Seismic Analysis of a Multi storey Reinforced Concrete Building in Different Types of Seismic Zones and Soils

Ch.Charukesh[1], B. Mano Yasaswi.v[2], K.Prudhvi[3]

[1]*B.Tech,Civil Engineering, MVR college of Engineering and Technology , Paritala, India.*
[2]*B.Tech, Civil Engineering, MVR college of Engineering and Technology, Paritala, India.*
[3] *Assistant Professor, Department of Civil Engineering, MVR college of Engineering and Technology, Paritala, India.*

Abstract- The main goal of this paper is to show the nature of the reinforced concrete building (G+13). when it is in the various seismic zones (zone II,III,IV,V) and different types of soils (type I,II,III).As we all know there are 2 types of methods of seismic analysis, we considered linear static analysis aka seismic coefficient method for analysis of a G+13 residential reinforced concrete structure, in this paper using ETABS v9.7.1 software as per IS:1893 (part 1)-2002.Here in this paper, apart from seismic weight we also determine storey drift, base shear, storey shear.

Index Terms- seismic coefficient analysis, base shear, seismic weight, storey drifts, storey shear.

I. INTRODUCTION

Extended 3D analysis of building system AKA ETABS is a paramount software produced by computer and structures, Inc. Used to analyze mainly high raised structure like BRUJKLIFA. This is widely used among all leading constructions and design companies. In this paper we discussed about the comparative results of seismic weight, base shear, storey drifts and storey shear with respect to their seismic zones and types of soils of a residential reinforced concrete structure. Here we considered a structure G+13 storey of 22.5m x 22.5m model in ETABS. Total building of height 44.8m making height of each floor 3.2m. Analysis of structure is done and output results are obtained and compared, with respect to seismic zones and types of soils as per IS1893-2002(part-1).

II. STRUCTURE INFORMATION

A. Case

A 22.5m x 22.5m, 14 storey residential regular building is considered for study. Storey height is 3.2m.Analysis and modeling of the structure is done in ETABS software.

B. Structure data

Length x width	22.5m x22.5m
No. of storey's	(G+13)
Beams	0.4m x 0.6m
Columns	0.4m x 1m
Slab thickness	150mm
Thickness of external wall	120mm
Supports	Fixed
Length of each bay	4.5m
Grade of steel and concrete	Fe500 and M30

C. Loading considerations

Loads acts on structure is Live load(L.L), Dead Load(D.L), Seismic Load.
Live load: 3KN/m^2 .
seismic zone: II,III,IV,V.
Zone factors: 0.10,0.16,0.24,0.36.
Type of soil: I,II,III.
Response reduction factor: 5
Importance factor: 1
Damping ration: 5%.
Time period: 0.850sec(calculated as per IS:1893:2002).

III. ANALYSIS OF STRUCTURE

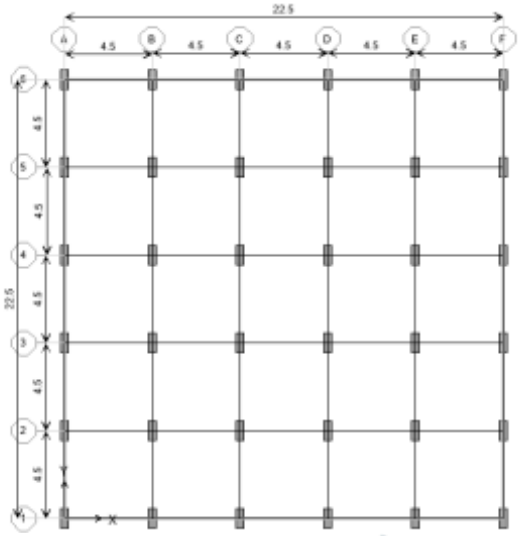


Fig. 1 Plan of structure

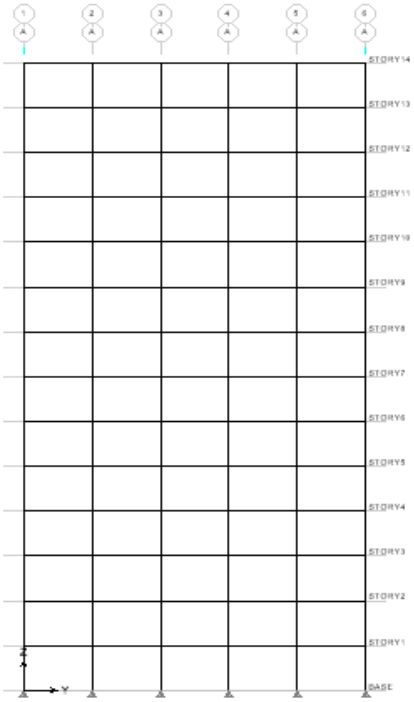


Fig. 2 Elevation of structure

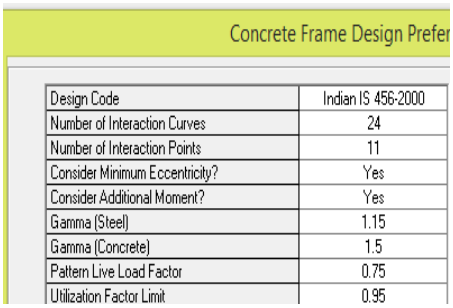


Fig. 3 Procedure for changing preference of codebook in ETABS

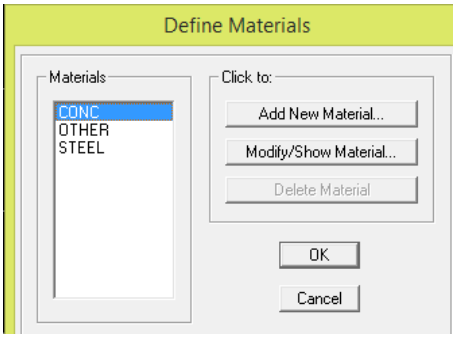


Fig. 4 Procedure for changing preference of codebook in ETABS

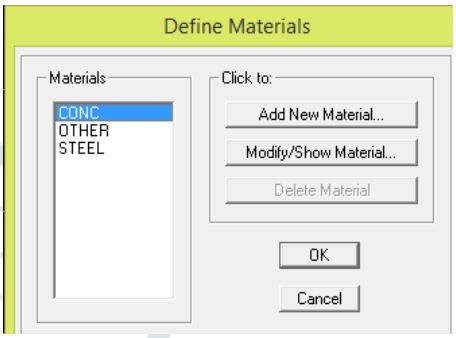


Fig. 5 Procedure for giving concrete properties

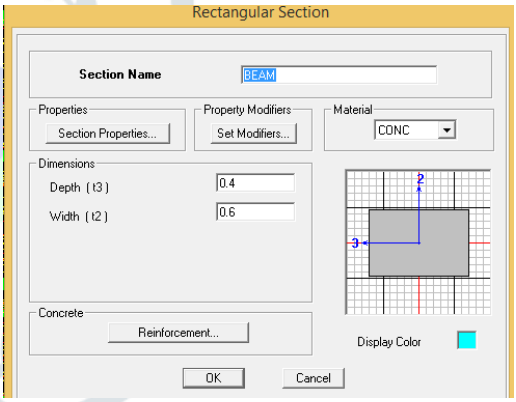


Fig. 6.1

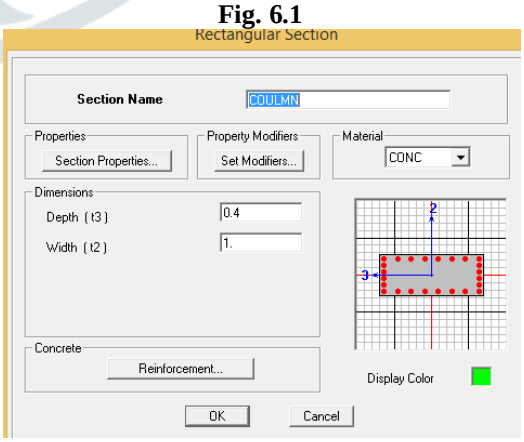


Fig. 6.2 Procedure for giving Beams and columns

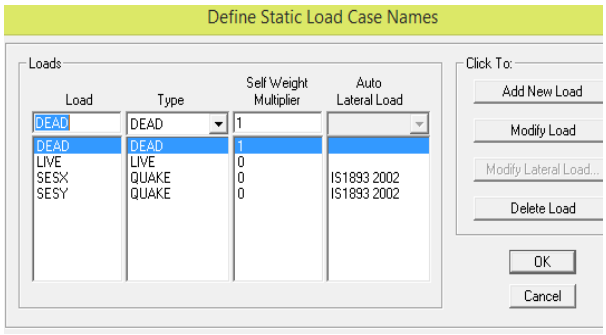


Fig. 7 Procedure for giving static load cases

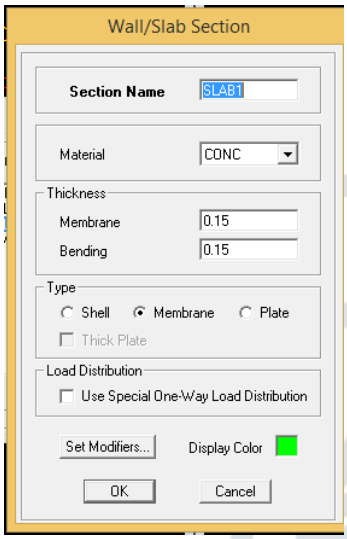


Fig. 8.1

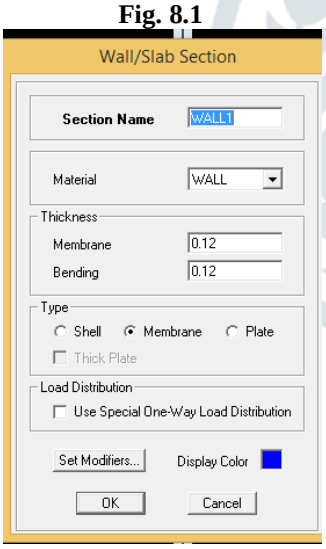


Fig. 8.2 Procedure for modeling of slab and wall

C. UDL due to walls

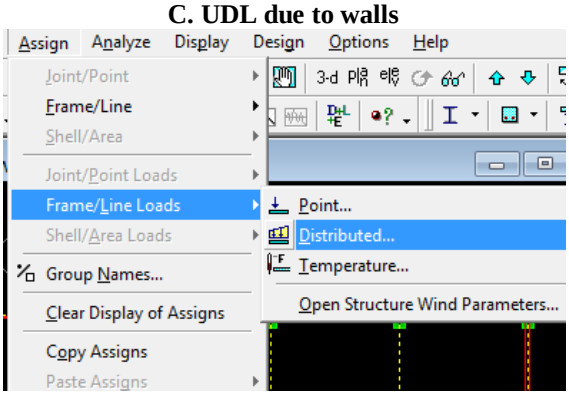


Fig. 9 Procedure to assign UDL to beams

UDL of wall= 0.12(thickness) x 3.2(height of wall) x 20(brick density)=7.68KN/m

D. Live load on floor area

Table 8 Percentage of Imposed Load to be Considered in Seismic Weight Calculation

(*Clause* 7.3.1)

Imposed Uniformity Distributed Floor Loads (kN/ m^2)	Percentage of Imposed Load
(1)	(2)
Upto and including 3.0	25
Above 3.0	50

Fig. 10 Live load is considered 3KN/m^2 on each floor **(referred as per IS1898(part 1) :2002)**

E. Load combination

As per IS 1893:2000, the load combination Dead load +Live Load becomes,

D.L + 25% L.L

This live load reduction is defined by a command mass source in ETABS.

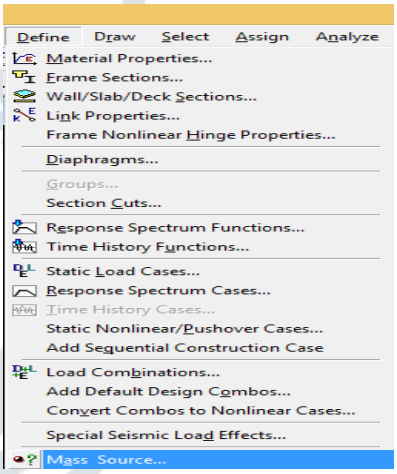


Fig . 11 Procedure for defining mass source

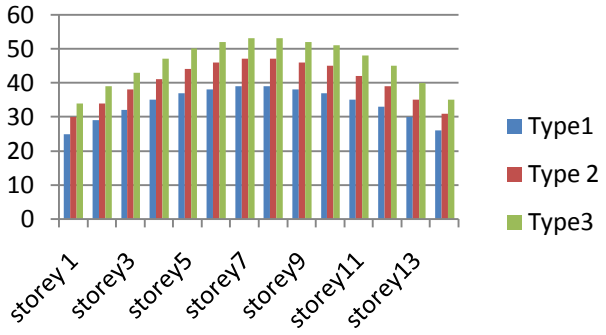
IV. Output of analysis

Comparative results of base shear, seismic weight, storey drift, and storey shear of different types of soil with respect to seismic zones

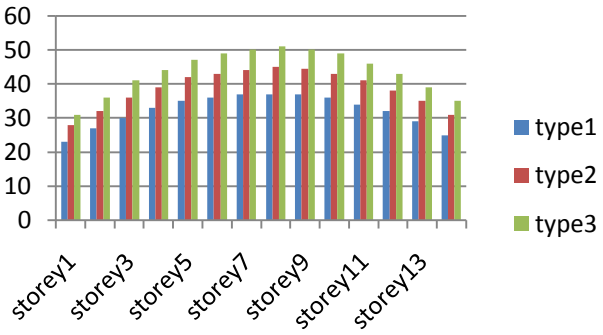
A. Results of seismic zone II and type of soil I,II,III.

Soil type	Base shear	Seismic weight
I	1366.77	106793.48
II	1640.13	106793.48
III	1858.81	106793.48

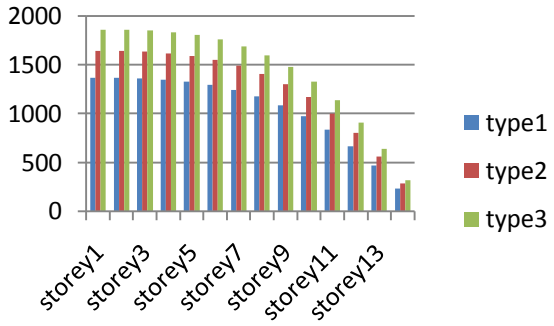
Table. 1



Graph. 1.1 Storey drifts in x-direction



Graph. 1.2 Storey drifts in y-direction

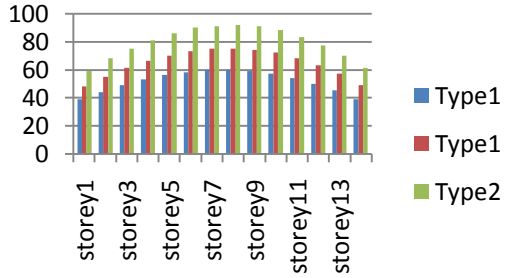


Graph. 2 storey shear

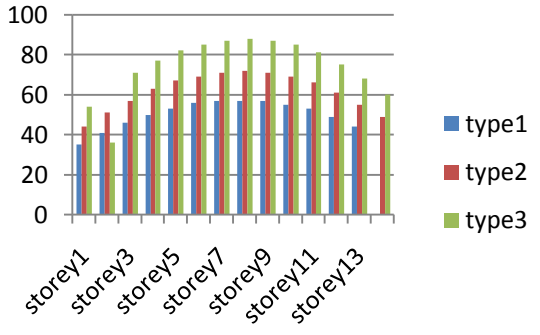
B. Results of seismic zone III and type of soil I,II,III.

Soil type	Base shear	Seismic weight
I	2102.73	106793.48
II	2624.21	106793.48
III	3222.37	106793.48

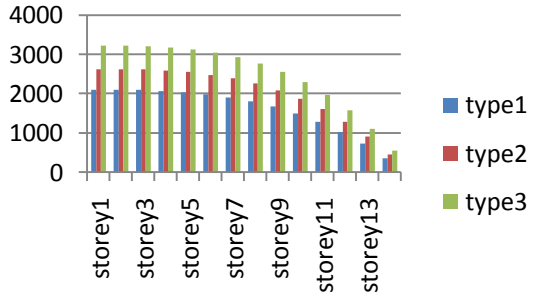
Table. 2



Graph. 3.1 Storey drifts in x-direction



Graph. 3.2 Storey drifts in y-direction

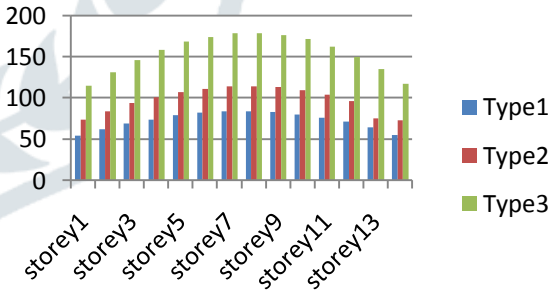


Graph. 4 storey shear

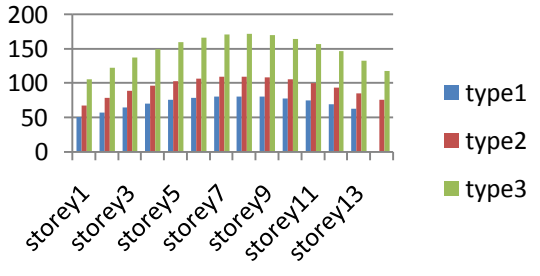
C. Results of seismic zone IV and type of soil I,II,III.

Soil type	Base shear	Seismic weight
I	2894.35	106793.48
II	3936.31	106793.48
III	4833.56	106793.48

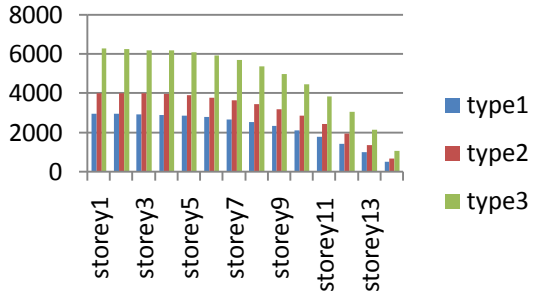
Table. 3



Graph. 5.1 Storey drift in x-direction



Graph 5.2 Storey drift in y-direction

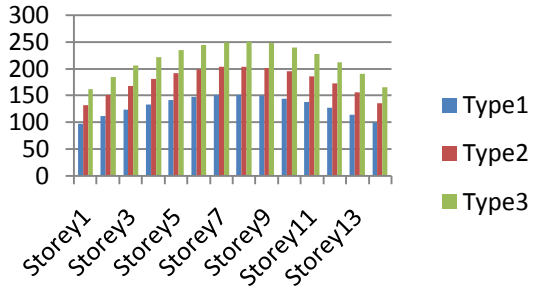


Graph. 6 Storey shear

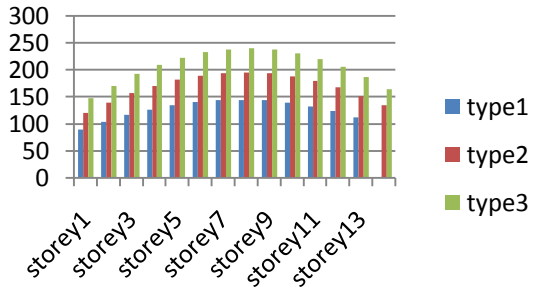
D. Results of seismic zone V and type of soil I,II,III.

Soil type	Base shear	Seismic weight
I	5272.92	106793.48
II	7129.18	106793.48
III	8754.22	106793.48

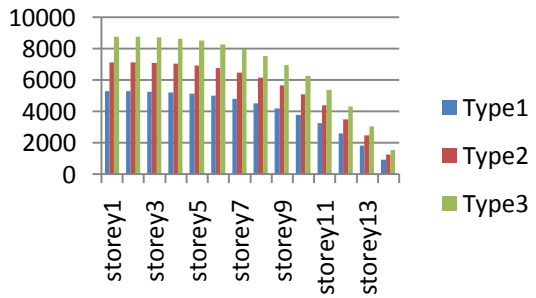
Table. 4



Graph. 7.1 Story drift in x-direction



Graph 7.2 Storey drift in y-direction



Graph. 8 Storey shear

V. CONCLUSION

In the present study, an attempt is made to compare the results obtained from static analysis of reinforced concrete structure by Seismic Coefficient Method specified in IS 1893:2002 using ETABS.

- The base shear, storey shear and storey drift values of type 3 soil in every seismic zone have the higher value.
- The seismic weight remains constant, since the structure does not change.
- Storey shear in x direction and y direction remains same.
- In seismic zone III storey drift the value is moderate initially, and decreases rapidly later increases and forms a parabolic curve when plotted against storey.
- Zone V type III soil has the highest valve of base shear, storey drift, storey shear among all the seismic zones.

- **Storey drift** increase with respect to type of soil respectively in both x and y directions.
- **Storey drift** initially increases with increase in storey, later at middle storey they are equal and decreases gradually.
- **Storey drift** forms a parabolic curve when plotted against no. storey's in both x and y directions.
- **Storey shear** is initially high and decreases with increase in the no. storey.
- **Storey shear** forms a semi arc curve when plotted against no. storey.

REFERNCES

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