

Energy Efficient Buildings

Shristi Khosla¹ and S.K. Singh²

*1PG Student (Structures), Civil Engineering Department,
PEC University of Technology, Chandigarh.*

2Civil Engineering Department, PEC University of Technology, Chandigarh.

Abstract

The building sector alone represents about 35% energy consumption. Realizing the situation, the need of the day is to adopt sustainable green building design approach which is the ultimate solution to reduce the energy demand of the building. Over usage of conventional building materials not only cause global warming but also affects the natural resources. Green or sustainable building use key resources like energy, water, materials, and land more efficiently than buildings that are just built conventionally.

A study has been undertaken for the newly constructed and existing buildings in order to assess its potential and capacity to save energy. The paper thus deals with the various energy saving concepts which can be incorporated at the time of planning, designing, construction and execution stage to have energy efficiency in buildings keeping in mind the cost perspective. Some green buildings have been conceptualized incorporating the various parameters for energy savings and modelled in the software Autodesk Revit. These buildings are analyzed in Autodesk Green Building Studio to assess its energy efficiency, so that various measures could be optimized.

Keywords: Green Buildings, LEED-India, Autodesk Revit, Autodesk Green Building Studio.

1. Introduction

Sustainability has become increasingly important in the building industry in recent years. A movement has occurred to construct buildings in a more efficient and sustainable manner by reducing energy use and the costs associated in operating and

maintaining the building. A green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use; energy, water, and materials while reducing the impact on human health and the environment during the building's lifecycle, through better design, construction, operation, maintenance and removal.



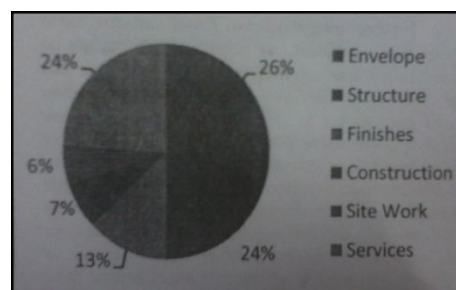
Figure 1: Green Building Design Concept.

Environment friendly innovative technologies like energy efficient materials, intelligent gadgets, energy efficient doors and windows, solar water heating and generating power, rain water harvesting, rain water harvesting are used by many developers in different parts all over the country, but now more and more builders and developers are going in for projects that promote an eco-friendly life style.

2. Energy Efficient Construction

2.1 Need for Energy Efficient construction

The need for energy efficient construction is taking momentum by the rising power consumption in real-estate sector. The buildings being designed and used today are consuming excessive energy for heating/cooling and lightning. There is about 30-40% energy saving potential in the building industry which shall not only reduce the load on the power sector to meet its demand but also help the inhabitants in reducing their energy bills (ECBC, 2007).



Source: Journal of Indian Building Congress, 2010

Figure 2: Percentage of energy Consumption by various components of building.

2.2 LEED - India

The leadership in energy and environmental design (LEED-INDIA) Green Building rating system is a nationally and internationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED-INDIA promotes a whole building approach to sustainability by recognizing performance in the following five key areas: - Sustainable site development, Water Savings, Energy efficiency, Materials selection and Indoor environment quality.

2.3 Various Energy Saving Concepts

- *Site Selection*- Although site selection is usually based on price, a poor decision can preclude several sustainable features. Making the most out of what the site has to offer can be the difference between a high performance building and traditional one.
- *Orientation*- Proper orientation allows for passive solar gain and day lightning. In the northern hemisphere, south facing windows have the greatest exposure to the sun. West facing windows need to be carefully designed, as the low angle of the setting can cause overheating.
- *Walls, and Roof*- the envelope of the building is a significant determinant of how much energy is required to heat and cool it. The challenge in designing the foundation, walls and roofs is to minimize conductive heat loss/gain while minimizing uncontrolled movement of air into the building.
- *Energy Efficient Appliances*- Use of energy efficient and eco-friendly appliance reduces utility cost. While purchasing new electrical appliances always look for BEE star rating. More stars indicate more efficiency. The small additional initial installation cost will be compensated many times over by the savings and the occupants comfort.

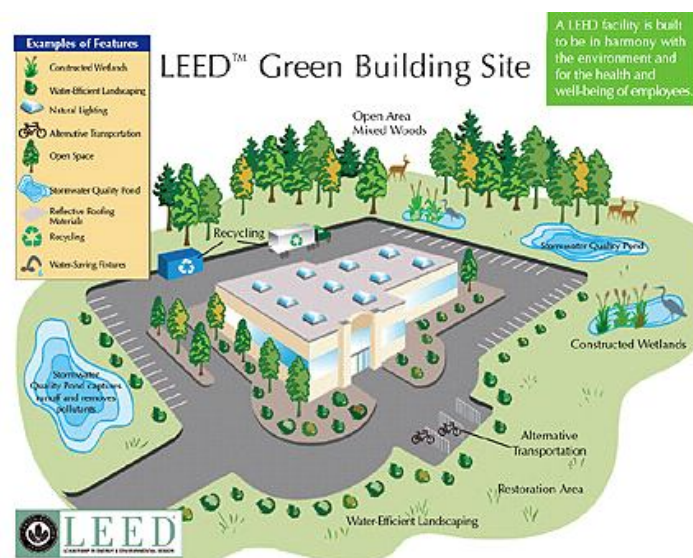


Figure 3: Green Building Site.

- *Heating, Air-Conditioning and Ventilation-* Reducing the heat load of the structure allows for the installation of a smaller heating and cooling system. The importance of high quality ventilation systems is often overlooked during the design phase, but is a fundamental consideration in green building.
- *Waste reduction-* Green architecture also seeks to reduce waste of energy, water and materials during construction. 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 occupants as well, by providing on-site solution such as compost bins to reduce matter going to the landfills.

2.4 Cost Effectiveness

A Green building costs 3-8% more than the conventional buildings. However, the cost is recovered within two to three years through savings in maintenance costs. Due to substantial reduction in operational costs, the total cost of ownership of green building is invariably lesser than the conventional building. Maximum cost increment is due to Efficient envelopes, systems and lightning which are ECBC recommendations. Once ECBC becomes mandatory, there will be no extra cost. Also an analysis shows that the Life Cycle Cost of Energy efficient buildings is lower than that of the conventional buildings (Source: TERI-GRIHA).

3. Energy Modelling for Building Performance

Traditional building design was largely reliant upon two-dimensional drawings (plans, elevations, sections, etc.). Building information modelling extends this beyond 3D, augmenting the three primary spatial dimensions (width, height and depth) with time as the fourth dimension and cost as the fifth. BIM therefore covers more than just geometry. It also covers spatial relationships, light analysis, geographic information, and quantities and properties of building components.

Autodesk Revit® software is specifically built for Building Information Modeling (BIM), empowering design and construction professionals to bring ideas from concept to construction with a coordinated and consistent model-based approach. Revit is a single application that includes features for architectural design, MEP and structural engineering, and construction. It allows to design a building and structure and its components in 3D, annotate the model with 2D drafting elements and access building information from the building models database. The Revit work environment allows users to manipulate whole buildings or assemblies (in the project environment) or individual 3D shapes (in the family editor environment).

Energy Analysis for Autodesk® Revit® software is a cloud-based energy simulation service powered by Autodesk® Green Building Studio® that supports sustainable design.

3.1 Energy analytical Model creation

The energy analytical model feature in Revit building design software provides tools for fast, flexible creation of models for energy simulation. It can create energy

analytical models to suit different design stage needs, workflows, and precision preferences either directly from architectural building elements and room/space elements, or create it manually using conceptual massing.

3.2 Whole building Energy Analysis

Conceptual energy analysis tools help to make every design more sustainable. It can help in presenting analysis results in a highly visual format for easy comparison and interpretation. Also the tools can be used to quickly compare the energy consumption and lifecycle costs of design alternatives right from within Autodesk Revit Architecture software.

Autodesk® Green Building Studio is a flexible cloud-based service that allows to run building performance simulations to optimize energy efficiency and to work toward carbon neutrality earlier in the design process. The Autodesk Green Building Studio web service provides: Annual energy cost • Lifecycle energy costs (30 year) • Annual energy consumption (electric and gas) • Peak electric energy demand (kW) • Lifecycle energy consumption (electric and gas) • Onsite energy generation from photovoltaic and wind systems • Water use analysis • Assistance with day lighting using glaze factor calculations • Natural ventilation potential calculations • Carbon emission calculations. Analysis results are presented in a highly-visual, graphical format for easy interpretation.

It can also facilitate collaborative design, allowing to transfer essential information on your building design to the applications used for engineering design or code analysis. The Autodesk Green Building Studio service can help to change the way building energy analysis is used in the building design process.

4. Conclusion

The construction industry in India is one of the largest economic activities. As the sector is growing rapidly, preserving the environment poses lot of challenges and at the same time presents opportunities for various persons involved in this industry. The sustainable construction is the creation and operation of a healthy, resource-efficient built environment based on ecological principles. It lays emphasis on resource-efficiency, environmental protection, and waste minimization. Energy efficiency is one of the simplest, quickest, cheapest, cleanest ways to address energy and environmental challenges. The incorporation of simple energy efficient measures in buildings can reduce a significant amount of energy consumption. Appropriate knowledge and technology is available for creating energy efficient and green buildings but behavioural, organizational and financial barriers need to be overcome for achieving desired results.

The construction industry must gear up for eco-friendly practices which will help in creating new jobs, and share inspiring cases from India and around the world. This will also help in transition to more sustainable economies, societies related to renewable energy, waste reduction and green building. With the increase in number of green projects, one can see a great future going green.

References

- [1] ECBC 2007 User guide published by Bureau of Energy Efficiency
- [2] The Energy Conservation Act-2001
- [3] Journal of the Indian Building Congress, 2010
- [4] Bureau of Indian Standards 2005, New Delhi
- [5] National Building Code of India 2005, New Delhi
- [6] www.grihaindia.org
- [7] www.mnre.gov.in
- [8] www.igbc.in
- [9] www.glassisgreen.com/Leed-India-green-certification
- [10] www.wikipedia.org
- [11] www.autodesk.in
- [12] www.sustainableresearchgroup.com