Analysis of GRIHA’s Variant for Large Development: Case of Educational Campuses in India

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Abstract With the world descending into chaos of 21st century namely ecological and environmental challenges, there is a need for force to work among us and to lift us, so as to create order out of those above mentioned chaos. Resources are depleting, they need to be saved, the environment needs to be protected. Several countries have started facing earth overshoot day almost every year now. To overcome these issues, different organizations are working on it and one of them in India is GRIHA. Also govt. of India has made it mandatory for some government projects to be GRIHA certified, and they are providing some incentives for that. Some PSU buildings also have made it compulsory to be GRIHA certified. There are different variants of GRIHA and one of them is, “GRIHA for large development”. Whenever large projects are designed, executed etc., they leave great impact on build environment, hence affecting ecology, the environment, so they must be well assessed with regards to building performance, since educational campuses are such large projects. In this paper, a qualitative evaluation research method is used. This paper studies the GRIHA’s variant for large development (mainly university campuses as they are like a small city within a country) and analyses the green features of the university campuses that are GRIHA certified.

Keywords: green building, green building rating, GRIHA LD, carbon footprint, educational campus

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1. Introduction

The two most undoubted environmental challenge of today’s era are, global warming and climate change. With rise in population and rapid urbanization, dependency on the resources have increased. There is a need to make strategies for saving resources, environment. The universities are the important sites of transformation, as centres of communication between people as well as vehicles of social change. Universities are key places for addressing global issues and fostering continuous action within both the generations, current as well as future [1]. Concern regarding the environment as well as sustainability within the higher education institutions has grown since the early 1970s [2]. Higher education institutions can have notable environmental impacts off-campus and on-campus, including water pollution, waste, air pollution, the use of toxic chemicals and degradation of habitat [3]. Universities Campuses also have impacts through material’s import. The extraction as well as production of the materials can have impact on environment and economy [4]. With the rising concerns on the issues related to environmental issues and climate change, universities should integrate sustainability in research and educational programs, as well as should promote issues related to environment to the society. The universities are the important sites for implementing sustainable development because the local politics is not much complex there and the autonomy of the governance structure is less complex than at the city level. With small scale and better structured Administration, universities can better lower the increasing effect of environmental problems, an area where cities sometimes struggle. Keeping all this in mind, GRIHA an Indian green building rating system have designed a variant for providing green building certification to the university campuses. This comes under GRIHA’s variant for large development. As it is human intrinsic nature that, until they are not given any appraisal they won’t work. So, if a university campus will be certified by GRIHA then several other universities will try to get GRIHA’s certification and this will help in saving resources and environment [5].

2. Research Methodology

In this paper qualitative research method has been used. The systematic literature review has been explored through internet and secondary data from relevant published academic literature from journals articles and research papers. The data collection in the qualitative research are the data that comes from a number of case
study examples that are described descriptively and are supported by illustrations and photographs to reinforce the arguments put forward. The basic concepts and backgrounds are investigated through literature and on-line media, observations for conducting qualitative analysis for GRIHA’s variant for large scale development, especially the educational campuses in India.

3. Green Building

Green building refers to a building that is designed in a smart way that it uses resources effectively as well as efficiently and has minimum negative impact on the environment. The green building’s aim is to reduce the demand on non-renewable resources and maximize reuse, recycling [6]. The concept of green buildings not only favours human health but also safeguards earth from harmful and poisonous after-effects, fulfilling the accountability of the concept of sustainable development. Green building is one of the major solutions to all the problems including, scarcity of water supply, rise in electricity consumption, worsening of indoor air quality, environment etc. Green building is a necessity of today’s era [7,8].

4. Green Building Rating System

A Green Building Rating System, as defined by Nguyen and Altan, is a tool for evaluating, enhancing, and promoting developments’ sustainability. These systems provide tools as well as better insights into sustainability through analysis and valuations as well as comparisons. This rating system converts the goal of design into performance objectives, also provides frame of reference for assessing the design [9]. It is a tool for measuring the environmental performance of a building through its life cycle. It includes different criteria based on various parameters like, site planning, energy, water management, waste management, etc. There are certain points under each set of criteria, a project that fulfils minimum criteria is assigned some set of points and then final certification is provided. There are different rating systems all over the world, like BREEM, CASBEE, USGBC, GREEN MARK, GREEN STAR, LEED etc., but on national level, IGBC, The GRIHA and LEED INDIA are there [10]. These rating systems are considered for fostering the more sustainable design of buildings, construction as well as operations by giving promotion to the environmental concerns. As there exist some difference between various green building rating systems, same building can be credited green by one but failed to be green credited by another system at the same time [11].

5. GRIHA

GRIHA is an acronym for Green Rating for Integrated Habitat Assessment. GRIHA means ‘Abode’ in Sanskrit. It is a national tool that measures the environmental performance of a building, campus and city as well. Many different international rating systems were clubbed, modified, and a new national rating system was developed to suit the construction industry. TERI, being strongly dedicated to each and every aspect related to sustainable development, acts as a driving force for popularizing the green buildings, its concept by forming a tool for measuring as well as rating the building’s environmental performance with respect to India’s climate and Indian standards. GRIHA was founded by TERI (The Energy and Resources Institute, New Delhi) in 2005. MNRE (Ministry of New and Renewable Energy, Government of India) adopts GRIHA as a national rating system for green building in 2007. The criteria and appraisals are revised every three years for considering the latest developments during that particular period. On broad scale, this system, with its activities as well as processes, will provide benefit to community at larger scale, by improving the environment through reduction of GHG (greenhouse gas) emissions, improvement of energy security, and reduction of stress on the natural resources.

It is a five star rating system mainly for the green building that lay emphasis on the passive techniques for visual as well as thermal comfort. For addressing energy efficiency, GRIHA supports the best effective use of building design for reducing demand of conventional energy. A building is evaluated on the predicted performance over the life cycle of building from the inception through the operation. GRIHA provides green building certification, based on various parameters and some set of points it provide final rating to a building/campus/city. GRIHA combine all the relevant building Indian codes as well as standards and acts as tool for facilitating the implementation of the same. GRIHA pay major attention on minimizing the carbon footprint, its emissions as well as various other impacts on environment. The various development agencies throughout the country are now following GRIHA’s initiatives and also govt. has made it compulsory for various govt. projects as well as PSU’s buildings to be GRIHA certified. There are three stages on the basis of which GRIHA assesses the projects and they are, pre-construction, building planning & construction, last but not the least is operation & maintenance stage [12].

There are different variants of GRIHA
a) GRIHA for existing building
b) GRIHA for Existing day school
c) SVA GRIHA
d) GRIHA LD for large development
e) GRIHA for cities
f) GRIHA for affordable housing

6. GRIHA Large Development (LD)

GRIHA LD stands for GRIHA for large development. It is one of the variant of GRIHA. The intent of GRIHA LD is providing the framework for assessing the environmental impacts of huge developments on large scale. All that projects that satisfy either of the two, the Total site area greater than or equal to 50 hectares &/or total built-up area greater than or equal to 1,50,000 sqm, can apply for a GRIHA LD rating and certification. Large developments included in GRIHA LD are the large mixed use townships, smart city neighborhoods, institutional and medical campuses, SEZ, hotels and resorts.
Table 1. Rating distribution as per GRIHA LD norms

| Overall Impact | Ratings |
|----------------|---------|
| 75% - 66%      | 1 Star  |
| 65% - 56%      | 2 Star  |
| 55% - 46%      | 3 Star  |
| 45% - 36%      | 4 Star  |
| 35% or lower   | 5 Star  |

In GRIHA LD, projects will be evaluated on the basis of six different sections namely: Carrying Capacity as well as Carbon Footprint (only indicative), Planning of the site, Energy, Water and waste water, Solid waste management, Transport as well as Social. Each section consists of two parts: Quantitative as well as Qualitative. Each section will be evaluated on the basis of both the parameters, qualitative as well as quantitative. In the section on Social, there is no quantitative parameter, so the evaluation will be done based on only qualitative parameters. Self-Sufficiency and Development Quality are the two appraisals for analyzing the projects. Self-sufficiency appraisals deal with overall resources (energy, water and organic solid waste) required/treated by the project and focuses on the quantitative analysis. Development Quality aspects deal with qualitative analysis based on several parameters. The overall rating for the project will be awarded out of 100, based on the overall assessment of all appraisals from all sections. There is rating for overall impact. Minimum rating of 1 star will be awarded if the project’s overall impact on environment lies between 75-66% and maximum rating i.e. five star will be awarded if a project’s overall impact lies between 35-25%. [13]

7. Case Study 1: Raksha Shakti University, Ahmedabad, India

Raksha Shakti University is a dream project of PM, Narendra Modi, is unique and one of its kind in India, Established in Gujarat.

- Project Name- Raksha Shakti University (RSU)
- Location- Ahmedabad, Gujarat, India
- Site Area- 7,28971.30 sqm
- Built-up Area- 99560 sqm
- No. of storeys- G+2

Typologies of building Blocks- Admin, auditorium, classrooms, cafeteria, faculty blocks, staff housing, student’s hostels, shops etc. The GRIHA LD master plan rating is 5 star The site is a wasteland which lies adjacent to Lavad village, which is a small agriculture community. Another village namely Muvada village, lies across the river opposite to the site. This is a heavy contour site.

7.1. Green Features Adopted in Raksha Shakti University

- Energy Consumption reduction- 58.7%
- Organic Waste – 66% treated on site (vermicomposting and biogas)
- Green Cover- 61.57sqm/capita
- Carbon Footprint-0.94 ton co2/capita
- Water consumption reduction- 58.7%
- STP- 330 KLD
- Rainwater Harvested – 1,87,384 kl/annum
- EPI - 108.8 kWh/sqm/year
- Solar PV Proposed – 150 MWp

The following are strategies that were adopted for reducing the development’s impact on natural environment:

- Reduction in hard paving and increase in landscaping has been done on the site
- 185 are the mature trees that are existing and out of which the number of uprooted trees is 39, while those retained are 146. In addition, 5,648 new trees will be planted on the site.
- For the treatment of wastewater STP will be installed.
- Low-flow fixtures will be installed to reduce wastage of water.
- This campus converts its major organic waste and remaining organic waste will be converted to vermicomposting.
- All 3R strategies are adopted for treating waste.
- The campus treats 66% organic waste generated on site.
- Footpaths, cycle tracks, parking as well as benches have been provided within the campus.
- For different transport modes both motorized as well as non-motorized vehicles, separate pathways have been designed within the campus. Motorized transport has been restricted to the residential and service areas only.
Table 2. Passive Design Strategies Adopted in Campus

| Thermal Requirements                  | Physical Manifestation                                                                 |
|--------------------------------------|----------------------------------------------------------------------------------------|
| Reduced Heat Gain                    | Orientation and shape of building is designed as per the climate zone, where E-W have minimal opening and have compact planning surrounded by dense vegetation |
| Decrease exposed surface area         | Increase thermal capacity                                                               |
|                                      | Massive structure with proposed GRC panel for admin and academics, whereas prefabricated jail for hostel block |
| Increase buffer spaces               | Increase shading                                                                        |
|                                      | External surfaces protected by overhangs, fins and trees.                                |
| Increase air exchange                | Increase surface reflectivity                                                           |
|                                      | High reflective and light colored tiles have been proposed on the roof area of all the buildings |
| Increase humidity level              | Promote heat loss                                                                       |
|                                      | Courtyards/arrangement of openings and building block is designed to facilitate air movement |
|                                      | Trees and water ponds are designed for evaporative cooling                                |

8. Case Study 2: IIT Gandhi Nagar, India

Indian Institute of Technology (IIT), Gandhinagar is the first campus in the whole country to get GRIHA LD certification.

- Project Category: Urban Design & Master Planning
- Project Name: IIT Gandhinagar
- Completion Date: July 15, 2015
- Location: Gandhinagar, Gujarat
- Plot size: 400 acres
- Area: 5600000 Sq. Ft.

The site lies between Sabarmati riverfront and highway. The site has difficult terrain and only around 55% of site is available for the development in various pockets. The main campus has been sited on the southern pocket. The campus has been designed in two phases, in first one the campus has been designed for around 2400 students and faculty, second phase includes overall plan designed for 4800 students and have expansion for 6000 students. One of the important features of this campus is its location as it stretches 3 km along the Sabarmati River bank, its terrain that is unique in itself and the river promenade that is being designed as a large landscape walkway. The campus has been designed as a green campus with pedestrian movement, majorly free from vehicular traffic. The campus has been designed in such a way to have maximum views along as well across the river, to retaining two existing depressions that are natural as prime visual as well as functional elements. On the river bank the entrance for the visitors is located. The Central Vista is a main space of the landscape and it is envisioned as the major open space of campus. It is a broad open space of about 50-60 meters wide, with shady trees presented on the either sides. Spines or central corridors are used to define spaces in the Academic Complex, Hostels and Housing areas, each in different ways. The Hostels as well as housing areas have central corridors that copy the winding and narrow streets of the old Ahmedabad.
Figure 6. Master Plan of the IIT Gandhinagar Campus

Figure 7. The central vista of IIT Gandhinagar Campus

Figure 8. Site plan of IIT Gandhinagar Campus
The master plan defines land for various different uses, in terms of size, shape as well as the development potential. The phases of developments have been defined so that this campus looks as well as feels as complete at all the stages of the development. The campus is majorly ‘low-rise’ with the elevator free walk-up buildings in its built form. There are very few high rise apartments for defining open spaces as well as for adding interest to skyline. The building’s form is courtyard type. The Gateway, the court, the colonnade, the water feature as well as shaded academic central corridors are the chief architectural components of this campus. [14,15]

8.1. Green Feature Adopted in IIT Gandhinagar

- Sustainable Site Planning: Reduction in hard paving and increase in landscape between the buildings in order to reduce the rise in ambient outdoor air temperature. The Urban drainage system that is sustainable has been placed on the site in the form of ponds.

- Management of water: The campus reduces its water demand annually by 41.86% by reusing the treated wastewater, using low flow fixtures etc.

- Optimization of energy: The buildings are planned in such a way that they are around 46% more efficient than GRIHA for Large Development base case in terms of energy. Street lightings are 85% more efficient than the GRIHA LD base case.

- Management of solid waste: Bio-gas plant is used on the site for treating all organic waste and converting it into electricity, all the organic waste from kitchen is converted to manure. 3R process is adopted in the campus for treatment of waste.

- Sustainable transport: Site planning has been done in such a way that it improves walkability within the campus through footpaths. E-rickshaws are provided for intra-site movement on the site. Electric charging facilities of electric charging has provided for more than 10% total car as well as parking slots for two wheelers.

- Social sustainability: All workers had clean water for drinking, facility of toilets as well as accommodation during construction. The institute incorporates certain measures related to environmental concerns for increasing awareness regarding environment with in the campus.
9. Conclusions

With the rapid industrialization, urbanization, economic growth, India is continuously facing various challenges, such as resource depletion, environmental degradation and climate change. With rise in demand for better living standard, the dependency on the natural resources per capita have increased, so stress on the environment has increased. This results in increasing the gap between demand and supply for resources etc. As per 12th Five Year Plan, people living in urban agglomerations were around 285 million. And in 2011, this number reached to 380 million and by 2030, 600 million people will be living in urban areas [16,17]. The rise in population and urbanization will result in emergence of around 60-70 cities with the population more than one million by the year 2030. There is increase in number of large scale developments that are coming up in the country. Whenever a large scale project is planned, executed, implemented etc., it consists of various buildings, other facilities related to infrastructure, all on one site. Assessing the Environmental Performance of such projects must exceed the environmental design of the buildings, as well as it calls for assessing larger issues related to environment and their impacts that are caused due to build environment. Evolution of large-scale developments/neighbourhoods etc., are bringing complicated changes to ecology, non-renewable resources and environment as well, at local and global scale. It’s high time attention should be paid to planning practices, guidelines that are being followed for planning cities etc., and must be designed in a way that they promote the sustainable development with minimum negative impact on environment [18,19]. In India, GRIHA is one such organisation that has designed one of its variant for measuring environmental performance of large scale projects. GRIHA LD helps in assessing large scale projects, so that large scale projects use resources effectively and have lesser impact on the environment. It will also help in attaining sustainability development goals. The calculations of GRIHA are simpler than IGBC so one can easily go for GRIHA LD rating certification [20,21].

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