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A Comparative Overview of the Existing Building Rating Systems

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ABSTRACT: **Evaluation of growth is an effective tool to understand the direction of development in both regional and national context. Since the adoption of SDG (sustainable development goal), it has become a crucial to evaluate the sustainability performance of projects. In last one decade several rating systems are developed to access the sustainability and efficiency of buildings and large development projects. However the assessment process and requirement of these rating systems varies based widely depending on the context of the region of its origin and its supporting institutions. Though most of them have made significant changes in recent years to adopt the context for any building at any location, yet their outcomes tends to present few interesting shades of the performance of the building. The study intends to explore key factors responsible for these variations among different building rating systems.**

Key words: Sustainable Building, Green Building Rating System, BREEAM, LEED, IGBC, GRIHA.

I. INTRODUCTION

Cities are becoming the engines of development in the modern world. On the other hand the urban systems such as transport, buildings, and all other public infrastructures are consuming more energy than ever before the buildings are becoming more complex &energy intensive due to the demand of higher level of comfort & safety. Today most of the cities in south Asia don't have a model to follow for sustainable development. Sustainability is a concept that they have borrowed from the western world. Whereas the tradition lessons of sustainability is ignored. Hence today "Sustainable" is the most misused word in world. There is a constant effort from the both the government & NGO sector for energy efficient buildings in India. The impact of built form is hardly being studied from energy demand perspective from city to building level & when it comes to builder & architects the priority always changes. The building design process often perceives the building as a standalone system. But in reality the building behaves differently in presence of other buildings around in building clusters.

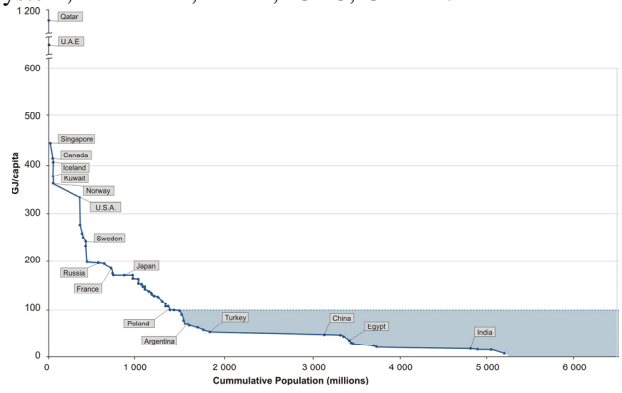

Fig. 1. Energy per capita as a function of cumulative population. (WEC Studies Committee 2005 - 07).

Energy per capita as a function of cumulative population.

The key challenge facing governments, business, and society at large is summarized in **Figure 1**. Average energy consumption per capita is shown for the nations of the world today (plotted as cumulative population), keeping in mind another one billion people (approximately) have no recorded energy use.

To allow everyone in the world to attain just the energy use per person of Poland today, or about 100 GJ/capita[1],would require about twice the amount of energy the entire world already uses today, assuming that people who are already above Poland's level maintain their current energy use per capita. To achieve the level of Russia's energy use today (200 GJ/capita), more than three times as much energy is required over what is used today. Especially due to highly growing energy demand in India & China, 1/3 of world population may have to face tough challenges to fulfill the demand in coming years.

China experienced severe energy shortages towards the end of 2005 and again in early 2008. During the latter crisis they suffered severe damage to power networks along with diesel and coal shortages. Supplies of electricity in Guangdong province, the manufacturing hub of China, are predicted to fall short by an estimated 10 GWatt. In 2012 China was forecast to have a second quarter electrical power deficit of 44.85 - 49.85 G. In India more than 45% of population is yet to get a regular electricity connection.

The energy used in a building can vary greatly depending on the behavior of its occupants. The acceptance of what is considered comfortable varies widely. Studies of identical homes in the United States have shown dramatic differences in energy use, with some homes using more than twice the energy of others. Occupant behavior can vary from differences in setting and programming thermostats, varying levels of illumination and hot water, and the amount of miscellaneous electric devices used. In India the per capita energy consumption is way below the developed countries. Our traditional practices & religious believe has always been guiding Indian life-style as a minimalist way of life. Since the western thinks is being induced to our mind through education Indians are slowly moving out of their root.

For the green building sector "Green Finance" could be a new dimension to make more efficient buildings with smarter investment opportunity. As the buildings save energy; saving adds to our own national energy production. Hence if 0.5% to 1.5% subsidy can be given on the interest then the investment in real estate sector can actually get a boost for investing in "Green Rated" Project. The subsidy can be given on the energy saving performance in periodic intervals on every installment towards the home loan taken by individual. As a result of which the owners has to be careful while use energy for any purpose to avail the discount on the interest rate on every installment. This will force the developers to get rid of the responsibility of the building soon after the construction. This can at least ensure the quality of building maintenance for the dept serving period. The discount can be proportional to the performance. The comparison can be done between "the persqmt." energy consumption of well a maintained "Green Building" to a Conventional building of good condition. As a result it creates a kind of competition to save energy, which will serve the common interest. Simply BEE rating can be taken as a means of evaluation.

According to a survey done by TERI around 15% of the energy in India is being consumed by buildings, which is below the average energy consumed in buildings in US or Europe. But it's interesting that around 20-25% of energy goes into construction of buildings & building materials. Whereas 25% of energy is being wasted in government buildings due to unproductive design features. In a way in 21st century India, there is not enough resource exist to consume the way Europe consumed in 19th century or USA did in 20th Century. With BAU the per capita need for energy in India will be nearly 2014KWH per annum in 2001. However only 15% of reduction is possible with "Green Technology", whereas densification can reduce 30% with any green technology in India. If applied together it can actually save up 40-45% energy in large Indian Cities. For Example in Delhi annual energy consumption can come down from nearly 90TWY (Terra Watt Year) to 60TWY with densification & green technology together. For Ahmadabad, it can come down to nearly 24TWY from more than 40TWY annually. In Kolkata it will reduce to 40TWY from 60TWY annually.

Energy being a major factor behind development and quality of life, it becomes very important for a developing country like India to save & harvest renewable sources of energy to cater the energy requirement of it fast growing population. In such case building that consumes lesser energy or zero energy are more useful for India.

Because of the design challenges and sensitivity to a site that are required to efficiently meet the energy needs of a building and occupants with renewable energy (solar, wind, geothermal, etc.), designers must apply holistic design principles, and take advantage of the free naturally occurring assets available, such as passive solar orientation, natural ventilation, day lighting, thermal mass, and night time cooling.

Many Green building certification programs do not require a building to have net zero energy use, only to reduce energy use a few percentage points below the minimum required by law.

[1] 1EJ = 1018 joules = 109 GJ = 24 million tons of oil equivalent (tons oil equivalent)

The Leadership in Energy and Environmental Design (LEED) certification developed by the U.S. Green Building Council, and Green Globes, involve check lists that are measurement tools, not design tools. Inexperienced designers or architects may cherry-pick points to meet a target certification level, even though those points may not be the best design choices for a specific building or climate.

A. *Green building by definition*

Green building (also known as green construction or sustainable building) is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Although new technologies are constantly being developed to complement current practices in creating greener 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 by:

1. Efficiently using energy, water, and other resources
2. Protecting occupant health and improving employee productivity
3. Reducing waste, pollution and environmental degradation.

But only a building cannot make much difference. Rather an integrated & sustainable development is a right solution to the whole issue. As Dr. Vinod Gupta said, "Eco Friendly" SUV is not a solution rather we should look for an alternative transport. Similarly only "Green Buildings" will not do, we need a whole business & political eco-system to support the development where "Green building" can perform Green.

II. REVIEW OF THE CURRENT RATING SYSTEMS INDIA

Leadership in Energy & Environmental Design (LEED) is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies intended to improve performance in metrics such as energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. Developed by the U.S. Green Building Council (USGBC), LEED is intended to provide building owners and operators a concise framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions.

LEED India is the indigenized version of the LEED rating system and is administered by the Indian Green Building Council (IGBC) under license agreement with the USGBC. Launch of LEED India Green Building rating system for New Construction and Core & Shell lead to a significant growth in registration of new commercial building projects for green certification. LEED India rating system refers to local and national codes wherever available and to intentional benchmarks in absence an Indian equivalent. LEED India rating system is a performance based approach. Rather than prescribing specific technologies & materials LEED India sets the performance benchmarks and encourages the project team to achieve them with optimal resource inputs in their context.

GRIHA, an acronym for Green Rating for Integrated Habitat Assessment, is the National Rating System of India. It has been conceived by TERI and developed jointly with the Ministry of New and Renewable Energy, Government of India. It is a green building 'design evaluation system', and is suitable for all kinds of buildings in different climatic zones of the country.

A.*Review of national building code of India.*

The National Building Code of India (NBC), a comprehensive building Code, is a national instrument providing guidelines for regulating the building construction activities across the country. It serves as a Model Code for adoption by all agencies involved in building construction works, be they Public Works Departments, other government construction departments, local bodies or private construction agencies. The Code mainly contains administrative regulations, development control rules and general building requirements; fire safety requirements; stipulations regarding materials, structural design and construction (including safety); and building and plumbing services. The Code was first published in 1970 at the instance of Planning Commission and then revised in 1983. Thereafter three major amendments were issued, two in 1987 and the third in 1997.

Considering a series of further developments in the field of building construction including the lessons learnt in the aftermath of number of natural calamities like devastating earthquakes and super cyclones witnessed by the country, a Project for comprehensive revision of NBC was taken up under the aegis of National Building Code Sectional Committee, CED 46 of BIS and its 18 expert Panels; involving as many as 400 experts. As a culmination of the Project, the revised NBC has now been brought out as National Building Code of India 2005 (NBC 2005).

NBC is simply a reference that explains the best practice for building construction. It is indeed a document that includes all that a green building should do. But the problem lies somewhere else. Government can come out with some best documents for Green Buildings but when it comes to implementation the real problem begins there.

1. The building By-Laws of various cities have only adopted the "PART 3 DEVELOPMENT CONTROL RULES AND GENERAL BUILDING REQUIREMENTS" & "PART 4 FIRE AND LIFE SAFETY". The rest are being adopted partially. So NBC always remained a thick book for reference only.
2. NBC is never being used for technical training. In architecture students mostly follow "Times Saver Standards", which is of American origin. The reference also comes from the west. So it's difficult for a person who is trained with "Times Saver Standard" to design for India. This is ironical that even today our education system has not moved out of the west influence.
3. In the ULBs the people giving approval are highly corrupt & incompetent. The political influence & poor governance makes it rather worse & vulnerable.
4. The most interesting fact is that the leading organizations in the country know this fact very well.
5. Till date IGBC has rated 98 buildings with 907 buildings registered for rating. Whereas GRIHA has registered only 40 buildings. But if we compare it with the number of buildings constructed in last 2002-03 since all this rating business come into being, the Green Buildings remain way far behind.

Simply making NBC a mandatory document will not do, rather incorporating NBC guidelines through city Bye-laws and ULBs will be effective. But a large reform need to come in ULBs to incorporate documents like NBC & it has to be done as soon as possible before our small cities get ruined by waste, traffic & Glass Box structures. Every house should be rated with a simple rating system, that can enable all to save energy, money & of course our environment. CASBEE the Japanese rating system can be an ideal model to follow.

B. *Energy conservation building code*

The code is mandatory for commercial buildings or building complexes that have a connected load of 500 kW or greater or a contract demand of 600 kVA or greater. The code is also applicable to all buildings with a conditioned floor area of 1,000 m2 (10,000 ft2) or greater. The code is recommended for all other buildings.

Applicable Building Systems

The provisions of this code apply to:

(a) Building envelopes, except for unconditioned storage spaces or warehouses,

(b) Mechanical systems and equipment, including heating, ventilating, and air Conditioning,

(c) Service hot water heating,

(d) Interior and exterior lighting, and

(e) Electrical power and motors.

Exemptions

The provisions of this code do not apply to:

a. Buildings that do not use either electricity or fossil fuel,
b. Equipment and portions of building systems that use energy primarily for manufacturing processes, and
c. Multi-family buildings of three or fewer stories above grade, and single-family Buildings.

Safety, Health and Environmental Codes Take Precedence

Where this code is found to conflict with safety, health, or environmental codes, the safety, health, or environmental codes shall take precedence.

This document is efficient enough for dealing with high energy consuming buildings mostly Centrally Air Conditioned buildings and Business Parks. ECBC standards are very extensive and can be of help if implemented nationwide in large scale. And audited to make sure it is implemented.

The TERI GRIHA norms are well defined. They talk more about the practice & the process of construction, design & evaluation. It is also taken care of the Indian Climatic conditions and encouraged devises of Indian origin.

(For detailed information, please refer the annexure 1 & 2)

- GRIHA doesn't tell much about the different building typology & lack proper sequence.
- GRIHA evaluation process is very complex and needs high level of workmanship for execution. But the point that can't be ignored is the stringent & specific norm also assures good quality.
- The end user should also bear certain responsibility towards the compliance & commitment. GRIHA norms should put more specific norms for this. Even LEED doesn't have such systems.
- Accessibility factor is not being highlighted. Especially for Schools & hospitals the "Green Practices" are not mentioned.
- Both LEED & GRIHA is silent about integration of building with urban infrastructure. Responsibility sharing between the urban authorities (ULBs) & the building owners yet to be addressed.
- Both LEED & GRIHA monitoring system need to have concurrent auditing system.

- Again in both the systems non-compliance is not being highly panelized. If high subsidy can be arranged for such green building through various financing agencies with conditional discount upon compliance then the process can work more efficiently. More over after obtaining the pre-qualification certificate the developer will sell the buildings & simple not comply with the norms. In this case it is used for promoting real estate sector not environment. That apart after selling the building to the private parties the builder will earn his share of profit and the user may not bother comply with the norm even if it loses its rating.
- Both the rating system doesn't rate the development as a whole. What doesn't it mean when students come in a SUV from far places to a Green Rated Air Conditioned International School?

The dilemma of growing Indian cities

Rising land price & construction material is being constantly making housing a costly affair for a common Indian Citizen. Hence with affordability becomes a prime concern for an average middle class man, when he plans to go for a new house. Now LEED rated buildings cost more than a conventional building with a small payback period. Whereas GRIHA building may not be expensive if designed carefully. The Initial fee of registration is more than a lakh rupee, which not affordable for everybody. May be few people who has enough to spend on their luxury can take it for social status.

Indians used to live in larger families, which played a very important role in reducing our ecological footprint. But today house is growing large but home is breaking apart. The modern working culture & faster transport are greatly responsible for this. But somehow people have no other choice. The development is getting centralized and smaller cities offer relatively smaller opportunities for better living.

But Community living & Housing society are doing the job to some extent. But sometimes it is too much to expect from a busy corporate life. May be we refer to our ancient gurus & great spiritual movements that taught our forefathers the art of living that leads to peace and stability in life. Today probably in India there are no model for sustainable development to follow. Jaipur, Delhi old city or Ahmedabad old city models cannot fit in to the wish-lists of aspiring Indians, where SUV & AC has topped the list. The model we should look in to have to be a hybrid of old wisdom & modern technology.

REFERENCES

[1]. Energy Consumption in Buildings by "MAPL Analysis".

[2]. Nakagami, H. (2006). "international Comparison of residential Energy Consumption" Jyukankyo Reasearch Institute Inc.

[3]. Parker, D., Hoak, D., Cummings, J., "Pilot Evaluation of Energy Savings from Residential Energy Demand Feedback Devices," Florida Solar Energy Center, January 2008.

[4]. Vieira, R., "The Energy Policy Pyramid - A Hierarchal Tool For Decision Makers"., Fifteenth Symposium on Improving Building Systems in Hot and Humid Climates, July 24–26, 2006 Orlando, FL

[5]. Noguchi, Masa, ed., "The Quest for Zero Carbon Housing Solutions", *Open House International,* Vol. **33**, No.3, 2008, Open House International

[6]. P. Eiffert. Guidelines for the Economic Evaluation of Building-Integrated Photovoltaic Power Systems. Prepared for National Renewable Energy Laboratory. January 2003.

[7]. "Green Building By the Numbers". USGBC. http://www.usgbc.org/ShowFile.aspx?DocumentID=3340. Retrieved 2008-12-01.
www.igbc.in - IGBC Website

[8]. Hopkins, R. 2002. A Natural Way of Building. Transition Culture. Retrieved: 2007-03-30

[9]. WEC Studies Committee. Deciding the Future: Energy Policy Scenarios to 2050. Reseach paper, London: World Energy Council, 2005 - 07.