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Study of Seismic Demands of Different An Symmetrical RCC Buildings Using Rubber Base Isolator Technique and Comparison of Fixed Base and Base Isolator Using ETABS

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***Abstract* - In present investigation the base confinement is system that has been utilized to shield the structures from the harming impacts of quake. The establishment of isolators at the base expands the adaptability of the building structures. The point of this examination is to ponder the seismic conduct of various structures under settled condition and base disconnected condition. In present examination Modeling is finished by taking a reference plan of a building and investigation of G+15 story RC building is done in ETABS programming for two cases. The first is settled base and the second one is base segregated. The Lead rubber bearing (LRB) is composed according to UBC 97 code and the equivalent was utilized for examination of base confinement system. Lead elastic isolator are given to both the structures and after that investigation are done for both settled base and base secluded structures under zone II and soil compose II i.e. medium soil (as indicated by IS 1893(part 1):2002). The outcomes got from investigation were Storey displacement. Storey shear, storey increasing speed, and Inter story float. Because of the nearness of isolators, the inter storey float, storey increasing speeds and storey shear is significantly decreased and storey displacement is expanded in both X and Y headings contrasted with settled base structures.**

INTRODUCTION

BASE ISOLATION

Base Isolation or Seismic Isolation is an Earthquake resistant design which uncouples structure from effects of ground motion. When the seismic isolation system is located under the structure, it is referred as Base Isolation. It isolates the super structure from ground. Building stays stationary to the disturbed configuration by providing relatively small motion by making structure isolated to the ground disturbances. The disturbances caused by the ground are possibly reduced by reducing natural frequency using Base isolation system. One of the most widely implemented and accepted seismic protection systems is Base Isolation. Seismic isolation is a design/strategy, which uncouples the structure for the damaging effects of the ground motion. The term isolation refers to reduced interaction between structure and the ground. Base isolation has a strategy to protect structure from earthquake in several aspects such as Period-shifting of structure, Mode of vibration, Damping and Minimum rigidity.

PURPOSE OF BASE ISOLATION

The basic criteria while providing superior seismic resistance of a building is the difficulty in minimizing the inter storey drift and floor accelerations simultaneously. Large interstorey drifts cause damage to non-structural components. These drifts can be minimized by stiffening the structure, but this leads to amplification of the ground motion, which leads to high floor acceleration, which can damage non-structural components. Making the system more flexible can reduce floor acceleration, but this leads to large interstorey drifts. The only practical way of reducing interstorey drift and floor acceleration simultaneously is to use Base Isolation, which provides the necessary flexibility, with the displacements concentrated at the isolation level. In traditional approaches, in order to achieve capacity, we should increase the elastic strength or else to maintain ductility. This leads to increase in floor accelerations and damage to structural components. Whereas in Base Isolation, rather than increasing capacity we decrease demand as we cannot indefinitely increase the strength of the structure. As earthquakes cannot be predicted or controlled, we modify demand by mitigating effects of the foundation to super structure. There are many possible ways to strengthen the system by introducing several devices in structural system. These include elastomeric bearings, sliders, rollers, sliding plates, rocking foundations etc. Of these elastomeric bearings and sliding foundations are most practical ones. Seismic isolation is intended to prevent earthquake damage to structures, buildings and building contents. One type of seismic isolation system employs load bearing pads, called Isolators. Since the isolators carry large vertical loads and deform to significant lateral displacement, the components of the structure above and below the isolator need to be designed properly. Specifically, to make isolation system work in proper manner, the structure should be free to move in any direction up to the maximum specified displacement. Base isolation is achieved by inventing several isolation devices to meet the desired requirements of an earthquake resistant structure.

MAIN OBJECTIVES OF BASE ISOLATION

- To lengthen Period of vibration
- To reduce Relative displacements
- Maintain Rigidity at low seismic intensity of loads

Whenever the earthquake risk is higher and to develop an effective and economical seismic resistant structure, we adopt isolation technique. Safety is the major criterion to be considered. If Earthquake forces are dominant compared to other forces, then we use Base Isolation. Flexibility and damping are the major aspects in Base isolation.

CONCEPT OF BASE ISOLATION

Seismic base isolation of structures such as multi-storeybuildings , nuclear reactors, bridges, and liquid storage tanks are designed to preserve structural integrity and to prevent injury to the occupants and damage to the contents by reducing the earthquake induced forces and deformations in the super-structure. This is a type of passive vibration control. The performance of these systems depends on two main characteristics:

1. The capacity of shifting the system fundamental frequency to a lower value, which is well remote from the frequency band of most common earthquake ground motions.
2. The energy dissipation of the isolator.

TYPES OF BEARINGS:
Following types of bearings are available as per literature as per their materials:
1. Flexible Columns.
2. Rocking Balls.
3. Springs.
4. Rubbers.
5. Other materials than rubber.

LITERATURE REVIEW

Dhananjay A. Chikhalekar and M. M. Murudi, In this paper, ten storey structures with fixed base and structure with high damping rubber bearing and viscous damper are considered and analysis is carried out using response spectrum method and nonlinear static analysis .Storey displacement, storey drift, natural time period and performance point of the structure were compared using the software SAP. Study shows that performance of base isolated structure against seismic effect is high when compared to the structure with viscous damper
Muralidhara.G.B and Santosh kumar.N.B ; In this paper comparison between the fixed base building and various isolation systems such as friction pendulum isolator , high damping rubber isolator and lead rubber isolator subjected to strong earthquakes were analysed. The study shows the high damping rubber isolated frame is performing better as compared to the other isolator stiffness. Julie S and Sajeeb R studied the seismic performance of the base isolators and mass dampers in the vibration control of the building. Displacement, story drift and base shear of the structure is compared. The study shows that base

isolators are superior in controlling the acceleration response.

Izumi Masanory studied on the remained literature, the first base isolated structure was proposed by Kawai in 1981 after the Nobi Earthquake (M=8.0) on journal of Architecture and building Science. His structure has rollers at its foundation mat of logs put on several steps by lengthwise and crosswise manually. After the San Francisco Earthquake (M=7.8) an English doctor J.A. Calantarients patented a construction by putting a talc between the foundations in 1909. The first base isolated systems actually constructed in the world are the Fudo Bank Buildings in Himeji and Simonoseki, Japan designed by R. Oka.After the world War-II, the U.S took a leading part of Earthquake Engineering.

Garevski A et al. The primary school "Pestalozzi" in Skopje, built in 1969, is the first building in the world for which natural rubber isolators were used for its protection against strong earthquakes. The first base isolated building in the United States is the Foothill Communities of Law And Justice Centre completed in 1985 having four stories high with a full basement and sub-basement for isolation system which consists of 98 isolators of multilayered natural rubber bearings reinforced with steel plates. The Superstructure of the building has a Structural Steel frame stiffened by braced frames in some Bays.

In India, base isolation technique was first demonstrated after the 1993 Killari (Maharashtra) Earthquake [EERI, 1999]. Two single storey buildings (one school building and another shopping complex building) in newly relocated Killari town were built with rubber base isolators resting on hard ground. Both were brick masonry buildings with concrete roof. After the 2001 Bhuj (Gujarat) earthquake, the four-storey Bhuj Hospital building was built with base isolation technique.

The Base isolation system has been introduced in some books of dynamic Engineering and the number of scholars has been increasing in the world.

Rubbers are further divided into four categories,

a. Rubber Bearing
b. Steel laminated rubber bearing (RB).
c. Lead rubber Bearing (LRB).
d. High damping rubber bearing (HDRB).

MODELING OF BUILDING

Plan of the building is as shown below, and modeling and design of building is done in ETABS

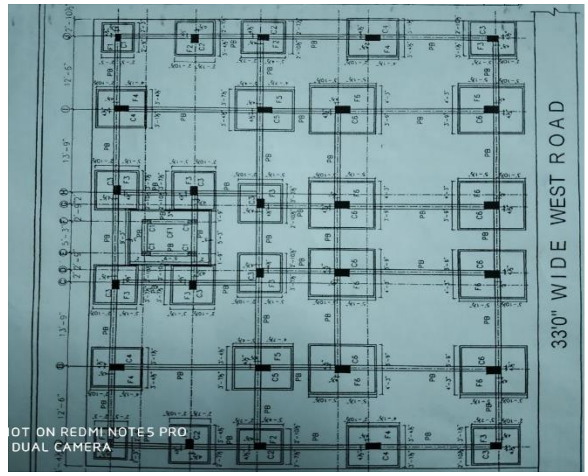


FIG 1: Column frame of the building

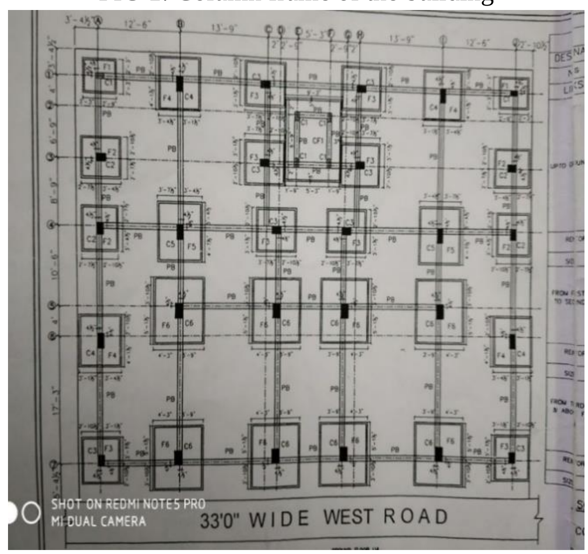


FIG 2: Column framing with center to centre distances between the columns

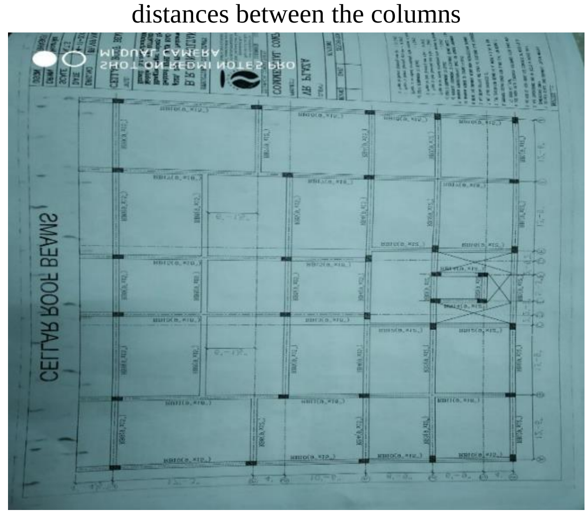


Fig 3: Beam framing of the building

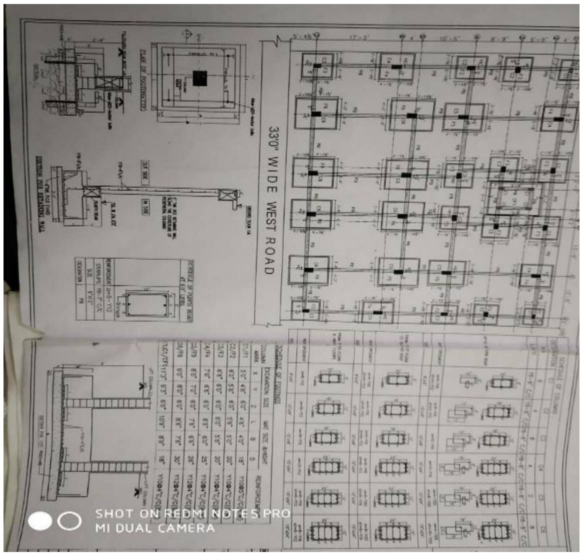


Fig 4: Building plan with other details

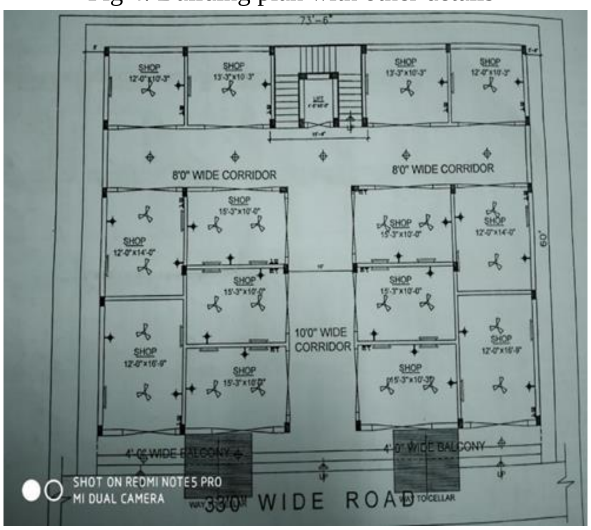


Fig 5: Shops showing with sizes of the rooms

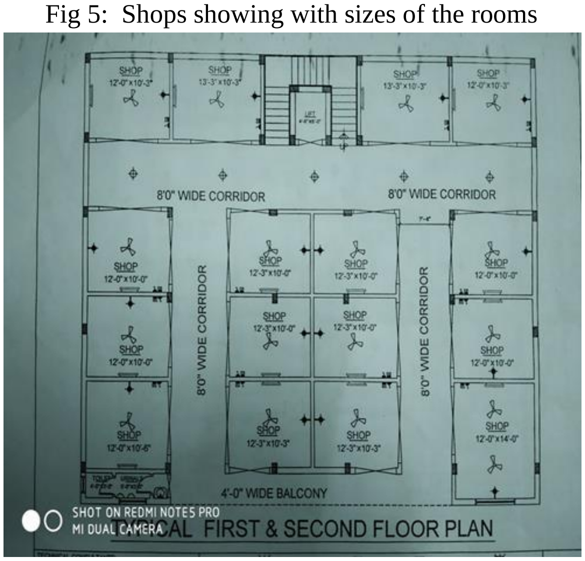
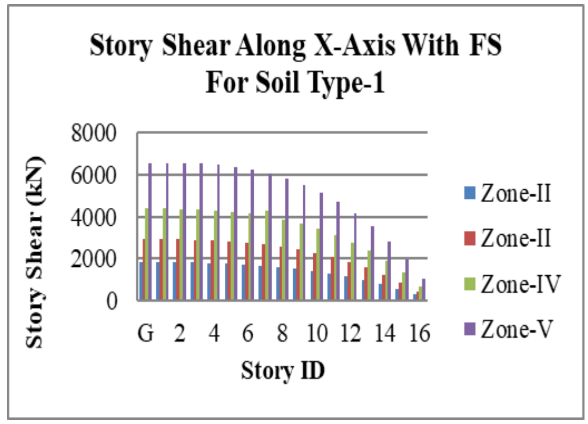


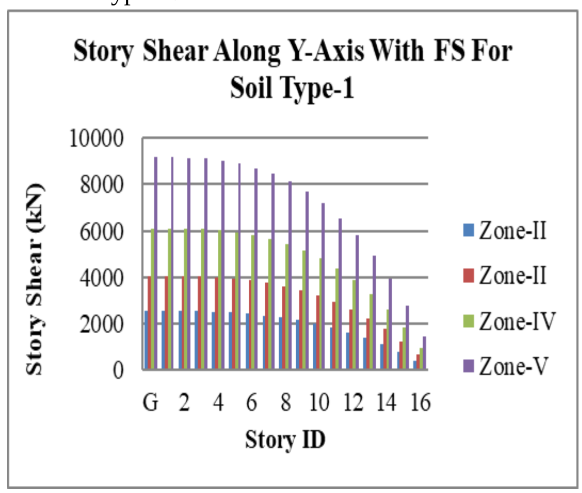
Fig 6: Typical first and second floor plan

RESULTS AND DISCUSSION

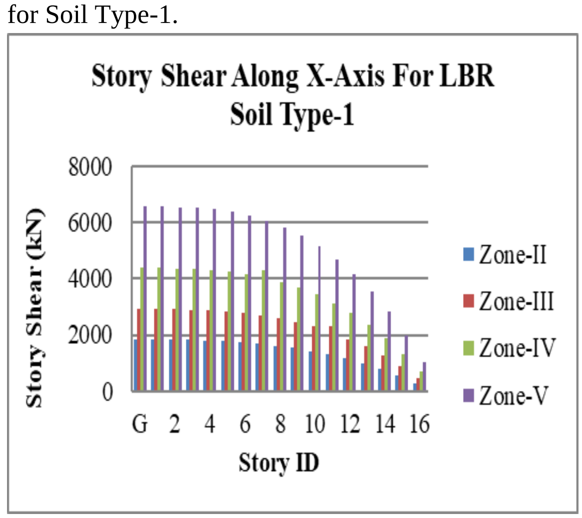
Story shear



Graph 1: Story Shear along X-Axis for Fixed Support for Soil Type-1.

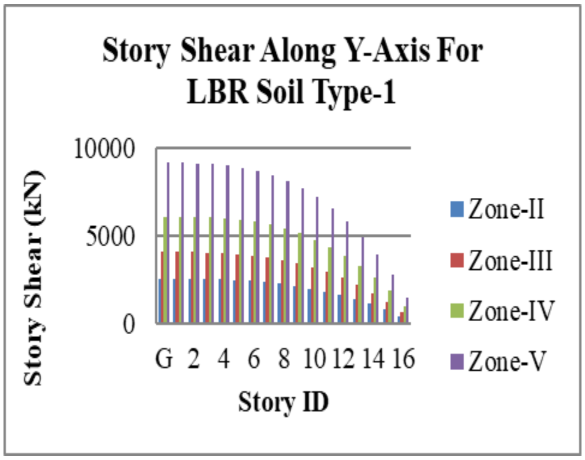


Graph 2: Story Shear along Y-Axis for Fixed Support for Soil Type-1.

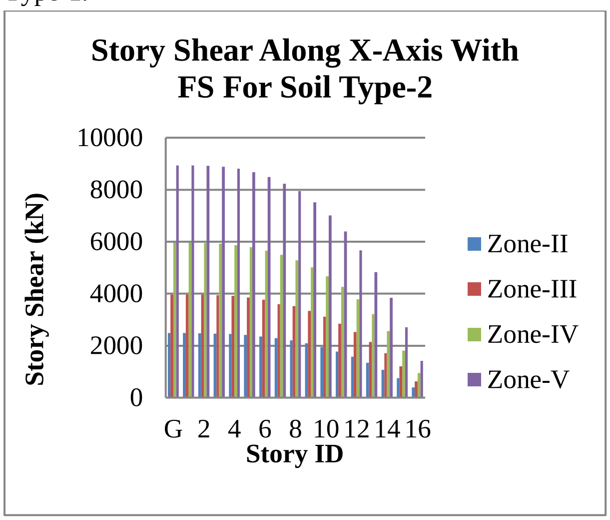


Graph 3: Story Shear along X-Axis for LBR for Soil Type-1.

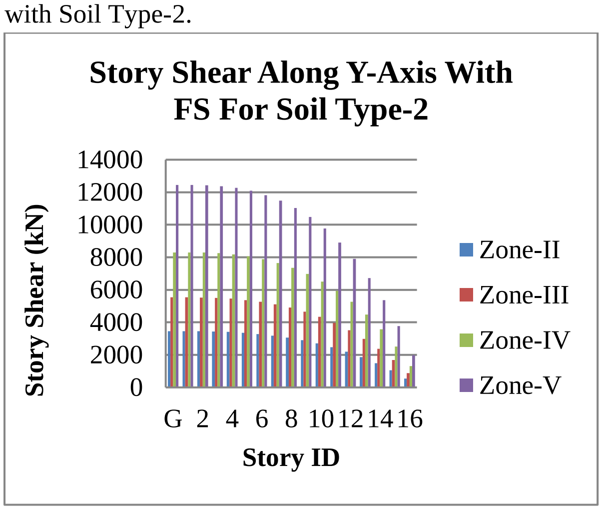
Graph shows base shear along X and Y Direction with fixed and base isolation support.



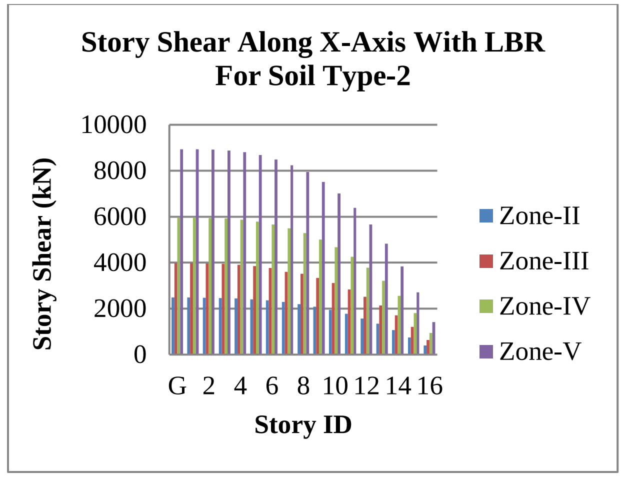
Graph 4: Story Shear along Y-Axis for LBR for Soil Type-1.



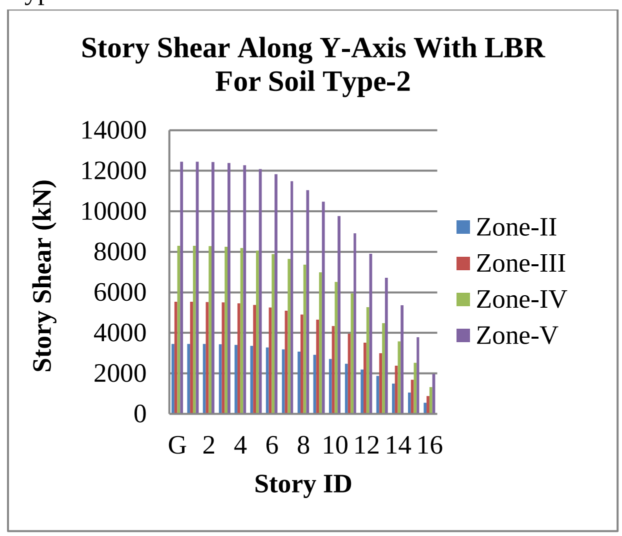
Graph 6: Story Shear along X-Axis for Fixed Support with Soil Type-2.



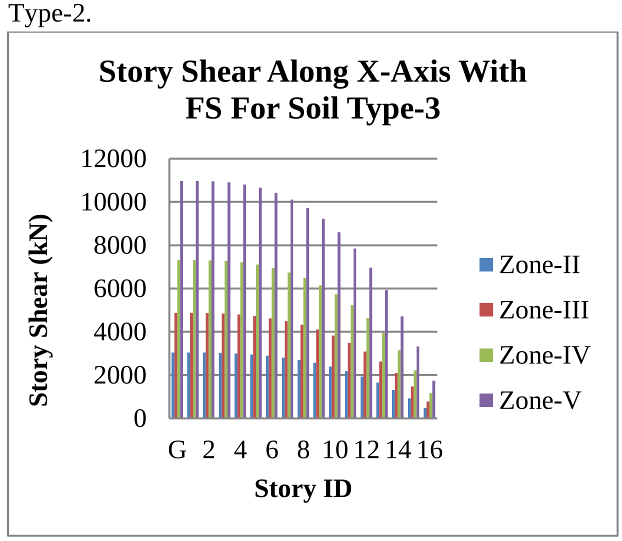
Graph 8: Story Shear along Y-Axis for Fixed Support with Soil Type-2.



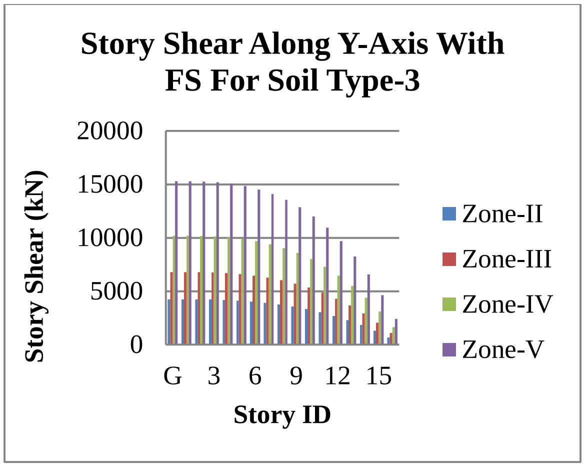
Graph 5: Story Shear along X-Axis for LBR for Soil Type-2.



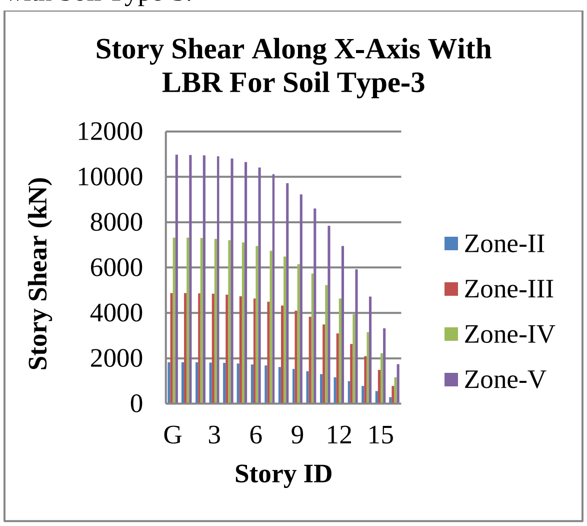
Graph 7: Story Shear along Y-Axis for LBR for Soil Type-2.



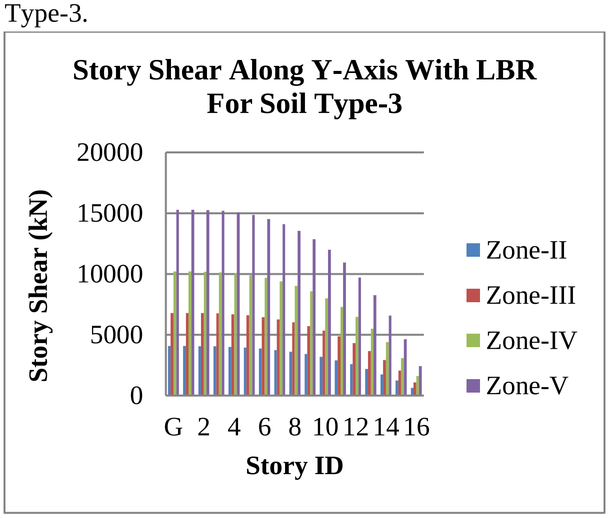
Graph 9: Story Shear along X-Axis for Fixed Support with Soil Type-3.



Graph 10: Story Shear along Y-Axis for Fixed Support with Soil Type-3.

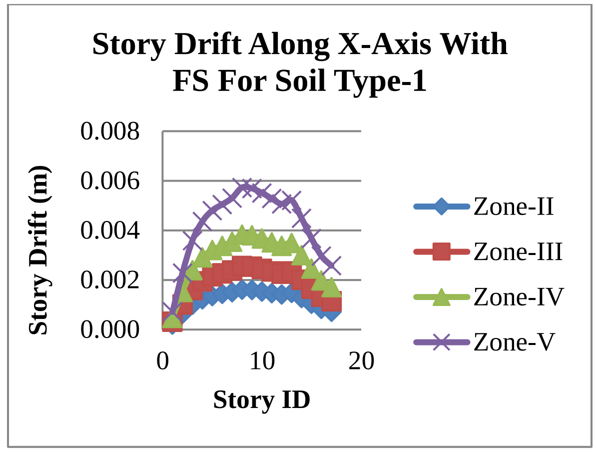


Graph 12: Story Shear along X-Axis for LBR for Soil Type-3.

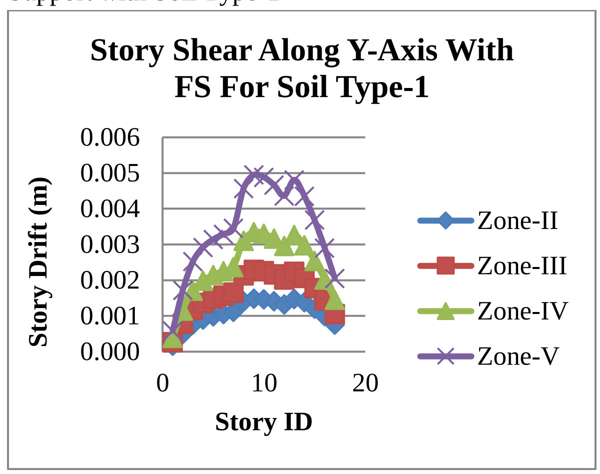


Graph 14: Story Shear along Y-Axis for LBR for Soil Type-3

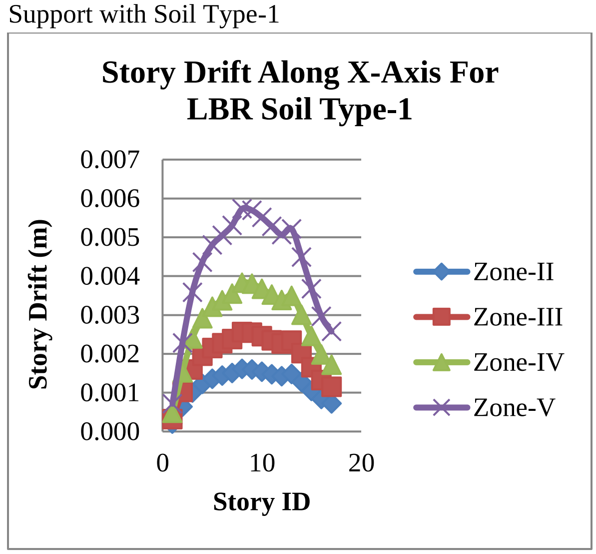
7.2 Story drift



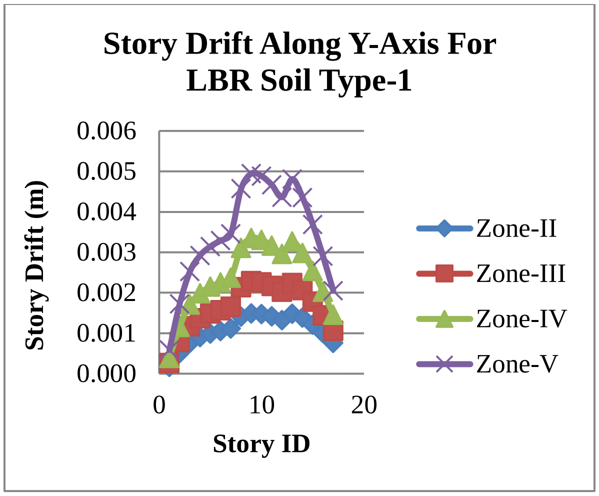
Graph 11: Story Drift along X-Axis with Fixed Support with Soil Type-1



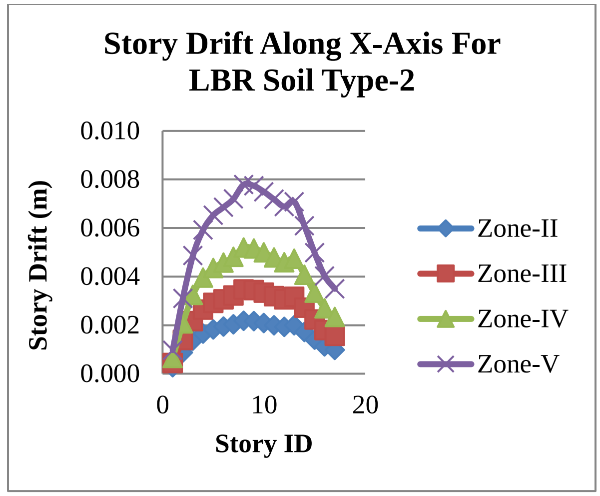
Graph 13: Story Drift along Y-Axis with Fixed Support with Soil Type-1



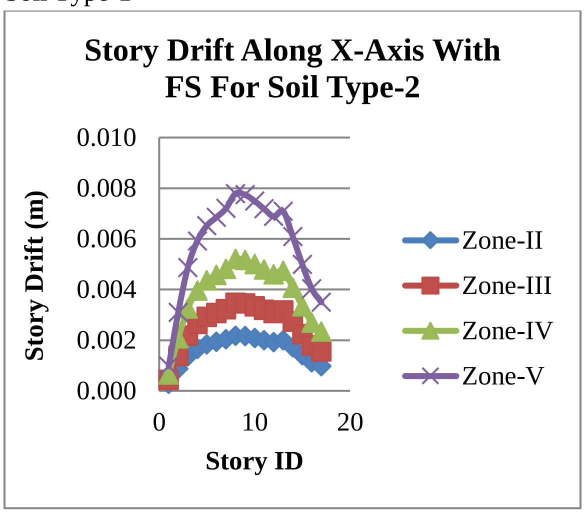
Graph 15: Story Drift along X-Axis with LBR with Soil Type-1



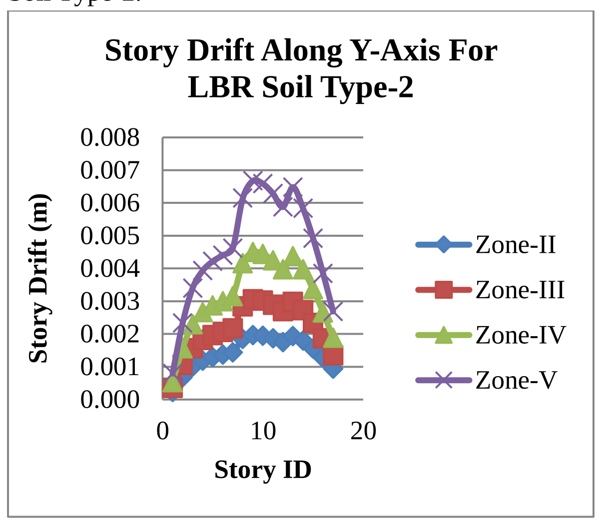
Graph 16: Story Drift along Y-Axis with LBR with Soil Type-1



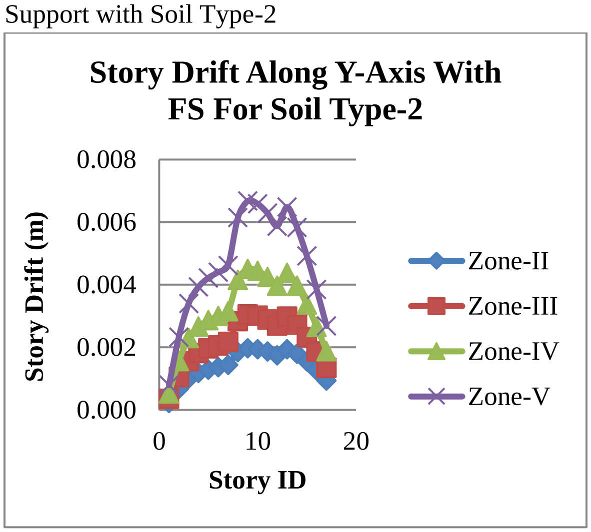
Graph 17: Story Drift along X-Axis with LBR with Soil Type-2.



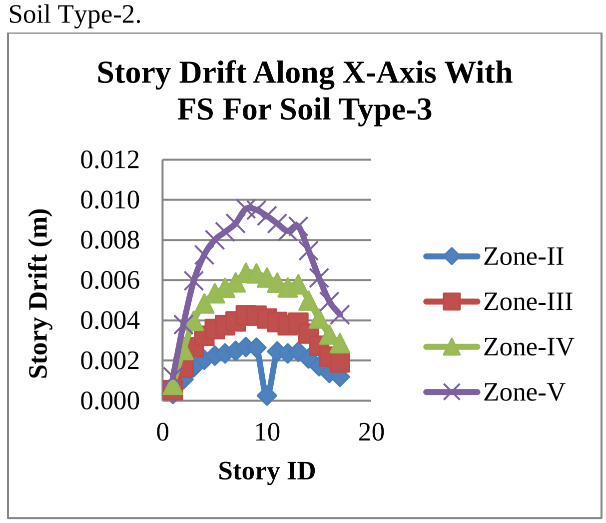
Graph 18: Story Drift along X-Axis with Fixed Support with Soil Type-2



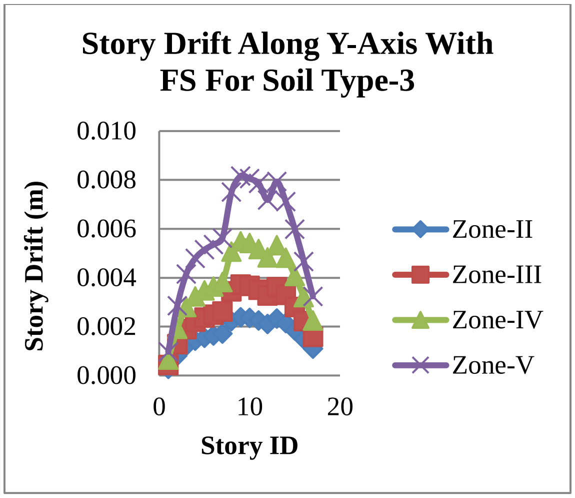
Graph 19: Story Drift along Y-Axis with LBR with Soil Type-2.



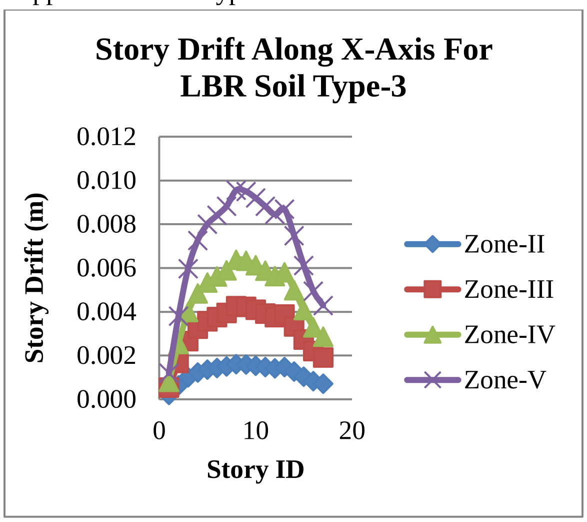
Graph 20: Story Drift along Y-Axis with Fixed Support with Soil Type-2



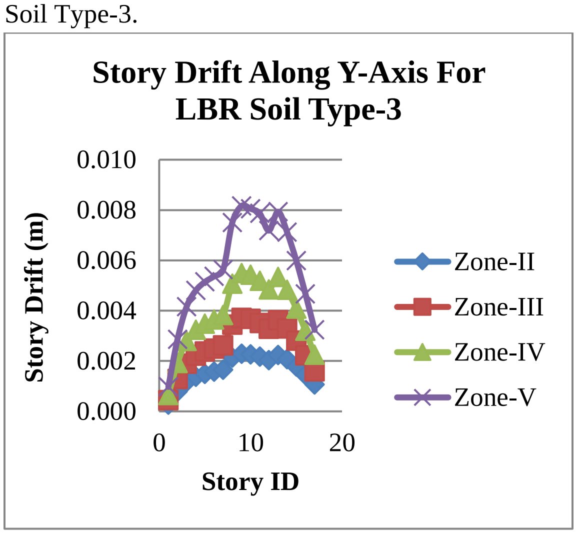
Graph 21: Story Drift along X-Axis with Fixed Support with Soil Type-3



Graph 22: Story Drift along Y-Axis with Fixed Support with Soil Type-3

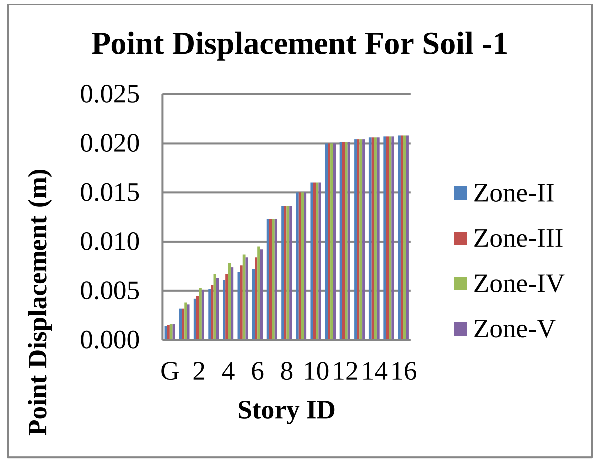


Graph 24: Story Drift along X-Axis with LBR with Soil Type-3.

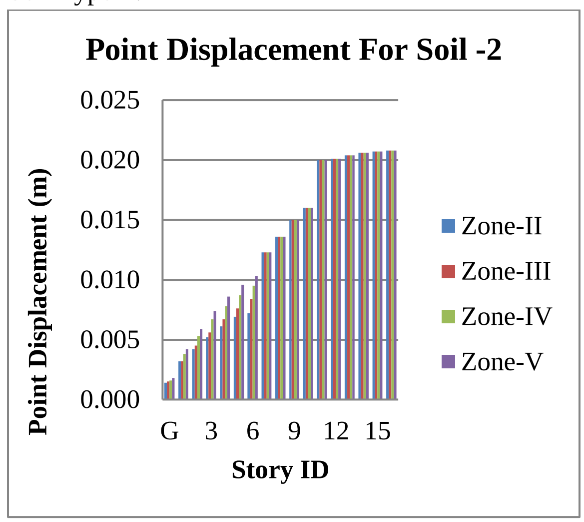


Graph 26: Story Drift along Y-Axis with LBR with Soil Type-3.

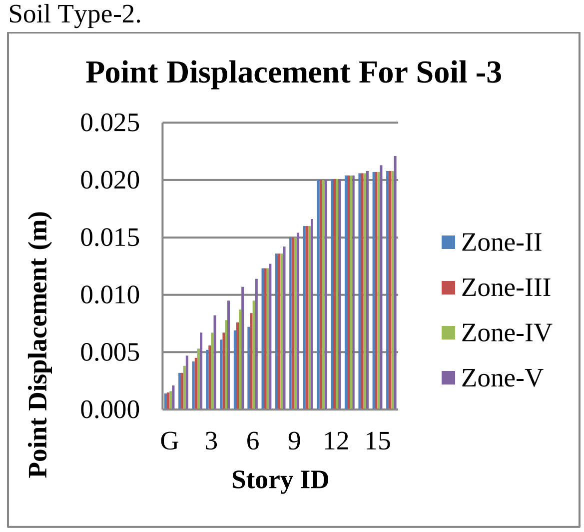
7.3: Point displacement



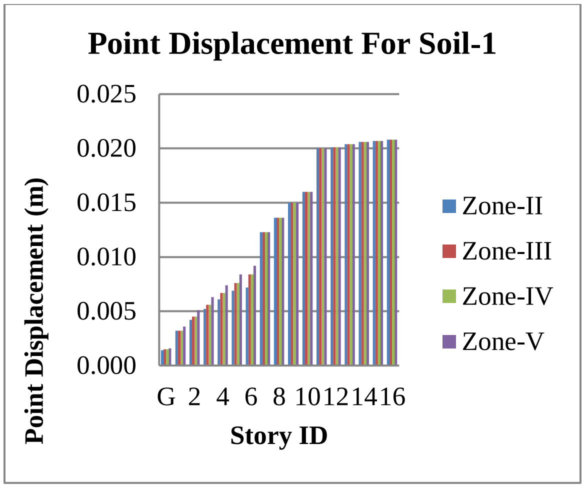
Graph 23: Story Displacement for Fixed Support with Soil Type-1.



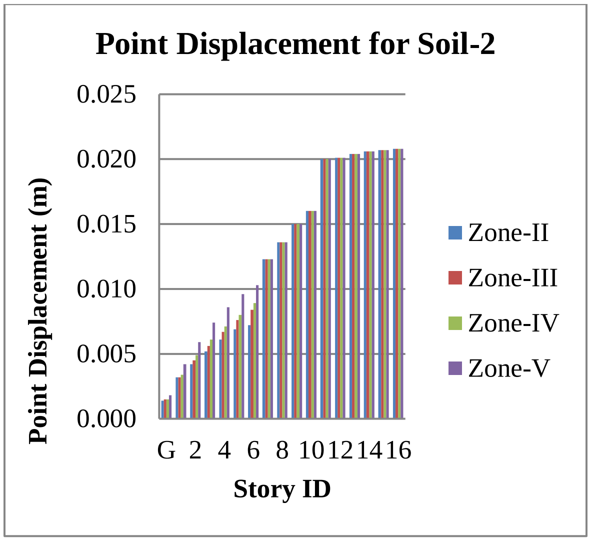
Graph 25: Story Displacement for Fixed Support with Soil Type-2.



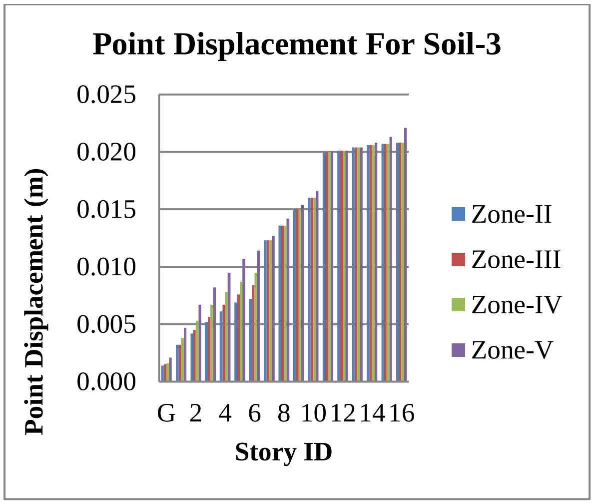
Graph 27: Story Displacement for Fixed Support with Soil Type-3.



Graph 28: Point Displacement for LBR Support with Soil Type-1.



Graph 29: Point Displacement for LBR Support with Soil Type-2.



Graph 30: Point Displacement for LBR Support with Soil Type-3.

CONCLUSIONS AND SCOPE OF FUTURE WORK

- When compared with fixed base structure, the base shear is reduced in base isolated structures, thus the response of building is good in base isolated structures than fixed base structures.
- For base isolated building Response have been increased from 0.26sec to 0.36 sec. Since the super structure will be subjected to lesser earthquake forces, the cost of isolated structure will be cheaper.
- This specific provision of stiffness attracts lesser seismic forces and thus resulting double benefits compared to conventional structure i.e. reduction of axial forces
- The point displacement for all the soil types will be same, whereas for seismic zones the point displacement is increases
- Similarly, strory drift and story shears also varies for different seismic zones.
- The emerging architectural designs are mostly irregular in geometry which leads to torsional and differential moments in X and Z directions. This may cause overstress to the frames. This can be overcome by provision of Base Isolator in the form of lead.
- A base-isolation system reduces Ductility demands on a building and minimizes its deformations.
- Base isolation increases the flexibility at the base of the structure which helps in Energy Dissipation due to the horizontal component of the earthquake.
- Hence the better fitted isolator based on the requirement is constructed economically to ensure Safe structure withstanding damages due to natural calamities.
- Based on the vertical capacity, maximum loading conditions and surface pressure use ISO9001 earthquake adsorbing device lead rubber bearing of size 200*1200mm for bridge and building.

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