Earthquake Resistant Structure Using E-TAB's

[1]Shruti Sanjay Kulkarni, [2]Rohan Kumar Choudhary,

[1]M. tech Student, [2]Assistant Professor
[1]Civil Engineering Department, SOET,
[1] Sandip University, Nashik, Maharashtra., India.

Abstract— Earthquake shaking is random and time variant. It is essentially a sudden series of motions of the earth surface originating from ground motion due to disturbance of the elastic equilibrium of the earth mass and spreading from there in all directions. Earthquake-resistant building designs consider the characteristics that influence their structural integrity in terms of stiffness strength, regularity and redundancy. The analysis and design of the structure will be done using E-TAB's. Earthquake-resistant structures are structures designed to protect buildings from earthquakes. The goal is achieved by providing flexible foundation which is better during seismic activity than conventional building. The foundation will be designed as flexible foundation. It is designed using E-TAB's. The analysis of structures with flexible and fixed foundation is compared. Earthquake resistant design provides ability of structures to sustain the earthquake and behave elastically during earthquakes.

***Keywords*—Random, Time Variant, Stiffness Strength, Regularity, Redundancy, Insert, Elastic Equilibrium, Flexible Foundation, E-TAB's.**

I. INTRODUCTION

Earthquake has destructive impact on the built environment and human life. So, it is necessary to decrease these maximum damages. The lesser of earthquake knowledge, its implementation in the building design leads to failure of buildings. Earthquakes are natural disaster that damage structures and buildings. Preventing the transfer of earthquake vibration to the buildings is important to protect the building from damage.

Structure cannot withstand the earthquake if it doesn't have good and stable foundation. It is difficult to inspect and repair foundations after a severe earthquake. Therefore, damage to foundation can be detrimental to the stability of the structure. Base-isolation for simple buildings, base-friction isolation may be achieved by reducing the coefficient of friction between the structure and its foundation or by placing a flexible connection between the structure and its foundation. Base isolation with lead rubber isolator is one of the methods to prevent the transfer of seismicity to buildings. Base isolation with lead rubber isolator is desirable methods to reduce the transfer of seismic loads to buildings. Flexible footing has degree of flexibility and soil beneath the footing experiences linear pressure distribution.

Normally, buildings are designed for vertical forces but when earthquake occurs the horizontal forces are acting. These horizontal forces are induced at the foundation. Due to this, superstructure vibrates. Therefore, to reduce these vibrations we can provide base separation. It separates the superstructure and substructure. Due to this only substructure vibrates, with steady superstructure and in large horizontal forces the very less amount of movement occurs in superstructure. It is suitable for hard soil only.

II. LITERATURE REVIEW

Most of earthquakes was severe due to this many buildings collapse. People require the houses that are safe in strong earthquakes. Using seismic base isolation will be able to satisfy this requirement. Base isolator behaves like energy dissipater. Time period, maximum storey, maximum storey stiffness and storey drift of structure affects using base isolation [1]

The base isolation has lower costs with greater performance and a fine architectural look as compared to a conventional fixed-base anti-seismic design. Base shear of structure, displacement of building according to seismic zones and wind pressure [2].

Base lateral displacements and toe story displacement can be within reasonable limits. The effectiveness of the LRB base isolation system in terms of reduced structural responses under seismic loading. As the base isolators was extensively used worldwide in high seismic areas except the same in India also. [3].

The base isolation seismic design provided protection technique which in turn allows the structure to function with no damage even after major earthquakes with a negligible increase in cost also it reduced the story shear, acceleration and simultaneously increases the time period, story displacement and story drift that induces flexibility in rigid structure by dissipating the energy to the foundation [4].

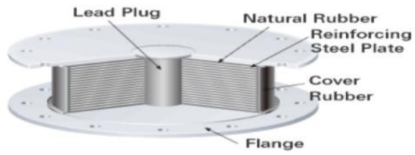


Fig 1Lead Rubber Bearing
(Base isolation of residential building using lead rubber bearing technique Vol. 7 Issue 05, May-2018)

III. METHODOLOGY

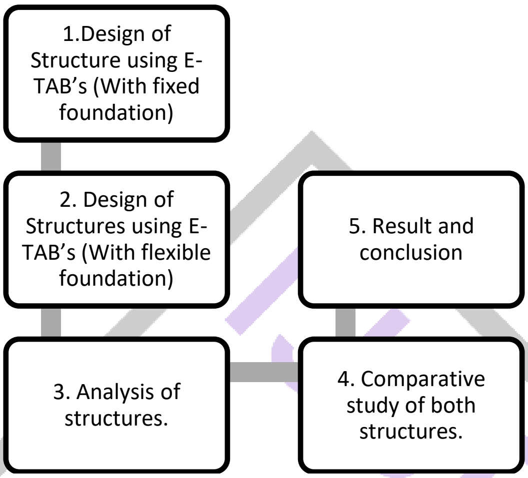
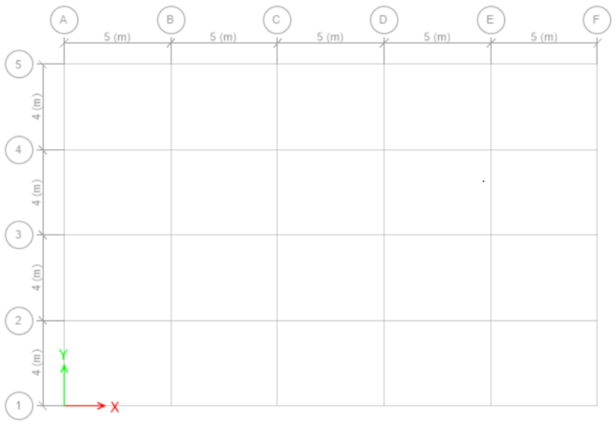


Fig 2
Flowchart of methodology

Fig 2 illustrates the methodology and the stepwise procedure as follows,

Step 1)-Selection of plan:



(Fig no.3)

(Plan of Building)

Considering 3 story building with grids spacing 4m in X-direction and 5m in Y-direction,

Bottom story height as- 0.45m and floor to floor height as 3m.

Step 2)-Model Initialization:
Selecting Display units as Metric SI and
Steel Design code- IS 800:2007

Concrete Design Code- IS 456-2000

Step 3)-New Quick Model System-
In this, the story and Grid Data needs to be selected.

Step 4)-Defining Material Properties-

In material properties we have to define property for concrete and steel

For Concrete Grade- M30 and for Steel Grade- 600

Step 5)-Define Beam and Column Sizes-

Beam Size=0.23x0.35m

Column Size= 0.35x4m (Clear cover =50)

Slab Thickness=150 mm

Step 6)- Quick Draw Beams and Columns

Step 7) -Quick Draw Slab

Step 8)-Fixed Joints

This property is very important in fixed base foundation and has to select Restrained Joints for the fixed foundation.

Step 9)-Consideration of Load Cases:

In case of earthquake:

load EQ X and EQ Y code selected as per IS1893-2002, Seismic Zone factor-z Per code- 0.36, importance factor- 1,

Step 10)-Assigning Loads:

Joint Point Loads are applied for unit KN/m.

Load Calculations-

Calculation of dead loads= Length x Width x Density of concrete

Dead Load of Beams=2.0125KN/M

Dead Load of Column= 3.5 KN/M

Slab Section-150mm slab thickness, 0.15x25= 3.75

Live Load considered- 3KN/M^2

Earthquake Load-

EQ X considered= 0.5 x Live load = 3x0.5

=1.5 KN/M^2

Step 11)- Load Application

Select all the beam section and then apply 2.0125 KN/M

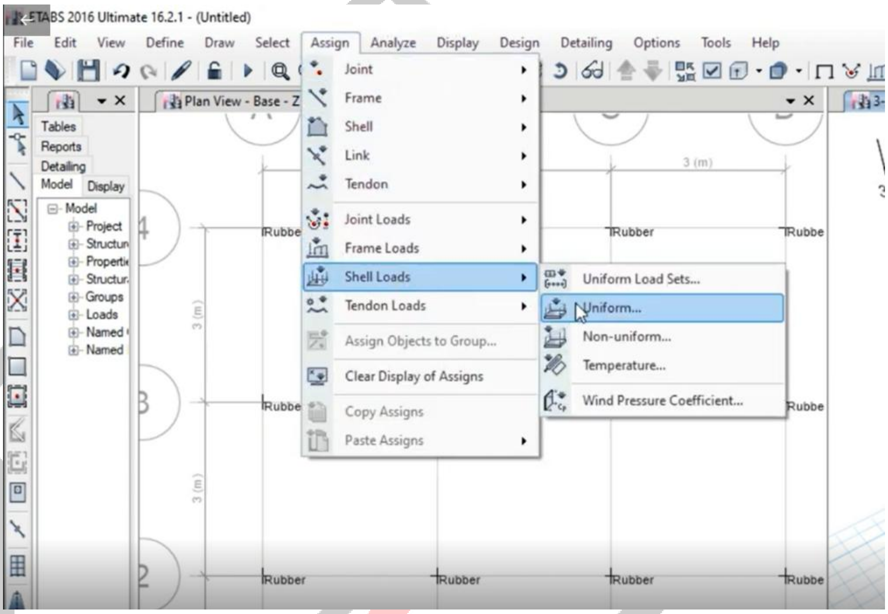
For Column section and then apply 3.5 KN/M

Applying Dead Loads:

(Fig no.4)
(Assigning Loads to Beams and columns)

Fig (4) shows the procedure for load application, Loads are assigned as frame load.

For Slab section and then apply 3.75 KN/M Load.



(Fig no.5)
(Assigning Loads to Slab)

Fig (5) shows the procedure for load application to slab, loads are assigned as shell load.

Applying Live Load

Fig no.3-14 shows, We have to select all the Slab section and then apply 3 KN/M^2 Load-

Loads are assign as shell loads and are applied in gravity direction.

Applying Earthquake Load

Select all the building and then apply 3 KN/M^2 Load and loads are assign as shell load.

Applying Wind Load:

Select all the building and then apply 3 KN/M^2 Load and loads are assign as shell load.

12) Analyzing the structure :

Analyze, check model and run the load cases.

IV. RESULTS AND DISCUSSION:

The aim of present study was to analyse building at seismically without and with base isolator.

Displacement is the difference between the initial position of a reference point and the position after the earthquake. The point affected by an earthquake has moved from where it was before the earthquake.

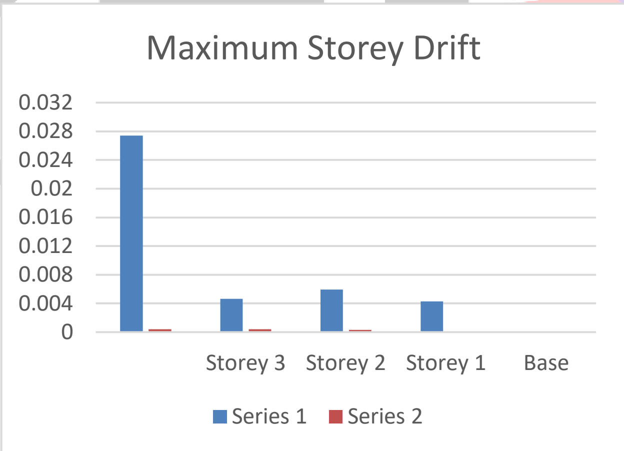
Series 1- Ordinary building

Series 2- Earthquake resistant Building

(Fig no.6)

(Maximum Story Displacement)

From (Fig no.6), we can conclude that, the maximum story displacement can be reduced in earthquake resistant building.
Story drift is the lateral displacement of a floor relative to the floor below.



(Fig no.7)

(Maximum Story Drift)

From (Fig no.7), we can conclude that, the maximum story drift can be reduced in earthquake resistant building.

V. CONCLUSION

1) The time period of structure increases. Due to this increase in time period structure experiences less amount of seismic forces acting.
2) The lateral earthquake Load and storey shear are reduced to significant amount due to use of base isolator.
3) The maximum storey stiffness of structure decreases in base isolated structure.

4) From the above data, the damage to the structure will be less as compared to fixed base structure. Thus, structure can be immediately occupied after the actual earthquake.

REFERENCES

1) hiraj Narayan Sahoo (2018), "Base Isolation of Residential Building using Lead Rubber Bearing Technique'', International Journal of Engineering Research & Technology (IJERT), Vol. 7 Issue 05, May-2018

2) Stefano Sorace and Gloria Terenzi (2014), "Analysis, Design, and Construction of a Base-Isolated Multiple Building Structure", Hindavi Volume 2014, 07 Aug 2014

3) Saurabh P. Kharat, Dinesh N. Biradar, Ajay S. Sagekar, Prathamesh V. Chavan, Prof. Reshma Shaikh (2018) "Case study on lead rubber isolation bearing", International Journal of Engineering Research & Technology (IJERT), Vol. 19 Issue 05, May-2018

4) Dr. Prof. Pravat Kumar Parhi (2018), "Base isolation of residential building using lead rubber bearing technique" , International Journal of Engineering Research & Technology (IJERT), Vol. 7 Issue 05, May-2018

5) Martelli and M. Forni, "Seismic isolation and other antiseismic systems recent applications in Italy and worldwide," Seismic Isolation and Protective Systems, vol. 1, no. 1, pp. 75–123, 2010.

6) L. Di Sarno, E. Chioccarelli, and E. Cosenza, "Seismic response analysis of an irregular base isolated building," Bulletin of Earthquake Engineering, vol. 9, no. 5, pp. 1673–1702, 2011.

7) S. Sorace and G. Terenzi, "Analysis and demonstrative application of a base isolation/supplemental damping technology," Earthquake Spectra, vol. 24, no. 3, pp. 775–793, 2008.

8) K. Agarwal, J. M. Niedzwecki, and J. W. van de Lindt, "Earthquake induced pounding in friction varying base isolated buildings," Engineering Structures, vol. 29, no. 11, pp. 2825–2832, 2007.