

A STUDY OF PLANNING, DESIGNING & CONSTRUCTION STRATEGIES FOR GREEN BUILDINGS

¹DHANYA V, ²M DHIVYA, ³MICHEAL RAJ, ⁴D A ANILA DANI

^{1,2,3,4} Department of Civil Engineering, R.V.S TECHNICAL CAMPUS, COIMBATORE, INDIA

ABSTRACT: Building sector is considered as the biggest source of greenhouse gas emissions around the world being green, or sustainable, is one of primary issues coming from internal/ external drivers for construction and engineering firms. The green building practice extends and supplement the traditional building design perspectives including economy, utility, durability, and comfort. This paper presents a review on recent advances dedicated on different state-of-art articles in the area of green building. The paper raises serious concern to take the necessary actions for green building development. The strategies offered here are presented as design options, or ideas to consider. They are voluntary. The strategies do not necessarily support each other, and the use of one strategy may preclude the use of others. Designers, owners and others will need to weight the benefits of using any particular set of strategies. There may be tradeoffs needed to achieve the diverse design goals of any particular project. The field of green building design is evolving quickly. The list of strategies presented here should not preclude the design team from exploring other strategies not covered in this document. This document is offered as a resource for those interested in exploring a variety of strategies to build more environmentally responsible buildings. It is intended to be useful for the design team of a green building project, including the owner, project managers, engineers, architects, landscape architects, value analysis consultants, green consultants, cost consultants, energy engineers, construction managers, government agencies and any other person or group involved in the design.

INTRODUCTION

India is a fast-growing country. Rapid industrialization, increasing population, infrastructure development and destruction of natural resources lead to construction of green building. Green building is a structure that is environmentally responsible and resource efficient throughout its lifecycle. Green building is also known for its sustainability and high performance. A 'Green' building is a building that, in its design, construction or operation, reduces or eliminates negative impacts and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life. Any building can be a green building, whether it's a home, an office, a school, a hospital, a community center, or any other type of structure. There are a number of features which can make a building 'GREEN'. These include:

- ❖ Efficient use of energy, water and other resources
- ❖ Use of renewable energy, such as solar energy
- ❖ Pollution and waste reduction measures, and the enabling of re-use and recycling
- ❖ Good indoor environmental air quality
- ❖ Use of materials that are non-toxic, ethical and sustainable

- ❖ Consideration of the environment in design, construction and operation

- ❖ A design that enables adaptation to a changing environment

STUDY OF GREEN BUILDINGS

Thermal comfort studies on traditional residential buildings of Kerala that is known for its use of natural and passive methods for a comfortable indoor environment, are under progress. Passive methods of achieving thermal comfort inside the buildings are the best solution to provide a healthy and energy efficient indoor environment. This is of supreme importance for buildings in the tropics where mechanical systems with high energy consumption are used to condition the indoor environment for thermal comfort. The people are forced to depend on such systems because, majority of the buildings are designed without giving adequate importance to passive methods for controlling the indoor environment. In many cases, failure to provide the required thermal conditions has resulted in discomfort, ill health and productivity loss. Presently, there is a constant need to evaluate the thermal conditions of the indoor environments to learn further

and proceed with the research in passive design. Water is a critical and finite resource. It covers over 71% of the Earth's surface and is essential for life, playing a key role in the production of food, human health and sustaining the natural environment.

However, water, particularly of drinking water quality, is becoming increasingly scarce in most of the populated regions of the planet. The pressure is on to reduce water demand by reducing wastage, to reuse or recycle as much as possible, and to look at other means of minimizing our impact on the water environment. Overall, we must be more efficient with our water utilization. Disposing of waste has huge environmental impacts and can cause serious problems. Some waste will eventually rot, but not all, and in the process, it may smell or generate methane gas, which is explosive and contributes to the greenhouse effect. Waste that is not properly managed, especially excreta and other liquid and solid waste from households and the community, are a serious health hazard and lead to the spread of infectious diseases. Unattended waste lying around attracts flies, rats, and other creatures that in turn spread disease.

Normally it is the wet waste that decomposes and releases a bad odor. This leads to unhygienic conditions and thereby to a rise in the health problems. Plastic waste is another cause for ill health. Thus, excessive solid waste that is generated should be controlled by taking certain preventive measures. Hence green building has high importance and relevance than ordinary residential building.

TOP EFFICIENT GREEN BUILDINGS IN INDIA

Solar Air Conditioning:

Turbo Energy Limited, Chennai the solar air conditioning in Turbo Energy systems in Chennai uses solar power to condition or control the air in the building by passive solar, solar thermal energy conversion and photovoltaic conversion in which sunlight is converted to electricity.

Earth Air Tunnels and Passive Cooling:

Aqua mall water solutions, Dehradun and Police Bhavan, IGP office, Gulbarga Earth tunnel Air conditioning system also known as passive air

conditioning installed in Aqua mall water solutions in Dehradun, is a wonderful utilization of nature. The system sucks in air from the outside and with the help of geothermal cooling the air is sent to interiors. The IGP office in Gulbarga uses Passive draught evaporative cooling (PDEC) system where air passes through a layer of water in the wind tower. This cools down the water and that water is sent to the interiors of the building which is similar to the Earth tunnel air conditioning system.

Thermal Storage:

TCS Techno-park and Grundfos Pumps, Chennai This is achieved with the thermal energy systems which collect energy and store it for later use, even months later. This also works inter-seasonally where during winters it uses the solar heat collected in the solar collectors and during summer it uses the cold air conditioning obtained from the winter air.

High Performance Envelope:

ITC Royal Gardenia, Bangalore ITC Gardenia in Bangalore has reduced heat gain to large extent by their design and have experienced serious energy savings.

In modern construction, a thoughtful integration of Green Building technology can make a tremendous difference in an overall appeal of a newly constructed building. Green Building helps preserve the external environment and provides great benefits to humans through the use of environmentally safe and energy-efficient building materials, efficient use of natural resources, human safety, wellbeing and health and wellness considerations. Constructing the building is safe for the surrounding environment and will not significantly interfere with the wild life, its patterns of daily life, and that it will not negatively affect the natural environment. nearby. It also means that building is constructed from environmentally friendly materials that are available locally and that the construction process is well designed to reduce the unnecessary pollution and negative effects on the environment.

FEATURE OF A GREEN BUILDING

Important feature of a green building is its design aimed at providing comfortable and safe environment for the human occupants. It means that building will be pleasant and safe for people to be in.

It could contain the elements of intuitive floor plans, spacious and well-lit hallways, fresh-air circulation and monitoring units, dampness and temperature controls. Use of Human safe materials and pleasant architectural design that provides psychological and physiological benefits for human occupants. The most fundamental benefit of Green Building is that it is environmentally friendly and safe for people occupying the building. A well designed and constructed green building is well integrated into the environment in which it is built and does not detract from it. It is pleasant and safe for people who use the building on a daily basis. Its aesthetic appeal of carefully designed and well-integrated architectural features, such as efficient use of space, intuitive layouts, and pleasant lighting offer psychological benefits to people. While, elements such as clean air monitoring and circulating systems, handicap access, clean water and other elements make it safe and beneficial to human health. Another important benefit of Green Building is Energy Efficiency, which deals with a building's energy consumption for cooling and Heating needs. Green building elements dealing with energy efficiency include the use of environmentally friendly insulation, energy efficient windows, and solar-reflective building envelope materials such as metal roofing, and metal wall panels that help minimize unwanted heat gain or loss inside a building. Other elements of a green building include effective use of natural lighting, and renewable energy generating systems all aimed at reducing energy consumption, which results in cleaner environment and direct cost savings for building owners.

We are traditionally used to using earth bricks, concrete, and wood in construction. They have been, and continue to be used in everyday construction, meaning the continued destruction of trees for timber, and the mining of resources to produce cement for binding sand, gravel, and bricks. For a better world, there are new processes, and sustainable as well as green building material alternatives that can be used in construction today.

MAJOR FACTORS OF ENVIRONMENTAL PERFORMANCE

According to the U.S. Department of Energy (DOE), the residential sector consumed 10.8 Quads of delivered energy and this does not include energy lost

during production, transmission and distribution to the consumers. Moreover, in residential buildings alone, 1192 million metric tons of CO₂ emissions were recorded in 2006. Between 1990 and 2008, total residential CO₂ emissions increased by 27.5% while population increased by only 22%. Also U.S. buildings emissions approximately equal the combined CO₂ of Japan, France and the United Kingdom (EIA 2008). In 2007, approximately 1,219,000 new single-family housing units were built in United States and perhousehold energy expenditure was increased about 12% from the averaged national amount of 2005 (\$1873). This trend thus indicates that construction of single-family units is on the rise and in the future, it will have a huge impact on the overall energy consumption in the U.S. Such ever-increasing demand could place significant strain on the current energy infrastructure and potentially damage world environmental health by CO, CO₂, SO₂, and NO_x effluent gas emissions and global warming. Use of BIM in environmental performance analysis Due to the technological developments and availability of modern construction materials the limitations of architect's imagination have been minimized (Laptali et al. 1997). As performance issues like comfort and energy become increasingly.

EFFICIENT USE OF RESOURCES In green building practices, efficient use of resources means using water saving faucets and plumbing elements, energy efficient lighting units and passive solar design. It also involves, the use of energy efficient building materials aimed to attain highly energy efficient building envelope with well insulated walls, floors and ceilings. A well-insulated building envelope will help keeping building cooler in the summer and warmer in the winter. Reduced energy consumption provides financial benefits for the building owners and helps reduce the carbon monoxide footprint of the building on the environment.

SCOPE

The increased demand of living and working places due to population explosion, construction industry grows rapidly. It causes severe impact like different types of pollution, leads to global warming and ozone depletion. It adversely affects the human welfare as well as natural habitats. The concept of sustainable

development can be traced to the energy crisis and environmental pollution.

The green building movement in the U.S originated from the need and desire for more energy efficient and environment friendly construction practices. Green building brings together a vast array of practices, techniques and skills to reduce and ultimately eliminates the impacts of buildings on the environment and human health. The green concept and techniques are aimed to achieve energy efficiency, effective waste management and consideration of natural resources and minimum use of fossil fuels. Construction methodology based on these concepts promotes to the health and well-being of the individual and the society at large. These buildings consume minimum energy, water and other resources during the entire life cycle.

OBJECTIVE

The project aims at the following,

- To select and study the energy consumption of an existing residential building.
- Assessment of the selected building using green building assessing tools.
- To adopt techniques to convert the selected building into green building.
- To prepare a 3D model structure showing the green concept to be adopted
- To compare the conventional and green residential building in terms of passive design, material, energy, water use and energy simulation.
- To conserve the natural resources, reducing the soil waste or zero discharge of waste, improved air and water quality, protection of ecosystem and biodiversity thus mitigating the adverse impact of the built environment on human health
- By employing waste management strategies these buildings aim to minimize the burden on municipal waste management facilities
- Using ecofriendly and regionally available construction material
- Need to check using another material in green building like aluminum
- Implementing energy generation and reducing consumption of building

➤ Global warming is going to be the number one problem in the world and there is a need to take the necessary action in the world, we hope the results researchers, governmental agencies and policy makes to set new rules for promoting green building design.

➤ Purpose of project is to convert the selected residential building into green which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste, and provides healthier spaces for occupants

LITERATURE REVIEW

Review of literature will give a deep knowledge in the minds of the reader on the specific topic of interest. Various literature was reviewed based on the objectives of the study.

Green buildings

Avinash shivajirao pawar Journal of Engineering Research and Studies aimed to design green building in order to minimize the demand on non-renewable resources, maximize the reuse, recycle and optimize the use of onsite resources. Green building is defined as the one which focuses on increasing the efficiency of resources and thereby reducing building impact on human health and environment. Paper outlines that the green building experiences in India have been exciting and challenging as well and serves to assist the country to conserve energy and natural resources by spurring increased recovery and recycling of building materials.

Green quotient evaluation of existing buildings

Sunita bansal, s.k. singh, srijit biswas (2013) International Journal of Advanced Research, Volume-3, Issue-5. A Case Study at Delhi regarding an organization's methods to improve a building's performance. Issues were evaluated regarding: - Water audit to establish the areas of the building consuming large amounts of water and targeted for improvement. Waste audit to find out total amount of solid waste generated and how much of it being recycled and sent to incineration and landfill. Condition audit to determine the current condition and expected remaining economic life of building's

components. Thermal audit encompasses thermal comfort, air quality, lighting levels and noise levels. These were audited to find how they currently perform & where improvements can be made.

Sustainable building material for green building construction, conservation and refurbishing

Usman aminus ummar , m.f khamidi and hasan (2012)

Journal of Management in Construction Research Association Sustainable building materials by definition are materials which are domestically created and sourced which decreases transportation costs and CO₂ emissions, they could consist of reused materials, they possess a lower environmental effect, they are thermally effective, they need less energy than conventional materials, they make use of renewable resources, they are lower in harmful emissions and they are economically sustainable. A sustainable building material needs to be used properly and contextually in every community development. The application of sustainable building materials not just minimizes transport costs, carbon emissions, and in most cases materials costs, it also offers employment and skills development opportunities for community members.

Green building project management: obstacles and solutions for sustainable development

Hwang and tan (2012) Journal of Project management aimed to the recent advances on green building design and implementation. Reviewed that we have explained that buildings consumed about 32% of total global final energy and consumed 19% of energy-related GHG emissions and would contribute to global warming. The main barrier for a wide adaptation of green and sustainable buildings in the construction industry includes higher initial expenses and the risks involved in such activities, which could be reduced by utilizing a green project management process.

Rumaiithi and beheiry (2016) Journal of Project management aimed to Sustaining green building initiatives and an argument was constructed on the need to manage these initiatives project. In addition,

there are some advantages associated with green buildings such as lower ecological effect and carbon footprint on the environment, healthier life style for residents and end users, higher service life, less water and energy consumption and less maintenance. The main barrier for a wide adaptation of green and sustainable buildings in the construction industry includes higher initial expenses and the risks involved in such activities, which could be reduced by utilizing a green project management process. Green project management processes may lower the expenses and risks of green projects and raise their competitive advantage versus conventional and less efficient projects. They studied the traditional project management processes used in the United Arab Emirates (UAE) construction industry and discussed the integration of green practices.

Eco efficient construction material for green building

S. Nazeer ahamed and r. Kiran kumar (2013) There are now many tools and techniques for selecting construction materials that are less damaging to the environment. Detailed analysis of the impacts of materials using these techniques can then be reduced to relatively straightforward guidance for the designer. Use natural materials that have low embodied energy and / or environmental impact, Timber (in preference to steel). Concrete reinforced with timber, bamboo or natural fibres. Building wastes, industrial wastes and recycled products. Aerogel materials may also be applied to a building's walls, attics, grounds and appliances. The unusual properties of aerogels open the way to a new range of opportunities for their application in buildings.

Energy efficient / Green and their related issues

Chen min ann, hussein mohammed abualrejal (2018) Identify the benefits of energy efficiency, explore the methods to apply efficient energy usage in green building, and explore the obstacles in attaining energy efficiency in green building. Implementation of energy efficiency practices should be minimized and enhance the effective of energy efficiency practices to attaining sustainability to the company.

Optimize of green building for low income

M.n. uddin, a. Muthu selvam (2018) Sustainable building model by using these tools based on energy efficiency, water efficiency, locally available and low carbon content materials, generate less waste and afford improved spaces for inhabitants, as compared to a traditional building. Observed as there are various sustainability concept for green building optimization such as site selection, orientation, materials selection, energy efficient appliance heating, cooling etc. Low income with the help of Autodesk Revit as well as EDGE Green Building Analyzer. The buildings mainly use the locally available building materials likes terracotta tiles and fly-ash based stabilized blocks. Therefore, it will help to optimize the building materials, construction cost and reducing ecological degradation.

METHODOLOGY

1. Understanding the Green building
2. Data collection
3. Construction plans
 - Program Planning and Site Selection
 - Site Design
 - Building Orientation and Configuration
 - Building Systems Design
 - Structure Design
 - Envelope Design
 - Ventilation Design
 - Water Systems Design
 - Lighting Design
 - Mechanical Design
 - Finalize Building Systems Design
 - Interior Finishes
 - Specifications / Construction Drawings
 - Construction and Commissioning

REFERENCE

1. Hwang, B. G., & Tan, J. S. (2012). “Green building project management: obstacles and solutions for sustainable development. Sustainable development”.
- 2.Hwang,B-G and Ng, W J (2013). “Project management knowledge and skills for green construction: Overcoming challenges.” International Journal of Project Management. 31(2): 272-284.
- 3.Ballard, G. (2000). “Lean project delivery system.” LCI White Paper 8, Lean Construction Institute, Ketchum, ID.
- 4Ballard, G. (2000). “Lean project delivery system.” LCI White Paper 8, Lean Construction Institute, Ketchum, ID.
- 5.Buildings and Climate Change Report: Summary for Decision makers, United Nations Environment Programme, 2009, 2-11.
- 6.Akshay B Mokal, “Green Building Materials- a way towards sustainable construction” International Journal of Application or Innovation in Engineering & Management, 4, 2015, 244-249.
- 7.Alnaser, N.W., Flanagan, R., Alnaser, W.E., (2008), “Model for Calculating the Sustainable Building Index (SBI) in the Kingdom of Bahrain”, Journal of Energy and Building, Vol. 40, Issue 11 pp: 2037- 2043
- 8.Indian Green Building Council (IGBC), (2012), “IGBC Green Homes”- Rating Systems, Abridged Reference Guide, Confederation of Indian Industry (CII),Hyderabad
9. Indian Green Building Council, (2013) cited in <http://www.igbc.in> retrieved on 2013 10.Abdullah, L., Jumadi, N., Sabu, R., Arshad, H., & Mohd Fawzy, F. F.(2015). Assessment criteria on sustainable rating tools used in Asian countries. Jurnal Technology
- 11.Wang W, Zmeureanua R, Rivard H. Applying multi- objective genetic algorithms in green building design optimization. Building and Environment 2005; 40(11):1512–25.
- 12.Usman Aminu Umar¹ , M. F. Khamidi², b and Hassan Tukur³, “sustainable building material for green building construction, conservation and refurbishing”.