International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 Impact Factor: 8.176 ISSN: 2582-3930

GREEN CONSTRUCTION OR SUSTAINABLE BUILDING

Kartik Sakharwade[1], Yogita Bhandarkar[2], Sachin Katre[3]

[1]Kartik Sakharwade, BE, Civil Engineering, SSIT, Nagpur
[2]Yogita Bhandarkar, BE, Civil Engineering, SSIT, Nagpur
[3]Sachin Katre, BE, Civil Engineering, SSIT, Nagpur

Abstract - Construction of residential, commercial, institutional, industrial building is very fast. Shelter is the basic need of mankind and without well-defined head offices and branches and other necessary buildings like go-downs etc. corporate world cannot work. A safe structure is very necessary say for residential purpose (like row houses, multistory buildings, etc.) commercial purpose, (like shops, mall, wholesale market) Institutional purpose (school, colleges, etc.) organizational purpose (like NGOs and other private organizations) corporates offices, industrial buildings, etc.

These contribute largely to adverse effect of environment like lessening of natural ground due to increase in concrete structures and pavement result is lessening a ground water storage, overuse of electricity, reduction in air quality due to AC, etc. this is causing degradation of environment. Forests and trees are cut down quadruple speed than their plantation concrete gardens are seen all around.

To reduce and trying to eventually encounter the above effects, green building is necessary concept. Green building provides natural ventilation sunlight, rainwater harvesting, terrace gardens and other facilities which will help the environment and provide the same luxurious life to humans. Green building have been practice knowingly or unknowingly for many years it is time to understand its concepts and implement it in construction and deliberately by and effectively.

Key Words: Buildings, Nature, Green Building, Rain Water Harvesting

1. INTRODUCTION

Shelter is one of the fundamental needs of human beings. As the time went on, man with his knowledge invented latest technologies and materials which helped him in construction of different types of buildings. These buildings and the materials used for construction brought rapid changes in the environment. Limitation of space, growth of population and rapid urbanization lead to community dwelling culture which increased problems like CFC emissions, insufficient ventilation and increase of waste materials during construction and maintenance of house arouse.

It is found that the building industry will consume 40% of total global energy and release about 3800megatons of CO2 into atmosphere. They have harmful impact on the nature.

According to a report the building industry has following impacts: Consumption of 40% of world's total energy.

Consumption of 30% of raw materials. About 25% of timber harvest is going down. 35% of CO2 emissions.

16% of fresh water is being depleted.

40% of municipal solid waste is being generated. 50% of ozone depleting CFCs are still in use.

30% of the residents have sick building syndrome.

The above issues have forced man to think along the terms of sustainable development which gave solution for his problem through "green building" concept Most of the people think that it is latest technology which has been invented in recent times. But a very few people know that this concept is being used since time immemorial. The Hawa Mahal in Jaipur Rajasthan in India is constructed in such a way that it has natural ventilation which is also one of the principles of green construction. Similarly many buildings were constructed using different principles of green construction unknown a green building, also known as a sustainable building, is a structure that is designed built, renovated, operated, or reused in an ecological and resource-efficient manner.

Green building are designed to meet certain objective such as protecting occupant health; improving employee productivity, using energy, water, and other resources more efficiently; and reducing the overall impact to the environment Green Building practices promote construction of buildings that are healthier for the occupants and healthier for the environment.

Green Building practices can reduce the tremendous impact that building design, construction and maintenance both have on people and nature. Energy and material consumption in buildings can contribute significantly to global climate change. Few recent trends in the building industry have achieved the momentum that has marked the growing interest in green building technology. Advances in techniques and materials have made it possible to do what was unthinkable only a few years ago: Design buildings that enhance the environment instead of exploiting it.

2. LITERATURE REVIEW

2.1 History of Green Building

Executive as "the practice of: 1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and 2) reducing building impacts of human health and the environment, through better siting, design, construction, operation, maintenance, and removal throughout the complete life cycle." While the green building movement has gained momentum in the last decade, the origin can be traced back to the late nineteenth century. According to David Gissen, curator of architecture and design and the National

Building Museum in Washington DC, structures such as London's Crystal Palace and Milan's Galleria Vittorio Emanuele II used methods that decreased the impact of the structure on the environment. Systems such as roof ventilators and underground air- cooling chambers were used to regulate indoor air temperature. In the early twentieth century, several skyscrapers such as the Flatiron Building and the New York Times Building in New York utilized deep-set windows and the Carson Pirie Scott department store in Chicago had retractable awnings. Both of these techniques were effective in controlling interior temperature while lessoning the buildings' impact on the environment From the 1930's through the 1960's, the forward thinking cooling methods mentioned above gave way to some new building technologies that would change inner-city building construction dramatically. The invention of air conditioning, reflective glass, and structural steel popularized the enclosed glass and steel buildings that litter the American city today. These buildings were able to be heated and cooled with massive HVAC systems that consumed huge amounts of cheap and readily available fossil fuels. The massive consumption of energy required to inhabit these buildings made their viability tenable and entirely dependent upon energy availability and cost.

2.2 Benefits of Green Building

The world over, evidence is growing that green buildings bring multiple benefits. They provide some of the most effective means to achieving a range of global goals, such as addressing climate change, creating sustainable and thriving communities, and driving economic growth. Highlighting these benefits, and facilitating a growing evidence base for proving them, is at the heart of what we do as an organization.

The benefits of green buildings can be grouped within three categories: environmental, economic and social. Here, we provide a range of facts and statistics from various third-party sources that present these benefits.

1. Environmental:

One of the most important types of benefit green buildings offer is to our climate and the natural environment. Green buildings can not only reduce or eliminate negative impacts on the environment, by using less water, energy or natural resources, but they can – in many cases – have a positive impact on the environment (at the building or city scales) by generating their own energy or increasing biodiversity.

- At a global level: The building sector has the largest potential for significantly reducing greenhouse gas emissions compared to other major emitting sectors – UNEP, 2009.

This emissions savings potential is said to be as much as 84 gigatonnes of CO2 (GtCO2) by 2050, through direct measures in buildings such as energy efficiency, fuel switching and the use of renewable energy – UNEP, 2016.

The building sector has the potential to make energy savings of 50% or more in 2050, in support of limiting global temperature rises to 2°C (above pre- industrial levels) – UNEP, 2016.

- At a building level: Green buildings achieving the Green Star certification in Australia have been shown to produce 62% fewer greenhouse gas emissions than average Australian buildings, and 51% less potable water than if they had been built to meet minimum industry requirements.

Green buildings certified by the Indian Green Building Council (IGBC) results in energy savings of 40 – 50% and water savings of 20 – 30% compared to conventional buildings in India.

Green buildings achieving the Green Star certification in South Africa have been shown to save on average between 30 – 40% energy and carbon emissions every year, and between 20 – 30% potable water every year, when compared to the industry norm.

Green buildings achieving the LEED certification in the US and other countries have been shown to consume 25 per cent less energy and 11 per cent less water, than non-green buildings.

2. Economic:

Green buildings offer a number of economic or financial benefits, which are relevant to a range of different people or groups of people. These include cost savings on utility bills for tenants or households (through energy and water efficiency); lower construction costs and higher property value for building developers; increased occupancy rates or operating costs for building owners; and job creation. Since the publication of WorldGBC's groundbreaking 2013 report, The Business Case for Green Building, we have sought to strengthen the link between green buildings and the economic benefits they can offer.

- At a global level : Global energy efficiency measures could save an estimated

€280 to €410 billion in savings on energy spending (and the equivalent to almost double the annual electricity consumption of the United States) – European Commission, 2015.

- At a country level : Canada's green building industry generated $23.45 billion in GDP and represented nearly 300,000 full-time jobs in 2014 – Canada Green Building Council / The Delphi Group, 2016.

Green building is projected to account for more than 3.3 million U.S. jobs by 2018 – US Green Building Council / Booz Allen Hamilton, 2015.

- At a building level: Building owners report that green buildings – whether new or renovated – command a 7 per cent increase in asset value over traditional buildings – Dodge Data & Analytics, 2016.

3. Social:

Green building benefits go beyond economics and the environment, and have been shown to bring positive social impacts too. Many of these benefits are around the health and wellbeing of people who work in green offices or live in green homes.

Workers in green, well-ventilated offices record a 101 per cent increase in cognitive scores (brain function) – Harvard T.H. Chan School of Public Health / Syracuse University Center of Excellence / SUNY Upstate Medical School, 2015.

Employees in offices with windows slept an average of 46 minutes more per night – American Academy of Sleep Medicine, 2013.

Research suggests that better indoor air quality (low concentrations of CO2 and pollutants, and high ventilation rates) can lead to improvements in performance of up to 8 per cent–Park and Yoon, 2011.

3. METHODOLOGY

3.1. Factors to Consider

• Lot design, preparation and development: Thoughtful and efficient site design and development practices help lessen environmental impact and improve the energy performance of new Constructions. The designs with a focus on saving trees, constructing onsite storm water retention/infiltration features and orienting the house to maximize solar power gain are basic aspects in a green building.

• Resource efficiency: It is a fact that a green building is most successful when the concepts are incorporated and implemented at the design phase- the time at which material/product/system selection occurs. Creating resource efficient designs and using resource efficient materials can maximize function while optimizing the use of natural resources. For instance, engineered wood products can help optimize resources by using materials in which more than 50% more of the log is converted into structural timber than conventional dimensional timber. But we need to weigh the benefit of such products against the amount of energy consumed during the process and accordingly make our selection. One aim of resource efficient construction is to reduce job-site waste. Invariably, there are leftover materials from the construction process. Adhering to a construction waste management plan helps reducing the quantity of landfill material. This can be achieved through taking advantage of available recycling facilities and markets for recyclable materials. This will help reducing the construction waste by at least two-thirds, creating potential cost savings for builders and reducing the burden on landfill space.

• Energy Efficiency: The energy efficiency is weighted heavily in greenest building programs. A whole system approach will bring improved results. Further, a careful window selection, building envelope air sealing, duct sealing, proper placement of air and vapour barriers, use of solar powered heating/cooling systems will contribute towards an energy efficient building.

• Water efficiency: Green homes often focus on conserving water both indoor and out. Implementing more efficient water delivery system indoors and native and water retaining and drought resistant landscaping selections outdoors can aid preventing unnecessary waste of valuable water resources. For an example use of heavy and light water-closet flushing options (implemented in The Tea Factory Hotel located in Nuwaraeliya in Sri Lanka) will help conserving water used indoor. Current research and practices have shown the natural processes can be a very successful method of filtering and removing contaminants from storm water and waste water which can then be reused successfully for irrigation purposes etc.

• Indoor environmental quality: An increase in respiratory ailments and allergies and the use of chemicals that can give off gas from materials have greatly contributed to sensitive awareness of the air we breathe inside our homes. The green building focuses on measures that can lessen the effects of potential contamination including controlling the source, diluting the source, and capturing the source through filtration. Operation, maintenance and building owner education- Improper and inadequate maintenance can hamper the designers' and contractors' efforts to create a resource efficient environmental friendly building. By educating owners with alternative environmental friendly products/systems for use in maintenance of buildings and providing owners with an effective and proper operation and maintenance manual may help obtaining their contribution to achieve green building objectives.

3.2 Green Building Material

1. Earthen Materials

• Earthen materials like adobe, cob, and rammed earth are being used for construction purposes since yore.

• For good strength and durability- chopped straw, grass and other fibrous materials etc. are added to earth.

• Even today, structures built with adobe or cob can be seen in some remote areas.

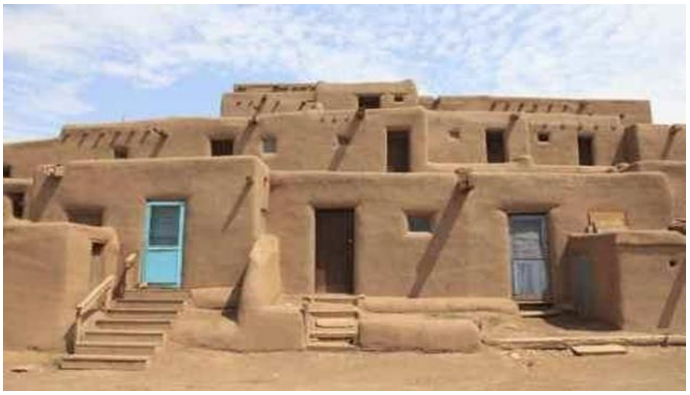

Fig 1: Adobe made Structure

2. Engineering Wood

• Wood is one of the most famous building materials used around the world.

• But in the process of conversion of raw timber to wood boards and planks, most percentage of wood may get wasted.

• This wastage can also be used to make structural parts like walls, boards, doors etc. in the form of engineered wood.

• Unlike solid wood, engineered wood contains different layers of wood, usually the middle layers are made of wood scraps, softwoods, wood fibers etc.

Fig 2: Engineered Wood Board over Solid Wood Board

3. Bamboo

• Bamboo is one of the most used multipurpose and durable materials used in construction.

• These trees grow faster irrespective of climatic conditions. So, it makes it economical as well.

• They can be used to construct frames or supports, walls, floors etc.

• They provide a good appearance to the structures.

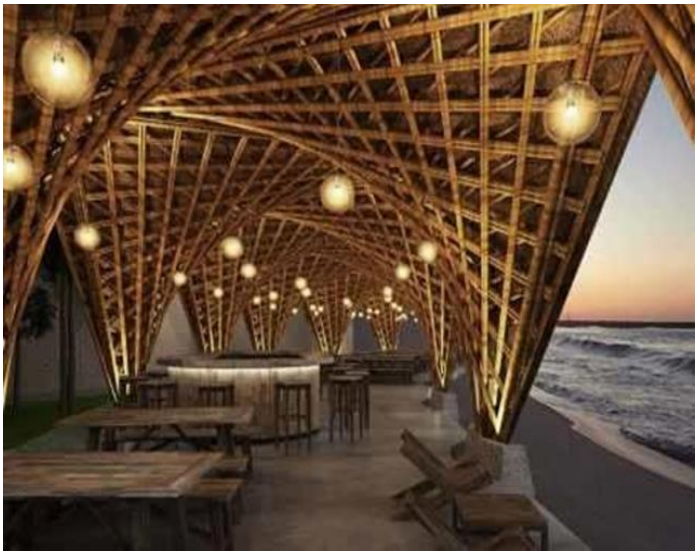

Fig 3: Bamboo Structure

4. Insulated Concrete Forms

• Insulated concrete forms contain two insulation layers with some space in between them. This space contains some arrangement for holding reinforcement bars, after placing reinforcement, concrete is poured into this space.

• They are light in weight, fire resistant, low dense and have good thermal and sound insulation properties.

Fig 4: Cordwood Wall

5. Straw Bale

•Straw bale is another green building material which can be used as framing material for building because of good insulating properties. They can also act as soundproof materials.

• Non-load bearing walls of straw bale can be used as fill material in between columns and, in beams framework is recommended.

• Since air cannot pass through them, straw bales also have some resistance to fire.

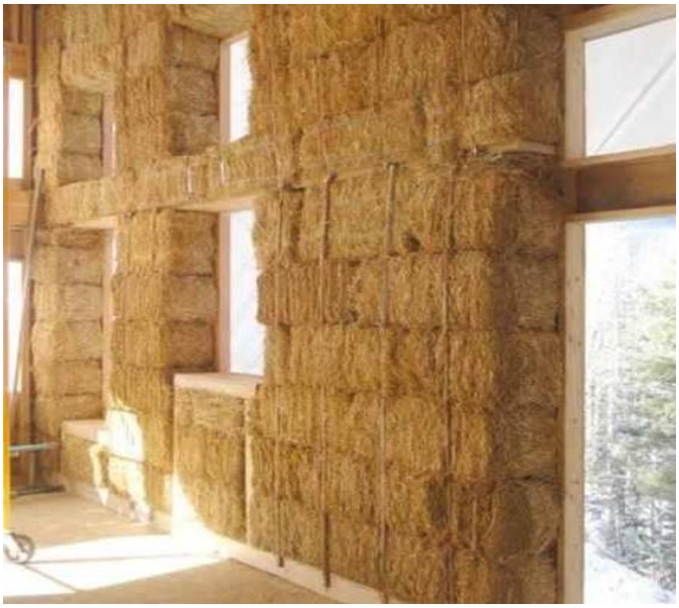

Fig 5: Straw Bale Wall

6. Earth Bags

• Earth bags or sand bags are also used to construct walls of a structure.

• These types of structures can be seen in military bases, near banks of water resources etc.

• Generally, bags made of burlap are recommended but they may rot very easily and hence, polypropylene bags are used nowadays.

Fig 6: Earth Bag Walls

7. Natural Fiber

• Natural fibers like cotton, wool can also be used as insulation materials.

• Recycled cotton fibers or wool fibers are converted into a batt and installed in preformed wooden frame sections.

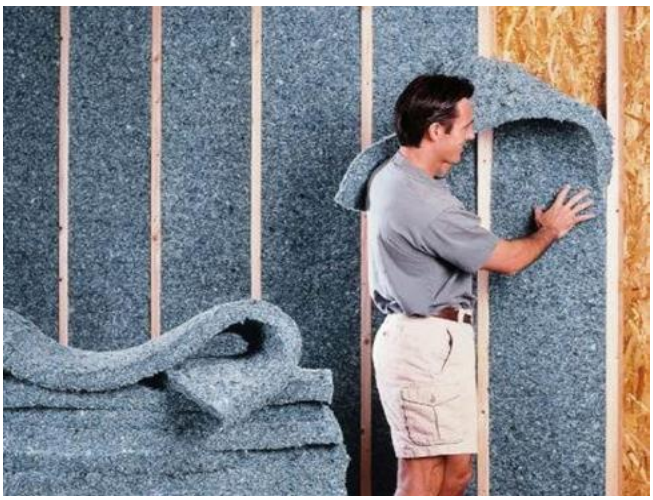

Fig 7: Cotton Insulation

8. Polyurethane

• Polyurethane foam is available in the form of spray bottles. They are directly sprayed onto the surface or wall or to which part insulation is required.

• After spraying it expands and forms a thick layer which hardens later on.

• They offer excellent insulation and prevent leakage of air.

Fig 8: Polyurethane Foam Spray

9. Fiberglass

• Fiberglass is also used for insulation purposes in the form of fiberglass batts.

• Even though it contains some toxic binding agents, because of its super insulation property at low cost it can be considered as a green building material.

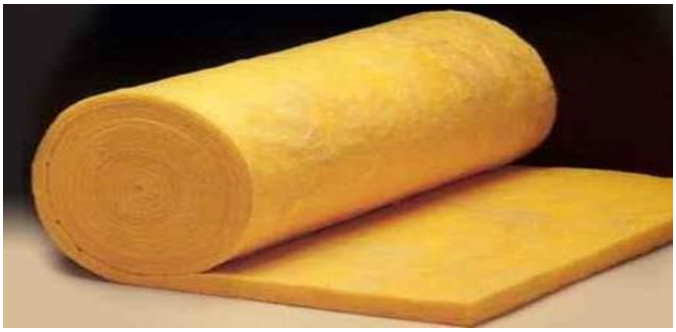

Fig 9: Fiberglass batt

10. Non-VOC paints

• Non-VOC paint or green paint is recommended over VOC containing paints.

• Presence of Volatile Organic Compounds (VOC) in paint reacts with sunlight and nitrogen oxide resulting in the formation of ozone which can cause severe health problems for the occupants.

• If non-VOC paint is not available then try the paint with very low-VOC content in it.

Fig 10: Non-VOC Paint

INDIAN GREEN BUILDING COUNCIL (IGBC)

The Indian Green Building Council (IGBC), part of the Confederation of Indian Industry (CII) was formed in the year 2001. The vision of the council is, "To enable a sustainable built environment for all and facilitate India to be one of the global leaders in the sustainable built environment by 2025".

The council offers a wide array of services which include developing new green building rating programmes, certification services and green building training programmes. The council also organises Green Building Congress, its annual flagship event on green buildings.

The council is committee-based, member-driven and consensus-focused. All the stakeholders of construction industry comprising of architects, developers, product manufacturers, corporate, Government, academia and nodal agencies participate in the council activities through local chapters. The council also closely works with several State Governments, Central Government, World Green Building Council, bilateral multi-lateral agencies in promoting green building concepts in the country.

STATUS OF ECOFRIENDLY STRUCTURE IN INDIA

The Green Building movement in India was triggered off when CII-Sohrabji Godrej Green Business Centre building in Hyderabad was awarded with the first and the prestigious Platinum rated green building rating in India. Since then, Green Building movement in India has gained tremendous impetus over the years.

With a modest beginning of 20,000 sq.ft. green built-up area in the country in the year 2003, today (as on 30th April 2021) more than 6,548 Green Buildings projects coming up with a footprint of over 7.83 Billion sq.ft are registered with the Indian Green Building Council (IGBC), out of which 2,214 Green Building projects are certified and fully functional in India. This growth has been possible with the participation of all stakeholders in the green building movement.

Today all types of buildings are going the Green way- Government, IT Parks, Offices, Residential, Banks, Airports, Convention Centre, Institutions, Hospitals, Hotels, Factories, SEZs, Townships, Schools, Metros etc.,

Currently, 4452 green building projects with a footprint of over 4.79 billion sq. ft. are registered with the IGBC.

The Council has set an ambitious target to facilitate 10 billion sq ft of registered green building footprint by 2022.

India has ratified the COP21 climate change agreement and plans to reduce its greenhouse gas emission per unit of GDP, by 33-35% from 2005 levels by 2030.

3. CONCLUSIONS

With increasing degradation of the environment because of increased energy consumption, environment conscious building design has become urgent. The benefits of green design to society in general, and building owners and users in particular, are manifold. The construction of such buildings results in reduced destruction of natural habitats and bio-diversity, reduced air and water pollution, less water consumption, limited waste generation and increased user productivity. With increasing threat on our planet earth caused by depleting resources and increasing emissions it is absolutely pertinent that all our future buildings should be designed to function as ‘‘Eco-Friendly Apartment’’

REFERENCES

1. https://www.naturalstoneinstitute.org › ...PDF History of Green Building – Natural Stone Institute
2. https://www.wienerberger.in
3. https://www.nbmcw.com › Need for Developing Green Building Concept in the Country - Nbm&Cw
4. https://slideplayer.com › slide - Objectives of a Green Building – ppt
5. https://www.worldgbc.org/benefits-green-buildings
6. https://juniperpublishers.com/cerj/CERJ.MS.ID.555638.php
7. https://theconstructor.org/building/green-building-materials/7028/
8.https://www.processindustryforum.com/energy/20-most-eco-friendly- buildings-on-earth
9.https://igbc.in/igbc/redirectHtml.htm?redVal=showAboutusnosign &id=abo ut-content
10. https://www.google.com/amp/s/www.weetas.com/article/green-buildings-advantages-and-disadvantages/amp/