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Time History Analysis of Various Shapes of Building Frame

Ms. Kajal K. Late[1], Prof. V.V.Nair[2]
Department of Civil Engineering, BATU University

***Abstract:** The seismic performance of different building frames varies greatly according to shape. (I.e. geometric plans of the structure). By using the original earthquake forces, i.e. the various time history earthquakes, the realistic behaviour of buildings can be examined. The research is conducted on a variety of shapes, including G+05 storey L-shape, Plus-shape, and Square building frames. Two Time Histories namely El Centro (1940) and Bhuj (2001) are used to study the variation in the acceleration and displacement. The results are validated by performing study on the application software (ETABS 2018) study reveals that unsymmetrical building frames are less effective in resisting the seismic forces also out of the two Time History studied El Centro (1940) Time History is producing max acceleration and displacement in the structure.*
***Keywords:** Seismic Response, Time History Analysis*

I. INTRODUCTION

India is one of the countries most vulnerable to both natural and man-made disasters. 85% of the region is at danger from one or more disasters, and 57% of it, including the capital of the country, is in a seismically active area. Engineering for earthquakes was developed comparatively early in India.

Despite an early start, the country's seismic danger is currently rapidly increasing. Some of the largest earthquakes ever documented in history occurred in India. In the north-eastern region of India, it has been observed that the symmetry of the structure, both in elevation and plan, has a significant impact on seismic performance. Although a realistic earthquake simulation is difficult, there is room to study asymmetrical structures and assess how well they perform from the standpoint of overall stability. In the case of a real earthquake, forces struck the structure from a variety of directions, and the behaviour depends on the stiffness of the structure in that direction.

Seismic forces typically cause the multi-story building to collapse at the weak point. These deficiencies are a result of irregularities in mass, stiffness, and power. Greater negative effects are caused by excess mass on higher floors than on lower floors. Due to a rise in inertial force and a decrease in the ductility of the vertical load resisting element, the structure collapsed. Therefore, it is necessary to research the effects of unsymmetrical buildings over different time periods. Because it cannot be predicted, simulating the force of an actual earthquake is extremely challenging. As a result, research is conducted using various time periods on an earthquake that occurred in the past.

II. OBJECTIVE

The purpose of the research paper is to examine the Seismic Response for various unsymmetrical building by using Time History Analysis. Study is carried out by using ETABS 2018 software.

The objective as follows

1) To Study the seismic behaviour of building frames with various plan geometries.
2) To Study different plan geometry variation for acceleration and displacement of building.
3) To Study interpretation for various Time Histories.

III.BUILDING MODEL CONSIDERED FOR THE ANALYSIS

For the research paper, 3 number of building are used for design purpose which are carried by using code provision. The building structures used for modelling are L, Plus and Square shape in plan. Material Properties and Geometric Properties are mentioned below in Table 1.

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TABLE I
MATERIAL PROPERTIES OF BUILDING FRAMES

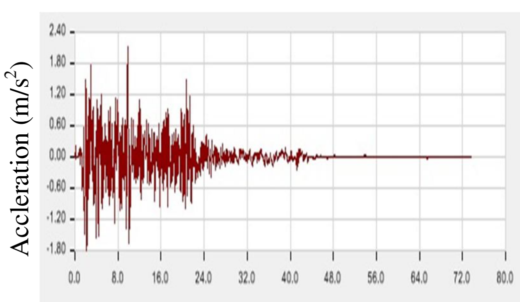
Sr. No	Items.	Descriptions		
I.	Building	L-Shapes	Plus-Shapes	Square-Shapes
II.	Number of stories	G+05	G+05	G+05
III.	Floor to Floor Height	4000 mm	4000 mm	4000 mm
IV.	Grade of Concrete (fck)	M20	M20	M20
V.	Grade of Steel (fy)	Fe415	Fe415	Fe415
VI.	Bay width (Both Direction)	3000 mm	3000 mm	3000 mm
VII.	Thickness of Slab	150 mm	150 mm	150 mm
VIII.	Column	450mmx450mm	450mmx450mm	450mmx450mm
IX.	Beam Size	230mmx300mm	230mmx300mm	230mmx300mm
X.	Live Load	3.0 kN/m²	3.0 kN/m²	3.0 kN/m²
XI.	Zone	3	3	3

IV. BUILDING MODEL CONSIDERED FOR THE ANALYSIS

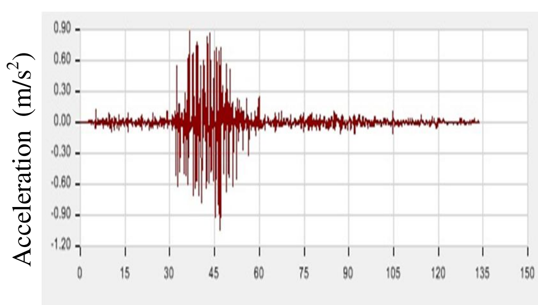
TABLE II
TIME HISTORIES

Earthquake Used	El Centro	Bhuj
Location	California.	Gujarat.
Date of EQ	18^{th} May. 1940	26^{th} Jan. 2001
Time	9:35pm	8:46am
Magnitude	6.9	7.7

TABLE III
TIME HISTORIES GRAPH



Time (sec)
Fig. 1 El-Centro



Time (sec)
Fig. 2 Bhuj

V. BUILDING MODEL CONSIDERED FOR THE ANALYSIS

In order to study L, Plus and Square Shape buildings, the software ETABS-2018 is used to model the buildings, and different Time Histories are used to conduct the research.

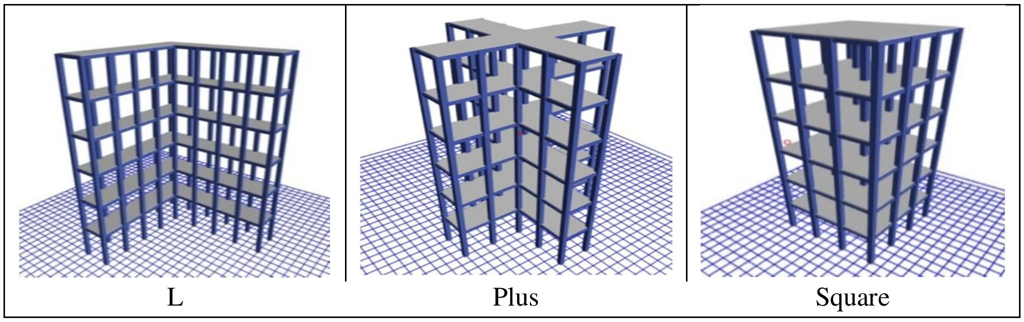


Fig.3 Various Shapes of Building plotted in ETABS-2018 software

VI. RESULTS

Various model of building frames are analysed and time history has been applied which are El Centro and Bhuj. The analysis is carried out at roof level by using ETABS-2018 software. El-Centro time history is used to experiment with the variance of displacement and acceleration for L, Plus, and Square shapes, while other time histories also produced results in a comparable manner. The acceleration and displacement variations for different time histories and shape building are plotted below. All title and author details must be in single-column format and must be centred.

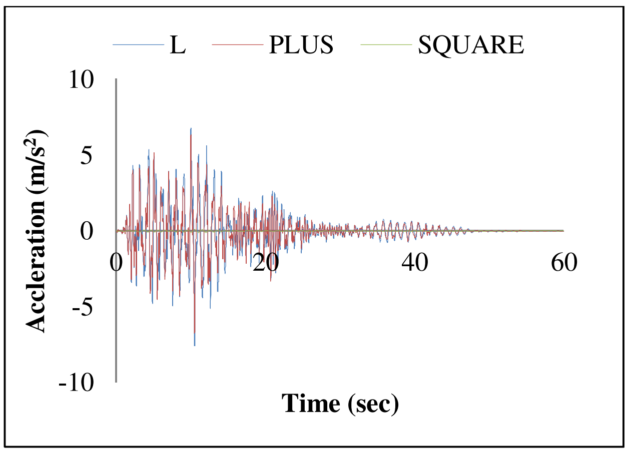


Fig.4 Acceleration Graph for El-Centro

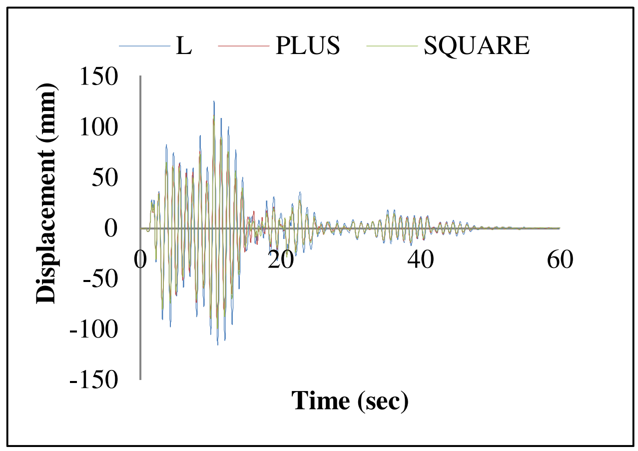


Fig.5 Displacement Graph for El-Centro

The results obtained from graph are drawn below. The comparison of acceleration and displacement are plotted below.

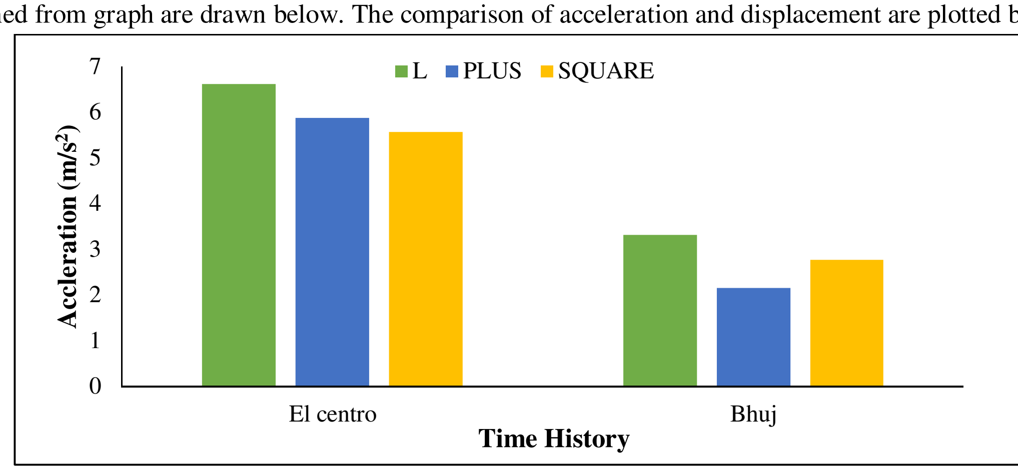


Fig.6 Comparison of Acceleration

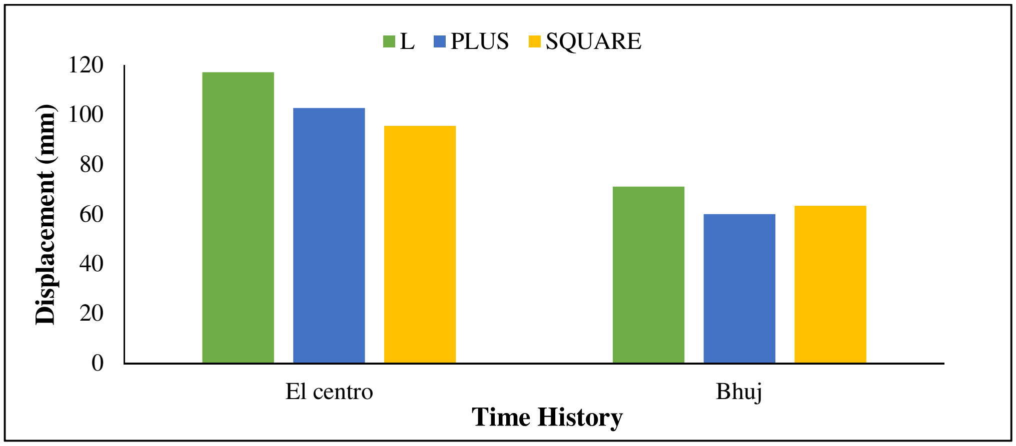


Fig.7 Comparison of Displacement

It can be seen from graphs of the acceleration versus time and displacement versus time of different earthquake forces that El-Centro time history causes the greatest displacement in the building frames. Additionally, it has been discovered that when compared to Plus shape and Square shape, L-shape buildings produce high displacement. The displacement between the Plus and Square Buildings is the same with less variation. After that, it was found that unsymmetrical in building frames produces significant displacement and lower earthquake force resistance. As a result, unsymmetrical buildings should to be strongly ignored.

VII. CONCLUSION

The research is done for three models which are L-Shape, Plus-Shape, and Square-Shape plan geometry. Acceleration and displacement for various time histories like Bhuj and El-Centro are modelled. Following are the conclusion observed.

1) El-Centro Time History shows maximum response among all Time Histories.
2) L-shaped buildings are found to be less efficient at withstanding earthquake force than other shapes, despite having more acceleration and displacement. (I.e. Plus, Square Shape). We can therefore draw the conclusion that using asymmetrical structures is not recommended because they are weaker and less stable.
3) Buildings in square shapes are found to be more stable to withstand earthquake pressures. As a result, symmetrical shape buildings are recommended for structural efficiency.

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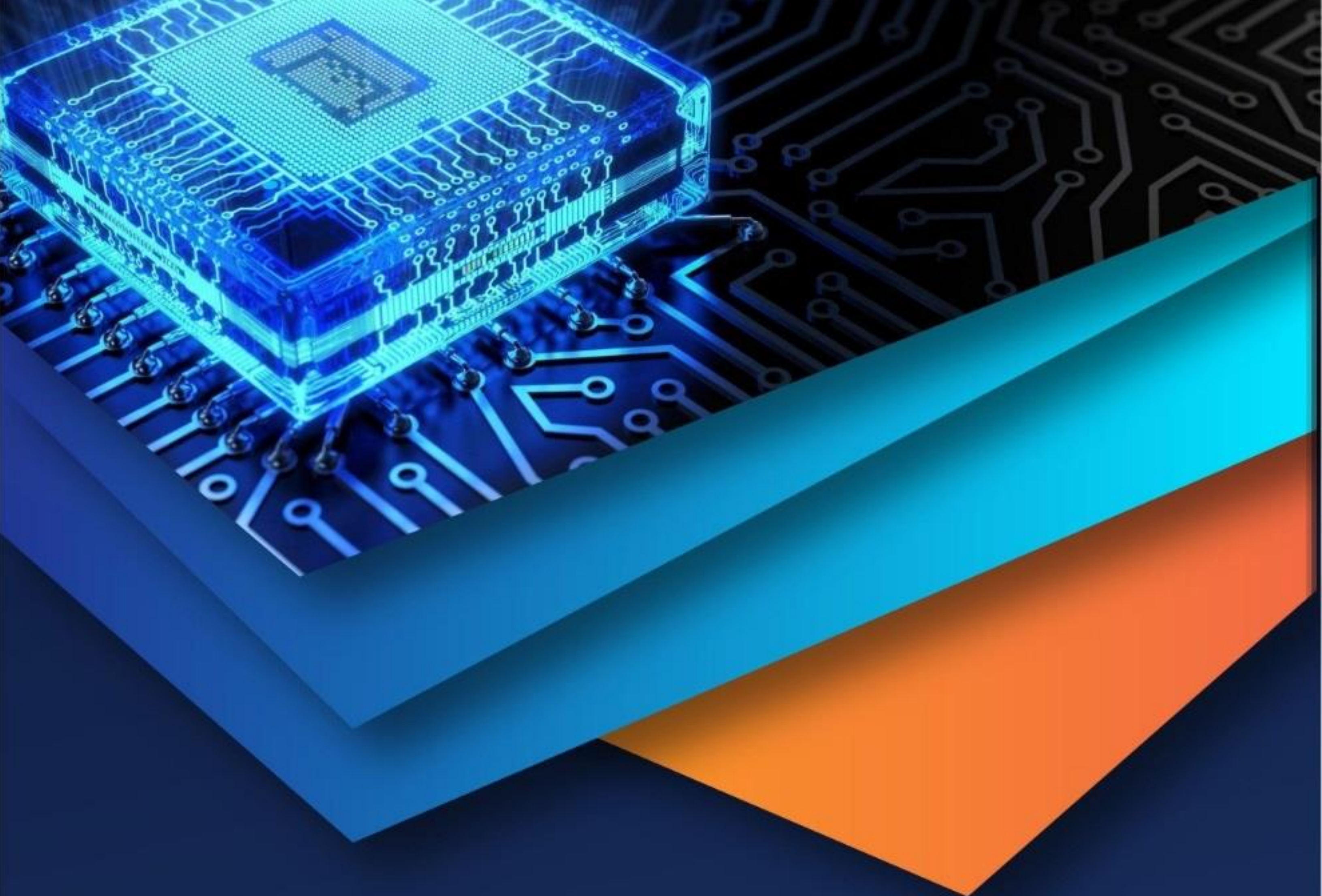

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