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A Study of Seismic Analysis of Building Using ETABS

Umer Bin Fayaz[1], and Brahamjeet Singh[2]

[1]M. Tech Scholar, Department of Civil Engineering, RIMT University, Mandi Gobindgarh, Punjab, India
[2]Assistant Professor, Department of Civil Engineering, RIMT University, Mandi Gobindgarh, Punjab, India

ABSTRACT- In this era, as urbanization is rapidly increasing the availability of land is becoming less, due to overpopulation and increased land cost. To overcome this rising problem, the only solution is to opt for multistorey buildings. The effective design and construction of earthquake resistant structures have much greater importance all over the world. For this ETABS provides both static and dynamic analysis for a wide range of gravity, thermal and lateral loads. This analysis mainly deals with the study of plans by using AutoCAD software. It is to analyze the design of G+5storey building. Seismic analysis of all types of structures is an important aspect when working in high seismic areas. With the help of seismic analysis, structures can be designed and constructed to withstand strong lateral movements of the crust during earthquakes.

KEYWORDS- Multi-Story Building, Column Jacketing, ETABS V21, Designer, Modelling, Story Drifts, Maximum Story Displacement.

I. INTRODUCTION

The rapid growth of high-rise buildings in urban areas has effectively erased the need for land. High-rise buildings can accommodate thousands of people at a time in a small area compared to the land needed for one- and two-story houses. However, these types of buildings are also vulnerable to natural disasters such as earthquakes. Earthquakes are the most dangerous in terms of the damage and destruction they cause to structural buildings. These natural disasters cause devastating damage to property and disrupt the development of affected areas[1]. The vibrations produced by an earthquake are characterized by randomness, as the ground vibrates in the earthquake zone in different directions, causing a variable acceleration of the ground that affects the foundation placed within the earthquake location, which in turn influences the elements of the structural building that vibrate and generate internal forces associated with the quantity of acceleration due to earthquake and with the weight of these elements. It is ascertained from the past earthquakes, that multistorey buildings have intimate high degree of damage leading to folding. Although they have been designed for safety of the occupants against natural hazards. Thus, adopting multi-storey buildings in seismically active areas, utmost care is ought to be taken while making these buildings earthquake resistant [2]. Since

We always aim to minimize the destruction caused by earthquakes, we will analyze how a multistorey building reacts/responds when it is subjected to the forces induced during an earthquake [3]. The analysis would be carried out using ETABS software considering Dead, Live & Seismic loads.

II. PROBLEM STATEMENT

We never know how safe a residential building is during any seismic activity. Indian subcontinent has a history full of disastrous earthquakes. The reason for high frequency earthquakes in India is because geological figures indicate that about 54% of the land is prone to earthquake. Therefore, RC multi-story buildings are designed for resisting both the vertical and horizontal load. A high-rise structure will undergo extra lateral load. Thus, we should give sufficient strength and stability to these tall buildings against lateral load. The effect of lateral loads like wind load, earthquake load is achieving escalating significance. While an RC structure may not completely resist the earthquake, its main objective is to resist and perform better during such an earthquake.

III. LITERATURE REVIEW

Ali Kadhim Salal [7] introduces a building designed and analysed for seismic and wind loads using ETABS software. In this case (18 x 18 m), ETABS program models an eight-story building. Assuming a height of 10 stories (3m), we get the height of the entire structure (31m).

Pushkar Rathod et al. [8] described seismic analysis can be used to design and build structures that can withstand strong lateral movements of the crust during earthquakes. Simple or complex structures that can be evaluated under static or dynamic conditions can be evaluated using ETABS. It's an optimized and productive analysis and design tool for everything from simple 2D wireframes to modern skyscrapers, making it one of the best programs for structural analysis of building systems.

Pardeshi Sameer et al. [6] examines the effect of various vertical irregularities on the seismic response of structures. The purpose of this project is to implement ductility by performing response spectrum analysis (RSA) of existing and irregular reinforced concrete building frames and time history analysis (THA) of existing reinforced concrete building frames using IS 13920 based on design. The analysis results of irregular structures are compared with regular structures.

Vijaya Bhaskar Reddy S. et al. [9] presents data from a comparative study of static loads in 5 and 10 story multi-story buildings. The importance of this work lies in assessing the design load of the structure. We concluded that the deflection of the members increases as no of floors increases. We can see that the axial strength of a 10-story building is greater than that of a 5-story building.

Abhay Guleria [10] highlight the structural behaviour of high-rise buildings with different floor plan configurations such as rectangular, C-shaped, L-shaped and I-shaped. A 15-story reinforced concrete simulation building constructed using ETABS analysis software was used. After analysing the structure, the maximum lateral force, bending moment and maximum displacement for the floor are calculated and compared for all analysis cases. As a result of analysing the high-rise building, it was found that the floor overturn moment is inversely proportional to the floor height. The modal shape was derived through dynamic analysis, and it can be concluded that the asymmetric design deforms more than the symmetric design.

A. A. Kale, S. A. Rasal [5**]** proposed ETABS builds and tests four different forms of multi-layered models of the same region according to the recommendations of IS-875-Part3 and IS1893-2002-Part1. The behavior of 15, 30 and 4x5 storey buildings was studied.

Dynamic effects can also be found in the response spectrum method. All parameters such as historical offset, historical drift, base shift, overturn moment, acceleration and duration are calculated. After comparing the results of all of buildings, it was concluded that which section is convenient, and the action of earthquakes or winds is important.

Gauri G. Kakpure, Ashok R. Mundhada [4] provides an overview of previous work performed on multi-story buildings about seismic analysis. It focuses on the static and dynamic analysis of buildings. This article provides an overview of the comparison of static and dynamic analysis of multi-story buildings. Structural parameters such as displacement, bending moment, basic shear, floor displacement, torsion, and axial force were the focus of the study.

IV. MODELLING

In this paper, a hypothetical G+5 story reinforced building is considered as shown in figure 1. This building represents a structure assumed to be built before the seismic codes were adopted or implemented. This structure hence has been designed for gravity loads with the considerations of wind loads and it lies in zone V.
Some of the notable specifications of the building are given in table 1 and are as follows:

Table 1: Salient Features of Proposed Building

Particulars	Values
Type of building	Multistorey building
Height of each storey	3m
Size of Beam	300mm * 400mm
Size of column	400mm * 400mm
Total height of building	18m
Seismic zone	V
Thickness of Slab	150mm
Support conditions	Fixed
Concrete grade	M30, fck = 30N/mm2
Load on beams	3Kn/m
Load on columns	7.56Kn/m
Dead load on slabs	3.75Kn/m2
Live load on slabs	3Kn/m2
Earthquake load on structure	1.5Kn/m2
Wind pressure Coefficient	0.86
Wind speed	39m/s

The plan view for base is shown in figure 1, & 3D view of the building used for the modelling is shown in figure 2:

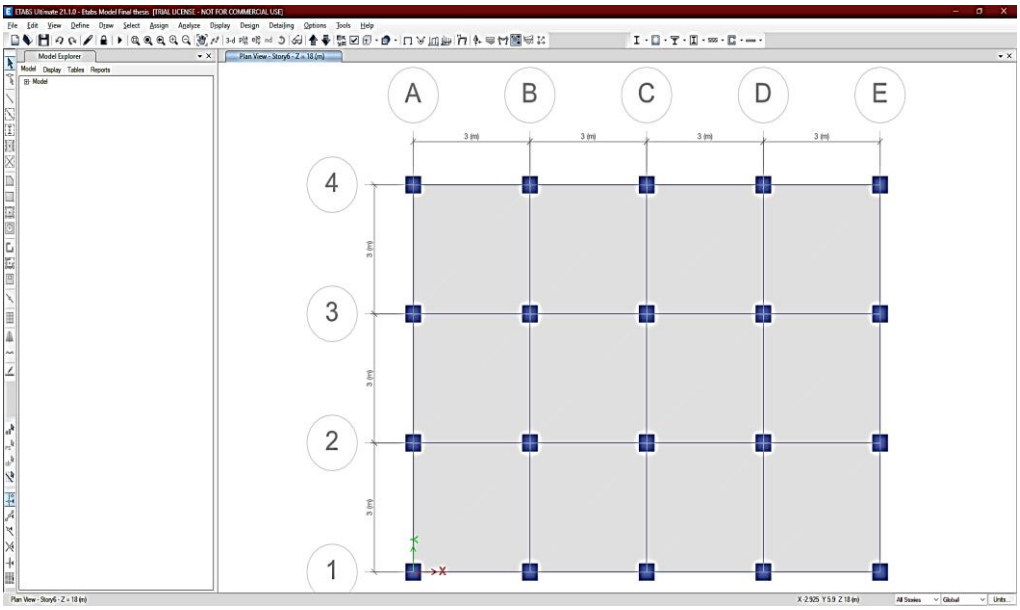

Figure 1: Plan View of the Building

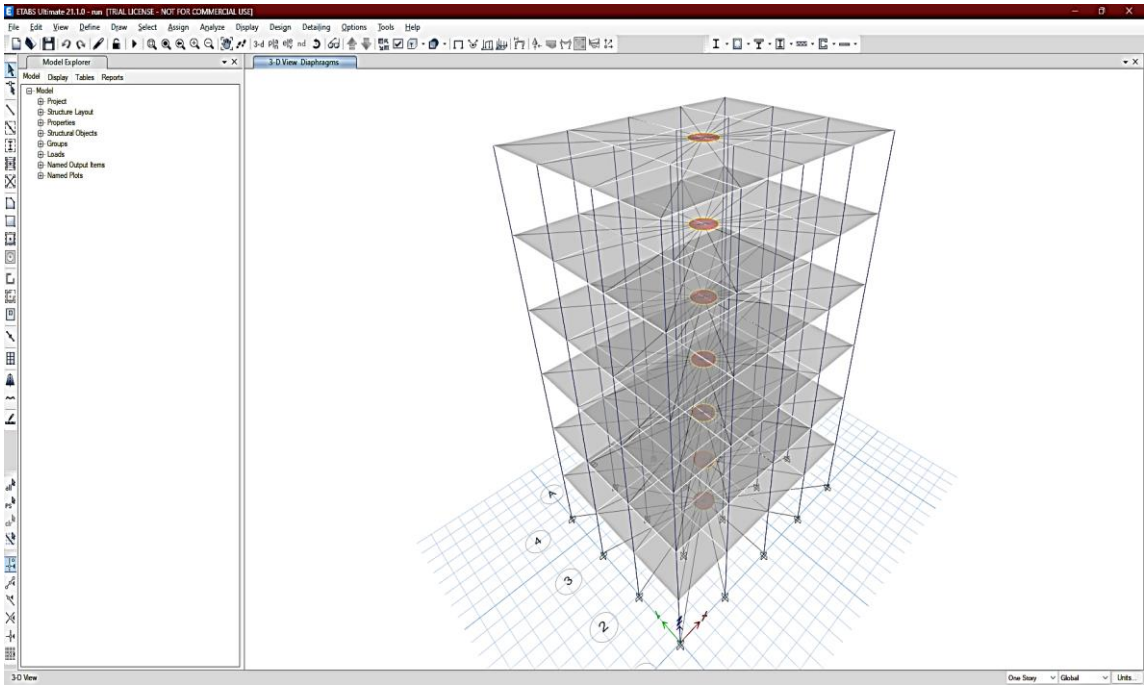

Figure 2: 3D View of the Building

V. RESULTS AND DISCUSSION

A. Drift Values

After the modelling of the building the drift values of the building due to the seismic loading in X and Y directions are shown in the below table 2.

Table 2: Drift Values in X & Y Direction

Story Drifts

File Edit Format-Filter-Sort Select Options

Units: As Noted Hidden Columns: No Sort: None Story Drifts

Filter: None

Story	Output Case	Case Type	Direction	Drift	Label	X m	Y m	Z m
Story6	EQ X	LinStatic	X	0.000686	17	12	0	18
Story6	EQ Y	LinStatic	Y	0.000752	20	12	9	18
Story5	EQ X	LinStatic	X	0.001166	17	12	0	15
Story5	EQ Y	LinStatic	Y	0.001249	20	12	9	15
Story4	EQ X	LinStatic	X	0.001585	17	12	0	12
Story4	EQ Y	LinStatic	Y	0.001683	20	12	9	12
Story3	EQ X	LinStatic	X	0.001925	17	12	0	9
Story3	EQ Y	LinStatic	Y	0.002032	20	12	9	9
Story2	EQ X	LinStatic	X	0.002141	17	12	0	6
Story2	EQ Y	LinStatic	Y	0.002242	20	12	9	6
Story1	EQ X	LinStatic	X	0.001623	17	12	0	3
Story1	EQ Y	LinStatic	Y	0.00167	20	12	9	3

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B. Story Response Plot

The story displacement plots which are showing in figure 3 and figure 4 clearly shows that the maximum displacement value for all stories.

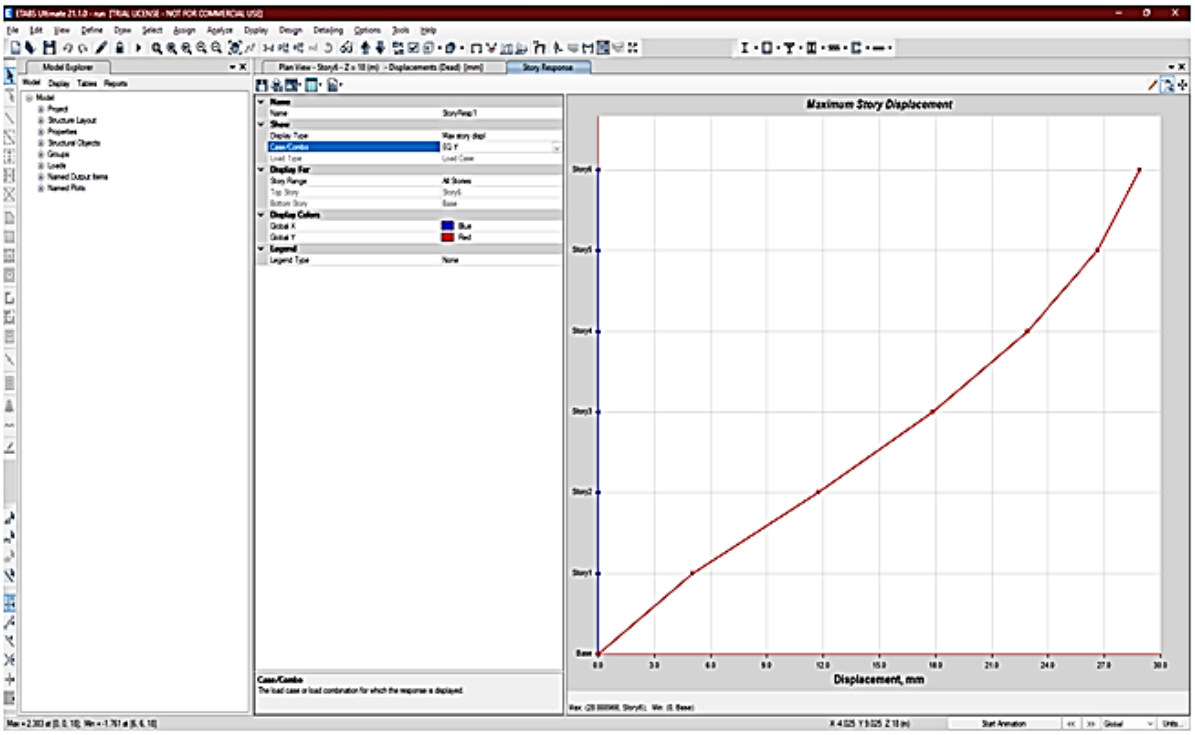

Figure 3: Maximum Story Displacement in X Direction

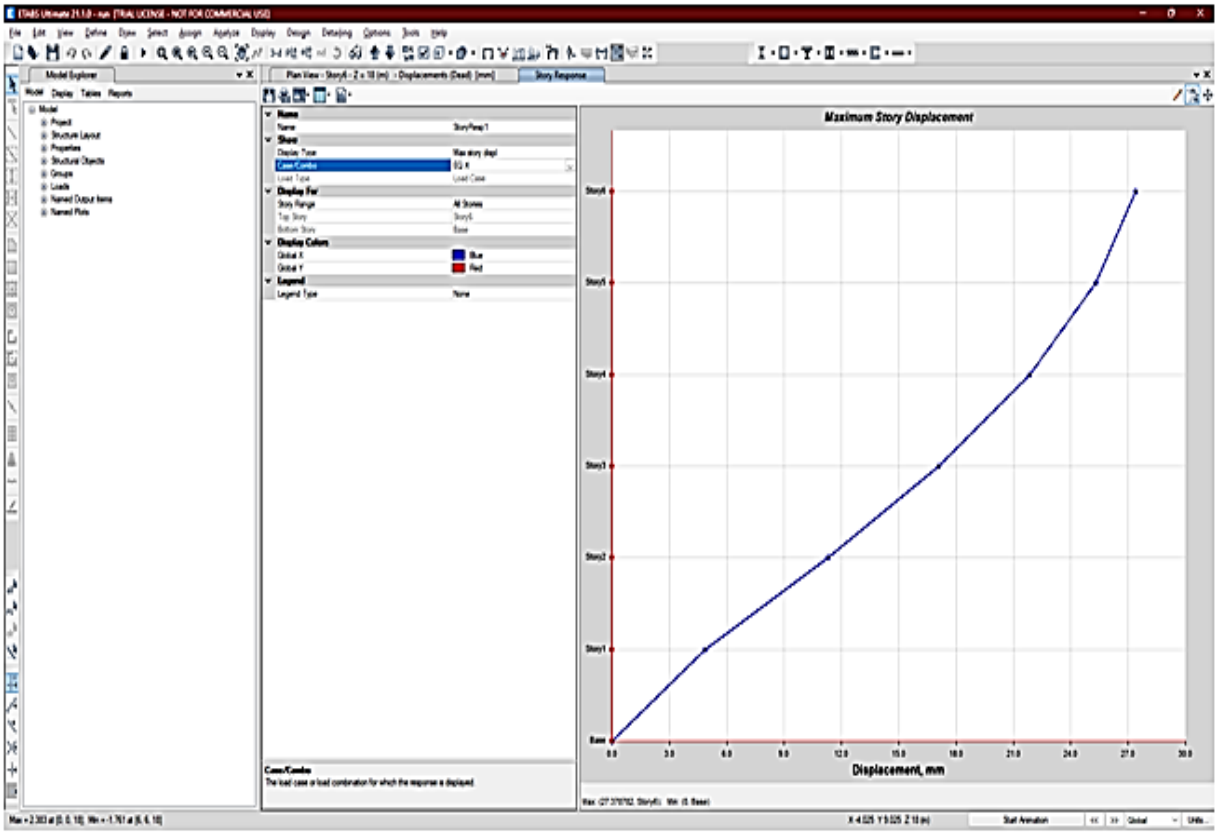

Figure 4: Maximum Story Displacement in Y Direction

VI. CONCLUSION

- ETABS was used to study the deformation of building structure when subjected to seismic loading.
- A G+5 building was subjected to seismic; wind and live loads were analyzed using ETABS 2018 software.
- Behaviour of the structure during active seismic loading is shown clearly using the graphs and lateral displacements.
- The deformation of structure in Y direction exceeds the deformation in X direction.
- The large deformation in Y direction is presumably due to the absence of shear wall.
- The members which are not appropriate will be displayed and suitable sections are recommended by the software.
- Better accuracy of the analysis can be obtained by using this software.
- From this analysis and design, we can conclude that the performance of the frame structure can be enhanced by introducing shear wall.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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