IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 16, Issue 2 Ser. V (Mar. - Apr. 2019), PP 22-27
www.iosrjournals.org

Non Linear Dynamic Analysis of Regular Shaped &L-Shaped Building

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Abstract: *Earthquake is one of the very important aspects to be considered while designing every structure. Lot of work has been reported by many researchers who worked to study the effect of structures with Different irregularities. By inspiring from their works the project is done using time history analysis in E Tabs 2015. In this paper two models of rectangular shape and L-shape each of G+5 are taken for analysis. Both the buildings are assumed to be in Zone V and having medium soil type. The previous Elcentro earthquake 1940 data has been take for analysis. For this analysis listed parameters are considered namely Maximum displacement and drift, Base shear, Maximum story acceleration and Time period. It is observed that Irregular shaped building leads to increase in displacement, drift, story acceleration, time period and member forces, but reduces the base shear.*

Keywords: *L-shaped Building, Time History Analysis, E Tabs, Lateral Displacement, Base Shear*

Date of Submission: 16-04-2019 Date of acceptance: 01-05-2019

I. Introduction

Earthquake means the sudden vibration of earth which is caused by moving of tectonic plates in earth crust. We know that different types of irregularities in buildings are used in modern infrastructure. During an earthquake, the building tends to fail. This is mainly due to discontinuity in geometry, mass and stiffness or some of different factors. This discontinuity is termed as Irregular structures. So plan irregularity is one of the major reasons of failures of structures during earthquakes. Now a day's different irregular shape of buildings are of higher demand in construction. So during planning stage all the related factors should be considered. Along with this the structure should withstand the lateral earthquake forces coming on it. So this study is done for understand the difference in response of different structure during an earthquake. In this study the building is considered in Zone V, with medium type of soil. The earthquake data of Elcentro earthquake 1940 is taken for analysis. The shape irregularity refers to uneven distribution of stiffness or strength when subjected to seismic action.

Generally there are following types of irregularities in structure;

1. Plan Irregularities
2. Vertical Irregularities

1.Plan Irregularity: This is the even inconsistency in the design of vertical parallel drive opposing components, this is the way creating a differential between the focal point of mass and focus of Inflexibility, that ordinarily result in huge torsional requests on structure. In other word the state of being no uniform, or quickly fluctuating, rather than steady. The Plan irregularity may be one or more of following

1) Torsional Irregularity
2) Re-entrant corners
3) Diaphragm Discontinuity
4) Out of Plane offsets
5) Non parallel system

Non-Linear Dynamic Analysis:-In this method, the seismic response of the structure is evaluated using step-by-step time history analysis. The main methodology of this procedure is almost similar to the static method of analysis. However, this approach differs in the concept that the design displacements are not established using the target displacement; but, is estimated through dynamic analysis by subjecting the building model to an ensemble of the ground motions. The calculated seismic response is very sensitive to the ground motion characteristics, and the analysis is carried out for more than one ground motion record.

Objectives of Study:-The objective of the present work is to study the behavior of regular shaped and L-shaped G+5 Building under earthquake load by adopting Non-linear Time history analysis to evaluate and study the differentiation in Base shear, story displacement also story drifts using E Tabs 2015.

II. Performance Analysis

In this area I have studied the base shear, displacement and story drift of both the models with respect to each other in E Tabs 2015. By comparing the results one can easily understand the response of structure and can predict the good shape structure which performs well against earthquake forces. Detailed study of mentioned factors is shown further. Models are shaped by considering Plan irregularities i.e. the plan area for each structure is same only there is difference of geometry. For both the types of structure total numbers of story are 5 and elevation is also same. The models used for analysis are as below

Table No.1. Details of Structure

Parameters	Regular Shaped Building	L-Shaped Building
Height of Each Floor	3 Meter	3 Meter
Grade of Concrete	M 25	M 25
Grade of Steel	HYSD 500	HYSD 500
Depth of Slab	150 mm	150 mm
Size of Beams	300 mm x 450 mm	300 mm x 450 mm
Size of Column	300 mm x 500 mm	300 mm x 500 mm
Thickness of Wall	230 mm	230 mm

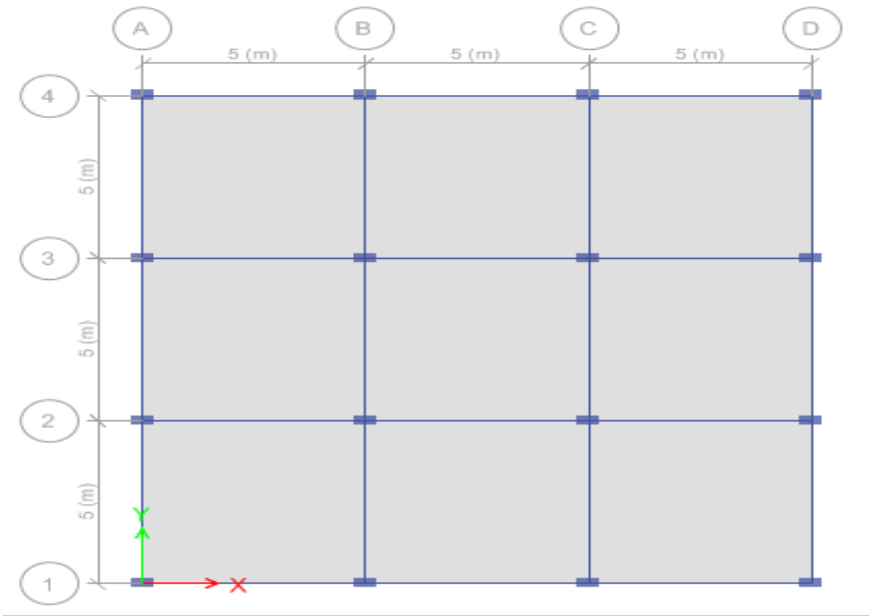
Table No.2. Seismic Data

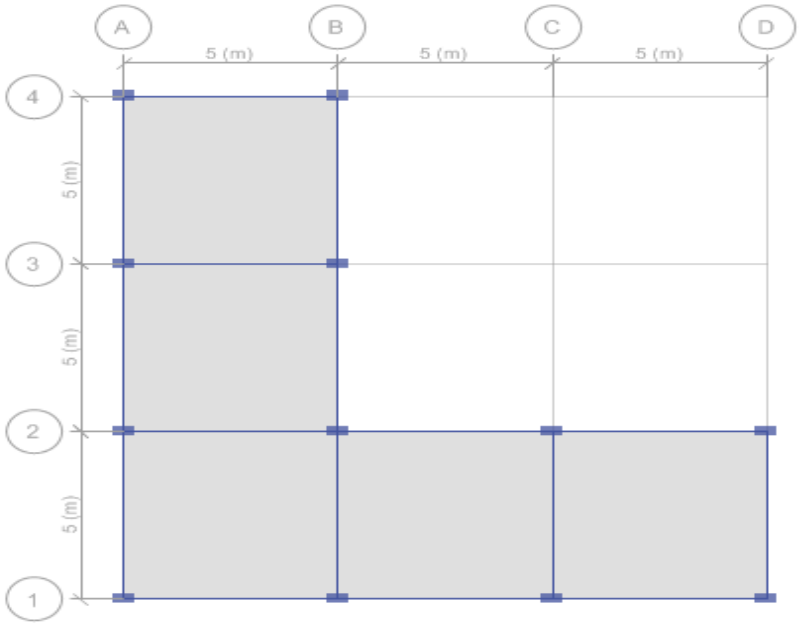
Earthquake Zone	V
Damping Ratio	5 %
Importance Factor	1
Type of Soil	Medium
Response Reduction Factor	5
Time Period	Program calculated
Poisons Ratio	0.15

Table No. 3. Load Cases Summery

Dead	Linear Static
Live	Linear Static
EQx	Linear Static
EQy	Linear Static
Wall	Linear Static
THA-x	Nonlinear Modal History (FNA)
THA-y	Nonlinear Modal History (FNA)

Plan View of Models Used





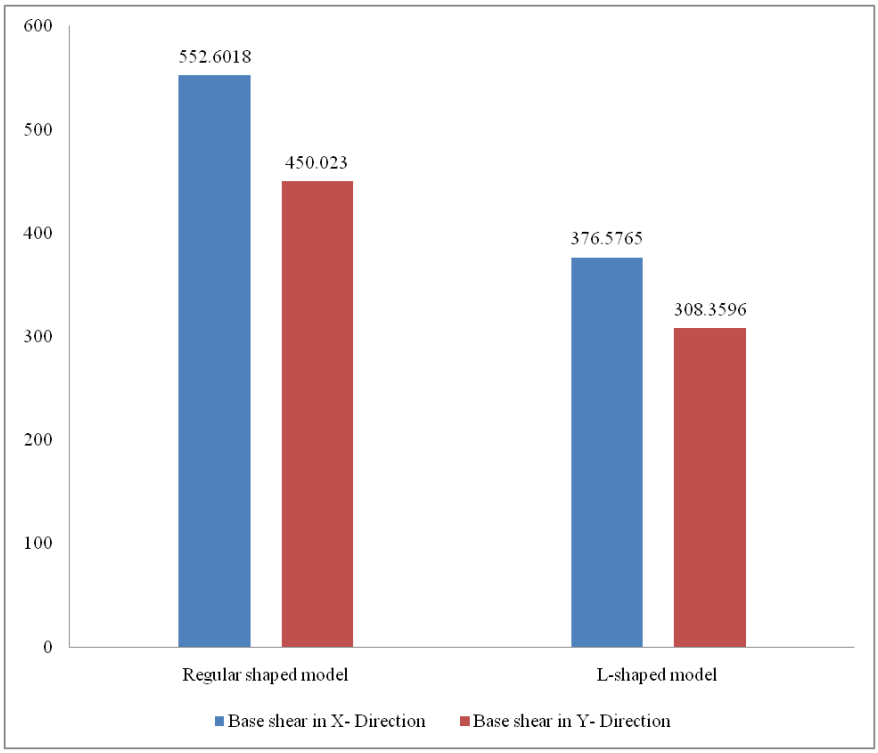
III. Result and Discussion

1. Base Shear

Comparison of weight of building and base shear evaluated for both the models in both the direction.

Table No.4. Base shear in X & Y Direction

Parameter	Regular Shaped Model	L-Shaped Model
Weight of Building	10480.6027 KN	6330.9569 KN
Base Shear In X- Direction	552.6018 KN	376.5765 KN
Base Shear In Y- Direction	450.023 KN	308.3596 KN



2. Storey Displacement

Storey displacement in both X and Y direction .

Table No.5. Displacement in X Direction

Displacement in X Direction		
Story	**Regular Shaped Model**	**L-Shaped Model**
Story7	2.03E-06	0.002
Story6	2.06E-06	0.002
Story5	1.76E-06	0.002
Story4	1.43E-06	0.001
Story3	1.00E-06	0.001
Story2	8.16E-07	0.0004239
Story1	5.11E-08	6.70E-05
Base	0	0

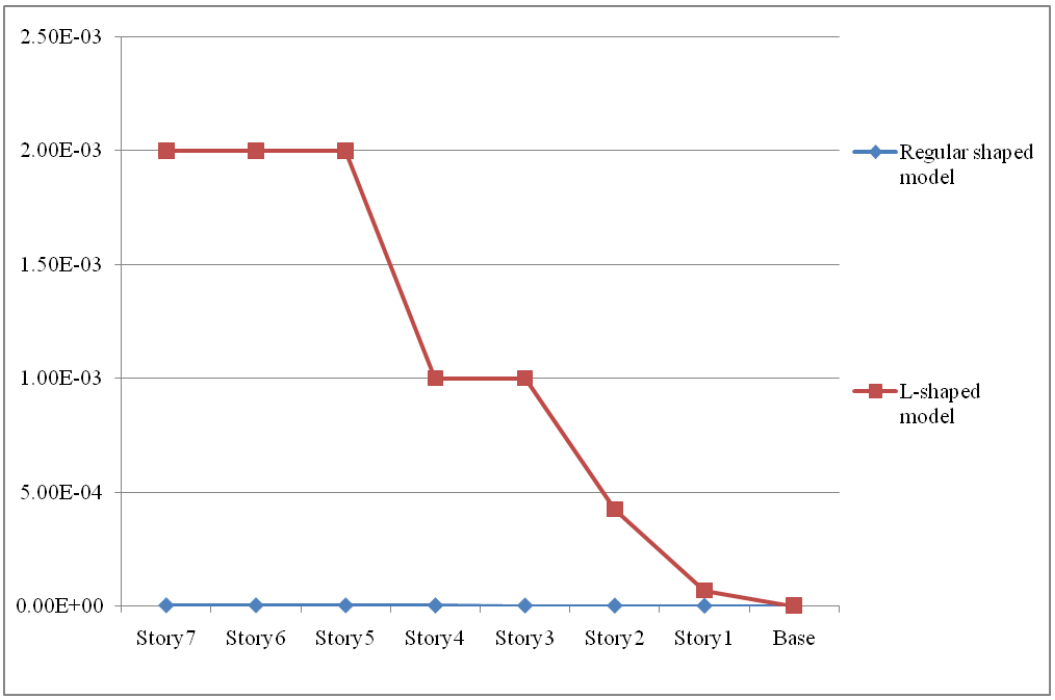
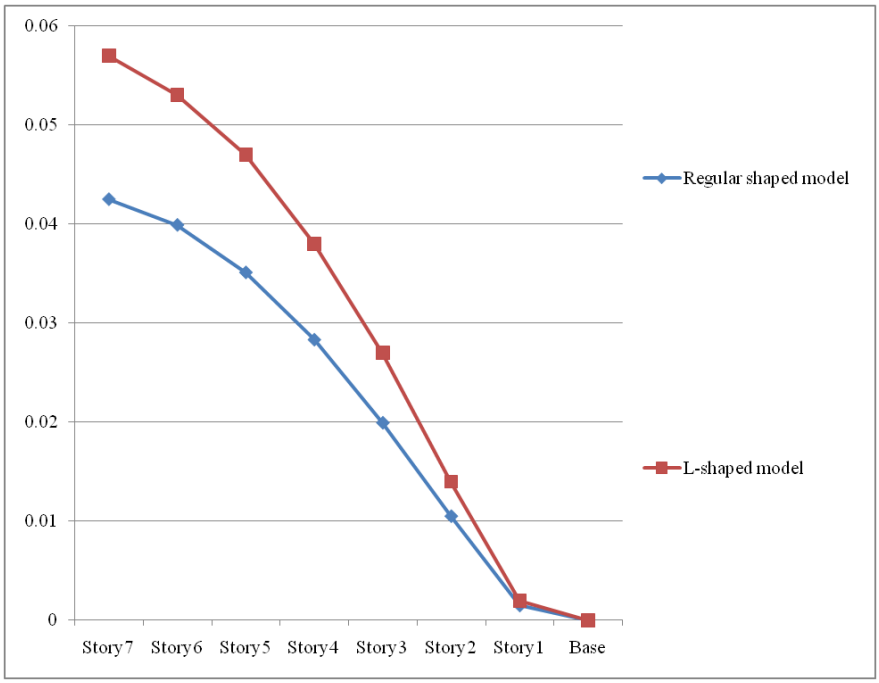


Table No.6. Displacement in Y Direction

Story	**Regular Shaped Model**	**L-Shaped Model**
Story7	0.04249782	0.057
Story6	0.0399058	0.053
Story5	0.03511782	0.047
Story4	0.02833317	0.038
Story3	0.01995328	0.027
Story2	0.01053583	0.014
Story1	0.00151867	0.002
Base	0	0



3. Storey drifts

The variation in storey Drifts is as shown

Table No.7. Storey Drift In X Direction

Story	Regular Shaped Model	L-Shaped Model
Story7	0	7.92E-08
Story6	0	1.09E-07
Story5	0	1.29E-07
Story4	0	1.40E-07
Story3	0	1.39E-07
Story2	0	1.19E-07
Story1	0	4.47E-08
Base	0	0

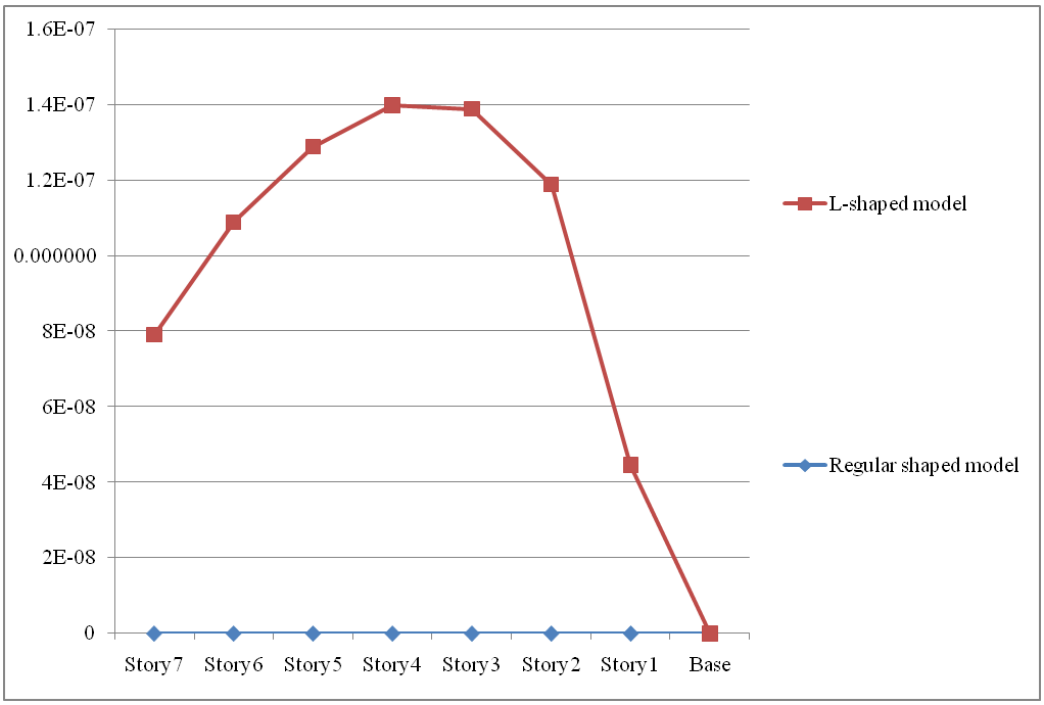
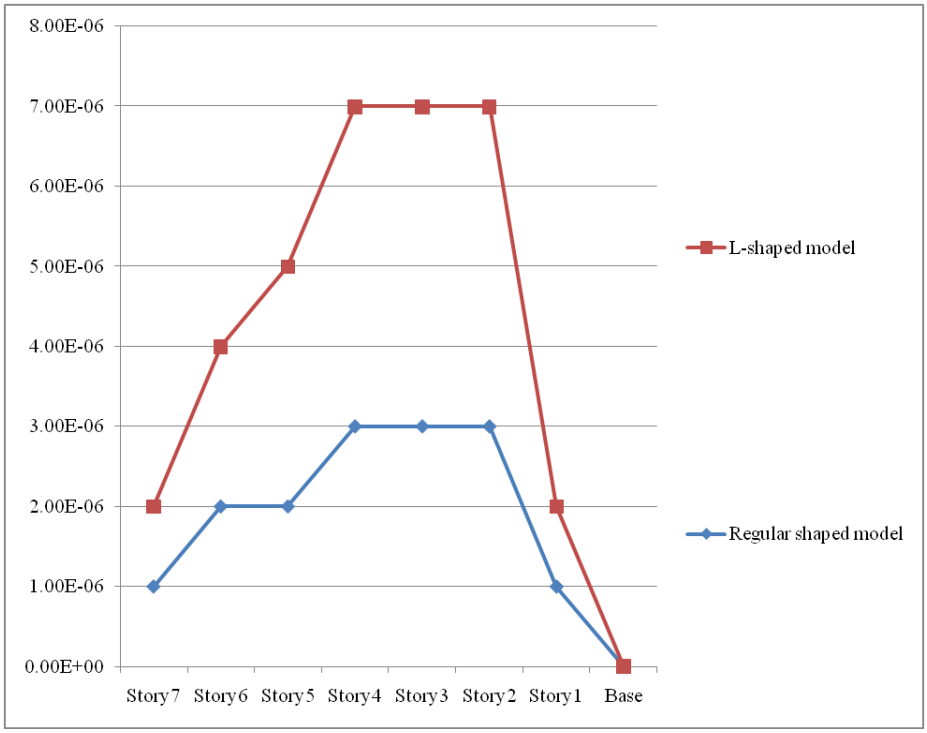


Table No. 8. Story Drift In Y Direction

Story	Regular Shaped Model	L-Shaped Model
Story 7	1.00E-06	1.00E-06
Story 6	2.00E-06	2.00E-06
Story 5	2.00E-06	3.00E-06
Story 4	3.00E-06	4.00E-06
Story 3	3.00E-06	4.00E-06
Story 2	3.00E-06	4.00E-06
Story 1	1.00E-06	1.00E-06
Base	0	0



IV. Conclusion

From the above study following conclusions are made,

1) Considering the resulted base shear we can say that of regular shape building is 31% to 32 % more as compared to L-shaped building.
2) Storey displacement is observed in both the models, in case of L-shaped building the displacement is more as compared to regular shape building in both X and Y direction
3) In both the buildings storey drift is more at middle floors as compared to bottom and top floors.
4) The drifting criteria as per IS 1893: 2002 which states the limiting value of storey drift is 0.004 times of floor height, the storey drift of both of the buildings are not exceeding the given limit.
5) Finally we can say that the response of regular shaped building is good in all aspects as compared to L-shaped building and hence is more suitable during earthquake.

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