

Green Rating Analysis of School of Engineering and Technology, Jain University Campus

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Abstract- The construction industry in India is one of the largest economic activities and is growing rapidly. The International Energy Agency says that estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions. The construction, characteristics, operation, and demolition of buildings are increasingly recognized as a major source of adverse environmental impact. Without significant transformation of building construction and operations, such impacts are expected to increase with population growth and changes in other demographic and economic factors. One strategy for achieving that transformation is most widely known by the term Green Building. We have gone past the point where going „green“ is an option. It has now become an absolute necessity to not only mandatorily construct green but rate Green Quotient of our existing buildings also according to suitable green rating systems. In this work, the detailed green rating of the Jain University Campus situated adjacent to state highway, before Kanakpura, Bangalore rural district is done. The tool adopted for rating is the IGBC () Green Campus Rating System (New & Existing) Abridged Reference Guide 2017. The rating of the campus in each category has been done and the points have been allotted based on the existing condition of the campus. By this evaluation process, the degree of sustainability of the Campus is analyzed and rating is given. It will be a guiding factor in adapting measures for increasing its sustainability.

INTRODUCTION

India is witnessing a rapid growth in the field of infrastructure development. In fact construction industry has become one of largest economic activities and it's still growing. The average growth rate is 9.5% per year while, the global average growth rate is 5% a year. As this sector is energy and resource demanding, the wise utilization and preserving them for future generations pose many challenges. Water, energy and fossil fuel prices have

become national issues. To overcome all the hurdles, there is a need to move towards water and energy efficiency, reduction of dependency on fossil fuels, waste management and conserving bio diversity. For this purpose and to make the sustainability accessible to all and with the vision of making India one of the leaders in sustainable development, Indian Green Building Council (IGBC) has developed several rating tools, suiting all kinds of constructions.

Objective: The objective is to evaluate the present degree of sustainability of the Jain University campus in all the categories as mentioned by IGBC Green Campus Guidelines. And the outcomes of this rating will guide in taking measures that will increase the sustainability of the campus. By which the campus will be more energy efficient and environment friendly.

The minimum credit points for different certification are as follows: Level of Certification	New Campus	Existing Campus	Recognition Level
Certified	40 - 49	36 - 44	Best practice
Silver	50 - 59	45 - 53	Outstanding performance
Gold	60 - 74	54 - 66	National excellence
Platinum	75 - 100	67 - 90	Global leadership

Well-being, Green Education, Innovation in Design. Each category consists of few criteria which add up to total of 34 criteria. And 100 credit points will be for new construction and 90 points for existing building. The work is to evaluate each criteria and reward the respective points to it, as specified by the IGBC Guidelines. And at the end have to add all the points and find out the degree of sustainability of the campus. Table no. 1.2: Threshold criteria for certification levels.

Project details: The details of the campus choose for rating School of Engineering and Technology, Jain University. Type: Educational campus, Total area: 300 acres, Built up area: 1,31,399 sq.m,

Number of buildings: 28, Different type of spaces: Library, Laboratories, Seminar halls, Auditoriums, Indoor and outdoor sports facilities, Hostels, etc, Nature of occupancy: Both day and night, Number of occupancy: 5000 students (1700 stays in hostel), Location: 45th km NH-209, Kanakapura main road, Jakkasandra post, Ramanagara District- 562 112. Other details are Fenced area: 300 acres, Golf course: 18 acres, Cricket ground: 4.6 acres, Football ground and lawn area: 5 acres, SPRINTOOR: 0 sq ft (indoor), Library: 5000 sq ft with 300 seating capacity.

Literature Survey: Sunita Bansal, S.K Singh, Srijit.B [1], stated that the construction phase, operation phase and demolition phase of buildings are more responsible as a major source of adverse impact on environment. This can be avoided only by the significant transformation in all these mentioned phases of buildings, or else such impacts are expected to rise exponentially by the growth of population and infrastructure development. The International Energy Agency stated in one of its publication that existing buildings are responsible for about 40% of the world's total primary energy consumption and contributes 24% of global carbon dioxide emissions. In their work, a case study on an existing building situated in Delhi- NCR has been done to inspire stakeholders, consumers and builders of construction to improve the performance of existing buildings. SumaTeja Reddy Vanakaru [2], did work on Andhra university campus. And she proposes that Buildings are major users of our potable water supply it consumes 20% of the available water. The goal of the Water Efficiency is to encourage smarter use of water, inside and out. The objective of this paper is to highlight the rising need for water conservation and its importance as a part of building design and construction. The study has examined how the International students Hostel in Andhra University is reducing water usage and benefits through its water efficiency measures. Ms Sadhana Laxman Ogale and Roza Parashar [3], did extensive work on the waste management in Tata Motors Ltd, Pune (industrial campus). The waste generated by the industrial activity such as by mills, factories, mining operations or excavation which include any material that are rendered as useless. The study carried out has evaluated the current status and identification of

major problems related to waste recycling and disposal. Various treatment technologies adopted by Tata motors are critically reviewed, along with their advantages and limitations. Ashish Srivastava, Rajendra B. Magar and Dhaval S Shah [4], reviewed the IGBC rating systems and their benefits. They conclude that the green building concepts significantly reduces the wastage at every stage of the green buildings. The initial higher cost of new green building is 16% compared to conventional building. The saving in energy and resources will have long term recovery within 2 to 5 years of the total life cycle of the building. The review involves the evaluation of realistic rating aimed for the proposed new building, as per overall requirements as required for fulfilling the IGBC rating program. This involves the identification for the reduction of greenhouse gases with financial implications and tangible benefits to a client over a life cycle period of the building in a specified time frame. GRIHA rating of Fortis Memorial Research Institute, Gurgaon [5]. The institute adapts green techniques such as, 33% lesser energy consumption than the bench mark. The low flow plumbing fixtures are used to minimize the building water consumption up to 63%. Drip Irrigation method is adopted for landscaping along with native plant species this will reduce the landscape water consumption by 50%. And 100% treated water from sewage treatment plant is utilized for cooling towers and irrigation purposes. There is installment of solar photovoltaic panels for 25 KWp at site. Solar water heaters of capacity 8000 liters are also installed to meet the surplus hot water requirement. This earns 4 star rating to the institute. GRIHA rating of Manipal University Campus, Jaipur [6]. The campus has implemented several green concepts which has earned it 4 stars. Landscaping planned to minimize urban heat island effect based on Irradiation and Wind Studies. Swales and wetlands designed for 100% recharge of rainwater Almost 95% of construction waste reused or recycled. As this is a daytime use building, it has been designed to run only on daylight. Most of the spaces run on daylight throughout the year. And 16.6% reduction in structural steel and 15.2% reduction in structural concrete by quantity was achieved by using efficient building technology. Site Planning and Management (SPM): SPM Mandatory Requirement 1:

Green Buildings within the Campus are Intent: Design and construct high performance buildings within the campus to minimize the adverse impact on the environment.

Compliance options: Option 1: Green Building Built-up Area within the Campus: Ensure at least one building in the campus (or) 15% of the built-up area within campus (whichever is higher) is registered/certified under IGBC rating system.

Option 2: Green Features in the Campus Buildings. Design/ retrofit each building with the following green features: Water Efficient Plumbing Fixtures, Energy Efficient Lighting Fixtures, High Performance Air-conditioning Equipments.

Evaluation: The Campus has no IGBC registered/certified buildings or 15% built-up area which is IGBC registered/ certified. And the plumbing fixtures installed are general type, not water efficient. The lighting fixtures are of CFL not energy efficient LEDs. So the campus does not satisfy this mandatory requirement. Points: Not satisfied.

SPM Mandatory Requirement 2: Soil Erosion Control-Intent: Control soil erosion and sedimentation, thereby preserving good site conditions. Compliance options are Soil erosion control measures during construction should comply NBC-2005 code. Fertile topsoil should be preserved for future use or donation. Develop appropriate measures to check soil erosion, after occupancy. Evaluation is the fertile topsoil has been stockpiled and reused for landscaping purpose within campus. And also the area of slope, which is a potential area for soil erosion, has been turned into golf course and grass is maintained and trees are grown. This measure will check the soil erosion and sedimentation due to surface run-off within the campus.



Fig. no 3.1.2. Soil erosion control measures. Points: Satisfied.

SPM Credit 1: Green Buildings within the Campus Points: 10: Intent-Design and construct high performance building within the campus. Compliance Options are Option 1: Green Buildings Built-up Area within the Campus (10 points). The buildings within campus should be certified or registered under appropriate IGBC rating system. Registered Projects Built-up Area Points awarded are as below:

Registered Projects (Built-up area of campus, excluding parking)	Points
20%	1
25%	2
30%	3
35%	4
40%	5

Table no. 3.1.3(a). Registered projects points table

Certified Projects (Built-up area of campus, excluding parking)	Points
10%	1
15%	2
20%	3
25%	4
30%	5

Table no. 3.1.3(b). Certified projects points table.

Certified projects Built-up Area, Points are awarded as: Option 2: Green Features in the Campus Buildings (Max. 10 points), Design / Retro-fit individual buildings with at least 5 of the following green features. Passive Architecture (2 points), Heat Island Effect, Roof (2 points), Water Efficient Plumbing Fixtures (3 points), Waste Water Reuse (2 points), (For Flushing and individual air-conditioning systems Cooling tower make-up), Eco-friendly Refrigerants (1 point), Energy Efficient Lighting Fixtures (3 points), High Performance Air-conditioning Equipment (3 points), Applicable only for air-conditioned buildings in the campus, On-site Renewable Energy (3 points), Day lighting (2 points), Outdoor Views (1 point). Evaluation: The campus does not have any IGBC registered or certified buildings. And also none of the suggested green features are implemented in the campus. Points: 0

SPM Credit 2: Site Preservation Points: 1-3. Intent: Encourage to retain the site characteristics during the design and construction phase. Evaluation: This credit is not applicable for existing campuses.

SPM Credit 3: Green Cover or Vegetation Points: 1-6, Intent: Promote habitat and biodiversity by minimizing disturbance to green cover. Compliance

Options: Option 1: Demonstrate that the campus has retained or restore green cover or vegetation. Points are awarded as below:

Percentage of site area with green cover/vegetation	Points
≥15%	1
≥20%	2
≥25%	3

Table no. 3.1.5. Vegetation points table



Fig. 3.1.5. Green cover within campus.

Option 2: Plantation of Tree Saplings : The green cover shall have minimum of 15 trees or tree saplings per acreage it gains 1 point. If campus has 20 trees or 25 trees per acre then 2 or 3 points respectively.

Evaluation: The campus has less than 15% of its area with green cover. And there are approximately 4500 trees and tree saplings within the campus. That is 4500 trees/300 acre = 15 trees per acre. Points: 1

SPM Credit 4: Heat Island Reduction, Non-roof Points: 1-4 Intent: Minimize heat island effect. Compliance options: Option 1: Non-roof Impervious Areas Provide shade from existing tree cover/ newly planted saplings within 5-8 years. The shade is for all Non-roof Impervious areas like footpaths, pathways, roads, driveways, bicycle lanes, uncovered surface parking etc,. If the shade provided is ≥50% then 1 point and if it is ≥75% then 2 points shall be awarded. Option 2: Covered Parking Provision of shade for ≥ 50% of parking gains 1 point and ≥ 75% then 2 points. Evaluation: There is provision of shade for all the roads, pathways, footpaths within the campus. That is more than 75% of non-roof area. And there is no shaded (structured) parking within the campus. Points: 2

SPM Credit 5: Outdoor light pollution Reduction Points: 2 Intent: Reduce light pollution during night time. Compliance options are Option 1: Perspective approach Upward Lighting: Design exterior lighting so that no external lighting fixture will emit more than 5% of the pre designed fixture lumens, at an angle no greater than 90 degrees from nadir (straight

down). Lighting Power Density: For exterior areas, the lighting power density should be reduced by 25% below the ASHRAE standard 90.1-2010 baselines.

Option 2: Simulation approach- Design exterior lighting as stated in ASHRAE standard 90.1-2010

Evaluation: There is horizontal high mass lighting at several points like canteens, golf course and at Jain international residential school. Lighting of the campus is not designed as per the conditions of IGBC or ASHRAE standard 90.1-2010. Points: 0



exterior lighting

Exterior lighting at canteen



Shaded and light provided pedestrian networks

Public transport

Sustainable Transportation (ST):Credit 1: Pedestrian network Points: 3

Transport (2 Points), Provide access to a public transportation facility (bus-stop/ intra-city railway station), Within 800 meters walking distance from the campus entrance(s).

Option 2: Shuttle Service (2 Points):Operate or contract electric/ CNG powered vehicles to cater at least 10% of occupants. Or conventional vehicles to serve at least 20% of the campus occupants. Evaluation: The campus has the access to the public transportation facility such as buses and autos. The bus and auto stand is right in front of the university campus entrance. Points: 2

Water Conservation WC Mandatory Requirement 1: Rainwater Harvesting: Intent: The aim is to improve ground water table and also to reduce dependence on municipal water through effective rainwater management. Compliance Options: Option 1: Design and implement rainwater harvesting system to capture/ percolate at least ‘1-day rainfall’ runoff volume from roof and non-roof areas in the campus. Option 2 is in areas where, Authorities does not recommend rain water recharge (or) if the groundwater table is less than 8 meters, the project is required to provide justification for not implementing rainwater harvesting system in the campus. Evaluation: Rainwater harvesting technique is not implemented in the campus. And also there is no high ground water table present in the region. Points: Not satisfied.

WC Credit 1: Rainwater Harvesting Points: 2-6: Intent are Enhance the ground water table and thereby reduce municipal water demand. Compliance Options – Option 1 is Design rainwater harvesting system in order to capture/ percolate at least ‘one-day rainfall’ runoff volume from roof and non-roof areas in the campus. Points are awarded as in table:

S No	Average Peak Month Rainfall (mm)	One-day Rainfall (% of average peak month rainfall)		
		2 points	4 points	6 points
1	Up to 250	12%	15%	18%
2	251 – 350	10%	12.5%	15%
3	351 – 500	8%	10%	12%
4	501 – 700	6%	7.5%	9%
5	701 & above	4%	5%	6%

Table no. 3.3.2(a) Rainwater harvesting.

S No	Average Peak Month Rainfall (mm)	One-day Rainfall (% of average peak month rainfall)		
		2 points	4 points	6 points
1	Up to 250	6%	9%	12%
2	251 – 350	5%	7.5%	10%
3	351 – 500	4%	6%	8%
4	501 – 700	3%	4.5%	6%
5	701 & above	2%	3%	4%

Option 2: In the region of high ground water table, points are awarded as follows. Evaluation: The rainwater harvesting technique is not implemented in the campus. Points: 0

WC Credit 2: Landscape Design Points: 1-4: Intent-Design the campus landscape to ensure minimum water consumption. Compliance Option: Limited use of turf in the campus to conserve water and / or ensure that landscaped area is planted with native / drought tolerant / adaptive species.

Type of landscape	Percentage of Total Landscape area	Points
Turf Area	≤40%	1
	≤20%	2
Drought tolerant/ native/ adaptive species	≥40%	1
	≥60%	2

Landscape design points



Native trees Sprinkler irrigation at cricket ground



Sewage treatment plant Sand filter and carbon filter

Evaluation: The turf area is less than 40% of the landscaped area. Trees species like mango, coconut, teak, silver, pongamia, neem, jamun and asoca are present in the campus almost all of them are native species or adaptive species. Points: 3

WC Credit 3: Management of Irrigation Systems Points: 1-2:-Intent: Implement water efficient management techniques in order to reduce water demand for irrigation. Compliance Options: Install highly efficient irrigation systems and techniques to incorporate the following features: (1 point for every three measure; maximum 2 points), Provide central shut-off valve, Soil moisture sensors integrated

within irrigational system, Segregated independent zones for different watering needs. Minimum 50% of landscape planting beds must have drip irrigation. At least 75% of turf area must have sprinkler system. Time based controller for the valves, Pressure regulating devices, any other innovative methods, Evaluation: The campus complies 3 measures suggested by IGBC. There is provision of central shut-off valve for irrigation pipelines. Each turf areas are segregated such as, cricket ground, football ground, golf course, gardening etc for their individual watering needs. And sprinkler system is installed for irrigation purpose in more than 75% of area. Points: 1

WC Credit 4: Waste Water Treatment and Reuse
 Points: 1-4: Intent: Treat waste water generated within the campus and reuse it. It will avoid polluting the receiving natural streams. Compliance options are Waste water treatment: (2 points), Provide an on-site treatment plant to treat 100% of waste water generated in the campus Option 2: Waste Water Reuse: (2 points). Use at least 25% of treated water for landscaping and centralized Air-conditioning cooling tower makeup water. More than 25% of reuse gains 1 point and more than 50% of reuse gains 2 points. Evaluation: There are 3 wastewater treatment plants implemented within the campus which treats 100% of waste water generated. Each of the capacity 50000 lts – 100000 lts per day and the treated water from 2 treatment plants are utilized for landscaping and 1 plant is let-off. Points: 4



Sludge drying beds

Capacity of the pump (kW)	Minimum Efficiency (%)
< 5	≥ 50
5 to 14	≥ 60
15 to 49	≥ 70
>50	≥ 85

Pump efficiency table

On-site renewable energy to total annual energy consumption of the campus equipments (excluding buildings).	Points
≥10%	1
≥20%	2
≥30%	3
≥40%	4
≥50%	5

On-site renewable energy points table.

Organic Waste	Percentage of Waste Treated	Points
Food waste	≥75%	1
	≥25%	1
Garden waste	≥50%	2

Organic waste points table

WC Credit 5: Optimize Waste Use for Construction
 Points: 1-4: Intent: Enhance water use efficiency, during construction phase. Evaluation: This criteria is not applicable for Existing Campus. WC Credit 6: Water Metering
 Points: 1-2-Intent: Encourage sub-metering to enhance efficient water performance. Compliance options: Demonstrate sub-metering for minimum 3 of the following water use applications as applicable: (1 point for every 3 measures). Municipal water supply, Bore well water consumption, Consumption of treated waste water, Water consumption for landscaping, Water consumption for centralized Air-conditioning cooling tower makeup, Building-level water consumption, any other major source of water consumption. Evaluation: There are no sub-metering for water for any usage. The main and biggest supply of water to the campus is kaveri water by Bangalore sewage and water supply Board (BWSSB). Water meter for kaveri water by water board is situated in the BWSSB office itself. And there are only 7-8 bore wells working in the campus and not one is metered. So this criteria does not earn any points. Points: 0

Energy Efficiency (EE): Credit 1: Energy Efficiency in Infrastructural Equipment, Points: 1-10- Intent: Enhance energy efficiency thereby reducing impacts resulting from energy use. Compliance Options: For all infrastructural equipment/ systems within the campus, achieve energy efficiency for the following systems: (maximum 10 points). Lighting Systems: Lighting Power Density: (5 points) Reduce lighting power density by at least 30% for exterior areas over ASHRAE standard as baseline. Lighting Controls: (2 points) All non-emergency exterior and common area

lighting should have daylight sensor/ timer-based control. Pumps and motors: Pumps shall have minimum efficiency as follows: (2 points).Motors (> 3.5 HP) shall have minimum 85% efficiency (1 Point).Centralized Air-conditioning Systems: (3 points).Campuses which have installed Centralized Air-conditioning systems shall have a COP/ IPLV of at least 2.5% over ASHRAE standard 90.1-2010 baseline. $\geq 2.5\%$ efficiency over baseline gains 1 point, $\geq 5\%$ efficiency over baseline gains 2 points, $\geq 7.5\%$ efficiency over baseline gains 31 points.

Evaluation: Lighting systems: Right from the designing and subsequent retrofitting, the campus authority has not followed any standard guidelines for its lighting needs. But all lightings are Philips CFL bulbs. And there are no daylight sensors for exterior lightings, they are operated manually.

Pumps and motors: There are several types of pumps and motors used for different needs. Most of the pumps are of ABB, Kirloskar and Crompton Greaves make. All the pumps of 1.1 kW capacity(Make: ABB) has 74% efficiency. And of 3.7 kW capacity (Make: Crompton) has efficiency of 81.5% (IEI standard).

Motors of 5HP capacity (Make: Crompton) has efficiency of 84.6%. Heavy capacity motors like 50 HP(Make: Kirloskar) has an efficiency of 92%. So, all the pumps and motors are within required efficiency ranges. Centralized Air-conditioning Systems: There are no centralized AC systems installed in SET building. Only individual AC units are provided in few rooms wherever needed. And those are of Philips made and most of them are 3 starred AC units. So 1 point can be given for this compliance option. Points: 4

Credit 2: On-site Renewable Energy Points: 1-5: Intent: Promote use of renewable energy to minimize impacts of fossil fuel energy. Compliance options: Demonstration on-site renewable energy generation plant to substitute at least 10% of total annual energy consumption of the campus equipments excluding buildings. Evaluation: The campus does not have any on-site renewable energy generation facility. So no points for this criterion. Points: 0

EE Credit 3: Off-site Renewable Energy Points: 1-4 Intent: Encourage the use of off-site renewable energy technologies, to minimize the environmental impacts by the fossil fuel generated energy. Compliance options: Option 1: Demonstrate that the project has purchased Renewable Energy Certificates (RECs) (1 REC = 1MWh) equivalent to at least 20% of total annual energy consumption of the campus infrastructural equipment/ systems, excluding buildings. Option 2: Demonstrate that the project has invested stake in off-site renewable energy equivalent to at least 20% of its total annual energy consumption by the campus infrastructural equipment/ systems, excluding buildings. Evaluation: The University have not purchased any RECs or invested in any off-site renewable energy. So no points for this criteria. Points: 0

EE Credit 4: Energy Metering Points: 1-2:-Intent: Encourage sub-metering to improve energy performance, thereby save energy. Compliance Options: Demonstrate sub-metering for at least three of the following energy use applications, as applicable: (1 point for every three measures; maximum 2 points).Municipal water pumping, Ground water pumping, Treated waste water pumping, Exterior area lighting, including landscapes, Centralized air-conditioning systems, Generation of renewable energy, Power backup systems (e.g. Generators sets),Building-level energy consumption, Any other energy consuming equipment and systems. Evaluation: The campus has energy sub-metering for the municipal water pumping, power backup systems of 350kW capacity (e.g. Generators sets),building-level energy consumption, treated waste water pumping, Points: 1 Material and Resource Management (MRM)-MRM Mandatory Requirement: Segregation of Waste, Post-occupancy: Intent: Facilitate segregation of waste at the point of source, thereby avoiding waste being sent to landfills. Compliance option: Provision of wet and dry waste bins at all exterior common areas in the campus, as applicable. Divert the collected waste so it will be easy for hauling and provision of wet and dry waste bins for disposal of batteries, 'e' waste, lamps, medical waste. Evaluation: Plenty of waste bins are provided at all interior and exterior areas. And the waste collected is easily accessible for hauling. Eatables are restricted only to the

cafeteria/canteen, and proper hygiene is maintained by concerned workers from sodexo. Separate bins for collecting medical waste within medical centre. Points: Satisfied.

MRM Credit 1: Organic Waste Management, post-occupancy Points: 1-3: Intent: Implement effective waste management, so as to avoid organic waste being sent to landfills and thereby improve sanitation & health. Compliance Options: Install on-site waste treatment system for handling organic (food and garden) waste generated in the campus, including buildings. The generated manure or bio-gas shall be utilized as appropriate.

Points are awarded as below:- Evaluation: Approximately 500 kg of organic waste is generated in the campus. As there is no on site organic waste treatment facility, all the waste is collected and given off to a pig farm. And the garden waste is not converted into manure because the garden waste is treated with fertilizer and pesticides. So the campus does not comply any condition of IGBC. Points: 0
 Credit 2: Handling of Waste Materials, During Construction: Intent: Facilitate the segregation of construction and demolition waste at source, during construction phase, to promote reuse or recycling of materials. Thereby avoiding waste being sent to landfills. Evaluation: This Criteria is Not applicable for Existing Campuses.

MRM Credit 3: Local Materials: Intent: Encourage the use of locally available building materials, thereby, minimizing the transportation and storage associated environmental impacts. Evaluation: This Criteria is Not applicable for Existing Campuses.

Health and Well-Being (HWB): HWB Mandatory Requirement 1: Tobacco Smoke Control: Intent: Reduce exposure of non-smokers to the passive smoking situations. Evaluation: There is a strict prohibition on smoking within the campus. Points: Satisfied.

Credit	Criteria	Available points	Obtained points
SPM Mandatory Requirement 1	Green buildings within the campus	Required	Not satisfied

SPM Mandatory Requirement 2	Soil erosion control	Required	Satisfied
SPM Credit 1	Green buildings within the campus	10	0
SPM Credit 2	Site preservation	Not applicable	Not applicable
SPM Credit 3	Green cover or Vegetation	6	1
SPM Credit 4	Heat island reduction, Non-roof	4	2
SPM Credit 5	Outdoor light pollution reduction	2	0
	Total	22	3

Site Planning and Management points table.

Credit	Criteria	Available points	Obtained points
ST Credit 1	Pedestrian network	3	3
ST Credit 2	Bicycle lanes network	4	0
ST Credit 3	Access to sustainable transportation	4	2
	Total	11	5

Sustainable Transportation points table.

Table no. 4.1(b). Category 3: Water Conservation (WC)

Credit	Criteria	Available points	Obtained points
WC Mandatory requirement 1	Rainwater Harvesting	Required	Not satisfied
WC Credit 1	Rainwater Harvesting	6	0
WC Credit 2	Landscape design	4	3=
WC Credit 3	Management of Irrigation system	2	1
WC Credit 4	Waste water treatment	4	4
WC Credit 5	Optimize water use in construction	Not applicable	Not applicable
WC Credit 6	Water metering	2	0
	Total	18	8

Water conservation points table

Credit	Criteria	Available points	Obtained points
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EE Credit 1	Energy efficiency in infrastructural equipment	10	4
EE Credit 2	On-site renewable energy	5	0
EE Credit 3	Off-site renewable energy	4	0
EE Credit 4	Energy metering	2	1
	Total	21	5

Energy efficiency points table

Category 4: Energy Efficiency (EE); Category 5: Material and Resource Management (MRM)

Credit	Criteria	Available points	Obtained points
MRM Mandatory requirement 1	Segregation of waste, post-occupancy	Required	Satisfied
MRM Credit 2	Organic waste management, post-occupancy	3	0
MRM Credit 3	Handling of waste, during construction	Not applicable	Not applicable
MRM Credit 4	Local materials	Not applicable	Not applicable
	Total	3	0

Material and resource management points table

Credit	Criteria	Available points	Obtained points
HWB Mandatory requirement 1	Tobacco smoke control	Required	Satisfied
HWB Credit 1	Basic amenities	1	1
HWB Credit 2	Health and well being	4	4
HWB Credit 3	Universal design	1	1
HWB Credit 4	Basic facilities for construction workforce	Not applicable	Not applicable
	Total	6	6

Health and well-being points table

Credit	Criteria	Available points	Obtained points
GE Credit 1	Green education	2	1
GE Credit 1	Green campus guidelines	1	0
	Total	3	1

Green education points table

Credit	Criteria	Available points	Obtained points
ID Credit 1	Innovation in design process	4	2
ID Credit 2	IGBC Accredited professional	2	0
	Total	6	2

Innovative design points table

Category	Available points	Obtained points
Site Planning and Management	22	3
Sustainable Transportation	11	5
Water Conservation	18	8
Energy Efficiency	21	5
Material and Resource Management	3	0
Health & Well-being	6	6
Green Education	3	1
Innovation in Design	6	2
Grand total	90	30

Final points table

Certification Level	New Campus	Existing Campus	Recognition
Certified	40 – 49	36 – 44	Best Practices
Silver	50 – 59	45 – 53	Outstanding Performance
Gold	60 – 74	54 – 66	National Excellence
Platinum	75 – 100	67 – 90	Global Leadership

Certification level table

DISCUSSION

The campus is able to achieve 30 points out of 90 points. These points are unable to attain any certification level for the Jain University. The threshold for certification levels are as follows:

The campus falls short of 6 points to become as a certified campus.

Site planning and management: In this category, campus fails to satisfy a mandatory requirement. That is, Certified or registered green buildings within the campus. Due to the same, the campus loses 10 points also. As there is not enough green cover or vegetation within the campus it loses 5 points. Absence of covered parking facility within the campus is seen. The outdoor lighting system has designed as per ASHRAE standards; this also loses some points.

Sustainable Transportation: The campus has excellent access for public transportation, within 50 meters of distance from the entrance. There is no bicycle lane network within the campus. And also no electric or CNG powered shuttle services within campus.

Water Conservation: Under this category, the campus fails to satisfy a mandatory requirement, rainwater harvesting. This is one of major step in being sustainable campus. It is critical requirement for the campus as they earn water efficiency. And also gets 6 points in rating. And also lack of water metering for several uses.

Energy Efficiency: Another area in which the campus fails to show progress is in the field of adaption of energy efficiency. In this category, campus achieves only 5 points out of 21 points.

Material and Resource Management: In this category the campus scores 0 out of 3 points. This is due to the bad organic waste management practices. Neither food waste nor garden waste is handled usefully, like for preparation of bio gas or manure.

Health and Well-being: The campus does outstanding in Health and well-being category. It gains 6 points out of 6 points and also satisfies a mandatory requirement of tobacco smoke control. **Green Education:** The lack of green campus guidelines for the occupants and campus users is noted. And also university should do awareness drives including public and NGOs frequently.

Innovation in Design: The campus has done green auditing for SET and its hostel. It is an major step by University towards sustainability. Although the campus has lot of potential to become a green campus, it fails to achieve so. One of the major setbacks is that the administration has not considered Green building concepts right from its design and construction period. But still the campus has good opportunity to implement and practice sustainability techniques in the field of retro fitting design, water conservation, site management and renewable energy.

CONCLUSION

Retrofitting:-As the campus is already constructed (existing campus category) there remains few measures which will put campus in the path of green way of operation. Retrofit all the water fixtures with low flow design. Example: flush, taps etc. Install moisture sensors for irrigation purpose of landscaping, Retrofit all non-emergency lighting fixtures by LEDs (Presently CFLs are in use), Installing daylight sensors for exterior lighting can contribute for energy savings. For new buildings to construct within campus, follow ASHRAE standards.

Waste management: Campus generates approximately 500 kg of food waste and a 1000 kg of garden waste. But these are not handled in a useful manner. With this quantity of waste generation campus can install a biogas generation plant and the generated bio gas will replace the part of LPG usage for the kitchens. And the garden waste can be turned into manure which in turn fed to the gardens or turf within the campus. But the use of chemical fertilizer and pesticides for landscaping poses as hurdle for converting it to manure.

On-site renewable energy: SET building alone consumes 104.81 MWH of electricity per month. That is $104.81 * 12 = 1.257$ GW per year. The electricity bill of this will be around 9 lakh rupees per month. By observing all these, it is well known that there is a need for switching to renewable energy. By the initial investigation done as part of this work, the wind speed in the region where campus is located is very less than the required threshold speed to operate a wind fan. The average wind speed to start electricity generation is 11.8 to 14.4 km/h. But the campus area has only 9 to 10 km/h of wind speed. So, it is clear that there is no chance of installation of wind energy within campus. As the campus has large land and many buildings in it, rooftop solar panels can be installed to harness electricity which will replace the part of fossil energy generated electricity use (as per the capacity of solar energy installation). Solar energy is easy to maintain and one of clean source of energy.

RR No.	Tariff	Subdivision	Billing Month	Reading Date	Reading	RR No.	Tariff	Subdivision	Billing Month	Reading Date	Reading
KPHNT2	HT-2(C)(D)	Illahalli	Feb 2018	01 Mar 2018	201822323412401						
REVENUE Present Reading: 01 Mar 2018, 07170 Previous Reading: 01 Feb 2018, 07159 Difference: 0719 Meter Constant: 400 Consumption: 200.0 Loss/Adj Consumption: 0 Net Consumption (EC): 200.0											
DETAILS OF CHARGES Tax: 0.00 Interest on Revenue: 0.00 Interest on Tax: 0.00 Total Interest: 0.00 Demand Charges: 200 Demand Charges 1: 200 Demand Charges 2: 0 Parat Charges: 0 Parat Charges 1: 0 Parat Charges 2: 0 EC 1: 1st Slab: 100000 EC 1: 2nd Slab: 4818 EC 2: 1st Slab: 0 EC 2: 2nd Slab: 0 EC 3: 1st Slab: 0 EC 3: 2nd Slab: 0 TCC EC: 0 Tax: 0 Churnat EC: 0 PF Parat: 0 Rebate/Discount: 0 Bill Amount: 89941.00 Credits: 0 Total Bill Amount: 89941.00 Amount Payable: 89941.00											
TCC Slabs 6 To 10 10 To 18 18 To 22 22 To 6 Total: 0											
NOTE: Payment made on DUE DATE after 3 PM at ATP Counters attracts one day's interest. Bangalore Electricity Supply Company (BESCOM) - Wholly owned Government of Karnataka. Assistant Executive Engineer (E.L.), (C) Illahalli											

Figure no. 5.3.1. SET electricity bill

And there is a lot of support is there by state government as well as Ministry of New and Renewable Energy (MNRE) government of India. The University should really work on this aspect in order to become clean energy consumer thereby becoming green campus.

Rainwater harvesting: Being water self-sufficient is a basic measure and also a bigger leap towards being a green campus. Kanakapura region, where campus lies, receives an average of 295 mm of rainfall yearly. The rainwater harvesting technique should be implemented for all roofed structures like, buildings, canteen, trussed structures, parking, etc.

Sustainable development: The administration should implement green concepts in all aspects of development of the University whether it is site development or energy efficiency or water conservation or sustainable transportation or infrastructure development.. The only way of development is sustainability. Sustainability has not remained as an option, it has become necessity.

HWB Credit 3 Universal Design Points: 1
 Intent: Ensure that the design of the campus caters to differently able and senior citizens.
 Compliance Options are Easy access to the main entrance of the buildings, Appropriately designed preferred car park spaces to have an easy access to the building's main entrance or closer to the lift lobby, on slippery ramps, with handrails on at least one side (as applicable), Uniformity in floor level

should be there for hindrance-free movement in exterior common areas, Restrooms (toilets) in campus/ building common areas designed for differently able people, Provide adequately wide main walkways / pathways in exterior common areas, Visual warning & Way finding signage in exterior common areas. Evaluation: The campus characteristics implemented are there is easy access to the main entrance of the building, Car parking is close to the Main entrance, all floors are easy to access and are symmetrical. there are wide walkways in exterior common areas, visual warning and way finding signage are provided. Points: 1

HWB Credit 4: Basic facilities for Construction Workforce Points: 1 Intent: Encourage the welfare of the construction workforce by providing safe and healthy working conditions. Evaluation: This criteria is not applicable for existing campuses.

Green Education (GE): GE Credit 1: Green Education

Intent: Promote green education by involving campus occupants, local communities & NGOs, to increase awareness levels and encourage implementation of eco-friendly practices. Compliance Options are the outreach/ educational programmes can include, but not limited to, promotional materials (posters, brochures, etc.), information portals, awareness programmes. Constitute a formal committee/ forum with the involvement of campus occupants, local communities & NGOs, to identify and implement at

least two eco-friendly practices/ green initiatives within and outside the campus.

Evaluation: The campus conducts seminars and awareness programs on sustainability quite frequently under the School of Engineering and Technology to create awareness among campus users/ students. Campus has a 2 year post graduate program “Building science and Technology”, under civil engineering department. The course completely deals with sustainability and green practices. The campus does not have any formal committee/ forum with involvement of students and campus occupants and local communities to implement at least 2 green practices within and outside the campus. Points: 1

Credit 2: Green Campus Guidelines Points: 1

Intent: Prepare and give descriptive guidelines to campus occupants and facility team to help them maintain and use green aspect of the campus.

Compliance Options: Design & publish the following:

Campus guidelines providing all the information that helps campus users to utilize and maintain its green features, post occupancy. Project specific green campus operation and maintenance and renovation guidelines which will help university throughout its operational and renovation process. Evaluation: There is no ‘green campus guidelines’ or ‘operation & maintenance guidelines’ developed by the college. Points: 0

Innovation in Design (ID)

Credit 1: Innovation in Design Process Points:1-4

Intent: Providing the projects an opportunity to be awarded points for innovative performance in green campus categories not specifically addressed by the IGBC Green Campus rating system.

Compliance Options:

Option 1: Innovation: Identify the intent of innovation credit, requirement for compliance, approach used to meet the required measures, and documentation to demonstrate compliance.

Option 2: Exemplary Performance: The project is eligible for exemplary performance, if the design and/ or construction measures Greatly exceed the credit requirements of the IGBC Green Campus rating system.

Evaluation: Carbon and water footprint mapping exercise was undertaken for Centre for Emerging Technology (CET). The purpose was to measure the carbon footprint of the School of Engineering and Technology (SET) and its hostel buildings. The Green House Gas (GHG) protocol has been used to find out the carbon footprint. The result of this exercise shown that use of grid electricity, staff and student commute and paper consumption are the primary sources of emissions constituting 55%, 20% and 10% of emissions respectively. The GHG emission and reporting has been done in accordance with guidelines laid by Confederation of Indian Industries (CII) and ISO 14064. Points: 2

ID Credit 2: IGBC Accredited Professional Points: 1-4

Intent: Encourage and promote the involvement of IGBC Accredited Professionals in green campus projects, so as to integrate appropriate design measures and streamline the certification process from IGBC. Compliance Options are minimum three participants of the project team shall be IGBC Accredited Professionals. Evaluation: There are no IGBC Accredited Professionals from the project team (from the university). Points: 0

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