Analysis and design of Eco-friendly and resource efficient G+1 bungalow using ETABS

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Abstract - **As we know, seeing today's depleting environmental conditions, global warming, water shortage, depletion of non renewable fossil fuels and other increasing difficulties it is very much the need of the hour that we as Civil Engineers should start using renewable and green resources in our construction field for residential buildings, bridges, industries etc. So by this project we are practically implementing these techniques while designing the G+1 bungalow so that it sets an example for other fresh engineers like us in using green resources and eco friendly methods of Construction.**

keywords - **ETABS Software, G+1 Bungalow, Solar Panels, Photovoltaic Cell, Green Energy, Eco-Friendly, Power Consumption, Capacity of Solar Panels, Floor Plans, Design Drawings, Approximate Estimate, Economic, etc.**

I. INTRODUCTION

By implementing green concepts in residential buildings we have made an attempt to use renewable resources more sensibly in order to create an eco-friendly environment which will excel the living experience for residents, and minimize the ecological footprints of the building. We are using green building design which can easily implement in our country i.e India. The study presents hands on design and analysis of the residential building by keeping in mind various Principle such as orientation, waste and water conservation, position of sun, natural ventilation, construction waste management and application of solar heat in the building. As we know that construction of buildings leads to the global warming as they produce around 40 percent of all global co2 which results as India's position on 144 position in carbon emission (1.5 metric ton) in the world. Green building has ability to degrade the carbon footprint as there is less use of energy by 30-35 %, carbon dioxide emission around 30%, and waste around 70%.

II. METHODOLOGY

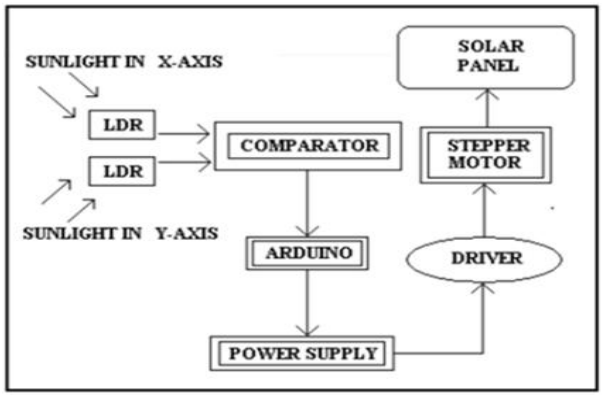
Following are the methods used in designing the green bungalow

1. **Effective window design** - In a building for good ventilation process area of windows should be 15% to 20% of the total floor area of building. They should be constructed mostly on the North-East side for the good solar access and minimal amount on west facades.
2. **Orientation of building -** As sun remains in south direction for maximum direction so to reduce electric load at day time we should place our longer sides of the building in longer direction. Most useable spaces of building i.e. master bedroom, living area and kitchen should place in East to south orientation as maximum UV rays can eliminate germs from these spaces.
3. **Water conservation -** In Urban areas consumption of water is increasing significantly which is causing decreasing of water table. Rain water harvest is one of the key factor in conservation of water according to the survey if we have one month of annual rainfall it can fulfill necessity of 6 days of water for daily purposes.
4. **Energy Conservation -** Solar Heat gain coefficient should be reduce for interior cooling purpose by using glass windows frames which can maintain building temperature. Energy- efficient luminaries of high light output with efficiency should be installed. South exposure to the building for solar heat gain coefficient is helpful in reducing heating effect during winter season.
5. **Lighting controls -** Sensor which can determine occupancy is used which can automatically off lights which is major factor for lighting control. Daylight sensors are used so that it can switch off internal lighting when daylight level is sufficient. Control on perimeter should be there so that it can be used when there is not adequate daylight. Luminance is a factor for clear view of any objects and lux is its SI unit.
6. **Reducing energy used for heating water -** This can be controlled by time control sensor which will work automatically as a requirement of water usage. Hot water thermostats is used which maintain temperature of water 550C to 600C for normal requirement as it can switch off electric heating elements when hot water from the boiler is available.

Design Details Of The Solar Panels With Solar Tracker

So we need a specific mechanism that moves the solar system and makes it follow the solar radiation falling from the sun on the surface of the earth, This mechanism is a solar tracker, a device that makes the payloads (photovoltaic panel, parabolic troughs, Fresnel reflectors, lenses or the mirrors of a heliostat) oriented toward the sunbeam to get most of the radiation energy

that falls on the surface of the panel or collector to increase the converted energy. To achieve maximum output power that produced by solar panels as the sun moving across the sky and keeps the panel perpendicular to the radiation sun. We will use Two-Axis Solar Tracking System with active tracking cause it the effective way to track the sun in elevation and azimuth angles.



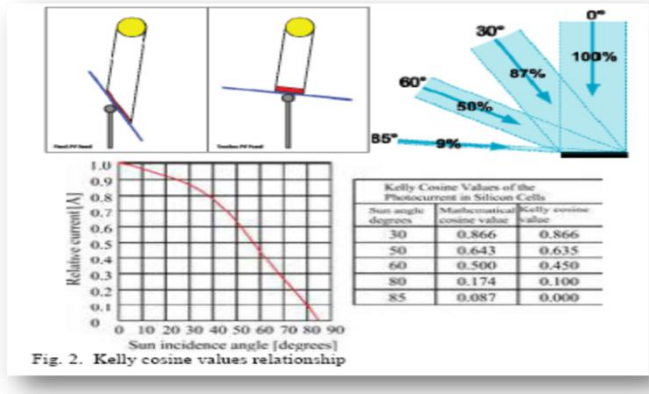


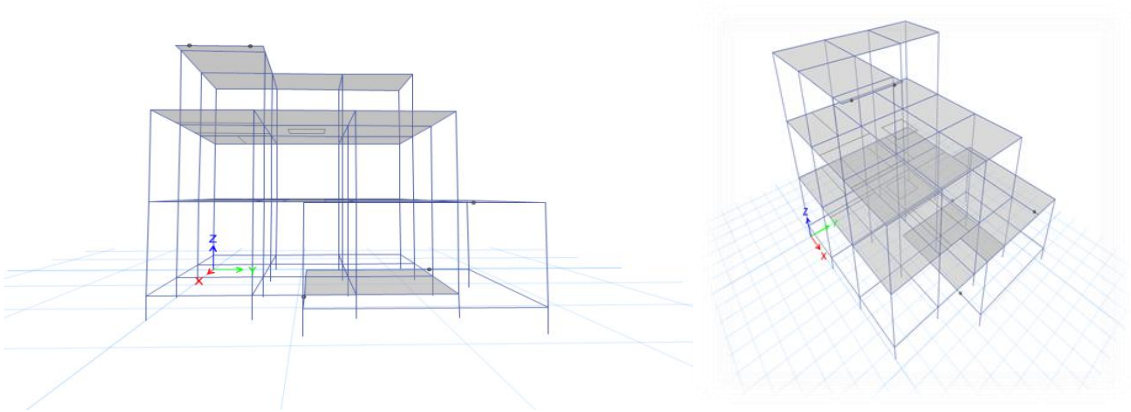
Fig. 2. Kelly cosine values relationship

Sr no	Item	Quantity of items	Wattage (Per unit quantity)	Operating hours (per day)	Power consumption (In watts per day)
1.	LED Bulbs / tubelights	60	60	8	480
2.	Compound lights	40	100	12	1,200
3.	Ceiling fans	30	40	15	600
4.	Refrigerator	2	1500	1.5	2,250
5.	Sewing machine	2	70	0.5	35
6.	Television	1	150	10	1500
7.	Water heater	3	3000	5	15,000
8.	Water pump	2	2000	0.5	1,000
9.	Kitchen appliances(all)	-	-	-	700
10.	Washing machine	2	2000	3	6,000
11.	Vacuum cleaner, Ironing machine etc	-	-	-	700
12.	CCTV Cameras	8	10	24	240
13.	Other Electronic items (P.C., mobile chargers, emergency torches etc)	-	-	-	600
14.	Gardening equipments and tools	-	-	-	600
15.	Garage equipments and tools	-	-	-	500
				TOTAL :-	31,405

So we round up to the higher decimal i.e 32,000 watts per day.
Therefore total power consumption for the bungalow = 32 kW / Day i.e 1.33 kWh
Since the solar panels also have the responsibility to charge the batteries which will be useful at nights when there is no active solar supply and also after considering unseen future bad weather conditions, inavailbailability of solar radiations during monsoons , we take 4 times our minimum power requirement and round it up i.e 5kW
Therefore , **Total power required = 5 kWh**

III. RESULTS AND DISCUSSION

The Following are the Structural design drawings in 3d view obtained from ETABS Software



Solar Panel Details

BRAND	TATA POWER SOLAR ROOFTOP PANEL
CAPACITY	5 KWH
ACCESSORIES INCLUDED	BATTERY
	INVERTOR
	SENSORS
	POWER MONITORING SYSTEM
WARRANTY	25 YRS PERFORMANCE WARRANTY
	5 YRS PANEL WARRANTY
TOTAL COST	RS. 3,88,000 /- (WITH 20% GOVT. SUBSIDY)

ETABS SOFTWARE RESULTS

Result from software for % Steel required for various structural members is in the range of **0.18% to 0.2%** and the Bungalow is found to be **Structurally Safe**

IV. CONCLUSION

By selecting and carrying out this project we will plan, design, prepare cost estimate and to execute the construction of the G+1 bungalow using ETABS software and also planning, designing, estimation and installation of the above mentioned green and eco-friendly devices and techniques to build an overall energy efficient Bungalow and its facilities to encourage and make use of green energy concepts in construction industry for a cleaner, greener environment and for our better future.

V . REFERENCES

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