JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Review on Design Techniques of Green Building

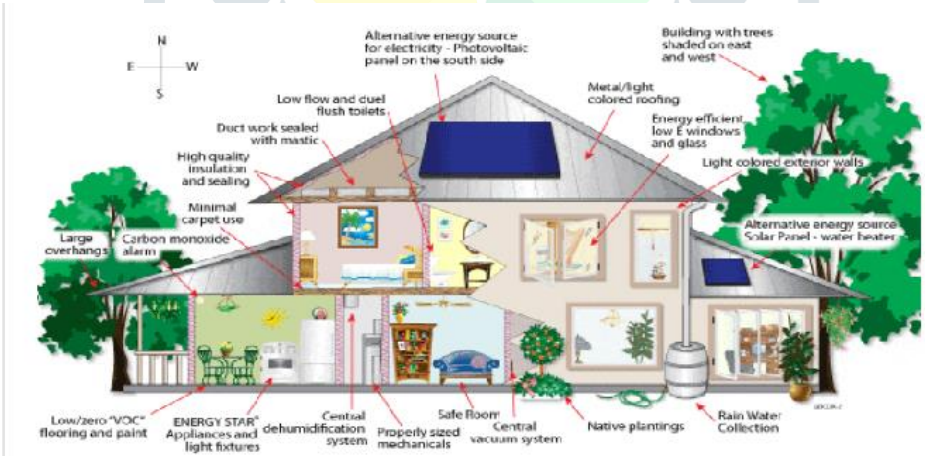
[1]Varsha Kakatkar, [2]Sanyogita S. Desai, [3]Netaji P. Kumbhar, [4]Shirish B.Chougale, [5]Omkar Jamdar
[1]Lecturer, [2]Lecturer, [3]Student, [4]Student, [5]Student
Department of Civil Engineering, Dr A. D. Shinde Institute of Technology, Bhadgaon, Kolhapur

Abstract: Green Building is a sustainable construction concept which meets the needs of the present with good consideration of future demands and requirements. Sustainability in constructionindustry is brought basically by good technical use of sustainable materials and energy etc.with simultaneous minimization in wastage and pollution. In the past two decades the growth of Green Buildings has been remarkable, both in terms of the spread of the Green Building movement worldwide as well the development of alternative systems for rating Green Buildings in various countriesthat started on this mission. Today many countries have adopted some form of a formal Green Building rating system or other. This will help people to get an idea about the various mandates, designing of this type of green buildings.

Index Terms **– Green building, Sustainability, planning, designing.**

I. INTRODUCTION

Buildings account for more than 40% of all global carbon dioxide emission, one of the main culprits implicated in the phenomenon of global warming in which India comes on 144th position (1.4 metric ton) in carbon emission rating in the world. Green Building is the concept of building sustainable structure which are environmental friendly comprises of specific design, planning, execution, constructionmethods, construction materials, maintenance and is efficient right from the being foundation laid to the demolition. It also benefits the users with energy saving, land saving,water saving, material saving, etc. Green building also saves the resources up to the maximum level and it includes saving of energy, saving of land, saving of material, saving of water, etc. during the entire life of building it also protect the environment. Green building technology focus on less consumption, maximum efficiency, economy protection of environment and optimization.



II. REVIEW OF LITERATURE

According to the national institute of science (USA), building generate 35% of the carbon di oxide, 49% of Sulphur dioxide, and 25% of nitrogen oxide found in the air. Green Buildings must subscribe to the principle of conscientious handling of natural resources, which means causing as little environmental interference as possible, using environment friendly materials, requires low operational energy, utilizes renewable sources of energy to fulfil its requirements, follows high-quality and longevity as a guideline for construction. This work is an attempt in the direction to make people, communities and general public aware about the advantages of green buildings for sustainable environmental development and management [1].

Zero energy building is a building with zero net energy consumption. It is a major contributor of pollutants leading to pollution of Air, water, noise and energy. This directly leads to Climatic changes, deforestation, rising sea level and also loss of biodiversity. The aim of this study is to learn the various possible techniques and technologies to reduce the consumption of energy and resources by optimum utilization which will leading to a net zero energy green building. Different techniques to reduce Waste and types of pollution are also studied. By combining both theories and practical ideas to plan a better future, by selecting the best and most practical techniques and methods, various service and support systems for the building can be planned. From this study they came to know that by 2050, 50% of the buildings will be converted into green buildings [2].

This paper provides an overview of how green building relates to sustainable development practices and deals with the various energy saving concepts which can be incorporated at the time of planning, designing, construction and execution stage to have energy efficiency in buildings keeping in mind the cost perspective. The promotion of sustainable building practices is to pursue a balance among economic, social, and environmental performance in implementing construction projects [3].
Twin motion was used in order to produce high quality images and videos, whereas on the other end sketch up was used for 3D Modelling. Passive and active energies are being used here in the form of direct and indirect sunlight like chromatic glass and solar panels and for waste we have used composites, zero VOC paints and cooling roofs to facilitate natural cooling and ventilation. We have also used rotating solar panels to capture maximum energy from the sun and because of its monochromatic properties, monochromatic glass reflects a great amount of UV light, which keeps the environment cool and helps to reduce global warming. Dual plumbing is becoming increasingly popular as it conserves water and helps to reduce water bills by reusing the grey water [4].

III. GRIHA ACT

GRIHA is India's National rating system which is developed by TERI (The Energy and Resource Institute). GRIHA generally helps in reducing energy consumption, waste generation, and overall impact on environment with respect to certain limits.
It broadly practices 5 "R" philosophy for sustainable buildings which are as follows:

- Refuse- to blindly adopt international trends, materials, technologies, products, etc.
- Reduce- the dependence on high energy products, systems, processes, etc.
- Reuse- materials, products, traditional technologies, so as to reduce the cost spentin designing buildings as well as operating them.
- Recycle- all the form of waste generated from the building site, during construction,operation and demolition.
- Reinvent- engineering systems, designs and practices such that India creates globalexample that the world can follow rather than we following the whole world.

GRIHA accesses the building out of 34 criteria and awards points out of 100. The building should get at least 50 points for being rated as green building.

IV. PASSIVE DESIGN STRATEGIES

Passive design strategies focus on utilizing natural elements and architectural techniques to create comfortable indoor environments without relying heavily on mechanical systems. Incorporating passive heating, cooling and lighting techniques such as orientation, insulation, shading, natural ventilation, day lighting and thermal mass to reduce energy consumption and enhance comfort.

1. **Building Orientation:** Optimizing building orientation to maximize solar gain in cold climates and minimize it in hot climates. This involves placing windows and openings to take advantage of natural daylight and heat from the sun during winter while shading them during summer to reduce cooling loads.

2. **Insulation:** Incorporating high-quality insulation in walls, roofs, and floors to minimize heat transfer between the interior and exterior spaces, thus reducing the need for heating and cooling.

3. **Thermal Mass:** Using materials with high thermal mass, such as concrete, stone, or rammed earth, to absorb and store heat during the day and release it slowly at night, helping to stabilize indoor temperatures.

4. **Natural Ventilation:** Designing buildings with operable windows, louvers, and vents to facilitate cross-ventilation and promote airflow, which can help regulate indoor temperatures and improve indoor air quality.

5. **Daylighting:** Maximizing natural daylight penetration into interior spaces through the strategic placement of windows, skylights, and light shelves, reducing the need for artificial lighting during the day and enhancing visual comfort and productivity.

6. **Shading Devices:** Installing shading devices such as overhangs, awnings, fins, and vegetation to block direct sunlight and reduce solar heat gain, especially on south-facing windows in hot climates.

7. **Natural Landscaping:** Incorporating trees, shrubs, and other vegetation around the building to provide shade, reduce heat island effect, and enhance microclimate conditions.

8. **Passive Solar Design**: Incorporating passive solar heating techniques such as direct gain, where sunlight enters the building through south-facing windows and is absorbed by thermal mass, and indirect gain, where sunlight is collected and distributed through a thermal mass wall or Trombe wall.

By integrating these passive design strategies into the planning and design of buildings, architects and designers can create energy-efficient, comfortable, and sustainable spaces that reduce reliance on mechanical systems and minimize environmental impact.

4.1 SHAPES AND ORIENTATION OF GREEN BUILDING

Both the factors of shape and orientation must move hand in hand during the construction of a green building. The shape and the design plan selected for the building have to be evolved such a way that it will support an optimum orientation. The top logical positioning helps in determining the building orientation. The choice of orientationlargely depends on the space that available. Managing the natural elements mainly the sun and wind features helps to evolve a building that have good orientation features. If we let the largest part of the building to face towards the sun, then the area can receive maximum natural daylight. This is a type of natural ventilation that is earned without any power source. But certain hot regions ask for less sun exposure at a particular period of time. This condition varies based on the geographicallocation of the building. The sun stays long for southern walls of the structure. Hence this orientation helps to have maximum exposure to the sun that is not direct and harmful. The wind has a great role in bringing the building to additional stress. These also have animportant role in the effective heating or the cooling of the building structure.

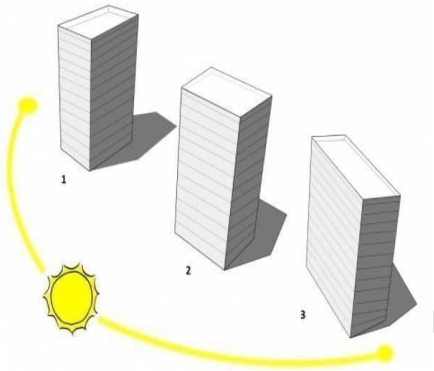


Fig. 1 Orientation of Green Building

4.2 WATER CONSERVATION IN GREEN BUILDING

Water conservation is a critical aspect of green building design, aiming to minimize water consumption, reduce strain on water resources, and promote sustainable water management practices. Here's how water consumption is typically addressed in green building projects:

1. **Efficient fixtures and appliances:**
   Install water-efficient fixtures such as low-flow toilets, faucets, and showerheads to reduce indoor water usage without sacrificing performance or comfort. Incorporate ENERGY STAR-rated appliances and equipment, including dishwashers, washing machines, and water heaters, that use less water and energy during operation.
2. **Rainwater Harvesting:**
   Implement rainwater harvesting systems to capture and store rainwater for non-potable uses such as landscape irrigation, toilet flushing, and cooling tower makeup water. Design rooftop catchment systems, gutters, downspouts, and storage tanks to collect rainwater runoff and supplement municipal water supplies.

Fig. 2 Installation of RWH system at Infosys Pune by Using Technology

3. **Greywater Recycling:**
   Treat and reuse greywater from sinks, showers, and laundry facilities for irrigation, toilet flushing, and other non-potable applications. Install greywater recycling systems with appropriate filtration and disinfection processes to ensure water quality and safety.
4. **Water-Efficient Landscaping:**
   Design landscapes with native, drought-tolerant plants that require minimal irrigation and maintenance, reducing outdoor water demand. Incorporate efficient irrigation systems such as drip irrigation, micro-sprinklers, and soil moisture sensors to deliver water directly to plant roots and minimize runoff and evaporation.
5. **Permeable Surfaces and Site Design:**

Use permeable pavements, porous materials, and vegetated swales to reduce stormwater runoff and replenish groundwater supplies. Design site layouts and grading plans to promote natural infiltration, minimize impervious surfaces, and manage rainwater onsite.

6. **Water Metering and Monitoring:**
   Install submetering systems to monitor water usage in different building zones, identify leaks, and track performance over time. Implement water management software and analytics tools to analyze consumption patterns, optimize efficiency measures, and achieve water conservation goals.
7. **Educational Outreach and Behaviour Change:**
   Provide educational resources, workshops, and outreach programs to raise awareness about water conservation practices and encourage sustainable behaviors among building occupants. Engage tenants, residents, and facility managers in water-saving initiatives, water-wise landscaping practices, and responsible water use habits.

Fig.3 Arrangement of Rainy Filter

By integrating water conservation strategies into green building design and operations, architects, developers, and building owners can minimize water waste, protect water quality, and contribute to the resilience and sustainability of the built environment.

V. BENEFITS OF BREEN BUILDING OVER CONVENTIONAL BUILDING

A Green Home can have number of benefits, both direct and indirect. The immediate andmost direct benefit is in the reduction in water and operating energy costs right from dayone, during the entire life cycle of the building.

Direct Benefits:

- Energy savings: 20 - 30%
- Water savings: 30 - 50%
- 80% of materials used are either recycled or recyclable ones.

Indirect Benefits:

- Improved air quality
- Excellent day lighting
- Health & wellbeing of the occupants
- Conservation of scarce national resources
- Enhance marketability for the project

VI. CONCLUSION

As the green movement is spreading its wings, more & more corporates and construction firms are seeking GRIHA ratings. India being a vast country, it is required that provisions be made for utilization of regional methods and materials. Present work is an attempt in the direction to make people, communities and general public aware about the advantages of green buildings for sustainable environmental development and management. This paper involves highlighting the benefits of sustainable practices, emphasizing energy efficiency, reduced environmental impact, improved indoor air quality, and enhanced occupant comfort. It underscores the importance of incorporating renewable materials, efficient technologies, and thoughtful site planning to create buildings that contribute positively to the environment and human well-being. Additionally, it may stress the need for ongoing monitoring and adaptation to ensure the building continues to meet its green objectives over time.

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