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"GREEN TRENDS IN CONSTRUCTION TECHNOLOGY"

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ABSTRACT

Green building (also known as green construction or sustainable building) refers to both a structure and the using of processes that are environmentally responsible and resource- efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. In other words, green building design involves finding the balance between homebuilding and the sustainable environment. Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective of green buildings is to reduce the overall impact of the built environment on human health and the natural environment by:

- *Efficiently using energy, water, and other resources*
- *Protecting occupant health and improving employee productivity*
- *Reducing waste, pollution and environmental degradation*

The implementation of latest technology in construction will lead to better building with green rating. This paper outline the solutions for the energy efficient futuristic buildings. Buildings are the greatest consumers of water, energy and materials. The idea of green buildings promotes use of renewable energy, recyclable & recycled products. Green building has to save water, energy and material compared to conventional building. Green building is which one high thermal insulations, Rain water harvesting, terrace gardening, ventilation and energy efficient appliances.

I. INTRODUCTION

"A green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants as compared to a conventional building."

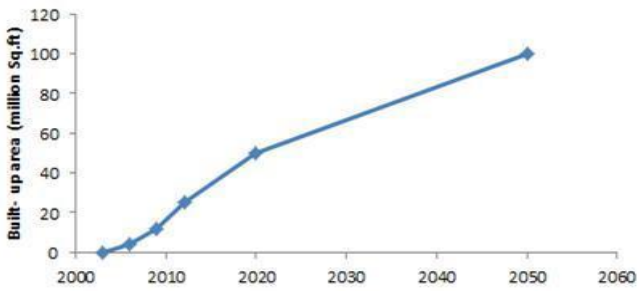

Fig 1 Growth of green building in India

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Green building design is looked in an integrated way. Site planning Building envelope design
Building system design HVAC (heating ventilation and air conditioning), lighting, electrical, and water heating
Integration of renewable energy sources to generate energy onsite. Water and waste management
Selection of ecologically sustainable materials (with high recycled content, rapidly renewable resources with low emission potential, etc.).
Indoor environmental quality (maintains indoor thermal and visual comfort and air quality).

II. BENEFITS OF GREEN BUILDING

Green building consume 40% to 60% (depending on the range of measures adopted) lesser electricity as compared to conventional buildings. This is primarily because they rely on passive architectural interventions in the building design, and high efficiency materials and technologies in the engineering design of the building.
Green building also attempt to work towards on-site energy generation through renewable energy utilization to cater to its energy needs. For instance, solar thermal systems can help generated hot-water and replace the conventional electrical geyser in buildings. Solar PV panels can help generate electricity which can reduce the buildings dependence on grid power.
Green buildings consumes 40% to 80% (depending on the range of measures adopted) lesser water as compared conventional buildings. By utilizing ultra-low-flow fixtures, dual plumbing systems and rain-water harvesting, green building not only reduce their demand for water use but also look at on-site supply options to cater to its internal and external (landscape) water demands.
Green buildings generated lesser waste by employing waste management strategies on site. They may also employ waste to energy or waste to resources (like manure or compost) strategies on site, to minimize their burden on municipal waste management facilities and landfills.
Green buildings generate lesser pollution both during construction materials, barricading of the site to prevent air and noise pollution during construction and operation, and so on, ensures reduced impact on the surrounding environment.
Green building ensures proper safety, health and sanitation facilities for the labourers (during construction) and the occupants (while in use).
Green buildings offer higher image and marketability.

III. WHAT IS GREEN BUILDING RATING SYSTEM?

There are three primary rating systems in India.

A. Griha

Green Rating for Integrated Habitat Assessment (GRIHA) is India's own rating system jointly developed by TERI and the Ministry of New and Renewable Energy, Government of India.
Commonwealth Games village, New Delhi, Fortis Hospital, and New Delhi, CESE (Centre for environment sciences) & Engineering Building, IIT Kanpur, Suzlon one Earth, Pune and many other buildings has received GRIHA rating.

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B. IGBC

IGBC rates green buildings in four different categories:

IGBC Green Homes

IGBC Green Factory Building

LEED India for new construction

LEED India for core and shell.

Table1 Certification level

Rating	Point
LEED Certified	26 – 32
LEED Certified Silver level	33 – 38
LEED Certified Gold level	39 – 51
LEED Certified Platinum level	52 – 69

C. BEE

BEE (Bureau of Energy Efficiency) its own rating system for the buildings based on 1 to 5 stars scale. More stars mean more energy efficiency. BEE has developed the Energy Performance Index (EPI). The unit of kilo watt hours per square meter per year is considered for rating the building and especially targets air conditioned and non-air conditioned office building.

The Reserve Bank of India's buildings in Delhi and Bhubaneswar, the CII Sohrabji Godrej

Green Business Centre and many other buildings has received BEE 5 Star ratings.

IV. SITE SELECTION & PLANNING

Availability of the natural advantages.

- Availability of the electric power.
- Available means of communication.
- Climatic condition.
- Contours of the area.
- Development of the surrounding area.
- Drainage of the area.
- Facility available for the sewage disposal.
- Fertility of the soils.
- Frequency of the floods.
- Growth of the trees.
- Nature of the soil.
- Position of the streams and lakes.
- Water resources, etc.

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V. WATER CONSERVATION

(A).Monitoring water use: Use of water meter conforming to ISO standards should be installed at the inlet point of water uptake and at the discharge point to monitor the daily water consumption.

(B)Use of water saving devices/ fixtures: • Low flow flushing system.

- Sensor based fixtures.
- Waterless urinals.
- Auto control valves.

(C)Efficient irrigation equipment:

- Drip irrigation.
- Efficient central systems.
- Sprinkler irrigation.

(D) Fixed time schedule for watering.

(E)Treatment techniques.

(F) Rain water harvesting.

(G) Estimation of water use in building

Parameters:

office population: Fixed =

1700, Floating = 1800 Residential population : 7000 Consumptions of water lpcd of office population : 45 litres per day Consumptions of water lpcd of residential population : 155 litres per day

Peak water demand:

Maximum daily demand Office population = 1.5 × 3500 × 45 = 236250 litres/day

Maximum daily demand Residential population = 1.5 × 7000 × 155 = 1627500 liters/day

Total water demand = 1863750 liters/day

Net water demand = 4365000 liters/day = 4.36 MLD

(H). Rain water harvesting:

Rain water harvesting = Rainfall × Area of catchment × Run coefficient = 1.4 × 15000 × 0.85 = 17850 m^3 =17.85 MLD

VI. ENERGY CONSERVATION

(A). **Energy conservation in lighting survey:** Use compact fluorescent lamp (CFL) in place of incandescent lamps.

Commonly T12 fluorescent tube is used which consumes 40W power by tube plus 10-18W power by electromagnetic ballast. Replace these lamps with more efficient T8 or T5 lamps.

Use of metal halide lamps in place of LPMV or HPSV lamps. Use LED lighting.

Proper installation of luminaries.

Improving lighting control (Occupancy Sensors). Use maximum daylight.

Proper maintenance.

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Energy management systems.

(B).Solar photovoltaic system:

In solar photovoltaic system solar energy is directly converted to electric power. This makes the system far more convenient and compact compared to thermal methods of solar energy conservation. It uses the energy of visible and infrared regions of the solar radiations for conservation into electric power.

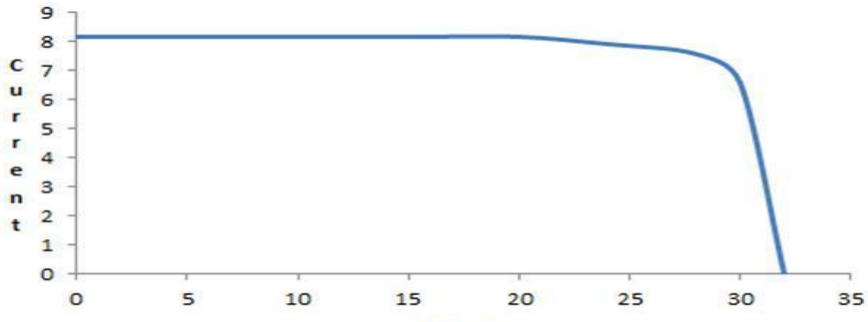

Fig 4 Solar photovoltaic characteristics

The graph between voltage and current generated by solar photovoltaic system is a non-linear. The voltage and current varies with temperature.

C).Design of solar photovoltaic system

Table 2 Load estimation:

ITEMS	WATTAGE	NOS.	APPRO. WORKING HOURS PER DAY	ENERGY CONSUMPTION (Wh/day) = watts * nos *hours
CFL lamps	15	36	2	1080
Fluorescent tube	35	104	3	10920
Fan	60	35	3	6300
Computer	150	15	4	9000
Printer	70	15	1.5	525
T.V	250	2	5	2500
Water cooler	1000	2	5	10000
Motor	1100	1	2	2200

Total energy consumptions per day = 42525Wh/day

Input energy of the inverter = 42525/0.90 = 47250 Wh

Sizing the solar array:

Actual operating conditions of the solar panels are = 35 V, 8.57Amp Battery efficiency = 0.85

Efficiency of the controller circuit of the battery = 0.90

The solar array has to generate = 47250/0.85 × 0.90 = 61764.70 Wh/day

It needs to generated (array voltage is 35 V) = 61764.70/35 = 1764.70 Ah

Assuming good sunshine of 6 hours most of the days,

The solar array has to generated = 1764.70/6 = 294.11

Amp No. of panels required = 294.11/8.57 = 34.31 = 34 panels

Sizing the batteries:

Depth of discharge = 0.70

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Required charge capacity = 47250/12 = 3937.5 Ah

No. of batteries required = 3937.5/150 × 0.7 = 37.5 = 38 batteries For 3 days autonomy = 38 × 3 = 114 batteries

Sizing of the inverter:

Total connected load to the inverter is = 2681 W Inverter efficiency = 0.90

Input energy of the inverter =42525/0.90 = 47250 Wh No. of inverter =47250/8000 = 5.90 = 6 Inverter

For 3 days autonomy = 6 × 3 = 18 Inverter

(D). Total energy consumption in green building (office area):

Equipment/ Devices	Watts	Nos.	Approx. Working hours per day	Total energy consumption pe day (KWh)
CFL lamp	15	864	2	25.92
Fluorescent tube	35	2400	3	252
Ceiling fan	60	720	3	129.6
Computer	150	200	5	150
Printer	70	60	2	8.4
LED T.V	250	5	5	6.25
Water cooler	1000	24	2	48
Motor	1100	12	2	26.4

Total energy consumption:

= 25.92 + 252 + 129.6 + 150 + 8.4 + 6.25 + 48 + 26.4 = 646.57 KWh/day Monthly energy consumptions in KWh:

= 646.57 × 24 = 15517.68 Kwh

Total electricity bill in Rs:

Fixed charge = 200 × 12 = 2400 Rs

Energy charge = 15517.68 × 4.9 = 76036.63 Rs Fuel charge = 15517.68 × 1.24 = 19241.92 Rs Electricity charge @ 25% = 24479.63 Rs Meter charge = 20 × 12 = 240 Rs

Total electricity bill = 2400 + 76036.63 + 19241.92 + 24479.63 + 240 = 122398.18 Rs

(E).Total energy consumption in conventional building (office area):

Total energy consumption per day:

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Equipment / Devices	Watts	Nos.	Approx. Working hours per day	Total energy consumption per day (KWh)
Incandescent lamp	60	192	4	46.08
Fluorescent tube	40	2458	5	491.6
Ceiling fan	70	732	3	153.72
Computer	150	200	5	150
Printer	80	50	2	8
T.V	300	5	4	6
Water cooler	1000	24	2	48
Motor	1500	12	2	36

Total energy consumption:

= 46.08 + 491.6 + 153.72 + 150 + 8 + 6 + 48 + 36 = 939.4

Monthly energy consumptions in KWh= 939.4 × 24 = 22545.6 Kwh

Total electricity bill in Rs:

Fixed charge = 200 × 12 = 2400 Rs

Energy charge = 22545.6 × 4.9 = 110473.44 Rs

Fuel charge = 22545.6 × 1.24 = 27956.54 Rs

Electricity charge @ 25 % = 35267.49 Rs

Meter charge = 20 × 12 = 240 Rs

Total electricity bill = 2400 + 110473.44 + 27956.54 + 35267.49 + 240 = 176337.47 Rs

Total saving in green building Rs.:

Total saving = 176337.47 − 122398.18 = 53939.29 Rs

(F). Total energy consumption in green building (Residential area):

Total energy consumptions/day:

Equipment / Devices	Watt	Nos.	Approx. working hours per day	Total energy consumptio per day (KW
CFL Lamps	15	826	7	86.73
Fluorescent tube	35	688	7	168.56
Ceiling fan	60	684	5	205.2
Computer	100 – 200	195	4	117
T.V	210 – 400	308	5	385
Fridge	225 – 500	290	5	435
DVD	80 -85	300	2	48
Heater / Geyser	1000 – 3000	153	1.5	229.5
Oven	800 – 1000	23	1.5	27.6
Mixer	150 - 450	182	0.5	13.65
Iron	40	200	0.5	4
Washing machine	600 - 800	68	2	81.6
Hair dryer	1250 – 1500	45	0.33	18.56
Radio	50 – 200	140	2	28

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Total energy consumptions /day:

86.73 + 168.56 + 205.2 + 117+ 385 + 435+ 48 + 229.5 +27.6 + 13.65 + 4 + 81.6 + 18.56 + 28 1848.4 KWh

Monthly energy consumption in KWh = 1848.4 × 31 = 57300.4 KWh

Total electricity bill in Rs:

Fixed charge = 10 Rs × 342 = 3420 Rs

Energy charge = 57300.4 × 3.6 = 206281.44 Rs Fuel charge = 57300.4 × 1.18 = 67614.47 Rs Electricity charge @ 15% = 42623.38 Rs Meter charge = 20 × 342 = 6840 Rs

Total electricity bill = 3420 + 206281.44 + 67614.47 + 42623.38 + 6840 = 326779.29 Rs

(G). Total energy consumption in conventional building (Residential area):

Total energy consumption/day:

Equipment / Devices	Watt	Nos.	Approx. working hours per day	Total energy consumption per day (KWh
Incandescent lamps	60	352	5	105.6
Fluorescent tube	40	692	10	276.8
Ceiling fan	70	692	5	242.2
Computer	100 – 200	200	4	120
T.V	210 – 400	300	5	450
Fridge	225 – 500	280	5	420
DVD	80 -85	290	2	46.4
Heater / Geyser	1000 – 1500	150	2	300
Oven	800 – 1000	25	1.5	37.5
Mixer	150 - 450	182	0.5	27.3
Iron	40 -60	200	0.5	6
Washing machine	600 - 800	68	2	108.8
Hair dryer	1250 – 1500	45	0.33	22.27
Radio	50 – 200	140	2	42

Total energy consumptions /day:

105.6 + 276.8 + 242.2+ 120 + 450 + 420 + 46.4 + 300 + 37.5 + 27.3+ 6 + 108.8 + 22.27+ 42

2204.87 KWh

Monthly energy consumption in KWh: = 2204.87 × 31 = 68350.97 KWh

Total electricity bill in Rs:

Fixed charge = 10 Rs × 342 room = 3420 Rs

Energy charge = 68350.97 × 3.6 = 246063.49 Rs

Fuel charge = 68350.97 × 1.18 = 80654.14 Rs

Electricity charge @ 15% = 50546.64 Rs

Meter charge = 20 × 342 = 6840 Rs

Total electricity bill = 3420 + 246063.49 + 80654.14 + 50546.64 + 6840 = 387524.27 Rs

Total saving in green building Rs.:

Total saving = 387524.27 − 326779.29 = 60744.98 Rs

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VII. MATERIAL CONSERVATION

A.Suggestion for reducing wastage:

- Strict supervision and control of materials.
- Creating an awareness of consequence of waste
- Correct material planning and ordering.
- Intensifying security.
- Effective site management.
- Introducing incentive schemes.
- Improving material quality
- Improving storage facilities.
- Good line of communication between top management and workers.

VIII. CONCLUSION

Green building reduces energy consumptions in numerous ways. Decrease embodies energy of the building through efficient design, use of recycled and local materials and recycling construction waste. Green building design reduces energy consumption over its lifetime. Strategically placing windows and skylight can eliminate the need for electrical lighting during the day. High quality insulation reduces temperature regulation costs in both summer and winter. Green building consumes less water as compared to conventional building.

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Solar photovoltaic system http:// www.prosuindia.com/solarpv module.pdf