices which not only enable conservation the natural resources but also enable us to enhance the environment and contribute towards adopting & encouraging sustainable construction practices green materials recycled materials for which the cost for construction and installation have also been measured. This concept of retrofitting benefits from making use renewable sources of energy and making it the primary source, such as the making use of sunlight and converting it into electricity. Costs and benefits of such retrofit, comparisons between the two systems are used in the cost-benefit study.

Keywords – Green Building; Retrofit; Energy Conservation; Cost-benefit analysis; Renewable energy;

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1. INTRODUCTION

1.1 General

Retrofitting is defined as the addition of new features to the buildings, different structures, bridges etc. & help to increase resistivity, strength & overall lifespan of the structure. Retrofitting an existing building can prove to be one of the most environmentally sustainable, cost-effective method for enhancing & upgrading building quality & living standards, it can also help to prolong the life of existing buildings. Implementation of retrofits of building and industries and converting the same should be promoted. Further analysis has been carried out in order to provide a complete range of quantitative data on the direct and indirect impacts of retrofitting on the environment, the cost differences between retrofitting with traditional structural design, the cost of maintenance as well as the effect on end users and the surrounding area of the modified structures. A 'green' building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life.

1.2 Necessity of Retrofitting

There are 3 major factors which influence the need of retrofit installation:

- Power saving If energy prices continue to increase, the comparative benefits of energy power will become increasingly vital.
- Improved productivity of workers from a business viewpoint, there will still be strong motivation to improve the performance of employees.
- Positive effects on health and well-being of workers A number of studies have demonstrated that using green retrofitting provide the workers with a view that involves more natural landscapes will advance well-being.

1.3 Objective

AIM

the main function in the prevailing building to make it 3 star rated green building whether LEED rated or IGBC rated or applying mixed parameters enlisted by them.

OBJECTIVE

- To apply the concepts & parameters of green retrofitting which are found suitable & feasible coming out of our literature.
- To suggest effective green retrofitting methods certified by paramount green rating

systems such as IGBC and LEED, which can be adopted by the various corporation and house owners and help in their decision making.

- To analyse the cost effectiveness of institutional building retrofitting by means of a cost benefit analysis and give a clear picture about the idea of going for such a retrofit.

2. LITERATURE REVIEW

Nushrat and Saad Bin (2017) stated the economic and social benefit of green building. Aspects of green building were studied and SWOT analysis was done. In financial analysis, the total economic cost and non-monetary cost are calculated. The excess cost for construction of green building was calculated. It is theoretically possible to calculate the relative benefits of green building.

Claudio Favi et al., (2018) stated new & organized approach to address uncertainty and sensitivity analysis in Life Cycle Assessment (LCA) for the decision- making process in building renovation. The paper proposes a probabilistic LCA approach for building retrofit measures through a simplified case study of building renovation, involving interior insulation as retrofitting measures.

Muhammad Khairi et al., (2017) stated the importance of retrofitting the existing building to green building to reduce the dependency on constructing new buildings. They discussed the application, benefits and disadvantages of retrofitting an existing building. Retrofitting is one of the most environmentally friendly and effective solutions to improve the energy performance of building.

Hadas Gabay et al., (2014) stated the questions by developing a cost benefit model based on voluntary green building standard, and focusing on office buildings of different sizes and standards. They estimated the best alternative leading to maximum savings in resources use, and the economical alternative, which minimizes initial investment.

Eugen Mitrica (2019) stated the cost benefit analysis methodology for retrofitting investments. For large scale implementation of green building retrofitting a large volume of investment is required. We need to compare the future flow of yearly energy savings with the investment. The benefits created by saving the energy and consequently reducing the carbon foot print, can be very attractive.

A. Sharma et al., (2013) has studied existing building of central Library of Indian Institute of Technology Roorkee which was studied and recommendation of retrofit options for sustainable aspects such as site planning, energy and water use, materials and resources and indoor environment quality was given. Green retrofit measures with payback in 5 years or less can reduce energy use and carbon emission by 40 %.

Binoy and Sharadindu (2017) stated the sustainable development implies fulfilling the needs of the present without negotiating the ability of the future needs. They studied the amount of electricity generated by renewable energy. This paper suggests us the various alternatives by which we can retrofit the existing buildings considering cost parameters.

Alok Thacker and Deepa Joshi (2018) carried out green audit in existing educational complex and provided suggestions for green retrofitting using LEED rating system. Cost analysis has been carried out for application of proposed measures for the green retrofitting measures. The repayment time of the investments has been evaluated.

Nandish Kavani & Fagun Pathak (2015) studied the retrofit of an existing building into a green building taking into account the characteristics of energy, water and materials along with cost considerations in accordance with the rating system of LEED and suggested measures to improve the green performance of the building for efficiency.

Mohd. Ahmed & Mohd Abul Hasan et al., (2018) stated the comparison between the world green building rating systems and presents an insight into green building rating systems aspects and motives. To qualify the building green or sustainable, the developed and developing countries have their own rating systems and certification methods.

Stefano Cascone (2018) states that to improve the energy performance of existing buildings, the retrofit with green roof is an effective solution. This study through active thermal simulation estimates the extent of energy savings originating by the use of two different types of green roofs applied on the flat roof of a multi-storey residential building.

3. METHODOLOGY

Introduction

Among the sources of waste production, the construction sector prevails, so the need for a well-organized waste management system, disposal system and resource recycling is expected. Not only has the heavy use of electrical equipment contributed to the extinction of energy sources, but it has also had a significant influence on the welfare of living beings. Water may not be the issue in this current situation but in future will prove to be a problem of maximum concern leading to unbalanced energy distribution throughout. So there is earnest need of water conserving systems in a house. Retrofit installation could lead to the abovementioned issues being rectified. The need for alertness among the public for active green

buildings could lead to their demand for more environmentally friendly buildings

3.1 Study of Parameters

Selection of the parameters was the crucial part of our thesis work as these selected parameters we were going to use for the retrofitting of the whichever building we choose for our study & implement all these parameters on that building. Efficiency of site planning and building design, efficient water and waste management for reducing water usage and waste. enhancement of indoor environment quality like indoor air and thermal quality, efficiency in selection of sustainable materials for construction, etc. all these things had to be studied thoroughly which selecting the parameters.

3.2 Selection of Case Study

During the internship at Life Republic by Kolte-Patil developers I found out that the monthly consumption of the power by the selected case of institutional building is high which is why we decided to take this study to analyse the overall power consumption & select the green parameters which will reduce the power consumption of this building with green technology increasing the lifespan of the structure

3.3 Data Collection & Data Analysis:

All the primary data was collected such as plans, drawings, electric bills and water bill. From the business development manager. As he guided through the deficiencies while constructing the institutional building, we were able to grasp these deficiencies and started working on them to make the structure more durable with the help of green parameters. Once we received the data then we analysed & understood the data by material readings & drawing study of the different floors, sections, elevations & views.

3.4 Selection of Feasible Parameters:

Selection of parameters is one of the important tasks which were done after thoroughly studying all the general parameters. Out of all the parameters studied we found the most feasible parameters for our study.

3.5 Cost Calculation:

While calculating the cost of implementing these parameters we decided to go mostly for the local material so that it will be easily available in a less cost. All the financial benefits of applying the green parameters in a structure were identified & calculated to understand the payback period of the initial cost which we are paying. The financial benefits from green building assessments include tangible benefits, such as savings due to improvements in energy efficiency, reduced water use, materials use and waste. Intangible benefits include improvements in productivity in workplaces, better health and comfort in residential settings, reduced burdens on infrastructure, etc. These tangible benefits depend not only on which performance enhancements were confirmed by the assessment but also on the persistence over time of the measures introduced.

3.6 Cost Benefit Analysis:

At the end we performed a cost benefit analysis of the conventional building vs. the retrofitted green structure to understand the actual cost savings. These cost savings clearly tells us the financial benefits of the implementation of our parameters into the structure. Energy efficient building saves money, reduces financial risk from rising energy costs, and is a proven best practice among leading companies. So after the implementation it was clear that the cost savings were more compared to the conventional structures

3.7 Case Study Details

- Chosen Case Study: School Building
- Area: Jambe, Hinjewadi, Pune
- Developer: Kolte Patil Developers
- Township Name: Life Republic Township
- Architect: Space Designers Syndicate
- School Name: ANISHA GLOBAL
- School Playground: 18322.39SQM
- School Area: 19441.71SQM
- No. of Classrooms: 44

4. RESULT AND DISCUSSION COST BENEFIT ANALYSIS

Table: Cost Benefit Analysis

Energy Efficiency				
Sr. No	Parameters	Before Retrofit (kWh)/Month	After Retrofit (kWh)/Month	Saving/Profit (Rupees)
1.	Energy Consumed	7464.70	0.00	58693.20/ Month
2.	BLDC Fans	88.15	35.28	18715.28/ Month
3.	LED Fixtures	61.74	36.26	12836.00/ Month
4.	Photovoltaic Panels	0.00	6300.00	7293.00/ Month DD

Water Efficiency				
Sr. No	Parameters	Before Retrofit Liters/Day	After Retrofit Liters/Day	Saving/Profit (Liters)
1.	Low Flow Fixtures	32413.00	15054.40	17358.6
2.	Rain Water Harvesting	0.00	444371.00	444371.00

TOTAL INSTALLATION COST

1	Photovoltaic Panels	7,50,000
2	Brushless DC (BLDC) Fans	5,04,000
3	LED Lighting	10,440
4	Low Flow rate Fixtures	3,40,000
5	High solar reflective index - Aluminium paints	2,29,300
6	Low U Factor - UPVC Double Panel Windows	2,13,120
7	Grass pavers	6,22,205
8	Vertical gardening	1,98,112
9	Rainwater Harvesting	2,63,000
	Total Cost	**31,30,177**

5. CONCLUSION

Study is established from the following:

1) Study of research papers based on retrofitting of old buildings into green building.

2) Study of case papers, literature reviews & future scope of the research papers.

3) Selection of suitable real scenario case for the project work.

4) Collection of secondary data from the school building

5) Analysis of the data & calculations made from the available data

From the data analysis & cost benefit analysis done in the project clearly states that around 1,00,000/- can be saved every year if we implement the green retrofit methods stated above in the project. Also, the life of the building will increase with the increase in the building efficiency. This green retrofit can be implemented in every re-development project & it will make huge profits to the owner with a payback period of solar panel system is 8.5 years.

Environmental benefits of green buildings are well recognized. The report is talking about green building economic benefits. We have proposed retrofitting of a school building on 9 parameters namely Photovoltaic panels, Brushless DC (BLDC) fans, LED lighting, Low flow rate fixtures, Aluminium Paints, UPVC double panel windows, Grass pavers, vertical gardening and rainwater harvesting. The proposed total cost incurred for retrofitting is 31, 30,177/-

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