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Research Paper

## EARTH QUAKE ANALYSIS OF MULTI STORIED RESIDENTIAL BUILDING BY USING ETABS SOFTWARE

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**Abstract** In order to compete in the ever growing competent market it is very important for a structural engineer to save time. As a sequel to this an attempt is made to analyze and design a Multistoried building by using a software package SAP2000. For analyzing a multi storied building one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions. There are several methods for analysis of different frames like kani's method, cantilever method, portal method, Matrix method.

The present project deals with the seismic analysis of a multi storeyed residential building of G+7 is carried out. The dead load, live load, seismic load and wind loads are applied using SAP2000 with its new features surpassed its predecessors and computers with its data sharing capabilities with other major software like AutoCAD, and MS Excel. We conclude that SAP2000 is a very powerful tool which can save much time and is very accurate in analysis. The results like displacement, shear force, bending moment, torsion, time period and frequency are studied using SAP2000 Software.

### I. INTRODUCTION

Earthquake analysis methods to incorporate the forces during event of an earthquake. Intensity of these forces depends on the magnitude of the earthquake.

#### Dynamic actions on buildings-wind and earthquake

Dynamic actions are caused on buildings by both wind and earthquake. But, design for wind forces and for earthquake effects are distinctly different. The initiative philosophy of structural design use force as

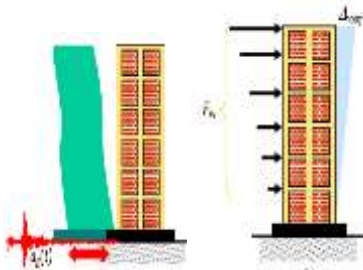
the basis, which is consistent in wind design, wherein the building is subjected to a pressure on its exposed surface area; this is *force-type* loading. However, in

earthquake design, the building is subjected to random motion of the ground at its base (Figure 1.1), which induces inertia forces in the building that in turn cause stresses; this is displacement-type loading.

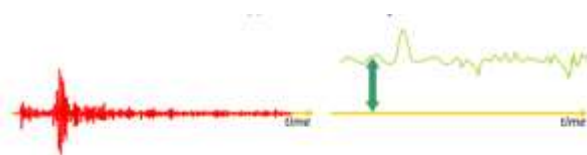
Another way of expressing this difference is through the load-deformation curve of the building – the demand on the building is force (i.e., vertical axis) in force-type loading imposed by wind pressure, and displacement (i.e., horizontal axis) in displacement-type loading imposed by earthquake shaking.

Wind force on the building has a non-zero mean component superposed with a relatively small oscillating component. Thus, under wind forces, the building may experience small fluctuations in the stress field, but reversal of stresses occurs only when the direction of wind

reverses, which happens only over a large duration of time. On the other hand, the motion of the ground during the earthquake is cyclic about the neutral position of the structure. Thus, the stresses in the building due to seismic actions undergo many complete reversals and that took over the small duration of earthquake.



Difference in the design effect on a building during natural actions of earthquake



Nature of temporal variations of design actions

**Basic aspects of seismic design**

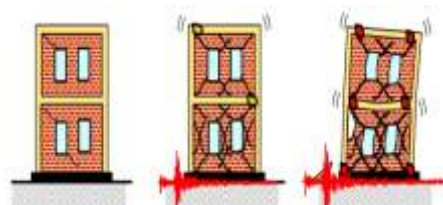
The mass of the building being designed controls seismic design in addition to the building stiffness, because earthquake induces inertia forces that are proportional to the building mass. Designing buildings to behave elastically during earthquakes without damage may render the project economically unviable. As a consequence, it may be necessary for the structure to undergo damage and thereby dissipate the energy input to it during the earthquake. Therefore, the traditional earthquake-resistant design philosophy requires that normal buildings should be able to resist

- a. Minor (and frequent) shaking with no damage to structural and non-structural elements;
- b. Moderate shaking with minor damage to structural elements, and some damage to non-structural elements; and

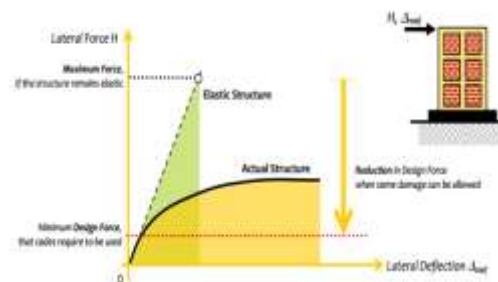
- c. Severe (and infrequent) shaking with damage to structural elements, but with NO collapse (to save life and property inside/adjoining the building).

Therefore, buildings are designed only for a fraction (~ 8 – 14%) of the force that they would experience, if they were designed to remain elastic during the expected strong ground shaking and thereby permitting damage. But, sufficient initial stiffness is required

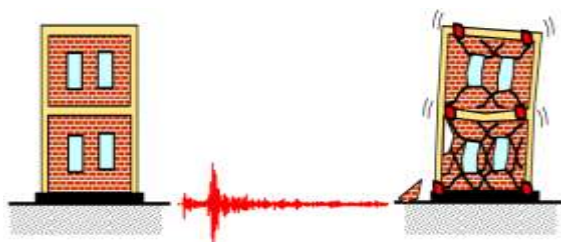
to be ensured to avoid structural damage under minor shaking. Thus, seismic design balances reduced cost and acceptable damage, to make the project viable. This careful balance is arrived based on extensive research and detailed post-earthquake damage assessment studies. A wealth of this information is translated into precise seismic design provisions. In contrast, structural damage is not acceptable under design wind forces. For this reason, design against earthquake effects is called as earthquake-resistant design and not earthquake-proof design.



Earthquake-Resistant Design Philosophy for buildings



Basic strategy of earthquake design: Calculate maximum elastic forces and reduce by a factor to obtain design forces



Earthquake-Resistant and NOT earthquake proof

The design for only a fraction of the elastic level of seismic forces is possible, only if the building can stably withstand large displacement demand through structural damage without collapse and undue loss of strength. This property is called ductility.

It is relatively simple to design structures to possess certain lateral strength and initial stiffness by appropriately proportioning the size and material of the members. But, achieving sufficient ductility is more involved and requires extensive laboratory tests on full-scale specimen to identify preferable methods of detailing.

In summary, the loading imposed by earthquake shaking under the building is of displacement-type and that by wind and all other hazards is of force-type. Earthquake shaking requires buildings to be capable of resisting certain relative displacement within it due to the imposed displacement at its base, while wind and other hazards require buildings to resist certain level of force applied on it. While it is possible to estimate with precision the maximum force that can be imposed on a building, the maximum displacement imposed under the building is not as precisely known. For the same maximum displacement to be sustained by a building, wind design requires only elastic behaviour in the entire range of displacement, but in earthquake design there are two options, namely design the building to remain elastic or to undergo inelastic behaviour. The latter option is adopted in normal buildings, and the former in special buildings, like critical buildings of nuclear power plants.

### Objectives of the study

For this study the following objectives were made

1. Seismic Analysis of G+7 multi story building by using IS 1893-2016 code book
2. Analysis results like displacement, shear force, bending moment, torsion etc are carried out by using SAP2000 software
3. To study the behavior of G+7 building is done by using SAP2000 software.

## II LITERATURE REVIEW

**M.Raju<sup>1</sup> ,V.V.AmarNarasing Rao<sup>2</sup>, et al.,(2023)** In this paper work a multi-storey building is being analyzed by using ETABS Software. The analysis is done based on Response Spectrum Analysis. From this project results we can concluded that a building could be construct by using soil type 2 as a reference in zone 2.

**Ali Kadhim Sallal ,et al.,(2016)** The main purpose of this software is to design and analysis multi-Storeyed building in a systematic process. This paper present a building where designed and analyzed under effect of earthquake and wind pressure by using ETABS software. From this project The value of dead, live and floor finish loads obtained by the ETABS program are similar to the manually calculated values The analysis results of the structural integrity of building in withstanding the design earthquake loadings was conducted and was judged to be safe.

**Sagar N. Khadake<sup>1</sup>,Dr. Sourabh Kumar Singh<sup>2</sup> , et al.,(2024)** This paper focus on ETABS Structural Design for Seismic Loads on High-Rise Buildings. Through such type of designs and constructions may withstand strong lateral movements of the earth crust during earthquakes. From this project The solution to this is to construct high rise building to

accommodate more families. To design such type of high rise buildings, ETAB software is preferable. For the design of structure it is essential to consider seismic loads for many cities in India and all over the world.

### III BUILDING DESIGN CONSIDERATION

The term '**planning**' is a very broad one that typically refers to making plans for some sort of undertaking. This might involve; assessing needs, quantifying resources, defining goals, developing strategies, describing and allocating tasks and monitoring progress.

Building design refers to the broadly based architectural, engineering and technical applications to the design of buildings. All building projects require the services of a building designer, typically a licensed architect. Smaller, less complicated projects often do not require a licensed professional, and the design of such projects is often undertaken by building designers, draftspersons, interior designers (for interior fit-outs or renovations), or contractors. Larger, more complex building projects require the services of many professionals trained in specialist disciplines, usually coordinated by an architect. The below mentioned details are the building plan which is considered for the estimation process. One is ground floor which is completely used for the parking purpose and other one is typical floor plan which involves the remaining five floors plan which is shown in the below figures.

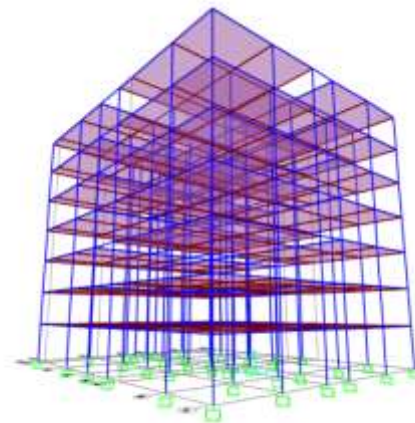


Typical floor plan of Building

#### Model Specifications

Utility of building	:	Residential complex
No of stories	:	G+7
Type of construction	:	R.C.C framed structure
Geometric details:		
Ground floor	:	3.3m
Floor to floor height	:	3 m.
Height	:	24.3 m.
Beam Size		
Width	:	0.30 m.
Depth	:	0.46 m.
Column Size		
Width	:	0.46 m.
Depth	:	0.46 m.
Materials:		
Concrete grade	:	M25
All steel grades	:	Fe550 grade
Bearing capacity of soil	:	180KN/M <sup>2</sup>
Seismic zone	:	Zone V
Soil type	:	II.
Importance factor	:	1.
Response reduction factor	:	5.
Damping	:	5%.

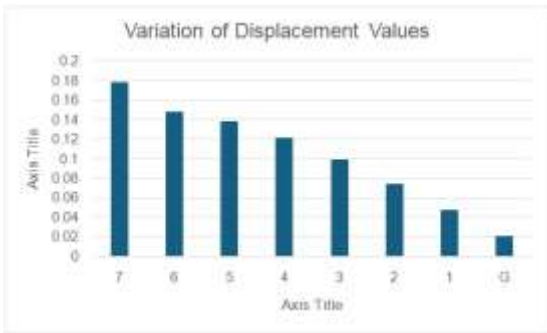
#### Building models in ETABS Software



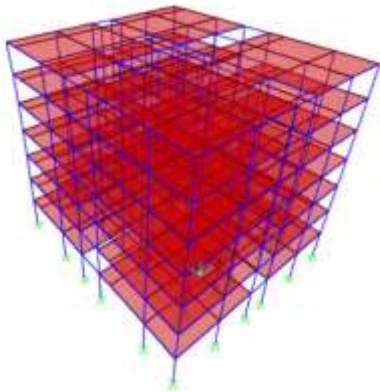
Building model in SAP 20000

### IV RESULTS AND ANALYSIS

**Displacement Values**



Variation of Displacement Values

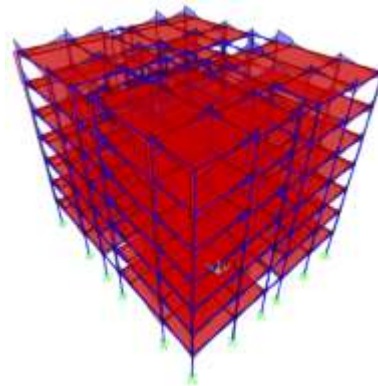


Displacement of building due to seismic load  
**Lateral load P**

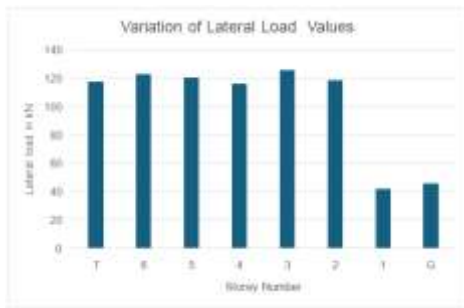
**Comparison of Shear force**



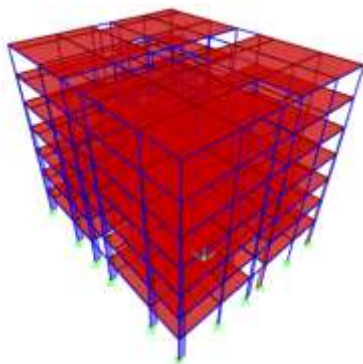
Variation of Shear force V Values



Shear force diagram of G+7 due to seismic load

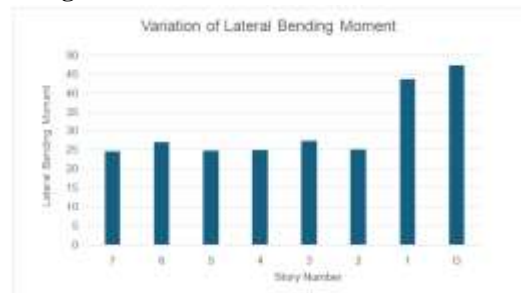


Variation of Lateral Load Values

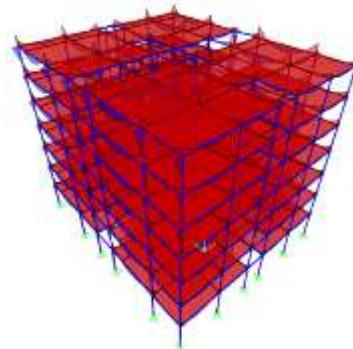


Lateral load diagram of G+7 due to seismic load

**Bending moment**

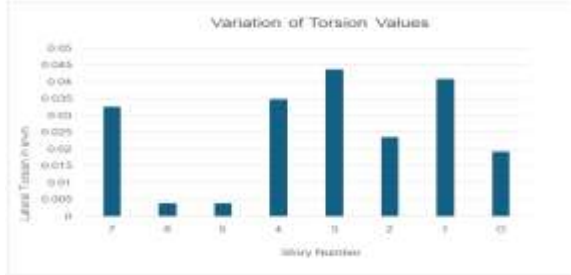


Variation of Lateral Bending Moment

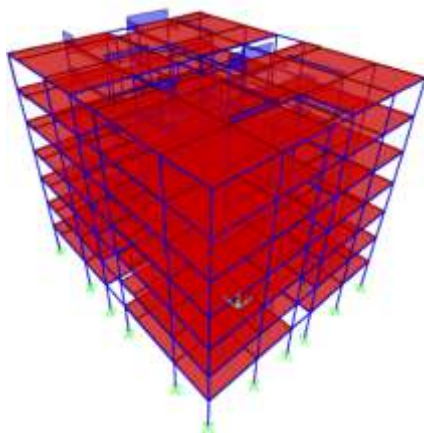


Bending moment diagram of G+7 due to seismic load

**Comparison of torsion**

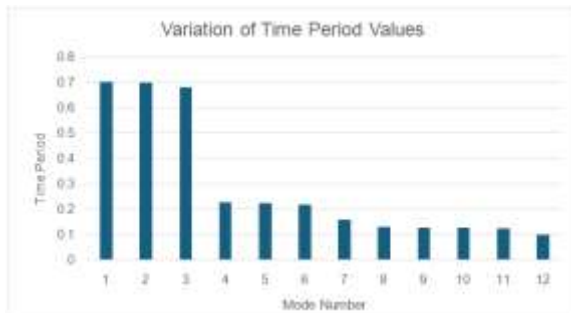


Variation of torsion Values



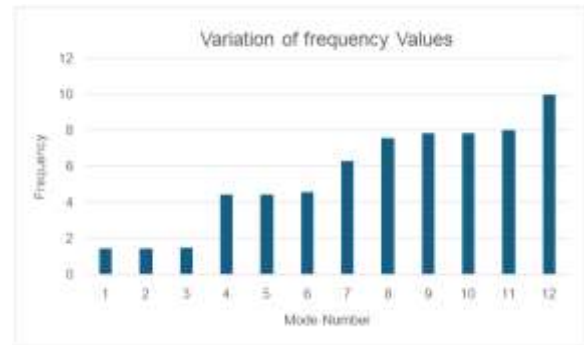
Torsion diagram of G+7 due to seismic load

**Time period**



Variation of Time Period Values

**Frequency**



Variation of frequency Values

**V CONCLUSIONS**

From this study the following conclusions were made

1. Earthquakes are one of nature's greatest hazards to life on this planet and have destroyed countless cities and villages on virtually every continent.
2. In this project we studied a G+7 multi storey building with seismic loading condition as per IS 1893-2016 code provisions.
3. The value of displacement decreases from top storey to bottom storey as per seismic analysis results.
4. The value of lateral load decreases from top storey to bottom storey as per the results obtained.
5. The intensity of shear force and bending moment values are increasing from top storey to bottom storey because of the presents of high intensity of seismic loading effect at ground section.
6. The values of torsion effect due to seismic loading condition increasing from top storey to bottom storey as per the analysis results obtained from SAP2000.

**References**

Chaitanya A. Khotare, Aniket G Dond, et al.,(2025), "Seismic Analysis of Multi-Story

Building by E-Tabs Software” International Research Journal of Engineering and Technology (IRJET) Volume: 12 Issue: 06 | June 2025 www.irjet.net e-ISSN: 2395-0056 p-ISSN: 2395-0072

Fathima Shalbana, Niba E, Farsana C V, et al.,(2022), “Analysis and Design of Multistorey Building using ETABS”, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 11 Issue 05, May-2022

M.Rajul ,V.V. Amar Narasing Rao2, et al.,(2023), “Analysis of Multi-Storey Residential Building Using ETABS”, IJSRD - International Journal for Scientific Research & Development| Vol. 11, Issue 3, 2023 | ISSN (online): 2321-0613

Ali Kadhim Sallal, C V ,et al.,(2016), “Design and analysis ten storied building using ETABS software-2016”, International Journal of Research in Advanced Engineering and Technology ISSN: 2455-0876 Impact Factor: RJIF 5.44 www.newengineeringjournal.in Volume 4; Issue 2; May 2018

Sagar N. Khadake1,Dr. Sourabh Kumar Singh2, et al.,(2024) “ETABS Structural Design for Seismic Loads on High-Rise Buildings”, Journal of Emerging Technologies and Innovative Research (JETIR) [www.jetir.org](http://www.jetir.org) (ISSN-2349-5162)

S Abhishek1, Manoj S K2, Roopa B D3, et al.,(2018), “Design and Analysis of Residential Building using E-TABS” , International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

Allauddin Shaik, Chaitanya A. Khotare , et al., (2019), “Analysis of Multi-Storey Building by Response Spectrum Method using E-Tabs

Software” , International Journal of Engineering Research & Technology (IJERT) Published by : <http://www.ijert.org> ISSN: 2278-0181 Vol. 8 Issue 10, October-2019

Umer Bin Fayaz1, and Brahamjeet Singh2 , et al.,(2020), “A Study of Seismic Analysis of Building Using ETABS”, International Journal of Innovative Research in Engineering and Management (IJIREM) ISSN (Online): 2350-0557, Volume-10, Issue-6, December 2023

Rohit Kumar1 , Nitish Jauhari2 , et al., (2023), “Model and Analysis of Earthquake on Multi Storey Buildings using ETABS Software” IJSRD - International Journal for Scientific Research & Development| Vol. 8, Issue 5, 2020

Dr. E. Ramesh Babu ,Kusuma.S , et al.,(2020), “SEISMIC ANALYSIS OF MULTISTORY BUILDING USING ETABS WITH COMPARISON OF RESPONSE SPECTRUM METHOD AND TIME HISTORY METHOD” Journal of Emerging Technologies and Innovative Research (ISSN-2349-5162)