# Energy Consumption and Efficiency in Green Buildings

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*Abstract*— Buildings, as we all can rightly agree to, are the measuring blocks for any development. The Development of any country largely depends upon the building of structures. From modifying the conventional buildings, the trend has now wholly shifted to a whole new concept of Green Buildings. Green building, refers to both the structure and the process involved that are environmentally accountable and amenity efficient throughout the lifestyle of the building. For the past more than half-a-century, many researchers and scholars have done the research for the development and improvement of green building construction and related technologies around the globe. Considering the environmental conditions, India has become the world second largest emitter of greenhouse gases. The initial economic consumption of a green building may seem to be a matter of concern for some, but for a long run loop, say for after 50 years, it would prove to be most economically efficient building involving all the ecological measures. The study consummates that as much as 40-50% energy saving is possible in green buildings. This paper deliberates about the aspect of energy efficient buildings, i.e. Green Buildings in India's aspect to diminish energy usage besides climate changes over greenhouse gases. Finally, the author would emphasise on the necessity of Green Buildings.

***Key words:*** Energy, Green Buildings

## I. INTRODUCTION TO GREEN BUILDING

In this craving world when people are in a lot of hustle-n bustle, the words like "conservation" and "efficiencies" hovers them. "Conservation of resources" is what green buildings demands. To be more specific, the green building should be energy-retaining, land-preserving, water preserving, material-preserving, environment-friendly and pollution reducing, summarized as "Four preservings and one benign" [4]. The so-called "green" is just a symbolic representation that lays emphasis on sustainable growth and environmental relationship to achieve a bond between folks, countryside and buildings. This bond holds the need-of-an hour of a man keeping the future aspects in mind as well as a check on an individual's ecosystem and the rate of consumption of resources, especially the non-renewable resources.

The green buildings, also called the sustainable buildings, or ecological building are actually climate adaptive building that focuses on working along with such a technology, that helps us to adapt to climatic changes, keeping aside the psychological aspects and accepting the changes without adapting much change in our lifestyle (technical aspects and personal aspects of human need) [3]. Similarly to orthodox building ventures, green building ventures have an assortment of goals that may not necessary be consistent.

The concept of green building has taken a hype since over half a century now that certainly is one of the reasons for the revolutionary changes the world is witnessing.

For creating a better environment for emerging Green Building, countries round the biosphere began to articulate relevant standards. US contemplated the ASHRAE and environment management since the first energy-preserving standard to 2011 (Danielski, 2012). GB in China commenced relatively late. The United Nations started ASHRAE i.e. (American Society of Heating Refrigerating and Air Conditioning Engineers) customary "Energy preserving in Design for Innovative Building" for the first time in 1975. In 2009, Britain disclosed Low Carbon Transition Plan, essential all new buildings achieving zero-emission from 2016, all new public buildings from 2018, all official buildings from 2019 and all residential finish Smart Meters inauguration before 2020 (Peters, Fudge, & Sinclair, 2010). Recently, European Union broadcasted a more advanced and perfect legal system in energy preserving field, which is designated Building Energy Efficiency Performance Law. The law requires all public buildings must be adjacent to nil energy intake by 2020 [4]. The Indian Green Building Council (IGBC), since 2001, is working on advance India forward along with the developed economies of the world. The IGBC Green New Buildings rating system addresses the utmost important countrywide penchants which include water sustentation, managing waste materials, energy efficacy, reduction of usage of relic fuels, lesser dependence on the habit of virgin materials and health & well-being of dwellers. The assessment system compels the solicitation of National standards and codes such as the NBC, ECBC, CPCB strategies, and numerous others. The overall equitable is to be better than the national ethics so as to create new scales [IGBC Green Buildings Rating Systems – version 3.0].

Thus, what the world is witnessing, the ultimate goal of Green Building is lowering down the consumption and emissions - reducing energy utilization, usage of recycled materials, as well as localization of resources to lower down the cost and energy emission.

## II. CONTEXTUAL INFORMATION

### *A. Definition of Green Buildings*

The term green buildings can be defined as the buildings which reduce the impacts on the background and human fitness [10]. Likewise, Kilbert [9] suggest that the green building's character as principle and practice of feasible construction; he delineates the green buildings as: "Healthy facilities designed and built in resource efficient manner using ecologically based ethic" [4].

### *B. Obligation of Green Buildings*

The following are the key necessity of viable green buildings; 26% less energy usage, 13% lower cumulative maintenance cost, 27% higher occupant's contentment and 33% less CO2

 

emissions [12]. Based on the information collected on case studies by Australian and International agencies, Madew [11] stated the following profitable paybacks of green buildings; 60% decrement in water and liveliness utilization; yield escalation up to 25 %, least 14 % higher rate of reoccurrence along with 10% higher market value of the asset etc. [4]

### *C. Various Advantage of Green Buildings Usage*

#### *1) Shadow Consequence*

Plants plays a significant role in regulation of heat. Solar transmittance of layers of creeping floras such as Virginia Creeps an inborn plant in UK and North America , extent from 0.43 to 0.14 and can cut solar emission by 40% [13],[16],[17] and the rest amount of heat passes via plants and distresses the enclosed weather of the buildings. [5]

#### *2) Thermal Isolation*

Isolation which is used for the inland is much more operative than inland isolation especially during midsummer months [13]. Every reduction in interior temperature up to 0.5 degree Celsius can lessen the power consumption of Air conditioner about 8 %. [5]

#### *3) Evaporative Cooling*

Evapotranspiration can be defined as the means of water loss by plant due to evaporation and transpiration over a period of time [18]. The evapotranspiration process consumes 680 kWh for evaporating every m3 of water which acts as a passive air conditioner system [14].

## III. CASE STUDY GREEN BUILDING CONCEPT IN INDIA

Buildings, being a key to India's future, are also the most energy rigorous activities in terms of heating and cooling. Ventilations, use of solar panels and enhanced insulations are some of the ways to reduce energy usage for heating and cooling.

### *A. Energy Intake Pattern*

The metropolitan inhabitants are going to grow from 47% in 2000 to 70% in 2050. Figure 1 displays the inhabitants rise in developing countries like China, India and Brazil. By 2050, 73% of the Chinese inhabitants are expected to be urban as compared to 40% in 2005. The radical change in Indian urbanization is essentially due to social as well as political motivation. Due to the diverse temperature and climate in India, which lies in the subtropical zone, the effective way of reducing emission is through good insulation, efficient boiler, window glaze and window ventilation system to recover heat. Energy expenditure in India is mostly through cooking. Rural India and parts of urban India use biogas as its main energy initiator for cooking as compared to the countries like China and South Africa where most Energy usage in through electrical appliance. India's overall energy obligation is expected to raise at 6.5% per year in the middle of years 2016-17 to enhance India's projected growth rate. India find its way in becoming the world's second prime emitter of greenhouse gases.

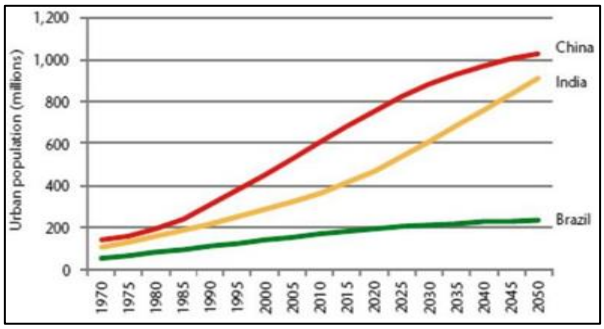


Fig. 1: The Growing Metropolitan Inhabitants In Emerging Nations (China, India, Brazil) (WBCSD, 2009). [8]

### *B. India's Sustainable Development*

Green Buildings are often termed as being a milestone towards development. The growth in infrastructure holds the key for India's economic growth. The growing demand is often being met by road networks, water sanitation and transportation, etc. efficient use of natural resources makes all the difference in achieving sustainability. For instance, using isolated reinforced cement concrete (RCC) as barricading walls are cast-off in scorching environments to check on the emission rate, installation of integrated windows that comprise light tables with double panned glassy window certifies building efficiency up to 20-25%. Usage of low energy material, glass technology in buildings with insulating walls and proper ventilation helps to encounter energy marks and reserve energy depot.

Compelled by the need-of-an-hour and the urgency to go green, a Green Building Rating System is also adopted. Different standards have been adopted worldwide depending upon the climatic and tropical zones of the country along with its natural features.

### *C. Green Building Rating Systems*

For being environment conscious, and in order to warrant green and sustainable certification - many countries have opted for Green Building Ratings. The Indian Green Building Council (IGBC), since 2001, is viable to march India forward along with the blooming economies of the world. The IGBC Green New Building Rating system in script the prime concerns which include water preservation, managing waste, energy efficiency, decrement in the use of petroleum, not being over-reliance on the usage of virgin materials.

The IGBC provides LEED ratings to the erections in India. The Green Rating for Integrated Habitat Assessment (GRIHA), is the Nation-wide rating organization in India that is being The Energy and Resources Institute (TERI) and intensify together with Ministry of New and Renewable Energy, India. It is a design estimation scheme for ecological structures and is preconceived for all kinds of structures through each of the climatic zones in India. In 2008, reports suggest that Mumbai secured the first position by citing 30 Green Building projects which was the highest among the Indian cities. In IGBC data of 2008 suggest 315 green buildings in India, of which 250 are profitmaking properties. The requisition of codes like ASHARE/ECBC as a benchmark can assist in designing high performance building.

## IV. RESEARCH METHODOLOGIES

A standardized literature search was conducted for the collection of data from presented examination which includes articles presented in renowned periodicals. The Potential sources were ASCE, Science Direct, and IJETAE.

A research was done for evaluation of the extent of the literature which speaks about the commercial concerns of Green buildings. Moreover, a considerable amount of literature emphasises about the economic returns besides advantage of Green Buildings. A summary of the research paper is mentioned in Table 1. Each author has studied about the advantage of Green Building methodology of adoption.

| S.no | Author(s) Year | Periodical | Nation | Procedure | Conclusions |
|---|---|---|---|---|---|
| 1. | Dong , Andrew and Jing (2016) | Elsevier Ltd. | USA | Identification of the Green Building technology's effects to Home energy consumption | Findings identify 43% of the annual decrease in energy usage and energy expenditures for a typical American home |
| 2. | Jinkyun, Seungho, Jonghurn and Hiki (2014) | Elsevier Ltd. | South Korea | Matrix analysis for subsystem combinations | Enumerating the energy depletion features of HVAC&R system is uncertain, because the energy investments provided by this scheme rest on numerous aspects |
| 3. | Yanan , Li, Baojie and Doudou (2014) | Elsevier Ltd. | China | Calculation of energy consumed by buildings in China | China has been the sphere's major carbon emitter and the world's largest energy user nation since2011. |
| 4. | Luay and Kherun (2016) | Elsevier Ltd. | Malaysia | Summary of review paper data | Green price payments concluded by trial investigations fall inside a series from−0.4% to 21%. |
| 5. | Irene and Andrew (2016) | Elsevier Ltd. | Hong Kong | Case study of the climatic condition of Hong Kong | Research considered the feasibility of smearing a double-skin green front, to high-rise housing structures in Hong Kong in order to decrease energy depletion for refrigeration in scorching and moist summer |
| 6. | Qian , Yu, Jian and Tao (2016) | Elsevier Ltd. | China | Rough set theory was used to examine the combat grade between various plan aims from investor's point of vision | Green buildings exhaust 26% less energy associated to orthodox structures. |
| 7. | Farrukh , Ibrahim Dincer and Marc (2016) | Elsevier Ltd. | Canada | A multigenerational system integrating renewable energy sources for a greenhouse was developed and assessed using energy and exergy analysis. | The energy and exergy efficiencies of the overall system are found to be 46.1% and 7.3%, respectively |
| 8. | Ramesh and Emran (2013) | IJETAE | India | Energy consumption pattern | 50% energy can be saved in the construction sector |

Table 1. Summary of the papers

Ramesh et al. [8] And Dong et al. [1] studied about the GB technology's energy consumption found that 50% and 43% annual reduction in energy usage in Indian building sector and American home respectively. It was stated that integrated design approaches can reduce the energy consumption by 72% but projects can be more expensive than individual solution. Jinkyun et al. [2] studied about the energy consumption characteristics of HVAC system. Luay et al. discussed the empirical investigation drop inside a range from -0.4 to 21%. On the basis of credit point achievement buildings are rated as 4 star (For best exercise), 5 star (Australian merit) and 6 star (For world guidance). Irene et al. [5] studied about double skin green front to high rise structures in Hong Kong for reduction in energy depletion. He mentioned about the solar conduction of lone and multiple layers of creeping floras like Virginia creeps fluctuating from 0.43 to 0.14 and can diminish solar emission by 40-80%.

## V. CONCLUSION

Green Building is also known as sustainable buildings or zero energy buildings which focus on working with a technology which helps us to adapt according to the climate. It can be concluded that:

- The necessity of green buildings is because it uses 26% less energy, 13% less maintenance, provides 27% higher occupant satisfaction & 33% lesser CO2 emission.
- Various types of plants like Virginia creeper can be planted which can keep the room cool by evapotranspiration process.

- With the increase in urban population, India's over-all energy necessity is projected to raise by 6.5% for the year 2016-17. India has become world's second largest emitter of greenhouse gasses. As per the data of IGBC of 2008, around 315 green structures are in India of which are 250 are profitable projects.
- Integrated design of the building can reduce energy consumption by 72%.

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