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Green Building

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***Abstract*— Due to rapid advancements in technology and growth, the demand for energy is increasing to a great extent.The need of the hour is of energy saving and making use of renewable sources of energy.The concept and todays trend towards this is Green building(also known as sustainable building) refers to both a structure and the using of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from design, operation, construction, renovation, maintenance**

***Keywords*—Renewable, Sustainable, life cycle, LEED**

I. INTRODUCTION

A green building is one which uses lesser energy, water, natural resources & creates less waste and is healthier & safer for the people to live in [1]. In other words, green building design involves finding the balance between homebuilding and the sustainable environment. This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages.[2] The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.[3]

Green architecture, or green design, is an approach to building that minimizes harmful effects on human health and the environment. The "green" architect or designer attempts to safeguard air, water, and earth by choosing eco-friendly building materials and construction practices.

Enhanced indoor air quality

Constructing green building emphases more on the designing of ventilation system so that the people get the filtered, clean air and proper lighting most of the time. Indoor lighting also helps in controlling the dampness which is one of the main cause of dust mites and bacteria and generation of deadly diseases. So good ventilation systems enhanced the air quality of the building and protect the people from the diseases.

Figure 1

Higher productivity of occupants

Green building consists of the non- toxic material, proper ventilation which helps in reducing the toxic gases, bacteria and also balanced the temperature of indoor and thus make safer and healthier for the people

Use of non-toxic material

Green buildings are built from renewable, non-toxic, reusable and recyclable materials. For manufacturing building low emission material are used like nowadays low volatile organic compounds paints are used by the constructor .VOC Paints are dangerous for the environment it quickly enter into air and create a ozone and cause air pollution. So by using non-toxic material also enhanced the life occupancy.

Energy saving to the extent of 30 - 40 %

A green building has a great capacity to reduce the energy consumption. As few studies had also proved that installing energy saving appliances can remarkably reduce the energy and also helps in savings our natural resources.

Increased water saving upto 20% - 30% and efficient use of water recycling

Water saving is another important factor in sustainable building. Water can be wasted by leaking (toilet leaking can waste up to 90 gallons per day), pool showers, while doing construction work and from other activities. Recycling rainwater and using it for toilet flushing, gardening, washing and other way can save waste-water.

II. HOW THE GREEN BUILDING GETS THEIR CERTIFICATION AND WHAT IS THE RATING SYSTEM IN INDIA?

Green building is a LEED-certified (Leadership in Energy and Environmental Design) building. LEED is establised by the U.S. Green Building Council (USGBC), the organization promoting sustainability through Green Buildings. LEED is the rating system developed for certifying Green Buildings and for assessing the building performance against certain fixed criteria[4]. To receive LEED certification, building projects have to satisfy certain minimum criteria and earn points to achieve different levels of certification. Currently, India has 2190 LEED registered buildings and 398 LEED certified buildings with 1.26 billion square feet buildup area. Now how to get the LEED certification the building project must has to get them rated from the rating agencies. The three main rating systems for Green buildings in India are:

1. IGBC
2. GRIHA
3. BEE

Other rating scheme:

1. EDGE

1. Indian Green Building Council (IGBC)

Indian Green Building Council (IGBC) has licensed the LEED Green Building Standard from the U.S. Green Building Council and is responsible for providing the LEED Certificate in India. Giving a brief of IGBC. IGBC is formed by Confederation of Indian Industry (CII) in 2001 and is deliberately doing effort to promote ecofriendly concept in the Indian industry. IGBC is the non- profit research institution having its offices in CII- Sohrabji Godrej Green Business Centre, which is itself a LEED certified Green building and was awarded with the prestigious Platinum rated green

building rating in India. Since then the Green Building movement in India has boost up and get the recognition. IGBC promotes sustainability based on the principles of five performances in the following areas:

- Sustainable site development
- Water saving
- Energy efficiency
- Materials selection
- Indoor environmental quality

IGBC has also launched different rating programs to suit variety of building types.

a) IGBC Green Homes Version
b) IGBC Green Factory Building
c) IGBC Green SEZs
d) IGBC Green Townships
e) LEED 2011 for India - New Construction
f) LEED 2011 for India

EDGE (Excellence in Design for Greater Efficiencies) Program in India

The IFC, a member of the World Bank Group, and the Confederation of Real Estate Developers Associations of India (CREDAI), a body of private real estate developers, have also promoting green buildings in the country through IFC‟s EDGE certification. EDGE focuses on energy and water efficiency in buildings. It allows the builders and home-owners to choose environment-friendly technical solutions while capturing costs and projected savings. And the result is saving of atleast 20% in energy, water and material according to the IFC Report. Serge Devieux, IFC‟s Regional Director for South Asia said that “We aim to help builders introduce cost-effective green features into their designs and work with financial institutions and the government, to support their widespread

Green Rating for Integrated Habitat Assessment (GRIHA)

GRIHA is India‟s own rating system developed by TERI and Ministry of New and Renewable Energy, GOI. The rating process begins with the online submission of documents as per the prescribed criteria followed by onsite visit by a team of professionals from GRIHA Secretariat. GRIHA rating system consists of 34 criteria categorized in four different sections.

a) Site selection and site planning
b) Conservation and efficient utilization of resources
c) Building operation and maintenance
d) Innovation

Bureau of Energy Efficiency (BEE)

The Indian Bureau of Energy Efficiency (BEE) developed its own rating system for the office buildings based on 1 to 5 star scale. More stars means that more energy efficiency. BEE has developed the Energy Performance Index (EPI). The unit of Kilo watt hours per square meter per year is considered for rating the building. BEE has launched the Energy Conservation Building Code (ECBC). This 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. The Reserve Bank of India‟s buildings in Delhi and Bhubaneswar, the CII Sohrabji Godrej Green Business Centre and many other buildings have received BEE 5 star ratings

III. FAMOUS GREEN BUILDINGS IN INDIA

CII - Sohrabji Godrej Green Business Centre

CII-Sohrabji Godrej Green Business Centre was established in the year 2004, as CII‟s Developmental Institute on Green Practices & Businesses, aimed at offering world class advisory services in the areas of green buildings, energy efficiency, water management, environmental management, renewable energy, green business incubation, and climate change activities. The Green Business Centre in Hyderabad is awarded one of the greenest buildings in the world and through Indian Green Building Council (IGBC) is spreading the Green Building movement in the country

Figure 2

ITC Green Centre- Gurgaon

The ITC Green Centre is also certified as one of the world's greenest buildings located in the city's famous hub, Gurgaon, the ITC (Indian Tobacco Company) Green Centre, a 170,000 square foot office complex had captured the prestigious LEEDS Platinum Award in 2004. The USGBC has re-certified the ITC Green Centre in 2012 as the world's highest Platinum rated green building. As per the ITC sources the energy use by ITC Green centre has reduced by 51% and every drop of the rainwater is recycled and used for the gardening in the building.

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Figure 3

Hillary Clinton, then US secretary of state said when she visited the Green Centre "This building may not be a regular stop on the tourist map, and no one would confuse it with the Taj Mahal. But it is a monument to the future,"

Suzlon Energy Limited – Pune

Suzlon Energy Limited has also succeeded in adding its name in the famous green building list. The building has three floors and is sited on 10.5 acres area. It achieved LEED for new construction Platinum certification from the IGBC, as well as Five-Star GRIHA certification. As per the organization report, 5% of its annual energy is generated on-site through conventional and building-integrated photovoltaic panels (20%) and wind turbines (80%).

Energy is saved by employing LED lighting systems and solar water heating. 100% of sewage grey water is recycled into flushing, landscaping and air cooling systems, while 100% of rainwater is harvested.(information taken from *www.usgbc.org/projects/**suzlon**-one-earth*

Figure 4

Birla International School, Jaipur

Even the international schools are also into the race of green building rating system. Apart from corporate sector and residential areas many schools are also taking the initiative to provide the healthier and safer environment to the students and so they are getting their registration done for the rating.

Figure 5

Solar Air Conditioning- Turbo Energy Limited, Chennai

The R & D Administrative Building of TEL was awarded with the prestigious Platinum award from LEED USGBC in 2009 and had got 62 points out of 69 from Leed. The solar air conditioning in Turbo Energy systems in Chennai uses solar power to control the air in the building by using photovoltaic cells to generate electricity form solar energy to be used for lighting of the office. Albido paint was applied on the roof with reflectivity of 82% and shading effect by solar dishes. The building has on/off type day lighting control to reduce artificial lighting energy consumption. Rain water from roof harvested in ponds through pipes and this water is then used for the factory usage, gardening and for other purpose

Figure 6

Doon School Residential Buildings

The old buildings at the Doon School, Dehradun, were demolished and five duplex three-bed room master residences were constructed. The exterior of the buildings have exposed brickwork with sloping profile sheeting.

Authorities can claim that this establishment is one of India's first green school campuses that opted for recycling measures and successfully achieved cent per cent self-sufficiency in energy, water and organic fertilizer

Figure 7

Nokia - Gurgaon

Another India‟s most sustainable buildings is the office of Nokia in Gurgaon which has been awarded the Green Building Award and prestigious LEED „Gold‟ rating by USGBC. It‟s smart lighting and ventilation systems, high-efficiency chillers, heat recovery wheel, green guard certified furniture and online CO2 monitoring system makes it most sustainable & reliable building. According to Nokia India officials, benefits realised from the green establishment include 30 per cent energy savings, 35 per cent water savings and improved health (not quantifiable) of its occupants over a sustained period. "The recorded energy consumption at the Nokia office in Gurgaon is 143.96 KWH/SqMtr per year," Kaul said. In 2011, Nokia used 40 per cent of renewable electricity

Figure 8

Indira Gandhi International Airport – Delhi T3

Terminal 3 has been awarded green building “LEED INDIA GOLD” rating from IGBC. The „Leadership in Energy and Environmental Design New Construction' rating was awarded to T3 for features like sustainability, water efficiency, energy and atmosphere, material and resources, indoor environmental quality and innovation in design categories

Important features of T3: Sustainability Water efficiency Energy and atmosphere, Material and resources Indoor environmental quality and Innovation in design

Figure 9

Olympia Tech Park, Chennai

By effective usage of grey water in the building, Olympia Techpark in Chennai has able to meet its heating and cooling requirements. They have a dual pumping line where the treated gray water is used for flushing or in irrigation. With a HVAC system they are able to have cool, indoor comfort when it‟s hot outside providing a year-round indoor comfort solution

Figure 10

RMZ Millenia Business Park, Chennai

RMZ Millenia Business Park in Chennai is the famous net zero energy building. Its design emphasizes conservation featuring trees to reduce adverse environmental impact, adequate natural light and shaded landscaped areas to reduce ambient temperature.

The building has installed the Digital Occulux sensor that would dim-up and dim down the lights based on occupancy and daylight availability

Figure 11

IV. ADVANTAGES OF GREEN BUILDINGS

With new technologies constantly being developed to complement current practices in creating greener structures, the benefits of green building can range from environmental to economic to social. By adopting greener practices, we can take maximum advantage of environmental and economic performance [5]. Green construction methods when integrated while design and construction provide most significant benefits. Benefits of green building include:

Environmental Benefits:

Reduce wastage of energy
Conserve natural resources
Improve air quality &Reduce water wastage
Protect biodiversity and ecosystems

Economic Benefits:

- Reduce operating costs
- Improve occupant productivity
- Create market for green product and services

Social Benefits:

- Improve quality of life
- Minimize strain on local infrastructure
- Improve occupant health and comfort

V. CONCLUSION

Green Building Concept is the present and the future of buildings around the world. Green building is a financially,health,and most importantly environmentally responsible idea that more people need to adopt .Many building materials and renewable energy sources exists to lessen ones's impact upon the environment.This trend is the saviour of our future generation and being followed by not even the developed countries but also the developing ones.

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