GREEN BUILDING CONSTRUCTION PRACTICES FOR RESIDENTIAL STRUCTURES
Problems and Feasible Solutions

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Abstract : The Building sector in India is growing at a rapidly. There is a need for introducing green concepts and techniques in this sector which will help to address issues like water efficiency, energy efficiency, handling of waste, conservation of natural resources, etc. The Indian Green Building Council (IGBC) is at the forefront in introducing green concepts and techniques in the construction sector. The main aim of this article is to study the norms specified by the IGBC in "IGBC Green New Buildings Rating Systems". Primarily, all the norms with regards to actual site activities and practices were identified. A study of the IGBC certification process was carried out. Subsequently, a detailed study of the IGBC norms for the construction of new green buildings was conducted. Obstacles in fulfilling the norms of the IGBC on site were identified by conducting site visits. After identifying the problems with the execution part, solutions to the problems were formulated and compressed into the form of a training module. These solutions include charts and formats to be implemented on the sites. This study draws the conclusion that the problems arising on site during the construction of a green building can be sorted out with ease with the help of proper planning and meticulous efforts of execution.

Index Terms **– Green Buildings, construction, execution.**

I. INTRODUCTION

Green building refers to both the structure and processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to demolition. Basically, green building design involves finding the balance between homebuilding and the sustainable environment. This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages. [1] The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. [2]

Leadership in Energy and Environmental Design (LEED) is a set of rating systems for the design, construction, operation, and maintenance of green buildings which was Developed by the U.S. Green Building Council. Other certificates system that confirms the sustainability of buildings is the British BREEAM (Building Research Establishment Environmental Assessment Method) for buildings and large-scale developments. Currently, World Green Building Council is conducting research on the effects of green buildings on the health and productivity of their users and is working with World Bank to promote Green Buildings in Emerging

Markets through EDGE Excellence in Design for Greater Efficiencies Market Transformation Program and certification.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective of green buildings is to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation [2]

A similar concept is natural building, which is usually on a smaller scale and tends to focus on the use of natural materials that are available locally. [3] Other related topics include sustainable design and green architecture. Sustainability may be defined as meeting the needs of present generations without compromising the ability of future generations to meet their needs. [4] Although some green building programs don't address the issue of the retrofitting existing homes, others do, especially through public schemes for energy efficient refurbishment. Green construction principles can easily be applied to retrofit work as well as new construction.

Green building brings together a vast array of practices, techniques, and skills to reduce and ultimately eliminate the impacts of buildings on the environment and human health. It often emphasizes taking advantage of renewable resources, e.g., using sunlight through passive solar, active solar, and photovoltaic equipment, and using plants and trees through green roofs, rain gardens, and reduction of rainwater run-off. Many other techniques are used, such as using low-impact building materials or using packed gravel or permeable concrete instead of conventional concrete or asphalt to enhance replenishment of ground water.

While the practices or technologies employed in green building are constantly evolving and may differ from region to region, fundamental principles persist from which the method is derived: siting and structure design efficiency, energy efficiency, water efficiency, materials efficiency, indoor environmental quality enhancement, operations and maintenance optimization and waste and toxics reduction. [5][6] The essence of green building is an optimization of one or more of these principles. Also, with the proper synergistic design, individual green building technologies may work together to produce a greater cumulative effect.

On the aesthetic side of green architecture or sustainable design is the philosophy of designing a building that is in harmony with the natural features and resources surrounding the site. There are several key steps in designing sustainable buildings: specify 'green' building materials from local sources, reduce loads, optimize systems, and generate on-site renewable energy.

II. WORK DONE

The IGBC has specified a list of criteria to fulfil in order to achieve green building certification [7]. These criteria carry specified number of points. The fulfilment of these credits will help to create a green building.

In the present study, the criterion is studied in detail and the criterion related to site activities are segregated.

In order to identify the problems in the implementation of these criterion on site a case study on a residential building in Ravet near Pune was undertaken. Considering the conditions on this site, possible solutions are proposed for various problems.

In this paper, the problems in implementation of IGBC criterion on site and possible solutions are presented.

The following are the criteria specified by the IGBC, along with the problems that arose at the site and their solutions are as follows:

a. SSP CREDIT 5: Preservation & Transplantation of Trees. (Points: 1)

IGBC Requirement:

- Case1: Preservation or Transplantation of Existing Trees: At least 75% of existing fully-grown trees should be preserved or transplanted within project site/campus
- Case 2: Plantation of Tree Saplings: Plant tree saplings that can mature into fully grown trees within the next 5 years

Problems Faced on Site While Executing This Requirement:

- No awareness regarding this requirement
- Lack of interest owing to extra time and money to be spent on preservation of the trees
- Constraints of space to preserve or transplant trees
- Building design made without consideration for location of trees on proposed work site

Possible Solutions to The Problems:

- Create a log of all trees on the site (Classify trees based on size as small, medium, large)
- Check which of the trees can be transplanted on the premises of work site
- Ensure that design of structure is such that it does not require annihilation of the available greenery
- For fully grown trees, provide a fence around the circumference of the trees' canopy with bright colored flags.

b. SSP CREDIT 10: Basic facilities for Construction Workforce (Points: 1)

IGBC Requirement:

Provide basic facilities for construction workforce to exceed the guidelines of 'The Building and Other Construction Workers Act, 1996 & Rules, 1998'.
Adequate housing to meet or exceed local / labour byelaw requirement.
Sanitary facilities:

- Provide at least 3 toilet seats & 3 urinals for the first 100 workers and one additional toilet seat & urinal for every 100 workers thereafter (or) as defined by local / labour byelaw. (The sanitary measures should be provided separately for men and women).
- First-aid and emergency facilities.
- Adequate drinking water facilities.
- Personal protective equipment (by owner / contractor).
- Dust suppression measures.
- Adequate illumination levels in construction work areas.
- Site emergency alarm.
- Day care/ crèche facility for workers' children.

Problems Faced on Site While Executing This Requirement:

- No awareness regarding basic facilities to be provided
- Lack of interest owing to extra time to be spent for providing the facilities

- Economic constraints to set up the facilities
- Space constraints to set up facilities
  Project planning done without considering the basic facilities to be provided

Possible Solutions to The Problems:

- Understand the basic facilities needed for the workforce (for male & female workers separately)
- Include all specified facilities in site planning
- Allocate adequate funds for execution of this requirement
- Specify location for setting up the facilities on site at the time of planning
- Consider basic facilities such as Toilets, washing areas, clean drinking water, resting area, safe and stable shelters, etc.

c. BMR CREDIT 3: Handling of Waste Materials During Construction (Points: 1)

IGBC Requirement:

- Demonstrate that at least 75% of waste generated during construction (as per owner / developer's scope) is diverted from landfills, for reuse or recycling. Use consistent metrics, either weight or volume, to show compliance.
- The project is eligible for Exemplary Performance under ID Credit 1 - Innovation in Design Process, if at least 95% of waste generated during construction (as per owner / developer's scope) is diverted from landfills, for reuse or recycling.

Problems Faced on Site While Executing This Requirement:

- Conventional practices of dumping in landfills
- Lack of awareness on alternate options of handling construction waste
- Fear of extra funds for handling waste materials
- Extra efforts and time invested to process and handle waste materials
- Increase in construction cost due to transportation process

Possible Solutions to The Problems:

- Use rubble and other such waste generated as filling material on sites
- Waste from demolition sites can be reused by undergoing some processing; e.g. crushed bricks can be milled to proper sizes to serve as aggregates, reinforcing steel can be recycled, other waste materials like crushed mortar can be used as rubble, excess of cement mix can be used as lean concrete paving, etc.

d. IEQ CREDIT 8: Indoor Air Quality Management, During Construction (Points:1)

IGBC Requirement:

Develop and implement an Indoor Air Quality (IAQ) management plan during construction and pre-occupancy phase, addressing the following measures, as applicable:

Note: Consider 'During Construction Indoor Air Quality Management Guidelines' from National Building Code (NBC) of India, Part 7 - Constructional Practices and Safety.

Problems Faced on Site While Executing This Requirement:

- Lack of awareness about requirement of maintaining air quality standards
- Inadequate measures to maintain required standards
- Ignorance about methods to measure Indoor Air Quality

Possible to Solutions to The Problems:

- Educate site officials about importance of IAQ
- Take measures to control pollution levels on sites
- Maintain regular logs to check air quality levels
- Purchase proper equipment to test air quality.
- Ensure that they are within specified ranges

III. CONCLUSION

This study highlights the important factors or credits required to be considered during construction, so as to get certification of a green building. Basically, all the site activities that need to be carried out to achieve a green building certification are highlighted here.

The various criterion such as Preservation & Transplantation of Trees, Basic Facilities for Construction Workforce, Waste water Treatment, Handling of Waste Materials During Construction, Use of Certified Green Building Materials, Products & Equipments, Indoor Air Quality Testing, After Construction & Before Occupancy and Indoor Air Quality Management During Construction are

the credits that need to be achieved on site during construction, in order to earn a green building certification. There are several different types of problems that arise on site during the execution of these criterion.
It may be noted that meticulous planning and scheduling maybe helpful in solving the problems that arise on the site. The engineers need to be pro-active and ensure that all the available options, to solve the problems arising on site, are explored.

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