



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

Green Quotient Evaluation of Existing Buildings : A Case Study

Sunita Bansal¹, S.K. Singh², Srijit Biswas,³

1. Associate Professor, Department of Civil Engineering, Manav Rachna International University, Faridabad, India,
E-mail:sunitabansal221@gmail.com
2. Professor, Department of Environmental Engineering, Delhi Technological University, Delhi, India,
E-mail:sksinghdce@gmail.com
3. Professor, Department of Civil Engineering, Manav Rachna International University, Faridabad, India,
E-mail:srijitbiswas@yahoo.com

Manuscript Info

Manuscript History:

Received: 28 March 2015
Final Accepted: 29 April 2015
Published Online: May 2015

Key words:

Green Building, LEED, rating system, performance evaluation, existing buildings, etc.

*Corresponding Author

Sunita Bansal

Abstract

The construction, characteristics, operation, and demolition of buildings are increasingly recognized as a major source of adverse environmental impact. Without significant transformation of building construction and operations, such impacts are expected to increase with population growth and changes in other demographic and economic factors. One strategy for achieving that transformation is most widely known by the term Green Building[3]. We have gone past the point where going 'green' is an option. It has now become an absolute necessity to not only mandatorily construct green but rate Green Quotient of our existing buildings also according to LEED-EB. Existing buildings in Delhi-NCR form the main bulk of the building stock, and they are a significant consumer of energy and water resources, and thus negatively affecting the environment. The International Energy Agency released a publication that estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions [5]. Undertaking a green retrofit of an existing building brings about both tangible and intangible benefits- reduce the energy and water consumption, improve the building's indoor environment quality and reduces 'sick building' syndrome. In this paper, a case study on an existing building in Delhi-NCR has been presented to inspire all stakeholders in the industry to make a concerted effort to improve the performance of our existing buildings in every sense and ensure a better built environment for our future. Regulations have to be framed by the Govt. for every building to evaluate their green status and thus minimize the negative effects of building industry on the environment.

Copy Right, IJAR, 2015,. All rights reserved

INTRODUCTION

The National Capital Territory of Delhi, has a population of about 11 million and a metropolitan population of about 16.3 million, making it the second most populous city and second most populous urban agglomeration in India[11]. The urban expansion in Delhi has expanded beyond the NCT to incorporate towns in neighboring states and at its largest extent can count a population of about 25 million residents as of 2014 [2]. Buildings in Delhi-NCR are an integral part of the city's heritage, skyline and a valuable asset but they also consume significant energy and

resources. Built up area in Delhi has been on a rise and using Green Building concept for new construction can definitely reduce the environmental impact of buildings in Delhi. But the area in and around Delhi was probably inhabited before the second millennium BC, and there is evidence of continuous inhabitation since at least the 6th century B.C.[1]. Thus, besides the new constructions, there is quite a huge potential of existing buildings to adversely affect the environment unless their operation and maintenance methods checked and evaluated. Mandatory restrictions will have to be imposed in the Govt. Policies regarding energy/water use and CO₂ emissions[4]. Aside from energy/water efficiency, many other significant sustainability improvements can be made in existing buildings in terms of resource use, waste reduction via recycling programs[6] as also, sustainable purchasing policies, procurement, and ongoing operations & maintenance procedures which will improve a buildings' performance[7,8]. In addition to the tangible benefits, there are other 'intangible' benefits associated with green buildings such as Employee comfort and indoor environmental quality that are hard to quantify but are equally important to address[5]. 'Indoor Environmental Quality (IEQ)', encompasses items like access to natural daylight, air quality, views, thermal and physical comfort, and the ability to control one's environment (i.e. temperature, air flow and lighting) which have positive psychological and physical effects and contribute to happier, healthier occupants. Good IEQ has been shown to increase productivity, decrease absenteeism due to sickness and improved morale of the employees. Thus good IEQ will also contribute towards economic benefits in the same manner as energy or water efficiency[9]. A well designed and well operated building will have enhanced value, demand and lower operating costs. The need to build, operate and maintain our buildings in a more sustainable way will only increase as energy costs rise, potable water and material resources become increasingly scarce and the impact of Govt. legislation increases.

Green Building Rating Schemes like LEED by IGBC or GRIHA[10] by TERI can be used to assess the environmental performance of buildings in India. Leadership in Energy and Environmental Design (LEED) is an internationally adopted program of the U.S. Green Building Council (USGBC,1998) and later adopted by Indian Green Building Council(IGBC). The system covers the majority of certified projects as New Construction, or LEED-NC. But, adverse effects on environment, sustainability and potential cost savings do not stop once a building is constructed. To address this, the USGBC developed LEED for Existing Buildings, or LEED-EB[12] which includes 14 prerequisites and 85 distinct credits.

LEED for Existing Buildings: Operations & Maintenance ("LEED EBOM" or "LEED EB") establishes uniform standards for existing buildings that focus on environment sensitive operations and maintenance. An existing building that applies and achieves LEED certification, whether at the Certified, Silver, Gold, or Platinum level, demonstrates high performance as "green building" in five major categories: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality (USGBC,2009)[12]. LEED EBOM certification is highly achievable for a number of different building types, and is becoming increasingly popular as building owners and managers exhibit their environment responsibility and seek to distinguish their spaces from among those of their competitors. Evaluating your building for its green status sets a target level of achievement against these tools, and can be used to track the progress[13]. Here, the existing building is in Delhi-NCR which has been evaluated for green status using LEED-EB rating tool, de facto green building standard. The case study presented here documents the sustainability approach taken in the specific organization and building. It also offers insights on getting an organizational commitment to pursue LEED-EB certification, managing a environmentally responsible project, the problems that may arise, and the solutions that can be used to address those problems.

2. METHODOLOGY

This case study details the actions the organization took to improve the building's performance, and offers guidance to further improve its LEED-EBOM rating. It also facilitates other campuses to complete a successful LEED-EB project. The organisation under study is an integrated global pharmaceutical and life sciences company engaged in manufacturing and supplying of APIs, Solid Dosage Formulations, Radiopharmaceuticals, Allergy Therapy Products and Life Science Ingredients. The following issues were evaluated against the standards laid out in LEED-EBOM.

2.1 ENERGY

An energy audit was undertaken to find out which areas of the building are consuming large amounts of energy. Then these areas were targeted for improvement. The energy audit included electricity, gas use and any other energy source used. Also, energy bills were reviewed to discover any abnormal variation in consumption. There are incentive schemes available to help fund the cost of an energy audit. Efficient Equipment, Renewable Energy, Energy Efficient Transportation facilities were also recorded.

2.2 WATER

A water audit was performed to establish the areas of the building that are consuming large amounts of water and targeted for improvement. This was done in conjunction with a review of water bills to determine any variation in consumption that may be abnormal. Also, there are incentive schemes available to help fund the cost of a water audit. The type of water fittings (i.e. sinks, toilets, urinals and showers) that were installed were catalogued or reviewed in order to evaluate their individual water consumption (i.e. flow rates). Some or all of the water fittings needed to be replaced. All new premises and existing premises undergoing renovation are required to only be installed with water fittings and products (i.e. taps, dual flush Low Capacity Flushing Cisterns (LCFCs), urinals and urinal flush valves) that are labeled with at least one or more ticks under WELS (Water Efficiency Labeling Scheme). Water Treatment, Alternate Sources, Metering, Irrigation measures of green areas etc was recorded.

2.3 WASTE

A waste audit was undertaken to find out the total amount of solid waste the building generated and also how much of it was being recycled and how much was sent to incineration and landfill. This knowledge helped us find opportunities to increase recycling efforts and reduce the amount of waste sent to incineration and landfill.

2.4 CONDITION AUDIT

A condition audit was undertaken intended to determine the current condition and expected remaining economic life of building's components. It produced a complete inventory of building (including equipment) that identifies deficiencies. Typical areas to be examined included the structure, external walls and roof, mechanical, electrical and IT systems, hazardous materials (asbestos, lead, etc), security and safety issues were reviewed.

2.5 INDOOR ENVIRONMENTAL QUALITY

Many existing buildings have a poor indoor environmental and/or air quality (IEQ/IAQ). IEQ encompasses thermal comfort, air quality, lighting levels and noise levels. Each of these were audited to find out how they currently perform and where improvements can be made.

2.6 OCCUPANT SATISFACTION

Occupant surveys were conducted to judge the current performance of building. After all, the occupants are the people who spend the most time in the building. The occupant survey highlighted any day-to-day building performance that falls below employees' expectations and also highlighted thermal comfort, noise, glare, transport and other operational issues. To be effective, the audit was carried out in a highly structured manner so that the results can allow comparison with a well-established, benchmarked database of criteria.

2.7 FACILITIES MANAGEMENT

Facilities management providers contribute significantly to the success of an organization. Ineffective providers can lead to occupant dissatisfaction and premature failure of major building systems. A review of the facilities management was conducted which included- Management process used in the property, Maintenance schedules and Operations & Maintenance manuals (O&M), Building Management System for its calibration and correct use.

Based on the observations of the building and points awarded for different categories under LEED-EBOM, assessment of the building was done. Points earned and suggestions for each category are tabulated as under-

Table No 1. Site & Facility Management (Maximum 18 Points)

Intent: Environmentally sensitive site maintenance practices to be followed to reduce site maintenance costs while creating and maintaining an outdoor space that is healthy for occupants and local plant and wildlife, support alternative transportation, protect and/or restore natural sites.

IGBC Category	Criterion to be followed	Max. Point	Present Scenario	Present Points	Our Suggestions	Scope of Points
Site & Facility Management (Maximum 18 Points)	Green Policy	Mandatory	In place	Mandatory	Nil	Mandatory
	Waste collection & Disposal	Mandatory	Waste segregation and disposal of non-hazardous waste not in place	Mandatory	Recycling and reusing of the non-hazardous waste	Mandatory
	Eco-friendly Commuting Practice: 25%, 50%	4	Provide shuttle services to nearest public transportation facility	2	Encourage car pools for people by setting up forums where people could discuss their daily route and club in with others travelling on the same route	4
	Eco-friendly	2	Less than 15% of	2	Usage of organic	2

	Landscaping Practice: 25%, 75%		immediate area is landscaped, however maintaining a green belt in front of the office building		fertilizers majorly is a thumbs up; can increase the overall landscaped area in the building premises	
	Heat Island Reduction, Non-roof: 50%, 75%	4	Less than 50% of shaded non-roof hardscape area	0	Shade from solar panels/ structured surface parking	4
	Heat Island Reduction, Roof: 50%, 75%	4	Wing C and wing B's roof is covered with reflective coating having a high SRI and accounts 70.04% of total roof area	2	Adopting similar practices with roofs of Wing A	4
	Outdoor Light Pollution Reduction	2	No external Lighting is upward looking	2	Nil	2
	Building Operations & Maintenance	2	Have in place O&M plan for HVAC systems, power back-up systems, elevators and building management systems	1	Carry-out energy and water audit, once in 3 years and explore opportunities for improvement	2
	Total (A)	18		7		18

Table No 2. Water Efficiency (Maximum 26 Points)

Intent: Maximize the use of strategies and technologies that reduce the amount of potable water consumed in buildings and reduce municipal water supply and treatment burden.

IGBC Category	Criterion to be followed	Max. Point	Present Scenario	Present Points	Our Suggestions	Scope of Points
Water Efficiency (Maximum 26 Points)	Water Efficient Fixtures	Mandatory	Yearly water consumption is double of the consumption as guided by IGBC	Mandatory	Immediate action should be taken to install water smart devices in the building premises	Mandatory
	Water Efficient Fixtures: 20%,30%,40%	6	Yearly water consumption is double of the consumption as guided by IGBC	0	Immediate action should be taken to install water smart devices in the building premises	2
	Rain Water Harvesting: 25%, 50%	4	No system installed yet	0	Install a rain water harvesting system that stores 50% of the runoff	4
	Waste Water Treatment, 100%	4	No system installed yet	0	Concept of zero discharge can be used.	4
	Waste Water Reuse, 75%, 100%	4	Not in use	0	The reused water can be sent to the already installed water softening unit and used for cooling towers and flushes.	4
	Water Metering	4	Only 2 water meters	0	Install water meters on	4

			installed; one for measuring the total extraction of ground water and other for soft water demand		each floor, water meters for flushing, irrigation requirements	
	Turf Area: 50%, 25%	4	Less than 15% of immediate area is landscaped.	0	Increase the green cover of the site to at least 15%	4
	Total (B)	26		0		22

Table No 3. Energy Efficiency (Maximum 30 Points)

Intent: Verify that fundamental building systems and assemblies are performing as intended to meet current needs and sustainability requirements. Also, the goal is to establish energy efficiency and system performance, encourage renewable and alternative energy sources to support ozone protection protocols.

IGBC Category	Criterion to be followed	Max. Point	Present Scenario	Present Points	Our Suggestions	Scope of Points
Energy Efficiency (Maximum 30 Points)	Eco-friendly Refrigerants & Halons	Mandatory	R134a refrigerant is used	Mandatory	Change the refrigerant of stand by chillers from R22 to R134a	Mandatory
	Minimum Energy Performance	Mandatory	Check	Mandatory	Nil	Mandatory
	Improved Energy Performance : 10%, 12.5%, 15%, 17.5%, 20%, 22.5%, 25%	14	EPI calculated was 172.34kWh/year/m ²	0	Use improved energy and rated appliances	6
	On site Renewable Energy: 2.5%, 5%, 7.5%	6	No on-site Renewable Energy systems in use	0	Installation of Solar panels for energy generation is the most apt renewable source of energy at the location and for the type of building	4
	Off Site Renewable Energy: 25%, 50%, 75%	6	Nil	0	Installation of Solar panels, biogas plants in the production units under the company	4
	Energy Metering	4	Only 1 energy meter installed for the building	0	Installation of energy meters for central HVAC, lightening consumption, power back-up systems, etc	4
	Total (C)	30		0		18

Table No 4. Health & Comfort (Maximum 14 Points)

Establish good indoor air quality- eliminate, reduce and manage the sources of indoor air pollution, ensure thermal comfort and systems controllability. Provision for occupant connection to the outdoor environment should be there.

IGBC Category	Criterion to be followed	Max. Point	Present Scenario	Present Points	Our Suggestions	Scope of Points
Health & Comfort (Maximum 14 Points)	Tobacco Smoke Control	Mandatory	No Smoking Area	Mandatory	Setting up a smoking area with proper exhaust and ventilation or designate a space 7.6 m from all outdoor intakes (doors, windows, etc)	Mandatory
	Fresh Air Ventilation	Mandatory	Check	Mandatory	Nil	Mandatory
	Carbon dioxide Monitoring & Control	2	Nil	0	Install CO ₂ sensors and maintain a differential CO ₂ level of 530 ppm	2
	Isolation of Polluting Equipment & Systems	2	Check	2	Isolate printer rooms and install an exhaust fan	2
	Eco-friendly Housekeeping Chemicals	2	Check	2	Nil	2
	Thermal Comfort, Indoor Temperature & RH	2	The comfort condition maintained is 26+ 2 degree C and RH in the range of 30 to 70 %	2	Conduct a survey once in 6 months and show that 80% of the building occupants are satisfied with the temperatures maintained.	2
	Facilities for Differently Abled People	4	Ramps with raining, uniformity in floors and car spaces having easy access to lift lobby	0	Braille and Auto assistance in lifts to be worked upon; restrooms for differently abled people	4
	Occupant Well-being Facilities	2	The building has a gymnasium and indoor games facility for at least 10%	2	Meditation/ Outdoor games	2
Total (D)	14		8		14	

Table No 5. Innovation Category (Maximum 12 Points)

Intent: Recognize exemplary performance in any achieved LEED-EB credit and innovation in green building not addressed by current standards.

IGBC Category	Criterion to be followed	Max. Point	Present Scenario	Present Points	Our Suggestions	Scope of Points
Innovation Category (Maximum 12 Points)	Innovation Credits	10	Maintenance of the park in front of the building	2	Apply innovations as suggested in the report	10
	IGBC AP	2		0	Involve an IGBC AP as a principal participant of the project	2
	Total (E)	12		2		12

Total (A+B+C+D+E)		100		17		84
------------------------------	--	------------	--	-----------	--	-----------

3. DISCUSSION

The company uncompromisingly has adopted an approach which defines sustainability as 'Business as usual'. Their promise of Caring, Sharing, and Growing along with their stakeholders is the essence of all their activities that are directed towards sustainable growth. To further augment their promise, the following policies have been framed and implemented:

- Sustainability Mission
- Climate Change Mitigation Policy
- Environment, Health & Safety Policy
- Green Supply Chain Policy
- Business Code of Conduct
- Whistle-blower Policy
- Quality Policy

The policies are in place but the company scores just 17 points when assessed against LEED criteria which do not enable it to earn even a certification, for which minimum 50 points are required. But the company can incorporate the suggestions made in the report, major ones being installing solar panels, smart water devices, rain water harvesting, other water efficiency measures, recycling non-hazardous waste, encouraging car pools, smoking areas etc. All this will not incur larger costs than the benefits accrued. If the company is able to score greater than 70 points, it qualifies for Gold or a Platinum certification which gives it a Global Leadership as also exhibition of greater corporate social responsibility towards environment protection.

4. CONCLUSION

Existing buildings in Delhi-NCR comprise the larger segment of the built environment. Their operation and maintenance protocols contribute majorly towards negative effects on environment. We need to assess the performance of each major building according to the green building standard for existing buildings-LEED-EBOM. Depending on the points earned as per this scheme, major renovations and retrofits can be designed to include sustainability initiatives and have a good LEED-EBOM Green Building Rating. This will reduce operation and maintenance costs and environmental impacts, and can increase building adaptability, durability, and resiliency. Conserving energy is not the only reason for retrofitting existing buildings; rather the goal should be to create a high-performance building by applying the integrated, whole-building design process. The integrated project team may discover a single design strategy that will meet multiple design objectives so that the building will be less costly to operate, will increase in value, last longer, and contribute to a better, healthier, more comfortable environment for people. In an era of LEED-certified construction and growing concern for sustainability, it may also be observed that constructing new, energy-efficient buildings can be less eco-friendly than renovating old ones. Mandatory Regulations have to be imposed by the Govt to enforce Greener built environment and also incentives be given to those who implement.

5. REFERENCES

1. Asher, Catherine B (2000) [2000]. "Chapter 9:Delhi walled: Changing Boundaries". In James D. Tracy. City Walls. Cambridge University Press. pp. 247–281. ISBN 978-0-521-65221-6. Retrieved 1 November 2008.
2. "Cities with population of 1 Lakh and Above". Census india.gov.in. Retrieved 30 January 2014.
3. Fischer, E. A. (2009). Issues in Green Building and the Federal Response: An Introduction. Congressional Research Service.
4. Gour, A.A., Singh, S.K., Tyagi, S.K. and Mandal, A. (2015) Variation in Parameters of Ambient Air Quality in National Capital Territory (NCT) of Delhi (India), Atmospheric and Climate Sciences; **5**:13-22.
5. J.C, howe. (2010). Overview of green buildings. National Wetlands Newsletter, 33(1).
6. Shishir Bansal, S.K. Singh, (2014), "A Sustainable Approach Towards The Construction and Demolition Waste", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 2, February, 2014.

7. Shishir Bansal, S.K. Singh, (2015), "SUSTAINABLE HANDLING OF CONSTRUCTION AND DEMOLITION (C & D) WASTE", International journal of sustainable Energy and Environmental Research, 4(2): 22-48
8. Sunita Bansal, Srijit Biswas, S.K. Singh, (2015), "APPROACH OF FUZZY LOGIC FOR EVALUATION OF GREEN BUILDING RATING SYSTEM", International Journal of Innovative Research in Advanced Engineering (IJIRAE), Volume 2, Issue 3: 35-39.
9. Sunita Bansal, Srijit Biswas, S.K. Singh, (2015), "SELECTION OF MOST ECONOMICAL GREEN BUILDING OUT OF n-ALTERNATIVES: APPROACH OF VAGUE FUZZY LOGIC", International Journal of Research in Engineering and Technology, 4(2): 164-168.
10. TERI. (2010). Green Rating for Integrated Habitat Assessment (GRIHA). Delhi: Ministry of New & Renewable Energy Government of India
11. "[Urban agglomerations/cities having population 1 million and above](#)" (PDF). Provisional population totals, census of India 2011. Registrar General & Census Commissioner, India. 2011. Retrieved 26 January 2012.
12. USGBC. (2009). LEED-Existing Buildings Operations and maintenance. US Green Building Council.
13. USGBC. (December,2004). LEED-EB Project Case Study:JohnsonDiversey Headquarters.