Study and Seismic Analysis of High Rise Buildings using Etabs Software

Ajay Namdev[1], Dr. Rajeev Chandak[1]
[1]*Department of Civil Engineering, Jabalpur Engineering College, Jabalpur (M.P.)*

Abstract -Due to increase in population, there is shortage of land and to overcome this, skyscrapers are opted for. These types of skyscrapers are influenced by natural phenomena. As such, earthquakes are the most dangerous due to the damage and impacts they cause to structural components, which cannot be controlled. These natural disasters cause structural damage and disrupt normal life cycle development. The term base isolation has two words: the first is 'base', meaning a part that supports or acts as a foundation beneath a structure, and the second is 'isolation', meaning the state of being uneven.. During seismic strikes, traditional building structures, where the foundation is fixed to the ground, respond with a gradual rise from ground level to the top of the building. This can result in serious damage or complete collapse of structures. To avoid these consequences as well as to meet functional requirements in service, resiliency is built into the base of the structure, usually by placing lead rubber bearing insulators between the structure and its foundation. Seismic base isolation is one of the best methods among side load resistance systems.

Key Word- Multistory Buildings; Seismic Analysis; Displacement.

1. INTRODUCTION

Base insulation uses the term insulation in the sense of a state of isolation and base as a part that supports or serves as a base for an object or structure. The lead rubber bearing (LRB) system chosen for this study consists of material samples such as plate, rubber and central core. It was selected to establish an innovative simplified design process for insulators incorporated in multi-storey building structures. Recent studies have shown that it is important to use multi-layer laminated rubber bearings with steel reinforcement layers in most insulated buildings.

These natural disasters cause structural damage and disrupt normal life cycle development. Because this is a global concern, much of the analysis must be explored and results provided to create a framework to meet the deadline. With technological advancement, humans tried to combat these natural phenomena in various ways, such as developing early warning systems for disasters, adopting new prevention measures, adopting adequate relief and rescue measures. But, however, this is not true of all natural disasters.

Structural analysis mainly involves discovering the structure behind something that happens. Such behavior can be caused by the weight of objects such as people, furniture, wind and snow, or other types of stimuli such as earthquakes, ground shaking caused by nearby explosions, etc. In short, all these loads are dynamic, including the load of the structure, because at some point these loads do not exist. The difference between dynamic and static analysis is based on whether the applied motion has sufficient acceleration compared to the natural frequency of the structure.

The main parameters of seismic analysis of structures are load capacity, ductility, stiffness, damping and mass. The selected structural model type is based on the external action, structure behavior or structural content, selected structural model type.

The materials used for the structural system of skyscrapers are reinforced concrete and steel. Most North American-style skyscrapers have a steel structure, while residential blocks are usually constructed of concrete. There is no clear definition of any difference between a tower block and a skyscraper, although a building containing fifty or more shops is generally considered a skyscraper.

2. LETERATURE REVIEW

Abhay Guleria (2014) The case study in this article mainly emphasizes on the structural behavior of multi-storey buildings for different floor plan configurations such as rectangular, C, L and I-shaped. Modeling of 15

floors is RCC. The frames are constructed and used in ETABS software for analysis. After analysis of the structure, the maximum shear force, bending moment and maximum displacement of the floor are calculated and compared for all analyzed cases. Analysis of a multi-storey building revealed that the floor falling moment varies inversely with the height of the floor. From dynamic analysis, the shapes of the modes are generated and it can be concluded that asymmetric planes suffer more distortion than symmetric planes.

Dr.K.R.C.Reddy, Sandeep A. Tupat et al. (2014) state in their research that hundreds of wind and earthquake masses have been estimated for a twelve-storey RC framed structure. Based on the results obtained the following conclusions are drawn. Earthquakes and wind shocks increase with altitude of the constitution. Wind loads are more valuable for tall structures than earthquake loads. Buildings must be designed to meet recommended loads regardless of significant wind or earthquake forces.

Vinayak Bikulkarni, Mahesh VT Atikondab (2016) Dynamic analysis performed using STAAD Pro software. The load on the structure was considered as per IS standards. Dynamic analysis can be response spectrum method or time history analysis method. The response spectrum method uses the rules laid down in IS 1893 (Part 1) 2002 and time history analysis can be done using data from past earthquakes. This article uses data from the 1940 El Centro earthquake. The results are determined and compared floor by floor in terms of lateral displacement with respect to each floor.

Ali Kadhim Sallal (2018) The main objective of this software is to design and analyze multi-storey buildings in a systematic process. This work presents a building where it was designed and analyzed under earthquake and wind pressure using ETABS software. In this case, a (18 m x 18 m) and eight storey structure has been modeled using ETABS software. Ten floors (3 metres) are considered high and constitute the total height of the structure (31 metres).

Pardeshi Sameer (2016) This article deals with the effects of various vertical irregularities on the seismic response of a structure. The objective of the project is to perform Response Spectrum Analysis (RSA) of regular and irregular RC frames and Time History Analysis (THA) of regular RC frames and to do resilience based design using IS 13920 compliant response spectrum analysis. feedback. The results of the analysis of irregular structures are compared with regular structures.

Pushkar Rathore and Rahul Chandrashekhar (2017): With the help of seismic analysis, structures can be designed and constructed to withstand high lateral movement of the earth's crust during earthquakes. Any type of basic or highly advanced structure that is in static or dynamic conditions can be evaluated using ETABS. ETABS is a coordinated and productive tool for analysis and design ranging from simple 2D charts to modern skyscrapers, making it one of the best structural software for building systems.

Vijaya Bhaskar Red (2015): This article presents an example of comparative study of static loads for multi-storey structures of 5 and 10 floors. The importance of this task is to estimate the design load of a structure. They concluded that limb deflection becomes greater as n increases. Of floors. It can be seen that axial force is higher in 10 storey buildings as compared to 5 storey buildings.

3. ANALYSIS LOADS ACTING ON MULTI-STOREY

Loading in high-rise buildings differs from low-rise buildings in several aspects, such as greater accumulation of gravity loads from the top to the bottom floor, increased importance of wind loading and greater importance of dynamic effects. Thus, tall structures require accurate estimation of loads for safe and economical design. Except permanent load, other loads are not evaluated correctly. Live loads can be roughly estimated by a combination of experience and past field observations. Wind and earthquake loads are random in nature and difficult to predict. Their estimation is done on the basis of probabilistic approach. The following discussion describes some of the more common types of loads on elevated structures.

1. Dead loads
2. Live loads (or) Imposed Loads
3. Gravity loads
4. Wind loads

5. Earthquake loads.

4. MODELLING AND DESIGNING OF BUILDING

The time periods of the proposed structures are estimated in the application software, i.e. ETABS. The prototype structure model of the given geometry and element size is prepared in ETABS. The analysis provides a timeline of the structure. The ETABS building is modeled as a set of area, line and point objects. These objects are used to represent physical walls, floors, columns, beams and braces, and link/spring members. The basic geometry of the frame is defined in terms of a simple three-dimensional grid system. Material properties like concrete, rebar and section properties like beam, column are defined as frame elements and slab elements are defined as area elements.

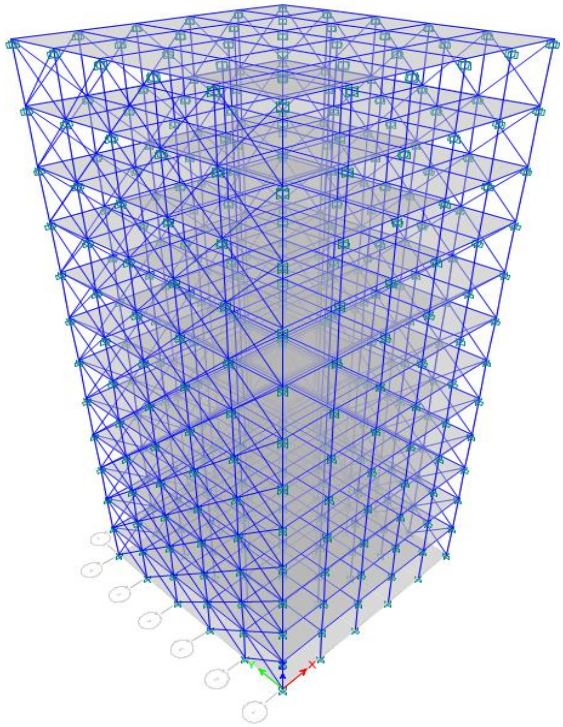

Figure 1. Geometry

5. DESIGNS AND ANALYSIS

Table 1. Load Pattern Definitions

Name	Is Auto Load	Type	Self Weight Multiplier	Auto Load
~LLRF	Yes	Other	0	
Dead	No	Dead	1	
EQ	No	Seismic	0	IS 1893:2016
EQY	No	Seismic	0	IS 1893:2016
Live	No	Live	0	
WX	No	Wind	0	Indian IS 875:2015
WX(1/2)	Yes	Wind	0	Indian IS 875:2015
WX(2/2)	Yes	Wind	0	Indian IS 875:2015
WY	No	Wind	0	Indian IS 875:2015
WY(1/2)	Yes	Wind	0	Indian IS 875:2015
WY(2/2)	Yes	Wind	0	Indian IS 875:2015

6. RESULT AND DISCUSSION

Table 2. Calculated Base Shear

Direction	Period Used (sec)	W (kN)	V_b (kN)
Y	0.004	29479.5932	2653.1634

Table 3. Applied Story Forces

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
Story10	30	0	427.8191
Story9	27	0	346.5335
Story8	24	0	273.8042
Story7	21	0	209.6314
Story6	18	0	154.0149

Story	Elevation	X-Dir	Y-Dir
	m	kN	kN
Story5	15	0	106.9548
Story4	12	0	68.4511
Story3	9	0	37.3486
Story2	6	0	16.5994
Story1	3	0	4.1498
Base	0	0	0

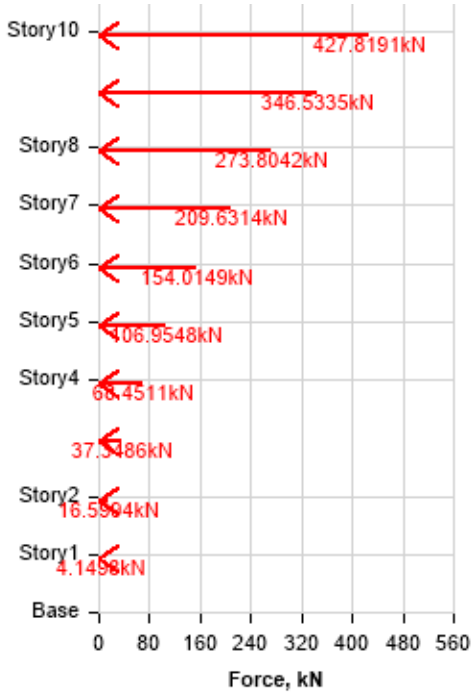

Figure 2. Applied Story Forces

Table 4. Base Reactions

Output Case	Case Type	Step Type	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
Dead	LinStatic		-468	-468	69428.8472	556517.8602	-530148.3544	-468	0	0	0
Live	LinStatic		0	0	6037.8753	44705.141	-45284.0648	0	0	0	0
EQ	LinStatic		-635.9002	0	0	0	-17695.7694	4732.4821	0	0	0
EQY	LinStatic		0	-832.375	0	23300.8612	0	-6242.8124	0	0	0
WX	LinStatic	Max	0	0	0	0	0	0	0	0	0
WX	LinStatic	Min	0	0	0	0	0	0	0	0	0
WY	LinStatic	Max	0	0	0	0	0	0	0	0	0
WY	LinStatic	Min	0	0	0	0	0	0	0	0	0

Table 5. Centers of Mass and Rigidity

Story	Diaphragm	Mass X kg	Mass Y kg	XCM m	YCM m	Cum Mass X kg	Cum Mass Y kg	XCCM m	YCCM m	XCR m	YCR m
Story10	D1	165057.65	165057.65	7.5	8.3598	442706.37	442706.37	7.5	8.3014		
Story9	D1	165057.65	165057.65	7.5	8.3598	607764.02	607764.02	7.5	8.3173		
Story8	D1	165057.65	165057.65	7.5	8.3598	772821.67	772821.67	7.5	8.3263		
Story7	D1	165057.65	165057.65	7.5	8.3598	937879.32	937879.32	7.5	8.3322		
Story6	D1	165057.65	165057.65	7.5	8.3598	1102936.96	1102936.96	7.5	8.3364		
Story5	D1	165057.65	165057.65	7.5	8.3598	1267994.61	1267994.61	7.5	8.3394		

Story	Diaphragm	Mass X kg	Mass Y kg	XCM m	YCM m	Cum Mass X kg	Cum Mass Y kg	XCCM m	YCCM m	XCR m	YCR m
Story4	D1	165057.65	165057.65	7.5	8.3598	1433052.26	1433052.26	7.5	8.3418		
Story3	D1	157353.77	157353.77	7.5	8.4019	1590406.03	1590406.03	7.5	8.3477		
Story2	D1	157353.77	157353.77	7.5	8.4019	1747759.79	1747759.79	7.5	8.3526		
Story1	D1	157353.77	157353.77	7.5	8.4019	1905113.56	1905113.56	7.5	8.3567		

7. CONCLUSIONS

Structural analysis mainly involves discovering the structure behind something that happens. Such behavior may be caused by the weight of objects such as people, furniture, wind and snow, or by other forms of excitation such as earthquakes, ground shaking caused by nearby explosions, etc. A G+10 storey high-rise building subjected to seismic, wind and live loads was analyzed using ETABS software. The behavior of the tall building was clearly shown using graphs and lateral displacements. Members who are not suitable will be received and the software recommends suitable sections. Better accuracy of analysis can be achieved by using this software.

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