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# Design and Analysis of Residential Multistorey Green Building

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**ABSTRACT:** Green building (also known as green construction or sustainable building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition.

The term green building is used to describe buildings that are designed, constructed and operated, to have a minimum impact on the environment, both indoor and outdoor.

In this project, design and analysis of a five storey (Stilt+5) apartment building with all basic amenities which will be very helpful and useful for the members residing in the apartment. Green building concepts and applications are implemented to construct a more renewable and eco- friendly apartment with all the necessary amenities for better, healthier and safer living.

**KEYWORDS:** Green building, residential multi-storey apartment, analysis, IGBC (Indian Green Building Council).

## I. INTRODUCTION

An apartment is a multi-storeyed building with 3-7 stories of floors and each floor containing 2-4 flats or houses. Apartment house, also called apartment block, or block of flats, building containing more than one dwelling unit, most of which are designed for domestic use, but sometimes including shops and other non-residential features.

The green building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. In doing so, the three dimensions of sustainability, i.e., planet, people and profit across the entire supply chain need to be considered.

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.

## II. GREEN BUILDING CONCEPTS

### ENERGY EFFICIENCY SOLUTIONS

#### 1. Energy saving air conditioners (HVACs)

Enhanced comfort, improves indoor air quality, reduced risk of illness.

#### 2. High performance glass windows

Reduces ingress of heat and allows higher penetration of heat (prescribed by IGBC).

#### 3. Efficient building management systems

Centralized management of infrastructure equipment.



#### **4.Green roofing**

Mix of mineral and organic compounds, ash, sand, coir, crushed bricks roof tiles. Aims for high quality water-proofing, roof repellent, drainage systems.

#### **5.Passive solar design**

Heated entirely by sunlight, with no additional fuel-based heating.

#### **6.Green walls**

Green walls can cover more exposed hard surfaces in the built environment.

#### **7.Photo voltaic array on rooftop**

Can be used to meet the building's own energy consumption requirements.

### **WATER EFFICIENT TECHNOLOGIES**

#### **1. Rain water harvesting**

Collecting rooftop rain water for future use.

#### **2. Composting toilets**

Treats human waste by a biological process called composting.

#### **3. Grey water recycling and reuse**

Water emanating from bathrooms, wash basins, washing machine and dishwasher are recycled and reused.

#### **4. Pressure reduction**

Pressure reducing valves maintain a consistent water pressure at the fixtures across the entire building from top to bottom.

### **ALTERNATE BUILDING MATERIALS**

#### **1. Fly Ash Concrete**

Reduces greenhouse gas emission absorb moisture more easily than cement make fly ash stronger and exhibit a higher grade of overall strength than conventional concrete.

#### **2. Silica fume cement (geo polymer: flyash-silicafume)**

It has the lowest impact environment impacts with higher strength.

#### **3. Bamboo flooring**

Light weight, high tensile and temperature resistance.

#### **4. Wool bricks**

Wool bricks obtained from mixing wool and natural polymer from seaweed are found to have 37% more strength, increased resistance to wet and cold climate and reduced CO<sub>2</sub> emissions than burnt bricks.

### **III. BUILDING DESIGN**

The design will involve the following:

Proposed green building for Residential Purpose. The floor height is 3.00m in upper Floors. The green building S+5, stilt - car parking and five floors with two flats in each floor. 2 flats of 745 sq. ft in each floor.

As per IS 456-2000, SP-16 design has been done for the following structures such as slabs, beams, columns, foundation and stair case.

#### **1. SLAB**

Slab is designed as per coded provisions for two-way slab. Here in this project slab of living room, bedroom, kitchen, dining is designed for min reinforcement of 0.12% of cross-sectional area and for min spacing which is  $\leq 300$  mm.



**Short span direction: 10mm  $\phi$  @ 110mm c/c.**

**Long span direction: 8mm  $\phi$  @ 260mm c/c.**

**Torsional reinforcement: 7nos of 10mm  $\phi$  bars in both directions @ each corner.**

**2. BEAM**

In this the beams are designed with provisions of min spacing of reinforcements with stirrups.

**12mm bar of 4 numbers as tension reinforcement and 2 bars of 12mm on compression side.**

**Provide 8mm diameter 2 legged stirrups @ 380mm c/c spacing.**

**3. COLUMN**

The columns are designed for each room corresponding to axial loading with provisions of 1.5% of min reinforcements are provided.

**6 bars of 22mm diameter.**

**8mm ties spacing at 300 mm spacing.**

**4.FOUNDATION**

Foundations designed here are isolated footings with respect to the soil conditions at the site with provisions of 1.25% of min reinforcements are provided.

**25mm diameter bar @ 450mm c/c spacing.**

**20mm diameter bars @ 450mm c/c spacing,**

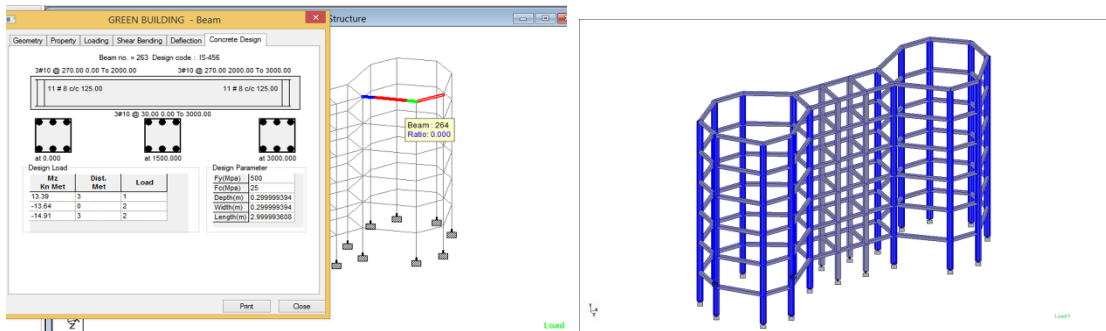
**5.STAIR CASE**

Stair cases designed here are type dog legged staircase with provisions of 0.12% of min reinforcements.

**Steel of one bar of 6mm diameter per step, distribution reinforcement in the form of 6mm diameter bars @ 300mm c/c.**

**IV. DESIGN RESULTS**

The following are the output of design obtained from **STAAD. Pro** software.



**Figure 1: Concrete design of beam**

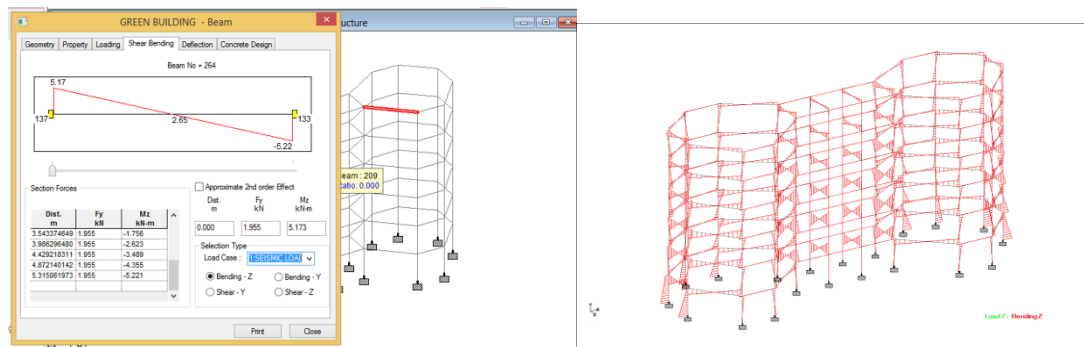


Figure 2 : Shear bending of beam

## V. CONCLUSION

A well facilitated residential apartment with suitable green building techniques and concepts was designed and analysed.

Designs were carried out with the guidance of IS 456:2000 and SP16. Analysis carried out in STAAD PRO. Loads and load combination are as per the guidelines specified in IS 875: part1, part2, part3 and IS 1893:(1) 2016.

Effective green building technologies- use of alternate building materials (fly-ash concrete, silica-fume concrete, wool bricks) and adaptation to energy efficient building systems such as use HVAC's, high performance glass windows, green roofing, active and passive solar designs, water efficient strategies- Rainwater harvesting, grey water recycling and reuse and pressure reduction has been discussed.

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