

The Emerging Trends in Green Building Construction Practice

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Abstract-Green building is already widely adopted globally, with strong growth expected in many countries. Globally buildings are responsible for a huge share of natural resource consumption. The building sector has the greatest potential to deliver significant cuts in emissions at little or no cost. Globally buildings account for 9 billion tones of CO₂ annually. If new technologies in construction are not adopted during this time of rapid growth, emissions could double by 2050, according to the United Nations Environment Program. The emerging trends in green building practices aim to reduce the environmental impact of building; energy-efficient, environmentally sound methods are used in design and construction. This paper is focusing particularly on the innovations done in the last few years in the field of green building construction.

Keywords: Green Buildings, New technology, Benefits, Emerging trends, CO₂ emission

1 INTRODUCTION

The built environment makes a significant contribution to environmental degradation. Buildings including construction, operations and deconstruction impacts, use approximately 15% of the world's fresh water resources, 40% of the world's energy and produce approximately 30% of the world's greenhouse gas emissions. The analyst forecast global market to grow at a CAGR of 9.6% during the period 2016-2020. To prevent the worst effects of global climate change and minimize other negative environmental impacts, it is therefore important to address the environmental impacts of buildings. In fact, energy efficiency reductions in the construction and operation of buildings, offers one of the single most significant opportunities to reduce man's impact on climate change.

The smart market report revealed that consumer demand has pushed the world green building market to 1 trillion-dollar industry and expected huge growth in the future.

2 GOALS OF GREEN BUILDING

The basic goal of green building is attractive, comfortable, affordable shelter that does no harm to the Earth in its manufacture, or its use. This overarching goal is driven by four further goals:

1. Reducing impacts on the Earth from constructing buildings and their materials
2. Reducing impacts which arise during occupancy
3. Reducing the impact of the structure at the end of its life
4. Creating a more desirable human experience

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3 BENEFITS TO GREEN BUILDING

Green buildings improve the health, wellbeing, and quality of life for occupants as well as the surrounding community. The community also benefits from a reduction in pressures on the local infrastructure and service delivery systems. One of the most often cited benefits of green building is the reduction in energy costs that stem from energy efficiency measures, which also help reduce greenhouse gases. Green buildings have benefited not just to owners and occupants, but to the larger environment as well. Emission reduction, water conservation, storm water management, temperature moderation, and waste reduction, energy and water savings, increased property values, decreased Infrastructure strain, improved employee attendance, increased employee productivity, sales improvements, development of local talent pool, improved health, improved schools, healthier lifestyles and recreation are the benefits of sustainable construction.

4 ADAPT NEW TECHNIQUES AND STRATEGIES FOR GREEN BUILDING

Traditionally green building aims to be sustainable by aiming for low carbon emissions, typically by being energy efficient. Achieving energy efficiency in buildings will depend on the building type. In offices you need to address lighting and heating, ventilation and air-conditioning (HVAC). The most obvious way to work towards energy efficiency and hence carbon neutrality is to employ techniques to control the temperature. Comfortable indoor temperatures can be achieved by the use of effective passive heating and cooling systems which harness natural ventilation and shading. Increased solar shading, controllable natural ventilation and high thermal mass significantly decrease energy usage and carbon emissions. Adapted Energy-efficient techniques include, Passive solar, Passive cooling, Active solar, Earth shelter, Energy devices: Heat pumps; Photovoltaic panels, earth walls; earth bricks; Rammed earth systems; Ceramic structures; Earth ships – earth-sheltered structures made of soil-filled tires, Isolative materials, Plant materials like Stressed straw panels.

5 EMERGING TRENDS IN GREEN BUILDING CONSTRUCTION

In addition to energy efficiency and better conservation of resources new trends and innovative materials will be an important factor in the development of sustainable construction. New materials and methods are developed as smart, sustainable upgrades of traditional materials, as they effectively deal with the natural elements. Some of them are:

5.1 Retrofitting existing buildings

Retrofitting and renovation or refurbishment of existing buildings are upgraded energy efficiency or decrease energy demand. Generally, this includes the adoption of energy-efficiency strategies. In the commercial sector this includes: utilizing variable-speed drive, HVAC systems and increasing efficiency in lighting by replacing with electronic ballasts and replacing incandescent lighting with CFLs.



Figure: 1 ITC Maurya, New Delhi

5.2 Low income housing

Low-cost housing scheme is to subsidize the construction of each house. Due to these cost constraints the units typically only include a small pre-paid electricity unit, two plug points and two light units and establish a number of energy saving measures which can be incorporated into low-income housing. These measures include: Ceilings with insulation; Internal and external plastering; Plastic membrane under floor; Sealing the house at ground level

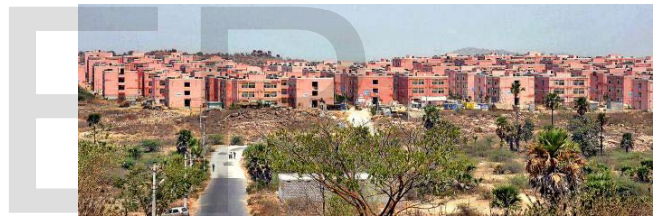


Figure: 2 JNNURM housing colony, Hyderabad

5.3 Water conservation methods

Buildings consume 15% of the world's fresh water resources. The growing awareness of the global crisis in fresh water supply will lead to reduce water consumption in buildings with ultra low flow fixtures, rain-water recovery systems, retrofit old plumbing and innovative water technologies.

5.4 Carbon neutrality

The threatening of global climate change has forced a focus and move towards carbon neutrality in all human activity. For the built environment this will mean a trend towards zero carbon buildings. The United Kingdom (UK) has pledged that by 2016 all new homes have to be zero carbon homes. This means that all new homes in the UK, from 2016, are to be built in such a way that the building will have net zero carbon emissions over the course of a year, after taking account of: emissions from space heating,

ventilation, hot water and fixed lighting To meet the zero carbon homes standard, homes should.



Figure 3 Indira Paryavaran Bhawan, New Delhi

5.5 Green or living roofs

One technique that has gained popularity is that of using living or green roofs. A green roof is a roof of a building that is partially or completely covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane. This type of roof has several advantages, including its beauty, its ability to assist the house with blending into the environment and providing climatic stabilization. A living roof reduces heating and cooling loads on a building; reduces storm-water runoff; filters pollutants and carbon dioxide out of the air; and increase wildlife habitat in built-up areas, among other advantages. It is believed that if 8% of roofing in the city is greener then the ambient temperature in the city can be reduced by up to 2 degrees.



Figure 4.CII-Sohrabji Godrej Green Business Centre, Hyderabad

5.6 Living walls or Vertical garden

Living walls or bio walls or vertical gardens can be grown on just about any type of wall, with or without the use of soil, and they can be placed both on outdoor and indoor walls. A popular example of a living wall is at the Musee du quai Branly, Paris. These walls attempt to make use of bio-filtration and photo remediation to draw air through the root system of the wall. Beneficial microbes actively

degrade the pollutants in the air before returning the new, fresh air back to the building's interior. Passive living walls do not have any means of moving the air into the root system.

5.7 Biomimicry

Biomimicry is the concept of copying designs and innovations found in nature. The East gate Centre in Harare, Zimbabwe (Figure 5) is a shopping centre that has mimicked strategies used by termites in termite mounds for temperature control. Termites keep temperatures constant within their large vertical mounds by constantly opening and closing a series of heating and cooling vents throughout the mound over the course of the day. With a system of carefully adjusted convection currents, air is sucked in at the lower part of the mound, down into enclosures with mud walls, and up through a channel to the peak of the termite mound. The termites constantly dig new vents and plug up old ones in order to regulate the temperature. However, it has a ventilation system which operates similarly to a termite mound. Outside air that is drawn in is either warmed or cooled by the building mass depending on which is hotter, the building concrete or the air. It is then vented into the building's floors and offices before exiting via chimneys at the top. The complex also consists of two buildings side by side that are separated by an open space that is covered by glass and open to the local breezes



Figure 5 Exterior of the East gate Centre, Harare

5.8 Cradle-to-cradle design

An emerging concept of cradle-to-cradle design aims to create buildings, communities and systems that generate wholly positive effects on human and environmental health. Cradle-to-cradle design is based on the closed-loop nutrient cycles found in nature, in which there is no waste, as opposed to cradle to-grave design which sees materials as a waste management problem. For example, these buildings would use materials designed as biological nutrients that could biodegrade safely and restore soil after use. There could also be materials that are technical

nutrients as well as potentially infinitely recyclable. The future may in fact have buildings that function more like trees, in that they may make oxygen, sequester carbon, fix nitrogen, distil water, provide habitat for thousands of species, accrue solar energy as fuel, build soil, create microclimate, change with the seasons and are beautiful.

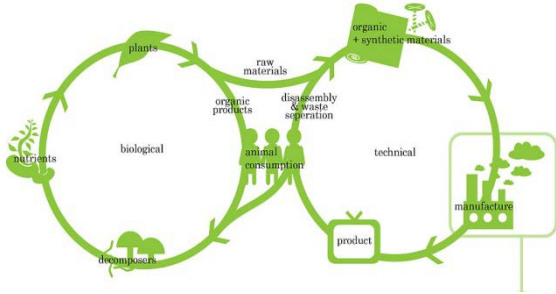


Figure: 6 Biological and Technical cycle

5.9 Glass Fiber Reinforced Gypsum (GFRG) Panel Building System

Production of Gypsum in 2014 is 246000 thousand metric tons of stockpiled gypsum, generated as waste at various fertilizer plants and mining. Research has found gypsum to be a durable material, and it is already heavily in use as partition walls. Experts predict that a building made of GFRG panels can have a life span of 60 years. A GFRG building does not require beams and columns.

Table:1 Advantages of GFRG panels

82%	• Less Construction time
76%	• Less Sand usage
65%	• Less Labour time
50%	• Less Cement usage
35%	• Less Steel usage
27%	• Less Coarse aggregates



Figure: 7 GFRG residential building, IIT, Chennai

5.10 Monolithic Concrete Construction System uses Aluminum Formwork Technology

In this system instead of traditional column and beam construction; all walls, floors, slabs, columns, beams, stairs, together with door and window openings are cast in place in one operation on site by use of specially designed, easy to handle modular form work made of Aluminum . Using the formwork system, rapid construction of multiple units of repetitive type can be achieved. Suitable for both low rise to high rise structures



Figure: 8 Oxygen towers, Visakhapatnam, India

It is 100% recyclable; the reinforced bars used in this system on average weight 33 Kg per square meter, as compared with about 50 Kg in conventional methods.

5.11 Low-emittance windows and smart glass

For instance, a green version of windows is low-emittance windows, which are coated with metallic oxide to block the sun's harsh rays during summer and keep the heat inside in the winter. More than serving the conventional function of windows, low-emittance windows significantly bring down HVAC costs.

A more advanced version of this, which has yet to be widely and commercially available, is smart glass, also known as electro chromic glass. Using a small amount of electricity, the smart glass charges ions to control the amount of light it reflects. In effect, this glass tints during the sun's peak hours and returns to transparent at night

There are many types Green architecture glasses are available in the market which includes the following

1. Insulated (doubled and triple glazed glass)
2. Gas filled glazing
3. Heat- absorbing tinted
4. Low emissivity coatings
5. Spectrally selective glass
6. Reflective coatings
7. Electro chromic glass

The design and placement of glass is a fundamental constituent of Green architecture. It permits natural light and puts together the interior of office and residential buildings with the exterior. Natural light enhances productivity in the workplace and helps uphold a healthy environment

5.12 Green Concrete

Green concrete is an environment friendly concrete. Green concrete improves the three pillars of sustainability: environmental, economic, and social impacts. Green concrete should follow reduce, reuse and recycle technique or any two processes in the concrete technology. The three major objectives behind the green concept in concrete is to reduce greenhouse gas emission; to reduce the use of natural resources such as limestone, shale, clay, natural river sand, natural rocks that are consuming for the development of human mankind that are not given back to the earth; and the use of waste materials in concrete that results in the air, land and water pollution. This objective behind green concrete will result in the sustainable development without destruction natural resources.

5.13 Passive building

The expression passive building refers to a construction standard that can be achieved using various types of construction materials. It can also mean a green building construction that guarantees an interior climate as comfortable in summer as it is in winter without a conventional heating system. The purpose of the passivhaus is to reduce energy consumption in residential buildings by capturing a passive solar energy contribution, reinforcing building insulation, using renewable energies and recuperating heat. The passive building mark includes many specific and technical elements concerning windows, insulation and facade seals, air renewal, etc. Rigorous testing is carried out to obtain the passive building mark.



Figure: 9 Transport Corporation of India Ltd (TCIL), Gurgaon

Individual passive houses are often compact. This is one condition for achieving low energy consumption.

5.14 Building Management system (BMS)

Building management system (BMS), is a computer-based control system installed in buildings that controls and monitor building's mechanical and electrical equipment such as Illumination control, Electric power control, Heating, ventilation and air-conditioning (HVAC), Security and observation, Access control, Fire alarm system, lifts, elevators, Plumbing, Closed-circuit television, Other engineering systems, Control Panel, PA system, Alarm Monitor, Security Automation etc. A fully optimized BMS can save energy to the cost extent of 15% to 20% as compared to a building without BMS



Figure: 10 A fully optimized BMS system

5.15 Rain garden with native plants

A rain garden is a planted depression or a hole that allows water runoff from impervious urban areas, like roofs, driveways, walkways, parking lots, and compacted lawn areas, the opportunity to be absorbed. This reduces rain runoff by allowing storm water to soak into the ground (as opposed to flowing into storm drains and surface waters which causes erosion, water pollution, flooding and groundwater)



Figure: 11 CII-Sohrabji Godrej Green Business Centre, Hyderabad

The purpose of a rain garden is to improve water quality in nearby bodies of water and to ensure that rainwater available for plants as groundwater rather than being sent through storm water drains straight out to sea. Rain gardens can cut down on the amount of pollution reaching creeks and streams by up to 30%. Native and adapted plants are recommended for rain gardens because they are more tolerant of one's local climate, soil, and water conditions; have deep and variable root systems for enhanced water infiltration and drought tolerance; habitat value and diversity of local ecological communities; and overall sustainability once its established.

6 CONCLUSIONS

This paper concludes that the built environment is without any doubt a major contributor to global CO₂ emissions and has a larger impact on the natural resource. The uptake of green building concepts and techniques is largely focused on eco-efficiency and healthy living. It should be noted that simply reducing negative impacts by a certain percentage is not going to solve the world's environmental problems; though it can certainly help if it becomes standard practice by all stakeholders. This includes moving towards true sustainability by utilizing holistic measures. The primary focuses of the green building professionals, governments, builders and occupants are adopting innovative sustainable measures in their future construction.

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