

# Reliability Analysis of High Rise Building

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**Abstract** - Researchers and Engineers are working on variety of materials and use of lightweight materials which can reduce the use of conventional concrete in some extent. More focus is on use of waste materials like fly ash, rice husk etc. In this paper investigation on high rise building using properties of materials- EPS and concrete is done using ETABS and also reliability analysis is done. Reliability is the ability of a structure to comply with given requirements under specified conditions during the intended life for which it was designed. Planning of building is done in such a way that less space is occupied with more occupancy. Wind and earthquake analysis is done on G+16 storey building for concrete and EPS and various properties like base shear, storey drift and storey displacement is compared for both the materials. It was observed that stability of expanded polystyrene (EPS) material meets the requirement.

**Key Words:** EPS, reliability analysis, lightweight materials.

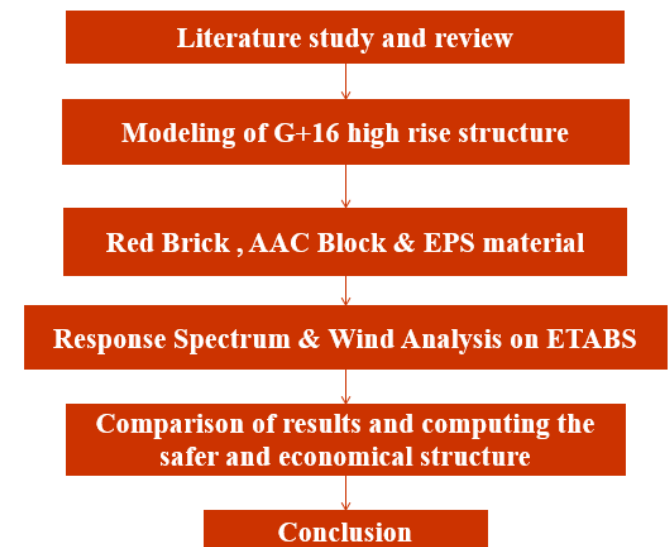
## 1. INTRODUCTION

Human activities mainly the construction activities has increased the carbon footprint and are causing severe damage to the environment. It has also led to disturbance in the ecological cycle. This growing concern has caused the researchers and engineers to focus on new materials which will have less impact on the environment. With the growing population comes huge resource demand. So, sustainable development shall be done along with adopting the waste reduction techniques. In this past years, different methods have been immersed to provide environmental benefits like use of light weight material. These materials led to speedy construction and also reduced the raw materials required. These specific characteristics result in lower environmental loads and enhanced seismic resistance [1].

Drift analysis is done to check the stability of structure. As building heights increase, the forces of nature begin to dominate the structural system and take on importance in the overall building system. The analysis and design of tall building are affected by lateral loads, particularly drift or

sway caused by such loads Response-spectrum analysis is a linear-dynamic statistical analysis method which measures the contribution from each natural mode of vibration to indicate the likely maximum seismic response of an essentially elastic structure. Lateral drift is the amount of side-sway between two adjacent stories of a building caused by lateral loads. Horizontal deflection of a wall refers to its horizontal movement between supports under wind or earthquake loading.

## 2. METHODOLOGY



## 3. DESIGN

For linear dynamic analysis, sixteen storey is considered having built-up area of (24x 19.5) m. Height of each storey is same i.e. 3 m. The slab thickness is 125 mm. The dimensions of beam and column are given in table 1. Outer wall thickness is 230 mm and inner wall thickness is 115 mm. The dead load is considered as (density x thickness + floor finish) = (25\*0.125\*1 + 0.75) = 3.875 KN/m<sup>2</sup>. The live load of 2 KN/m<sup>2</sup> is considered on the building. Masonry load for 230 mm wall is 13.225 KN/m<sup>2</sup> and for 115 mm wall is 6.612 KN/m<sup>2</sup>. The modelling of the building is done with the help of CSI based software ETABS. The linear

Table 1-Size of beam and column

No	Beam/Column	Size (mm)
1	Beam	230 x 400
2	Beam	230 x 450
3	Column	230X400
4	Column	300 x 450
5	Column	300 x 600
6	Column	350 x 700

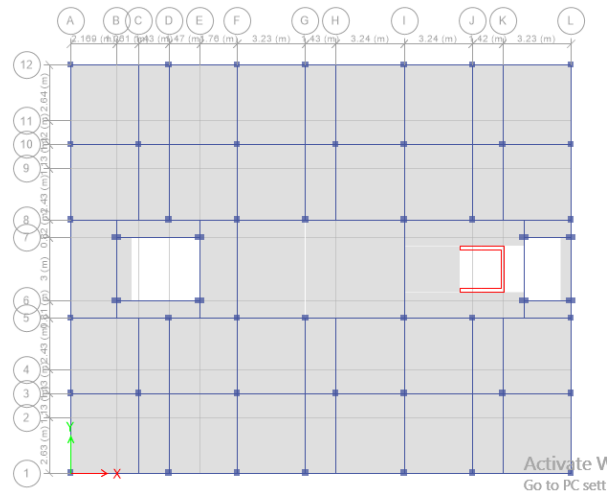


Fig. 2 - ETABS model top view1

Dynamic, Response Spectrum analysis is used to analyze the Lateral loads acting on the building. As per code if the height of the building is between 40-90m in Zone1, 2, 3. Modal analysis using Response Spectrum Method. Along with that Wind analysis (linear static) is also performed. Fig 1 shows the architectural view of each story floor plan and Fig 2 shows the ETABS model top view. The details of the Material properties are given in table 2 & 3.

Table 2- Properties of Concrete

Modulus of elasticity	27386.13 Mpa
Poisson's Ratio (u)	0.2
Coefficient of thermal expansion	$\alpha = 0.0000055/^\circ\text{C}$
Shear Modulus (G)	11410.89 Mpa

Table 3- Properties of Steel

Modulus of elasticity	199947.98 Mpa
Poisson's Ratio (u)	0.3
Coefficient of thermal expansion	$\alpha = 0.00000117/^\circ\text{C}$
Shear Modulus (G)	76903.07 Mpa

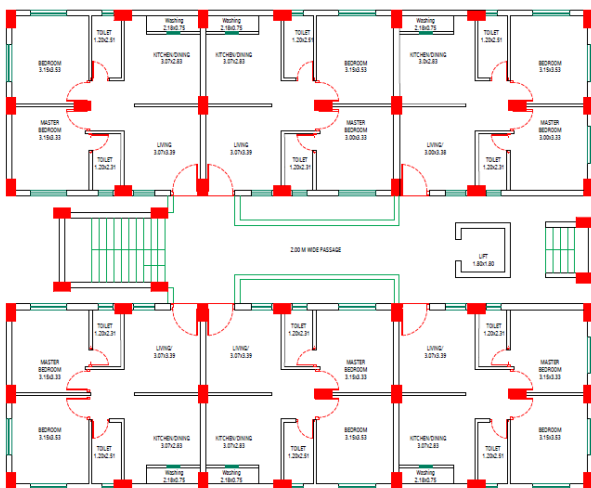


Fig. 1- Architectural view of each story floor plan

The material used for the comparison is EPS. Density of EPS are (15, 20, 30, 35) kg/m<sup>3</sup>. [4]

### 3. RESULTS AND INTERPRETATION

The materials used shows the results in reduction of displacement, drift due to earthquake. It has been observed that with the use of EPS, top storey displacement and inter-storey drift is minimized from 40 to 50%. The comparative analysis is shown for both the buildings in the form of graphs. Fig. 3, Fig. 4 & Fig. 5 shows the comparison between Red Brick, AAC block and EPS for storey displacement and storey drift.



Fig. 3.1 – Displacement chart for Red Brick

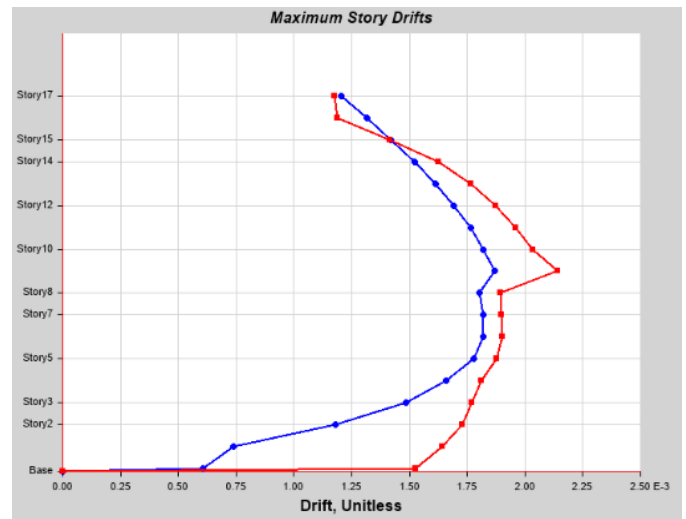


Fig. 4.2 – Storey Drift chart for AAC Blocks

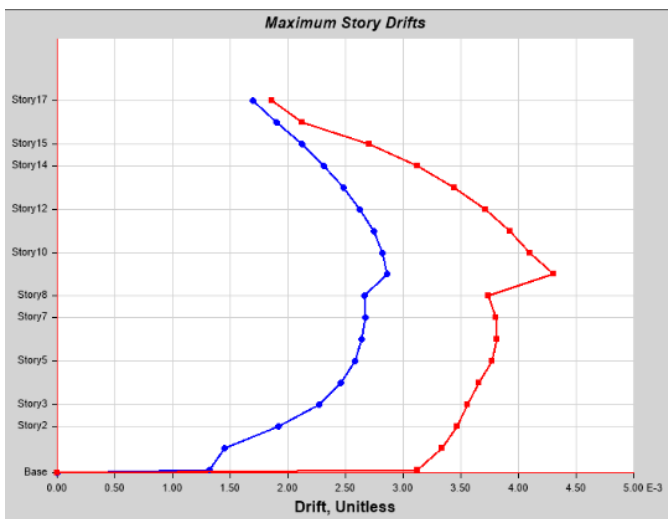


Fig. 3.2 – Storey Drift chart for Red Brick

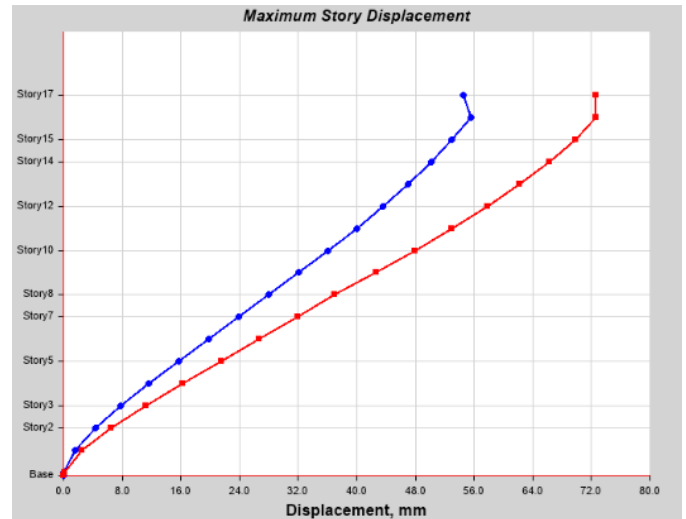


Fig. 5.1 – Displacement chart for EPS

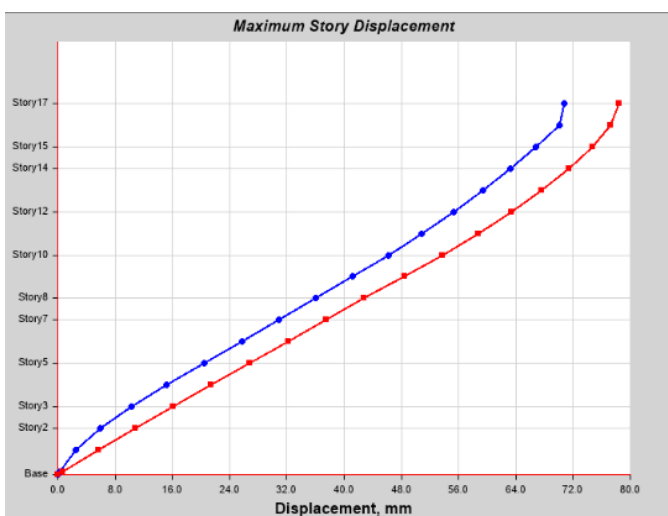


Fig. 4.1 – Displacement chart for AAC Blocks

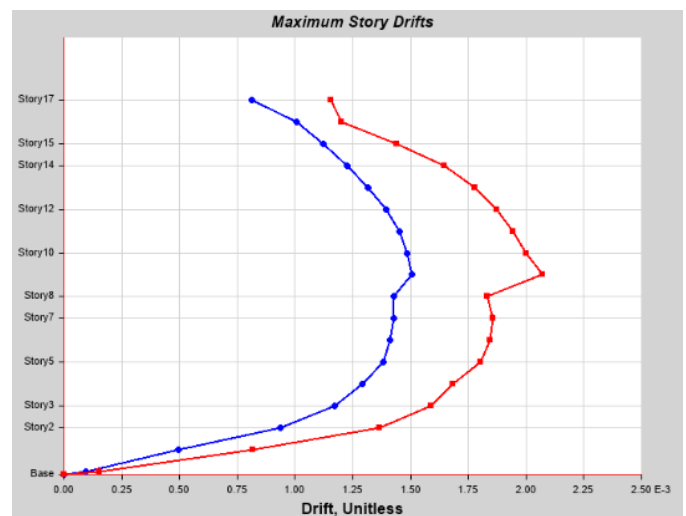


Fig. 5.2 – Storey Drift chart for EPS

#### 4. CONCLUSION

The introduction of AAC Blocks and EPS material in the structure reduces the seismic response of the structure. Because of AAC Blocks & EPS, displacement and inter-story drift at various floors shows significant reduction. With these shear force and bending moment of all columns can reduce up to (40) %. Reduction in axial force is very small as compared to reduction in shear force and bending moment in all columns at top storey. AAC & EPS reduces the weight of the building due to which the lateral forces acting on the building changes to less by 50%. This makes the structure stable. It was observed that the structure with AAC & EPS has performed considerably well in displacement and storey drift as compared with brick masonry and also as it reduces the overall cost of structure and causes reduction in material use, it can be better option for construction with desirable stability.

#### 5. ACKNOWLEDGMENT

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