Review Article

GREEN BUILDINGS - A REVIEW

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Abstract

The improving energy efficiency of buildings and energy systems, developing sustainable building concepts and promoting renewable energy sources. “Green” or “sustainable” buildings use key resources like energy, water, materials, and land more efficiently than buildings that are just built to code. With more natural light and better air quality, green buildings typically contribute to improved health, comfort, and productivity. A green building depletes the natural resources to the minimum during its construction and operation. The aim of a green building design is to minimize the demand on non-renewable resources, maximize the utilization efficiency of these resources, when in use, and maximize the reuse, recycling, and utilization of renewable resources. It maximizes the use of efficient building materials and construction practices; optimizes the use of on-site sources and sinks by bioclimatic architectural practices, uses minimum energy to power itself, uses efficient equipment to meet its lighting, air-conditioning, and other needs, maximizes the use of renewable sources of energy, uses efficient waste and water management practices, and provides comfortable and hygienic indoor working conditions. In sum, the following aspects of the building design are looked into in an integrated way in a green building.

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1. Introduction

A sustainable building, or green building is an outcome of a design which focuses on increasing the efficiency of resource use energy, water and materials while reducing building impacts on human health and the environment during the building's lifecycle, through better sitting, design, construction, operation, maintenance, and removal. Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by (i) Efficiently using energy, water, and other resources and (ii) Reducing waste, pollution and environmental degradation.

Green building practices aim to reduce the environmental impact of buildings. Buildings account for a large amount of land use, energy and water consumption, and air and atmosphere alteration. The environmental impact of buildings is often underestimated, while the perceived costs of green buildings are overestimated. A recent survey by the World Business Council for Sustainable Development finds that green costs are overestimated by 300 per cent, as key players

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in real estate and construction estimate the additional cost at 17 per cent above conventional construction, more than triple the true average cost difference of about 5 per cent (Doreen et al., 2012).

2. Building Materials

Building materials typically considered to be 'green' include rapidly renewable plant materials like bamboo (because bamboo grows quickly) and straw, lumber from forests certified to be sustainably managed, ecology blocks, dimension stone, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and or recyclable (e.g. Trass, Linoleum, sheep wool, panels made from paper flakes, compressed earth block, adobe, baked earth, rammed earth, clay, vermiculite, flax linen, sisal, seagrass, cork, expanded clay grains, coconut, wood fiber plates, calcium sand stone, concrete (high and ultra high performance, roman self-healing concrete, etc.). The EPA (Environmental Protection Agency) also suggests using recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects. Polyurethane heavily reduces carbon emissions as well. Polyurethane blocks are being used instead of CMTs by companies like American Insulock (Sailor, 2008). Polyurethane blocks provide more speed, less cost, and they are environmentally friendly. Building materials should be extracted and manufactured locally to the building site to minimize the energy embedded in their transportation.

3. Reduced energy use

Green buildings often include measures to reduce energy use. To increase the efficiency of the building envelope, (the barrier between conditioned and unconditioned space), they may use high-efficiency windows and 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 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 loads. Finally, 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 (Fadi Chlela et al., 2011).

4. Reduced waste

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 onsite solutions such as compost bins to reduce matter going to landfills. To reduce the impact on wells or water treatment plants, several options exist. “Grey water”, 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 (Thomas Menino, 2009). 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.

5. 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 (Srinivas, 2010). 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
- Acquisition and disposal of buildings
- Supplier management
- Information systems and data population
- Compliance with regulations
- Team and personal objectives

The 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.

6. ISO 21931

ISO/TS 21931:2006, Sustainability in building construction Framework for methods of assessment for environmental performance of construction works 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 (Greg Kats and Leon Alevantis, 2008).

7. “TERI” In India

The Energy and Resource Institute plays a very important role in developing green building capacities in the country. MNRE (ministry of new and renewable energy) adopted Griha in November 2007, and launched it in North India. Now, it plans to use Griha in the South. Griha will focus on Indian climatic conditions, also called bioclimatic architecture. Griha is different from other rating systems, it not only focuses on Indian climate but Indian life style and economy as well. Griha is a 100 - point system with 34 criteria. Based on points obtained, the ministry grants stars. A five star building is the greenest building. Registration for certification needs to be completed before beginning the building project (ENVJS).

- Up to 30% reduction in energy consumption
- Limited waste generation due to recycling
- Less water consumption
- Reduced pollution

TERI came up with a rating system called GRIHA which was adopted by the Govt. of India as the National Green Building Rating System for the country. GRIHA aims at ensuring that all kinds of buildings become green buildings. The strengths of GRIHA lie in the fact that it rates even non-air conditioned buildings as green and puts great emphasis on local and traditional construction knowledge. The CESE building in IIT Kanpur became the first GRIHA rated building in the country and it scored 5 stars, highest in GRIHA under the system. It has become a model for green buildings in the country. It has proved that with little extra investment, tremendous energy and water savings are possible. There are various projects which are the first of their kinds to attempt for green building ratings like apartment residential buildings and non air conditioned buildings. Measures are being taken to spread awareness about the GRIHA -National Green Building Rating System of India.

8. Confederation of Indian Industry (CII)

The Confederation of Indian Industry (CII) plays an active role in promoting sustainability in the Indian construction sector. The CII is the central pillar of the Indian Green Building Council or IGBC. The IGBC has licensed the LEED Green Building Standard from the U.S. Green Building
Council and currently is responsible for certifying LEED-New Construction and LEED-Core and Shell buildings in India (Urbikain and Sala, 2009).

9. Indian Bureau of Energy Efficiency (BEE)

The Indian Bureau of Energy Efficiency (BEE) had launched the Energy Conservation Building Code (ECBC) on February 2007. The code is set for energy efficiency standards for design and construction with any building of minimum conditioned area of 1000 Sq meter and a connected demand of power of 500 KW or 600 KVA. The energy performance index of the code is set from 90 KWh/sqm/year to 200 KWh/sqm/year where any buildings that fall under the index can be termed as "ECBC Compliant Building". More over the BEE had launched a 5 star rating scheme for office buildings operated only in the day time in 3 climatic zones, composite, hot & dry, warm and humid on 25th February 2009.

10. The costs and financial benefits of green buildings

Integrating “sustainable” or “green” building practices into the construction of state buildings is a solid financial investment. In the most comprehensive analysis of the financial costs and benefits of green building conducted to date, a minimal upfront investment of about two percent of construction costs typically yields life cycle savings of over ten times the initial investment. For example, an initial upfront investment of up to Rs.100,000 to incorporate green building features into a Rs. 5 million project would result in a savings of at least Rs.1 million over the life of the building, assumed conservatively to be 20 years. The financial benefits of green buildings include lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower operations and maintenance costs and savings from increased productivity and health. These benefits range from being fairly predictable (energy, waste and water savings) to relatively uncertain (productivity/health benefits). Energy and water savings can be predicted with reasonable precision, measured and monitored over time. In contrast, productivity and health gains are much less precisely understood and far harder to predict with accuracy (Joe Hackler and John Holdren, 2008).

11. Conclusion

The green building experiences in India have been exciting and challenging as well. This will ultimately serve to improve not only the energy performance of buildings but will also assist the country conserve energy and natural resources by spurring increased recovery and recycling of building materials. The easy availability of most of the green materials and equipment in the country has made it easier for the designers to adopt local materials to a very large extent. Now there is an imminent need for service providers, who would be required in large numbers, not in hundreds but thousands, as the movement is heading to reach greater heights. The green building movement is here to stay for the benefit of individuals, society and the country at large. And energy savings are only the most obvious and most easily quantified of the cost benefits of green buildings. Furthermore, over time the real advantages offered by green buildings will be recognized increasingly as critical to companies’ having a competitive edge. We must think boldly and broadly about energy efficiency, conservation, and smart growth. Sustainability of growth – not mere growth – is the goal of both the smart company and the smart city. While, clearly, this is true for reasons related to the well being of our environment, it is equally true for reasons related to the competitive arena of the business world. Beyond the obvious importance of safeguarding our environment and health, high performance green building will also benefit India’s economy.

12. References

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