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COMPARATIVE STUDY AND ANALYSIS OF MULTI-STORIED (G+8) REGGULAR AND IRREGULAR BUILDINGS WITH DIFFERENT ZONES USING ETABS

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Abstract: Multi storey Rc structure are most dangerous earthquake it was found that main reason for failure of Rc building is irregular distribution of mass and strength stiffness or due to irregular geometrical configuration. in reality many existing buildings contain irregularity due to functional and aesthetic requirements .However fast Aspects in formulating. the seismic methodology by the seismic codes (IS 1893-2002).The review of seismic design codes and reported research codes studied show that the Irregularity .The principal objectives of this project is to study the structural behaviour of multi story RC structure for different plan configuration such as rectangular building along with L- shape, C-shape, H-shape in according with seismic provisions code (IS 1893-2002) using ETABS Software. The analysis involved load calculation and analyzing the whole structure on the of dynamic analysis.ie Response spectrum analysis and time history analysis confirming to Indian standard code of practice .For time history analysis past earth quake ground motion record is taken to study the response of all the structure. These analysis are carried out by the different seismic zones(zone1 zone 2) .

***Key Words*: Irregularity, Time History Method ,ETABS , Response Spectrum Analysis , Dynamic Analysis**

1.INTRODUCTION ;. One of the most common causes of structural collapse during earthquakes is vertical irregularities. Structures with weak storeys, for example, were the most prominent structures to collapse. As a result, the impact of vertical irregularities on structural seismic performance becomes critical. The dynamic characteristics of these buildings vary from normal buildings due to changes in stiffness and mass as they rise in height. The irregularity in building structures is caused by irregular distributions in mass, weight, and stiffness along the height of the building, according to the IS 1893: 2016 description. The study and design of such structures become more complicated when they are built in high seismic zones.

There are two types of irregularities in Buildings

1. Vertical Irregularities
2. Plan Irregularities

Vertical Irregularities Are Mainly o f Five Types

1.**Stiffness Irregularity** (Soft Storey) - The lateral stiffness of a soft storey is less than 70% of the storey above or less than 80% of the average lateral stiffness of the three storey

2.**Mass Irregularity** - When the seismic weight of any storey exceeds 200 percent of the weight of its neighbouring storeys, mass irregularity is present. In the case of roofs, irregularity is not a factor to consider.

3.**Vertical Geometric Irregularity** - When the horizontal dimension of the lateral force resisting mechanism in any storey is more than 150 percent of that in the adjacent storey, the structure is called vertical geometric irregular.

4.**In-Plane Discontinuit**y in Vertical Elements Resisting Lateral Force - A lateral force resisting element with an in-plane offset greater than the length of the element.

5.**Discontinuity in Capacity** - A weak storey is described as one whose lateral strength is less than 80% of that of the storey above it. According to IS 1893; 2016, Part 1, linear static analysis of structures can be used for normal structures of limited height since lateral forces are measured according to the structure's fundamental time span

1. 1 **SCOPE AND OBJECTIVE OF THE PROJECT;**

This project aims at evaluating multi-storey building having same area as irregular shape building with L, C, T; I shape against seismic loads and seismic vibrations, using the structural engineering software ETABS version 16. However, the goal is to achieve a sustainable and efficient structure with approved functionality and increased ductility. To guarantee this achievement, there are a number of important objectives that have to be accomplished:

- By assessing building capacity with regard to seismic loads and studying the performance and weaknesses of the structure like general displacements and undesired brittle failures.
- By performing a global analysis, the overall behaviour of the structure can be assessed regarding safety, efficiency and ductility. Moreover,

the weak points of the structure can be checked by studying the results of the frequencies and by collecting the critical displacements.

- By modifying the structure with a suitable seismic retrofitting technique according to IS 1893-2016 & IS 13935-2009. The chosen technique will consider the structural behaviour building and its current capacity
- Conventional building having regular plan is analysed
- Irregular shape like L,T ,I , C shape buildings were considered in this project work.
- Determination behaviour of irregularity buildings in seismic zone II, III, IV

2. METHODOLOGY;

- The aim of the current thesis work is to study seismic responses (store displacements, storey drift. Fundamental time period and base shear) of regular and irregular plane irregularity building located in different seismic zones (for Zone II, III, and IV) as per IS 1893-2016
- Five models of different plan irregularity are models in ETABS and their responses are noted down and compared to evaluate the results and conclusion
- Dynamic Analysis is carried out using Response spectrum method & Time history method to evaluate the seismic responses of varies models defined below

2.1 Modeling;

- **Model 1** consists of a square model of length and breadth 24 Meters. each and height 30 meters namely 10 floor. With 4 bays in both the directions with a span of 6 meters each and is analyzed for seismic zones II, III, and IV and the results and noted down
- **MODEL 2**
- Model 2 consists of a L shaped model of length and breadth 30 meters each and height 30 meters namely 10 floor. With 2 bays in both the directions with a span of 6 meters each and is analyzed for seismic zones II, III, and IV and the results and noted down
- **MODEL 3**
- Model 3 consists of a C shaped model of length and breadth 30 meters each and height 30 meters namely 10 floor. With varying bays configurations in both the directions with a span of 6 meters each and is analyzed for seismic zones II, III, and IV and the results and noted down
- **MODEL 4**
- Model 4 consists of a T shaped model of length 36 meters and breadth 24 meters each and height 30 meters namely 10 floor. With varying bays configurations in both the directions with a span of 6 meters each and is analyzed for seismic zones II, III, and IV and the results and noted down
- **MODEL 5**
- Model 5 consists of a I shaped model of length 36 meters and breadth 24 meters each and height 30 meters namely 10 floor. With varying bays configurations in both the directions with a span of 6 meters each and is analyzed for seismic zones II, III, and IV and the results and noted down

MODEL 1) Square Model:

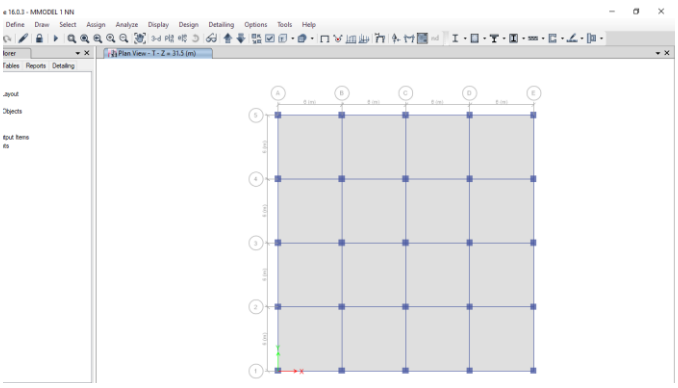

Figure 2.1: ETABS Square Model

Model 2) L Shaped Model:

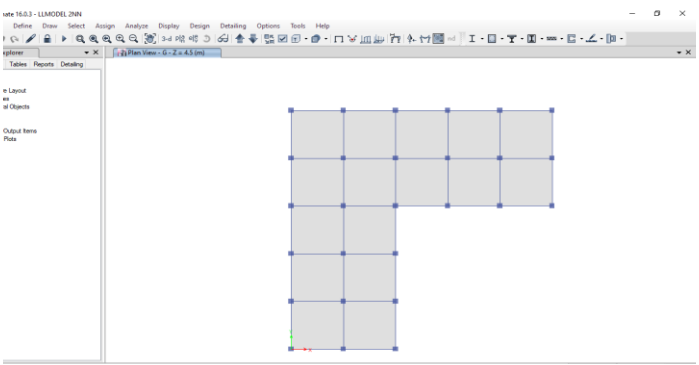

Figure 2.2: ETABS Model L

Model 3) C Shaped Model:

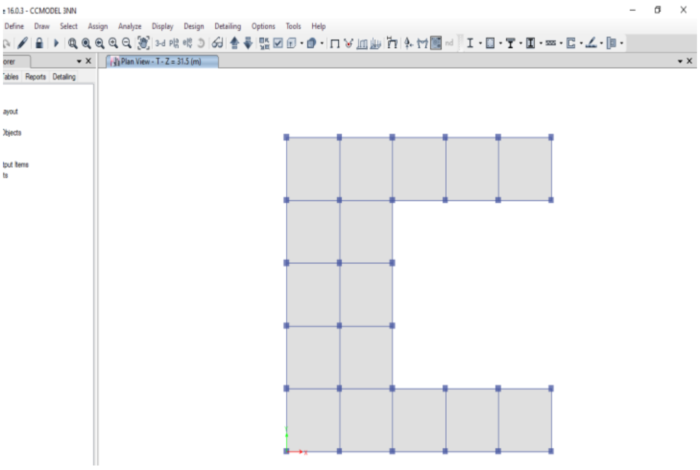

Figure 2.3: ETABS Model C

Model 4) T Shaped Model:

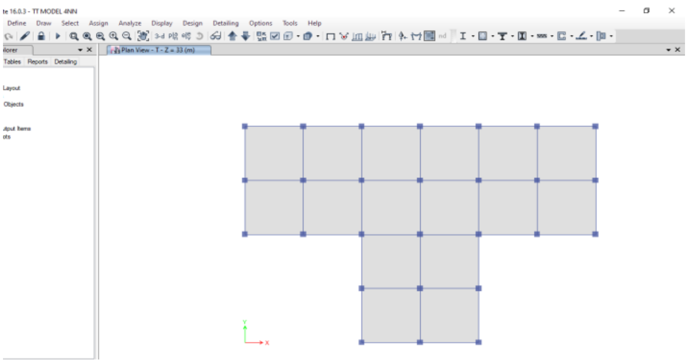

Figure 2.4: ETABS Model T

Model 5) I Shaped Model:

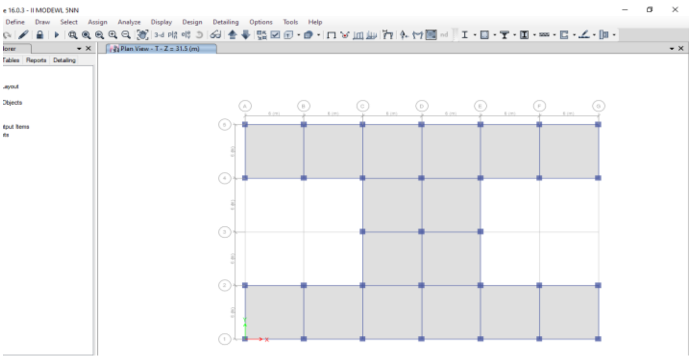

Figure 2.5: ETABS Model I

Steps involved:-

- Obtaining the architectural and structural design of the building.
- Inputting material and section properties.
- Defining material property and member section definitions.
- The model of the structure.
- Loading definition, assigning loadings.
- Response spectrum definition.
- Load case for response spectrum analysis.
- Perform dynamic linear analysis.
- Matching of base shear.
- Checking the results.

3. **Defining material Properties:**

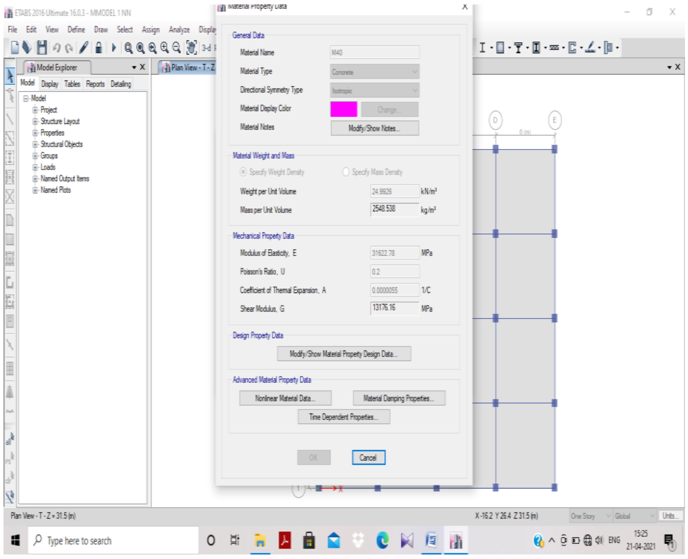

Figure 3.1: M40 grade is used for columns

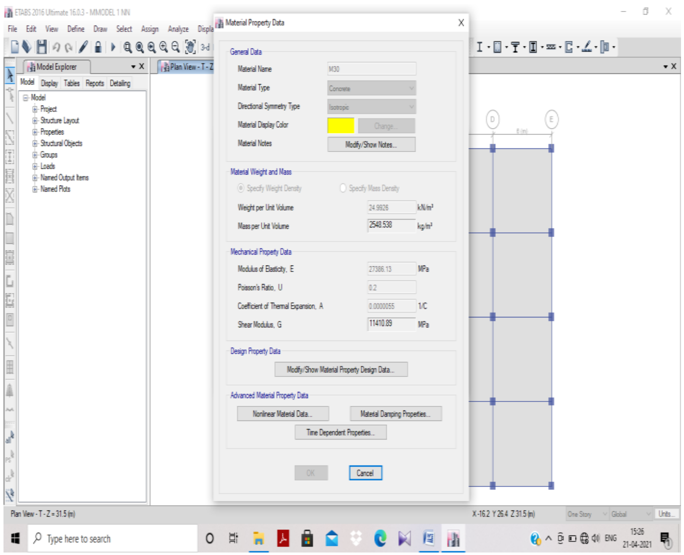

Figure 3.2: M30 grade is used for beams

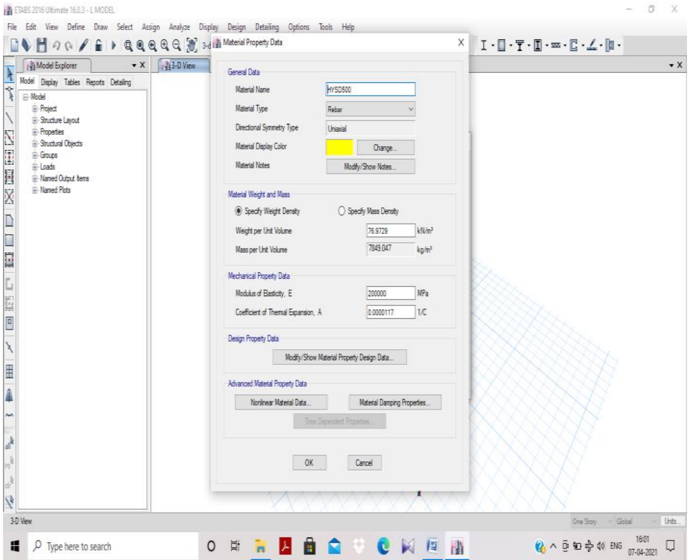

Figure 3.3: Fe500 is used for steel bars

4. Section properties:

Beams of size 300X600 is used

Columns of size 600x600 is used

Slab of thickness 150mm

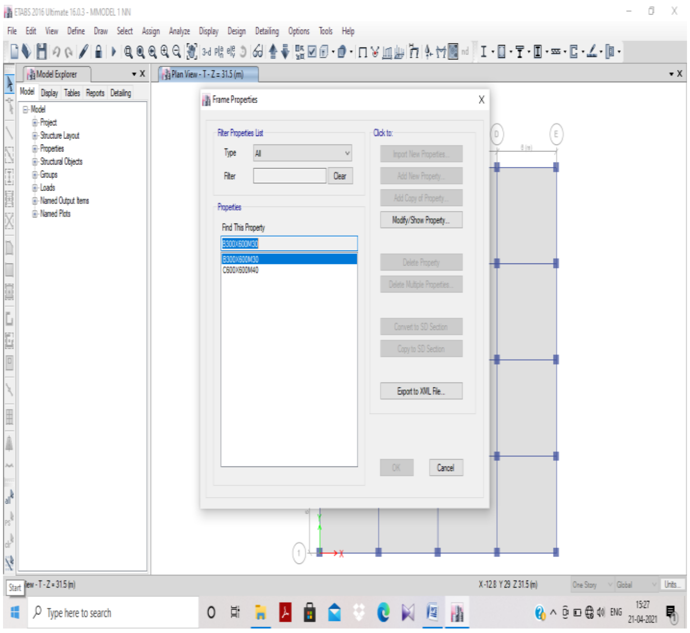

Figure 4.1 : Section properties

Design loads :

The loads which have been used for the modelling are as follows:

- Self-weight of the structure
- Floor finish
- Wall load
- Typical live load
- Roof live load
- Seismic load

1. Dead load as per IS: 875 (Part I)-1987

i) Self weight of slab (150 mm thick) - 3.75 KN/m2

ii) Loading due to Floor Finishes - 1.50 KN/m2

2. From masonry walls – 9.6kN/m 3.

3. Live load as per IS: 875 (Part-II)-1987

i) Live load on floor – 3.00 KN/m2

ii) Live load on roof - 1.50 KN/m2

4. Earthquake load. IS: 1893-2016

I. Zone factor - 0.1

II. Zone factor - 0.16

III. Zone factor - 0.24

ii) Soil type - II

iii) Importance factor - 1

iv) Time period in X direction - 0.49

v) Time period in Y direction - 0.55

The structure was analyzed for dead load, live load, seismic load and their combinations. The structural adequacies of existing members were checked as per the guidelines in IS: 456-2000 and SP-16.

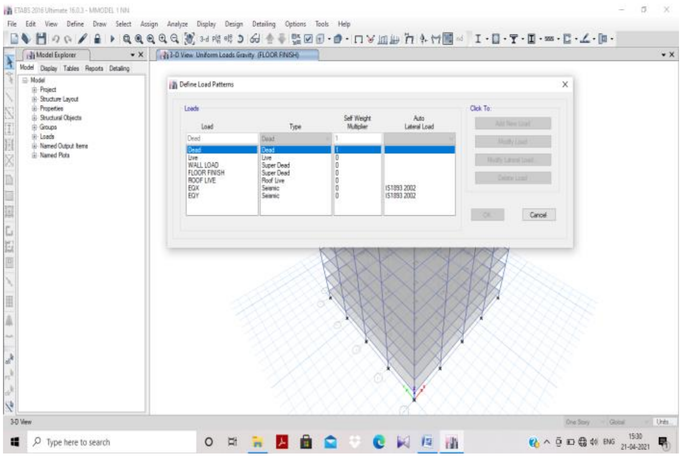

Figure 4.2: Self weight

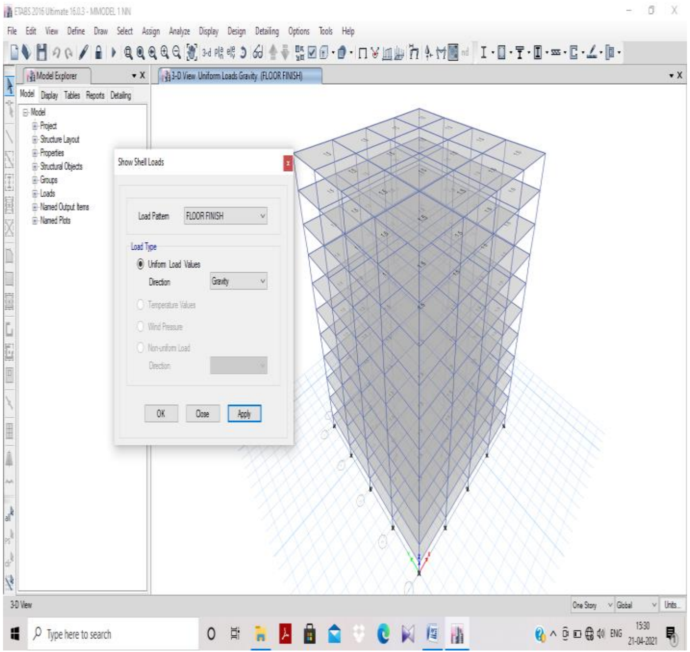

Figure 4.3: Floor finish load for Square Model

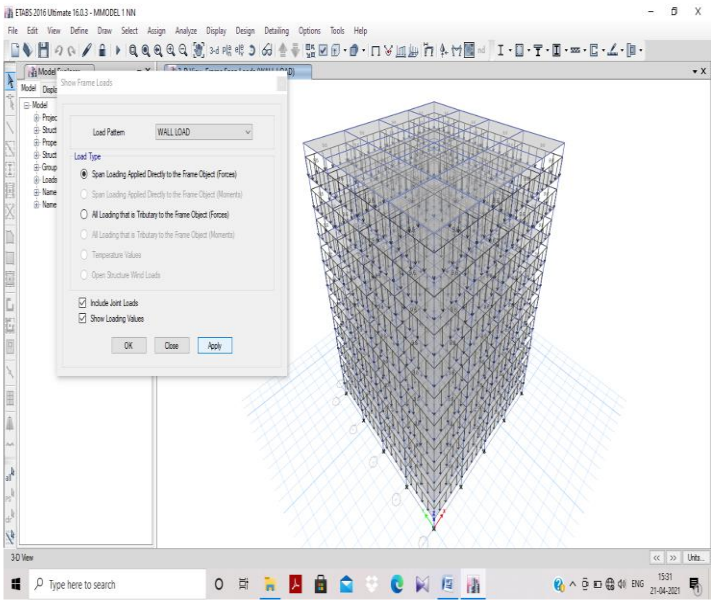

Figure 4.4: Wall load for Square Model

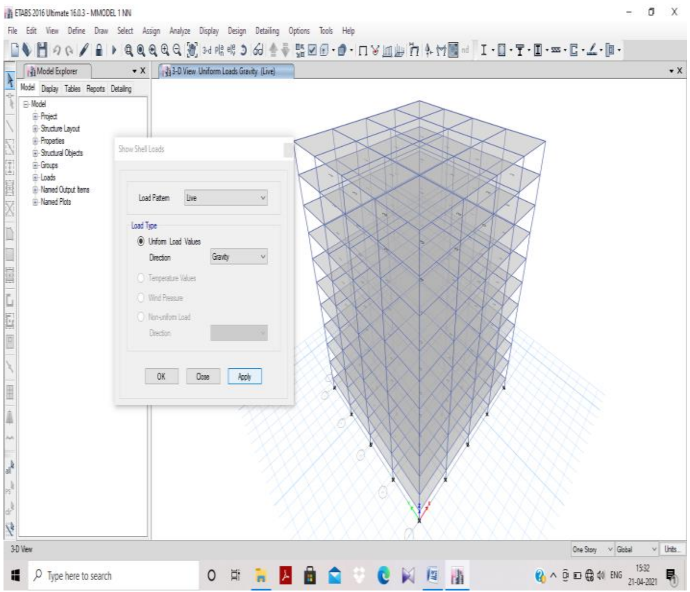

Figure 4.5: Typical live load for Square Model

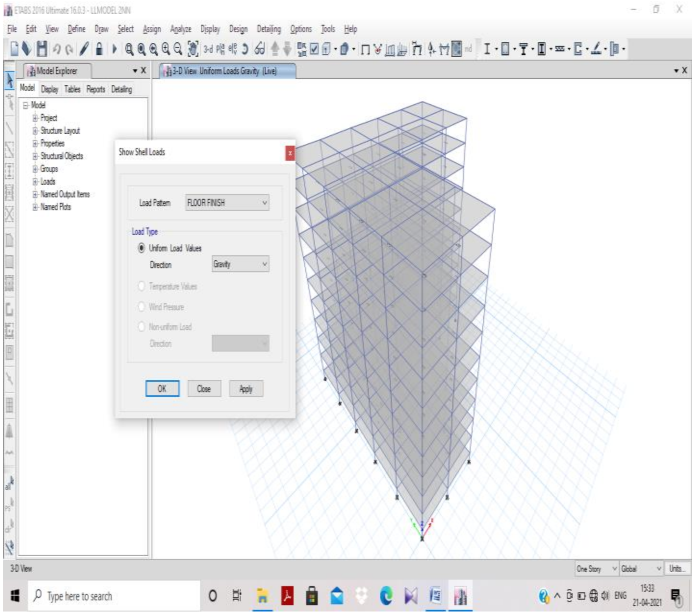

Figure 4.6: Floor finish load for Model L

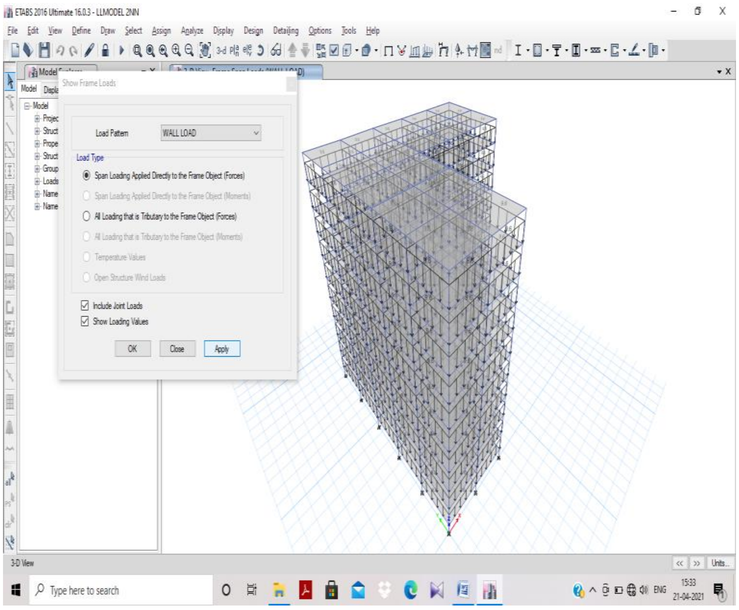

Figure 4.8: Wall load for Model L

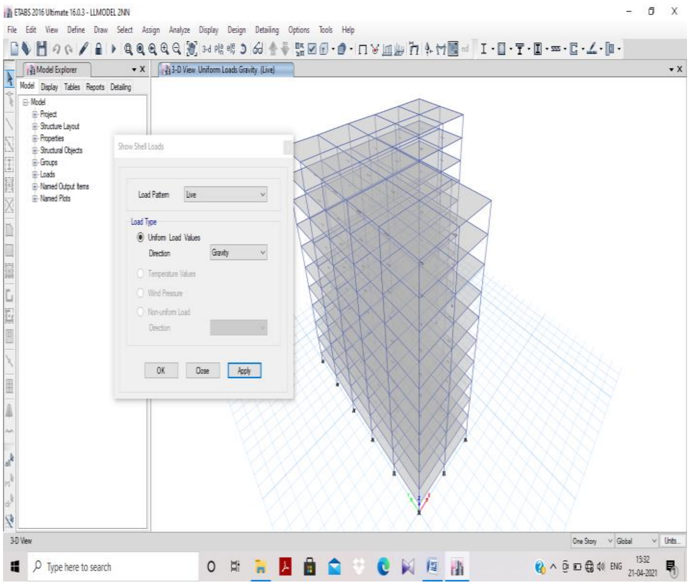

Figure 4.7: Typical live load for Model L

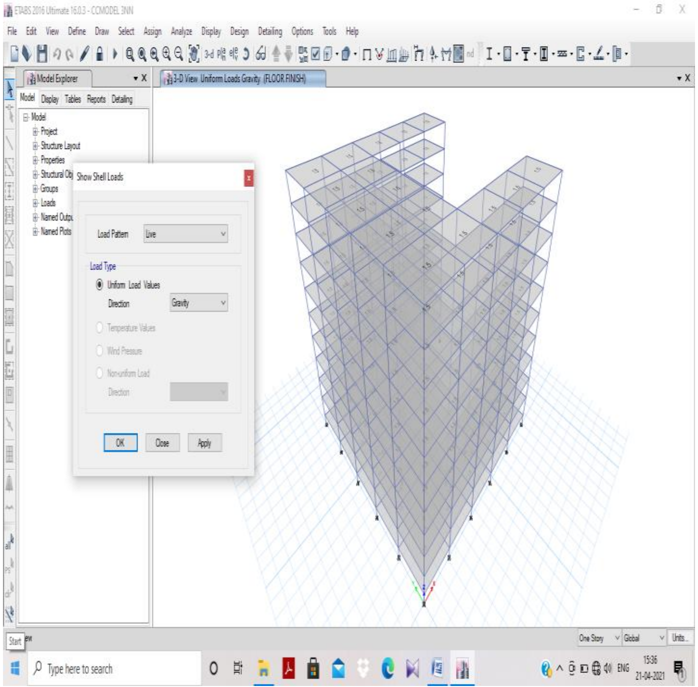

Figure 4.9: Typical live load for Model C

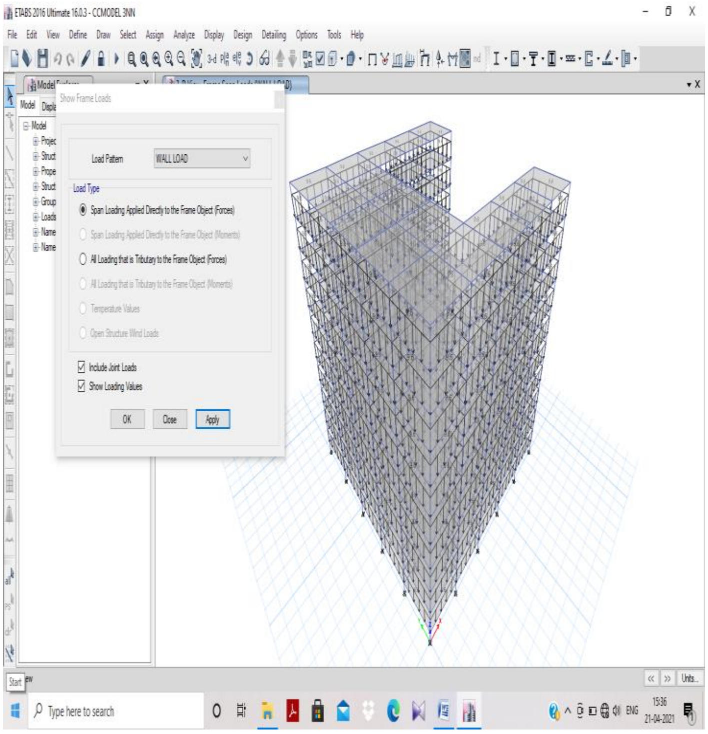

Figure 4.10: Wall load for Model C

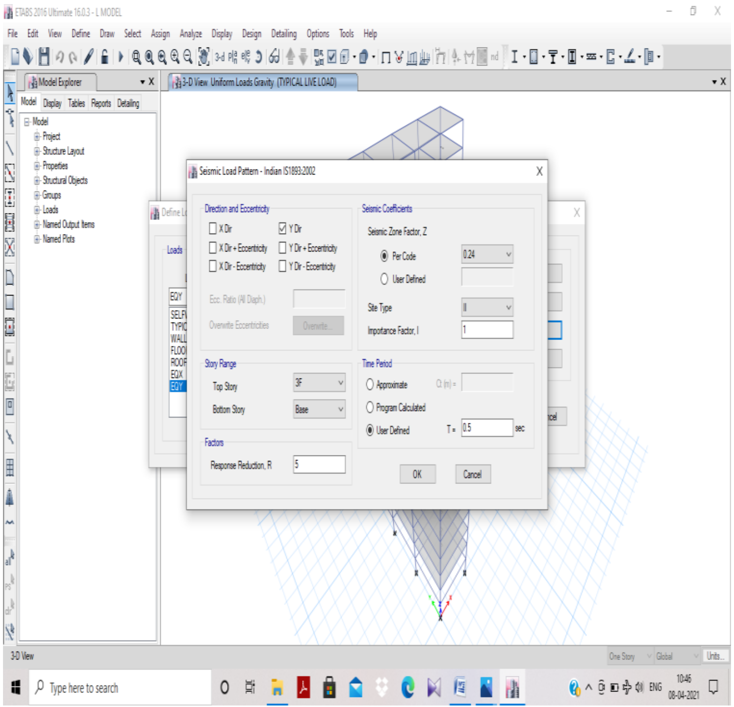

Figure 4.11: Seismic load definition in Y- Direction

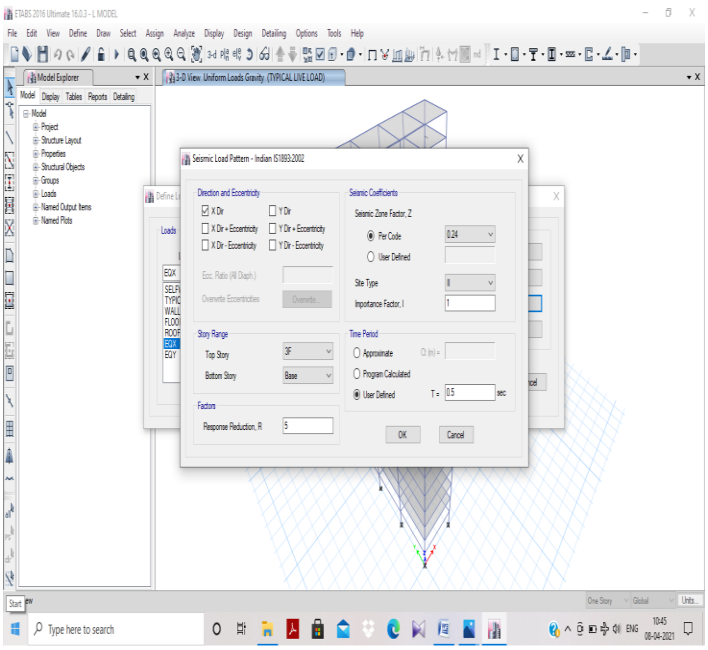

Figure 4.10: Seismic load definition in X- Direction

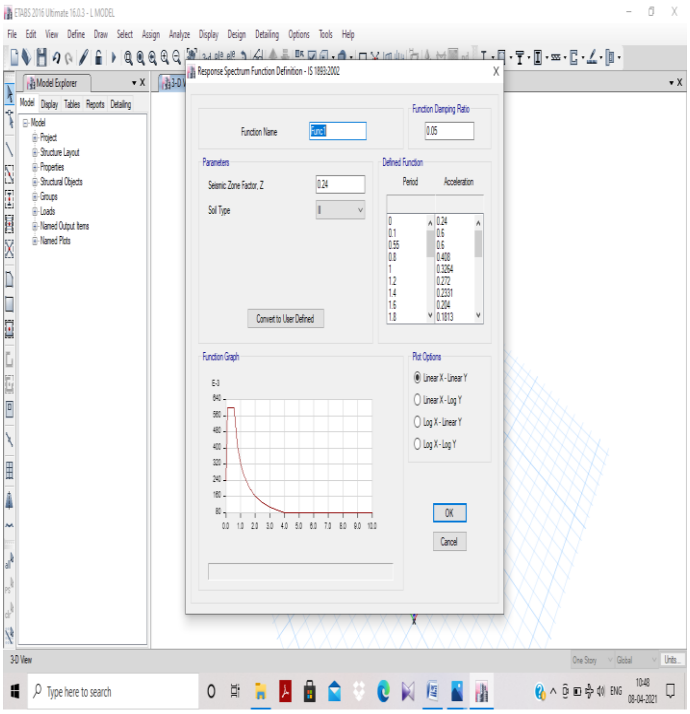

Figure 4.11: Response spectra Method

5. DISCUSSION OF RESULTS

In this study a G+B+8 storey square model (area 576m²) and model L, model C , model T, and model I of same area 576m² were analyzed

- Regular model having are of 576m² include dead load, live load and dynamic (Response spectrum and Time history analysis) earthquake loading.
- Model L (area 576m²) include dead load, live load and (Response spectrum and Time history analysis) dynamic earthquake loading.
- Model C (area 576m²) include dead load, live load and (Response spectrum and Time history analysis) dynamic earthquake loading.
- Model T (area 576m²) include dead load, live load and (Response spectrum and Time history analysis) dynamic earthquake loading.
- Model I (area 576m²) include dead load, live load and (Response spectrum and Time history analysis) dynamic earthquake loading.

5.1Displacement:

The maximum values of displacements are tabulated by comparing X and Y directions. The values of displacement of different models are obtained by subjecting the models to response spectrum analysis and time history analysis (linear) shows max displacement. Further the tabulated results are plotted in a graph

Table 1: Max Displacement values for Zone II (Response spectrum X and Y direction

SL NO	MODEL	MAX DISPLACEMENT (mm) SPECX	MAX DISPLACEMENT (mm) SPECY
1	SQUAREMODEL	17.96	17.96
2	MODEL L	20.41	20.41
3	MODEL C	16.01	21.79
4	MODEL T	10.75	10.52
5	MODEL I	15.04	18.96

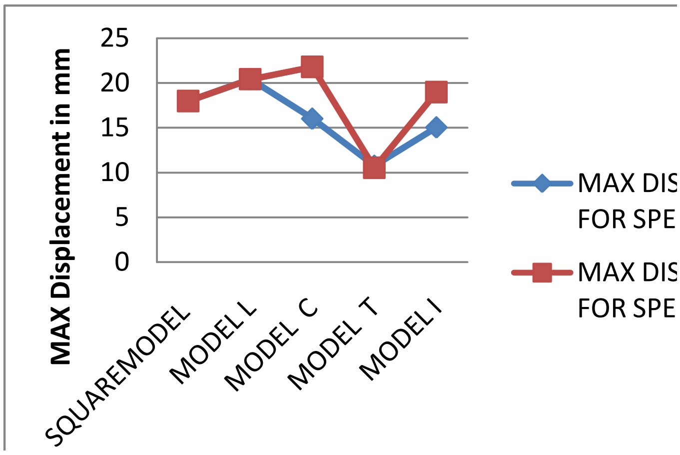

CHART 1: **Graph of displacement variation**

TABLE 2: Max Displacement values for ZONE II (Time history X and Y direction)

SL NO	MODEL	MAX DISPLACEMENT (mm) THX	MAX DISPLACEMENT (mm) THY
1	SQUAREMODEL	16.23	16.23
2	MODEL L	17.49	17.49
3	MODEL C	15.01	18.26
4	MODEL T	12.34	11.76
5	MODEL I	14.23	18.19

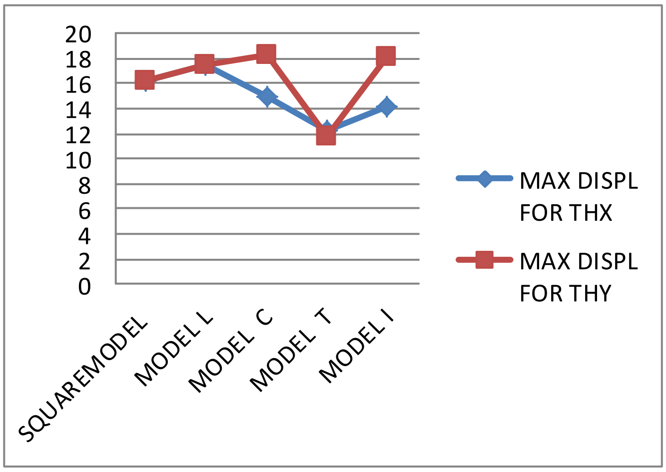

CHART 2:**Graph of displacement variation**

5.2 STORY DRIFT

Table 3: Max Storey Drift values for Zone II (Response spectrum X and Y direction)

SL NO	MODEL	MAX STOREY DRIFT SPECX	MAX STOREY DRIFT SPECY
1	SQUAREMODEL	0.000862	0.000862
2	MODEL L	0.000971	0.000971
3	MODEL C	0.000769	0.000702
4	MODEL T	0.000492	0.000481
5	MODEL I	0.000726	0.000894

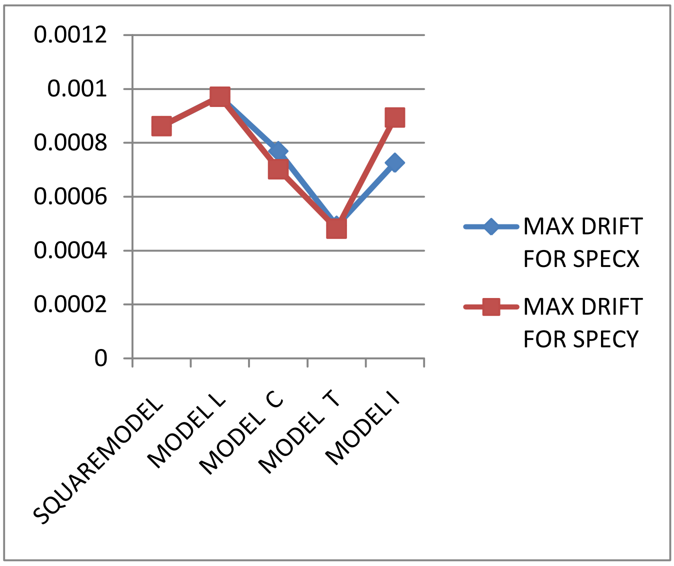

CHART 3: Graph of Storey drift variation

Table 4: Max Storey Drift values for Zone II (Time history X and Y direction)

SL NO	MODEL	MAX STOREY DRIFT THX	MAX STOREY DRIFT THY
1	SQUAREMODEL	0.000845	0.000845
2	MODEL L	0.000960	0.000960
3	MODEL C	0.000823	0.000975
4	MODEL T	0.000482	0.000469
5	MODEL I	0.000737	0.000899

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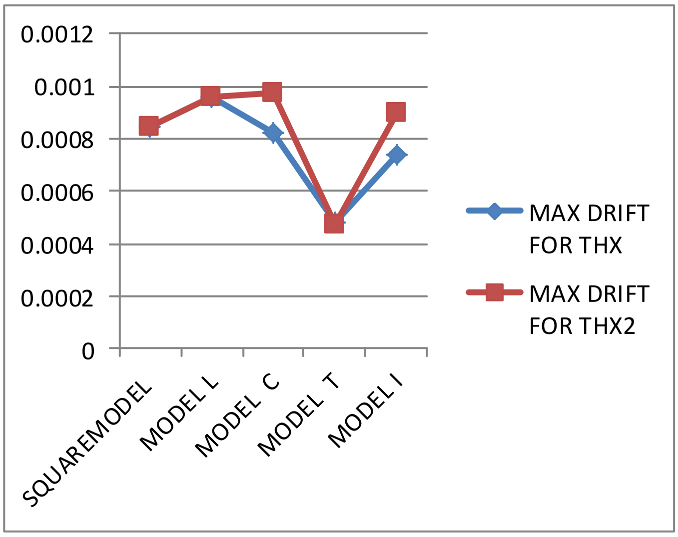

CHART 4: Graph of Storey drifts variation

5.3 Time period

Table 5: Time period values for different Models

SL NO	MODEL	MAX TIME PERIOD FOR ZONEII MODEL Seconds	MAX TIME PERIOD FOR ZONEIII MODEL Seconds
1	SQUAREMODEL	1.49	1.49
2	MODEL L	1.48	1.48
3	MODEL C	1.50	1.50
4	MODEL T	1.75	1.75
5	MODEL I	1.535	1.535

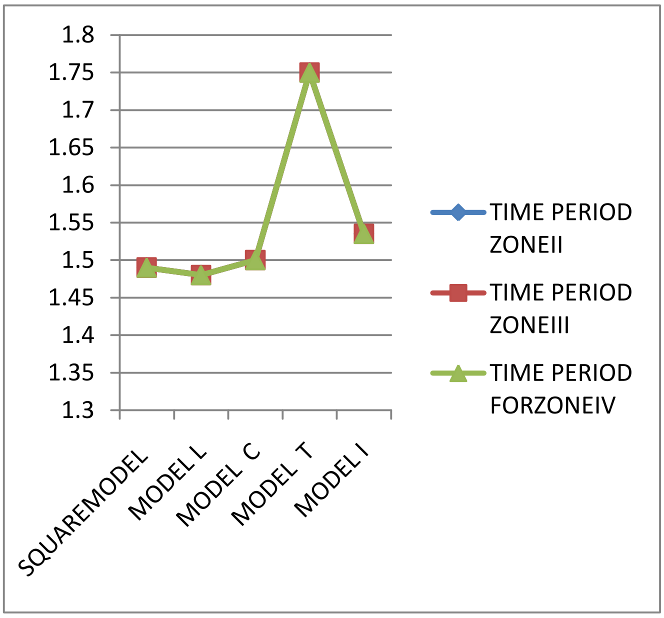

CHART 5: Graph of variation in time period

5.4: Base shear

Base shear is a measure of the maximum expected lateral force that will happen due to the seismic ground motion at the base of the structure. Since base shear value directly proportional to weight of the building, the regular model is having fewer loads compared to other models. Calculation of base shear rely on upon, soil conditions at the site, concurrence to potential sources of seismic activities. The base shear values are obtained for the optimal angle of Diagrid and for different structural forms in the below table 3

Table 6: Base shear values for Zone II, III

SL NO	MODEL	MAX BASE SHEAR FOR ZONE II MODEL KN	MAX BASE SHEAR FOR ZONEIII MODEL KN
1	SQUAREMODEL	1589.480	4238.630
2	MODEL L	1634.930	4359.810
3	MODEL C	1703.090	4541.580
4	MODEL T	870.290	2320.770

5	MODEL I	1725.810	4602.17

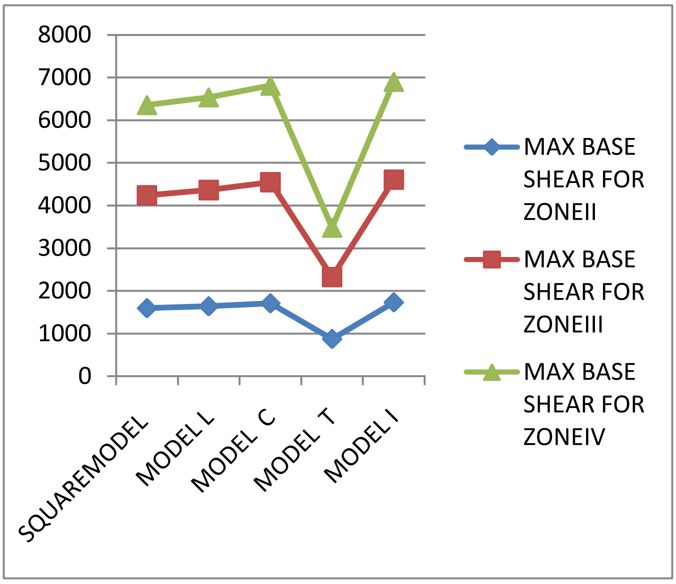

CHART 6: Graph of variation in base shear.

6. CONCLUSION

By considering the five models with different zones and their behaviour in dynamic earthquake loading. It is concluded that Model T (with zone iv) gives the most suitable results. As it tends to reduce the time period, reduce the lateral displacement and storey drift in both X and Y direction by a good margin

REFERENCES

[1]. "Comparative Study of the Static and Dynamic Analysis of Multi-Storey Irregular Building" Bahador Bagheri, Ehsan Salimi Firoozabad, and Mohammadreza Yahyaei
[2]. Static and Dynamic Behaviour of Reinforced Concrete Framed Building: A Comparative Study
[3]. Prakash Sangamnerkar*, Dr. S. K. Dubey,
[4]. Design Cell,M. P. Housing and Infrastructure Development Board, Bhopal (M.P.) 462013
[5]. Professor, Deptt. Of Civil Engineering, Maulana Azad National Institute of Technology, Bhopal (M.P.) 462051
[6]. Response Analysis of Multi-Storey RC Buildings under Equivalent Static and Dynamic Loads According to Egyptian Code SayedMahmoud1, Waleed Abdallah2 1Department of Construction Engineering, College of Engineering, Dammam University Dammam, Saudi Arabia 2Faculty of Engineering at Mataria, Helwan University Cairo, Egypt
[7]. Static and Dynamic Behavior of Reinforced Concrete Framed Building: A Comparative Study
[8]. Prakash Sangamnerkar*, Dr. S. K. Dubey
[9]. Design Cell,M. P. Housing and Infrastructure Development Board, Bhopal (M.P.) 462013
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