GREEN BUILDING DESIGN AND ESTIMATION

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Abstract

This abstract delves into the fundamental principles of green building design, encompassing energy efficiency, sustainable materials, water conservation, and indoor air quality. It emphasizes the integration of renewable energy sources, advanced insulation techniques, and eco-friendly construction materials. Estimation in green building projects involves assessing the cost implications of implementing these sustainable features. It encompasses life-cycle cost analysis, considering initial expenses versus long-term savings. The future of green building technology is full of opportunities for us to some of the damage we have done to the planet and environment.

We can save energy, water and natural resources by making use of green building technology such as rain water harvesting system to save water and by installing solar panels on the roof we can reduce the energy consumption. So, here we are comparing the regular RC structure and integrated green building. Green building affords a high level of environment, economic, and engineering performance. This includes energy efficiency and conservation, improved indoor air quality, resource and material efficiency, and occupant's health and productivity.

We are going to follow the Codes and guidelines of "Green Building Council and Certificate Systems". key focuses of green building methods are be use of natural, recycled and sustainable buildings materials, effective design and use of water and power systems, reduction in pollution and waste.

1.0 INTRODUCTION

Green building design is a progressive and environmentally responsible approach to designing, constructing, and operating buildings. It places a strong emphasis on sustainability, energy efficiency, and minimizing environmental impact. The goal of green building design is to create structures that are not only eco-friendly but also promote health and well-being, while reducing resource consumption and operating costs. In this report, we will delve into the principles and practices of green building design and discuss the various elements that make it a sustainable and forward-thinking approach to construction.

Green building design, often referred to as sustainable or eco-friendly design, represents a significant shift in the construction industry's approach. Traditional building practices have historically focused primarily on aesthetics, cost, and functionality, often with little regard for the environmental impact. In contrast, green building design considers the full life cycle of a building, from construction to operation, and strives to minimize its negative environmental effects.

2.0 LITERATURE REVIEW

Lin Chen. "Sustainability considerations of Green Building Construction." December 2020

Sustainable building materials are crucial for environmentally conscious construction, and considering their social and environmental impacts is essential for a healthier future. By prioritizing

sustainability, we can create buildings that minimize harm to the environment and promote a better world for generations to come.

Shivaji, IIT Guwahati "Green building material and their common use in everyday life." January 2022

Green building materials and sustainable construction practices are crucial for reducing energy consumption and promoting environmental efficiency in the building industry. By adopting green building principles, we can create eco-friendly structures that minimize harm to the environment and promote a healthier future for generations to come.

Mridu Pavan Chakrabarty and Nitin Lekhwani "Green Building Materials Market Growth, Trend and Opportunity: South Asian Perspective" January 2023

Green buildings offer a promising solution to reduce energy consumption and operating costs while promoting occupant health. The market for green building materials is poised for significant growth, driven by increasing demand for sustainable construction practices. By adopting green building materials and technologies, we can mitigate environmental impacts and create a healthier and more sustainable built environment.

The main objective to concentrate in Green Building is that, green building has the potential to save 30%-40% energy with reduction of operating cost and enhance good health.

Bal Ramdas, Prakash Meher, Snehashish Behra, Bibik Rath, GIET Orissa "Comparison between normal building and green building- A case study approach." International Research Journal of Engineering and Technology, Issue: 05 May-2022

Sustainable building practices are crucial for reducing environmental impacts and promoting eco-friendly construction. Green buildings prioritize responsible waste management, local resource utilization, and renewable materials, paving the way for a healthier and more sustainable future.

3.0 METHODOLOGY

Green Techniques

Emphasis of four 'R's: Via sound designing, construction and building commissioning without compromising structural durability, indoor pollutant levels, ventilation, building code requirements, or marketability includes

Reduce: Lower quantity of building material, resources, and embodied energy are used.

Reuse: Construction materials that are practical and structurally sound is reused.

Recycle: Recycled materials are used, and home is designed for recyclables.

Renewable: Energy from natural sources and renewable building materials are emphasized.

The technique which emphasizes these four "**R**'s" is called as Green Techniques.

These Green techniques can be classified as follows:

- Structural or civil techniques.
- Electrical techniques
- Conservation techniques
- Generation Techniques
- Special systems/ techniques
- Solar panels
- Grey water treatment
- Rain water harvesting
- HVAC systems
- Net Zero Energy building

We are implementing the 5 techniques in the project they are:

1. Rain water harvesting
2. Solar panels
3. Wind tower
4. Grey water treatment
5. Energy efficient
6. Prevention of soil erosion

Rain water harvesting

- The topographical area of the site should be selected the lowest point of the area to construct the rain water harvesting tank.
- Trench is excavated to pass the water and pit for storage, in the storage pit the stone pitching is provided at sides to prevent the percolation, erosion.
- In the storage pit a pump is provided to lift the water to make contact with oxygen. This continuous movement of water helps to prevent the mosquito breeding, water contamination and algae formation.

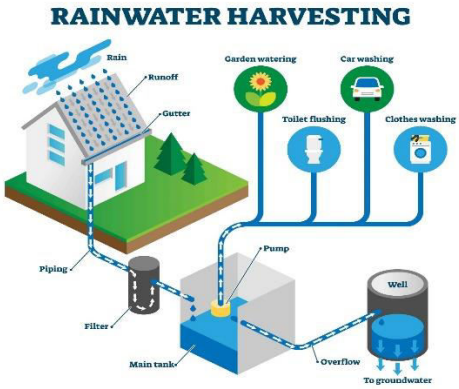

Fig: Rain water harvesting

Solar panels

- The 20% of the building energy requirements are provided by solar photovoltaics.
- This solar panels are installed above the 4m from the surface.
- They have an installed capacity of 23.5kW.
- These solar PV collects the solar energy from both sides and produces 22% of electricity which is 6% greater than normal solar panels.

Fig: Solar Panels

Wind Tower

- The indoor air quality is continuously monitored by BMS and a minimum fresh air is pumped into the conditioned spaces at all times.
- The fresh air was drawn into the building through wind towers, this building consists of 2 wind towers which constructed with clay bricks with small openings and sprinklers.
- Here the atmospheric temperature air and turns it into cool air.
- The use low volatile organic compound (VOC) paints these doesn't absorb heat which improve the indoor air quality.

Fig: Wind tower

Energy Efficient

- Energy efficiency can be maximized by utilizing materials components, and systems that help reduce energy consumption in buildings and facilities.
- To increase the efficiency of the building envelope, they may use high-efficiency windows and insulation in walls, ceilings, and floors.
- The use of aerated autoclave concrete blocks (AAC) for front or exterior walls which reduces the load on air-conditioning by 15-20%.

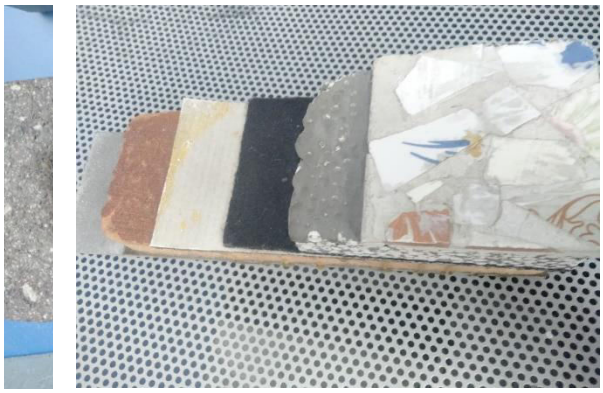

Fig: AAC Block

Prevention of Soil erosion

- The goal of this strategy is to reduce or eliminate runoff due to impervious (watertight) surfaces.
- Minimizing or eliminating impervious surfaces by designing driveways, walkways, and patios that allow storm water runoff to infiltrate into the ground minimizes the impact on aquatic systems.
- Uncompacted gravel, crushed stone and open or porous paving blocks can be used for Walkways and other light traffic areas.

Fig: Honey comb Grids

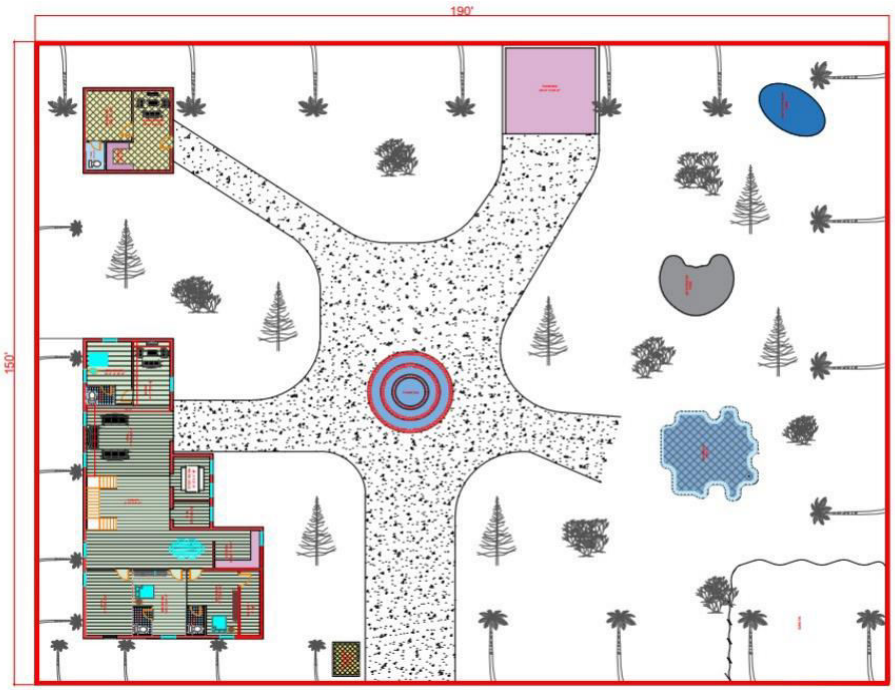

Fig: Green Building Plan

4.0 ESTIMATION OF BUILDING

Estimation in civil engineering is the process of determining the number of materials, resources, and especially project costs needed to operate during a construction project.

Concrete estimation of building =111.087m³

The average annual rainfall in Hyderabad is 782mm.

- Suppose the area available for rainwater harvesting is 100sq meters.
- Taking a runoff co-efficient of 0.15 as per garden or green land.
- ➢ Plot area = 29000sq feet
- ➢ Built of area =2720sq feet
- ➢ Utility of building: Residential building

- No of stair cases: 3
- Height of floor: ground floor -3 meters
  : first floor -3 meters
- Grade of concrete: M20
- Total quantity of concrete for building = 74.8932 m³

1. Brick work

- Total no. of bricks required
- Total quantity of brickwork = 96.592m³
- Size of brick without mortar = 0.19×0.09×0.09m
- Volume of brick without mortar = 0.001539m³
- Size of brick with mortar = 0.2×0.1×0.1m
- Volume of brick with mortar = 0.002
- No. of bricks = $(Total\ quantity\ of\ brickwork)/(Volume\ of\ brick\ with\ mortar)$
  = 96.592/0.002m³
  = 48296 No's

2. Rainwater Harvesting potential

= 782×100×0.15 = 11,730 $\approx$ 12000 litres per year

Trench size:

2 meters scale, 4 meters long and 1.5 meter deep.

12m³ = 12000 litres

3. Solar Panels Estimation

Number of Solar Plates

The 26400 W solar panel is not the market

The Solar Panel Below is Available in the Market

125W, 180W, 375W, 440W

Number of Solar Panels = $\frac{TOTAL\ SOLAR\ PANEL\ WATTS}{SINGLE\ SOLAR\ PANEL\ WATTS} = \frac{26400}{440}$ **= 60**

Number of Solar Panels = 60×440W

4. Grey Water Calculations:

Selection of treatment method:

- Phytoremediation.

Treatment capacity

- Total grey water **780 liters/day.**

Area required for treatment:

- The total area required for the phytoremediation system = 3m² × 8persons
  = 24m² $\approx$ 258.3ft².
- 780litres/day $\rightarrow$ sewage tank
- Sewage tank of 25000 liters
- 780litres /day × 30days = 23400 $\approx$25000litres (3m×3m×3m)
- Sump of 500 liters (pre-treatment)
- Filtration pond $\rightarrow$ 2m×2m×2m (primary treatment)
- Polishing pond → 2m×2m×1m (final treatment)
- Treated water tank = 500 liters

- Storage pond or utility

5. Swimming Pool Calculations:

Total estimation= **2431050**

6. Wind Tower:

- Wind direction north east
- Mean wind velocity/ wind speed ranges from 3 to 6 m/s
- Let us assume an average wind speed of 4-6m/s
- Design consideration
- Building height = 8m
- Wind tower height = let us consider wind towers height 13m as 5m above to the building height
- Tower diameter = 1.5m
- Wind capacity estimation

Wind power density = $0.5 \times \rho \times A \times v^3$

P = air density (approximately 1.225kg/m³)

A = swept area of wind tower

V = wind speed velocity

$$= 0.5 \times 1.225 \times \frac{\pi}{4} \times [1.5]^2 \times 5 = \mathbf{5.4\ kw/m^2}$$

5.0 ANALYSIS AND DESIGN OF GREEN BUILDING

Staad Pro V8i is the most popular structural engineering software product for model generation, analysis and multi-material design. It has an intuitive, user-friendly GUI, visualization tools, powerful analysis and design facilities and seamless integration to several other Modeling and design software products. The software is fully compatible with all Windows operating systems but is optimized for Windows XPLO

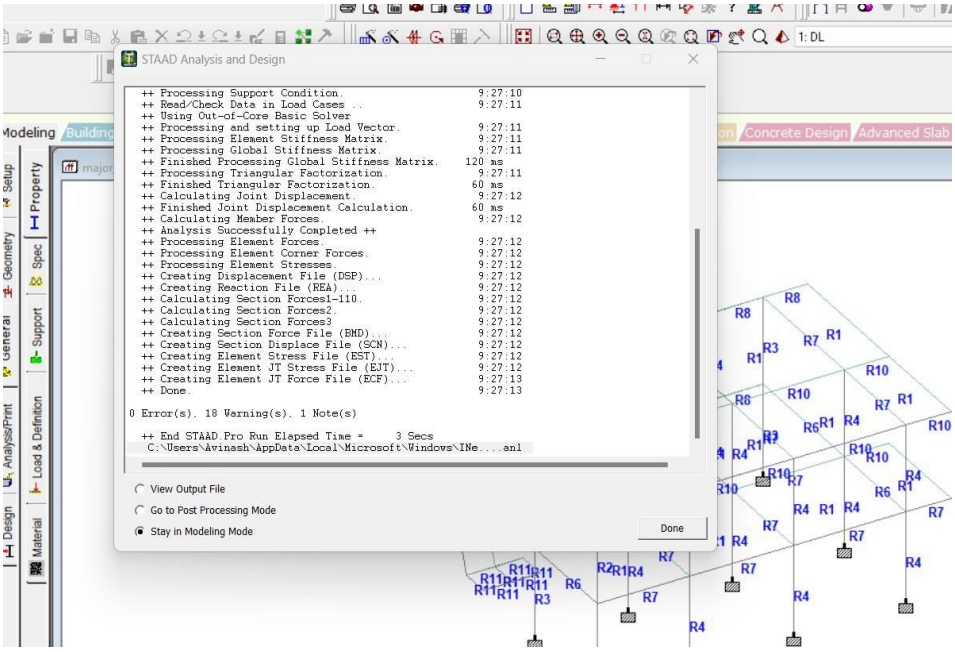

Fig: GUI showing the analysing window

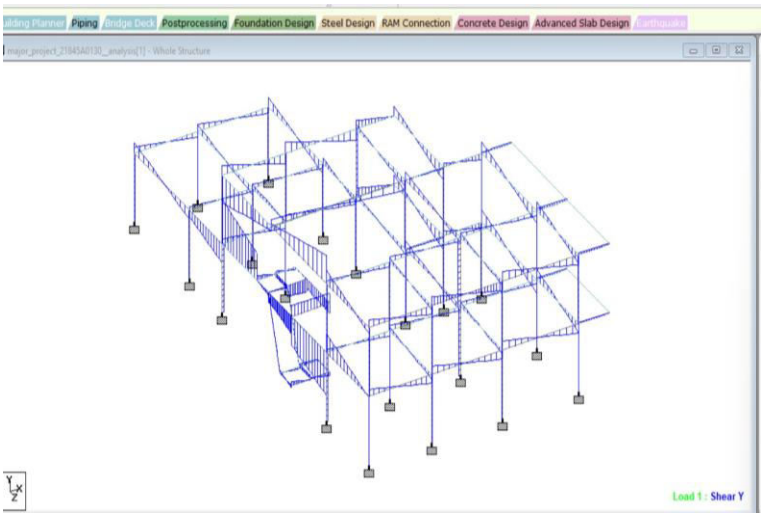

Fig: Shear force

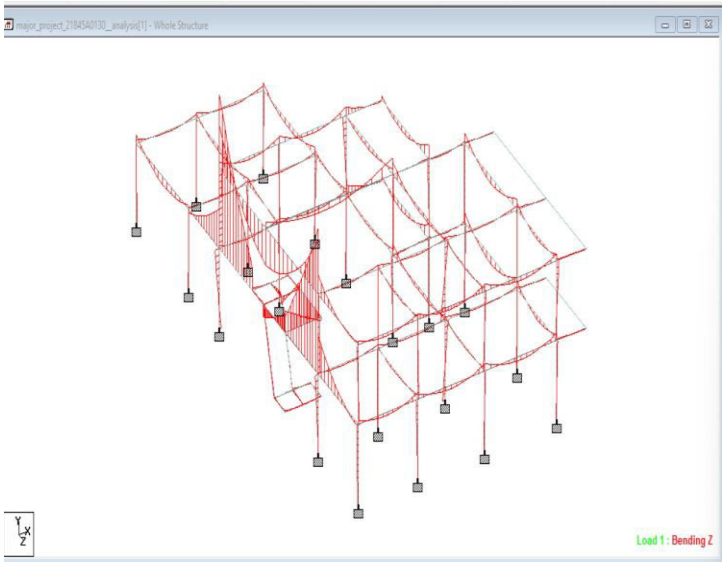

Fig: Bending moment

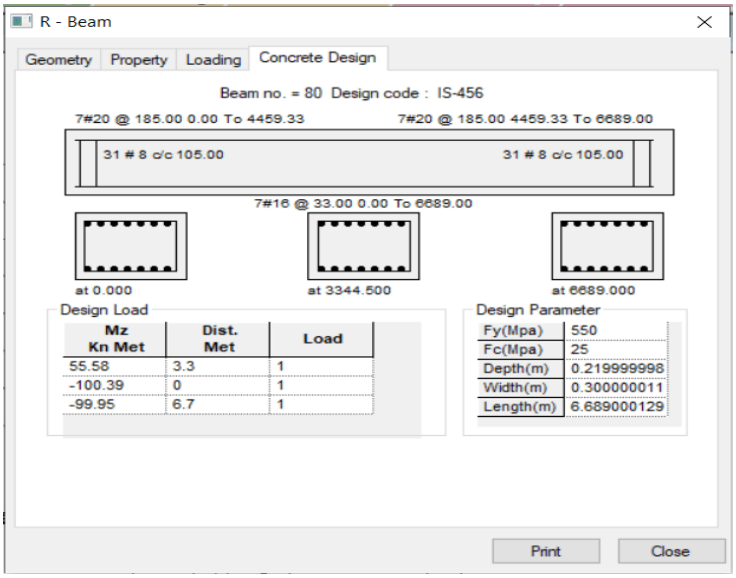

Fig: Design details of Beam

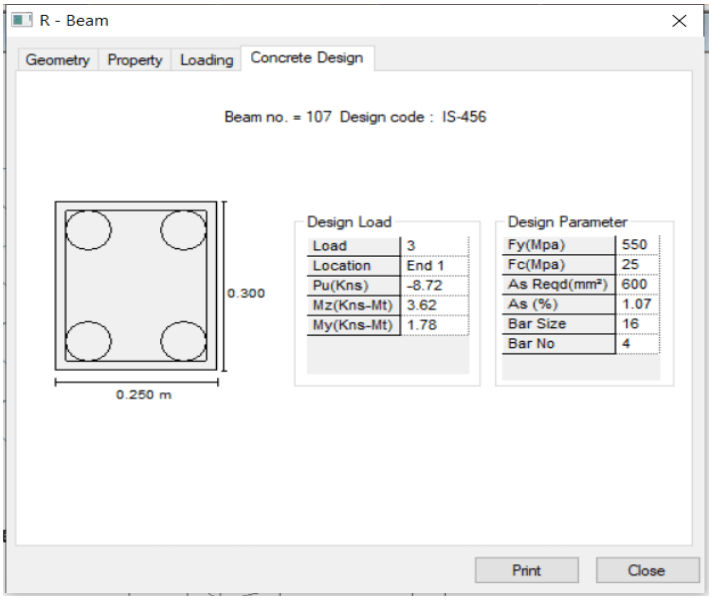

Fig: Design details of Column

CONCLUSION

Green building design and estimation play pivotal roles in creating sustainable structures that minimize environmental impact and promote energy efficiency. By integrating eco-friendly materials, efficient systems, and innovative design strategies, green buildings not only reduce carbon footprint but also offer long-term economic benefits. Accurate estimation methodologies ensure cost-effectiveness and viability, making green building practices essential for a more sustainable future.

- The aim of the project was to understand, plan and design green building.
- That has been achieved by studying different green technologies for buildings.
- By planning and designing building layout, development of plan, elevation, sections etc.
- We also performed modelling, Analysis and Design, as we recommend this project is eco-friendly, sustainability and improve air quality which in-directly increases the life span of human beings. These types of projects should be constructed more in India to improve the economy and above aspects.

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