Stepping towards a Sustainable University Campus through green rating system for Campuses

A Case study of Shri Mata Vaishno Devi University, Katra, Jammu and Kashmir

[1]Tahir Ahmad, [2]Sheeba, [3]Mansoor Hussain, [4]Rituraj Sharma

[1]Architectural assistant, [2]STSA planning, [3]Junior Engineer, [4]Student
[1]Architects Organization, J&K, India

Abstract:
Educational campuses have always been considered the main societal hub for knowledge and learning with plenty of built spaces around. In India from the last past decades the number of educational campuses for higher education and their enrolment has witnessed a tremendous increase of 74 times with just 500 in 1950 growing to 37,204, as on 31st March, 2013[1]. These institutions are monitored and regulate by the various apex level bodies like AICTE, COA, CSSR, ICHR UGC etc. with focusing on the quality and improvement of educational system. It is very obvious that with the increase in educational campuses there will also be increase in built spaces and energies to fulfill the daily needs, operations in teaching and research thus completely relying on the environment for its survival and degrading the environment which is hardly seen and considered a matter of concern. Now, in order to ensure energy efficiency and environmental sustainability, these developments and activities need to be on green campus concepts (MNRE)[2]. A green building depletes very little of the natural resources during its construction and operation. The aim of a green building design is to minimize the demand on non-renewable resources and maximize the utilization efficiency of these resources when in use and utilization of renewable resources.[3] The aim of the paper is to examine the efficiency of existing building of SMVDU, Katra based on the criteria given by IGBC green campus for existing buildings and find ways on different category to achieve for highest recognition level of certification.

IndexTerms **- IGBC, Green building, environmental sustainability, SMVDU.**

I. INTRODUCTION

The twenty first century is shaping up to be a transitional era for the way the human beings lives on this earth. The pressure we are placing on the planets resource has become increasingly unsustainable. The energy consumed during building operation is the most important input to the carbon cycle from buildings; but it is not the only one. The construction, renovation, and demolition of buildings also generate a significant flux of wood and other materials. Various progressive world events have taken place to increase the awareness on environmental and sustainability goals such as the Rio Earth Summit of 1992, Maastricht Treaty of 1992, Kyoto Conference on Global warming 1997, Johannesburg Earth Summit of 2002, Washington Earth observation Summit of 2003, and Paris Agreement, 2015.

While India is on the extreme verge of an urban revolution with its population in towns and cities expected to reach 600 million by 2031, according to a new UN-backed report which pegged the gap in urban infrastructure investment in the country over the next 20 years at a whopping $827 billion.[4] And most worrying is the energy consumption in these habitats especially along urban areas of India is rapidly increasing causing immense pollution and pressure on the city, one such recent example is the emergency order of Delhi Government to close schools in view of the heavy smog, the worst the history of national capital .So at most important it will need to build climate-friendly cities to address the challenge of environmental disaster.

The International Energy Agency released a publication that estimated that the existing buildings are responsible for more than 40 % of the world's total primary energy consumption and for 24 % of global carbon dioxide emission that means buildings play a vital role in shaping our sustainable future. So, there is a great potential for energy saving and greenhouse gas reduction in these existing building. Now more positively so far a green building strategy policy for existing buildings can potentially reduce greenhouse gas emission.

Almost in every part of India green term is expanding and adopting by the people. However, understanding and implementing green solutions at educational campus especially where most of the youths are engaged to pursue education can be a vital platform to start about the environment which ultimately are the foundation of tomorrow's world.

II. SMVDU AIMING TOWARDS ACHIEVING GREEN RATING

Shri Mata Vaishno Devi University (SMVDU) has been established under the Jammu And Kashmir Shri Mata Vaishno Devi University Act, 1999.An act of the J&K State Legislature (ACT No. XII of 1999 dated 12th May 1999) as an autonomous, highly

Technical & fully Residential University. The University is located on 470 acres of land in the lap of Trikuta Hills, the abode of Shri Mata Vaishno Devi at about 2700 feet above the sea level. The pyramidal type architecture merge beautifully with the valley like ambience of the surrounding serene hills.

SMVDU is dedicated to ensuring the built infrastructure of the University has sustainability as a core principal, both in the construction and administration of buildings. Moreover the vice chancellor of SMVDU is very much interested to achieve IGBC Existing Building rating system for all its existing buildings on campus and for that reason a centrally green audit committee is also constituted at university level. Also the committee is currently in the process of pursuing green rating for all its new and existing buildings.

III. GREEN RATING SYSTEM – A GOAL TOWARDS ENERGY EFFICIENCY

Currently in India there are two prominent green rating systems that start from a last decade. One system is Green Rating for Integrated Habitat Assessment (GRIHA), is the national rating system for the country endorsed by the Ministry of New & Renewable Energy (MNRE), Government of India. Another system is, 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)[5].

Both the green rating system IGBC and GRIHA can be used to assess the environmental performance of buildings in India. The IGBC system covers majority of the certified projects for new .The rating systems aims to quantify the environmental, economic and socio-economic benefits of green building design with emphasis on sustainable site planning, optimized energy performance, efficient materials and construction practices, water and waste management strategies; and indoor environmental quality. But a lot of buildings have been already built which do have effects on the environment though out its life cycle. To address the certification for existing building IGBC developed LEED for existing buildings

IV. METHODOLOGY

Based on the overall understanding of the existing conditions of infrastructures at SMVDU and various information gathered available, the case studies is taken and identified for the purpose of this study.

This case study details on the criteria set by the IGBC for existing campuses. Rating is done in accordance to it and guidance is written to further improve LEED- rating. As the university is funded by shrine board an organisation under which lots of construction is being take place. The study will also facilitates other shrine board projects to complete a successful LEED rating for its upcoming and existing projects as to make a holistic approach towards sustainable development.

4.1. Various categories under IGBC green campus

IGBC Green Campus rating system addresses green features under the following categories:

1) Site Planning and Management
2) Sustainable Transportation
3) Water Conservation
4) Energy Efficiency
5) Material and Resource Management
6) Health & Well-being
7) Green Education
8) Innovation in Design

4.2. Certification levels

The threshold criteria for certification/pre-certification levels as per IGBC rating green campus are as under:

Certification Level	Existing Campus	Recognition
Certified	36 - 44	Best Practices
Silver	45 - 53	Outstanding Performance
Gold	54 - 66	National Excellence
Platinum	67 - 90	Global Leadership

V. ACHIEVED CREDITS FOR EXISTING CAMPUS OF SMVDU AND REMARKS

Detailed study is being conducted based on the following template based as per the IGBC Rating System for Green Campuses (Existing campus) released on November 2015, all the mandatory requirements and the credits are being attempted and remarks are added for any change to meet the necessary or required action.

5.1. Site Planning and Management

Site Planning and Management		Credits Required	Credits Achieved
SPM MR 1	Green Buildings within the Campus	Mandatory	

SPM MR 2	Soil Erosion Control	Mandatory	
SPM Credit 1	Green Buildings within the Campus	10	4
SPM Credit 3	Green Cover or Vegetation	6	6
SPM Credit 4	Heat Island Reduction, Non-roof	4	2
SPM Credit 5	Outdoor Light Pollution Reduction	2	1

Green Buildings within the Campus (SPM MR1): Under this mandatory category SMVDU should Design and construct high performance buildings within the campus to get at least one building or 15% of built-up area certified under IGBC or retro-fit existing or new building with efficient water, lighting and HVAC system as per IGBC guidelines and annexure.

Soil erosion control measures (SPM MR2): The vulnerable areas within the site have been identified and seen that the edges of the 'nallah' which are prone to soil erosion have guard walls built while the rest of the campus has a lot of natural vegetation which prevents the erosion of soil to a great extent.

Construction of high performance buildings within the campus (SPM MR1 and Credit 1): High performance buildings need to be constructed within the campus. High performance or green features of the buildings may include some of the following:

i. Proper illumination level within the buildings to reduce the dependency on artificial lights during the daylight hours.
ii. Proper ventilation within the buildings to reduce the dependency on HVAC systems.
iii. Roof and wall assembly should have proper U-value and SHGC value to reduce the dependency on mechanical energy.
iv. Passive energy systems must be used.
v. Buildings should have efficient lighting, sanitary and kitchen fixtures.
vi. Buildings should cater to the needs of all (differently abled, pregnant ladies, senior citizen etc)

Restoration of natural vegetation within the campus (SPM Credit 3): The campus has 88.24% of its total area in its natural form. IGBC recommends a minimum of 15% of the site area to be in its natural form. Hence, proper maintenance and improvement is only needed.

Minimization of heat island effect in the roof and non-roof areas (SPM Credit 4): Most of the building in the campus is having a pyramidal roof shape such as the Trikuta, Kailash and Shivalik Hostels etc have sloping roofs covered by slate tiles, there are other blocks such as the A, B, C, D blocks, Neelgiri and Vindhyanchal hostels which have flat roofs made of concrete finish. While on the one hand, slate tiles are quite suitable for the climate of Jammu with adequate solar reflectance and durability, flat concrete roofs, on the other hand, absorb a lot of solar radiation and heat up the interior of the buildings for a longer period which in turn results in the use of more electrical energy in the form of HVAC systems and use of fans. A good idea to tackle this problem is by using building materials on the roof surface which is have a very high solar reflective index (SRI). Although green roofs are aesthetically more appealing, yet it would require more maintenance and hence would not be a very suitable alternative.

The non-roof areas which contribute to heat island effect are the pavements, roads, parking areas etc. Heat island effect can be highly minimized in these areas by the plantation of trees which have spread canopies to shade maximum portions of the roads and pavements. Deciduous trees, which shed their leaves by the winters, are more suitable in the campus as the winters are harsh and thus required direct sunlight. Some examples of such trees which can be used are Gulmohar, Alstonia, Arjuna Tree etc. Parking areas can have grass pavers or can be covered by the shade of trees as well for the reduction of heat island effect.

Enhancing the nocturnal environment by controlling light pollution (SPM Credit 5): Some signs of light pollution are glare and urban sky glow. They can be reduced by the use of fixtures which emit no more than 5% of its light at an angle of more than 90 degrees. Also, the lighting power density should be at least 10% lower than the ASHRAE standards.

5.2. Sustainable transportation

Sustainable Transportation		Credits Required	Credits Achieved
ST Credit 1	Pedestrian Network	3	1
ST Credit 2	Bicycle Lanes Network	4	0
ST Credit 3	Access to Sustainable Transportation	4	3

Provision of safe, comfortable and well interconnected pedestrian network (ST Credit 1): Pedestrian Safety on campus should be prioritized and presently there is no dedicated pedestrian paths along either side of the main access road . Some changes to roads and sidewalks on campus need to be done in order to interconnect pedestrian network to all the buildings which are safe and accessible at all times. Comfort for the pedestrians can be taken care of by proper lighting during the dark hours and shade during the summers by the plantation of trees with wide foliage.

Provision of bicycles lane and bicycle network (ST Credit 2): This must be done to reduce the demand of automobiles and thus contribute to a clean environment as well as healthy lifestyle to the users. Currently there is no separate Bicycle lane and few riders on campus are expected to use the vehicular roads in most instances. The university Master Plan should include creating bicycle paths and zones, and promoting bicycle use as an alternative form of transportation .

Easy access to public transportation to reduce the demand of private vehicles (ST Credit 3): Both the entrance gates of the university campus have access to public transportation (bus stops), with buses plying to Katra and Domail-Jammu.

5.3. Water Conservation

Water Conservation		Credits Required	Credits Achieved
WC MR 1	Rainwater Harvesting	Mandatory	
WC Credit 1	Rainwater Harvesting	6	2
WC Credit 2	Landscape Design	4	1
WC Credit 3	Management of Irrigation Systems	2	1
WC Credit 4	Wastewater Treatment and Reuse	4	0
WC Credit 6	Water Metering	2	2

Rainwater harvesting to enhance the groundwater table and use the excess rainwater for various uses (WC MR 1 & CR 1): Analysing the annual average rainfall for the past 5 years during the peak monsoon season the campus has dynamic runoff potential which can generates enormous surface runoff during rainy seasons. So, decentralise ground water recharging pit should installed at every individual building to collect the rainfall and the overflow from these pits and other catchments areas should connect to a possible collection area from where it can be used for landscaping and flushing after recycling which can finally reduce the fresh water demand of the campus.

Use of water efficient management systems (WC Credit 3): In order to have an efficient irrigation system (for the proper management of landscape), highly efficient systems and techniques must be installed. They may include the following:

i. Central shut-off valve
ii. Soil moisture sensors
iii. Segregation of zones in turf and landscaping areas
iv. Drip irrigation system and sprinkler irrigation systems
v. Time based controller for the valves so that the evaporation is minimised
vi. Pressure regulating devices

Treatment of waste water for reuse (WC Credit 4): Use of dual plumbing systems throughout the different blocks in the university campus. This is the best measure to separate grey and black water at the source. Black water (waste water generated from the WC's) takes long process to be treated; however, the grey water (waste water from sinks and wash basins) can be treated easily to be further used in flushing toilets and for landscaping.

Water metering to keep track of the volume of water being used (WC Credit 6): Separate zones for water use must be created and each zone must be metered separately so that the water consumption in different zones is monitored and can be saved according to the needs.

5.4. Energy Efficiency

Energy Efficiency		Credits Required	Credits Achieved
EE Credit 1	Energy Efficiency in Infrastructural Equipment	10	6
EE Credit 2	On-site Renewable Energy	5	2
EE Credit 3	Off-site Renewable Energy	4	0
EE Credit 4	Energy Metering	2	1

Energy efficiency in infrastructural equipment (EE Credit 1): The illumination levels in all the academic blocks of the university campus have been evaluated in order to figure out the existing scenario and found not up to the mark in few classrooms than the recommended illumination levels. All the electrical equipment within the campus must achieve energy efficiency for the following systems according to ASHRAE standards:

i. Lighting Systems: Lighting Power Density should be reduced by 30% over ASHRAE standards. This can be done by the proper selection of efficient equipment from the market.
ii. Lighting Controls: Motion sensors, time based controllers, CO2 sensors etc should be used in order to have savings in energy.
iii. Pumps and Motors: Pumps and motors (>3.5HP) must have an efficiency of at least 85%.
iv. HVAC system: Centralised HVAC systems should be installed if required and they must have an efficiency of 10% over ASHRAE standards.

Use of on-site renewable energy (EE Credit 2): On site renewable sources of energy include solar power plants, windmills, biomass generation etc. So far solar water heaters and solar lighting panels are being used in Vaishnavi Hostel. However, this is only a small portion of the total energy consumed and as Solar hot water systems cannot be considered as power generation source and cannot be subtracted from the total annual energy consumption of the proposed case

Use of off-site renewable technologies (EE Credit 3): Renewable sources of energy as suggested by the Ministry of New and Renewable Energy, India include wind power, bio power, solar power and small hydel projects. The project must demonstrate the certification of 20% of the total energy consumed as renewable source of energy.

Energy metering to keep track of the amount of energy being used (EE Credit 4): Separate electricity zones must be created and each zone must be metered separately so that the electrical energy consumption in different zones is monitored and energy can be saved in zones according to the needs.

5.5. Material and Resource Management

Material and Resource Management		Credits Required	Credits Achieved
MRM MR 1	Segregation of Waste, Post-occupancy	Mandatory	
MRM Credit 1	Organic Waste Management, Post-occupancy	3	2

Segregation of waste at the source (MRM MR 1): Waste management and recycling reduce the amount of material entering into the waste stream and also saves lots of energy for segregation. So, Organic and inorganic waste shall be separated at the source. Keeping in mind that each person produces 0.2kg of organic waste per day and the source, organic waste converters shall be installed. E-waste (batteries, CD's etc.) shall be separately collected before disposing them out of the campus.

Food waste to be converted	450 kg
Garden waste to be converted	64994.8 kg

Effective management of organic waste (MRM Credit 1): Organic Waste Converters of proper capacity must be installed with

No. of students	No. of staff members	Food waste	Total area of campus	Garden Waste	Total Waste
1600	200	180	1299898	259979	260159.6

assumptions that food waste of 0.1kg/person/day is generated and garden waste of 0.2kg/m2/day is generated. The university campus has populations almost near to approximately 1,800 comprising of students, staff and faculty member. i.e. around 1600 students and 200 faculties and staff so, the calculations for generation of organic waste for 1600 students and 200 teachers and staff are as follows:
Table 1.Showing the total organic waste generated

Table 2.Showing the amount of organic waste to be converted

The total food waste generated is 180kg per day and a total of 175kg per day must be treated to meet the required credit. A total of 260159.6 kg of garden waste is generated per day out of which a minimum of 130079.8 kg must be treated to meet the required credit.

5.6. Health and well being

Health & Well-being		Credits Required	Credits Achieved
HWB MR 1	Tobacco Smoke Control	Mandatory	
HWB Credit 1	Basic Amenities	1	1
HWB Credit 2	Health & Well-being Facilities	4	4
HWB Credit 3	Universal Design	1	0

Minimisation of the ill-effects of passive smoking by bringing tobacco smoke control (HWB MR 1): Smoking should be prohibited in all public spaces by the

use of proper signage and efficient management through administration. This must be done in order to reduce the ill effects arising from passive smoking.

Easy accessibility to basic amenities (HWB Credit 1): In order to reduce the amount of fossil fuels consumed by automobiles, basic amenities of daily importance should be available at a walking distance of 800m. Some of the basic amenities available at walking distances are:

- Medical Aid Centre/ Shri Mata Vaishno Devi Narayana Super speciality Hospital
- Delhi Public School and Govt. Sec. Schools
- Grocery shops,
- Barber's shop
- Stationary shop
- Bank/ ATM
- Cafeteria/ Restaurants
- Laundry, Gas Agency
- Post office
- Guest house
- Auditorium

Health and Well-being facilities (HWB Credit 2): Health and well-being facilities must be provided within the campus to enhance the physical, mental and spiritual well-being of the occupants. Some of the facilities that have been provided are:

i. Gymnasium
ii. Outdoor ground
iii. Indoor sports facilities

Facilities such as aerobics, swimming pool, yoga and meditation centre must also be provided.

Universal design for the differently abled people (HWB Credit 3): The design of the campus shall take into consideration the needs of the physically handicapped, pregnant ladies, senior citizens etc. The universal designs may include ramps, tiles for the blind people, audio systems in lifts, if any; handicapped washrooms etc and standards should be as per NBC and byelaws

5.7. Green Education

Green Education		Credits Required	Credits Achieved
GE Credit 1	Green Education	**2**	**1**
GE Credit 2	Green Campus Guidelines	**1**	**0.5**

Promotion of green building awareness (GE Credit 1): People must be made aware about the practices that need to be followed at their personal level, distribution of pamphlets etc. Also green Technical Training, Workshop and Seminar should conduct under the supervision of professional expert from the industries like IGBC, GRIHA,USGBC,ECBC etc.

Provision of descriptive guidelines/ guidebooks to educate the occupants (GE Credit 2): The University have mandatory environmental studies course under undergraduate programme. But it should also include educative guidelines and handbooks to the occupants of the campus mostly to the students so that green practices are followed and spread among them.

5.8. Innovation in Design

Innovation in Design		Credits Required	Credits Achieved
ID Credit 1	Innovation in Design Process	4	0
ID Credit 2	IGBC Accredited Professional	2	0

Innovation in design (ID Credit 1): Innovation in Design category for green campuses is not specifically addressed by the IGBC Green Campus rating system. But a better sustainable design & construction practices than the standard baseline or outstanding construction measures exceed the prescribed credit requirements of the IGBC Green Campus rating system can achieved the credits.

IGBC Accredited Professional (ID Credit 2):
Under this category atleast three participants of the project team should be IGBC Accredited Professionals. So, for this credit the university should support and encourage the university staff, faculties and concern members to apply for IGBC AP certification

examination prior to Certification for their project. IGBC AP exam is open for all professionals acting in Building & Construction Industry and there are no minimum criteria.

VI. CONCLUSION

As per general observation SMVDU have achieved a total of 40.5 credits approximately which falls under certified level for best practices but a lot of augment and initiates need to be done strictly as per IGBC rating system for green campuses (existing campus) in order to achieve higher level of certification and recognition.

A part from the above categories of green campus criteria the University should works to educate and engage students, staff, and faculty to set an example of campus sustainability and should also ensure that new building design and construction is approached with sustainability firmly in mind. Lastly and largely the university should invite professional and trainers from the industries to deliver lecture on energy efficient and green campuse. Few of the professional bodies which are into green buildings and can really boost the knowledge of green campuses are as ECBC (Energy conservation building code), GRIHA (Green rating for integrated habitat assessment) and IGBC (Indian green building council.

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