BEE (Bureau of energy efficiency) and GREEN BUILDINGS

Dr. Supriya Vyas[1], Ar. Seemi Ahmed[2] and Ar. Arshi Parashar[3]

Abstract:

Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment. *This paper enumerates the various methods of bringing in energy efficiency. It introduces the Bureau of Energy Efficiency BEE (a national body) and presents an overview of the "Energy Conservation Building Code" (ECBC). In this paper, a case study of IIT* Kanpur has been *presented in detail. Despite its huge campus spread over an area of 4.3 square kilometres (1,100 acres) surprisingly, it uses only 605 kWh/m2 per year. Some more "Energy Efficient" buildings of India are also mentioned .In view of fast depleting energy reserves, energy conservation is need of the hour. Efficiently design homes and offices can cut energy bill substantially.*

The Bureau of Energy Efficiency, the relevant code and the Star Rating program, will go a long way to encourage energy efficiency. This program will help identify the careless owners who are frittering away the precious sources of energy. Continued support from the State Governments and the private sector is essential for the success of the program.

We need to wake up and act- and act fast before it is too late. Looking to the dwindling sources of energy and the danger of climatic deterioration caused by high carbon emissions, energy efficient buildings are necessity of today.

Keywords:

BEE (Bureau of Energy Efficiency), ECBC (Energy Conservation Building Code), GRIHA, Energy efficient buildings.

Referring this Paper

Vyas, Supriya; Ahmed, Seemi and Parashar, Arshi (2014). BEE (Bureau of Energy Efficiency) and Green Buildings. International Journal of Research (IJR). Vol-1, Issue-3. Pg-23-32

[1] Assistant Professor, Department of Architecture and Planning,
M.A. National Institute of Technology, Bhopal India,

[2] Assistant Professor, Department of Architecture and Planning,
M.A. National Institute of Technology, Bhopal India,

[3] Student, M.Plan (IV Sem), Department of Architecture and Planning,
M.A. National Institute of Technology, Bhopal India,

Introduction:

Buildings cause a number of environmental problems as a result of their construction, operation and maintenance. They consume a large amount of energy and resources, affect the quality of urban air and water and contribute to climate change. This is because buildings are designed as per building codes without any reference to any major environmental impacts over their entire life cycle.

With recent exponential increase in energy pricing, the formerly neglected or underestimated concept of energy conservation has swiftly assumed great significance and potential in cutting costs and promoting economic development, especially in a developing-country scenario. Energy efficiency in buildings can be achieved through a multipronged approach involving adoption of bioclimatic architectural principles responsive to the climate of the particular location; use of materials with low embodied energy; reduction of transportation energy; incorporation of efficient structural design; implementation of energy-efficient building systems; and effective utilization of renewable energy sources to power the building. India is quite a challenge in this sense. Several buildings have come up, fully or partially adopting the above approach to design. Reckless and unrestrained urbanization, with The Building Energy Rating Certificate (BER) is part of the Energy Performance of Buildings EU Directive. The aim of the Directive, which first came into force in Ireland on 4 January 2003, is to make the energy performance of a building transparent and available to potential purchasers or tenants. Then it became a practice in India also, from 27th may 2007. The BER is simply a check to see how good your house or building is at using energy and will measure how much energy and carbon your building may typically use or produce over a given year. It is only concerned with the fabric of the dwelling and does not take account of occupant behaviour.

GREEN BUILDING:

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. 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.

Although 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.

Figure 1 below shows the benefits of Green building.

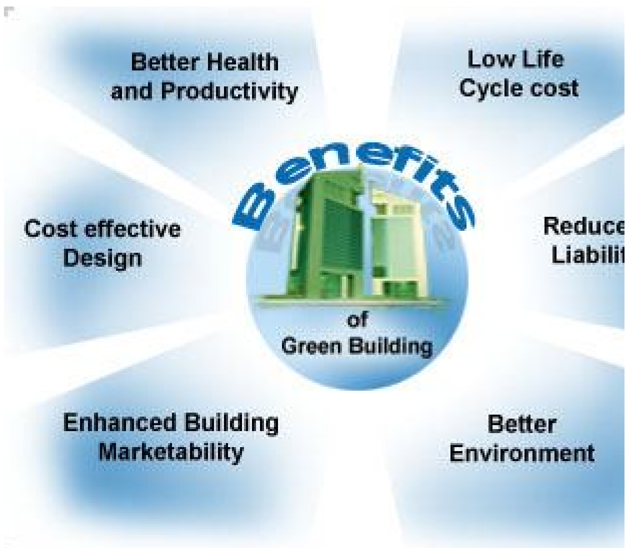

Fig 1: Green building benefits

BUREAU OF ENERGY EFFICIENCY (BEE):

Bureau of Energy Efficiency (BEE) is a statutory energy conservation body under the power ministry. The Government of India set up BEE on 1st March 2002 under the provisions of the Energy Conservation Act, 2001.

The Major Regulatory Functions of BEE include:

- Develop minimum energy performance standards and labeling design for equipment and appliances
- Develop specific Energy Conservation Building Codes
- Activities focusing on designated consumers
- Develop specific energy consumption norms
- Certify Energy Managers and Energy Auditors
- Accredit Energy Auditors
- Define the manner and periodicity of mandatory energy audits
- Develop reporting formats on energy consumption and action taken on the recommendations of the energy auditors

The Major Promotional Functions of BEE include:

- Create awareness and disseminate information on energy efficiency and conservation
- Arrange and organize training of personnel and specialists in the techniques for efficient use of energy and its conservation
- Strengthen consultancy services in the field of energy conservation
- Promote research and development
- Develop testing and certification procedures and promote testing facilities
- Formulate and facilitate implementation of pilot projects and demonstration projects
- Promote use of energy efficient processes, equipment, devices and systems

- Take steps to encourage preferential treatment for use of energy efficient equipment or appliances
- Promote innovative financing of energy efficiency projects
- Give financial assistance to institutions for promoting efficient use of energy and its conservation
- Prepare educational curriculum on efficient use of energy and its conservation
- Implement international co-operation programs relating to efficient use of energy and its conservation.

ENERGY CONSERVATION BUILDING CODES (ECBC):-

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. mts and a connected demand of power of 500 KW or 600 KVA. The energy performance index of the code is set from 90 kW·h/sq./year to 200 kW·h/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 & humid on 25 February 2009.

Energy conservation building codes are mechanism to prescribe energy use/conservation in commercial buildings. These codes are formed to comply with energy consumption norms and standards and to prepare and implement schemes for its efficient use and conservation state governments have power to amend building codes to suits local and regional climatic conditions.

Energy conservation building codes set the minimum energy efficiency standards for design and construction at the same time in encourage energy efficient design without constrain on the building function comfort health or the productivity of the occupants with proper regard for economic considerations.

GRIHA- the National rating System

TERI, being deeply committed to every aspect of sustainable development, took upon itself the responsibility of acting as a driving force to popularize green building by developing a tool for measuring and rating a building's environmental performance in the context of India's varied climate and building practices.

The rating system called 'Green Rating for Integrated Habitat Assessment' (GRIHA) quantifies parameters like energy consumption, waste generation, renewable energy adoption over the entire lifecycle of the building. In 2007, it was adapted and adopted by the Ministry of New and Renewable Energy (MNRE) as the national rating system for green buildings in order to bring down the ecological impact of buildings in India to a nationwide acceptable level. GRIHA currently operates under ADARSH (Association for Development and Research on Sustainable Habitats) and is supported by the National Advisory Council (NAC) and Technical Advisory Committee (TAC).

It takes into account the provisions of the National Building Code (NBC) 2005, the Energy Conservation Building Code (ECBC) 2007 announced by BEE and other IS codes, local bye-laws, other local standards and laws. The system, by its qualitative and quantitative assessment criteria, would be able to 'rate' a building on the degree of its 'greenness'. The rating would be applied to new and existing building stock of varied functions – commercial, institutional, and residential.

A CASE STUDY: CESE Building, IIT KANPUR

Architect	Kanvinde Rai and Chowdhury Architects and Planners
Energy consultant	TERI (The Energy and Resources Institute)
HVAC consultant	Gupta Consultants and Associates
Electrical consultant	Kanwar Krishen Associates Pvt. Ltd
Landscape Architect	Mr. Yogesh Kapoor

ABOUT CESE:

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.

The CESE is a research facility at the IIT (Indian Institute of Technology), Kanpur on a plot area of 175 000 square metre (approximately 4.5 acres) (Fig 2) the facility houses laboratories, seminar rooms, and discussion rooms. Given the function of the building, it was decided that it should be designed in an environment friendly manner. The evaluation committee has awarded a final score of 93 out of 100 to the building. The building has incorporated many green features following the TERI-GRIHA recommendations. Some special features of this building are as follows:

-The building is fully compliant with the ECBC (Energy Conservation Building Code).
-Sustainable site planning has been integrated to maintain favorable microclimate.
-The architectural design has been optimized as per climate and sun path analysis.
-The building has energy-efficient artificial lighting design and daylight integration.
-It also has energy-efficient air conditioning design with controls integrated to reduce annual energy consumption.
-Passive strategies such as an earth air tunnel have been incorporated in the HVAC design to reduce the cooling load.

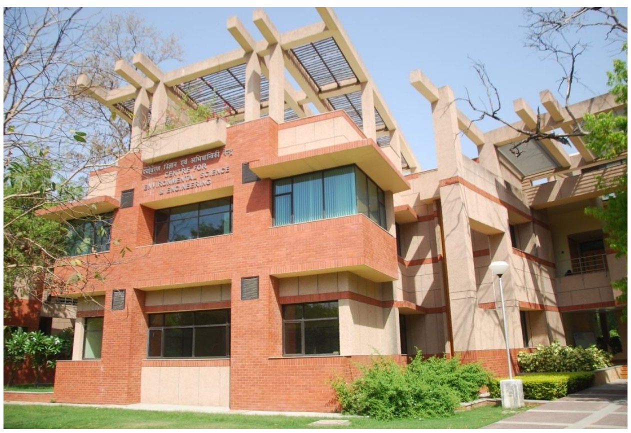

Figure 2: View of CESE building.

Performance

The EPI (Energy Performance Index) of the building is predicted to be 45.43 kWh/m2/annum, which is 41.3% less than the TERI GRIHA benchmark. In comparison to a conventional building, 59% energy savings are predicted in the CESE building. The Centre has attempted to conserve and utilize resources efficiently; recycle, reuse, and recharge the systems at every stage of design and construction.

Key Sustainable Features:

The building attempted various GRIHA criteria to make it into a green building. Few such criteria's are elaborated as follows:

Sustainable site planning

In order to minimize impact of site development on the environment and surroundings, several best practice guidelines were adopted like demarcation of site for construction, installation of dust screen around the disturbed area to prevent air pollution and spillage to undisturbed site area. Top soil was excavated, stored and preserved outside the disturbed construction site. Erosion control systems were adopted and several trees on site were protected. To increase the perviousness of site and to reduce heat island effect caused due to hard paving around the building, total paving around the building was restricted to 17%, and more than 50% of the paving is either pervious or shaded by trees. Irrigation water demand has been reduced by more than 50% in comparison to GRIHA benchmark. Adequate health and safety measures related to construction were taken.

Energy Conservation

-Renewable energy from photovoltaic panels provide annual energy requirements equivalent to 30% of internal lighting connected load.

- Hot water demand is met by solar hot water system

Figure 3. 1.2 KWp High Efficiency Solar Concentrator with Tracker being installed at IIT Kanpur Courtesy: Moser Baer Photovoltaic Pvt Ltd.

Architectural design:

Architectural design optimized as per the climate of Kanpur, sun path analysis, predominant wind direction, and existing vegetation.

There is a large water body to cool the micro climate.(Fig 4) The Orientation of building is North – South. There is daylight integration in all living spaces. . Common circulation areas are natural day lit and naturally ventilated through integration of skylights and ventilators.

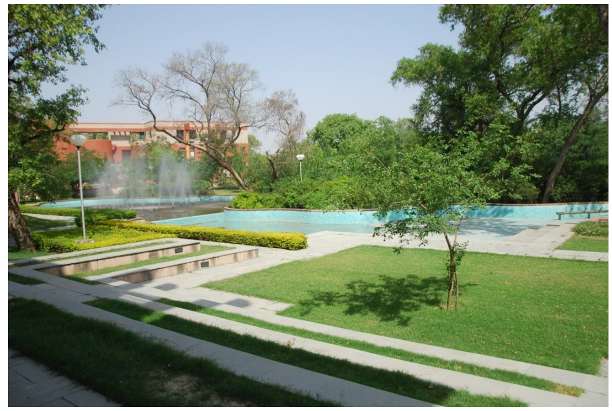

Fig 4: Greenery and water body around the building

Efficient window design:

By selecting efficient glazing, external shading to reduce solar heat gain but at the same time achieve glare free natural daylight inside all the laboratory spaces of the building.

Portland Pozzolona Cement (PPC) with fly-ash content is used in plaster and masonry mortar.

Wood for doors is procured from commercially managed forests. Modular furniture made from particle board is used for interiors.

Landscape protection:

Existing trees have been preserved and protected. Roof shaded by bamboo trellis and green cover to reduce external solar heat gains from the roof.

Water cooled chiller has been selected that complies with the efficiency recommendations by the ECBC (Energy Conservation Building code).

Variable Frequency Drive installed in the Air Handling Units (AHUs).It also has energy-efficient air conditioning design with controls integrated to reduce annual energy consumption.

Earth air tunnel system is used for free cooling/heating of the building for a major part of the year. This technology uses the heat sink property of earth to maintain comfortable temperatures inside the building.

Figure 6. Roof shaded by bamboo trellis and green cover been incorporated in the HVAC design to reduce

Low energy strategies such as replacement of water cooler by water body to cool the condenser water loop, integration of thermal energy storage and earth air tunnels enabled reduction in chiller capacity.

Optimized architectural design and integration of energy efficient fixtures has resulted in the reduction in annual energy consumption by 41% from GRIHA's benchmark.

Water conservation

There are two ways of conserving water during post construction and after the building is occupied. One is landscape water demand and second is building water demand. In this building, reduction in landscape water demand by more than 50% was achieved by use of minimum grass/lawn area, maximum green area under native vegetation and native trees. Low flow plumbing fixtures are used in the building resulting in reduced water consumption from GRIHA's benchmark in this building by 62%.Waste water is treated and reused for irrigation. Rain water harvesting has been designed. The building's water body adopts rainwater harvesting norms.

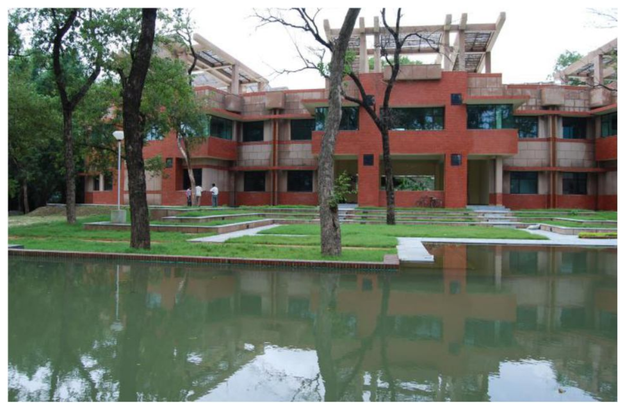

Figure 7. Maintained water bodies

Energy-efficient HVAC:

Depending on the brief and nature of the project, non-air-conditioned (non-AC) and air-conditioned (AC) spaces are treated differently. Non-AC areas are designed to maximize the thermal comfort levels with the use of natural ventilation, passive techniques, and low energy consuming evaporative cooling strategies. The AC areas on the other hand are designed to minimize the load of installed HVAC systems and hence reduce energy consumption in building.

- Efficient fixtures, efficient lamps, Daylight integration have been used **in lighting system.**

CONCLUSION:

Looking to the dwindling sources of energy and the danger of climatic deterioration caused by high carbon emissions, energy efficient buildings are the necessity of today. Construction of energy efficient building like CESE in IIT, Kanpur should be encouraged more and more. 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.

The Bureau of Energy Efficiency, the relevant code and the Star Rating program, will go a long way to encourage energy efficiency. This program will help identify the careless owners who are frittering away the precious sources of energy. Continued support from the State Governments and the private sector is essential for the success of the program.

REFERENCES:

1. Proceedings of AMTID 2011, NIT Calicut, Jun 22-24, 2011 Ratings of Energy Efficient Buildings: A Case of IIT, Kanpur, by Dr. Supriya Vyas.
2. Majumdar, Mili*; Tata Energy Research Institute, India Ministry of Non-Conventional Energy Sources (2001).* Energy-efficient Buildings in India. TERI Press. ISBN 9788185419824.
3. Chen, Olivia (2008-11-05). *"Bamboo-Veiled Dormitory by Architecture BRIO*"(http://www.inhabitat. com/ 2008/ 11/ 05/magic-bus-dormitory/).
4. U.S. Environmental Protection Agency. (October 28, 2009*). Green Building Basic Information.* Retrieved December 10, 2009, from http:/ /www. epa. gov/ greenbuilding/ pubs/ about. htm
5. Hopkins, R. 2002. *A Natural Way of Building. (http:/ / transitionculture. org/ articles/ a-natural-way-of-building-2002/)* Transition Culture. Retrieved: 2007-03-30.
6. Sharma, Shashikant Nishant (2014), Urban Forms in Planning and Design, *International Journal of Research (IJR*), Volume-1, Issue-1.
7. Mili Majumdar, *Energy-efficient Buildings in India,* Tata Energy Research Institute, India, Ministry of Non-Conventional Energy Sources
8. *Book : Representative designs of energy-efficient buildings in India by TERI*
9. *http://www.nrg-builder.com/greenbld.htm*
10. *http://www.thefreelibrary.com/Green+architecture+in+India:+combining+modern+technology+with+...-a01695971*
11. *"The Druk White Lotus School" (http:/ / www. pbs. org/ e2/ teachers/ teacher_207. html). PBS. . Retrieved 2009-02-05.*
12. *http:/ / www. cleantechfinland. fi/ solutions/ green construction/*
13. *http:/ / www. Publications. Parliament. uk/ pa/ cm200405/ cmselect/ cmenvaud/ 135/ 13507. htm#a23*
14. *Environmental Performance Index 2010 (epi.yale.edu/)*

Contact Information:

Dr. Supriya Vyas
Assistant Professor, Department of Architecture and Planning,
M.A. National Institute of Technology, Bhopal India,
supriya_vyas@hotmail.com

Ar. Seemi Ahmed
Assistant Professor, Department of Architecture and Planning,
M.A. National Institute of Technology, Bhopal India,
Email: seemiahmed2002@yahoo.com

Ar. Arshi Parashar
Student, M.Plan (IV Sem), Department of Architecture and Planning,
M.A. National Institute of Technology, Bhopal India,
Email: arshiparashar@gmail.com