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Parameters of Green Building Rating System and Application by Virtue of Architecture

[1]Kanchan Mahulkar, [2]Ar. Prof. Sanjay Deshmukh, [3]Ar. Prof. Pooja Boparikar, [4]Ar. Prof. Revati Mundhada

[1,2,3,4]Department of Architecture, P R Pote College of Architecture, Amravati, Maharashtra, India

[1]kanchanmahulkar21@gmail.com, [2]arch.sanjaydeshmukh@gmail.com, [3]ar.poojabaporikar@gmail.com, [4]armundhadarevati@gmail.com

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ABSTRACT

The term Green Building refers to a structure and using processes that are environmentally responsible and resource-efficient throughout a building's lifecycle. Research shows that Green Building improves tenants' satisfaction and health, enabling higher individual productivity in respective areas of expertise. As a result of the increased interest in Green Building concepts and practices, a number of organizations have developed standards, codes and rating systems conservation of water, energy, and building materials, and occupant comfort and health. In this project report we shall study the various design parameters of Green Buildings. The Green Building as a concept holds a key to sustainable development. Today many countries have adopted some form of a formal Green Building rating system or other. The Concept emphasizes the need to consider the regional and global effects of building and development, their Rating system. In this report we study the practical guide lines for developing site-integrated buildings and maintaining the ecological integrity of the site. assessment of existing natural and cultural site characteristics, existing infrastructure, and building requirements. Efficiency and Conservation suggests specific methods of protecting natural watersheds, reducing water usage and pollution, and setting up systems to use grey- and blackwater.

1. INTRODUCTION

Economic activities either affect or are affected by natural and environmental resources. Development without environmental considerations can cause serious long-term damage to the quality of life of present and future generations. Many studies worldwide have shown that the era of global warming has been accelerated due to human activity, a fact that is quite concisely summarized in the following information available on the website http://www.climatecrisis.net/, which is climate change initiative started by Al Gore, the ex-Vice President of United States, who set out the global warming issues in a stupefying film called —An Inconvenient Truth. The evidence is overwhelming and undeniable. We are already seeing changes. Glaciers are melting, plants and animals are being forced from their habitat, and the number of severe storms and droughts is increasing. If the warming continues, we can expect catastrophic consequences.

- Deaths from global warming will double in just 25years-- to 300,000 people a year
- Global sea levels could rise by more than 20 feet with the loss of shelf ice in Greenland and Antarctica, devastating coastal areas worldwide
- Heat waves will be more frequent and more intense
- Droughts and wildfires will occur more often
- The Arctic Ocean could be ice free in summer by 2050.
- More than a million species worldwide could be driven to extinction by 2050(Source.climatecrisis.net)

What is stated above is literally the veritable tip of the iceberg in terms of the evidence and data depicting the scale of crisis facing our world today. The major contributors to global warming are now well documented, and include among others manufacturing, transportation, land use change and forestry, electricity, heat, fossil fuel combustion and importantly construction sites as well as buildings.

There are varying estimates of the role of buildings and construction in the global warming phenomenon. Among the ones that stand out are the facts published by the United Nations Environment Programme (UNEP) Sustainable Building and Construction Initiative (2006) states the following: ―The building and construction sector represents over 111 million people directly employed worldwide with 75% in developing countries and 90% in micro firms (less than 10 employees). It contributes to approximately 10% of the global GDP with a worldwide annual investment evaluated at US $ 3,000 Billion.

Considering its entire lifespan, we know that the built environment is responsible in each country for:

- 25 - 40% of the total energy use
- 30 - 40% of solid waste generation
- 30 - 40% of Global Green House Gas Emissions (CO2, N20, CH4, HFC, PFC, SF6)

It is now a well proven fact that the built environment and construction sector is as much a contributor to the global warming phenomenon as are emissions from factories, transportation modes and other such factors. Fortunately, the Green Building movement is an affirmative step towards tackling climate crisis and the good news is that the stake holders in the building and construction sector worldwide have started acting on it.

The concept and Issues that come hand in hand with ―Green Buildings is the main focusof our study. This project is a compilation of facts concerning Green Buildings, its basic attributes, its benefits, the rating systems through which Green Buildings are recognized and certified, the design parameters of Green Buildings as well as a study of the emerging Green Building landscape in India.

The information has been compiled to furnish a startup document for understanding the basic nuances of a movement that is already shaping serious changes in the way people build and occupy structures across the world. This document has been kept simple presentation so that the basic issues in relation to Green Buildings are easily understood.

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2. WHAT IS GREEN BUILDING

At the outset it is important to understand what a 'Green Building' is. In this

fast-emerging field of sustainability there are many interpretations of what a Green Building denotes. The basic essence of a Green Building is very succinctly summarized by the USGBC (United States Green Building Council), one of the pioneers in propagating Green Buildings across the globe, states, the term, "Green Building is synonymous with, High Performance Building, sustainable design and construction‟ as well as other terms that refer to a holistic approach to design and construction…. Green building design strives to balance environmental responsibility, resource efficiency, occupant comfort and well-being, and community sensitivity." (LEED-NC Version 2.1 Reference Guide).

TERI (The Energy and Resources Institute), a not-for profit organization working in the field of sustainable development defines it as, A Green Building is designed, constructed and operated to minimize the total environmental impacts while enhancing user comfort and productivity (GRIHA, 2008).

Building green can involve many facets, but the main objectives include efficient use of land and energy, water conservation, improved indoor air quality, and resource conservation, primarily by using recycled & regional materials. Green building brings together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of buildings on the environment. Conventionally built buildings use more energy than necessary. Designing and operating buildings from an energy efficient perspective can significantly reduce the waste in energy, water usage and materials.

3. RATING PARAMETERS FOR GREEN BUILDING

There are several parameters on which a building is evaluated before being given a green rating:

1. Efficient use of resources like energy and water

This is an essential feature of a green building. Techniques like rainwater harvesting and reuse of

recycled water emphasise on water conservation. A green construction also retains natural hydrological sources. Similarly, suitable designs can cut down artificial lighting needs and even air conditioning costs, saving energy. Resources like water are scarce, and efforts must be made to conserve them.

2. Use of renewable energy

The use of renewable resources to meet energy needs reduces the carbon footprint of a building. Thus, new energy solutions which are powered by solar or wind remain the key criteria for a green project.

3. Pollution and waste reduction measures

A green building is expected to generate minimal waste. It must promote recycling and reuse of materials and emphasise on the reduction of non-biodegradable waste.

4. Good indoor air quality

Indoor spaces need to have efficient ventilation designs for good air quality. The design structures should allow cross-ventilation and free flow of air. Indoor pollution is quite harmful to health and is said to be much more intense than outdoor pollution. Since an occupant is expected to spend a lot of time indoor, the air quality impacts health and well-being. A smooth flow of air, thus, promises a reduction of pollutants.

5. Use of non-toxic materials

The kind of materials used in construction and upkeep is significant. The materials used in green buildings should be devoid of contaminants and preferably recyclable. For example, paints with toxins in them, or materials that harm the environment, should be avoided.

6. Ecological consideration in design, construction and operation

Environmental impacts should be considered while planning the layouts. The native ecology should not be damaged and, if possible, should be conserved. Site selection is not just crucial for the kind of soil and local flora; it also takes into account factors like transport. For example, you must consider if the vehicular movement by the residents from the project site to other parts of the neighbourhood will have any environmental impact.

7) Consideration of the living quality of occupants

Apart from healthy air quality, efforts are also required to maintain suitable temperature with proper daylight in all the areas of the unit. Similarly, visual appeal and aesthetics are an important part of a green design. Access to sufficient daylight cuts down energy costs and positively impacts the health of the occupants.

8. Innovation

Innovative techniques and methods also get points in a green building rating mechanism. New developments like smart metering and new technologies are rewarded. Besides, a rating agency might have additional criteria for its assessment.

"India's green building infrastructure must be bolstered by a regulatory framework that encourages climate change mitigation and effective implementation of existing policies. Green building certification organisations are also working to elevate the role of green buildings beyond the environment and economy by emphasising on the personal health and well-being benefits they provide. Additional measures like improving resilience, supporting public transportation, increased green spaces, public health and wellness, and promoting equity can also strengthen the policy implementation. It is time for us to focus on existing buildings as well. Involving sustainable measures in existing buildings will have a positive impact on the environment as it will reduce the greenhouse gas emissions", adds Gopalakrishnan Padmanabhan, Managing Director, Southeast Asia and Middle East, GBCI.

A building has its impact on nature like living beings. Green buildings do not cause any harm or stress to the environment during its entire life cycle. Hence, sustainability must be the centre piece of new designs and architecture for the well-being of occupants as well as ecology.

4. CASE STUDY

A. Viraj Tower

An ambitious project undertaken by the Raunak Group Pvt. Ltd., Viraj Tower is located at Devdaya Nagar, Pokhran Road, Thane- West. The project boasts of 44 credits (out of 75) with a pre-certified LEED Silver rating awarded by the Indian Green Building Council. Some of the salient green features of the project are illustrated as follows:

Material Efficiency: In this project, there is a preference for building materials that are less resource exhaustive, recycled to a great extent, and are non-toxic. Thanks to the greater awareness about the relevance of green production materials, the market is undergoing innovation and rapid transformation. Green construction materials (certified wood-based or rapidly renewable) and materials with high recycled-contents are now available in greater numbers and at costs that are very much competitive with their traditional counterparts. It has been decided to opt for concrete that contains fly ash from coal-fired power plants or slag from the iron and steel industry. Similarly, the use of kiln-fired bricks will be minimum and sun-dried compressed and

stabilized earth blocks will be adopted. These require much less energy to manufacture and create no debris or pollution when buildings are demolished. Building green involves establishing construction waste management plan which starts with the adoption of design that minimizes construction debris. Standard-sized or modular construction techniques have been adopted to generate less waste and lower disposal costs. Policies were adopted to purchase building materials from local and regional markets within a radius of 300-500 km and to recycle materials on-site as much as possible help to lower the environmental impacts and transportation costs. The adoption of waste prevention and recycling options has led to greater sustainability.

A brief outline of the materials used for the project while keeping in mind the aspects of local availability and their reusability

Some of the Green Building materials which have been used in the project may be discussed laconically as follows:

1. Fly Ash

Fly ash is a fused residue of clay minerals present in coal. The high temperature generated when coal burns in thermal power plants, transforms the clay minerals in coal powder into a variety of fused fine particles of mainly aluminium silicate composition. Fly ash is a very fine powder and tends to travel in the air. Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 μmto 100 μm. They consist mostly of silicon dioxide(SiO2), which is present in two forms: amorphous, which is rounded and smooth, and crystalline, which is sharp, pointed and hazardous; aluminium oxide(Al2O3) and iron oxide(Fe2O3). Fly ashes are generally highly heterogeneous, consisting of a mixture of glassy particles with various identifiable crystalline phases such as quartz, mullite, and various iron oxides.

2. Autoclaved Aerated Concrete

AAC due to its insulating properties reduce the energy needed for heating and air-conditioning of building. AAC is manufactured using cement, fly ash (waste from thermal plants), lime, aeration agent and water. The aeration process generates minute non interconnecting cells which form the characteristics cellular or air Crete structure. The cellular structure makes the product light weight, fire resistant and impacts high thermal and acoustic insulation properties. The autoclaving process gives strength & stability to the product.

Uses of AAC Building Blocks: :AAC building blocks are used for all walls, external or internal, load bearing or nonloadbearing in all building construction such as residential homes, commercial, industrial building, schools and hospitals.

3. Recycled Building Materials:

- Fly ash concrete is a waste by product of coal-fired power plants. From one fourth to one half of cement can be fly ash concrete. This material also improves structural performance.
- Steel framing can be used as a substitute for lumber. Light-gauge steel is about one quarter recycled material, while heavier steel usually has more recycled content.
- Fiberglass insulation is almost always partially made from post-consumer glass. Cellulose insulation is made from fiberized newspaper. Fire retardants are added.
- Drywall is another commonly used recycled building material; it is often made from one hundred percent recycled paper facings.
- Recycled glass tiles are made from used glass that has been ground, melted, and re-formed.

4. Green Paint

Painting can have a major impact on the overall aesthetics of a space; sometimes more than even flooring and furnishings because of the enormous square footage of coverage. Paints may also have a major negative impact on the indoor air quality of a building, because they may contains chemicals called volatile organic compounds (VOCs) and other toxics components the evaporate into the air and are harmful to the health of the occupants. VOCs are primary contribution to smog generation. Environmental effects of paints:

Paints have three major components; a pigment for colour, a binder that holds the pigment to the surface and carrier or solvent (mineral spirits or water) to dissolve and maintain the pigment. Latex, water based paints have significantly lower environmental impacts than oils and solvent based plates since they don‘t use petroleum carriers or have nearly as many smog-forming emissions. According to the US Environmental Protection Agency (USEPA), 9% of the airborne pollutants creating ground level ozone come from the VOC in paint. Low & zero VOC paints have little and no smog-forming emissions.

5.Technical wood

The wood technology community and forest managers, working together can perhaps formulate practical guidelines so that trees in short

rotation can produce more volume of wood with desired properties. Appropriate intervention of wood science and technology can develop technologies that will lead to economical production of various wood products from locally available raw materials. These products should be market (domestic and international) oriented with optimum quality standards.

Manufacture of technical wood:

The waste wood from different sources is collected and reduced to chips by way of crushing and shredding. Metal objects are separated by means of a magnetic drum before at this stage. These correct size chips are passed through a drier to reduce the moisture content to about 8%. This is achieved by heat transfer method and bulk of the moisture evaporates while themoisture in the dryer is discharged by means of a suction fan. The dry chips are stored in soils and automatically fed into the mixture where the chips are mixed with resins, wax and other compound. This mass is fed into hot press where under very high temperature and pressure conditions it is formed into requisites sections. The press has many sections so as to achiev multi-dimension sections. These formed section are automatically stacked and allowed to stabilized at room temperature before use.

Uses of technical wood in the project:

Technical Wood has been used to replace natural timber in furniture, doors & windows frames / shutters, flooring and partitions.

6.Glass

Glass has been used for hundreds of years in architecture. Glass forms a major part of the outer envelope of buildings. It is also used to form internal building features such as partitions, doors and enclosures. Of late, glazing is a favored feature in buildings. Glazing not only adds to the aesthetic element but also has a tremendous impact on energy performance of buildings besides visual and acoustic effects. The right choice of glazing can also lead to significantly lower cost in building energy consumption. With an increasing need for resource efficient building solutions, selection of glazing assumes tremendous significance. Construction industry in India is poised for a rapid growth and hence the per capita consumption of glass is expected to grow rapidly from the existing 0.54 kg per capita.

7. High Performance Glass

High Performance Glass is one which reduces the ingress of heat and at the same time allows higher penetration of daylight. High performance glazing is one which can contribute to optimizing energy efficiency and at the same time enhance light penetration. High performance glazing has low U-value, low Shading Coefficient and High VLT (Visual Light Transmittance) and is the ideal choice for today's energy stressed buildings.

8.Energy Efficiency

Green buildings often include measures to reduce energy consumption both the embodied energy required to extract, process, transport and install building materials and operating energy to provide services such as heating and power for equipment. The designers have provided highefficiency windows and insulation in walls, ceilings, and floors in order to increase the efficiency of the building envelopeand reduce operating energy use. Another strategy of passive solar building designhas been implemented for the project. Designers have oriented windows and walls and place awnings, porches, and trees to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effective window placement will provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs.

9.Solar water heating system

The conventional solar water heating system essentially consists of two units, Viz. the connection unit and the storage unit. The collection units are, usually, a blackened plate to absorb most of the solar energy incident on it. The flowing water in thermal contact with the absorber gets heated and is transferred to the storage unit. The storage is well-insulated tank, to reduce the possible heat losses. The absorber in this case, is a set of N collection connected in parallel. The storage tank is an insulated one with two inlets, one for the hot water from the collector and other one to allow the cold water, from the mains, to reach the bottom of the tank without mixing hot water. There are two outlets as well, one for the withdrawal of hot water and the other one is use to feed cold water to the collector inlet. The entire length of the connecting pipes is covered with glass wool insulation to reduce the heat loss. Solar radiation incident on the flat plate collector heat the water inside.

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There are two outlets as well, one for the withdrawal of hot water and the other one is use to feed cold water to the collector inlet. The entire length of the connecting pipes is covered with glass wool insulation to reduce the heat loss. Solar radiation incident on the flat plate collector heat the water inside,The hot water, being less dense rises up the collector. The vacuum created by this flow is filled up by the cold water from the storage tank. Thus the upper end of the collector has hot water while the lower end has cold one. This hot water then enters the storage tank, from the inlet, from where it can be withdrawn for further use. In this case, an insulated storage tank is always filled

with cold water to be a continuous cold water tank supply from the mains to get hot water at a time.

10.Use of Compact Fluorescent Lights

Today in India at least 80 per cent of electricity is wasted because of the kinds of lamps, bulbs and other implements we use that consume more electricity. A CFL (Compact Fluorescent Light) reduces electricity cost. A CFL bulb gives five times more light than conventional electric bulbs. The CFL burning hours are more than 8 times the normal ones. Fluorescent tube lights, compact fluorescent lights, consume less electricity and do not produce too much heat. Hence it has been decided to maximize the use of CFL for illumination purpose in the project. Instead of using 60 W bulbs, if 15 W CFL bulbs are used; then at least 45W Electricity consumption per hour will be saved. Per month a saving of up to 11 units of consumption can be achieved behind every lamp used.

11.Water Efficiency

Water efficiency is an indicator of the relationship between the amount of water required for a particular purpose and the amount of water used or delivered. The key for achieving efficiency is reducing waste, not restricting use. It emphasizes the influence consumers can have in water efficiency by making small behavioral changes to reduce water wastage and by choosing more water efficient products.

The Green building water conservation strategies adopted in this project typically fall into four categories.

1. Efficiency of potable water use through better design/technology.
2. Capture of grey water non-fecal wastewater from bathroom sinks, bathtubs, showers, washing machines, etc. And use for irrigation.
3. On-site storm water capture for use or groundwater recharge.
4. Recycled/reclaimed water use, Taken together.

These strategies will help to reduce water use below code/common practice by over 30% indoors and over 50% for landscaping.

12.Construction Waste Management

Construction waste management forms an integral part of the Green Building assessment procedure. It was therefore decided to reuse most of the construction waste to achieve higher sustainability and earn relevant credits.

CONCLUSION

This research will identify the exciting developments taking place on the technology front and analyzes their implications for intelligent and green buildings, highlighting examples of "best in class" buildings employing green and intelligent technologies. These buildings are dynamic environments that respond to their occupants' changing needs and lifestyles.

-This research provided documented evidence to educate and influence end-users, building owners, architects, and contractors that a "greener building" can be achieved using intelligent technology and that this "greening" will provide a tangible and significant return.

-As the green movement is spreading more corporates and construction firms are seeking LEED ratings. India being a vast country, it is required that provisions be made for utilization of regional methods and materials.

-Concrete using fly ash or slag is known internationally as green concrete. Such green concrete is being used in many projects in India and due credit should be given to such projects.

-Local municipal corporations and housing finance institutions should also be involved in rewarding the green achievements of the builder by giving some sort of incentives by way of reduced property taxes, loans at concessional rates,etc.

-Manufacturers and suppliers of energy efficient building materials and alternative products, solid waste management and waste water recirculation system suppliers, etc. can also be offeredeasy and low interest finance as well as tax concessions or exemptions.

-In short, the concept of green buildings and its implementation should be made optional so that the concept can develop on its own. Government should encourage it by framing proactive provisions. If such guidelines are implemented in the right manner, then the concept of green buildings would get a big impetus.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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