EFFECT OF BASE ISOLATION ON SEISMIC PERFORMANCE OF RC IRREGULAR BUILDINGS

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ABSTRACT

In the present study of base isolation, irregular shaped six models have been analysed without base isolation, with rubber isolation and friction isolation using Etabs software. A building was analysed using the equivalent lateral force method and response spectrum analysis as fixed base (FB) and as isolated base (IB). So in this work the performance of RC building in dynamic are studied with base isolation and the results are compared with the results obtained for building without base isolation. A seismic evaluation of the building, isolated with the LRB and FPS, is performed using a nonlinear three-dimensional analytical model. The parametric study is concentrated on base shear and displacements of isolated models having geometric irregularities in vertical and plan.

Keyword : - *Base isolation, Irregular Buildings, Seismic Performance, LRB, FPS, Etab, etc….*

1. INTRODUCTION

Reinforced concrete is a major construction material for civil infrastructure in current society. Construction design has always preceded the development of structural design methodology. Earthquakes are one of nature's greatest hazards, throughout historic time they have caused significant loss of life and severe damage to property, especially to man-made structures. The first step in understanding earthquake risk is to dissect the earthquake risk or loss process into its constituent steps. Earthquake risk begins with the occurrence of the earthquake, which results in a number of earthquake hazards. The most fundamental of these hazards is faulting, that is, the surface expression of the differential movement of blocks of the Earth's crust. To avoid the consequences of earthquake there is a technique known as base isolation. Dramatic collapse of buildings has been observed after each disastrous earthquake, resulting in loss of life. To prevent such a loss Base isolation is used which enables a building to survive potentially devastating seismic impact by providing flexibility in to the connection between the building and the foundation. The mechanism of the base isolator increases the natural period of the overall structure, and decreases its acceleration response to earthquake /seismic motion. Base isolation is an effective method for earthquake resistant design to reduce vibrations transmitted from ground to the structure.

1.1 Base Isolation

The earthquakes in the recent past have given new ideas to them by giving enough evidence of performance of different type of structures under different earthquake conditions and foundation conditions. This has given birth to different type of innovative techniques to save the structures from the earthquakes.

The technique of base isolation has been developed in an attempt to reduce the response on buildings and their contents during earthquake attacks and has proven to be one of the most effective methods for a wide range of seismic design problems on buildings in the last two decades. Base isolation systems are increasingly utilized methods of advanced seismic resistance. The base isolation is technique that has been used to protect the structures from the damaging effects of earthquake. Base isolation or seismic isolation is an approach to earthquake-resistant design that is based on the concept of reducing the seismic demand rather than increasing the earthquake resistance capacity of the structure.

1.2 TYPES OF BASE ISOLATION SYSTEM

1.2.1 Elastomeric-Based Systems: The spring and damper elements connecting the building mass to its support are called bearings. Considering the basic concept of base isolation system, we need to manufacture devices that can provide appropriate stiffness in vertical direction and flexibility in horizontal direction. Following years of development, elastomeric bearings have been developed to fulfill the various needs of base isolation systems.

- Natural rubber Bearings
- Lead-Plug Bearings

1.2.2 Isolation System Based on Sliding: Base isolation using a sliding system is considered an easier strategy to approach and also the earliest method that have been developed. The basic concept of a sliding system is to reduce floor accelerations at the expense of shear displacements between foundation and upper structure.

- Friction Pendulum System

2. DESIGN OF ISOLATION SYSTEMS

2.1 Design of lead rubber bearing isolation system (LRB)by IS code (1893 Part I - 2002) method.

Step 1: Analysis of fix base building
Step 2: Set the target time period or displacement
Step 3: Determination of hysteresis parameters of isolator (Ku, Kd, and Qd)
Step 4: Calculation of bearing dimensions
Step 5: Check isolator stability
Step 6: Check strain limit in rubber
Step 7: Calculate remaining properties and summarize
Step 8: Calculation of properties of isolator for designed dimension Introduction

2.2 Design of friction pendulum system (FPS) by IS code (1893 Part I-2002) method.

Step 1: Analysis of fix base building
Step 2: Find The period Td of the friction pendulum system (FPS) isolated structure through a proper choice of the radius of curvature, RFPS
Step 3: Determine the effective stiffness Keff
Step 4: Determine the effective damping ratio ξeff
Step 4: Determine vertical displacement δv of the structure
Step 6: Check the condition (DR ≥ μ) for re-centering of the isolated structure

3. ANALYSIS OF STRUCTURE

In the present task, Six model has been used. Software ETAB-2013 has been used for performing analyses of this structure. The details for generating the structural model in the software are as given below:

Model Description	
Concrete Grade	M25
Steel Grade	Fe415
Storey Height	3.5
Slab thickness	150 mm
Seismic Zone	zone - V
Soil type	Type II
Importance factor	1
Response reduction factor	5
Live load	3 KN/m²
Dead load	2.5 KN/m²

From the Six model, three model has been prepared with geometric irregularity in plan and another three model has been prepared with vertical geometric irregularity.

- Model 1 : Plus shape G+5 story
- Model 2 : L shape G+5 story
- Model 3 : T shape G+5 story
- Model 4 : 14 story with vertical irregularity 0.22
- Model 5 : 14 story with vertical irregularity 0.60
- Model 6 : 10 story with vertical irregularity 0.125

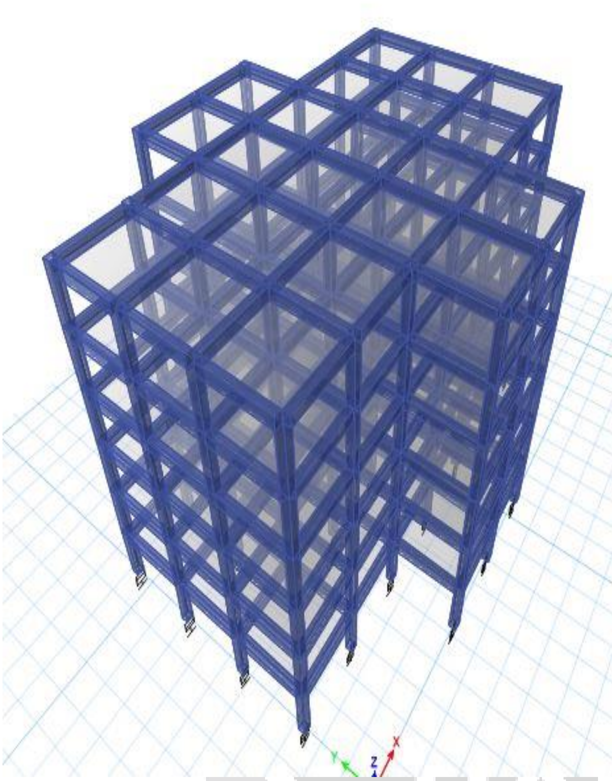

Fig -1 : Model 1

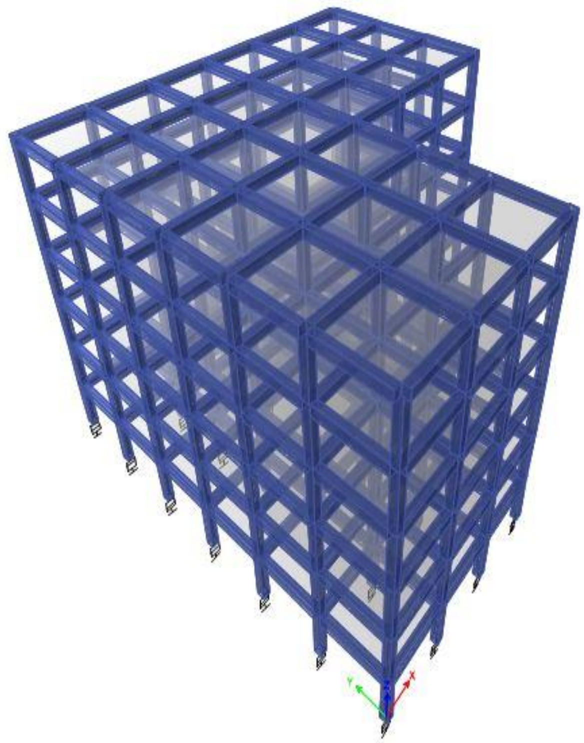

Fig -2 : Model 2

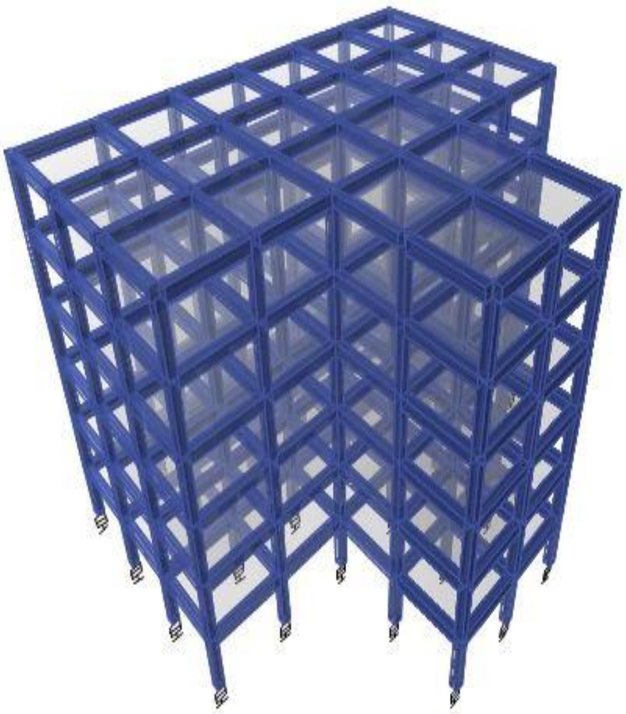

Fig -3 : Model 3

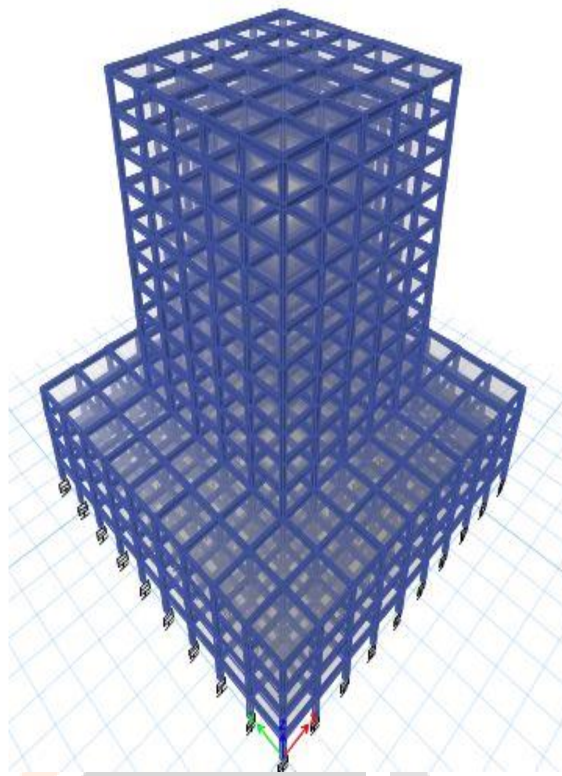

Fig -4 : Model 4

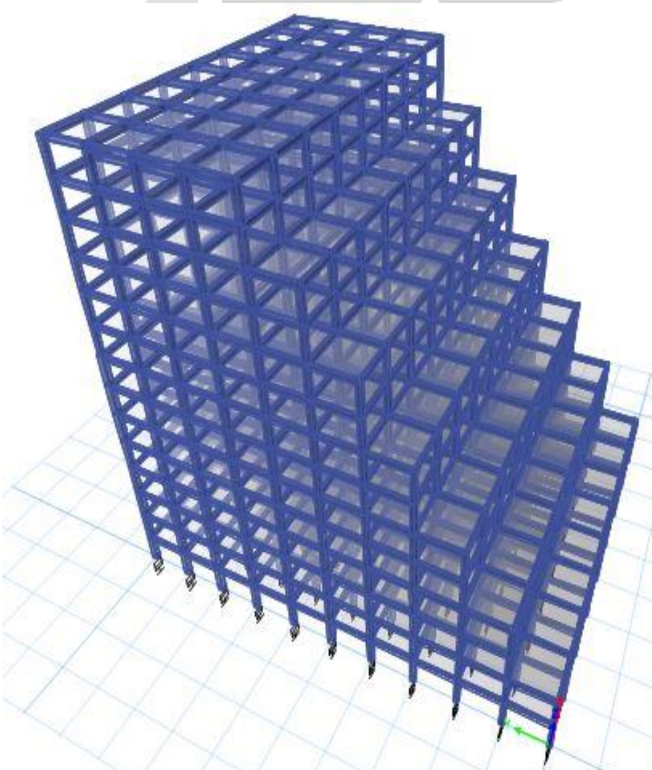

Fig -5 : Model 5

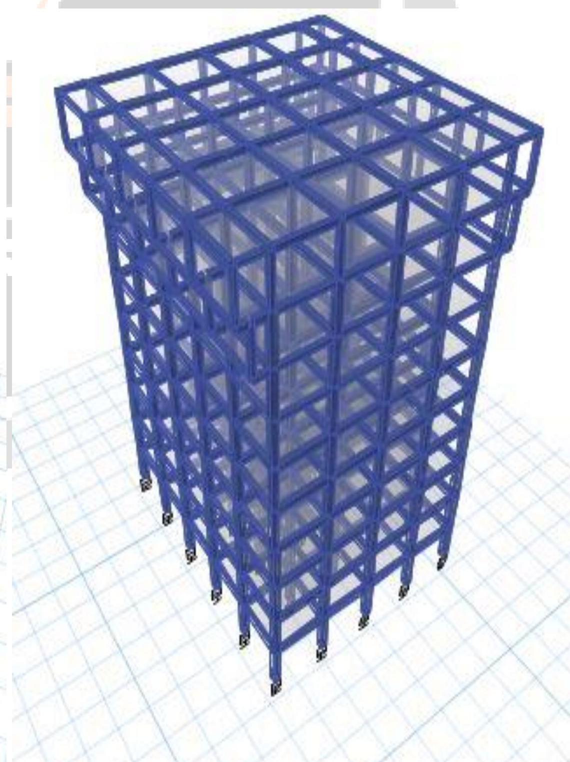

Fig -6 : Model 6

4. ANALYSIS RESULT

Compare the results for different model with different support conditions (i.e. Fix Base, with rubber isolation and friction isolation) for story shear and story displacements.

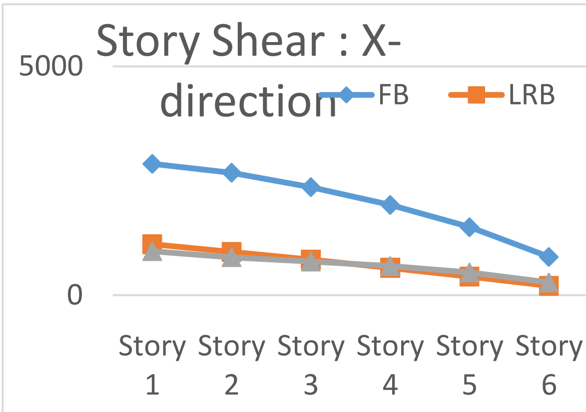

Chart -1: Story Shear X direction for Model 1

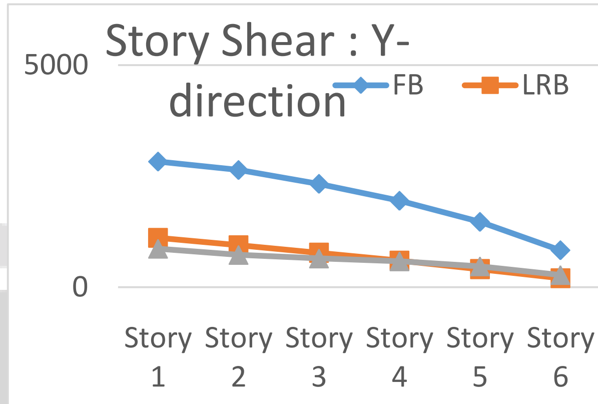

Chart -2: Story Shear Y direction for Model 1

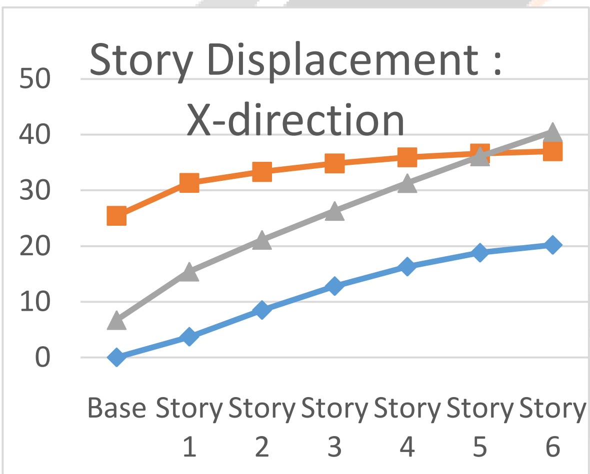

Chart -3: Story Displacement X direction for Model 1

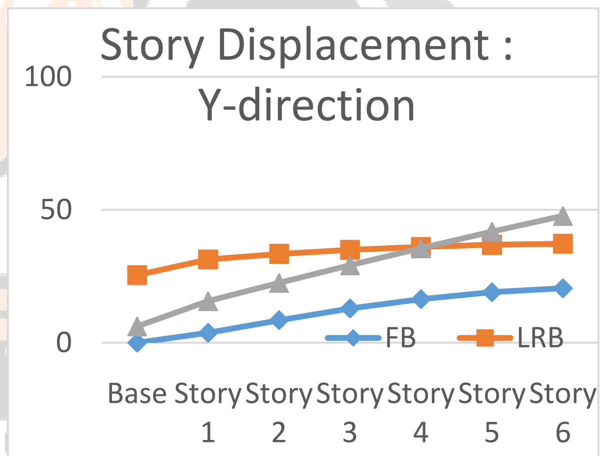

Chart -4: Story Displacement Y direction for Model 1

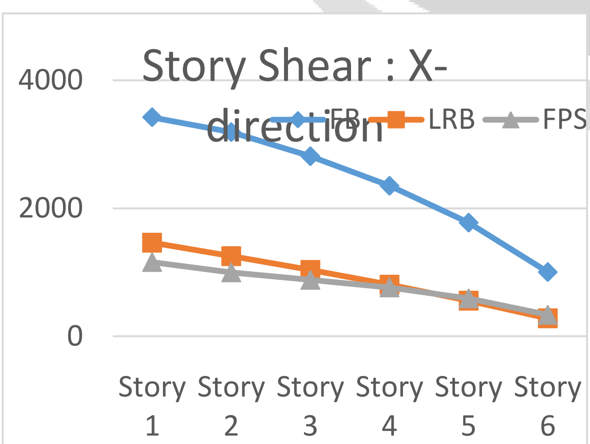

Chart -5: Story Shear X direction for Model 2

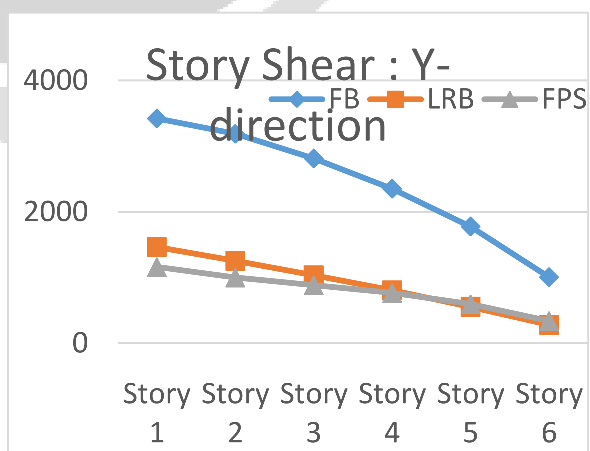

Chart -6: Story Shear Y direction for Model 2

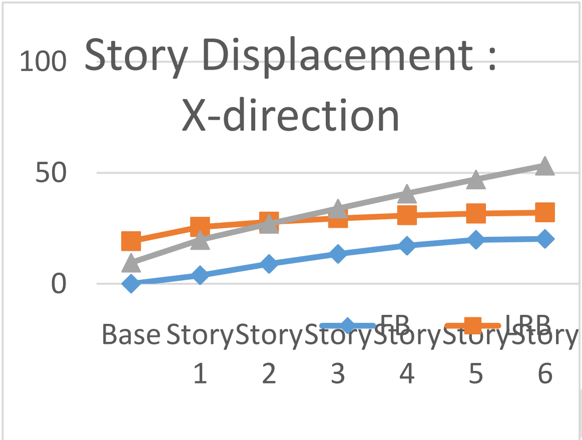

Chart -7: Story Displacement X direction for Model 2

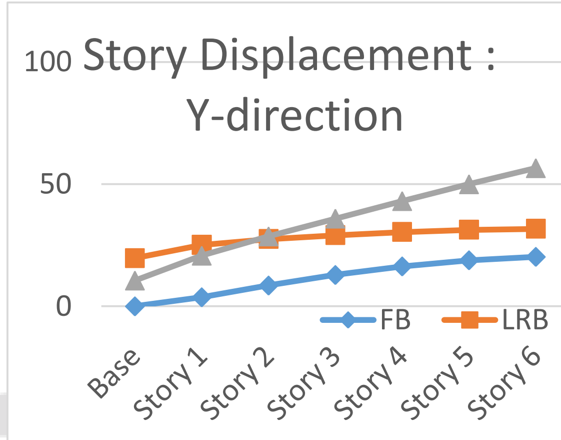

Chart -8: Story Displacement Y direction for Model 2

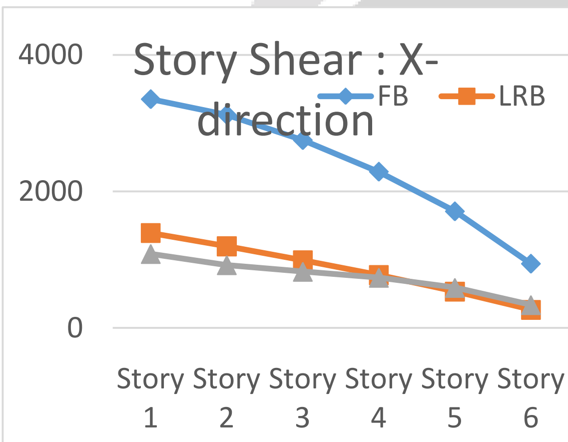

Chart -9: Story Shear X direction for Model 3

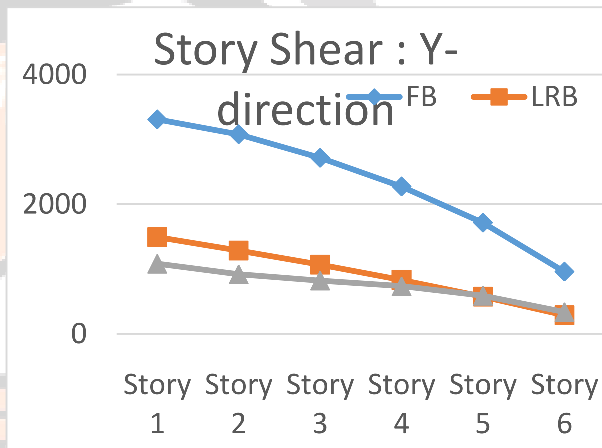

Chart -10: Story Shear Y direction for Model 3

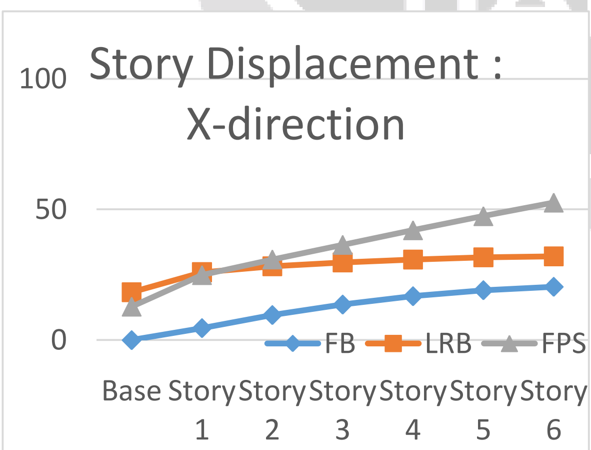

Chart -11: Story Displacement X direction for Model 3

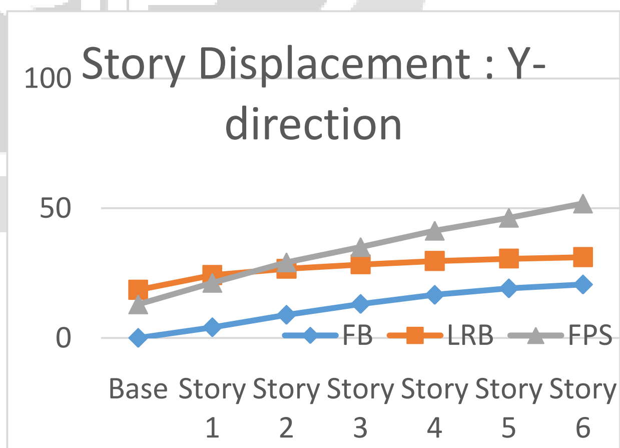

Chart -12: Story Displacement Y direction for Model 3

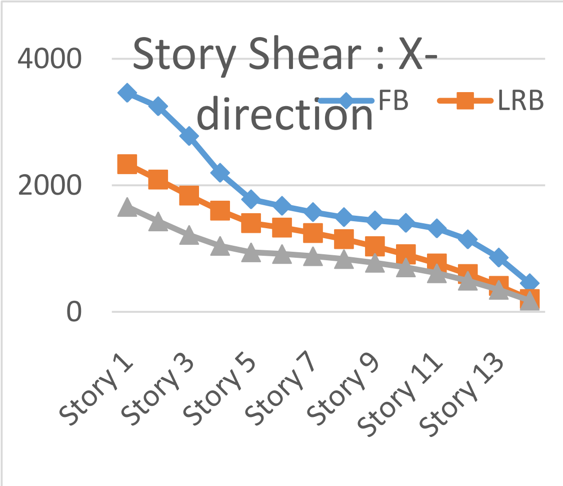

Chart -13: Story Shear X direction for Model 4

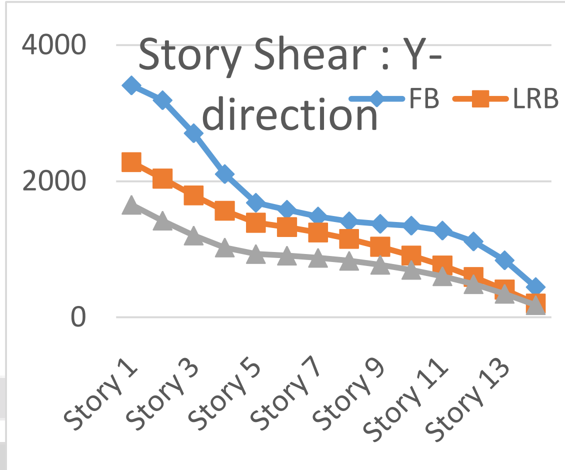

Chart -14: Story Shear Y direction for Model 4

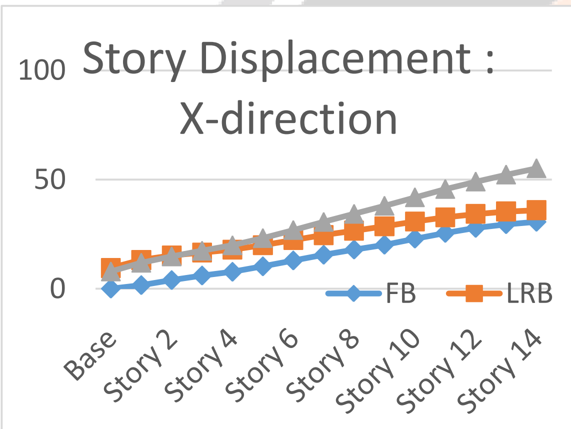

Chart -15: Story Displacement X direction for Model 4

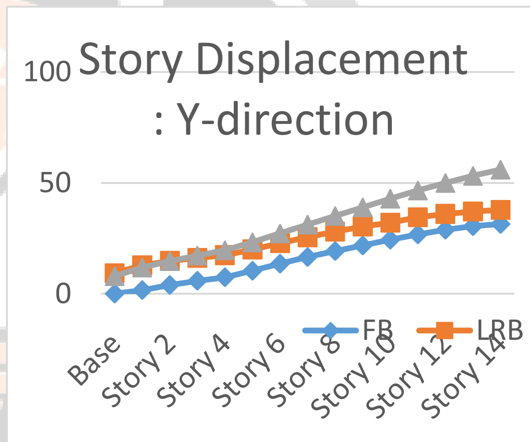

Chart -16: Story Displacement Y direction for Model 4

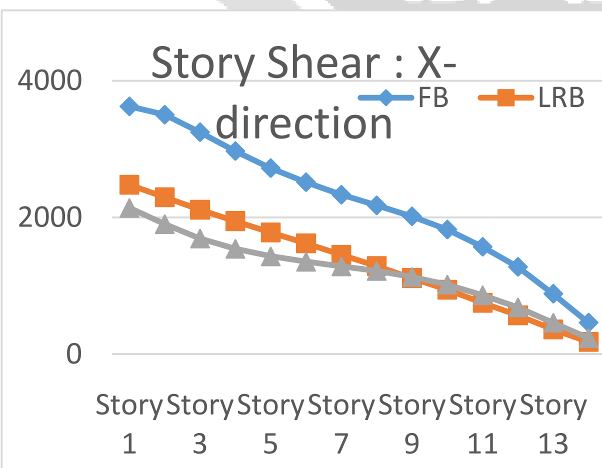

Chart -17: Story Shear X direction for Model 5

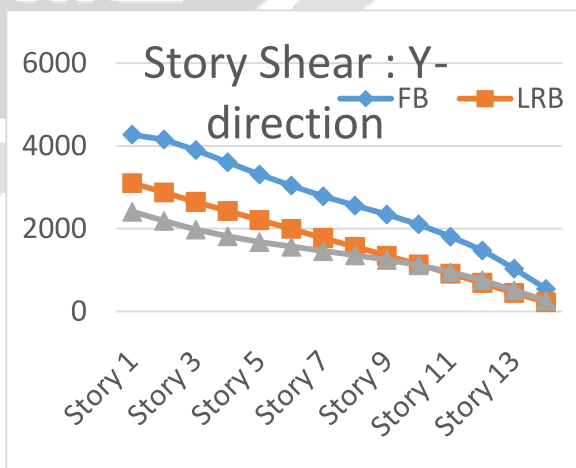

Chart -18: Story Shear Y direction for Model 5

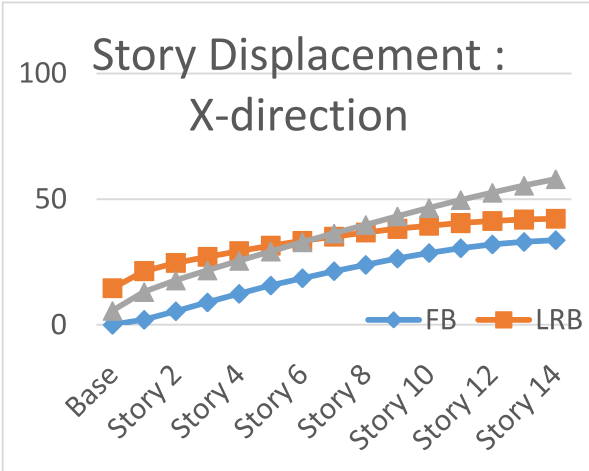

Chart -19: Story Displacement X direction for Model 5

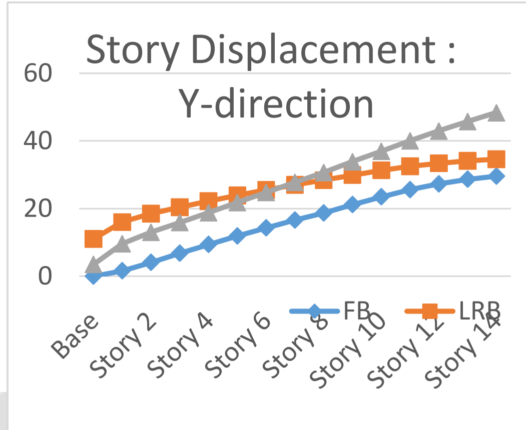

Chart -20: Story Displacement Y direction for Model 5

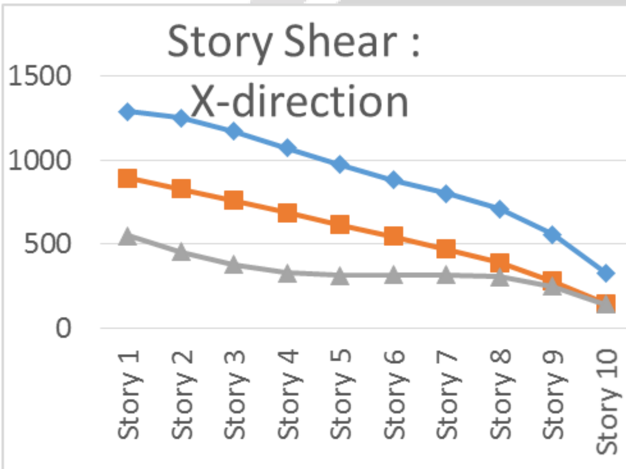

Chart -21: Story Shear X direction for Model 6

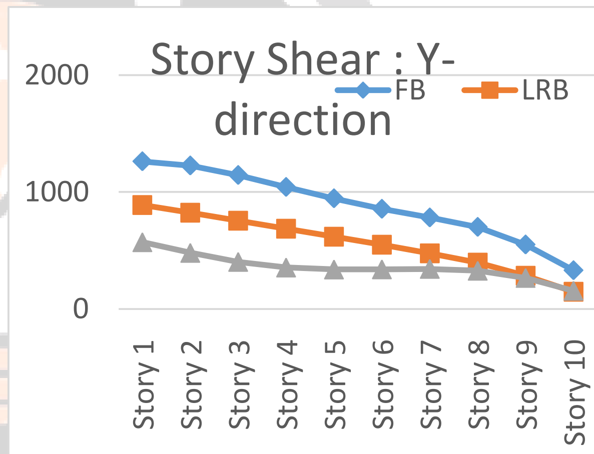

Chart -22: Story Shear Y direction for Model 6

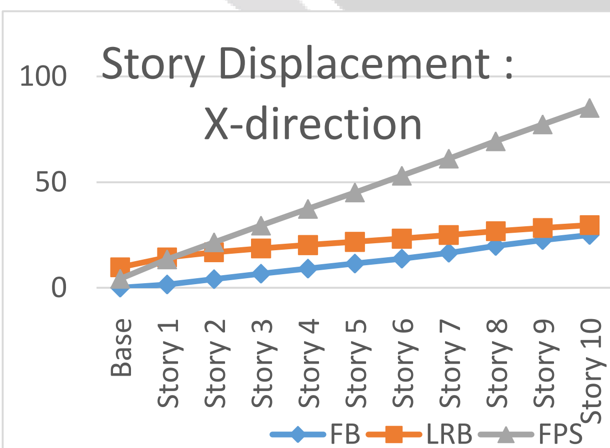

Chart -23: Story Displacement X direction for Model 6

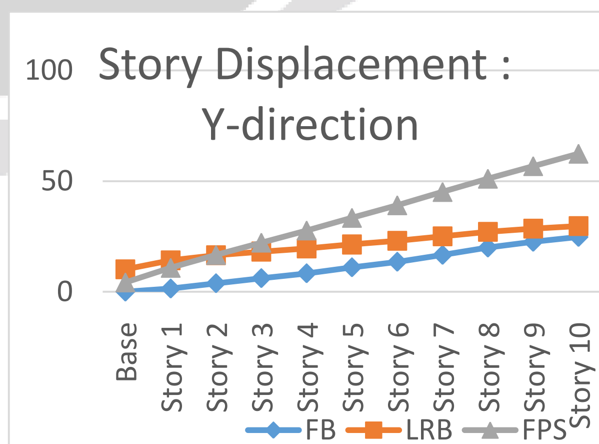

Chart -24: Story Displacement Y direction for Model 6

5. CONCLUSIONS

- When compared with fixed base structure, the story shear is reduced in base isolated structures.
- In comparison of isolated structures with LRB and FPS story shear decrease more with reduce in story height in FPS isolated structure.
- As per results story displacement value is high in base isolated structures compared with fix base structure. As story height increases the displacement value increases more in FPS isolated structures compared with LRB isolated structures.
- For structures with less height LRB isolated structure gave good results but for more height building response is good in FPS isolated structure.
- Thus it is concluded that the response of building is good in base isolated structures than fixed base structures.

6. REFERENCES

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