Role of Spatial Design in Green Buildings- A Critical Review of Green Building Rating Systems

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ABSTRACT-

Green Building is a movement today and given the resources, all buildings aspire to be green certified. While making green building, the task is to achieve efficiency of site, energy, water and waste. The effort is rated and ranked through different green building rating systems prevalent across the world and certification label is issued based upon the credits achieved. This research paper carries out a comparison of all rating systems currently available. The credits are studied and classified under various themes (Architecture, MEP, Materials and Practices). There are further two categories under each theme-products/technology and design. Each credit is put under one or the other category and theme. Categorization of credits revealed some astonishing facts and one of the most astonishing facts is that spatial design/architectural design hardly figures in green building rating systems across the world. Most of the credits can be earned through incorporation of more efficient technology/products. There is very little importance given to design input. While credits can be awarded for selecting higher efficiency chiller, there is no means of comparing efficiency of one type of building design to another simply because base case is different for each building in terms of design. The study reveals that potential of architectural design in achieving efficiency has totally been ignored through credits awarding system. The study concludes that some more credits need to be added to the existing system to take into account the impact of architectural design in performance evaluation of green buildings which would make not just the buildings but architecture of these buildings also green.

Keywords: green building, water, waste, energy, architectural

INTRODUCTION

Buildings have been established as one of the major consumers of energy through their lifetime. Be it United states of America, China, Russia, India or any other country, buildings consume around 30% of the generated energy. The issue was identified way back in 1970’s after the oil embargo and since then there have been attempts at reducing the energy consumption in buildings. [1] Besides attempts at reducing energy consumption, there has been a rising awareness to the issues of sustainability in buildings and built environment. This together led to the development of current rating systems to evaluate the performance of buildings based upon certain factors and parameters. In Below Diagram Show The
Different Sector such that Industry, Transport, Building And Agriculture energy consumed Respectively 28%, 27%, 34%, 11% in worldwide.

![Figure 1 Sector Wise Energy Consumption of the World](image)

Earlier rating systems used to rate building performance usually considered life cycle energy, embodied energy or carbon emissions [2]. However, they did not take into account many other factors related to sustainability of buildings. This was responded by many countries in the form of rating systems which covered many aspects clubbed under various domains. Many sustainable building rating systems which we see today including LEED [3], BREEAM [4], CASBEE [5], GBTOOL [6], Green Globes [7], CEPAS, TERI-GRIHA [8] have categorized aspects under the domains of Energy Optimization, Water Efficiency, Site Optimization, Environment Friendly Materials and products, Enhanced Indoor Air Quality and Optimization of Operation and Maintenance Practices. However, the weightage of these domains varies from one rating system to another based upon the focus as reported by Fowler and Raunch [9]. It also varies based upon the sector to which rating system is being applied to for example New construction, Existing Building, Commercial Interiors etc. A comparative chart of weightage assigned to various domains has been prepared by Chandratilake and Dias [10]. From Table 1 it is clear that maximum emphasis has been laid on Reduction of Energy Consumption in all leading Sustainable Building Rating Systems.

| System        | Site (1) | Energy (2) | Water (3) | Materials (4) | IEQ (5) | O&M (6) | Others |
|---------------|----------|------------|-----------|---------------|---------|---------|--------|
| BREEAM        | 15%      | 25%        | 05%       | 10%           | 15%     | 15%     | 15%    |
| CASBEE        | 15%      | 20%        | 02%       | 13%           | 15%     | 15%     | 15%    |
| Green Globes  | 11.5%    | 36%        | 10%       | 10%           | 20%     |         | 12.5%  |
| LEED          | 20%      | 25%        | 07%       | 19%           | 22%     |         | 07%    |
| GRIHA         | 21%      | 32%        | 16%       | 18%           | 3%      | 2%      | 8%     |

Table 1. Comparative Weightage for Various Domains in Different Rating Systems
Identification of Problem

Above is one type of classification based upon WBDG principles. [11] Under each of the above discussed domains, credits for various aspects could be achieved through 1. Building design, 2. Through selection of appropriate materials and construction techniques 3. Through use of latest technology systems and products such as in HVAC, lighting, plumbing etc and 4. Through best practices of operation and maintenance. Hence another way of classification could be to identify the possible strategy that would be used to achieve a certain credit. For this purpose, all credits were reclassified under four strategic heads - building design, construction, products and operations. Table 2 consolidates the credits under new classification.

While classifying the aspects on the basis of strategy, for all the systems, following was observed –

For Site Optimization-

- At least 3–4 points in each rating system were given only for selection of site based upon the proximities to community facilities, brownfield redevelopment and availability of public transportation. All these strategies did not require any design but commitment.
- Most credits were awarded to preserve and protect vegetation which requires design inputs.
- Credits were also awarded for site management during and after the construction to prevent any soil erosion.
- Points were awarded in some rating systems for maintaining and enhancing ecosystem.
Table 2. Comparative Weightage for Various Strategies in Different Rating Systems

| System    | Design (1) | Construction/Materials for construction (2) | Products/Systems (3) | Operations and Maintenance (4) | Others (5) |
|-----------|------------|---------------------------------------------|----------------------|--------------------------------|------------|
| Building Design | 6%         | 14%                                         | 24%                  | 40%                            | 10%        |
| elsewhere design |            |                                              |                      |                                | 6%         |
| BREEAM    | 6%         | 14%                                         | 24%                  | 40%                            | 10%        |
| CASBEE    | 7%         | 15%                                         | 24%                  | 37%                            | 15%        |
| Green Globes | 5%         | 28%                                         | 28%                  | 35%                            | 10%        |
| LEED      | 6%         | 24%                                         | 16%                  | 42%                            | 4%         |
| GRIHA     | 8%         | 12%                                         | 29%                  | 41%                            | 2%         |

Figure 3 Comparative Weightage Of Various Strategies Different Rating Systems

For Water Efficiency-

- Most credits could be achieved by using better products such as low flow fixtures, efficient cooling towers, better irrigation techniques such as drip irrigation etc. Some credits could be achieved through design of native landscape and vegetation pattern.
- Some credits were awarded only for installing water meters arguing that better M&V would result in enhanced efficiency.
Materials
- Most materials were required to be in compliance with Kyoto protocol. Materials which pollute the environment, have high VOC’s, have CHC and other components which have Global Warming Potential are prohibited to be used.
- Materials for building construction are specifically specified in codes such as ASHRAE and European standards which are followed for energy performance evaluation based upon their U value and R value. Fenestration materials have been specified in terms of their SHGC and U value.

Energy Optimization
- Most credits under this head could be achieved by installing high performance machinery such as chillers, HVAC systems, lighting fixtures, fans, pumps etc. which require innovation but not at building level.
- Maximum credits under energy efficiency are awarded for exceeding the energy performance through a base line. It can be assumed that Building design would play substantial role here but a closer look reveals that is not the case.

Problem Identification
While calculating building’s total energy consumption and EER, a base is prepared based upon the prescriptive requirements as per energy code. This consists of requirements related to building envelope, fenestration material, HVAC efficiency in parts and whole, Lighting systems efficiency etc. As the market is maturing, more products are becoming available in the market with higher efficiency and performance. However, there is no role for spatial design in achieving energy efficiency or in other words reporting energy saved over and above base case performance. It is mainly because of following-
- Building design essentially has to remain same for both base case and ‘as is’ case. This implies that any saving reported because of building design may get reflected in actual energy consumption but not in energy performance.
- The only feature which find a place is WWR for different orientations. This has resulted in fast pace improvements in fenestration products and increase in sensitivity of buildings owners towards WWR.

Here one may argue that overall reduction in energy consumption would be observed even if percentage savings above base case is not reported through Whole Building Simulation mechanism. The argument can be justified in isolation but while considering the impact of rating systems on building industry, the basis for this argument loses ground. It is because rating systems achieved a vital role of publicizing the idea of sustainable buildings and mainstreaming it.[12] That is why there has been an unprecedented upsurge in number of buildings aspiring to be rated as green. However, since ‘building’ is primarily a commercial activity, those practices gain momentum which have higher commercial value. In this case, strategies which yield more credits have more demand in the market. That is the reason spatial planning is almost ignored in green buildings. For certification, any building design could be made green by adding better systems and products and constructing the building using materials with low transmittance value or as prescribed in codes.
Conclusion and way forward

It is evident that rated Green Buildings give very little credit to spatial design. This is leading to an architecture which may be sensitive to environment through add-ons but not the intrinsic value of design. That is the prime reason why architects merely play a role of managers in green buildings rather than bearing prime responsibility of key designers. Buildings attempt thermal comfort through artificial means of HVAC while most of this job could be done only through design.

Hence there is a need to incorporate few more credits which evaluate the contribution of spatial design towards efficiency through parameters which could be quantified such as thermal comfort, acoustical comfort and visual comfort. Such parameters would evaluate only building design in absence of any systems/products for improving efficiency. This increases responsibility of architects towards creation of better buildings and in turn importance of better spatial design as compared to systems, materials and products. Unlike today, when buildings are a result of services, materials and systems; buildings would again attempt to be a derivative of function. And ‘Form follows Function’ rules.

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