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SvaGriha Rating for Green Buildings, A Design Tool for Low Carbon Climate Resilient Cities: A Case Study of Reduction in Water and Energy Demand

Tanu Bhatt[1] and Akshita Bhatt[2]

[1,2]Paryavas Environment and Habitat 1238, Mahagun Puram, Ghaziabad 201002
E-mail: [1]tanu.bhatt@paryavas.in, [2]akshita.bhatt@paryavas.in

Abstract—*A city as a built form is comprised of many types of structures, different in form, function and sizes. However the biggest share in the city is of buildings which are small and mainly for residential and commercial use. Such as Houses, Small shops Restaurants etc. A rating tool for measuring resource efficiency for smaller footprints is made by GRIHA(Green rating for Integrated Habitat Assessment) Council in India. It not only measures environmental impact made by smaller buildings but also suggests design tool to make buildings which are energy and resource efficient.*

This paper aims to analyse possible impact of implementing Rating on a city and how it can be helpful in promoting a low carbon climate resilient city through means of less requirement for energy for artificial lighting and reduction in water demand.

Keywords*: Green Building, Sustainability, Low Carbon Cities, Lighting Power Density, Building Water Demand*

1. INTRODUCTION

Building construction and its habitation has a direct play with the energy use and impacts on climate. As per the World Environment Outlook 2009, half of world's population in cities is already consuming two third of world's energy. By 2030, cities will be consuming 73 per cent of world energy, accounting for 70 per cent of CO_2 emissions. In India, building construction and usage consume one third of the primary electricity. The National Habitat Standard Mission states that building energy consumption has increased from a low of 14 per cent in 1970 to 33 per cent in 2004-05. [1] The increasing demand for energy results in proportional carbon emission.

2. CITY AND ITS RESIDENTIAL AND COMMERCIAL COMPONENT

A city as a built form comprises of many types of buildings which are different in sizes and its function. In any settlement majority of the buildings are of residential and commercial sectors. It comprises of large chunk in the overall developed land and subdivided into smaller parts. Majority of these buildings are usually smaller in size e.g. between 40 sqm to 200 sqm.

3. SVAGRIHA TOOL FOR GREEN RATING

A green building rating tool SvaGriha(Small Versatile Affordable Green Rating for Integrated Habitat Assesment) has been developed by GRIHA(Green Rating for Integrated Habitat Assessment) Council, a Society formed jointly by TERI(The Energy and Resources Institute) and MNRE (Ministry of New and Renewable Energy, India). Svagriha targets those smaller packets where development happens most quickly and habitation grows for a much higher density rather than its larger counterpart. SvaGriha is meant to provide rating and design tool to those smaller development where overall developed area in a single plot is less than 2500 sqm.

SvaGriha has 14 criteria sums up for 50 points where Griha Council's Comprehensive rating system GRIHA has 34 criteria which sums up for 100 points. SvaGriha addresses most common concerns for energy and resource efficiency as per the following table1.

These concerns Starts from site preservation. Then it addresses good passive design to reduce heat gain and hence less load on energy. Then it gives direction on water conservation and waste management. It also emphasizes on low energy building material and Green lifestyle.

Table 1: Broad classification of rating parameters in SvaGriha

Sub Group	Maximum points	Minimum points to be achieved
Landscape	6	3
Architecture & Energy	21	11
Water & waste	11	6
Materials	8	4
Lifestyle	4	1

Table 2: Criteria for SvaGriha rating

Criterion number	Criterion name	Points
1	Reduce exposed, hard paved surface on site and maintain native vegetation cover on site	6
2	Passive architectural design and systems	4
3	Good fenestration design for reducing direct heat gain and glare while maximising daylight penetration	6
4	Efficient artificial lighting system	2
5	Thermal efficiency of building envelope	2
6	Use of energy efficient appliances	3
7	Use of renewable energy on site	4
8	Reduction in building and landscape water demand	5
9	Rainwater harvesting	4
10	Generate resource from waste	2
11	Reduce embodied energy of building	4
12	Use of low-energy materials in interiors	4
13	Adoption of green lifestyle	4
14	Innovation(over and above)	2
Total		50

4. IMPACT OF ADOPTING SVAGRIHA

As per the data collected by Griha Council from its registered and certified projects, Buildings have shown a significant saving in energy and resources and hence it is reducing the carbon footprint generated by it. If rating system is adopted throughout the city, specifically in plotted residential and commercial sector, there can be tremendous saving in city's water and Artificial Lighting energy demand.

5. LIGHTING POWER DENSITIES

Artificial Lighting is one of the major energy consuming factors in residential and commercial sector. Criteria 4 mentioned in SvaGriha(refer table 2) states different threshold of Lighting Power Density (LPD) which is the amount of power consumption for lighting per unit area for different types of building use. E.g. for residential multifamily building, it is 7.5 W/sqm, For office Buildings it is 10.8 W/sqm, for restaurants it is 15.1 W/sqm etc. These thresholds are taken as reference from Energy conservation Building Code 2007 (ECBC) in India.[2](Refer table 3).

Table 3: LPD Threshold Limit for various Buling Type under ECBC

Building Area Type	Maximum Threshold LPD W/sqm
Hostel	10.8
Healthcare	10.8
Hotel/Motel	10.8
Library	14
Multifamily Residential	7.5
Office	10.8
Retail/mall	16.1
School	12.9
Café/Fast Food	15.1

As per the directions given in SvaGriha Manual,[3] for Efficient artificial lighting, It is mandatory to achieve efficiency in Lighting Power Density (LPD) and the value of LPD of any building should be below the threshold level as suggested. This can be achieved by using energy efficient lighting fixtures such as LED or CFL.

There has been a significant reduction observed in SvaGriha Registered buildings in their LPD, of which is the amount of power consumption for lighting per unit area.

Since Carbon emission is directly associated with global warming and caused by energy use, reducing energy consumption is necessary for a Low Carbon Environment.

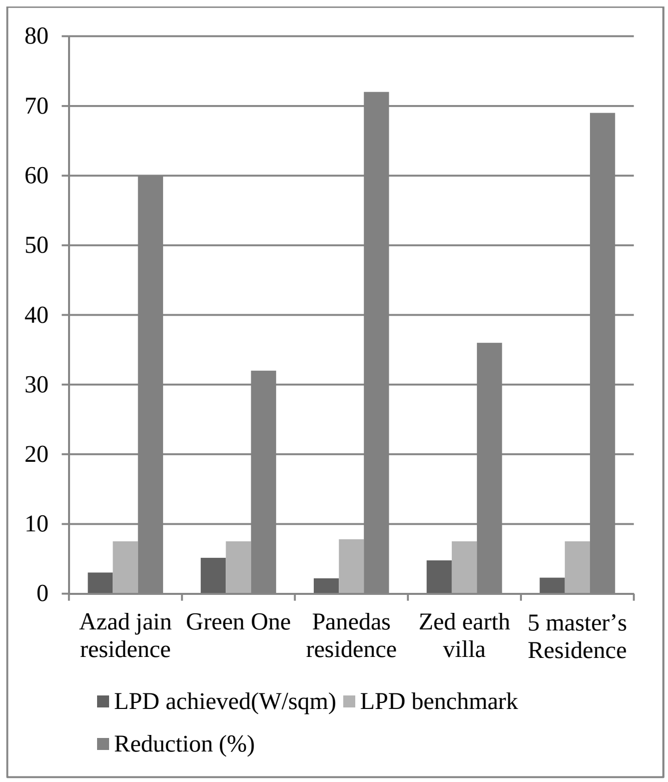

Fig. 1:LPD in Residential buildings under SvaGriha

Table 4: LPD in Residential Buildings under SvaGiha

Name	LPD achieved(W/sqm)	LPD benchmark	Reduction (%)
Azad Jain's residence	3.02	7.5	60
Green One	5.13	7.5	32

Panedas residence*	2.19	7.8	72
Zed earth villa	4.78	7.5	36
5 master's Residence	2.29	7.5	69

*the threshold value is taken from ASHRAE 90.1 specified LPD limit of 7.8 W/sq.m., as the project is situated outside India

Reflected in the table 3 and Fig. 3, There has been a saving in energy use ranging from 32%-60% is observed from various residential artificial lighting requirement. Which is huge considering the component of artificial lighting in residential sector is about one third of the overall energy requirement. [1]

Table 5: LPD in Commercial Buildings under SvaGriha rating

Name	LPD achieved(W/sqm)	LPD benchmark	Reduction (%)
Abhikalpan Office	4.78	10.8	56
APCD	4.62	10.8	57
EMPRI annex	3.29	10.8	70
Office GIZ	8.48	10.8	21
IOCL DO	6.41	10.8	41
Green Spaces Kalptaru	4.01	10.8	63
Bhajan Dhaba	3.9	15.1	74

Shown in Table 5, Fig 2, Commercial building is also showing significant reduction in energy requirement for artificial lighting ranging from 21%-70%.

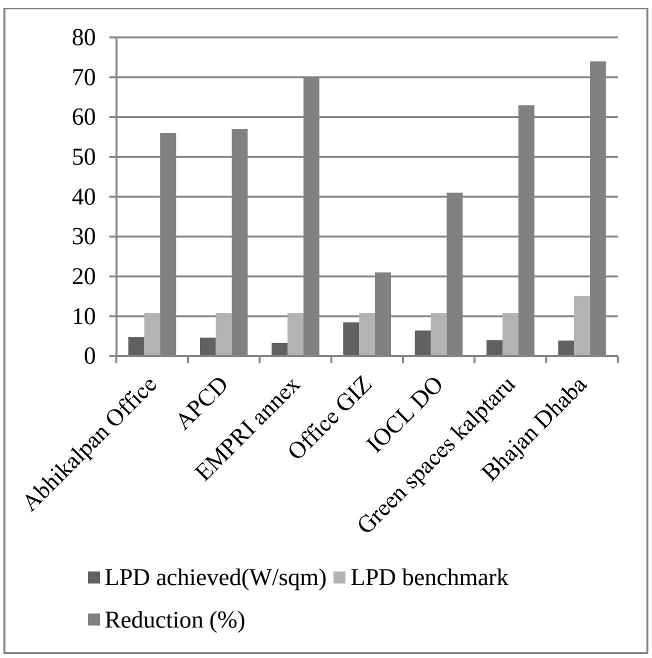

Fig. 2: Reduction in LPD in Commercial Buildings

6. REDUCTION IN BUILDING WATER DEMAND

Reduction is water demand is achieved through the directions given in the SvaGriha manual which states that the reduction should be done by means of low flow fixtures and building landscape should be having less lawn area and more tree cover.

Low flow fixtures mostly use aeration as a tool to provide efficient supply of water. This insures that amount of water released with relation to the time is less than that of common fixtures while the flow speed is maintained same for the reduced amount of water.

Following are the reduction in building water demand achieved by SvaGriha Registered Buildings as displayed in Fig.3 and Table 5.

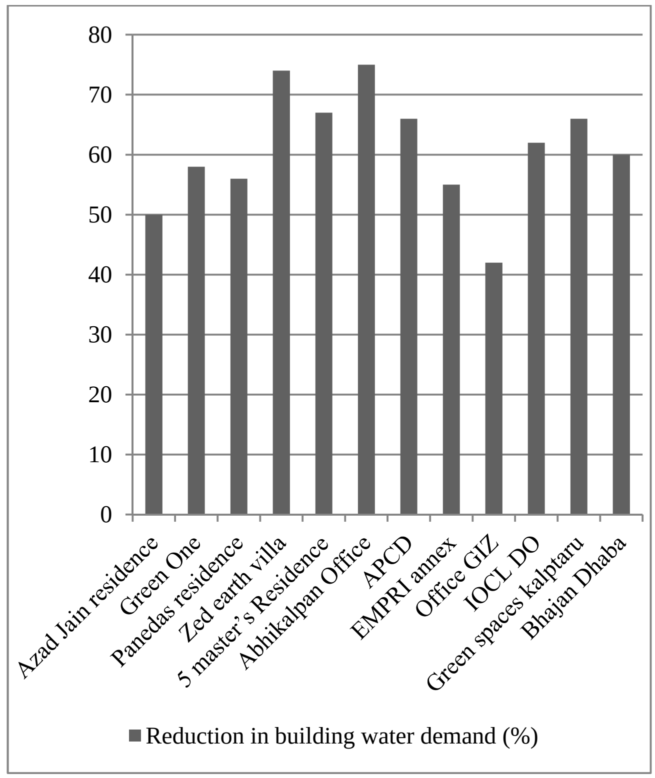

Fig. 3: Reduction in Building water demand in buildings under SvaGriha rating

Table 6: Reduction in Building water Demand by in Buildings under SvaGriha rating

Name	Reduction in building water demand (%)
Azad Jain residence	50
Green One	58
Panedas residence	56
Zed earth villa	74

5 master's Residence	67
Abhikalpan Office	75
APCD	66
EMPRI annex	55
Office GIZ	42
IOCL DO	62
Green spaces kalptaru	66
Bhajan Dhaba	60

It is evident from table 5 that all of the buildings perform better in reducing water demand. The reduction in water demand is observed for more than 50% in most of the cases.

Considering the case of NCT Delhi, Delhi jal Board(DJB), the public water distribuiton agency, supply 740 MGD of water to respective municipal bodies. The demand for water considering a per capita requirement of 225Lpcd/(Litre Per Capita per Day) works out to be 914 MGD leaving a shortfall of 174 MGD which is around 20% [5]. Considering the shortfall distributes equally among all the sectoral water use, this shortfall can be met if design tool, assuming it reduce demand by 50% is applied as a standard practice in atleast 40% of the household. Further, if it is applied in 80% of the household of the city, it can reduce its demand by 40% and place back itself on 33% surplus water supply which can be redistributed to needful neighbourhoods where groundwater is much below and municipal supply is short in amount.

Partly caused by climate change, our water resources are constantly reducing. There is need to conserve water and use available water efficiently and justifiably in order to be resilient with Climate change.

7. CONCLUSIONS

As described and illustrated above, most of the buildings from Plotted residential and commercial development, which opted for Svagriha rating, shown a huge reduction in their Building water demand and also in Lighting Power Density(LPD) from the base case. If applied at the city level, not only the shortfall between demand and supply of energy and water can be met but surplus resources can be distributed to those areas where supply is severely short. Through constant evolution in the rating tool over the time, it can be quite helpful in achieving goal of Low Carbon Climate Resilient city.

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