8th NATIONAL CONFERENCE On 'Emerging trends in Engineering and Technology'
Bharati Vidyapeeth's College of Engineering, Kolhapur (NCETET-2018)
10th March 2018 www.conferenceworld.in ISBN : 978-93-87793-03-3

# GREEN BUILDINGS ARE ENVIRONMENTAL SUSTAINABLE BUILDINGS

**Er. Saurabh Joshi[1], Er. Kiran Kangle[2], Er.Pramod Jadhav[3], Er. Ravindra Nikam[4]**

*[1,2,3]Assistant Professor Department of Environmental Engineering,*
*KIT's College of Engineering, Kolhapur (India)*
*[4]Assiociate Professor Department of Environmental Engineering*
*KIT's College of Engineering, Kolhapur (India)*

## ABSTRACT

*Green buildings are environmental sustainable buildings, designed such that they are eco-friendly in all ways. Green building practices aim to reduce the environmental impact of building. The first rule is that the greenest building is the building that doesn't get built. Since construction almost always degrades a building site, not building at all is preferable to green building, in terms of reducing environmental impact. The second rule is that every building should be as small as possible. The third rule is not to contribute to sprawl, even if the most energy-efficient, environmentally sound methods are used in design and construction. Buildings account for a large amount of land. According to the National Resources Inventory, approximately 107 million acres (430,000 km$^2$) of land in the United States are developed. The international national agency released a publication that estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions. 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. 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.*

***Keywords: Ground Water, Inventory, Replenishment***

## I.INTRODUCTION

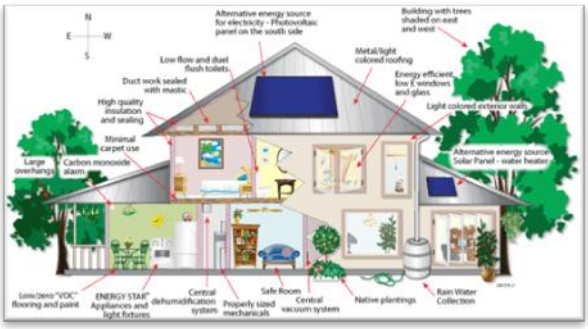
Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsible and resource efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. In other words, 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. The Green Building practice expands and complements the classical building design concerns of economy, utility,

durability, and comfort. 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. 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.

Ref:Taipei 101: The tallest and largest green building of LEED Platinum certification in the world since 2011.

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 new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed 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.




Ref: **Anatomy of green home**

Green building or natural building, which is usually on a smaller scale and tends to focus on the use of natural materials that are available locally. 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. 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. The concept of sustainable development can be traced to the energy (especially fossil oil) crisis and environmental pollution concerns of the 1960s and 1970s. The Rachel Carson book, "Silent Spring", published in 1962, is considered to be one of the first initial efforts to describe sustainable development as related to green building.The green building movement in the U.S. originated from the need and desire for more energy efficient and environmentally friendly construction practices. There are a number of motives for building green, including environmental, economic, and social benefits. However, modern sustainability initiatives call for an integrated and synergistic design to both new construction and in the retrofitting of existing structure

## II.LIFE CYCLE ASSESSMENT

A life cycle assessment (LCA) can help avoid a narrow outlook on environmental, social and economic concerns by assessing a full range of impacts associated with all cradle-to-grave stages of a process: from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Impacts taken into account include (among others) embodied energy, global warming potential, resource use, air pollution, water pollution, and waste. In terms of green building, the last few years have seen a shift away from a *prescriptive* approach, which assumes that certain prescribed practices are better for the environment, toward the scientific evaluation of actual performance through LCA. Although LCA is widely recognized as the best way to evaluate the environmental impacts of buildings (ISO 14040 provides a recognized LCA methodology), it is not yet a consistent requirement of green building rating systems and codes, despite the fact that embodied energy and other life cycle impacts are critical to the design of environmentally responsible buildings.

## III.SITTING AND STRUCTURE DESIGN EFFICIENCY

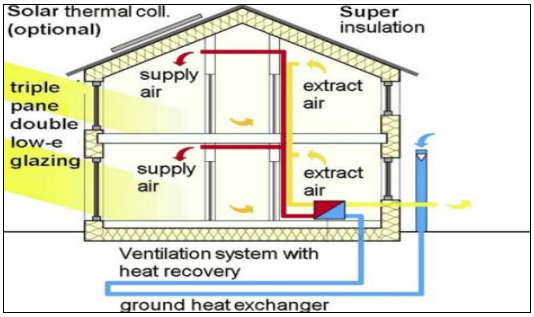
The foundation of any construction project is rooted in the concept and design stages. The concept stage, in fact, is one of the major steps in a project life cycle, as it has the largest impact on cost and performances. In designing environmentally optimal buildings, the objective is to minimize the total environmental impact associated with all life-cycle stages of the building project. However, building as a process is not as streamlined as an industrial process, and varies from one building to the other, never repeating itself identically. In addition, buildings are much more complex products, composed of a multitude of materials and components each constituting various design variables to be decided at the design stage. A variation of every design variable may affect the environment during all the building's relevant life-cycle stages.

## IV.ENERGY EFFICIENCY

**Ref: An eco house with turf roof and solar panels**

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. To reduce operating energy use, designers use details that reduce air leakage through the building envelope (the barrier between conditioned and unconditioned space). They also specify high-performance windows and extra insulation in walls, ceilings, and floors. Another strategy, passive solar building design is often implemented in low-energy homes. Designers orient windows and walls and place awnings, porches, and trees[1] to shade windows and roofs during the summer while maximizing solar gain in the winter. In addition, effective window placement (day lighting) can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs.

Onsite generation of renewable energy through solar power, wind power, hydro power or biomass can significantly reduce the environmental impact of the building. Power generation is generally the most expensive feature to add to a building.

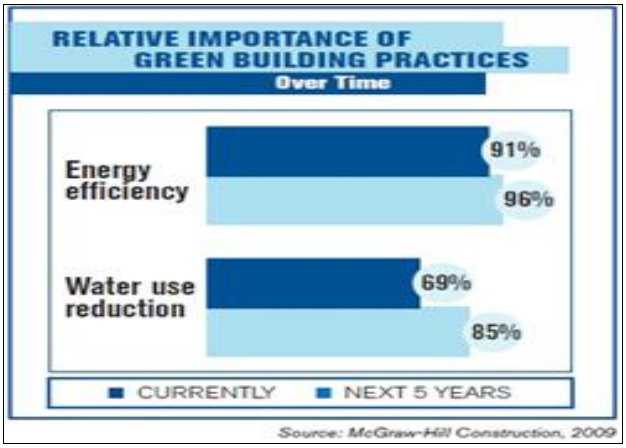



**Ref: Heat loss from passive house**

## V.WATER EFFICIENCY

Reducing water consumption and protecting water quality are key objectives in sustainable building. One critical issue of water consumption is that in many areas, the demands on the supplying aquifer exceed its ability to replenish itself. To the maximum extent feasible, facilities should increase their dependence on water that is

collected, used, purified, and reused on-site. The protection and conservation of water throughout the life of a building may be accomplished by designing for dual plumbing that recycles water in toilet flushing or by using water for washing of the cars. Waste-water may be minimized by utilizing water conserving fixtures such as ultra-low flush toilets and low-flow shower heads. Bidets help eliminate the use of toilet paper, reducing sewer traffic and increasing possibilities of re-using water on-site. Point of use water treatment and heating improves both water quality and energy efficiency while reducing the amount of water in circulation. The use of non-sewage and greywater for on-site use such as site-irrigation will minimize demands on the local aquifer.




**Ref: Efficient use of energy and water**

## VI.MATERIALS EFFICIENCY

Building materials typically considered to be 'green' include lumber from forests that have been certified to a third-party forest standard, rapidly renewable plant materials like bamboo and straw, dimension stone, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and/or recyclable. For concrete a high performance or Roman self-healing concrete is available. The EPA (Environmental Protection Agency) also suggests using recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects. Energy efficient building materials and appliances are promoted in the United States through energy rebate programmes.

## VII.INDOOR ENVIRONMENTAL QUALITY ENHANCEMENT

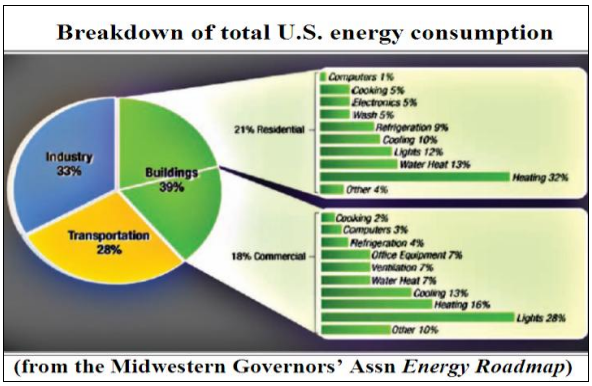
Indoor Air Quality seeks to reduce volatile organic compounds, or VOCs, and other air impurities such as microbial contaminants. Buildings rely on a properly designed ventilation system (passively/naturally or mechanically powered) to provide adequate ventilation of cleaner air from outdoors or recirculated filtered air as well as isolated operations (kitchens, dry cleaners, etc.) from other occupancies. During the design and construction process choosing construction materials and interior finish products with zero or low VOC emissions will improve IAQ. Most building materials and cleaning/maintenance products emit gases, some of them toxic, such as many VOCs including formaldehyde. These gases can have a detrimental impact on occupants' health, comfort, and productivity. Avoiding these products will increase a building's IEQ. Also important to indoor air quality is the control of moisture accumulation (dampness) leading to mold growth and the presence of bacteria and viruses as well as dust mites and other organisms and microbiological concerns.

Water intrusion through a building's envelope or water condensing on cold surfaces on the building's interior can enhance and sustain microbial growth. A well-insulated and tightly sealed envelope will reduce moisture problems but adequate ventilation is also necessary to eliminate moisture from sources indoors including human metabolic processes, cooking, bathing, cleaning, and other activities.


**Ref: Increase in no. of green buildings in India**

## IX.WASTE REDUCTION

Green architecture also seeks to reduce waste of energy, water and materials used during construction. For example, in California nearly 60% of the state's waste comes from commercial buildings. During the construction phase, one goal should be to reduce the amount of material going to landfills. Well-designed buildings also help reduce the amount of waste generated by the occupants as well, by providing on-site solutions such as compost bins to reduce matter going to landfills. To reduce the impact on wells or water treatment plants, several options exist. Wastewater from sources such as dishwashing or washing machines, can be used for subsurface irrigation, or if treated, for non-potable purposes, e.g., to flush toilets and wash cars. Rainwater collectors are used for similar purposes. Centralized wastewater treatment systems can be costly and use a lot of energy. An alternative to this process is converting waste and wastewater into fertilizer, which avoids these costs and shows other benefits. By collecting human waste at the source and running it to a semi-centralized biogas plant with other biological waste, liquid fertilizer can be produced.

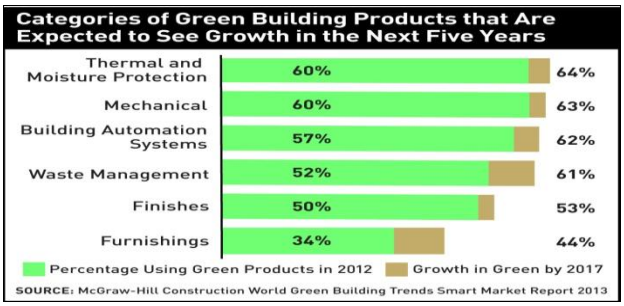



**Ref: Breakdown of total U.S. Energy consumption**

## X.COST AND PAYOFF

The most criticized issue about constructing environmentally friendly buildings is the price. Photo-voltaics, new appliances, and modern technologies tend to cost more money. Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building. In regards to the financial benefits of green building, "Over 20 years, the financial payback typically exceeds the additional cost of greening by a factor of 4-6 times. And broader benefits, such as reductions in greenhouse gases (GHGs) and other pollutants have large positive impacts on surrounding communities and on the planet." The stigma is between the knowledge of up-

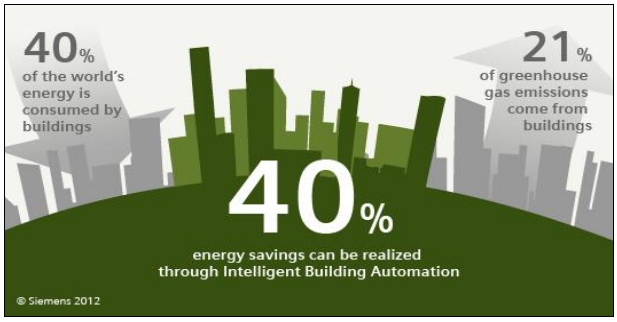
front cost vs. life-cycle cost. The savings in money come from more efficient use of utilities which result in decreased energy bills. It is projected that different sectors could save $130 Billion on energy bills. Also, higher worker or student productivity can be factored into savings and cost deductions.Numerous studies have shown the measurable benefit of green building initiatives on worker productivity. In general it has been found that, "there is a direct correlation between increased productivity and employees who love being in their work space." Specifically, worker productivity can be significantly impacted by certain aspects of green building design such as improved lighting, reduction of pollutants, advanced ventilation systems and the use of non-toxic building materials.




**Ref: Green building products in upcoming years**

## XI.REGULATION AND OPERATION

As a result of the increased interest in green building concepts and practices, a number of organizations have developed standards, codes and rating systems that let government regulators, building professionals and consumers embrace green building with confidence. In some cases, codes are written so local governments can adopt them as bylaws to reduce the local environmental impact of buildings. Green building rating systems such as BREEAM (United Kingdom), LEED (United States and Canada), DGNB (Germany) and CASBEE (Japan) help consumers determine a structure's level of environmental performance. They award credits for optional building features that support green design in categories such as location and maintenance of building site, conservation of water, energy, and building materials, and occupant comfort and health. The number of credits generally determines the level of achievement. Green building codes and standards, such as the International Code Council's draft International Green Construction Code are sets of rules created by standards development organizations that establish minimum requirements for elements of green building such as materials or heating and cooling.




**Ref: International frameworks and assessment tools**

## XII.IPD ENVIRONMENT CODE

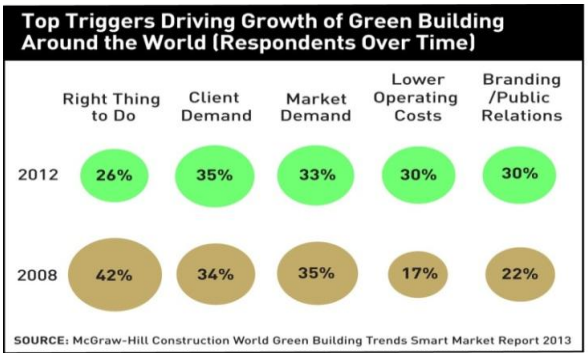
The IPD Environment Code was launched in February 2008. The Code is intended as a good practice global standard for measuring the environmental performance of corporate buildings. Its aim is to accurately measure and manage the environmental impacts of corporate buildings and enable property executives to generate high quality, comparable performance information about their buildings anywhere in the world. The Code covers a wide range of building types (from offices to airports) and aims to inform and support the following;

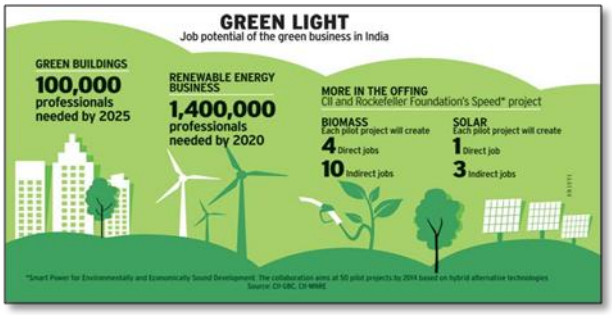
- Creating an environmental strategy
- Inputting to real estate strategy
- Communicating a commitment to environmental improvement
- Creating performance targets
- Environmental improvement plans
- Performance assessment and measurement
- Life cycle assessments
- Supplier management
- Information systems and data population
- Compliance with regulations
- Team and personal objectives

IPD estimate that it will take approximately three years to gather significant data to develop a robust set of baseline data that could be used across a typical corporate estate.

## XIII.ISO 21931

ISO/TS 21931:2006, Sustainability in building construction—Framework for methods of assessment for environmental performance of construction works—Part 1: Buildings, is intended to provide a general framework for improving the quality and comparability of methods for assessing the environmental performance of buildings. It identifies and describes issues to be taken into account when using methods for the assessment of environmental performance for new or existing building properties in the design, construction, operation, refurbishment and deconstruction stages. It is not an assessment system in itself but is intended be used in conjunction with, and following the principles set out in, the ISO 14000 series of standards.




**Ref: Job Profile in the sector of Green Building Designing Wikipedia**

## XIV.FINAL CONCLUSION

In today's vastly developing world, energy & environment are the two very important concerns. Environmental pollution & solid waste problems are also increasing day by day. Energy savings upto 60% is achievable, if the buildings are designed using green design principles. The final selection of the green design measures should be done after doing a cost benefit analysis of the same. The measures described have a payback period between 1-2 years & its benefits will last for years to come.Energy building design should not be an isolated effort by an inspired individual, but a standard design process should be adopted in all future buildings.

## REFERENCES

[1.] Yan Ji and Stellios Plainiotis (2006): Design for Sustainability. Beijing: China Architecture and Building Press. ISBN 7-112-08390-7

[2.] U.S. Environmental Protection Agency. (October 28, 2009). Green Building Basic Information. Retrieved December 10, 2009, fromhttp://www.epa.gov/greenbuilding/pubs/about.htm

[3.] Hopkins, R. 2002. *A Natural Way of Building.* Transition Culture. Retrieved: 2007-03-30.

[4.] Allen & Iano, 2008[Allen, E, & Iano, J. (2008). Fundamentals of building construction: materials and methods. Hoboken, New Jersey: John Wiley & Sons Inc.

[5.] GSA Public Buildings Service Assessing Green Building Performance

[6.] Howe, J.C. (2010). Overview of green buildings. National Wetlands Newsletter, 33(1)

[7.] Mao, X., Lu, H., & Li, Q. (2009). *International Conference on Management and Service Science, 2009. MASS '09.*, 1-5. doi:10.1109/ICMSS.2009.5303546

[8.] Carson, Rachel. Silent Spring. N.p.: Houghton Mifflin, 1962. Print.

[9.] Mao, X., Lu, H., & Li, Q. (2009). International Conference on Management and Service Science, 2009. MASS '09., 1-5. doi:10.1109/ICMSS.2009.5303546

[10.] U.S. Environmental Protection Agency. (October 28, 2010). Green Building Home. Retrieved November 28, 2009, from http://www.epa.gov/greenbuilding/pubs/components.htm

[11.] WBDG Sustainable Committee. (August 18, 2009). Sustainable. Retrieved November 28, 2009, from http://www.wbdg.org/designsustainable.php

[12.] Hegazy, T. (2002). Life-cycle stages of projects. Computer-Based Construction Project Management, 8.

[13.] Pushkar, S., Becker, R., & Katz, A.(2005). A methodology for design of environmentally optimal buildings by variable grouping. *Building and Environment*, 40. doi:10.1016/j.buildenv.2004.09.004