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EARTHQUAKE ANALYSIS OF A G+5 RESIDENTIAL BUILDING USING STAAD PRO ON MARSHY LAND

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ABSTRACT
Most engineers are investigating the seismic resistance of multi-story residential apartment structures with advanced non-linear approaches. This study uses the Staad Pro program and the considerably simpler comparable static approach to investigate the seismic resistance of a G+5-story building. By combining a dead load and super load, the seismic and non-seismic analyses of a comparable structure are further compared. It was observed that, in comparison to the non-seismic study, the seismic results exhibited far larger maximum moments and shear forces. Past seismic events have demonstrated that numerous structures were completely or partially damaged. Understanding these systems' unstable responses is therefore essential. The primary objective of the current study is to compare seismic and non-seismic structures. The analysis was finished in compliance with the requirements of IS codes 1893, 875, and 456:2000.

KEYWORDS: *Earthquake, Loads, Non-Seismic, Shear Force, Seismic, Axial Force, Bending Moment, Marshy Area Stadd Pro.*

1. INTRODUCTION

One classifies an earthquake as a natural calamity. Every year, a large number of people pass away as a result of earthquake-related structural failure. For instance, on April 16, 2016, an earthquake with a Richter scale value of 7.8 occurred. The earthquake that occurred hundreds of miles away from the epicenter claimed the lives of over 650 people due to the collapse of buildings. By using design concepts that are resistant to earthquakes, damage to structures can be reduced. This study compares an earthquake analysis—which includes dead and live loads—with an earthquake analysis—which includes dead, living loads, and earthquakes—of the G + 5-story residential building. It is possible to create an earthquake response to a structure using direct, non-linear, vertical, dynamic analysis.

The various methods of seismic analysis include

- Fixed Equilibrium Evaluation,
- Response to Analysis Issues,
- Linear Dynamic Analysis,
- Static Linear Analysis and
- Dynamic Nonlinear Analysis also known as Pushover Analysis.

1.1Pushover Analysis

Pushover analysis is an expected analysis strategy where the structure is subjected to various monotonically expanding parallel powers, with a dispersion which is stature insightful invariant, until the point that the objective removal is contacted. Pushover analysis involves a progression of progressive versatile analysis, superimposed to gauge a power uprooting bend of general structure.

Pushover analysis can be executed as power controlled or relocation controlled. In compel controlled pushover method, full load blend is connected as determined, i.e., drive controlled methodology ought to be utilized when the heap is referred to, (for example, gravity stacking). Likewise, in constrain controlled pushover methodology some numerical issues that influence the exactness of results happen since target relocation might be related with a little positive or even a negative parallel solidness on account of the advancement of components and P-delta impacts. Pushover analysis has been the favored technique for seismic execution assessment of structures by the real restoration rules and codes since it is reasonably and Page 6 computationally straightforward. Pushover analysis permits following the grouping of yielding and disappointment on part and basic level and additionally the advance of general limit bend of the structure.

On the off chance that the Nonlinear Static Procedure (NSP) is chosen for seismic analysis of the building, a scientific model straightforwardly fusing the nonlinear load-twisting attributes of individual segments and components of the building will be subjected to monotonically expanding sidelong loads speaking to dormancy powers in an earthquake until the point that an objective removal is surpassed. The objective relocation is planned to speak to the greatest uprooting liable to be experienced amid the outline earthquake. Since the numerical model records specifically for impacts of material inelastic reaction, the computed inward powers will be sensible approximations of those normal amid the outline earthquake. The connection between base shear power and sidelong dislodging of the control hub will be set up for control hub relocations running in

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the vicinity of zero and 150% of the objective removal, keeping in mind the end goal to acquire execution focuses and additionally the area of pivots in various stages, we can utilize the pushover bend. In this bend, the range AB being the versatile range, B to IO being the scope of moment inheritance, IO to LS being the scope of life wellbeing and LS to CP being the scope of crumple anticipation.

At the point when a pivot contacts point C on its power relocation bend then that pivot must begin to drop stack. The way in which the heap is discharged from a pivot that has achieved point C is that the pushover drive or the base shear is decreased till the power in that pivot is unfaltering with the power at point D. As the power is discharged, the greater part of the components empty and also the relocation is diminished. After the yielded pivot contacts the point D constrain level, the extent of pushover compel is again opened up and the removal begins to increment once more. On the off chance that the greater part of the pivots is inside the given CP restrain then that structure should be protected. However, the pivot after IO range may likewise be required to be retrofitted relying upon the noteworthiness of structure.

(a) Pushover analysis curve
(b) Analysis of frame in sap2000

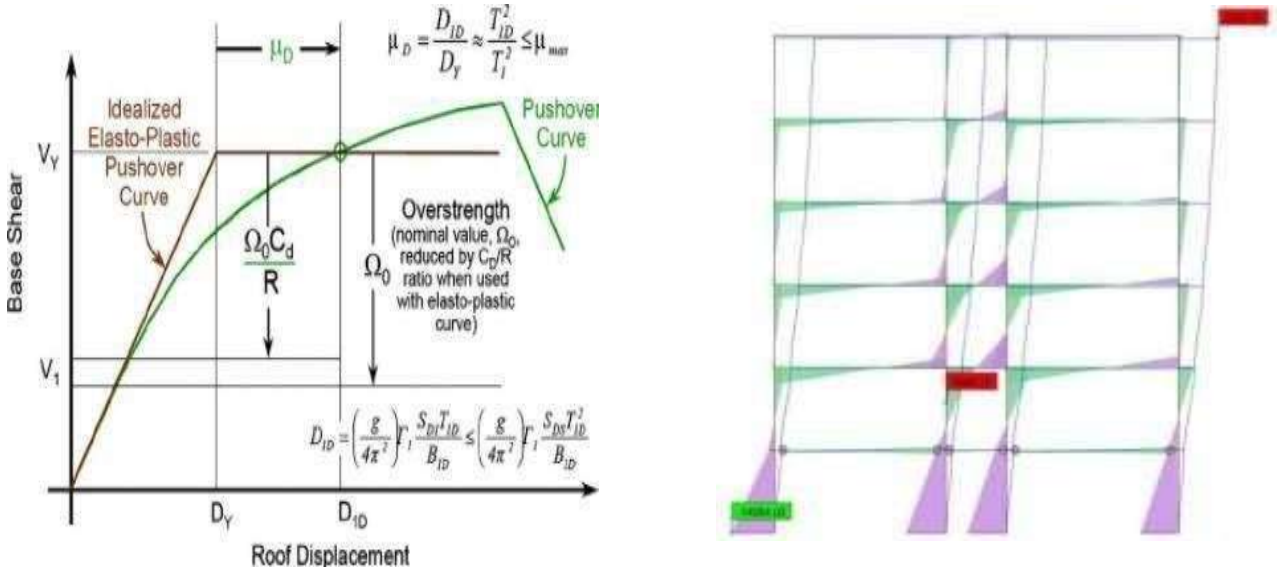


Fig 1: Pushover Analysis

1.2Seismic force

It has been seen in past seismic tremors that the structures on slants serve more savageness and overlay. Shudders make significant harm structures, for case, dissatisfaction of individuals in the building and if the power of tremor is high it prompts breakdown of the structure. In past years individuals have been created evidently and because of which urban zones and towns began spreading out. In light of this reason unmistakable structures are being basic slanting zones. India has a wide shoreline front line which is secured with mountains and inclinations. Particular resorts are being passed on in uneven zones to offer strategies to visitors. The structures in these zones are made on slanting grounds. An enormous bit of the unforgiving reaches in India goes under the seismic zone II, III and IV zones in such case working in setting of inclining grounds are exceedingly slight against seismic tremor. This is a conceivable after-effect of the way that the bits in the ground floor separate in their statures as appeared by the inclination of the ground. Sections toward one side are short and on flip side are long, by exemplary nature of which they are exceedingly sensitive. Seismic powers act more separate in slanting zones because of the colleague irregularity. Also, it has been inspected that the seismic tremor practices are inclined in slanting extents. In India, for instance, the upper east states. The lack of plain ground in slanting reaches powers headway advancement on slanting ground acknowledging assorted basic structures, for example, strengthened cement enveloped expert's workplaces, schools, motels and workplaces laying on uneven tendencies. The lead of structures amidst tremor relies upon the dispersal of mass and steadiness in both even and vertical planes of the structures. In inclining region both these properties change with abnormality and asymmetry. Such changes in seismically inclined locales make them displayed to more obvious shears and torsion.

Table 1.1: Seismic zones and their intensity

Seismic Zone	II	III	IV	V
Intensity	Low	Moderate	Severe	Very Severe
Z	0.10	0.16	0.24	0.36

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1.3 Equivalent Static Analysis of Seismic Actions-Subjected Structures

The equivalent static lateral force method is a streamlined method for designing structures that replaces the dynamic loading caused by an expected earthquake with a static force distributed laterally. In general, the two horizontal directions parallel to the primary axes of the building are used to evaluate the total applied seismic force V (Fig. 1.5). It assumes that the structure will react in its default lateral mode. To prevent torsional movement underground motions, the building must be low rise and reasonably symmetric in order for this to be true. The building must be able to withstand seismic effects coming from either direction, but not from both directions at once.

2. LITERATURE REVIEW

Alkari, Alaukik & Meshram, Sangita & Baig, Aasif. (2021). Seismic Analysis of Structure Considering Soil Structure Interaction. IOSR Journal of Engineering. In this paper we have made an attempt to study the soil structure interaction effect of different soil, on structural behavior of building. When Structure supported on mat foundation subjected to seismic loads. During dynamic loading the consideration of actual support flexibility reduces the overall stiffness of the structure. Therefore, it is necessary to study dynamic soil structure interaction. The main aim of the present study is to analyses the building that is supported on mat foundation for different soil conditions and compare the results of story displacement, column end forces and bending moments in beams. The analysis of the soil structure is done by using STAAD PRO.

Deoda, Vishal &Adhikary, Shrabony&Raju, Srinivasa. (2020). The present work attempts to study the seismic behaviors of two earthen dams, viz. Chang and Kaswati dam, located in Gujarat, India for different sets of time histories. Each set comprises eight earthquake time histories, where one time history set is compatible to Indian Standard IS-1893(1)-2016, Type-II spectrum (SC) and another time history set is compatible to Conditional Mean Spectrum (CMS) as per the recent state-of-art related to selection of time histories for dynamic analysis. Numerical simulation has been carried out in Geo studio (2012) software which uses the finite element method for analyzing the earthen dams and includes SEEP/W, SLOPE/W and QUAKE/W analysis for estimating seepage, slope stability and dynamic response, respectively. Steady-state method is used to determine the seepage through the dam body in seepage analysis and Morgenstern-Price method is used to determine the factor of safety in stability analysis. The failure phenomenon in the earthen dam after the application of earthquake load is studied, in which the dam material follows Mohr-Coulomb failure criterion. The reservoir level has been considered as one of the parameters for the numerical study. It is observed that the water level in the upstream has a significant effect on relative horizontal displacement as well as relative vertical displacement of the dam crest, amplification of ground motion at the dam crest and post-factor of safety of the dam for the considered sets of earthquake time histories. Moreover, it is also concluded that the selection of time histories is a very important step for seismic analysis of dams.

Gupta, Ankit. (2020). This paper extends to other types of structure the simplified methodology proposed by Constant opoulos et al. (1979) for the seismic design of tunnels. As a practical example, a large structure of reinforced concrete, of box shape and totally embedded in soil, is analyzed. The dynamic pressures acting on walls, roof and floor, due to body and surface waves, are considered in the analyses. A set of seismic load combination hypotheses are proposed to account for the different polarization planes of the seismic. The influence of neighboring buildings can be taken into account considering the new soil stress states that they produce.

Prashant, D &Hiwase, Prashant&Tomar, Ayush&Siddh, Sharda&Patil, Prof. (2020). Seismic Analysis and Comparative Study of Esra for Earthquake Zone V In India. International Journal of Advanced Science and Technology. 29. 3674-3679. A Water tank simply means a container to store water in huge amount of capacity. As known from very upsetting experiences, liquid storage tanks were collapsed or heavily damaged during the earthquakes all over the world. The economic lifetime of ESR is generally around 40 to 65 years. Damage or collapse of the tanks causes some unwanted events such as shortage of drinking and utilizing water, uncontrolled fires etc. Water tank parameters include the general design of tank and way of construction materials, linings. Various material is used for construction of water tank like: -plastic, concrete, steel, fiber glass. Therefore, to avoid all those disadvantages numerous or various studies is been carried out regarding tanks. In this study I have compared Elevated Service Reservoir (E.S.R) of Rectangular& Circular shape of 5lakh capacity and total height of 18m with 3m staging in Earthquake Zone V by Equivalent static analysis using STAAD.PRO software referring GSDMA guidelines for design of tank and IS 1893 PART2-2014 code. It can be observed that Circular water tank is more economical and preferable.

Singh, Ravikant& Singh, Vinay&Yadav, Mahesh. (2019). If the building structure is not properly designed and constructed according to IS codal provisions, it causes more damages and destruction of the human property, and also loss of living creatures. It is recommended that the structure should be properly analyzed, designed, and constructed with good quality material, so it's become safe to resist the earthquake load. Seismic analysis of the building structure is carried out to determine the seismic response of structure by using Time history analysis method. In this research paper seismic analysis of multi storey building structure is done. The response of the building is analyzed for various seismic loading. ETABs (Extended Three- dimensional Analysis of Building System) software is used for the modelling of the building. By using time history

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method, we can analyze the base shear, displacement and storey drift of the building. The comparison is done with equivalent static analysis also to know the variation in results. MATLAB (Matrix Laboratory) program is also used for performing the Time history analysis of the building using Elector seismic data.

Singh, Run Bahadur& Victor, Oshin& Jain, Shilpa. (2019). Civil engineering deals with constructing different types of structures with ensuring safety, durability and serviceability. Now days "earthquake "is phenomena that affects the structures with their safety and serviceability. The amount of damage that earthquake can done to structures is depend on Type of building, Type of soil, Technology used for earthquake resistance, and last but not the least Location of building. Effects of earthquake are largely depending on type of soil in which foundation of building is done because earthquake changes the motion of ground that results the failure foundation. So, it is important to study the behaviour of different soil at the time of construction of structures. Also, earthquake can be resisted by various technologies used in building, one of these are shear wall.

Hiwase, Prashant&Umredkar, Shreya&Shiwal, Anuj&Bhagat, Mr. &Tripathi, Aditya. (2019). In this rapidly expanding and developing world, new structures are being constructed at a high rate and, in this scenario, it is very important to analyses, estimate and evaluate them before being constructed in the field. Our research focuses on the analysis of Hostel building under static loading and also under the effect of lateral forces that is considering seismic forces in various Zones in India. The analysis has been carried out using Staad-Pro software. The building has been modelled as framed structure in Staad pro and all relevant loading have been applied using IS 875-Part 2 and Seismic loading has been considered with reference to IS 1893-2016. Analysis Sheets have been prepared according to relevant IS codes and similarly all structural elements have been analyzed and compared considering all relevant code books with verifying the results with some manual calculations.

Gupta, Ashish Sawant, V.. (2018). The normalized tensile reinforcement force for the seismic stability of reinforced soil walls using some rigorous methods considering the pseudo-static seismic forces is mostly used by the earlier researchers in the design of retaining walls backfilled with cohesive soil. Few studies have been presented using horizontal slice method without taking effect of the seismic acceleration in vertical direction. In the present study, a simplified solution has been presented using the pseudo-static equilibrium of the reinforced soil wall taking the effect of seismic accelerations in the horizontal and in the vertical direction. The seismic stability analysis presented here accounts the required total reinforcement strength in terms of the maximum value of reinforcement force coefficient and the critical inclination of failure plane. Taking some geometrical values of retaining wall and soil characteristics based on the literature, a detailed and comparative parametric study presented here accounts the effect of cohesion of the backfill, angle of internal friction of soil, horizontal seismic coefficient, vertical seismic coefficient and surcharge loading.

3. OBJECTIVE OF THE WORK

In order to determine the seismic response of a G+5-storey residential structure, equivalent static analysis is used in this research work.

1. To find out the effect of seismic and non-seismic loads on same structure.
2. A G+5 analysis is performed for a typical moment-resisting frame in zone II using professional software.
3. According to IS 1893-2002, seismic parameters like soil type, seismic zone, zone factor, importance factor, and response reduction factor are measured as criteria for earthquake-resistant structure design.
4. The structure is subjected to various load cases, including dead load, live load, and earthquake load.

4. CONCLUSION

The goal of this research project was to evaluate the seismic load placed on G+5 buildings. STAAD.PRO software is used for the analysis in order to produce better results. Any structure that is subject to dynamic loading is evaluated by the STAAD.PRO software, and the results are precise. According to the analysis above, the axial force and displacement of seismic and non-seismic structures differ, but the bending moment and shear force are identical.

REFERENCES

1. *Author- Sanjib Das, "STAAD.PRO CE - Seismic Analysis Using IS 1893 (PART-1)-2016".*
2. *Dr H. J. Shah, Dr Sudhir K Jain Document no.: IITK-GSDMA-EQ26-V3.0 "Design Example of a Six Storey Building".*
3. *Dr. JC Akar, Dr. EM Lui, "Seismic Analysis and Response of Multistorey Semi-Rigid Frames", Elsevier Science Ltd., Volume 21, Issue.5, May 1999.*
4. *"Seismic Analysis of tall buildings for different earthquake zones", IJETER (International Journal of Emerging Technologies in Engineering Research), Volume 5, Issue.4, April 2017.*
5. *Andrea Palestra, Matteo Izzi, Luca Pozza, Cristiano Loss, Ian Smith, "Seismic Analysis of multi-storey timber buildings braced with a CLT core and perimeter shear-walls", Springer Nature, 6th September 2018.*
6. *"Seismic performance evaluation of a tall building: Practical modelling of surrounding basement structures", Journal of Building Engineering, Volume 31, September 2020.*

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7. *Anurag Whine, Vedprakash Sahu "Seismic Analysis on RCC Frame Building Resting on Sloping Ground Using STAAD Pro. Software" Volume 5, Issue 2 ,2020 IJRTI.*
8. *Adhiraj A. Wadekar and Ajay G. Dahake "Analysis and Design of a Multi-Storey Building by Using Staad Pro" 10.21474/IJAR01/10746: April 2020.*
9. *Prof. Komal S. Meshram, Samiksha Kumbhare, Sagar Thakur, Diksha Mate, Amit Mundakir, Raksha Waghmare "Seismic Analysis of Building Using Staad-Pro" International Journal of Innovations in Engineering and Science, Vol. 4, No. 5, 2019.*