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Time History Analysis of G+15 RCC Building at Different Earthquake Location

Raj M. Bawane[1], Yomish N. Sakhare[2], Pavan S. Rathod[3], Pallavi A. Barai[4], Alisha sheikh[5], Assistant Prof. Sagar Doye[6]
[1, 2, 3, 4, 5]*B.E (Civil) Student, Department of Civil Engineering, Government College of Engineering Nagpur, India*

Abstract: Now a days multi-storey buildings is the most common word in the construction source, then study of earthquake and analysis of building using earthquake data essential for future safety. In the present paper study of nonlinear dynamic analysis of G+15 storied RCC building considering different locations is carried out and seismic responses of such building are studied. The building under consideration is modelled with the help of Staad Pro software. Three different earthquake data have been used considering at different locations for establishment of relationship between time vs acceleration graphs. The results of the study Shows similar variations pattern in Seismic responses such as base shear and storey displacements, base shear value calculate manually and compare with software value From the study it is recommended that analysis of multi storied RCC building using Time History method becomes necessary to ensure safety against earthquake force.
Keywords: Dynamic analysis , seismic responses ,time history

I. INTRODUCTION

All over world, there is high demand for construction of tall buildings due to increasing urbanization and population, and earthquakes have the potential for causing the greatest damages to those tall structures. Since earthquake forces are random in nature and unpredictable, the engineering tools need to be sharpened for analysing structures under the action of these forces. Earthquake loads are required to be carefully modelled so as to assess the real behaviour of structure with a clear understanding that damage is expected but it should be regulated. Analysing the structure for various earthquake intensities and checking for multiple criteria at each level has become an essential exercise for the last couple of decades. Earthquake causes different shaking intensities at different locations and the damage induced in buildings at these locations is also different.

Static Analysis, Nonlinear Static Analysis, Linear Dynamic Analysis; and Nonlinear Dynamic Analysis. Linear static analysis or equivalent static method can be used for regular structure with limited height. Linear dynamic analysis can be performed by response spectrum method. The significant difference between linear static and linear dynamic analysis is the level of the forces and their distribution along the height of structure. Nonlinear static analysis is an improvement over linear static or dynamic analysis in the sense that it allows inelastic behaviour of structure. A nonlinear dynamic analysis is the only method to describe the actual behaviour of a structure during an earthquake. The method is based on the direct numerical integration of the differential equations of motion by considering the elastic-plastic deformation of the structural element.

II. METHODOLOGY

The methodology adopted for this study is, first modeling the considered structure in STAAD .Pro. software and analyzing the same by Time History Method of analysis of different earthquake functions Bhuj and Nepal.. Time history analysis of G+15 building structure is the basic need of this project. analysis of a seismic behavior of an structure is a need of concern, and thereby establishing a comparison between structures at different locations.

1) Collected earthquake data of Bhuj , Nepal and Uttarkashi related with project topic Time history analysis of building.
2) In the present study, analysis of G+15 multi-story building for dead load and live load and structural modelling of 30m X 30m X 60m, building is carried out.
3) Input the dimensions of building along X, Y, Z direction and no. of bays along these three axes.
4) 3D model is prepared for G+15 multi-story building using STAAD. Pro.
5) Define and assigning the properties of structure like beam, column, supports and plate
6) Analysis and designing the structure with zero errors and warnings. determining the area of reinforcement using IS CODE 456 :2000.
7) Comparing the result of models by applying different earthquake data time vs displacement , time vs velocity and time vs acceleration.

III. LITERATURE SURVEY

Akita and Kuramoto (2008) Studied related with the higher mode responses in evaluating the responses of the multi-story irregular-shaped buildings consisting of mixed soft and rigid stories in which the story collapse mechanism is formed under earthquake motions. Therefore, the applicability of the proposed method for the irregular-shaped buildings was investigated in this paper. The modified method using the equivalent participation vector of the dominant higher mode for evaluating the time history responses of the inter-story shear and drift is proposed. The results showed that the predicted the time history responses of the inter-story shear and drift by the modified method has good agreement with the time history analysis result.

Patil (2013) Studied nonlinear dynamic analysis of Ten storied RCC building considering different seismic intensities is carried out and seismic responses of such building are studied. The building under consideration is modeled with the help of SAP2000-15 software. Five different time histories have been used considering seismic intensities V, VI, VII, VIII, IX and X on Modified Mercalli's Intensity scale (MMI) for establishment of relationship between seismic intensities and seismic responses. The result of the study shows similar variations pattern in Seismic responses such as base shear and storey displacements with intensities V to X. From the study it is recommended that analysis of multistoried RCC building using Time History method becomes necessary to ensure safety against earthquake force

Harshita *et al.* (2014) studied the dynamic behavior of multistoried symmetrical building frame using IS1893- 2002 code recommended response spectrum method and time history method. The time history analysis, two earthquake data such as from previous earthquakes corresponding to Bhuj (2001) and Spitak (1988). Study focuses to evaluate the base shear, response spectra at different story levels, bending moment diagram, shear force diagram variation in the building. Analysis has been carried out using the STAAD-PRO software based on the matrix analysis. Based on the result it is found that the base shear obtained from time history analysis is slightly higher compared to response spectrum analysis, this may be due to variation in amplitude and frequency content of the ground motion.

Rathod and Gupta .(2020) studied about time history and describe the result of the time history analysis on the ten storey structure. Earthquake occurred in multistoried building shows that if the structures are not well designed and constructed with and adequate strength it leads to the complete collapse of the structures. To ensure safety against seismic forces of multi-storied building hence, there is need to study of seismic analysis to design earthquake resistance structures. The main parameters of the seismic analysis of structures are load carrying capacity, ductility, stiffness, damping and mass. The various response parameters like base shear, storey drift, storey displacements etc are calculated.

A. Nonlinear Dynamic Analysis

It is known as Time history analysis. It is an important technique for structural seismic analysis especially when the evaluated structural response is nonlinear. To perform such an analysis, a representative earthquake time history is required for a structure being evaluated. Time history analysis is a step-bystep analysis of the dynamic response of a structure to a specified loading that may vary with time. Time history analysis is used to determine the seismic response of a structure under dynamic loading of representative earthquake .

Following are the design IS codes

(i) IS 456: 2000 – plain and reinforced concrete – code of practice (fourth revision)

(ii) Loading standard codes The loads to be considered for structural design are specified in the following loading standards: IS 875 (Part 1 to 5) : 1987 – code of practice for design loads (other than earthquake) for buildings and structures (second revision).

Part – 1: Dead loads

Part – 2: Imposed (Live) loads

Part – 3: Wind loads

Part – 4: Snow loads

Part – 5: Special loads and load combinations

(iii) IS 1893: 2002 – criteria for earthquake resistant design of structure (fourth revision).

B. Modeling in staad. Pro software

STAAD. pro is a computer-aided engineering software tool used mostly by structural, civil engineers, and architects which is originally pioneered and developed by Research Engineers International in the year 1997. Research Engineers international was duly bought by Bentley in the year 2005. This software has robust visualization structural analysis and design features and functionalities for dynamic analysis and design of any engineering structures including plants, metro stations, wastewater treatment plants, buildings, bridges, towers, tunnels, industrial structures, etc

1) Models

Structural details of building of all models are same only choose different location of building for time history analysis

Model 1:Design and analysis of building (applying dead and live load)

Model 2 :Design and analysis of building (applying dead, live load ,wind load and earthquake load)

Model 3: Time history analysis of building (Bhuj earthquake)

Model 4: Time history analysis of building (Nepal earthquake)

Model 5 : Time history analysis of building (Uttarkashi earthquake)

Table 1 : Earthquake location

Sr .no	Eartquake location	Date	Seismic zone
1.	Bhuj	26 th January 2001	v
2.	Nepal	25 th April 2015	-
3.	Uttarkashi	20 th octomber 1991	iv

C. Structural Details Of The Building

1)	Length of the building (along X Direction)	:	30
2)	Width of the building (along Y Direction)	:	30m
3)	Height of the building	:	60 m
4)	Column Dimension	:	1m*1m
5)	Beam Dimension	:	0.6m*0.7m
6)	Slab thickness	:	0.15m
7)	Wall thickness	:	0.23m
8)	Concrete Grade	:	25 N/mm^2
9)	Steel Grade	:	415 N/mm^2
10)	No. of storey	:	15
11)	No. of bays along length	:	6
12)	No. of bays along width	:	6
13)	Floor height	:	4m

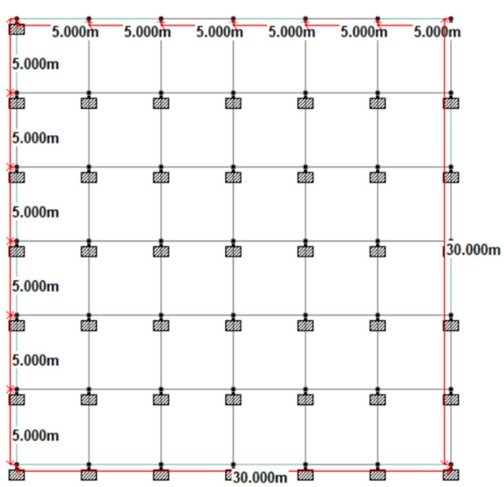

Figure 1: Plan of Building

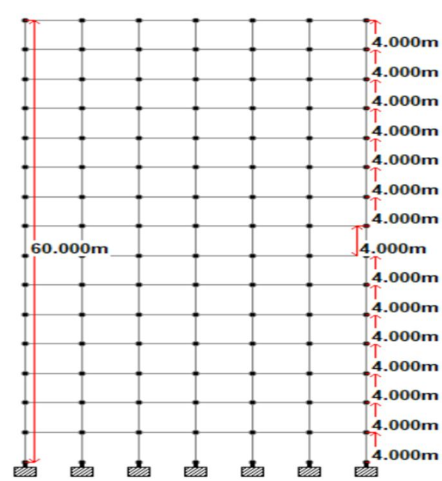

Figure 2: Elevation of Building

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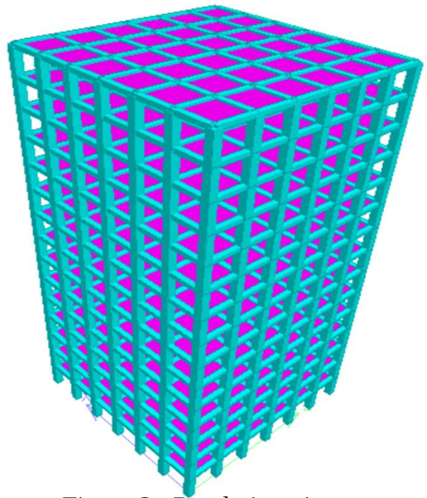

Figure 3 : Rendering view

IV. COMPARE RESULT AND DISCUSSION

A. Time vs Displacement

After postprocessing the graphs of time vs displacement along the x axis of 15 th floor shown in Fig 4 ,.

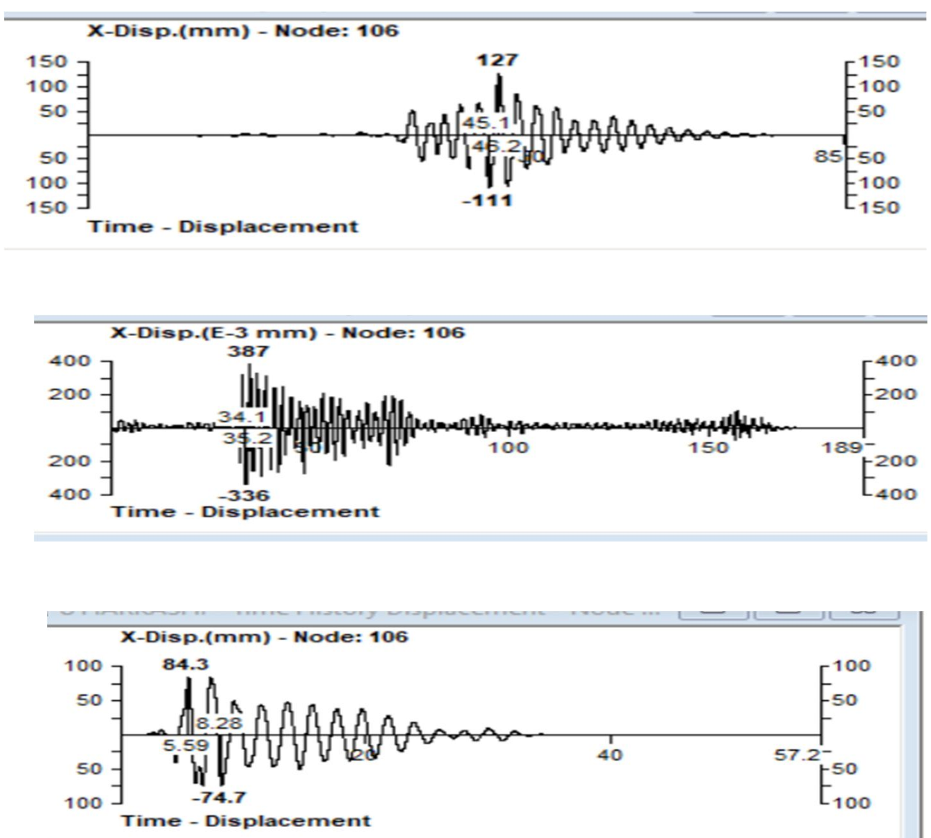

Figure 4 : 15 th floor time vs displacement graph Model 3, 4, 5

B. Column Design Result

Results of column design of different models after input the data of bhuj ,Nepal ,and uttarkashi earthquake, time vs acceleration data .Fig 5 show the comparative results get after analysis and design the models .

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Figure 5 **:** Results Of Column Design As Per THA (Beam No. 91)

V. CONCLUSIONS

1) Time history analysis can also provide valuable information on the performance of different structural components and systems under dynamic loads. By analysing the response of individual components, engineers can identify areas that may need to be reinforced or redesigned to improve the overall performance of the structure.
2) Another important conclusion from time history analysis is the importance of accurate modelling and simulation. Inaccurate or incomplete models can lead to incorrect predictions of the behaviour of a structure under dynamic loads, which can have serious consequences for its performance and safety
3) In conclusion, time history analysis is an important tool for understanding the dynamic behavior of structures under seismic, wind, or other types of dynamic loads. By providing insights into the behavior of structures under different conditions, it can help engineers and researchers design safer and more resilient structures.
4) According to results of THA, the storey shear force was found to be maximum for the first storey and it decreased to a minimum in the top storey in all cases.
5) According to results of THA, it was found that mass irregular building frames experience larger base shear than similar regular building frames.
6) According to results of THA, the stiffness irregular building experienced lesser base shear and has larger inter storey drifts.

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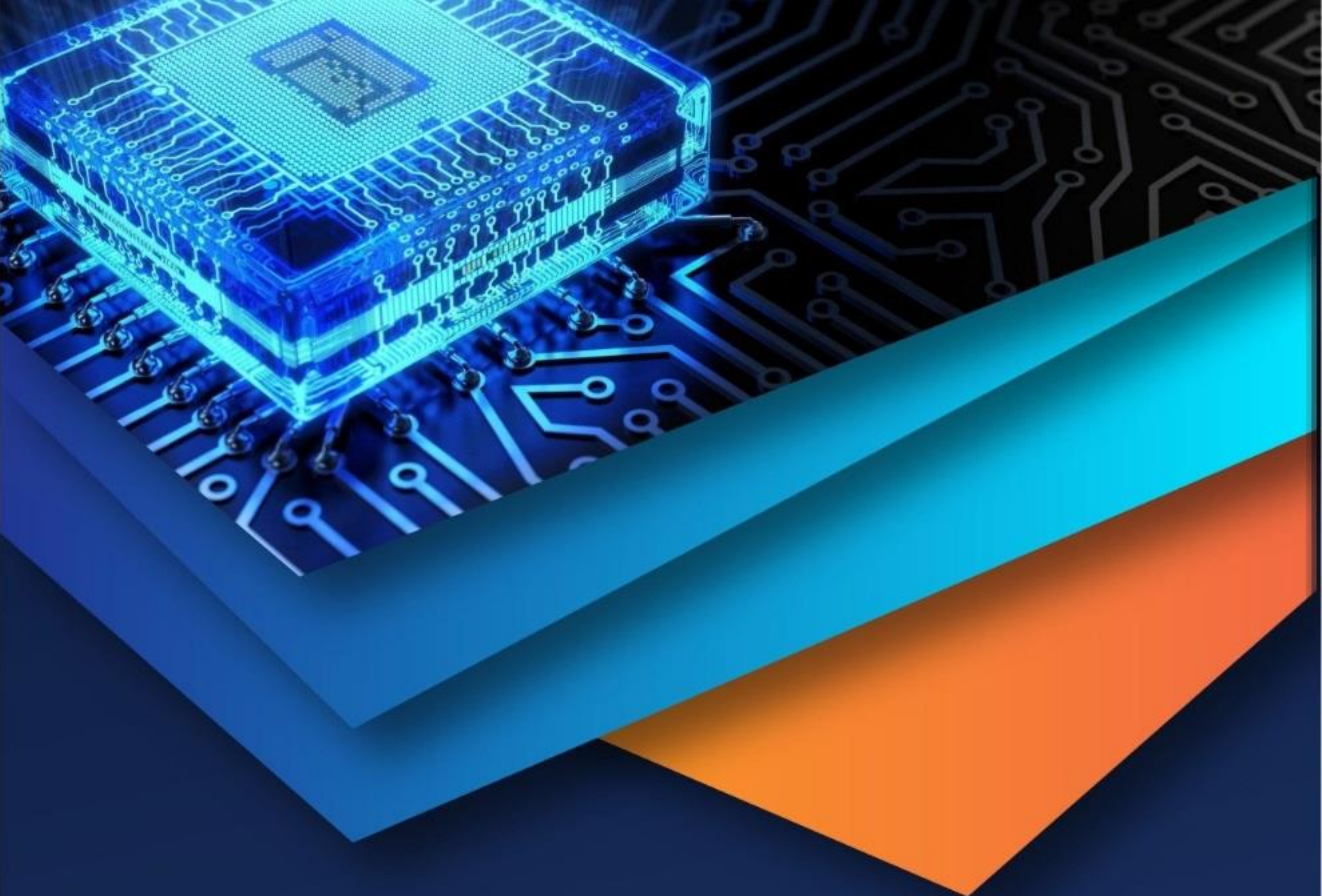

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