Comparative Analysis of Fixed Base & Base Isolation Building

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***Abstract*—The present work attempts to study the effectiveness of base isolation using lead rubber bearings (LRB) over conventional construction, using a case study of identical conventional and isolated building constructed in the most seismically active region in India (Zone V). Base isolators protect both structural and non-structural components by separating a superstructure from its substructure that is resting on a moving surface. In this study, two cases of G+9 plane symmetrical RCC frames are modelled and analyzed. First, a fixed base, and second, an isolated base (LRB). For both scenarios, building displacement is compared. For analysis ETABS software is use and for designing of isolator 1893:2002 (part 1) and UBC 97 design of seismic isolated structures.**

***Key words* — Base Isolation system, Base shear, LRB (Lead rubber Bearing), Storey displacement , Storey shear.**

I. INTRODUCTION

Base isolation is a design by strategy which uncouples super-structure from sub-structure, for reducing damping effects by the ground wave, as term isolation denotes to reduce contact between structure and ground.

When isolation system is located below the superstructure, then it's referred as " base isolation"

Also, when isolation system is located in between column of superstructure then it's referred as "mid isolation" The fundamental principal of seismic isolation system is to change the characteristic of the building from rigid to flexible.

The design of base isolation devices is a repeated procedure, The design of seismic base isolation system is beginning with initial design step on which mass and vertical load on isolators are calculated.

When a high rise building is providing with an isolation layer in a middle level , its upper structure, which is located above isolated layer, has great seismic resistance as a seismic isolation structure, it is also introduce building by which potential for new architectural are proposed through the use of this system, The recent development for anti seismic design is seismic isolation system, which may not decrease the ground movement but will help in keeping the influence of ground movement to its minimum.

Rubber bearing and Lead rubber bearing are key factor used to introduce elasticity in the structure. This is increase natural period of structure and storey displacement. The Rubber bearing contains of alternative layers of rubber and steel plates with one or more lead plugs that are injected into the holes.

II. PROBLEM STATEMENT

G+9 storied buildings are modeled using conventional beams, columns & slabs. These buildings were given square geometry . They are loaded with Dead, Live and Seismic Forces (according to IS: 1893(Part-1)-2002). These models are then analyzed using response spectrum method for earthquake zone V of India (Zone Factor = 0.36). The details of the modeled building are listed below. Modal damping of 5% is considered with OMRF (Response Reduction Factor, R=3) and Importance Factor (I) =1.5. The performance of the models is recorded through ETABS to present a brief idea about the role of base isolation in protecting the structure against earthquake hazards. The following assumptions were made before the start of the modeling procedure so as to maintain similar conditions for both the models:

1. Only the main block of the building is considered. The staircases are not considered in the design procedure.
2. The building is to be used for residential purposes, so we mainly focus on the response of the frame configuration.

3. At ground floor, slabs are not provided, and the floor is resting directly on the ground.
4. The beams are resting centrally on the columns so as to avoid the conditions of eccentricity. This is achieved automatically in ETABS.
5. For all structural elements, M25 & Fe 500 are used.
6. Supports are assigned in the form of either fixed supports (for fixed base building) or link supports (for base isolated building).
7. Seismic loads are considered in the horizontal direction only (X & Y) and the loads in vertical direction (Z) are assumed to be insignificant

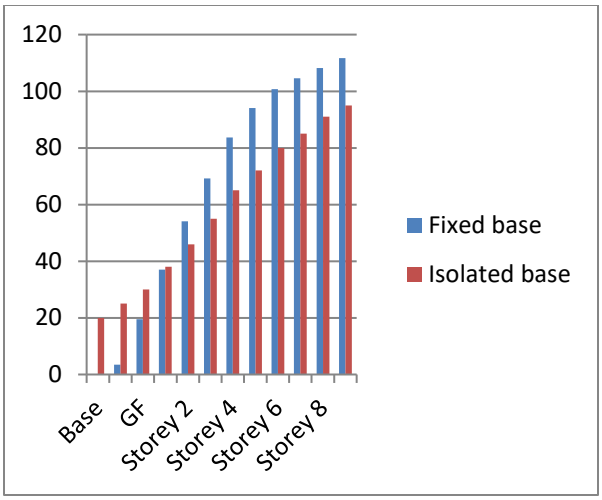
III. PROPERTIES OF BUILDING

Height of building -31.5m
Plan area -240 sq m
Plan dimensions _ 12x20m
Col size – 500x500mm
400x400mm
350x350mm
Beam size – 300x400mm
Thickness of slab – 125mm
External wall thickness – 230mm
Internal wall thickness – 230mm

IV. RESULTS

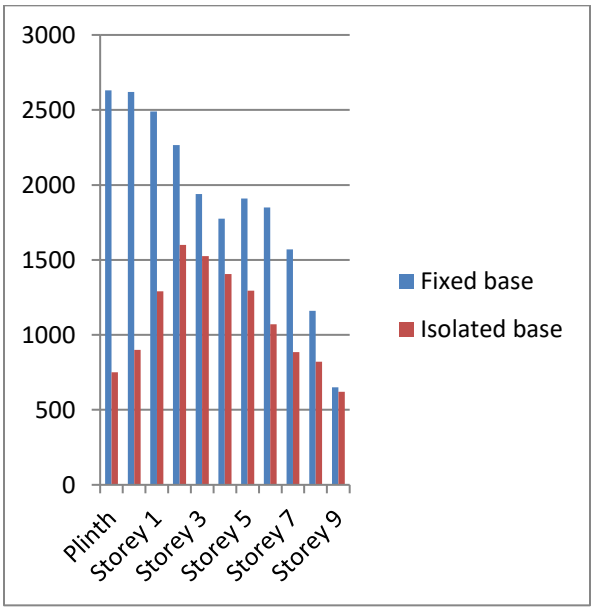
Storey displacement

Storey	Fixed base building (mm)	Base isolated building (mm)
Storey 9	111.718	94
Storey 8	108.163	92
Storey 7	104.588	91
Storey 6	100.698	85
Storey 5	94.091	80
Storey 4	83.638	72
Storey 3	69.195	65
Storey 2	54.107	55
Storey 1	36.993	46
GF	19.526	38
Plinth	3.409	28
Base	0	20



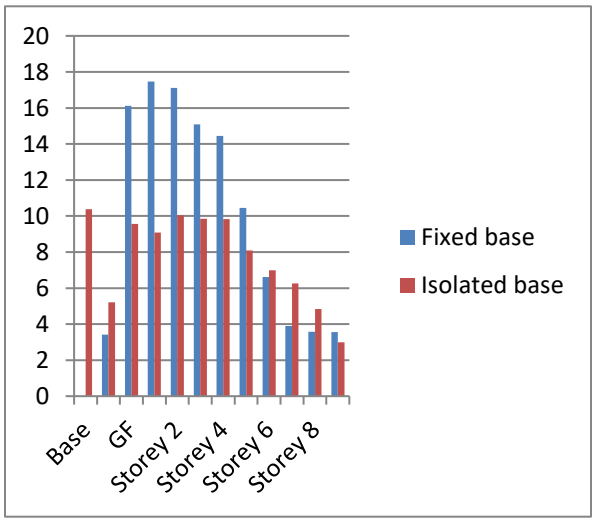
Storey shear

Storey	Fixed base building (kn)	Base isolated building (kn)
Storey 9	650	620
Storey 8	1160	820
Storey 7	1570	885
Storey 6	1850	1070
Storey 5	1910	1295
Storey 4	1775	1405
Storey 3	1940	1525
Storey 2	2265	1600
Storey 1	2490	1290
GF	2620	900
Plinth	2630	750

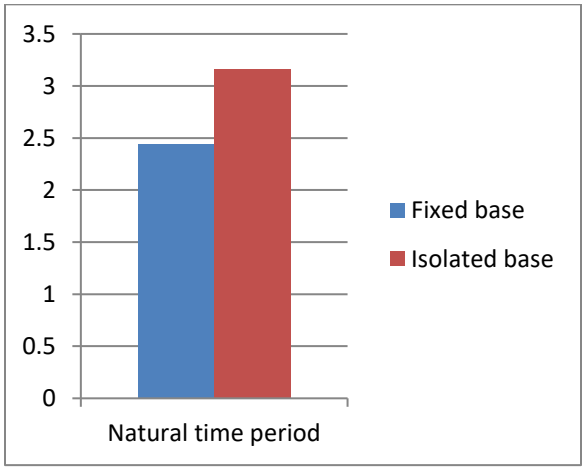


Storey drift

Storey	Fixed base building (mm)	Base isolated building (mm)
Storey 9	3.555	2.997
Storey 8	3.575	4.832
Storey 7	3.89	6.256
Storey 6	6.607	6.988
Storey 5	10.453	8.087
Storey 4	14.443	9.824
Storey 3	15.088	9.845
Storey 2	17.114	10.035
Storey 1	17.467	9.087
GF	16.117	9.556
Plinth	3.409	5.219
Base	0	10.38



Time period



V. CONCLUSION

Fixed base model and base isolated model by providing Lead rubber bearing these two models were analyses by Time history analysis from these buildings' models following conclusions can be made.

Story shear reduced after the lead rubber bearing (LRB) is provided as base isolation system which reduces the seismic effect on building.

Base shear is also reduced after providing LRB which makes structure stable and flexible during earthquake.

Story drifts are decreased in higher storey which makes structure safe against earthquake.

Base displacements are increased after providing LRB which is important to make a structure flexible during earthquake.

Net displacement will be reduced after providing LRB.

Natural periods are increased which reduces earthquake forces on the shaking.

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