Analysis of R.C.C. Structure In Seismic Zone Using LW Material on Etab's

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Abstract- *ETABS software stands for extended three dimensional analysis of building systems. The main purpose of this software is to design and analysis multi-Storied building in a systematic process. This paper presents a building where designed and analyzed under effect of earthquake by using ETABS software. This study is carried out to investigate seismic behavior of structure in Earthquake zone using light weight materials as Seismic forces acting on the structure mainly depends onto the weight of structure, the primary theme of this work is to reduce the self-weight of the concrete structures, which can be done by using the structural lightweight concrete, it will help in minimizing the lateral seismic forces on the structure and also helps in reducing the size of the structural members and area of reinforcement required while designing.*

Keywords- ETABS software, AAC block & SLWC, designed and analyzed.

I. INTRODUCTION

In this project design of two buildings one is made by lightweight materials such as autoclave aerated concrete, hollow bricks in partition walls and other lightweight materials in construction of building which give light weight building and other building are made by conventional material with consideration of earthquake forces and without considering earthquake forces. This project presents the economics of light weight concrete building versus conventional building. It includes the modeling, analysis and comparing between two buildings. After that we will compare both the results which made by software calculations.

II. LITERATURE REVIEW

Pooja K. Pardakhe Prof. M. R. Nalamwar (Comparative Study of R.C.C Structures In Earthquake Load Using Light Weight Materials)

In this report brief comparison is done between normal and light weight structure in earthquake load also presents brief analysis of building for G+10 by using Red brick, CLC block and AAC block with and without considering earthquake forces for zone II. Earthquake load calculation is also done for the structure in which earthquake forces are considered. Cost analysis is made by using Red brick, CLC & AAC block and overall modeling and analysis is done by using E-tab software to known the various bending moment and shear force acting on a building. By using AAC block and CLC block the overall cost of construction is reduce and it will be safe and economical in earthquake forces also.

Miss Akshata A Mulgund1, Dr. Dilip K. Kulkarni2 (Light Weight Concrete)

In these paper properties of light weight and normal weight concrete is compared as the Density of the normal concrete is 2200 to 2600 kg/m3. This weight will make it an uneconomical structural material. Attempts have been made in the past to reduce the self weight of concrete to increase the efficiency of concrete as a structural material. The light-weight concrete is a concrete which has a density of 300 to 1850 kg/m3.

A. Costa, A. Penna, G. Magenes and A. Galasco (Seismic performance and assessment of autoclaved aerated concrete block (AAC) masonry building).

The purpose of the presented work is the behavior assessment of autoclaved aerated concrete in seismic performance of R.C.C building very low weight of this material and its high deformability (low value of Young modulus in compression) tends to reduce inertia forces on the building induced by the seismic motion.

Indian Seismic Codes:

Seismic codes are extraordinary to an area or nation. They think about the nearby seismology, acknowledged dimension of seismic hazard.

The Bureau of Indian Standards (BIS) the accompanying Seismic Codes:

- IS 1893 (PART 1) 2002, Indian Standard Criteria for Earthquakes Resistant of Design Structures (5the update).
- IS 4326, 1993, Indian Standard Code of training for Earthquake Resistant Design and Construction of Buildings. (Second update).
- IS 13827, 1993, Indian Standard Guidelines for improving Earthquake Resistant of Earthen structures.
- IS 13828, 1993 Indian Standard Guidelines for improving Earthquake Resistant of Low Strength Masonry Buildings.
- IS 13920, 1993, Indian Standard Code for training for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.

The directions in these gauges don't guarantee that structures endure no harm amid the tremor of all greatness. In any case, to the degree conceivable, they guarantee that structures can react to tremor shaking of moderate forces without auxiliary harm and of substantial powers without all out breakdown.

III. RESEARCH AIM AND OBJECTIVES:-

In this, system will compare R.C.C structure and light weight R.C.C structure by using alternative light weight building material (AAC block & SLWC). the structures are of G+10 commercial building with same grid and the building are located in same earthquake zones i.e. Zone II (IS-1893-2002) and live load on both the building is same as per IS-875 part 2. The parameter user has studied is to investigate the, Bending moment, shear force, torsion, axial load, Cost of the building, Construction time, Earthquake loads.

IV. METHODOLOGY

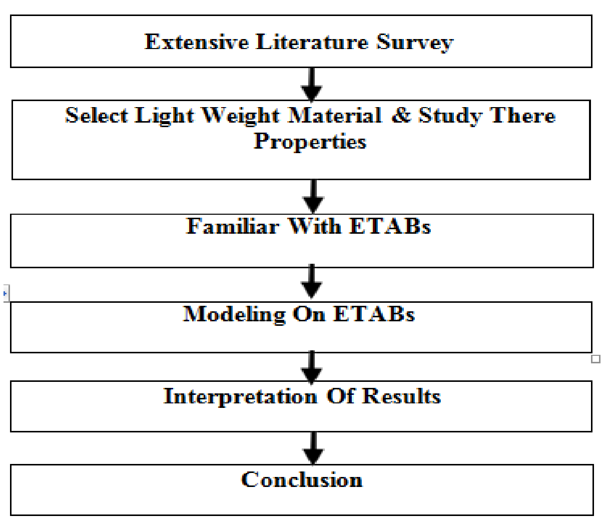

Figure 1 FLOW CHART OF METHODOLOGY

V. RESPONSE SPECTRUM METHOD

Due to earthquake the maximum response of a structure is obtained. This method gives the accurate result with respect, to time and response of the building. As per IS 1893-2002 the response spectrum is calculated according to zone factors and importance factors. The Z, I, and R had been given in Indian codes and according to soil condition the computational program can calculate with time period. The dynamic response of structures is applicable to the analysis of this method. In their linear range behavior, the areas of geometrical discontinuity or irregularity. Modeling and Analyze the buildings in ETABS software to carry out the storey deflection, displacement, storey drift, storey shear force and base shear of regular using equivalent static method and response spectrum method to compare the results. The dimensions of the members and the material properties were assigned. Load combinations of dead, live, seismic loads were assigned. The analysis is carried out. Results are studied.

VI. MATERIALS

A. Structural Lightweight Concrete

Structural lightweight concrete has a density (Unit weight) 1440 to 1840kg/m3 compared to normal weight concrete with a density is in range between 2240 to 2400kg/m3. For structural applications the concrete strength should be greater than 2500 psi (17MPa). The concrete mixture formed with a light-weight-coarse aggregate. In some cases a some or the whole fine aggregate could also be a lightweight product. We consider as 1800 kg/m3 for analysis.

B. Autoclaved Aerated Concrete (AAC)

Brick is the most commonly used building material in construction. AAC blocks are new construction material which is very light in weight. Compare to same size of (200mm x 100mm x 100mm,its 3 times lighter than traditional brick (clay brick);it means it covers more area in same weight as clay brick gives in one bricks. In this paper; attempt has been made to replace the clay brick with light weight AAC blocks. The usage of AAC block reduces the cost of construction up-to 25% as reduction of dead load of wall on beam makes it comparatively lighter members. The use of AAC block also reduces the requirement of materials such as cement and sand up-to 55%. We had taken as 6kn/m3.

VII. PROBLEM DEFINITION

A. Preliminary Data

Table 1: Preliminary Data

Sr. No.	Contents	Description
1	Zone	II & V
2	Number of Stories	G+10
3	Ground Storey Height	4m
4	Floor to Floor Height	3m
5	Wall Thickness	a) 250 mm thick including plaster (external wall) b) 150 mm thick including plaster (internal wall)
6	Live Load	a) 1.5KN/m² (Roof Level) b) 3.5KN/m² (FloorLevel)
7	Material	M25 & Fe 415
8	Density of Light Weight Concrete	18KN/m²
9	Density of AAC Block	6KN/m²
10	Density of Normal Concrete	25 KN/m²
11	Density of Red Brick	20 KN/m²
12	Size of Column	350x650 mm
13	Size of Beam in Longitudinal & Transverse Direction	300x400mm
14	Depth of Slab	120mm
15	Depth of Foundation	2.5m below ground
16	Floor Finish	1.0 KN/m²
17	Terrace Water Proofing (TWF)	2.0 KN/m²

B. Story Data

Table 3: Story Data

Name	Height Mm	Elevation Mm	Master Story	Similar To	Splice Story
TERRACE	3000	36500	Yes	None	No
Storey10	3000	33500	No	TERRACE	No
Storey9	3000	30500	No	TERRACE	No
Storey8	3000	27500	No	TERRACE	No
Storey7	3000	24500	No	TERRACE	No
Storey6	3000	21500	No	TERRACE	No
Storey5	3000	18500	No	TERRACE	No
Storey4	3000	15500	No	TERRACE	No
Storey3	3000	12500	No	TERRACE	No
Storey	3000	9500	No	TERRACE	No
Storey1	4000	6500	No	TERRACE	No
PLINTH	2500	2500	No	TERRACE	No
Base	0	0	No	None	No

C. Grid lines

Table 5: Grid Lines

Grid System	Grid Direction	Grid ID	Visible	Bubble Location	Ordinate M
G1	X	A	Yes	End	0
G1	X	B	Yes	End	4.3
G1	X	C	Yes	End	8.6
G1	X	D	Yes	End	12.9
G1	X	E	Yes	End	17.2
G1	X	F	Yes	End	21.5
G1	X	G	Yes	End	25.8
G1	Y	1	Yes	Start	0
G1	Y	2	Yes	Start	4.6
G1	Y	3	Yes	Start	9.2
G1	Y	4	Yes	Start	13.8
G1	Y	5	Yes	Start	18.4

D. Procedure for Analysis and Design Building by Etabs

Step 1: Create the Grid points and Generation of structure After getting opened the program, select a new model and a window appears where we had entered the details of grid dimensions and story dimensions of our building. Here the program had generated 2D and 3D structure by specifying the building details in the following two windows.

Step 2: Define property after created the grids;
Start to define the material property by and steel reinforcements). After that define section properties (beams, columns, slabs, and wall) by giving the specified details in defining. After that we define section size by selecting frame sections as shown below and added the required section for beams, columns etc.

Step 3: Assigning of Property
After defining the property for materials and section properties ,now draw the structural components using command menu → Draw line for beam and create columns in region for columns by which property assigning is completed for beams and columns sections.

Step 4: Assigning of Supports
After drawing the details of building (beams, columns, slabs, and wall), now assigned the supports by going to assign menu →joint\frame →Restraints (supports) →fixed.

Step 5: Defining of loads
The loads in ETABS program are defined as using static load cases command in define menu.

Step 6: Assigning of Dead loads
After defining all the loads, dead loads are assigned for external walls and internal walls.

Step 7: Assigning of Live loads
Live loads are assigned for the entire structure including floor finishing.

Step 8: Assigning of Seismic loads

Seismic loads are defined and assigned as per IS 1893: 2002 (Indian code) by giving the details of zone, soil type, and response reduction factor in X and Y directions

Step 9: Assigning of load combinations

Load combinations are given based on IS 875 1987 PART 5 using load combinations command in define menu .

Step 10: Analysis

After the completed all the above steps, now performed the analysis and check all the errors.

Step 11: Design

This step considers the last step of procedure. After completed the analysis, now performed concrete design on the structure as perIS 456: 2000 (Indian code). For this go to Design menu design \ check of structure then ETABS performs the design for every structural element.

VIII. ACTUAL ANALYSIS

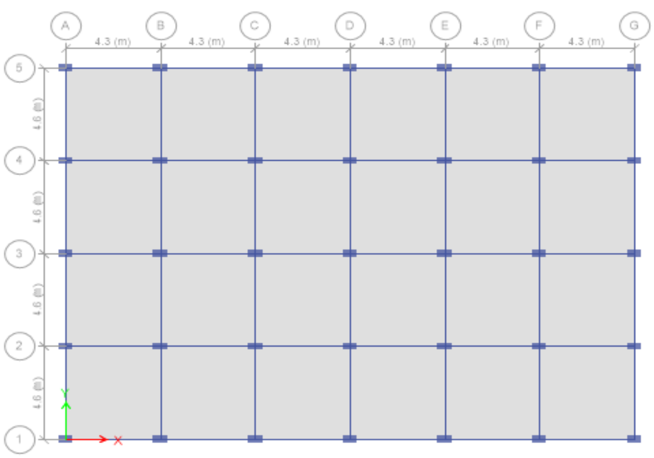

Figure 2 plan of the structure

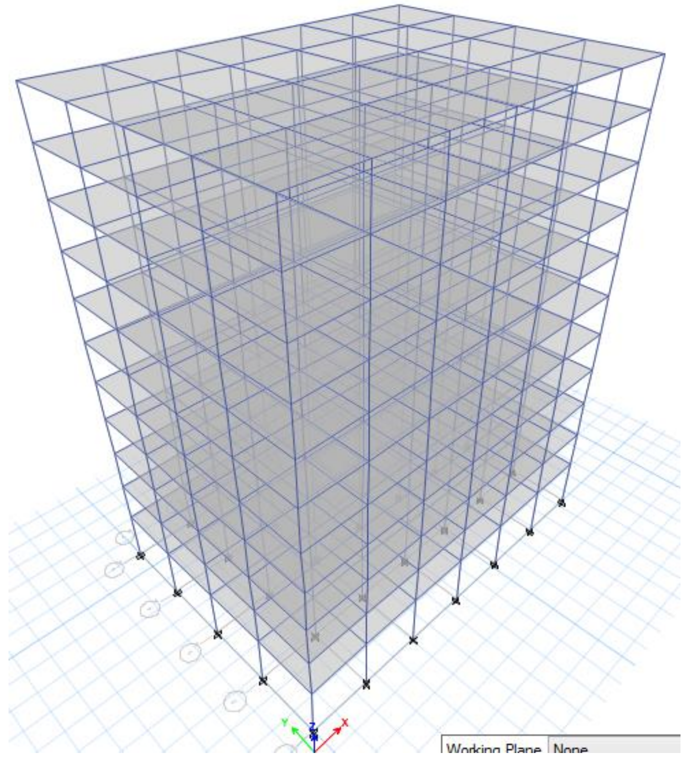

Figure 3 3D View

IX. RESULTS ANALYSIS

A. Calculated base shear

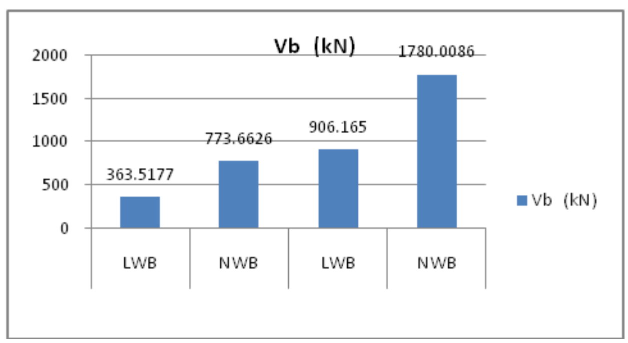

Figure 4 Comparison of Total base shear

B. Weight comparison

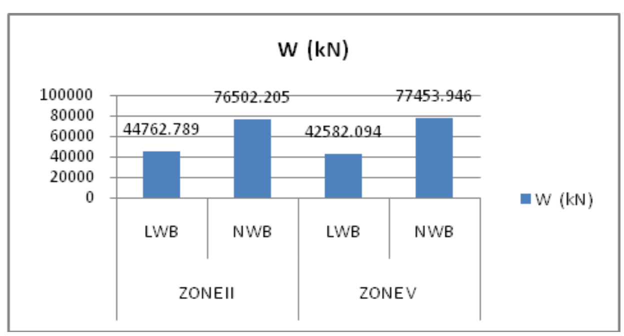

Figure 5 Weight comparison

C. Applied storey forces

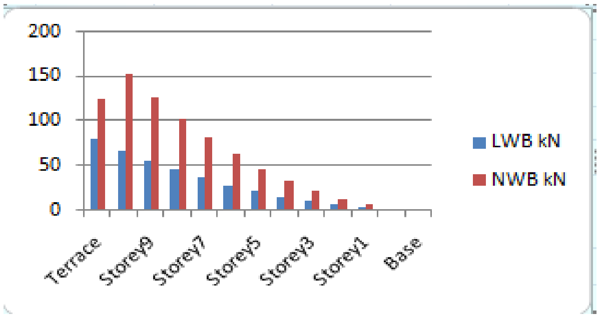

Fig.46 (a) for zone II

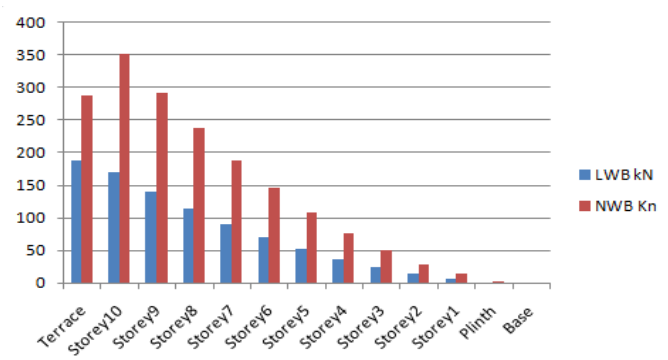

Fig.46 (b) for zone V

Figure 6 Comparison of Applied Storey Forces

D. Storey Displacement

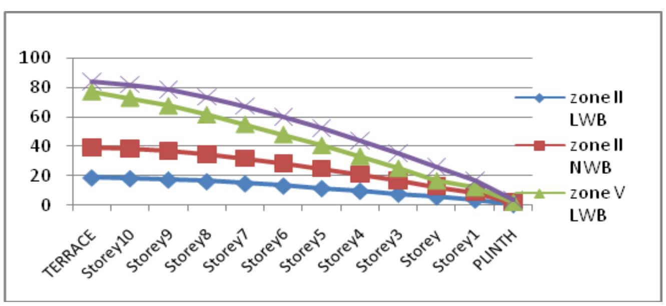

Figure 7 Comparison of storey displacement

E. Cumulative mass of building

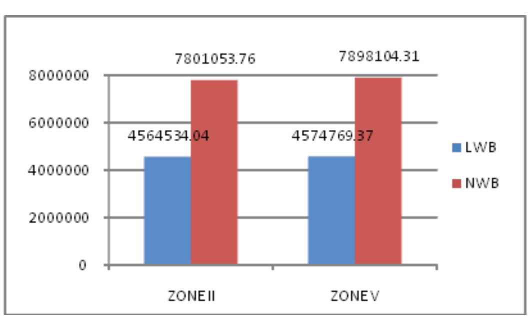

Figure 8 Cumulative Mass of building between NWB and LWB

F. Base reaction comparison

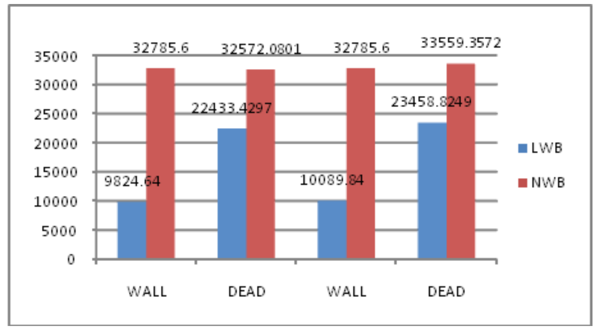

Figure 9 Comparison of Base reaction

G. Diaphragm Center of Mass Displacements

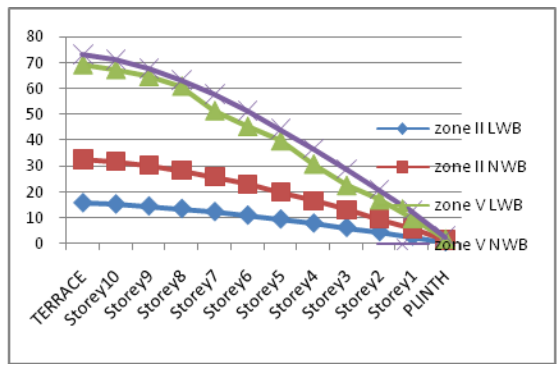

Figure 10 Comparison of Diaphragm Center of Mass

H. Comparison of Storey Drift

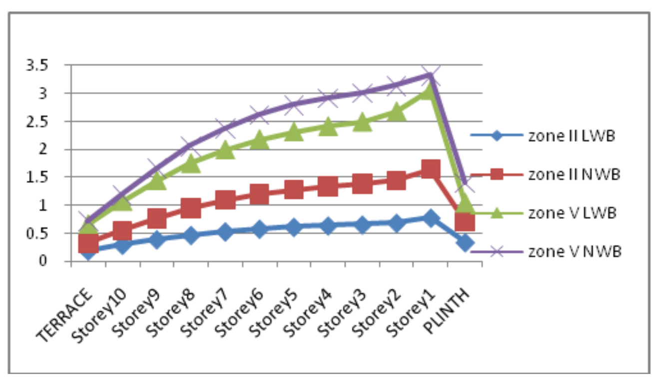

Figure 11 Comparison of storey drift

I. Comparison of Maximum Axial Force

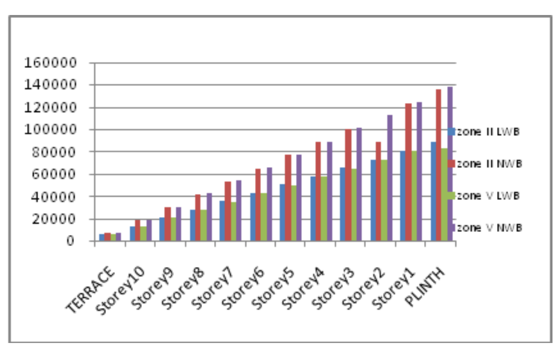

Figure 12 Comparison of Maximum axial force

J. Comparison of Maximum shear force

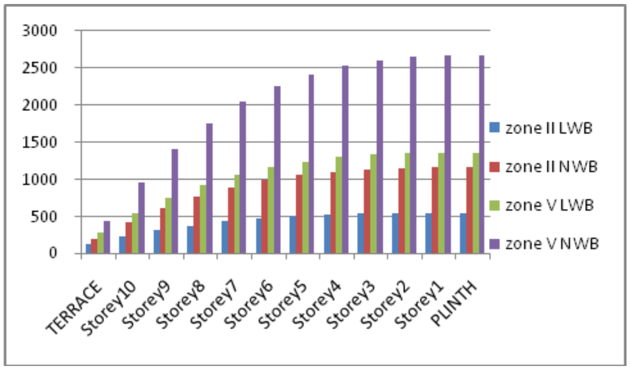

Figure 13 Comparison of Maximum shear force

K. Comparison of Maximum bending moment

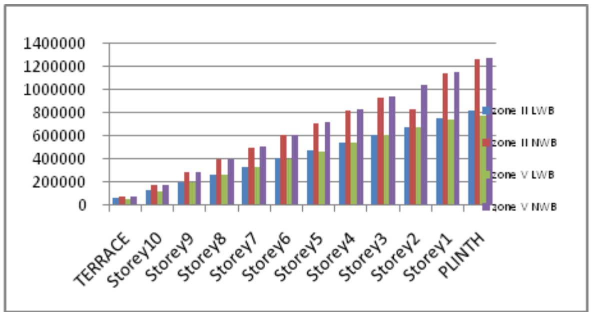

Figure 14 Comparison of Maximum bending moment

X. CONCLUSION

In this research we observed that for lightweight building structure base shear are reduced from 40% to 50% as compared to conventional building structure. Also as the weight of concrete is low as compared to normal concrete is proportional to reduce the mass of building as 30% to 35%. Indirectly, the structure made by using SLWC is economical because the cost of SLWC is low as compared to conventional concrete. The bending moment and shear force found in lightweight structure is reduced by 20% to 25% and 35% to 45%. The storey displacement and centre of mass displacement of lightweight concrete is lower than conventional concrete.

Finally in this study we concluded that the use of SLWC in construction in seismic zone reduced the percentage of damages as well as the cost of structure.

XI. ACKNOWLEDGEMENT

We would like to express gratitude to Prof.S.S. Kendhe, HOD of Civil Engineering, Jagadambha College of engineering and technology Yavatmal for their sincere efforts in carrying out the project work to bring up this study.

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