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CONVERSION OF EXISTING CONVENTIONAL BUILDING TO GREEN BUILDING USING SIMPLE VERSATILE AFFORDABLE GREEN RATING FOR INTEGRATED HABITAT ASSESSMENT AND COST ANALYSIS

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ABSTRACT
Present world is demanding sustainable practises in all walks of life and construction industry is not different. The sustainability concept in construction industry has come a long way but still there is need for new developments and inventions. One of the key aspect of sustainable construction is the concept of green buildings. It is the type of buildings that are environment friendly as well as resource efficient. There are several systems for assessing the green building and rating them accordingly. In India, there exist 3 major rating systems but all of these systems only account for very large buildings or small commercial buildings. This research focus on trying to accommodate a small existing residential building into the framework of one of the rating systems SVAGRIHA (Simple Versatile Affordable Green Rating for Integrated Habitat Assessment) for converting the partly conventional building into green building. The building condition was analysed and green building concepts were recommended. A simple cost analysis for the additional works and systems were also done to show the economical aspect of conversion to green building. A set of recommendation to better the green building rating systems as well as for administrative level were given.

2. INTRODUCTION

2.1. Green Building Concept

Construction industry has both negative and positive impacts on the environment, economy and society. According to estimates buildings consume more than 30% of energy utilizing 40% of resources while simultaneously generating 40% of wastes and 35% of harmful green-house gases (Mane 2017). Green building is the practice of creating structures and using processes that are environmentally responsible and resource efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building (Choudhary, 2018).Green buildings preserve precious natural resources and improve our quality of life.

There are a number of features which can make a building 'green'. These include:

- Efficient use of energy, water and other resources
- Use of renewable energy, such as solar energy
- Pollution and waste reduction measures, and the enabling of re-use and recycling
- Good indoor environmental air quality
- Use of materials that are non-toxic, ethical and sustainable
- Consideration of the environment in design, construction and operation
- Consideration of the quality of life of occupants in design, construction and operation
- A design that enables adaptation to a changing environment (worldgbc.org)

2.2. Green Building Rating Systems

Rating systems are a type of building certification system that rates or rewards relative levels of compliance or performance with specific environmental goals and requirements.Green

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building rating and certification systems require an integrated design process to create projects that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition.(Vierra, 2019). There are several rating systems in the world, the top 4 systems are, LEED, Green Globes, Green Star and BREEAM (Portalatin, 2015).

2.3. Green Building Concept in India

The movement of Green building in India began in the year 2001, with the establishment of IGBC (Indian Green Building Council) by Confederation of Indian Industries (CII) in cooperation with USGBC and Green building council of the world (Mane, 2017). According to IGBC as on 3rd November 2021 more than 7,002 Green Buildings projects coming up with a footprint of over 7.97 Billion sq.ft are registered with the Indian Green Building Council (IGBC), out of which 2,344 Green Building projects are certified and fully functional in India.In India there are 3 main green building rating systems. They are LEED (Leadership in Energy and Environmental Design), IGBC green rating and GRIHA (Green Rating for Integrated Habitat Assessment). The problem with all these systems is that none of them account for small residential existing buildings. There are no existing provisions in these systems to give a rating for converting an existing residential building of less than 2500 sq.m to a green building. This study aims at bringing light to such a conversion using a subdivision rating system of GRIHA which is called SVAGRIHA for small constructions. Here the standards of SVAGRIHA was used to try and convert a residential home to green building and do a cost analysis of the additional works to be carried out to get a SVAGRIHA rating.

3. LITERATURE REVIEW

Aishwarya Kodnikar et al (2018) conducted an analysis for green retrofitting of a residential building and conducted a survey on total 6 flats about its water consumption and energy consumption. It was used to suggest green building concepts on the existing building like energy conservation,renewable energy systems, water conservation methods etc. Pooja Choudhary et al (2018) studied an existing 4 storey building in Jaipur, Rajasthan and suggested concepts like suitable vermin compost system, methods of gardening and aluminium paint use and installation of concrete pavers to convert the building to a green building. Laxman Jadhav et al (2019) carried out a comparative study between the green building rating systems LEED, BREEAM and GRIHA and recommended a unique system which is less complicated than the existing system and suggested that there is a need for proper rating system for existing buildings. Jayesh C. Naik et al (2020) conducted an analysis of the SVAGRIHA rating system to be applied on a building in Thane and recommended additions and changes in order for the project to be constructed to get a SVAGRIHA rating of 4 stars. Ravi Gupta (2021) compared a conventional building with green building using the GRIHA criterions and suggested changes like using BEE star rated appliances, solar power plant, installations of smart meters etc. to the conventional building so that it could be converted to green building.

4. RESEARCH METHODOLOGY

4.1. Selected building's details

It is a single floor, residential building of area 120.774 sq. m with concrete pavements around and vegetation in the backyard. It is 15 years old brick masonry building with metal window frames and wooden doors.

4.2. SVAGRIHA rating system

Since there is no existing system for evaluation of a small residential building of area less than 2500 sq.m, the SVAGRIHA rating system was adopted for the study. It is a guidance-cum-rating system for small standalone structures like residential buildings, commercial offices, motels, dispensaries, schools etc. with a cumulative built up area less than 2500 sq.m. It was developed to reduce the environmental impact of small developments. It is a simple tool with guiding parameters that evaluate the performance with respect to the SVAGRIHA. It has around 14 criteria and are divided into 5 broad categories: architecture & energy, water & waste, materials, landscape and lifestyle. There are some mandatory sections in the criterions. The total points one can achieve is 50 and the rating ranges from 1-5 stars (SVAGRIHA manual, 2013).

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Table 1. SVAGRIHA Criterion point distribution (SVAGRIHA manual, 2013)

Criterion number	Criterion name	Points
1	Reduce exposed, hard paved surface on site and maintain native vegetation cover on site	6
2	Passive architectural design and systems	4
3	Good fenestration design for reducing direct heat gain and glare while maximising daylight penetration	6
4	Efficient artificial lighting system	2
5	Thermal efficiency of building envelope	2
6	Use of energy efficient appliances	3
7	Use of renewable energy on site	4
8	Reduction in building and landscape water demand	5
9	Rainwater harvesting	4
10	Generate resource from waste	2
11	Reduce embodied energy of building	4
12	Use of low-energy materials in interiors	4
13	Adoption of green Lifestyle	4
14	Innovation	2
Total		50

Table 2. SVAGRIHA Rating

Points achieved	SVAGRIHA Rating
25-29	★
30-34	★ ★
35-39	★ ★ ★
40-44	★ ★ ★ ★
45-50	★ ★ ★ ★ ★

4.3. Analysis of Existing Building

The SVAGRIHA rating evaluation was carried out in the existing building by checking the existing systems and conditions manually and points were awarded as per the manual. The criterions which are applicable were found out and suggestions were made for acquiring the required points.

4.4. Cost Analysis

For the existing building to be converted to green building many additions were required, so the average and general costs of the additions were calculated and feasibility checked. The prices and costs for various items and system installations was taken from the pricing information available online in various sites.

5. RESULTS AND ANALYSIS

5.1. Present condition and rating of building

The evaluation carried out on the building gave a result of only 14 points and some of the mandatory criterions were not met. So no ratings were given. Accordingly additions and changes were suggested for the building. The changes are as follows

- Change all the appliances to BEE star rated appliance for better energy efficiency.
- Installation of solar energy system on roof for renewable energy generation as well as for solar water heating.
- Incorporating low flow fixtures to reduce the water consumption in the building

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- A rainwater harvesting system for building use as well as for aquifer recharge.
- Zero waste concept applied by installing vermin compost system in the plot.
- Change the window frames to low energy materials
- Practise organic farming in the backyard as part of green lifestyle.

The changes suggested bring the total points of the building to 33 points earning a 2 star rating in SVAGRIHA.

5.2. Cost analysis of the additions

Change	Particulars	Quantity	Average Rate	Assumed Rate	Total Cost
Converting appliances to BEE rated	➢ Fan	4	1500	6000	6000
Solar Systems installations	➢ Solar energy system- 1KW ➢ Solar water heater (15Ltr)	1 1	45000-85000 10000	65000 10000	65000 10000
Low Flow fixtures	➢ Flush Valve ➢ Sink mixer ➢ Basin tap ➢ Bath tap ➢ Shower head	3 1 5 3 3	3500-5000 2500-5000 2500-5000 5000 3000-5000	4500 4000 4000 5000 4000	13500 4000 20000 15000 12000
Rainwater system	➢ Installation for 300sq.m	1	30000	20000	20000
Waste recycle	➢ Vermi composting system	1	25000	25000	25000
Low energy interior	➢ Vinyl window frames	162.75 sq.ft	320/sq.ft	52080	52080
Total					242580
additional	Unseen charges			10%	24258
TOTAL					266838

Total additional cost of conversion is about 270000 for the said building.

6. CONCLUSION

In this research paper an attempt was made to rate an existing residential building using the SVAGRIHA green building rating system. The various criterion were studied and additions and changes needed to convert the building to green building were identified. Lastly a cost analysis was done for the additional charges for the conversion to understand how economical the conversion will be.

The research showed that conversion of small scale existing residential building to a green building is indeed practical and is possible. But there is a lack of accurate rating system that can accommodate such a conversion. The study even though was on a particular case it could be extended to other such buildings as well. More researches in the subject is required and more simplified rating system with guidelines are yet to be developed.

7. RECOMMENDATIONS

The study gave way for understanding several aspects of green building concept as well green building rating system. The key suggestions and recommendations are:

- Need for a better and inclusive green building rating system in India that can accommodate small scale existing residential buildings
- More choices on the green building materials, there is need for more affordable green building supporting materials like low flow fixtures and paints.
- Government currently giving subsidies to solar power plants on roof but the government incentives must cover more of the green building materials and systems.
- Local government needs to focus more on green building awareness and offer incentives for the home owners in form of tax relaxations.

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