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Planning and Designing of Green Building

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ABSTRACT: Infrastructure Industry is experiencing a rapid growth in India. India is a country where infrastructure is main hurdle for the growth of Indian businesses. In 2010 budget, the total allocation for infrastructure is 1,73,552 corers, which is 46% of total allocation. Allocations for the scheme increased by 71% from Rs 76,000 crore ($9.2 billion) in the revised estimates for 2022-23 to Rs 1,30,000 crore ($15.8 billion) in the budget estimates for 2023-24. In today's scenario. The greenhouse gas emissions from these buildings are contributing mainly for Global Warming, Acid Rain etc.… Our demand on natural and finite resources such as energy, water and building materials can be reduced and our contribution to environmental quality can also be enhanced by incorporating green building principle into the design, construction, and renovation. Green buildings are designed and constructed to maximize the whole lifecycle performance, conserve resources, and enhance the comfort of occupants. This is achieved using renewable energy sources such as utilization of solar energy systems and by attention to natural elements such as maximizing natural lights and building orientation.

KEYWORDS: Green Building, sustainable energy, renewableenergy, solar energy.

I. INTRODUCTION

As per Indian Green Building Council (IGBC), Green building is defined as " 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." It is also known as "Green Construction" or "Sustainable Building."

It is a practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

The main objective of designing green building is to reduce the overall impact of the built environment on human health and natural environment by: -

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

The built environment has a vast impact on the natural environment, human health, and the economy. By adopting green building strategies, we can maximize both economic and environmental performance.

The objective of green building concept is to develop buildings which use the natural resources to the minimal at the time of construction as well as operation. Green buildings emphasize on the resource usage efficiency and press upon the three R's – Reduce, Reuse and Recycle.

The technique of green building maximizes the use of efficient construction materials and practices; boosts the use of natural sources and sinks in the building's surroundings; minimizes the energy usage to run itself; uses highly proficient equipment for the indoor area; uses highly proficient methods for water and waste management.

The term green building, which is otherwise known as sustainable design, is a construction practice that focuses on increasing the overall efficiency of the building itself. Goals include optimizing the way the building uses water, energy and internal materials while reducing the building's impact on the local environment and human health. Such goals are planned over the long-term in order to provide individuals with a better building usage experience over the life of the structure. Green building projects may also extend past the individual building in order to encompass a bigger scope. Site planning, community management and land-use configuration are all concepts that may benefit from green building solutions.

Why is it Important?

In recent years, more and more professionals have been focusing on energy efficiency in a variety of industries. Studies show that the development and long-term growth of larger communities has had a major impact on the surrounding natural environment. As such, experts are beginning to focus on the design, construction and large-scale manufacturing of green buildings that could provide individuals with a more responsible way to consume natural resources. Not only does the widespread functionality of green buildings improve the local environment, but those working and living inside the buildings can enjoy healthier atmospheres, free of unnecessary pollution and waste.

With greener buildings, planners can enhance and protect the local ecosystems and encourage biodiversity in the environment. This is vital for many species, which may be harmed by the larger presence of humans in the area. Greener building practices can also help improve the quality of water and air in the local area while conserving and restoring natural resources.

General Economic Benefits

Greener practices can also be highly beneficial for business owners. Some economic benefits include overall reduced operating costs and an improved occupant productivity level. Studies show that greener buildings can help enhance asset values while optimizing the life-cycle of the company's economic performance. Such practices extend into the long-term of the business to drive future profits and employee satisfaction.

II. METHODOLOGY

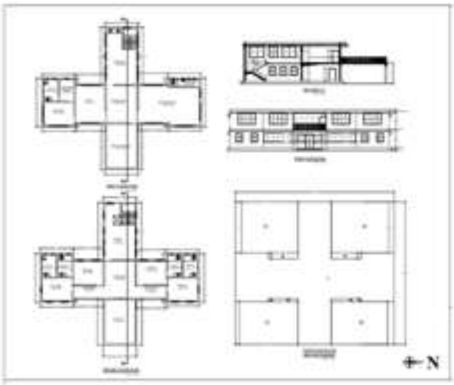
III. LOCATION AND LOCALITY

The project we are working on is in Murbad, Kalyan, Thane (Maharashtra)
https://goo.gl/maps/pvUJLiSxz1s3tdnU6

The locality is a rural area with a nearest transportation of bus-stand followed by ricksha stand.

As it is rural area there are some small fish and vegetable vendors. The restaurants in the nearby area have a decent ambience and hospitality.

The building is inside a big campus with a mesmerizing view of greenery and a an in-campus garden with a seating arrangement with a shed. The garden is very well, maintained and campus have a lot of trees planted which makes the cross ventilation of the building great which saves the overall energy of the building.



GOVERNMENT REST HOUSE and FLOOR PLAN

IV. EXPERIMENTATION

BUILT UP AREA CALCULATION	
FOR TYPICAL FLOOR	
26.55 X 23.75 X 1NO =	630.56 SQ.MT.
TOTAL ADDITION	= 630.56 SQ.MT.
DEDUCTIONS	
1 10.50 X 8.50 X 1NO =	89.25 SQ.MT.
2 10.50 X 8.50 X 1NO =	89.25 SQ.MT.
3 5.00 X 1.00 X 1NO =	5.00 SQ.MT.
4 5.00 X 1.00 X 1NO =	5.00 SQ.MT.
5 5.00 X 0.45 X 1NO =	2.25 SQ.MT.
6 5.00 X 0.45 X 1NO =	2.25 SQ.MT.
7 10.50 X 7.15 X 1NO =	75.07 SQ.MT.
8 10.50 X 7.15 X 1NO =	75.07 SQ.MT.
TOTAL DEDUCTION	= 343.14 SQ.MT.
TOTAL BUILT UP AREA	= 287.42 SQ.MT.

BUILT UP AREA SUMMARY				
FLOOR	COMM. AREA	RESI. AREA	excess. balc.	TOTAL AREA
GR. FLOOR	----	287.42	---	287.42
1 ST FLOOR	---	287.42	---	287.42
TOTAL	----	574.84	---	574.84
TOTAL RESIDENTIAL AREA =	574.84 SQ.MT.			

WIDTH OF WALL
FIRST FLOOR = 0.23M
GROUND FLOOR = 0.23M

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SCHEDULE OF DOORS & WINDOW

SCHEDULE OF DOORS & WINDOW		
TYPE	SIZE	DESCRIPTION
ED	2.00 x 2.40	T.W. PANELLED DOOR
D	1.20 x 2.40	T.W. PANELLED DOOR
D1	1.05 x 2.10	T.W. PANELLED DOOR
D2	0.75 x 1.85	—— WITH VENTILATOR
W	3.00 x 1.90	ALU. SLIDING WINDOWS
W1	2.40 x 1.90	
W2	1.50 x 1.90	
W3	1.20 x 1.50	
V	0.60 x 0.75	ALU. LOUVERED VENTILATOR

Type	Size (HxW)	Description
W	1.57 X.98 1	Double glazed glass
W1	1.90 X 2.40	Double glazed glass
W2	1.90 X 3.00	Double glazed glass
W3	1.37 X 1.72	Double glazed glass
W4	1.50 X 1.20	Double glazed glass

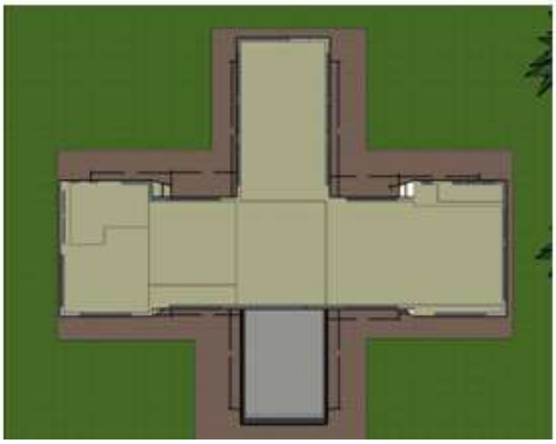
Green Building Window Schedule

MODELLING SOFTWARE

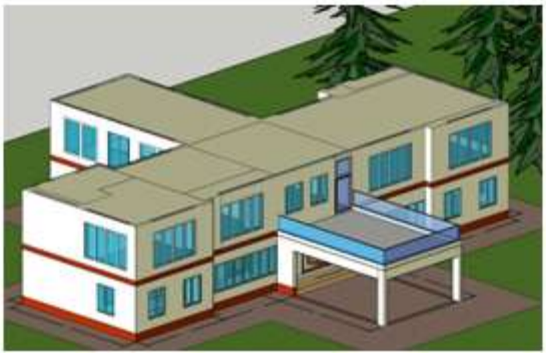
SketchUp is a suite of subscription products that include SketchUp Pro Desktop, a 3D modelling Computer-Aided Design (CAD) program for a broad range of drawing and design applications — including architectural, interior design, industrial and product design, landscape architecture, civil and mechanical engineering, theatre, film, and video game development.

SketchUp was developed by startup company @Last Software of Boulder, Colorado, co-founded in 1999 by Brad Schell and Joe Esch. SketchUp was created in August 2000 as a 3D content creation tool and was envisioned as a software program for design professionals. The program won a Community Choice Award at its first tradeshow in 2000. The first macOS release of SketchUp won a "Best of Show" at Macworld in 2002.

Front View in Sketch Up of Existing Building



Top View in SketchUp of Existing Building



3D Isometric View in SketchUp of Existing Building

SIMULATION SOFTWARE: - E-QUEST
The Quick Energy Simulation.

Imagine a building energy simulation tool comprehensive enough to be useful to all design team members, yet so intuitive any design team member could use it, in any or all design phases, including schematic design. E-QUEST is well named because it provides something that you have been looking for, but have been unable to find a sophisticated, yet easy-to-use building energy analysis tool. With E-QUEST, you will be able to provide professional-level results in an affordable level of effort.

Evaluate today's building technologies at the speed of today's design process E-QUEST was designed to allow you to perform detailed analysis of today's state-of-the-art building design technologies using today's most sophisticated building energy use simulation techniques but without requiring extensive experience in the "art" of building performance modelling.

E-QUEST = enhanced DOE-2+ Wizards + Graphics

This is accomplished by combining a building creation wizard, an energy efficiency measure (EEM) wizard, and graphical reporting with a simulation "engine" derived from the latest version of DOE-2. Reliable detailed simulation has never been easier!

E-QUEST was initially supported as a part of the Energy Design Resources program which was funded by California utility customers and administered by Pacific Gas and Electric Company, San Diego Gas & Electric, and Southern California Edison, under the auspices of the California Public Utilities Commission.

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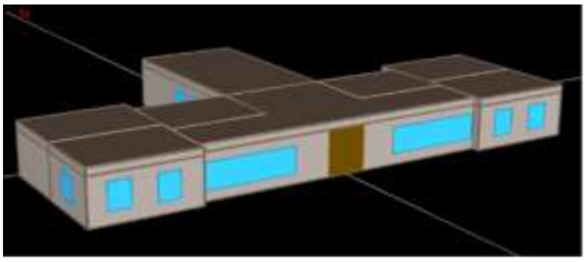
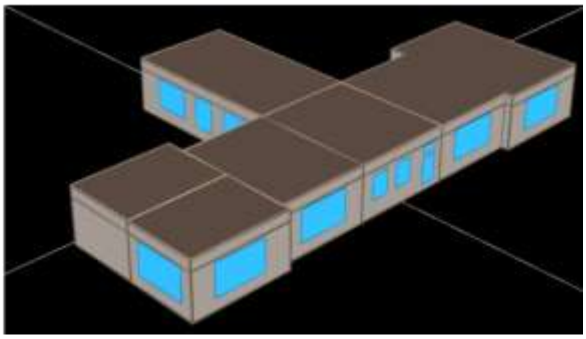


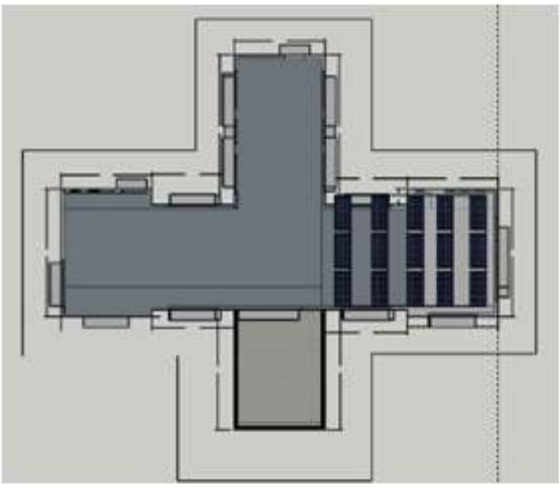


3D Isometric Views of Ground and First floors in -quest of Existing Building

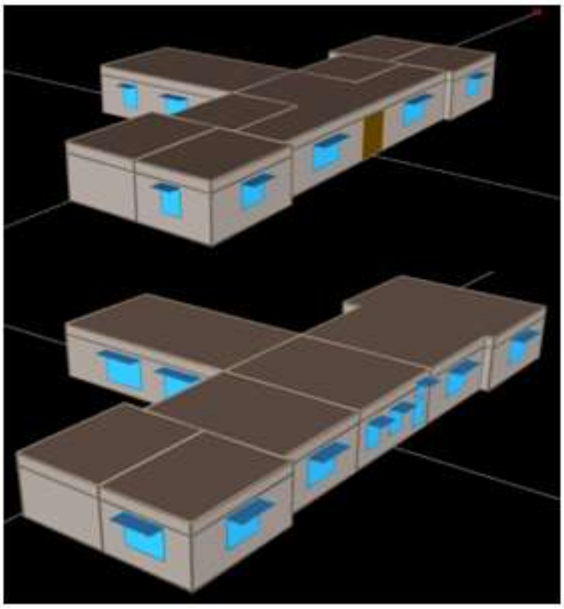
GREEN BUILDING MODEL IN SKETCHUP

3D Isometric Views of Ground and First floors in SketchUp of Green Building

Front View in SketchUp of Green Building



Top View in SketchUp of green Building



3D Isometric Views of Ground and First floors in E-quest of Green Building

V. CALCULATIONS

Location: Murbad
Longitude: 19˚2'N
Latitude: 73˚3'

1. **Average Sunshine hours per day of Murbad=10.5hrs**

$\delta=23.45\sin(\frac{360}{365}+(284+n))$ (1)

Where n=average no. of days in month of whole year

2. **Day Length**

$t_d=\frac{2}{15}\cos^{-1}(\tan\delta\times\tan\delta)$ (2)

3. **Sunrise Hour angle**

$\omega_s=\cos^{-1}(-\tan\Phi\times\tan\delta)$ (3)

4. **Solar Irradiance**

$H_o=\frac{12}{\pi}\times I_{sc}(1+0.033\cos\frac{360n}{365})$
$\times(\omega_s\times\sin\Phi\times\sin\delta+\cos\Phi\times\cos\delta\times\sin\omega_s)$ (4)

5. **Day Length**

$Smax=\frac{2}{15}\omega s$ (5)

6. **Average Daily Global Radiation**

$H_g=H_o(a+b\times(S/S_{max}))$ (6)

7. **Solar Panel Calculations**

- 1 solar panel capacity = 540w/hr

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- Daily Consumption= 30KW = 30000W
- AC load=12kw
- Other Equipment's=18kw
- Sun available with bright sunlight is 5hours
- Production Ratio of a solar panel is 1.4
- Average usage per year is 30×365=10950kw
- Therefore, total solar panels required = 10950÷1.4÷540=14.48=15solar panels

8. Payback Period of solar panels:

- Our 30kw plant costs Rs 11 lakh
- Average yearly consumption of each kw is 4units of power each day.
- This output can increase in summer and can decrease in winter.
- Assuming the per unit rate of electricity is Rs 7/unit
- Per day unit generation will be: 30kw×4= 120units
- Per year: 120×365= 43800units
- So yearly savings are: 43800units×Rs7/unit=Rs 306600
- So, the payback period can be calculated Rs 11,00000÷Rs 306600=3.6 years

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
n	15	46	74	105	135	166	196	227	258	288	319	349
δ	-21.2˚	-13.9˚	-2.8˚	9.4˚	18.8˚	23.3˚	21.5˚	13.7˚	2.21˚	-9.6˚	-19.14˚	-23.33˚

Average Sunshine hours per day of Murbad=10.5hrs According to Kleen's recommend

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
N	15	46	74	105	135	166	196	227	258	288	319	349
td	10.33	11.37	11.87	12.43	12.89	13.13	13.09	12.64	12.10	11.55	11.08	10.86

Day Length

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
N	15	46	74	105	135	166	196	227	258	288	319	349
ωs (degree Celsius)	82.30	85.30	89.03	93.27	96.72	98.53	97.79	94.81	90.76	86.66	83.03	81.45

Sunrise Hour Angle

Month	January	February	March	April	May	June
N	15	46	74	105	135	166
H_o(KJ/m^2/day)	38439.24	37887.71	37928.96	37298.36	36690.70	36308.66

Month	July	August	September	October	November	December
N	15	46	74	105	135	166
Ho (KJ/m2 /day)	36297.01	36662.68	37274.69	37850.89	38233.16	38401.40

Solar Irradiance

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
n	15	46	74	105	135	166	196	227	258	288	319	349
Smax	10.97	11.37	11.87	12.43	12.89	13.13	13.03	12.64	12.10	11.55	11.07	10.86

Day length

Month	January	February	March	April	May	June
n	15	46	74	105	135	166
H_g(KJ/m^2/day)	29213.43	27490.08	26856.06	25740.66	24823.57	24321.82
Month	July	August	September	October	November	December
n	15	46	74	105	135	166
H_g(KJ/m^2/day)	24414.26	25090.42	26110.76	27218.23	28171.31	28612.22

Average Daily Global Radiation

9. Calculation of shading of Green Building

- δ Horizontal Shadow Angle=Solar Azimuth Wall−Wall Azimuth

205.3−90=115.3˚

- ○ Vertical Shadow Angle(E)
- ○ TanE=tanα×secα(Inverse)
- Incident angle(β) cosβ=cosα×cosδ

=cos46.77×cos115.30=107.02˚

- Vertical Shadow Angle(E)
- ○ TanE=tanα+secα=68.11
- ○ Projection level=1.37+0.11=1.48
- ○ Tan68.11=1.48÷X
- ○ X=0.6m
- ○ Projection Level=1.5+0.11=1.61
- ○ Tan68.11=1.64÷X
- ○ X=0.64m
- ○ Projection Level=1.9+0.11=2.01
- ○ Tan68.11=2.01÷X
- ○ X=0.7m

Sun calc path of sun

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10. Solar Rooftop Calculator

Solar Roof Top Calculation

11. Heat Load Calculations of Conventional Building

FACTORS	VVIP BED (Ground Floor)	VIP BED 1	ROOM1	ROOM2
Effective room sensible heat load (BTU/HR)	5536.91	5487.32	5197.84	5638.53
Outside air (CFM)	71.23	71.97	69.65	74.6
Sensible Heat (Qs)	334.63	334.13	327.13	360.47
Internal Heat=Number of people × sensible heat gain (BTU/HR)	1225	1225	1225	1225
Light Load (BTU/HR)	2150.57	2201.57	2061.57	2358.85
Equipment Load=No. of equipment× Load× Equipment Load (BTU/HR)	5715.4	5661	6065.6	6065.2
Total (BTU/HR)	14163.7	14004.15	10935.68	14623.71
Effective Room Sensible Heat Load (BTU/HR)	15296.79	14768.64	38961.55	15793.60
Q_L (Heat Load) (BTU/HR)	181.67	183.52	327.46	190.23
Latent Heat Internal Load (BTU/HR)	1025	1025	1025	1025
Total (BTU/HR)	1206.63	1208.52	1352.21	1215.23
Effective Room Latent Heat Load with 8 %t safety factor (BTU/HR)	1303.16	1305.20	1460.38	1312.44
Effective Room Total Heat Load (TR)	1.38	1.36	1.03	1.42
Effective Room Sensible Heat Factor	0.92	0.92	0.88	0.92
Dehumidified (C.F.M.)	880.31	802.07	579.93	837.55

FACTORS	DINING HALL	HALL	MEETING HALL	VVIP BED
Effective room sensible heat load (BTU/HR)	4065.422	6089.9	11007.42	3120.458
Outside air (CFM)	114	112.13	231.94	70.65
Sensible Heat (Qs)	480.7	526.79	1089.68	331.94
Internal Heat=Number of people × sensible heat gain (BTU/HR)	1225	1225	1225	980
Light Load (BTU/HR)	3445.71	5343.01	5275.85	2118.85
Equipment Load=No. of equipment× Load× Equipment Load (BTU/HR)	5715.4	5943.2	2672.4	3923.6
Total (BTU/HR)	14163.7	18448.04	32296.6	10474.7894
Effective Room Sensible Heat Load (BTU/HR)	15296.79	19923.88	34875.128	11311.92
QL (Heat Load) (BTU/HR)	181.67	285.9315	591.44	180.15
Latent Heat Internal Load (BTU/HR)	1025	1025	1025	820
Total (BTU/HR)	1206.63	1310.93	10841.44	1000.15
Effective Room Latent Heat Load with 8percent safety factor (BTU/HR)	1303.16	1415.80	11708.8	1080.16
Effective Room Total Heat Load (TR)	1.38	1.78	3.90	1.03
Effective Room Sensible Heat Factor	0.92	0.93	0.75	0.891
Dehumidified (C.F.M.)	880.31	1056.59	1849.63	600

Heat Load Calculations of Green Building

FACTORS	Dining Hall	Hall	Meeting Hall	VVIP bed (1st Floor)
Effective room sensible heat load (BTU/HR)	4065.422	4189.243	7151.17	3120.458
Outside air (CFM)	114	57.18	231.94cfm	70.65
Sensible Heat (Qs)	480.7	240.85	976.93	331.94
Internal Heat=Number of people × sensible heat gain (BTU/HR)	1225	1225	9800	980
Light Load (BTU/HR)	3445.71	3385.23	5275	2118.85
Equipment Load=No. of equipment× Load× Equipment Load (BTU/HR)	2890	5920.4	12872.4	3923.6

Total (BTU/HR)	12106.83	13674.7	36075.5083	10474.7894
Effective Room Sensible Heat Load (BTU/HR)	13075.37	14768.64	38961.55	11311.92
QL (Heat Load) (BTU/HR)	290	145.80	591.44	180.15
Latent Heat Internal Load (BTU/HR)	2050	1025	8200	820
Total (BTU/HR)	2340	1170.8	8791.44	1000.15
Effective Room Latent Heat Load with 8percent safety factor (BTU/HR)	2527.2	1171.46	9494.75	1080.16
Effective Room Total Heat Load (TR)	1.2	1.26	4.01	1.02
Effective Room Sensible Heat Factor	0.83	0.92	0.8	0.891
Dehumidified (C.F.M.)	827.42	845.32	2066.18	600

FACTORS	VVIP BED	VIP BED 1	ROOM 2	ROOM 1
Effective room sensible heat load (BTU/HR)	3094.51	2991.09	3007.906	2931.775
Outside air (CFM)	69.60cfm	71.94cfm	74.6cfm	69.53cfm
Sensible Heat (Qs)	294.14	303.03	350.47	292.86
Internal Heat=Number of people × sensible heat gain (BTU/HR)	1225	735	980	980
Light Load (BTU/HR)	2101	2172.21	2358.85	2099.24
Equipment Load=No. of equipment× Load× Equipment Load (BTU/HR)	4049	3961	4365.6	4141.2
Total (BTU/HR)	10763.65	10162.33	11062.76	10445.07
Effective Room Sensible Heat Load (BTU/HR)	11624.74	10975.31	11947.78	11280.67
Q_L (Heat Load) (BTU/HR)	177.48B	183.44	190.23	177.30
Latent Heat Internal Load (BTU/HR)	1025	615	820	820
Total (BTU/HR)	1202.48	798.44	1010.23	997.30
Effective Room Latent Heat Load with 8percent safety factor (BTU/HR)	1298.67	862.31	1091.04	1077.08
Effective Room Total Heat Load (TR)	1.02	0.91	1.06	0.97
Effective Room Sensible Heat Factor	0.89	0.92	0.92	0.91
Dehumidified (C.F.M.)	685.33	627.76	692	598.22

VI. SELECTION OF MATERIAL FOR GREEN BUILDING

The most innovative invention in the concrete family and composite materials is ferrocement, which can conserve resources, save energy, protect the environment, and reduce human efforts. The modern ferrocement system for green housing has demonstrated high standards of energy efficiency in housing construction. The ferrocement technique can create extremely energy-efficient homes. It is seen that with thermal insulation installed as part of the construction panels, high levels of thermal performance are achieved, resulting in a reduction in CO2 emissions. In developing countries where there is a high demand for housing, ferrocement can be an effective and low-cost alternative construction material. Ferrocement is long-lasting and cost-effective due to locally available materials and the availability of cheap labour in developing countries. The primary goal of our project is to propose a low-cost house using ferrocement technology, which will reduce the cost of housing projects to the point where they are affordable to people living in slums and will aid in the removal of slum areas from urban development.

Constituent Materials for Ferrocement

1. Cement
2. Fine Aggregate
3. Water
4. Admixture
5. Mortar Mix
6. Reinforcing mesh
7. Skeletal Steel
8. Coating

Process of Ferrocement Construction

- Fabricating the skeletal framing system.
- Applying rods and meshes.
- Plastering.
- Curing

Mechanical properties

Tensile Strength: In tension, the load carrying capacity is essentially independent of specimen thickness because the matrix cracks before failure and does not contribute directly to composite strength. The tensile strength of ferrocement is directly Proportional to the number of layers of the wire mesh.

Compressive strength: The results from laboratory studies on the compressive strength of mortar containing silica fume and fly ash reveal that compressive strength ranging between 89.42MPa and 49.43MPa depend upon the mix ratio, water binder ratio, replacement level and dosage of superplasticizer. The mortar 1:2, water binder ratio 0.35 with 5%silica fume,20%fly ash and 0.2% to 0.6% superplasticizer could be considered as suitable mortar for casting of thin ferrocement laminates.

Bending (Flexure): The results from experimental study on flexural behaviour of ferrocement reinforced with chicken mesh reveal that based on load carrying capacity, deflection and crack width, the partial replacement of cement by 5% silica fume and 20% fly ash with volume fraction 2.823% and 3.770% can successfully produce mixes of adequate early strength and increased long strength development coupled with excellent flow characteristics.

Impact Resistance: The experimental results on impact strength indicated that Ferrocement laminate with addition of fly ash and silica fume to the matrix distribute the stresses over large area resulting increase in energy absorption capacity due to impact. It can be very effective in preventing the spalling of the mortar cover at failure and can lead to comparable results in terms of impact strength.

Properties of Wire mesh

Wire mesh type	Properties	Values
	Average diameter	1.2 mm
	opening size of mesh	12.5 mm × 12.5 mm
	yield strength in tension	410 N/mm²
Welded wire mesh	modules of elasticity	10000 N/mm²

Table 1: Properties of Wire mesh.

Series*	Number of layers of wire mesh		Total volume fraction of reinforcement in longitudinal direction vf, percent	Water-cement ratio	Cube compressive strength of mortar, fcu
	Top	Bottom			N/mm²
A	2	2	0.482	0.5	34.42
B	3	3	0.823	0.5	34.42
C	4	4	0.965	0.5	35.56
D	5	5	1.206	0.5	35.56
E	5	5	1.206	0.45	44.33
F	5	5	1.206	0.55	24.13
G	2	5	0.844	0.5	35.63
H	0	5	0.603	0.5	35.63

Material Properties

VII. RESULTS: -

ENERGYSIMULATION OF CONVENTIONAL (Existing) BUILDING

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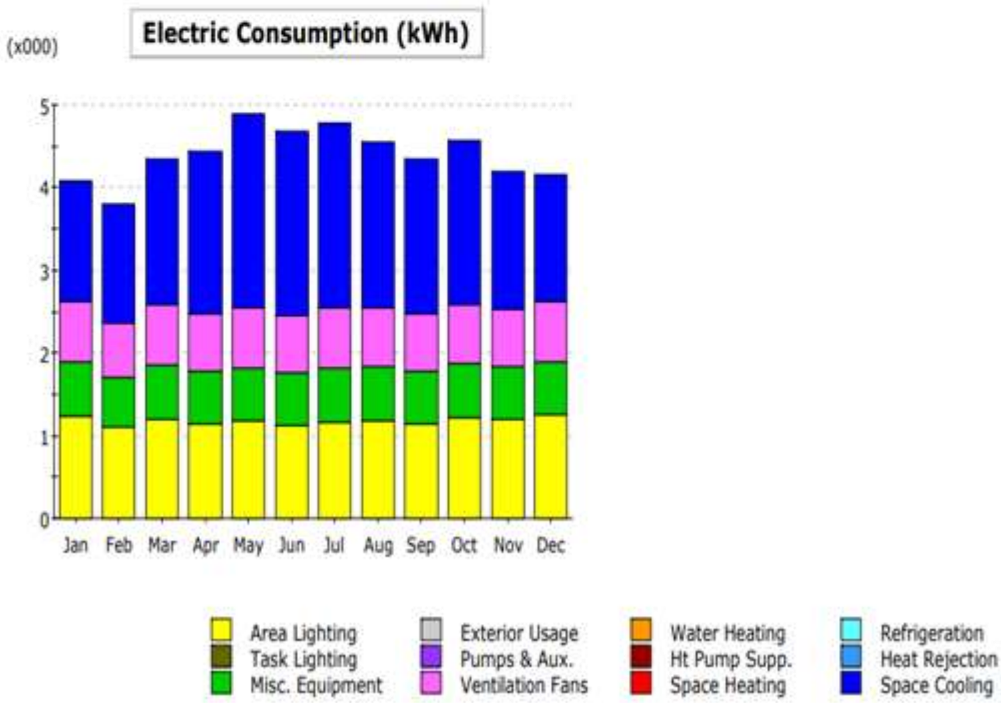

Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	1.47	1.45	1.76	1.97	2.34	2.21	2.22	2.00	1.87	1.99	1.65	1.53	22.46
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	0.72	0.65	0.72	0.70	0.72	0.70	0.72	0.72	0.70	0.72	0.70	0.72	8.53
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.65	0.59	0.65	0.63	0.65	0.63	0.65	0.65	0.63	0.65	0.63	0.65	7.70
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	1.24	1.11	1.21	1.15	1.17	1.13	1.17	1.17	1.14	1.21	1.20	1.25	14.14
Total	4.09	3.81	4.34	4.45	4.89	4.68	4.77	4.55	4.34	4.58	4.19	4.16	52.83

Result (Ground floor)

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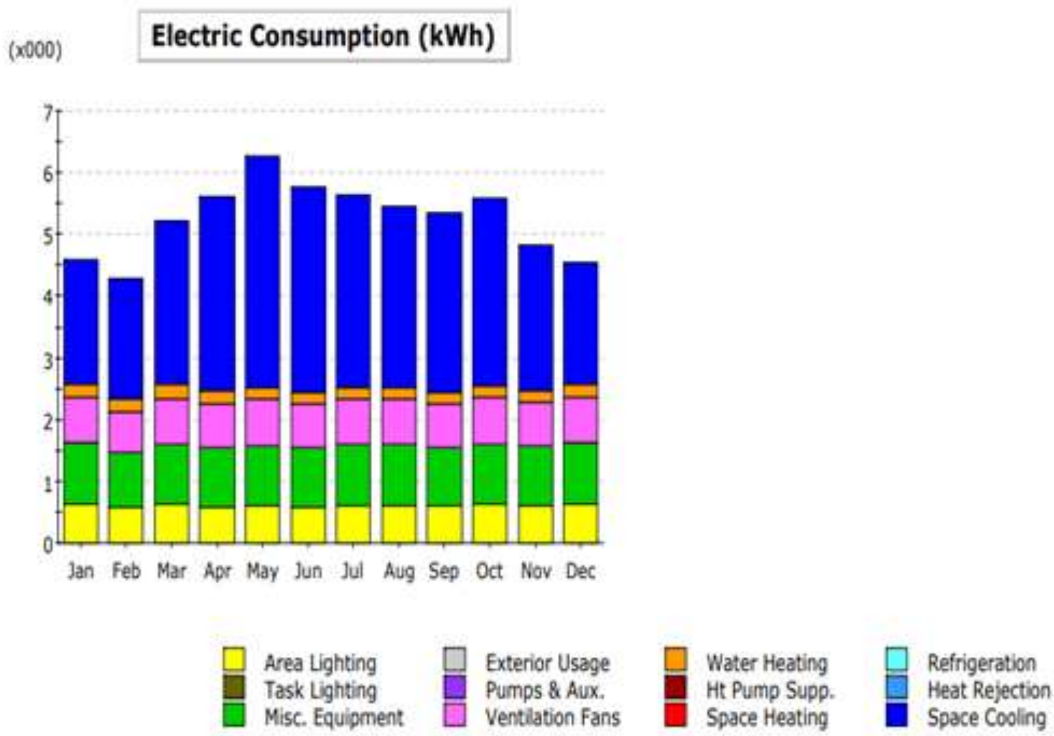

Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	2.01	1.96	2.65	3.15	3.74	3.32	3.12	2.94	2.90	3.06	2.35	1.96	33.17
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.22	0.20	0.22	0.21	0.20	0.19	0.19	0.18	0.18	0.19	0.19	0.21	2.36
Vent. Fans	0.74	0.67	0.74	0.72	0.74	0.72	0.74	0.74	0.72	0.74	0.72	0.74	8.71
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.98	0.89	0.98	0.95	0.98	0.95	0.98	0.98	0.95	0.98	0.95	0.98	11.57
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.64	0.57	0.62	0.59	0.60	0.59	0.61	0.61	0.59	0.63	0.61	0.64	7.30
Total	4.59	4.29	5.21	5.61	6.27	5.76	5.64	5.46	5.34	5.59	4.82	4.53	63.11

Result (First Floor)

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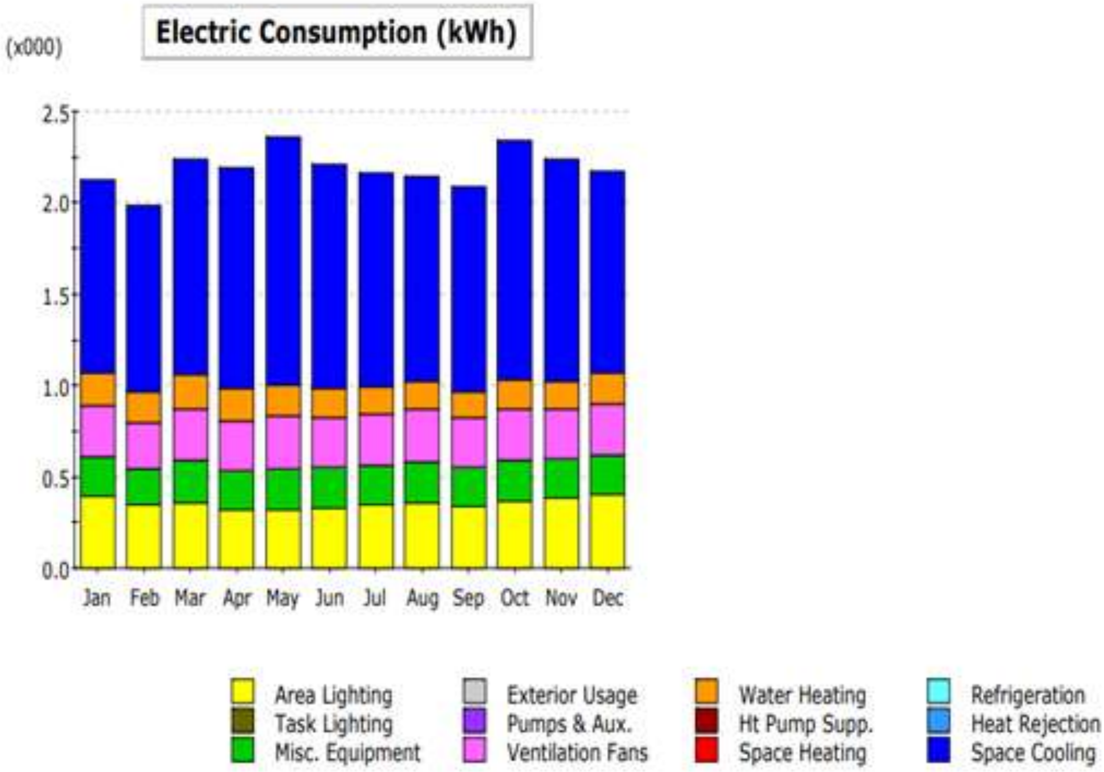
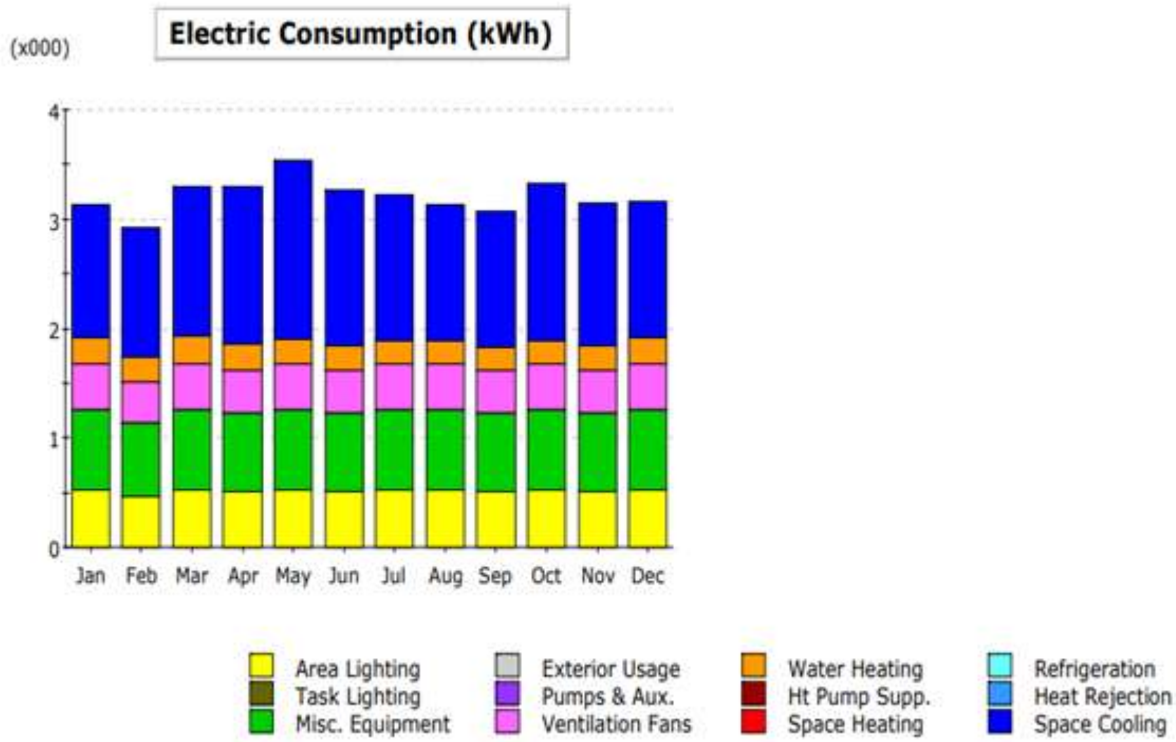
ENERGYSIMULATION OF GREEN BUILDING



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	1.06	1.02	1.18	1.21	1.36	1.23	1.16	1.13	1.12	1.31	1.22	1.10	14.12
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.18	0.16	0.18	0.17	0.17	0.16	0.15	0.15	0.14	0.15	0.15	0.17	1.95
Vent. Fans	0.28	0.26	0.29	0.27	0.28	0.28	0.28	0.29	0.27	0.28	0.27	0.28	3.34
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.22	0.20	0.23	0.21	0.22	0.22	0.22	0.23	0.21	0.22	0.21	0.22	2.60
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.39	0.34	0.36	0.32	0.32	0.33	0.34	0.35	0.34	0.37	0.38	0.40	4.26
Total	2.13	1.98	2.24	2.19	2.36	2.21	2.16	2.15	2.09	2.34	2.24	2.17	26.27

GB Result (Ground Floor)



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	1.21	1.19	1.37	1.43	1.63	1.43	1.33	1.24	1.24	1.43	1.31	1.25	16.08
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.24	0.22	0.25	0.24	0.23	0.21	0.21	0.21	0.20	0.21	0.21	0.23	2.67
Vent. Fans	0.42	0.37	0.42	0.40	0.42	0.40	0.42	0.42	0.40	0.42	0.40	0.42	4.89
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	0.74	0.67	0.74	0.72	0.74	0.72	0.74	0.74	0.72	0.74	0.72	0.74	8.73
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	0.52	0.47	0.52	0.51	0.52	0.51	0.52	0.52	0.51	0.52	0.51	0.52	6.15
Total	3.13	2.93	3.30	3.29	3.54	3.27	3.22	3.13	3.07	3.32	3.15	3.17	38.51

GB Result (First Floor)

We analytically calculated the heat load of the building and the heat load of conventional building is 18.23 TR and after applying the green building methods we reduced the heat load to 11.45TR. The results showed the reduction of 37.19 □. Also, we calculated the KW of the building with the help of E-Quest Software. The software helped us to analyze the calculate the energy consumption and the energy consumption of conventional building is 115.94KW(Figure22&23) and after applying the green building techniques we gained 64.87KW(Figure20&21). So, calculating with the help of software we got energy saving of 44□ .

VIII. CONCLUSION

As an important development direction of the modern construction industry and from the perspective of reducing building energy consumption and maintaining the sustainable development of the ecological environment, we studied the energy-saving design method of green buildings based on E-quest software. This report systematically expounded the design principles and

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design concepts of green buildings and gave the overall scheme of energy saving design of green buildings. we deeply studied the energy saving design elements of green buildings, which should be considered from the aspects of modelling software selection, envelope energy saving design, and lighting energy-saving design and put forward the energy-saving analysis method of green buildings based on Sketch-up and E-quest software. In addition, this report also put forward the energy saving effect evaluation method of green buildings based on E-quest from the aspects of the design of energy-saving and the energy saving effect evaluation model of green buildings. We got the energy saving of 30□ . An example further verified that the energy saving design method proposed in this paper had certain guiding significance for the field of green buildings. The energy saving design of green buildings based on E-quest software proposed in this report can not only provide a reference for the in-depth research of E-quest software but also provide technical support for the wide application in the field of green buildings.

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