International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 7
July 2017

Green Buildings and its Sustainability: A Review

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ABSTRACT

Green building is the practice of constructingor modifying structures to be environmentally responsible, sustainable and resource-efficient. This study includes the review on efficient use of energy, water and other natural resources, protecting occupant health, improving employee productivity and reducing waste, pollution and environmental degradation. The Green Buildings Ratings and Certification process has gained tremendous momentum over the last few years.LEED (Leader in Engineering and Environmental Development), GRIHA (Green Rating for Integrated Habitat Assessment), TERI (The Energy and Resources Institute) & SVAGRIHA (Small Versatile Affordable GRIHA) are green building rating system developed for Indian construction sector.It has been seen that renewable energy & green design can help to give a healthy & efficient house that is also environmental friendly and saves money in the long term. It has been considered that sustainable built environment is achieved once the local attributes of a region, interms of the aforementioned issues duringtheentireimplementationprocess.Environmental innovation in construction is the development of projects that contribute to sustainable development. This includes a range of ideas, from environmentally friendly technological advances to socially acceptable innovative paths towards sustainability.

Introduction

Construction industry has significant environmental, social and economic impacts on the society. As one of key outputs of the construction industry, buildings largely reflect these impacts during its lifecycle. According to the World Business Council for Sustainable Development, building block accounts for 40% of total energy consumption [1]. Energy consumption in India is also on the raise due to sharp urbanization, population explosion, and intensive growth of IT and related business. Buildings account for more than 41% energy consumption in developed countries. Energy consumption in building is mainly for building services like, HVAC, lighting, water heating, pumping and fans [2] amount to 40%. It is said that 18-20% of primary energy and 40% of total consumption takes place developed countries like US [2].Selecting environmentally preferable building products is an excellent method to boost a buildings environmental performance.

Green building is the practice of constructingor modifying structures to be environmentally responsible, sustainable and resource-efficient throughout their life cycle. This includes efficiently using energy, water and other natural resources, protecting occupant health, improving employee productivity and reducing waste, pollution and environmental degradation [3]. Green buildings accounts for improving environmental footprint by reducing energy use by 30-5-%, CO2 emissions by 35%, waste output by 70% and water usage by 40%. New developments are made everyday in the field of engineering that are meant to save energy and protect the environment. This is a very important time to be conscious of energy consumption, due to global warming. Naturally there will be experts constantly creating new technologies in this field, but another big question is whether there should be rules and regulations that force people to create or use green engineered products. While green building construction may appear costly for consumers, new developments in the engineering field are providing increasingly cost-effective solutions.

What is Green Building?

The term ‘Green’ refers to environmentally friendly practices from building design to landscaping choices. It also optimist & economic energy use, water use and storm water and waste water reuse. There is a growing

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level of public awareness of green building. However, there have been extensive debates on what a green building is or what the green building should cover. Indeed, the lack of clear definition of green building creates further challenges for promoting and implementing green buildings.

Although new technologies are constantly being developed to complement current practices in creating sustainability 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. The resources that can be used while the green building constructions are all recyclable materials like green concrete, fly ash, straw bales, grasscrete, bamboo, mycelium etc.

Green Building Features

Green Building have many advantages and features. Some important features are indicating below:

- Energy efficient equipment for air conditioning and lighting systems and use of onsite renewable energy.
- Measurement and verification plan to ensure energy and water savings.
- Reduction of building footprints to minimize the impact on environment.
- Minimal disturbance to landscapes and site conditions
- Use of recycled and environment friendly building materials.
- Use of non-toxic and recycled/recyclable materials.

Green Building Benefits

- The most tangible benefit is in reduction of operating energy and water costs right from day one during the entire life cycle of the building.
- Building consumes at least 40-50% less energy and 2030% less water visa-versa conventional building.
- Green buildings always fresh and healthy. The green buildings use interior materials with low volatile organic compound (VOC) emissions.
- Working in environment with access to daylight and views provides connection to the exterior environment.
- 30% to 40% reduction in operating cost.
- Health and safety of building occupants.
- Improve productivity of the occupants.
- Incorporate latest techniques and technologies.

As per the US General Services Administration research output and compared to the national average values green buildings uses 26% less energy, 54% less water consumption, 13% reductions in aggregate maintenance, 27% of higher occupant satisfaction and 33% of less CO2 emissions.

Societies Involved in Green Building

Motivated by a desire to appear environmentally conscious, many commercial facilities have adopted ―Green technologies‖ in order to earn ―Green and Sustainable‖ certifications. The Green Buildings Ratings and Certification process has gained tremendous momentum over the last few years [4, 5,6].GRIHA (Green Rating for Integrated Habitat Assessment), TERI (The Energy and Resources Institute) & SVAGRIHA (Small Versatile Affordable GRIHA) are green building rating system developed for Indian construction sector. GRIHA is a rating system which assesses the environmental performance of buildings on scale of 0-104. On the basis of number of points scored, a building can be rated between 1 & 5stars. GRIHA was developed by TERI and has now been adopted by the Ministry of New and Renewable Energy (MNRE) as the National Rating System for green buildings in India and to promote green buildings in India and to oversee the various activities associated with it, MNRE and TERI jointly established an independentlyregistered society called ADARSH (Association for Development and Research of Sustainable Habitats).

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Among all these the most popular one is LEED(Leaders in Engineering and Environmental Development), Certification. Many buildings today are striving to gain one of the few categories of LEED Certification. Seventy percent of new LEED Certified buildings fall under the new construction or major renovations category. With each variety of certification, there come different levels: Certified, Silver, Gold, and Platinum[13]. Any of the levels of certification would gain the accredited building acknowledgment as well as the obvious environmental and economic benefits. As stated on the LEED website, "LEED is a third-party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings" (2008). A LEED certification is widely respected, creating an encouragement and acceleration of the adoption of green building techniques.

Green buildings & Renewable energy

The best option for the sustainable development and to cope with the present environmental problems is use of renewable energy. This energy has lot of potential and it will not affect the environment. Conservation and energy efficiency are behind the ideas incorporated in the design: low toxic paint & material, water efficient plumbing fixtures, recycled material and locally produced sustainable material.

Renewable energy & green design can help to give a healthy & efficient house that is also environmental friendly and saves money in the long term. It hasbeeninternationally recognized to promote innovative approachesformitigationofcarbondioxide(CO2)emissionsdue to energyconsumptionassociatedwithbuildingconstructionand operation. Inviewofthattheenergyperformanceofgreen buildings hasanimmenseeffectonthesustainabledevelopment of thebuiltenvironment.AccordingtoKothari [7], sustainable developmentishighlyintertwinedwiththedeliberationofenergy. Thus, ononehand,renewableenergysourcesincludingsolar, winds, andwaves,etc.playasubstantialroleforsustainable developments;ontheotherhand,sustainableenergysources including thewaste-to-energysourcesarehighlyinfluential in the enhancementofsustainability [7].

Sustainable Features for Green Building

- The building is fully complaint with the ECBC (Energy Conservation Building Code).
- Sustainable site planning has been integrated to maintain favourable 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.
- Water body to cool the micro climate.
- Orientation of building: North – South.
- It also has energy-efficient air conditioning design with controls integrated to reduce annual energy consumption.

Smart growth and sustainable development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within two key concepts: a)the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given and b) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs. Communities are using creative strategies to develop, preserve natural lands and critical environmental areas, protect water and air quality, and reuse already developed land, in the resources conservation by reinvesting in existing infrastructure and reclaiming historicbuildings. Environmental innovation in construction is the development of projects that contribute to sustainable development. This includes a range of ideas, from environmentally friendly technological advances to socially acceptable innovative paths towards sustainability. Rapid changes in the economy and society create demands for new constructions of the built environment. Building innovations can provide the critical component of a

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competitive strategy in the construction sector. Investments in projects and in construction innovations and services are essential, but the initial high costs may make it difficult.

Theessenceofsustainability

Foremphasizingthesubstantialnegativeimpactsofbuildings on theenvironment,acomprehensiveanalysis [8] representsthe respectiveimpactsinUSasshownin Fig. 2which isclaimedtobe verysimilarinotherdevelopedcountries.Theenergy consumption andthegasemissionsarethereforethemostconsiderable negativeconsequenceswhichrequireinnovativesolutions. In essence,sustainabilityofbuiltenvironmentsisrecognizedas a holisticapproachtotheadaptationofenvironmental,economic and socio-culturalconcernsinthedesignandbuiltevolutionof architecture.Sustainabilitytrendsalsoencompasseconomic competitivenessspecifically whileconsideringhybridenergy systems [9]. Sustainabilitycanalsobeachievedthroughconsiderationof respectivefeaturesduringtheearlystagesofconceptual design process [10].

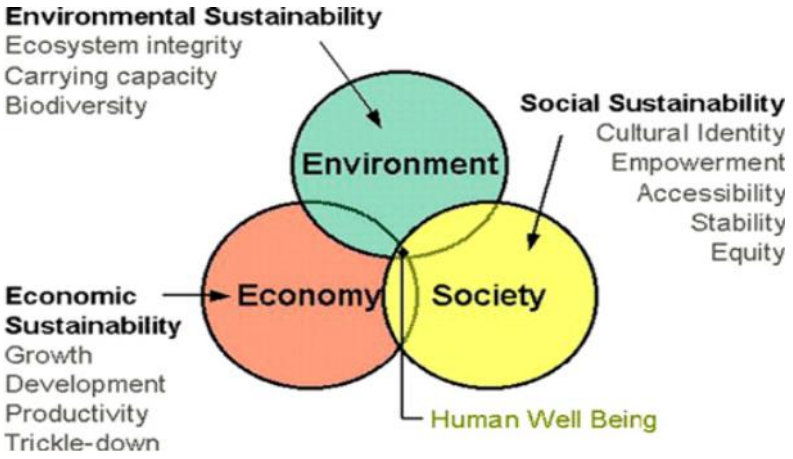

Fig 1. The Basis of Sustainable Developments [8].

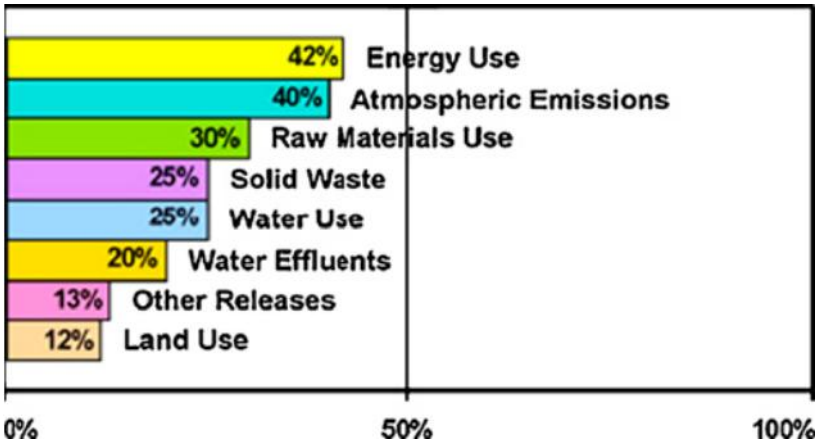

Fig 2. The Environmental Impacts of Buildings [8].

Asustainablebuiltenvironmentisachievedoncethe local attributesofaregion,intermsoftheaforementionedissues, havebeenconsideredduringtheentireimplementationprocess.
Recently,theconsiderationofnaturalresourcesandenergy conservationhasbecomeaglobalissueasaresultoftheglobal warming,climatechangeandtheincompatibilityofnatural resourcesandenergydemandduetothedepletionofenergy

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resources.Variousstudieshavebeencarriedoutinrelationtothis subject, focusingontheconceptsofenergymaintenance, embodied energyandrenewableenergyresources,leadingtothe concept ofthegreensustainablybuiltenvironment [11,12].

Conclusion

Buildings from the sustainable point of view are considered during the life cycle assessment a keytoward the improvement of environmental quality and energy conservation. The conclusions research arethat people should live in an environment that is designed and operates incorporating a) energyefficiency and renewable energy, b) with reduction of toxic materials c) without indoor pollution, d) watersaving, e) with trust in environmentally innovative projects f) in waste minimization and pollutionprevention, g) reuse of friendly building materials in order to achieve sustainable development also ensuringa better quality of life inside buildings based on the principals of "green buildings economy. It is to be hopedthat the development of experience, knowledge of economic benefits and competence will encouragedevelopers, occupiers and authorities to support an interactive strategy among the different actors involved inconstruction in the country. 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.

References

[1] WBCSD. Energy efficiency in buildings, business realities and opportunities. The World Business Council for Sustainable Development; 2007.

[2] W.L. Lee*, F.W.H. Yik , Regulatory and voluntary approaches for enhancing building energy efficiency, 2004, Progress in Energy and Combustion Science (30) 477–499.

[3] Green Buildings Certifications, an Overview and Strategic Guidance for Schneider Electric Employees by Brandi McManus.

[4] Krishnan Gowri, Green Building Rating Systems an Overview ASHRAE journal November 2004

[5] LEED reference package version 2.0, US, Green Building Council, June 2001

[6] Devi T, Laxmi, Green Building – Market opportunities and challenges, 2012,

[7] KothariR,TyagiVV,PathakA.Waste-to-energy:Awayfromrenewable energy sourcestosustainabledevelopment. Renewableand Sustainable Energy Reviews2010; 14:3164–70.

[8]LevinH,SystematicEvaluationandAssessmentof BuildingEnvironmental Performance(SEABEP),paperforpresentation to BuildingsandEnvironment", Paris,9–12June,1997.

[9] Yilanci A,DincerI, OzturkHK. Areviewonsolar-hydrogen/fuelcellhybrid energy systemsforstationaryapplications.ProgressinEnergyand Combustion Science2009;35(3):231–44.

[10] GhaffarianHoseini A,IbrahimR,Abdullah R.Graphicalvisualization principles formaintainingfunctionalrelativityofspacesduringarchitectural design. InternationalJournalofALAMCIPTA2009;4(1):9–16.

[11] Aste N,AdhikariRS, BuzzettiM. BeyondtheEPBD: Thelowenergy residentialsettlement BorgoSolare.AppliedEnergy2010;87:629–42.

[12] AsteN,PeroCD.Impactofdomesticandtertiarybuildingsheatingbynatural gas intheItaliancontext.EnergyPolicy2012;47:164–71.

[13]LEED for new construction v2.2: registered project checklist. (2008). *U.S. Green Building Council*, Retrieved 1/24/09.

[14] Rahman SM, Khondaker AN. Mitigation measures to reduce greenhouse gas emissions and enhance carbon capture and storage in Saudi Arabia. Renew Sustain Energy Rev 2012;16(5):2446–60.

[15] Drochytka R, Zach J, Korjenic A, Hroudová J. Improving the energy efficiency in buildings while reducing the waste using autoclaved aerated concrete made from power industry waste. Energy Build 2012;58:319–23.

[16] Danatzko JM, Sezen H, Chen Q. Sustainable design and energy consumption analysis for structural components. J Green Build 2013;8(1):120–35.

[17] Rajagopalan N, Bilec MM, Landis AE. Life cycle assessment evaluation of green product labeling systems for residential construction. Int J Life Cycle Assess 2012;17(6):753–63.

[18] Dewlaney KS, Hallowell M. Prevention through design and construction safety management strategies for high performance sustainable building construction. Construct Manage Econ 2012;30(2):165–77.

[19] Zuo J, Jin XH, Flynn L. Social sustainability in construction — an explorative study. J Construct Eng Manage 2012;12(2):51–62.

[20] Lam PT, Chan EH, Poon CS, Chau CK, Chun KP. Factors affecting the implementation of green specifications in construction. J Environ Manage 2010;91(3):654–61.

[21] Ruano MA, Cruzado MG. Use of education as social indicator in the assessment of sustainability throughout the life cycle of a building. Eur J EngEduc 2012;37(4):416–25.

[22] ApoorvVij, (2013) GRIHA, SVAGRAHA and Green Buildings in working studio on Building Smart Human Cities by IIA, Bhopal Chapter

[23] Ries R, Bilec M, Gokhan NM, Needy KL. The economic benefits of green buildings: a comprehensive case study. The Engineering Economist 2006; 51(3):259–95.

[24] Muse A, Plaut JM. An inside look at LEED: experienced practitioners reveal the inner workings of LEED. Journal of Green Building 2006; 1(1):3–8.

[25] Ries R, Bilec M, Gokhan NM, Needy KL. The economic benefits of green buildings: a comprehensive case study. The Engineering Economist 2 006; 51(3):259–95.