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COMPARISON OF RC BUILDING HAVING ASYMMETRIC PLAN WITH NBC & IS CODE NEAR SUNAULI BOARDER USING LINEAR DYNAMIC METHOD OF ANALYSIS

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ABSTRACT
This dissertation aims to study the performance of reinforced concrete (RC) building with a focus on existing seismic site effects in the terai terrain of Nepal and India Boarder Area. Construction is essential part of every developing country in this today's world. Every country has specific building design codes which provide the guidelines to engineers for the design of various structural elements like beam, column and slab. This paper is an attempt to evaluate and compare seismic performance of G+10 Storey with plan irregular building using ETABs 2018 software. Response Spectrum method is used for analysis. Storey displacement, Storey drift, Torsional irregularity and Base shear are considered as parameters. The findings of this study have the potential to impact future design practice of this particular region, enabling engineers to make informed decisions and develop more robust designs that account for the unique challenges posed by the local geological conditions in Nepal & India.
Keywords: Storey displacement, Storey drift, Torsional irregularity, Base shear

I. Introduction

As we all know, the current era is one of science and technology, with building projects taking place all over the world. The building has emerged as one of the key factors influencing progress in the modern world. Earthquakes are the primary cause of building damage in Nepal and India due to the impact of the Indian and Tibetan plates on Nepal and India. Therefore, we must adhere to the Indian Standard Code and the Nepal Building Code while constructing the building.

We take into account various loads occurring on a building when it is being constructed. There are various kinds of structures. Steel buildings, lightweight steel buildings, and RCC-framed buildings. We take into account various loads occurring on a building when it is being constructed. The primary focus is on the relative benefits and drawbacks of different building design codes when compared to specific criteria, such as loading analysis, design analysis, and cost considerations. A variety of cross-sectional and building material factors are taken into account based on strength. Based on loading comparisons, including live loads, dead loads, and wind loads, as well as other factors for different building elements such as beams, columns, and slabs, comparison work has been done. Furthermore, comparisons are made between the load combination and the load factor. The design capacities of several architectural design norms are examined in the present comparison. The RCC building models with G+10 stories and a regular design are taken into consideration for analysis in the current study. The ETABS 2018 software's dynamic approach is used for assessing the model.

There have been constant incidents of recorded damage resulting from large earthquakes across the world, that range from small local damage to more substantial damage that might've led to collapse. This analysis represents a potential hazard that can lead to significant structural damage, with potentially catastrophic consequences for the individuals residing or working within these buildings. In our country, especially in the villages as well as big cities tend to go major damages during earthquakes as it is pron to earthquake. This can cause the response of the building to increase significantly which can cause unnecessary lateral forces to generate in the building that can cause significant damages to the building. The goal of this research is to evaluate the effects of earthquakes on the responses of these reinforced concrete buildings near boarder area using IS code

& NBC code.

II. Literature

The purpose of this research paper is to compare the building codes of Nepal and India. Prior to the government's implementation of a new code for building design and analysis, Nepal had an outdated building code that architects had to abide by. This study uses RCC building models with G+8 storey for analysis, taking into account the regular plan throughout the building's analysis. ETABS software is used to analyze the model.(Shah & Chalotra, 2022)

This work analyzes 15-story RCC buildings with regular and irregular plans using the linear dynamic approach (response spectrum method) and corresponding static method. It was considered to be in the medium-sized soil IV seismic zone. This research compares the parameters of the regular and irregular plans using both static and dynamic analysis methods, including base shear, storey displacement, and storey drift.(Patil et al., 2008)

This study describes the seismic activity around the 7.8-magnitude earthquake that comes in the Gorkha area on May 12, 2015, and the subsequent series of aftershocks, including one with a magnitude of 7.3. This paper's goal is to investigate the following topics: non-structural damage, damage in unreinforced masonary structures, soft and weak storey effects, short column effects, design and detailing issues, construction and material quality, and seismic pounding.(Pokharel & Goldsworthy, 2017)

The behavior of G+11 Storied Buildings is studied, floor heights are given, and features related to the building construction are defined. The Staad.pro program is used to produce the building models. The soil type is medium, and zone III is the seismic zone are considered. There are ten building models set up. For this investigation, two forms of geometry—regular and irregularly shaped buildings with and without steps—are used.(Tennu Syriac, 2021)

This research compares the seismic provisions of reinforced concrete buildings with respect to seismic design. There is discussion of the provisions from IS1893, ASCE7, EN8, and NZS1170.5. There is comparison and contrast between parameters such as soil classification, hazard specification, and importance factors. There includes discussion of the Building Ductility classification and the Response Reduction/Behavior Factor. Seismic Base Shear and Design Response Spectra are examined using four seismic codes. Although the fundamental design methodology is similar throughout the many seismic design codes, there are several significant differences.(Amey et al., 2022)

A comparative analysis of IS 1893 and IS 13920 is presented in this work, together with an analysis of ASCE 7 regulations pertaining to site categorization, design response spectrum, modeling principles, drift control standards, and ductile detailing. It is evident that the SPT value single parameter is used to classify sites in India. The Indian code limits the design spectrum to a 4-second period; however, medium- and high-rise buildings may have longer design periods. The current Indian code's ductile detailing requirements are out of date, and crucial topics like joint shear design and strong and weak beam design are disregarded.(Khose et al., 2010)

The project's goal is to comprehend how asymmetry affects a structure's motion and create a controller that may reduce the torsional impacts. An LQR (Linear Quadratic Regulator) controller and a hydraulic linear actuator were used to create an active control system. A fifty percent reduction in peak angular displacement, equivalent to that of a passive design and comparable active systems, was one of the required response criteria. Peak angular displacement of a single storey was reduced by up to 55% using the MATLAB Simulink controller simulations. Additionally, there was a 74 percent reduction in the lateral displacement as a result.(Louis & Lauren Banks, 2022)

In this study, CSI ETABS was used to assess a number of high-rise buildings while the response spectrum analysis was applied. In order to conduct the research, a variety of high-rise building shapes, including H, O, and C shapes, were taken into consideration. The three differently shaped buildings have varying floor plans, with 12 and 16 stories, respectively. The response spectrum method of seismic analysis was taken into consideration for the accurate seismic analysis of all the buildings mentioned above. The O-shaped building has the greatest variation in B.M. and S.F. The highest displacement from the three irregular shapes-H, L, and O is produced by an L-shaped building.(Chaudhary & Mahajan, 2021)

The purpose of this study is to understand how the structure behaves in high earthquake zone III and to assess lateral displacement, storey drift, overturning moment, and design lateral pressures. In the current study, the movement of the structure has been assessed using Comparative Dynamic Evaluation for each of the four scenarios. The findings show that, especially in high seismic zones, buildings with extreme irregularity cause more deformation than those with less irregularity. Additionally, the height of the storey has an inverse relationship with the storey overturning moment. When compared to buildings with irregular shapes, the story base shear for regular structures is higher.An in-depth examination of irregular reinforced concrete buildings' seismic performance has been presented. Thorough research has been done on the problems associated with the seismic design and performance assessment of buildings that are torsionally flexible, torsionally irregular, and have columns that are discontinuous (floating columns) in the structural frame. It has been investigated how crucial it is to simulate the inelastic biaxial action of columns when assessing the way three-dimensional models of structures work seismically when subjected to various ground motion components.(Gwalani, 2023)

In this research paper there is comparative study on static and linear dynamic analysis i.e. Response spectrum analysis of 15 storey building. In which comparison between these two analysis shows that static analysis gives the higher value of result of storey drift, displacement, base shear, time period and frequency after comparison between these two analysis using Etab software.(Kakpure & Mundhada, 2017)

In order to assess the performance of current buildings when subjected to seismic loads, this dissertation focuses on the structural behavior of multi-story buildings for various plan configurations, such as normal structure along with L-shape and I-shape according with the seismic clauses suggested in IS: 1893-2002. Using STAADPRO V8i, the seismic load of a G+25-story RCC-framed building is modeled. Assuming linear static material properties, dynamic analysis is carried out. These analyses take into account the seismic zones IV and V, and for each zone, the behavior is evaluated using three distinct soil types: soft, medium, and hard. After comparison of storey drift, displacement, base shear, time period and frequency. It was found that regular building performed well during earthquake than that of irregular building. (Shrivastava & Bhaduria, 2017)

In this analysis, eight distinct configurations of a five-story structure with re-entrant corners and a conventional layout that served as a reference were first looked into. These anomalies are interpreted in accordance with IS 1893 (Part I): 2002, the Indian Standard Code, Article 7.1. The ETABS 9.7 version was used to analyze the entire set of models. The unintentional torsion in the positive and negative X, Y directions was also taken into account in the current investigation. Finding. The findings indicate that, particularly in high seismic zones, buildings with significant irregularities are more risky than those who have fewer irregularities. (Shrivastava & Bhaduria, 2017)

In this research paper, it can be seen that push over i.e. non-direct sucker analysis provides a good estimate of local and global inelastic twisting requests and also reveals design flaws that could be concealed by a flexible examination and the structure's execution level. According to code (IS: 1893-2002 section 1) in equivalent static and non-direct static examination, story floats are located inside the uttermost. (DS & Krishna, 2017)

The purpose of this study is to understand how the structure behaves in a high seismic zone and to assess the storey displacement, overturning moment, storeys drift, and design lateral forces. For comparison's sake, a fifteen-story building with four completely distinct shapes—rectangular, L-shaped, H-shaped, and C-shaped—is chosen. The ETABS 9.7.1 version was used to analyze the entire set of models. In the current study, the deformation of building has been assessed using comparative Dynamics analsis for each of the four scenarios. The findings show that, especially in high seismic zones, buildings with extreme irregularity cause greater deformation compared to structures with less irregularity. Additionally, the height of the storey has an inverse relationship with the storey overturning moment. (Sultan & Peera, 2015)

This research investigation examines the behavior and changes in shear wall length in buildings that undergo to equal height increases from 3.5 meters to 28 meters, or from ground storey (G) to G+7. T he shear wall thickness is maintained at 250 millimeters, and the shear wall's length is measured just once.The study was conducted using IS: 1893(part I):2002 for all zones and soil types, taking into ac count both wind and seismic forces, and IS: 875(par t III):1987 for wind loads & 96 buildings were examined. Structures with symmetrical dimensions are taken into account. The analysis's conclusions made it clear that shear wall placement and arrangement frequently had a big impact on the induced seismic responses of stories. In fact, across all building models, central core systems have the highest seismic reactions (approximately 50%), which might result in an earthquake-resistant design that is both affordable and well-thought-out. From the perspective of base shear design, it is preferable to employ shear walls arranged in parallel pairs along the periphery or intermediate panel when they significantly lower base shear, at least 33.20% less than in other configurations. (Mahmoud, 2021)

III. Conclusion

This research work investigates and compare the output of the analysis of the RCC framed residential building using Nepal Building Code (NBC 105:2020) & Indian standard code (IS 1893:2016) for seismic design. In this analysis, Linear dnamic analysis has been used for the comparison of G+10 unsymmetric plan RCC building using Response spectrum method of analysis using both NBC & IS code considerations. Considering the constraints of the employed model and the relevant by assumptions, we can outline the following conclusions:

1. From the analysis of Unsymmetric plan RCC building using two different codes in same territory at sunauli boarder , the storey drift in X & Y is seen as per NBC code is 0.002374 & 0.002243 but as per IS code is 0.002108 & 0.001922. The maximum value is seen by code NBC 105:2020. The allowable limit is 0.004 which is fine seen by using both codes analysis as it fall with in permissible limits.
2. From the analysis of Unsymmetric plan RCC building using two different codes in same territory at sunauli boarder , the storey displacement in X & Y is seen as per NBC code is 65.990828mm & 61.219272mm but as per IS code is 58.035155 mm & 52.376031 mm. The maximum value of storey displacement is seen by code NBC 105:2020. The permissible value is 0.004 times the storey height (33m) i.e. 132mm which seems to be fine both cases.
3. From the analysis of Unsymmetric plan RCC building using two different codes in same territory at sunauli boarder , the storey Base Shear is seen as per NBC code is 1587.6513 after scaling & as per IS code is 1372.5319 . The maximum value is seen by code NBC 105:2020.
4. The Frequency as per IS 1893:2016 code & NBC 105:2020 should be limit up to 33 HZ for the modal participating mass ratios in which model has cross 90% in summation of X-direction i.e. in our model 5^{th} mode has crossed 90% in model participating mass ratios and is 14.1303 rad/sec as per NBC 105:2020 & 15.2745 rad/sec as per IS 1893:2016 which is less than 33 rad/sec.
5. Based on the limited cases analyzed in this study. The value in drift, displacement, shear, time period in NBC 105:2020 is seen more than that of IS 1893:2016 code.
6. From the overall analysis, it can be concluded that for the high rise RC structure at boarder zone the NBC 105:2020 gives higher value than that of IS 1893:2016 as NBC consider more factor of safety during analysis of building which result in heavy and costly structure during the time of analysis. Therefore, for economic design of structure we may prefer IS 1893:2016 codal design but if we want to consider more factor of safety of the structure, we may prefer NBC 105:2020 as maximum part of Nepal is pron to earthquake.

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