

Determination of Storey Drift & Maximum Displacement for Multi-Storeyed Building Using Time History Method

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ABSTRACT: Seismic analysis is the major development in the field of civil engineering. The response spectra method has been taken over by performance based seismic design. In performance based design, the structure is designed considering drift and displacement as the criteria. In this paper STAAD Pro V8i software is used for determination of drift and maximum displacement for a G+6 structure. The structure is subjected to Bhuj 2001 ground motions that occurred in Gujarat. The loads are taken as per Is standard. The time history analysis is used for the analysis purpose. In this paper Bhuj 2001 ground motion has been taken and storey drift and maximum displacement has been determined.

KEYWORDS: Time History Method, drift, STAAD PRO software

I. INTRODUCTION

Earthquake has been a major problem for designing any structure. If the earthquake forces are not taken properly then it might cause havoc to the building as well as to the life of the people. The earthquake forces need to be considered properly. Story drift plays a major role while designing for earthquake. In this paper the G+6 structure is modelled using STAAD PRO V8i software. The building is subjected to different time history data. The storey drift has been determined for each storey. The loadings and the designing is done as per relevant Is codes.

II. RELATIVE WORK

Vikas Mehta, Kanchan Rana (2017) made a study on a time history analysis method for studying a multistoried building using STAAD Pro software. Jiang Naibin, Mao Qing and Zhang Yixiong (2007) carried out study on Research on Time-history Input Methodology of Seismic Analysis. Prakriti Chandrakar, Dr. P. S. Bokare (2015) studied A Review - Comparison between Response Spectrum Method and Time History Method for Dynamic Analysis of Multi-storeyed Building. Pruthviraj N Juni, S.C. Gupta, Dr. Vinubhai R. Patel (2017) did a study on Nonlinear Dynamic Time History Analysis of Multistoried RCC Residential G+23 Building for Different Seismic Intensities. Dr. S.K. Dubey, Prakash Sangamnerkar, Ankit Agarwal (2015) made a study on dynamic analysis of a structure subjected to earthquake forces. Nilesh B. Mevawala, Dr. Atul K. Desai (2016) studied Seismic Non-Linear Time History Analysis of Building Resting On Sloping Ground with Special Study on Nepal Earthquake. N. Torunbalci and G. Ozpalkanlar (2008) made a study on evaluation of earthquake response analysis methods for low rise-base isolated buildings. Hongliu Xia, Xinyu Huang, Xuan Zhao, Jianwei Liu (2004) made a study on determination method of design displacement response spectra based on ductility factor. Michele Betti, Luciano Galano and Andrea Vignoli (2015) carried out a study on Time-History Seismic Analysis of Masonry Buildings: A Comparison between Two Non-Linear Modelling Approaches. Arunava Das, Priyabrata Guha (2016) made a study on Comparative Study of the Static and Dynamic Seismic Analysis of RC regular and irregular frame structures.

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III.MODELING OF THE STRUCTURE

The main aim for this paper is to subject the earthquake forces to the G+6 structure .Structure with floor plan dimension of 20m by 25m were considered for the study purpose. The total height of the building is 23.7m.the floor to floor height of the building is 3.7m. The beam sizes considered for the study are 0.23m by 0.45m and column sizes are 0.3 m by 0.3 m. The live load considered for the study is 2 kN/m²and dead load of 5.6 kN/m². The building was analysed for Bhuj earthquake time history data.

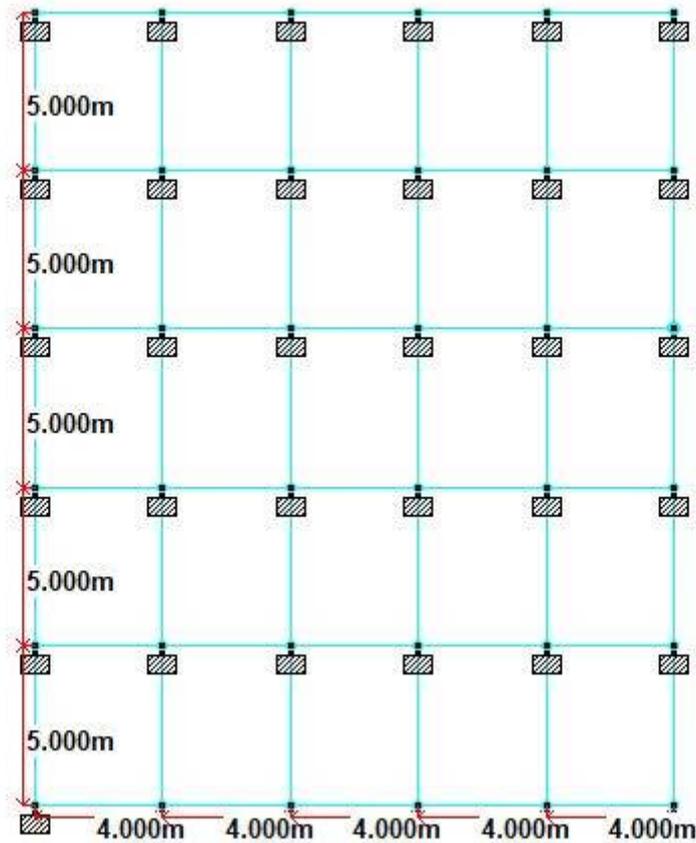


Figure 1: Floor plan of structure in STAAD PRO

The above figure 1 shows the floor plan of the structure . The dimensions for the floor plan are 20m by 25m . The floor plan is typical for all the floors . The dimension is taken from centre to centre of the beam . The supports are taken as fixed support.

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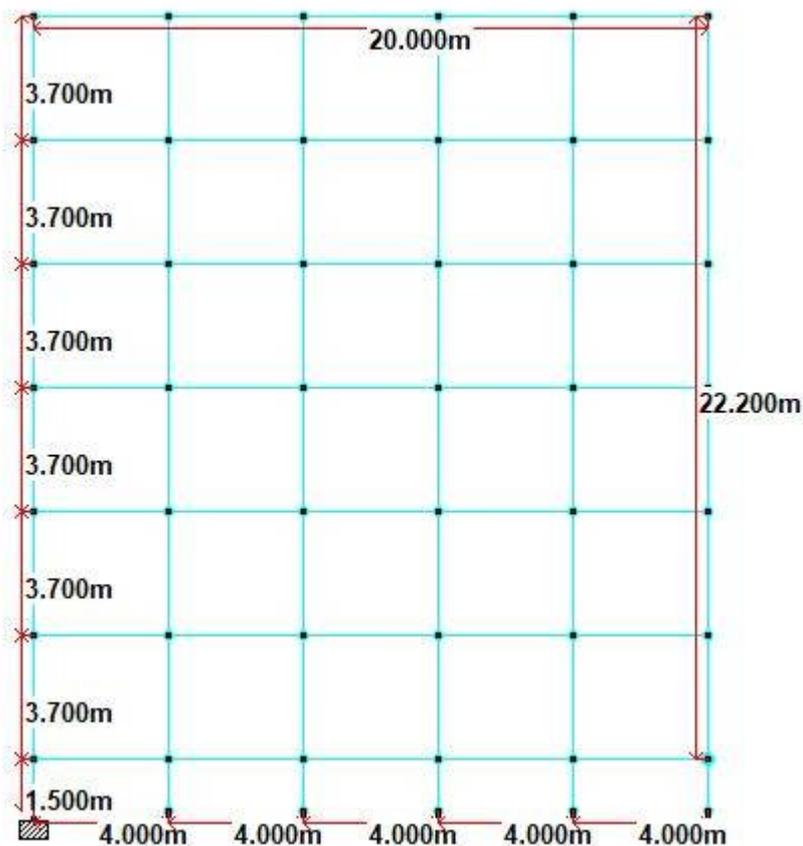


Figure 2: Elevation of building model

The above figure 2 represents the elevation of the building. The total height of the building is 23.70m. The foundation height is 1.5m and floor to floor to floor height is 3.7m. the top roof is taken as flat .

IV. PROBLEM STATEMENT

Time history is a nonlinear dynamic analysis is used as one of the method for seismic analysis .The dyamic response of the structure can be determine by using time history analysis. In this paper time history analysis is used to determine storey drift and maximum displacement of the structure.

V. DESCRIPTION OF BUILDING

Type of structure: High rise RC frame structure with shear wall
Occupancy: Office Building
Number of stories: 7
Foundation depth: 1.5m
Intermediate storey height: 3.7m

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Type of soil: Soft soil
Zone: V (Bhuj, EQ magnitude of 7)
Grade of Concrete: M25
Density of Concrete: 25 kN/m³
Modulus of Elasticity of concrete: 5000√f_{ck}

VI. EXPERIMENTAL RESULTS

The following table shows drift and maximum displacement at each floor level

Table 1: Drift & Maximum Displacement values at different floors.

Sr.No	Floor No	Maximum displacement in (mm)	Storey drift (in mm)
1	Ground floor	650	3
2	1	810	35
3	2	918	67
4	3	804	94
5	4	859	116
6	5	432	133
7	6	526	143

The above table 1 shows the maximum displacement values obtained from the analysis. At every floor level the maximum displacement and storey drift is determined. The maximum displacement and storey drift values are measured in mm .

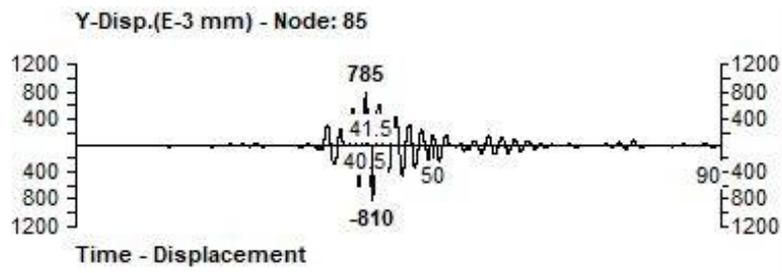


Figure 3: Displacement vs Time at 6th floor

Figure 3 shows time vs displacement value at the 6th floor . The maximum value is 810 mm . This graph is similar to the ground motion acceleration of the bhuj earthquake taken .

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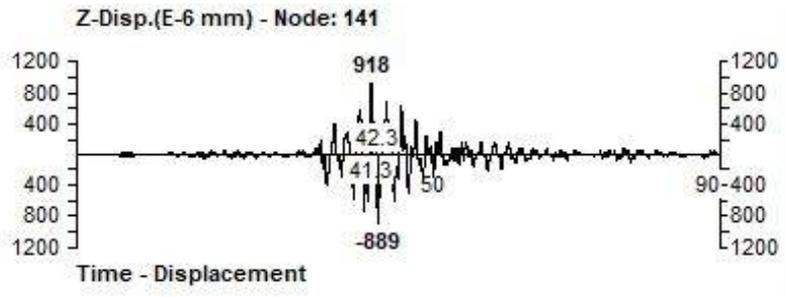


Figure 4: Displacement vs Time at 5th floor

Figure 4 shows time vs displacement value at the 5th floor . The maximum value is 918 mm . This graph is similar to the ground motion acceleration of the bhuj earthquake taken .

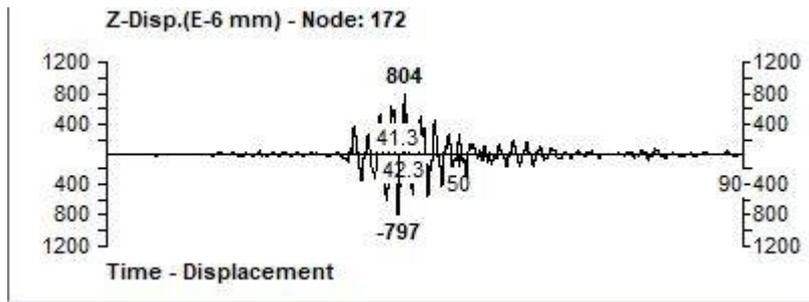


Figure 5: Displacement vs Time at 4th floor

Figure 5 shows time vs displacement value at the 4th floor . The maximum value is 804 mm . This graph is similar to the ground motion acceleration of the bhuj earthquake taken .

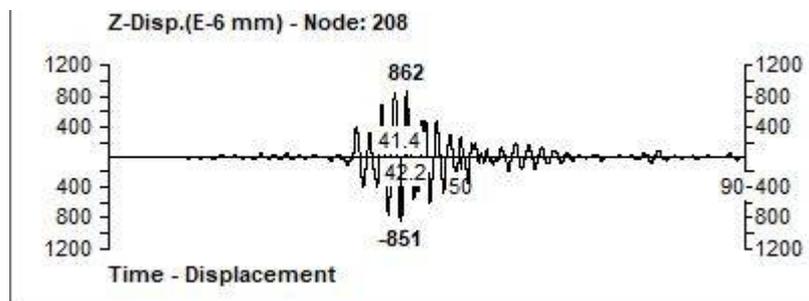


Figure 6: Displacement vs Time at 3rd floor

Figure 6 shows time vs displacement value at the 3th floor . The maximum value is 810 mm . This graph is similar to the ground motion acceleration of the bhuj earthquake taken .

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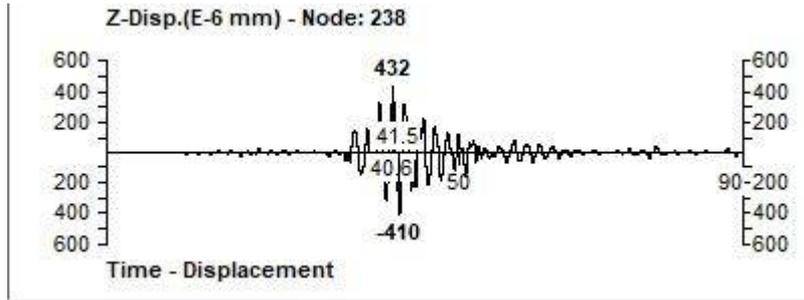


Figure 7: Displacement vs Time at 2nd floor

Figure 7 shows time vs displacement value at the 2th floor . The maximum value is 432 mm . This graph is similar to the ground motion acceleration of the bhuj earthquake taken .

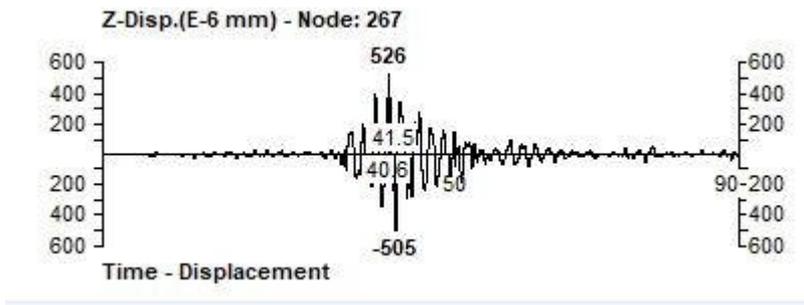


Figure 8: Displacement vs Time at ground floor

Figure 8 shows time vs displacement value at the ground floor . The maximum value is 810 mm . This graph is similar to the ground motion acceleration of the bhuj earthquake taken .

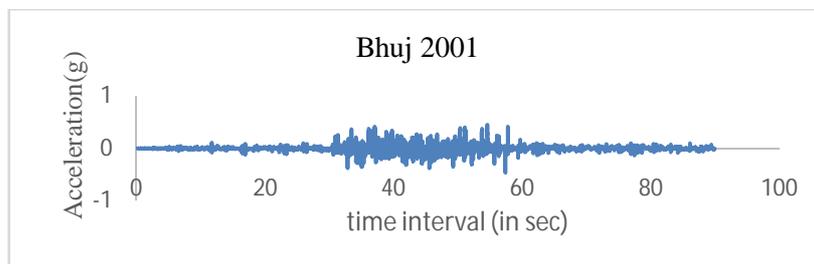


Figure 9: Time Vs Acceleration graph obtained from Bhuj Earthquake data

Figure 9 shows ground motion acceleration of Bhuj earthquake 2001. The time interval is taken on x-axis and acceleration is taken on y-axis. The time interval is 0.005sec.

VII. CONCLUSION

It was seen that the Time vs acceleration data of Bhuj earthquake is similar to that of Time vs displacement graph at each floor level. It was also seen that storey drift increases as the height of the building increases. As the ccleration of ground motion is maximum the displacement of the node is maximum.

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