

# Response of High Rise Building with Conventional Brick and Light Weight Brick with Seismic Loads

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*Abstract: In India population is increasing year by year and most of the land is highly productive and yielding three crops per a year, in that situation land acquisition has become quite expensive and housing cost goes on increasing, to solve this problem need to go for construction of High rise buildings. Now-a-days High rise buildings are a worldwide architectural phenomenon. To reduce the load on foundation we need to use lightweight materials. This project aims to carrying out seismic response of the high rise building with conventional brick and light weight brick. In this project a high rise office building of G+14 with plan dimensions of 19.2 m x 20.4 m and height 47.6m is considered for the analysis purpose using ETABS. Today, high rise buildings are a worldwide architectural phenomenon. The time require for calculating the load combination on them crave lot of time. The study includes understanding the main consideration factor that leads the structure to perform badly during earthquake in order to achieve their approx. behaviour under future earthquake. The main motive of this project is to scrutiny of a G+14 structure using ETABS. For greater height buildings, seismic load plays a vital role in both structural and safety considerations. The performance of the building is analysed for conventional bricks and light weight bricks. The comparison of obtained results for conventional and light weight bricks is done. The dynamic properties of this greater structures using with and without light weight bricks are investigated when subjected to lateral loading. It is observed that in case of lightweight bricks time period has increased, base shear is reduced and storey drift increases more at the base and less at the top.*

**Keywords:** Dynamic Properties, lateral loading, structural safety, shear.

## I. INTRODUCTION

The building which is taller than the maximum height which people are building willing to walk up is known as high rise building, therefore there is need for mechanical vertical transportation. A building whose height ranges from 35 to 100 meters and any unknown range varying from 12-39 floors are also known as high rise building. Residential apartments, hotels, office buildings and education buildings are included in this building.

Earthquakes are the most catastrophic natural hazards related to on-going tectonic processes which occur sudden and destruction takes place in few minutes. Even though earthquakes cannot be predicted directly, using past history records vulnerable zones can be identified. The response of the structure is greatly affected with the parameters like earthquake magnitude, ductility, configuration and construction quality. When earthquakes occur in densely populated urban environment with high building density and infrastructure, the percentage loss of life and property will be high.

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The highest earth magnitude which is recorded was occurred at Valdivia, in southern Chile in May, 1996 is world's largest earthquake. The earthquake occurs during December 2004 is the second largest recorded by strong motion seismograph recently. The earthquake which took place on 11th March 2011 in Tohoku, Japan is one of the dangerous which was recorded within the last century whose magnitude of shaking is occurred for a huge time of about 6 minutes. Conventional bricks are mixture of clay, sand, lime, iron oxide, magnesium and natural soil is used. Conventional brick density 1900Kg/m<sup>3</sup>. These bricks are time consuming process. The Conventional bricks compressive strength 350kg/cm<sup>2</sup>. The speed will be slow compared to light weight bricks. These materials also act as an eco-friendly as the pollution caused by manufacturing is less when compared with normal bricks. The maintenance cost is also low. For construction of external as well as internal wall, these bricks are used. In some cases they may also be used not only for load bearing but also non-load bearing walls. For many building applications conventional brick is the best material choice.

Lightweight bricks are a mixture of cement, fly ash, lime, gypsum and aeration agent. Lightweight brick density 600-1200kg/cm<sup>2</sup>. It is a rapid process and saves time. These bricks are recommended for high rise buildings in order to reduce the dead load of building. The basic raw material in lightweight bricks is fly ash hence soil consumption is zero.

## II. STUDY AREA

Region Amravati is the state capital of new Andhra Pradesh, which falls under the Seismic zone III. High rise buildings are constructing in this region and expecting many more in future. It is bounded by the Latitudes 16° 30'30"N Longitude 80° 37'E.

## III. PROBLEM PRESENTATION

In this investigation, the main focus is carried on the analysis of two categories of G+14 structures, one with conventional brick and other with light weight brick. The study of parameters like fundamental natural frequencies, time periods, base shear and displacements under earthquake forces are compared for both normal and substituted structures.

## IV. DIMENSIONS OF STRUCTURAL MEMBERS

Size of the Column is chosen as 230X500mm up to 4 floors and 300X600mm from 5<sup>th</sup> floor to 15<sup>th</sup> floor, beams with 230X400mm, Slab thickness is 120mm, Number of stories are (15) G+14, Storey height is 3000mm cellar and ground floor and 3200mm from First to thirteenth floor, X & Y directions bay widths=



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19.2 and 20.44 meters, Thickness of wall is 230mm, Support condition are fixed, Imposed load (floor)= 3.5kN/m<sup>2</sup> Live load (terrace)=1.5KN/m<sup>2</sup> and Input to the analysis is ETABS, Zone III.

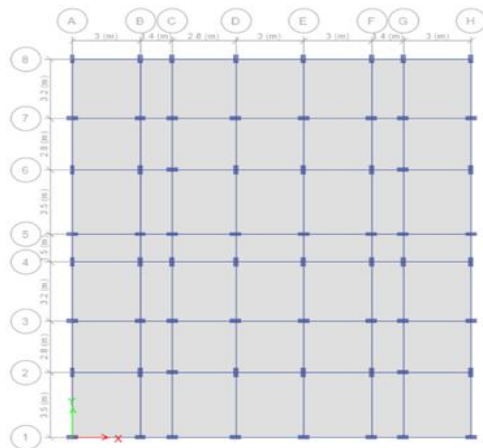


Fig 1: plan of the building

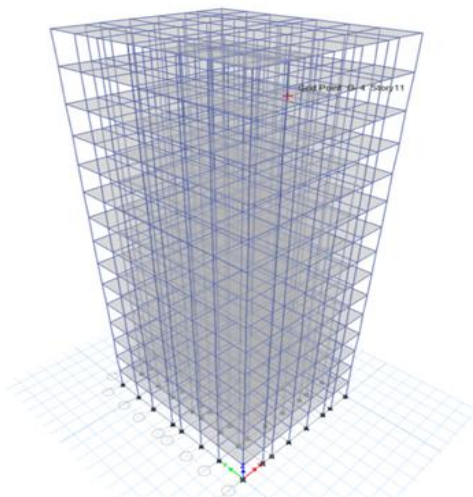


Fig2: 3D Elevation

## V. RESPONSE SPECTRUM METHOD

The method which represent a curve showing peak or steady-state responses like displacement, velocity and acceleration which are of single degree of freedom system subjected to lateral load is Response Spectrum Method. Depending upon the damping ratio, this gives the maximum or peak SDOF system response. Generally SDOF system response is evaluated by time or frequency domain analysis for a given time period of a system where maximum response is taken. Keeping time period on X – axis and response quantity on Y-axis a final plot is drawn. Same process is carried with different damping ratio to obtain overall response spectra.

## VI. ANALYSIS OF BUILDING AND MODELLING ETABS

A G+14 storey building with plan with plan of 19.2X 20.4 m and height of the building is 47.6m was analysed in ETABS by considering SRS method .

Modelled steps in ETABS:

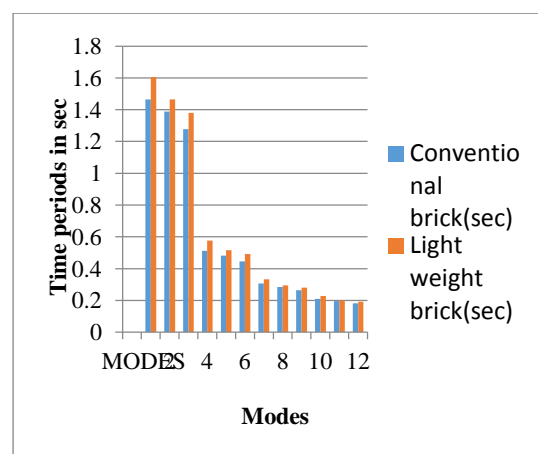
- Preparing grid for layout.
- Assigning member properties for beams, columns, slabs and wall panels.
- Preparing load case like dead load, live load and earthquake loads.
- Make load combinations and model mass for the structure.
- Assigning the loads on the structure.
- Run analysis.
- Results.

## VII. RESULTS

### Time periods

Modes	Conventional brick Model 1(sec)	Light weight brick Model 2 (sec)
1	1.464	1.606
2	1.388	1.464
3	1.278	1.381
4	0.512	0.576
5	0.481	0.517
6	0.446	0.492
7	0.306	0.332
8	0.285	0.294
9	0.265	0.281
10	0.210	0.227
11	0.196	0.200
12	0.181	0.192

TABLE 1:Time periods

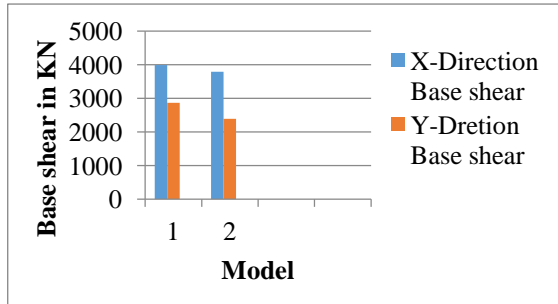


GRAPH1: Modes vs Time periods

**Base shear**

MODEL	X-Direction Base shear(KN)	Y-Direction Base Shear(KN)
Conventional Brick(1)	3991.91	2865.96
Light weight Brick(2)	3794.73	2392.45

**TABLE2:** Base shear

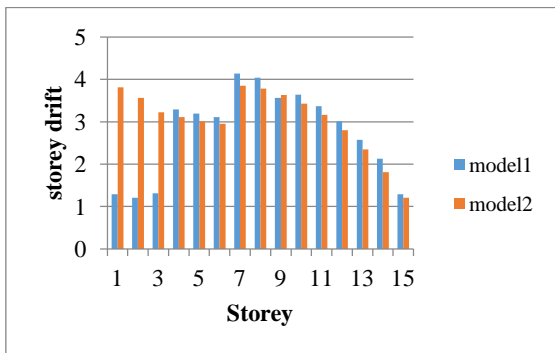


**GRAPH 2:** model vs Base shear

**Storey drift:**

Storey	Storey drift ratio*(10-3)	
	Conventional brick Model 1	Light weight brick Model 2
1	1.29	3.81
2	1.21	3.56
3	1.31	3.22
4	3.29	3.11
5	3.19	3.01
6	3.11	2.95
7	4.14	3.85
8	4.04	3.78
9	3.56	3.63
10	3.64	3.43
11	3.37	3.16
12	3.01	2.80
13	2.57	2.35
14	2.13	1.81
15	1.29	1.21

**TABLE3:** Storey drift

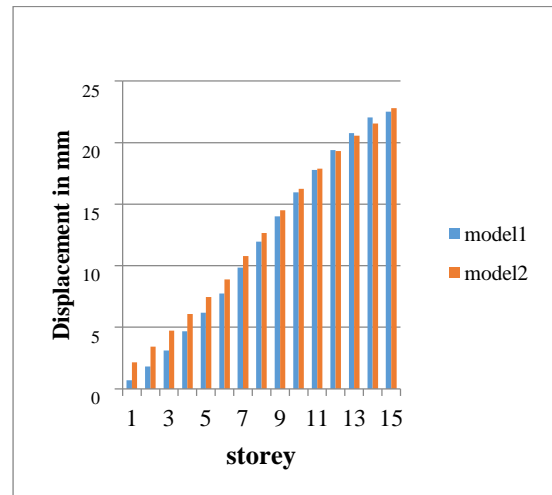


**GRAPH 3:** Storey vs Storey drift

**Displacements**

Storey	Conventional brick Model1 (mm)	Lightweight brick Model2 (mm)
1	0.68	2.14
2	1.82	3.41
3	3.12	4.73
4	4.68	6.08
5	6.18	7.46
6	7.73	8.88
7	9.84	10.77
8	11.96	12.66
9	14.01	14.50
10	15.96	16.25
11	17.77	17.87
12	19.39	19.32
13	20.77	20.55
14	22.04	21.55
15	22.51	22.80

**TABLE 4:** Displacements



**GRAPH 4:** Storey vs Displacement

**VIII. CONCLUSION**

In this project a comparison was made for a High rise building with conventional bricks and light weight bricks subjected to seismic loads. The following results Base shear, Time period, storey drift, displacements were observed. Faster building rates and lowers the commercial



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transportation and handling costs.

- 1) It has high thermal conductivity due to less density as compared.
- 2) We concluded that application of software in present study play an important role.
- 3) It is found that total base shear of structure is more when conventional bricks are used and it is less when light weight bricks are used
- 4) Displacements and Storey drifts are increased for light weight bricks as compared to conventional bricks under the dynamic earthquake loading
- 5) Time period has increased about 7.16% for light bricks as compared to conventional bricks

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## AUTHOR PROFILE



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