SUSTAINABLE DESIGN STANDARDS IN INDIA: THE EXCLUDED ISSUES

Requirements for LEED India to recognize climatic diversity

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ABSTRACT

Due to the recent emphasis on "Green Building" in different countries around the world, LEED (Leadership in Energy and Environmental Design) certification has emerged as one of the major recognized standards for measuring building sustainability. In 2005, the Indian Green Building Council (IGBC) adopted the original US rating system without substantive modifications in response to the significant contextual differences between the United States and India. In 2007, the IGBC published the LEED INDIA NC Version[1] 1.0 with changes to better respond to the Indian context. This version did not address climatic variations, which demand focused attention on particular sections, such as natural ventilation and daylighting. This paper highlights the essential significance of these critical issues in latest LEED Indian Guidelines in the current LEED standards with respect to comparison between performance of green buildings with and without the LEED certification.

1. INTRODUCTION

Green Buildings play a significant role in defining our future on this planet today. The design approach for such buildings thus has a major impact on the very sustainability of our civilization. In response to this challenge, at present we have certain standards and rating systems in different parts of the world to define and measure sustainable buildings of different categories and scale. LEED (Leadership in Energy and Environmental Design) developed by US Green Building Council (USGBC) is one of those Green Building rating systems widely accepted around the world. The major goals of LEED are to define Green Buildings by establishing a common standard of measurement and promote integrated, whole-building design practices. Though the rating system was originally developed considering the American context, it has been gradually accepted in more than 13 countries, including India. In India, before the advent of LEED there existed a number of national and international building standards and codes which fulfilled the requirement for sustainable design and the rating system in a discreet manner. The official certification of LEED for Indian buildings started in November, 2003, when US Green Building Council (USGBC) certified the CII Sohrabji Godrej Green Business Centre, Hyderabad with the highest Platinum certification level under its LEED Rating System (version 2.0). The first Indian version, referred to as LEED India Version 2.0 was launched in October 2006. The current version, known as LEED India NC (for new construction) Reference Guide Version 1.0 was released in January 2007. Currently, there are 18 LEED certified and 80 LEED registered projects in India with expected certification of 1000 buildings by 2012[2].

Although a number of amendments for the Indian version have been proposed to fit into the context by the steering committee appointed by IGBC, the basic structure of the guidelines is still based on the US version and consequently follows the standards and definitions derived from the climatic context of USA. India is very different in terms of climate and has its own set of priorities for sustainable buildings. It is hard to provide a single model of Green Building applicable to all parts of the country. Hence it becomes confusing when we celebrate the newly LEED certified buildings most of which have similar kind of design solution addressing the unique problems of different climate zones. There are few exceptions, but most of the critical design decisions are left to the discretion of the architect and builder and not on LEED Guidelines. Yet, these buildings manage to receive good LEED ratings as they can accumulate

[1] For new construction

[2] Source: Indian Green Building Council Website

sufficient credit points from other section to fulfill the requirement while buildings designed with better operational methods cannot ensure better recognition from the scoring system.

2. CONTEXTS IN INDIA: CLIMATE

While designing for a specific context, one needs to consider several aspect of that particular context such as geographical, climatic, economic, social, etc. These aspects are closely related to each other and thus each of them has affected the design solution. Climate is one of the major factors in determining methods and techniques in a sustainable design process. India being a very large and geographically diverse country, climate cannot be generalized into any single major category as it varies significantly depending upon the location. According to the National Building code of India there are five major climatic zones in India:

1. Hot-Dry
2. Warm-Humid
3. Composite
4. Temperate
5. Cold.

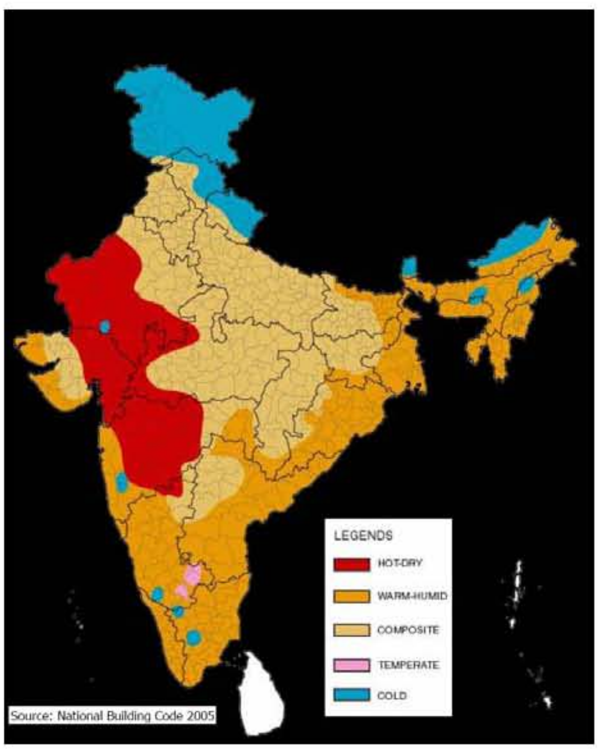

Figure 1: Climate zones of India

This climatic variation is one of the major driving factors behind the diversity in traditional architecture in different parts of the country. Consequently, the methods and techniques applied in the architectural solutions are responsive to the variation of climate, which includes solar radiation and sun path, humidity, and wind direction throughout the year.

From the foregoing discussion it becomes evident that every climate zone would require a different set of priorities for a truly sustainable design that relates to other local contexts. Hence, for research purposes a single major climate zone will be considered to reflect on LEED India and related guidelines. The Warm and Humid climate zone encompasses a major part of the country and is one of the difficult contexts to handle due to excessive humidity during summer and monsoon, combined with high sun angle. Major cities like Mumbai, Kolkata, and Chennai fall into this zone and have a significant impact on the building industry and the environment. This allows study and comparison of performance of buildings with same context and similar function recognized either by LEED and/or other organizations as green buildings.

3. KEY DESIGN ASPECTS FOR WARM AND HUMID CLIMATE

For a sustainable Green building, some of the major concerns for a climate responsive, and thus sustainable building, are the indoor environment quality, water management and use of material resources. These factors are very closely related and together effect the overall performance of the building.

3.1. Indoor Environmental Quality

Air: The indoor environmental quality largely depends on a number of aspects, such as air temperature, humidity air flow and dust particles present in air. The steady-state heat flow (heat loss) between the human body and the surrounding environment required to maintain the body core temperature is controlled by different factors, which include heat loss by evaporation, radiation and convection. Other factors like clothing and pollution also have significant impact. Generally, the comfort temperature range is 68-77°F (20-25°C) with minimal wind flow.

In warmer environments, where the air temperature exceeds 80°F (26.6°C) with more water vapor present in air, the human body has to depend more on evaporative methods than on convection or radiation to lose heat. Hence, it can be argued that under this climatic condition, the building indoor environment requires more air movement to maintain the comfort temperature for the major portion of the year. The architectural solution for this requirement thus is to provide more cross ventilation across the building. The comfort level is not a very simple attribute to determine as the comfort temperature varies from place to place, which is discussed later.

The effects of solar radiation upon a building can be divided into following categories:

A. Heat Gain: The sun is the primary source of heat on this planet. Without artificial heating or cooling and considering the human body heat generation and air movement, the intensity of solar heat gain majorly controls the temperature within a building throughout the day. The intensity depends upon the angle of incidence of sun rays which is determined by the daily and annual sun path charts. All of these vary depending upon the climatic and geographical features of the building location. With the knowledge of solar movement in a particular place, we can determine which portion of the building will have maximum solar incidence. In a tropical warm and humid climate zone angle of solar incidence will be much higher throughout the year, especially in summer. Thus it is necessary to understand that the design should primarily minimize the heat gain during summer and prioritize heat gain enhancement during winter—when the temperature is not too low from comfort level unlike extreme climate zones. The design solution therefore should incorporate building orientation, façade systems and material chosen.

B. Daylighting: Using more of natural resource of light instead of artificial means is a key factor to any sustainable building for minimizing energy consumption. In a country like India, one can expect much more sun light than most western countries and it is essential to exploit this opportunity as much as possible. Considering the intensity of the sun glare and heat gain, one can optimize the solution by exploring the daylighting options, which allow us to have more ambient lighting over direct lighting and thus, reducing the heat gain and glare factor. This could be achieved by careful selection of shading devices, limitation of floor width and choice of appropriate material. Daylighting therefore is one of the critical issues that should be emphasized in any sustainable design guidelines for India.

3.2. Water Management

Resources of potable water are scarce around the world and it is a critical issue in countries like India. The average rainfall is higher in most of the Indian climate zones with respect to countries like the USA. First, it is necessary to maintain the flow of rainwater to ground to preserve the water table beneath, which is the primary supply of drinking water. A building should thus have a well planned storm and waste water management system with means to harvest water within the site. Second, re-use and land recycling of water is important for different activities and should be increased.

3.3. Material and Resources

Materials used in the buildings and their resources always remain one of the prime aspects of sustainable design, which connects all the other aspects together. For any climate zone one needs to choose building materials that are truly 'local' in terms of proximity of their origin, availability of natural ingredients and the process to produce the final product. To be more precise, the origin should be within the same climatic and geographic region of the building site. Hence, for the warm and humid climate zone it is not wise to import stones, glass and other materials from different part of country as primary building materials. Furthermore, solar radiation and use of glass and similar materials should be balanced with locally available high insulation materials like brick. This choice again indicates the kind of method and technology that can be used for shading and ventilation systems.

The above discussion could be summarized as follows:

For buildings in Warm and Humid climate zone in India

1. Air circulation (cross ventilation) is more effective than temperature control to achieve comfort.
2. Minimization of solar heat gain should have more concern than winter heating.
3. Daylighting is preferred for indoor illumination with consideration for glare issues.
4. Water resources are scarce and their use should be controlled.
5. Choice of materials is crucial and depends upon climatic and geographic variations.

4. LEED India Rating System: The Excluded Issues

As mentioned before, the LEED India Rating system is fundamentally based on the US version which allows up to 69 points. The level of certification is determined with the points achieved as follows:

- Certified: 26-32 points
- Silver: 33-38 points
- Gold: 39-51 points
- Platinum: 52-69 points

The project checklist distributes the points under different prerequisites and credits with variable number of maximum achievable points as:

1. Sustainable Sites: 13 points (prerequisite: Erosion and Sedimentation control)
2. Water Efficiency: 6 points
3. Energy & Atmosphere: 17 points (prerequisite: Fundamental building systems commissioning,

Minimum energy performance, and Fundamental refrigerant management)

4. Material & Resources: 13 points (prerequisite: Storage and collection of recyclables)
5. Indoor Environmental Quality: 15 points (prerequisite: Minimum IAQ performance, Environmental Tobacco smoke control)
6. Innovation & Design process: 5 points

Suggestions to make the LEED rating system more responsive to the Indian context were made by the official steering committee within IGBC before the release of LEED India NC Version 1.0 in January 2007, which is the current version in use to date. The amendments followed certain general guidelines, one of which mentions reviewing introduction of each section to suit Indian context. It was also mentioned that Indian standards will be referred to and adopted whenever they are found more stringent than the LEED guidelines. This suggestion list includes major modification for 1 credit, minor modifications for 5 credits and introduction of 3 new credits. Each section has potential strategies and technologies suggested for the design process.

4.1. Water Management:

The issue of water management is given considerable importance in the list of amendments. Under the Water Efficiency criteria, 3 points are allocated for water use reduction and use of recycled water for air conditioning systems, which recognizes one of the major concerns in India.

4.2. Material and Resources:

The Material and Resources section is quite elaborate and addresses local factors by providing credits for use of local materials and use of rapidly renewable materials. However, setting the radius of 800 Kilometers as the limit for finding local materials does not make good sense because the climate and topography can change drastically within that distance, making the whole objective useless. The choice of local and re-usable materials has significant influence on the effectiveness of solar shading and ventilation systems; the section requires more rigid statements under this issue clarifying the preferences of LEED.

4.3. Air Quality and Temperature:

The current versions of LEED India guidelines refer to other national and international standards to define the air ventilation criteria. For mechanically ventilated spaces, ASHRAE Standard 62.1-2004 is referred. On the other hand, for naturally ventilated spaces one has to refer the Carbon Trust “Good Practice Guide 237” (1998) and the flow diagram available in the Chartered institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005 for non-domestic buildings. Again under the Energy and Atmosphere section reference is made to Energy Conservation Building Code (ECBC) 2006; which was used before the advent of LEED in India. This guideline again refers to the National Building Code of India 2005 for natural ventilation requirements. Hence, the issues are as follows:

A. It is very difficult to consult all the other standards while designing and following LEED guidelines for different requirements. There are different definitions for the requirements based on different climates and times that are not applicable to the requirements of a particular climate zone.

B. LEED guidelines provide equal credit points for both mechanically and naturally ventilated spaces and fail to recognize the Indian context where it is wiser to prioritize natural ventilation systems over mechanical and respect the local climate and economy. Builders, who are not the most environmentally conscious people in India, dominate the Architectural Industry. Hence, with the current rating system they have every chance opt for mechanical ventilation over natural ventilation because it is a relatively easier route to earning the same number of LEED credits.

The only modifications made here are on the use of low energy emitting materials that respond to the material aspects. Hence, it can be said LEED does not show concern on how the air quality is maintained within a building and if that responds to the climatic conditions.

4.4. Solar Radiation:

Energy: Under the Energy and Atmosphere section HVAC is perceived as the single system which does not prioritize cooling over heating for a warm climate—where solar heat gain provides most of the heating in winter and needs to be minimized in summer. The guidelines follow the ASHRAE standard and raise many questions. Although there are credit points for using solar radiation as a renewable energy resource, the number of credits (1-3) does not seen to be encouraging enough to pursue the additional design measures.

Daylighting: The entire idea of daylighting is split under different credit points within Indoor Environmental Quality section as follows:

A. Controllability of systems: 1-2 points: This section gives some idea of how potential design strategies, such as operable windows, could address the daylighting requirements. However, the word daylighting is not mentioned here.

B. Daylight and Views: 1-2 points: Here the term is formally defined, and gives a sufficiently clear idea of the requirements. One can find design strategies to enhance daylighting suggested here, which is commendable. These facts notwithstanding, it is clear that this critical aspect of sustainable design pertaining to the climatic factors has not been given enough importance within the rating system as it is assigned only a few credits compared to the other aspects. Hence, the preference of daylighting over artificial lighting during daytime is not well established.

One to four credits are assigned to Innovation and Design Process, which can be a very important factor for designers to help choose a more context friendly approach. There are other commendable additions regarding building safety, alternate transportation, parking and emissions from generator sets. .

In summary, LEED India has two new prerequisites, three new credit points and has removed two credit points. These changes do not reflect the primary requirements of the sustainable design following the diversity of the country. It is also not an easy task to follow the guidelines as they refer to a number of other guidelines.

5. COMPARIATIVE GREEN BUILDING STUDY

The argument of the authors is that the current credit structure of LEED rating system and guidelines in India do not emphasize critical issues for sustainable building operations. This has allowed buildings designed with unsuitable design choices to claim equal, and in some cases even more sustainable, credits over buildings reflecting context sensitive design solutions. The idea of LEED rating thus, is converted to a marketing strategy for builders to sell the poorly designed and inefficient buildings. This can be easily recognized by comparing examples of sustainable buildings with similar functions within the same context, one recognized by LEED and the other recognized by any Pre-LEED green design organization. For research purposes, the authors have chosen the following buildings:

1. ***West Bengal Renewable Energy Development Agency (WBREDA)***, Kolkata, India, building type: office, year of completion: 2000, listed in TERI (Tata Energy Research Institute) list of energy efficient Indian buildings.
2. ***Technopolis***, Kolkata, India, building type: office, year of completion: 2006, LEED Rating: Gold.

Both the buildings are in operation and share the same climatic, geographical and functional context. The first building is one of the good examples of the energy conservation drive throughout the country before the advent of LEED rating systems. The other one boasts the new growth of the IT sector in Kolkata.

Figure 2: WBREDA Building, Kolkata

Designs of both the buildings are analyzed with the project checklist from LEED to compare the building operations based on the following aspects:

Indoor air quality and ventilation: The design of WBREDA building shows serious concern for natural ventilation throughout the year, responding to the warm and humid nature of Kolkata from March to October. This is the easiest and most economic way to maintain comfort level within the building. The orientation of the building allows the prevailing South-West breeze to flow through the building. The division of work zones also helps to minimize the requirement of mechanically ventilated spaces. To ensure continuous airflow, landscaping features, such as like trees and water, are scientifically used to enhance airflow speed and penetration. The chimney on the roof between the two types of ventilation zone completes the airflow pattern.

In contrast to the WBREDA building, the design for Technopolis relies mostly on mechanically controlled systems for HVAC control. These controls enable the required amount of fresh air intake and other aspects following the LEED and ASHRAE standards to maintain the indoor air quality. Provision for natural ventilation is almost absent in the design. An online CO_2 monitoring system and fans for air exchange makes the system more efficient, but at a higher installation and running cost.

Figure 3: Technopolis, Kolkata

As stated earlier, the climate in Kolkata is warm for a greater part of the year and almost comfortable for the rest of the year Mechanical heating is the least important factor to be concerned about while designing the HVAC system. For cooling, again, since the temperature is not very high, provision of natural ventilation and shade does half the job. Hence, the WBREDA building should achieve more points than Technopolis for this category. It will not be irrelative to mention that even the most efficient and economic mechanical HVAC system cannot match the energy saving of natural ventilation, as it will always require some energy to run itself.

The LEED rating guidelines, however, do not acknowledge the design and operation potential of the WBREDA building over the Technopolis building under the current credit structure. As previously discussed, there is no provision to earn more points for natural ventilation than mechanical ventilation for equally good indoor air quality and energy efficient indoor spaces. The only way to recognize the design features in the WBREDA building is to provide credits under Innovative Design/Operations section which again can be given for other innovative design features in Technopolis.

Solar radiation and daylighting: For a building in Kolkata where the solar angle is higher than the cold climate zones, it is more important to control the amount of solar heat radiation and amount of daylight than to provide unlimited amount of solar exposure. The WBREDA building is oriented North-South direction to minimize solar heat gain on East, West and South facades. Entrance of sunlight is permitted with a calculated amount of openings and solar shading devices, depending upon the directions. Thus, features like light-shelves and a light well allow ample daylight, but control glare at the same time.

Extensive use of glass and aluminum cladding on most of the facades of Technopolis, which is the current trend in almost every new corporate building in India, complicates the task to control solar heat gain and glare. Though the building incorporates glazing with low U factor and solar heat gain coefficient, it seems to be a secondary solution to compensate the wrong material selection. Artificial lighting is introduced to light the spaces, which results in higher energy consumption, even with energy efficient lighting systems and online monitoring and controls. This is not desirable, especially when a good design solution can effectively use the high daylighting potential efficiently.

Again, LEED provides only two points under the credit for daylight and views, and stipulates achieving a minimum two percent of daylight factor. In this category one point is given to daylight and the other point goes to providing good views. Only one point for such a major aspect for a green building under a warm-humid climate zone illustrates the bias against properly rating buildings with better daylighting operations.

The water management system for Technopolis however, has followed the LEED guidelines thoroughly with rainwater harvesting and other systems which at least meets one of the major sustainable requirements.

6. CONCLUSION

The LEED rating system is still a new concept for the building industry in India and one cannot expect that a rating system almost entirely based on a different context will be readily changed to address every single local aspect. At the same time, since the LEED rating system is now being considered as the primary model of sustainability, it has to be responsible enough to scrutinize every single definition and test it with different contextual aspects, climate being one of them. Natural ventilation and daylighting are some of the requirements for the truly sustainable operation of a building in warm-humid climate and also has immense impact on the lifecycle cost. The current LEED rating system in India, on the other hand, seems to have little concern for them with respect to other issues. This opens the door for the builders and designers to opt for easier and generic design solutions irrespective of the context and bypass the individual requirements without compromising the green building status. It also discourages the efforts to practice the intensive process of design to ensure appropriate building operations as they have little recognition in current LEED standards.

The comparative green building study of two contrasting buildings in India underscores the significance of addressing issues in LEED India that are critical to the local environment. The authors are of the opinion that until these concerns are at least equally emphasized as other issues, such as material and water management, with respect to every single context, the sustainable movement in India will produce buildings unsuitable for most of the Indian population.

REFERENCES

Indian Green Building Council. "LEED India NC Version 1.0." *www.igbc.in.* 2007. http://www.igbc.in/igbc/LEEDAbridVer.pdf (accessed April 21, 2008).

Buerau of Indian Standards. "Part 8, 5.4.3, 5.7.1.1." In *National Building Code of India*. 2005.

Burau of Energy Efficiency. "Energy Conservation Building Code." 2006. http://www.hareda.gov.in/ECBC.PDF (accessed April 21, 2008).

Confederation of India Industry. "LEED India, Summery of Suggestions." *www.worldgbc.org.* http://www.worldgbc.org/docs/LEED-INDIA%20SUGGESTIONS.pdf (accessed April 22, 2008).

Confederation of Indian Industry. "Green Building Movement in India-Catalysts and Course." *www.igbc.in.* http://www.igbc.in/igbc/publication.jsp (accessed april 22, 2008).

"Thermal comfort in the urban tropics." Chap. 3 in *An Urban Approach to Climate Sensitive Design-Strategies for the tropics*, by M. Rohinton Emmanuel, 63-95. Abingdon: Spon Press, 2005.

Merhotra, Rahul. "Architectural Responses in Rropical India." In *Tropical architecture : critical regionalism in the age of globalization* , by Alexander Tzonis, 193-213. New York: Wiley-Academy, 2001.

Srinivas, S. "Green Buildings in India: Lessons Learnt." *www.igbc.in.* http://www.igbc.in/igbc/publication.jsp (accessed April 21, 2008).

Sutaria, Ruchita, and Aalok Desmukh. "Whose Sustainability Is It Anyway?" September 2006. http://www.sustainable-design.ie/fire/India_Whose-Sustainability_PLEA2006-Paper939.pdf (accessed April 21, 2008).

Tata Energy Research Institute. *Energy-efficient buildings in India.* Edited by Mili Majumdar. New Delhi: Tata Energy Research Institute, Ministry of Non-conventional Energy Sources, Government of India, 2001.

Williams, Kath. "LEED Green Building Rating System." *http://greenbusinesscentre.com/articles.asp.* http://greenbusinesscentre.com/images/photos/1.pdf (accessed April 21, 2008).

Technopolis. http://www.technopolis.in/swf/technopolis.swf (accessed 06 11, 2008).