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"COMPARATIVE BEHAVIOUR OF RC BRIDGE WITH AND WITHOUT BASE ISOLATION USING NON LINEAR ANALYSIS METHOD"

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ABSTRACT : A large proportion of world's population lives in regions of seismic hazards, at risk from earthquakes of varying severity and frequency of occurrence. Earthquake causes significant loss of life and damage of property every year. So, to mitigate the effect of earthquake on building the base isolation technique one of the best solutions.

Seismic isolation consists of essentially the installation of mechanisms which decouple the structure from base by providing seismi isolators. The seismic isolation system is mounted beneath the superstructure and is referred as 'Base Isolation'.

Keywords: *Bridges, Base isolation, bearings, Time History Analysis (SAP2000).*

I. INTRODUCTION

A bridge is made up of two major parts namely, superstructure and substructure. Super structure consists of track structure, girder/ truss and bearing.Substructure consists of bed block, pier or abutment and foundation as shown in Fig 1.

Bridges are vulnerable when subjected to severe earthtremor. Although considerable progress has been made in earthtremor engineering, catastrophic bridge failure examples are found wherever large-scale earthtremor attack. Damage of the bridge structures occur primarily in the piers, which may in turn result in collapse of the bridge spans. Although the ductility design concept has been widely accepted for seismal design of structures in engineering practice, this may not be appropriate for bridges since they are short of structural redundancy in nature.

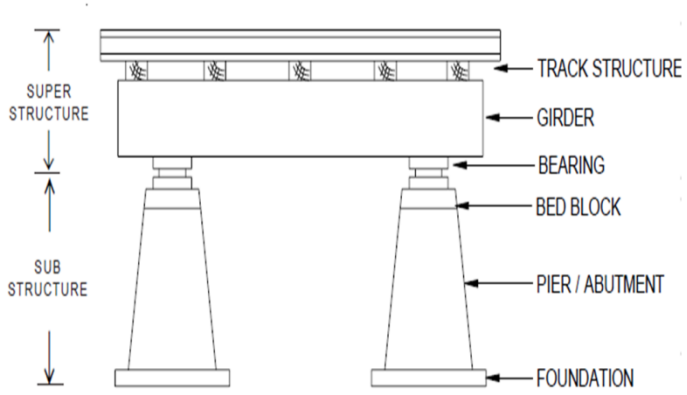

Fig.1 Parts of bridge

The present investigation is conducted to study the following

1. To understand the seismal behaviour of RC bridge with different base isolators in between superstructure and substructure.
2. To compare the various parameters with and without isolated bridge such as
   a. Base shear

b. Displacement of deck slab
c. Capacity of pier and deck

3. To check effectiveness of different isolators.

II. METHODOLOGY

3.1 Aim of the study

The project aims at applying the advancements in the field of earth tremor engineering by providing suitable isolation bearings to the proposed. RC Bridge to avoid painful loss of life and property in future during probable earthtremor.

3.2 Present method of analysis

In this study the performance of a RC BRIDGE subjected to severe earth tremor loads was evaluated using NON Linear analyses. Based on the findings from the analysis, a base isolation system was designed for the bridge. The parameters of base isolation system were chosen using the theory of multi degree of freedom dynamic systems. Then base isolation parameters were included into the initial model and the performance of the isolated structure subjected to the same seismal loads was evaluated. The two sets of results were compared and the structural effectiveness of base isolation system for that particular bridge was discussed. In addition, economic and practical aspects of base isolation systems were discussed and the conclusion with regard to feasibility of the system was drawn based on both structural and economic arguments.

3.3 Time history analysis

The earth tremor ground motions used in this study are the actual ground motions recorded at the base of the building during 2001 January 26, 08:46:42.9 I.S.T. Mag.: 7.0 mb, 7.6 Ms. Station: Ahmedabad, (**Bhuj Earth tremor)**.

These motions include components in the x (North-South) and y (East-West) directions shown The acceleration time history in the z direction. was not included. in the analysis as the study by **John A Martin Associates [1999]** showed that the effects of vertical excitation were insignificant.

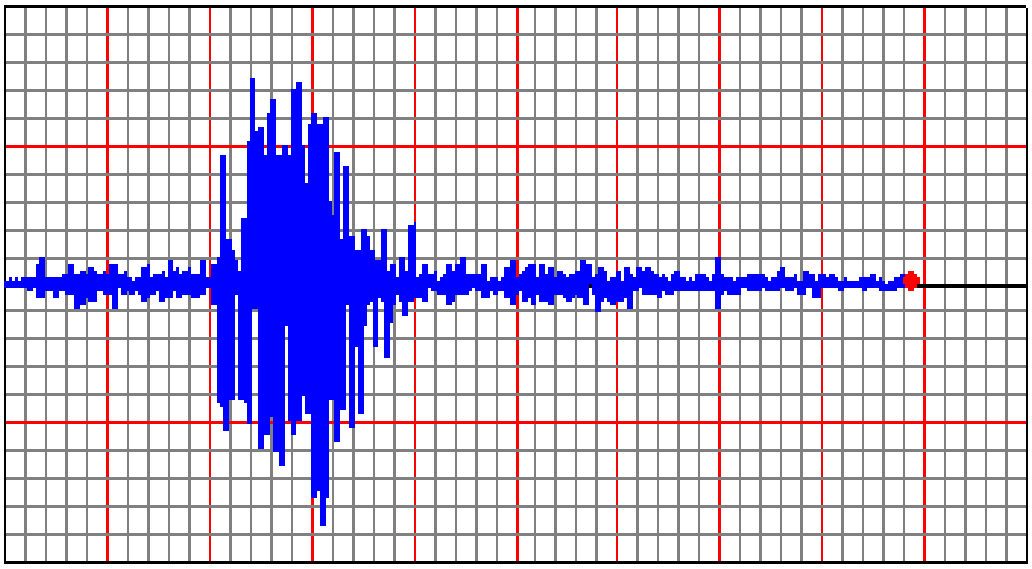

Fig 2 Bhuj Earthquake graphical Data

III. ANALYSIS

For the succesfull design of isolating system modal analysis of non isolated bridge is needed. Number of analysis for a non isolated bridge is performed using Sap2000 software. The main aim of this is to study the Stresses and displacements in the bridge under seismal loads.

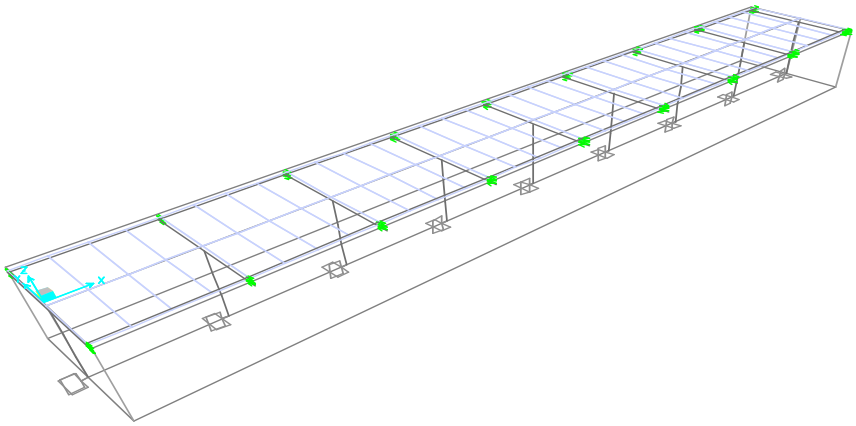

Fig 3 Spine model in SAP2000

Dimensions of LRB:	
Diameter of the bearing, D	100 cm
Total height of the bearing, h	61.8 cm
Number of rubber layers, N	28
Thickness of individual layers, t	1.5 cm
Diameter of the lead core, dp	18 cm
Number of steel plates, Ns	27
Thickness of steel plates, ts	0.4 cm
Thickness of top &bottom coverplates	4.5 cm

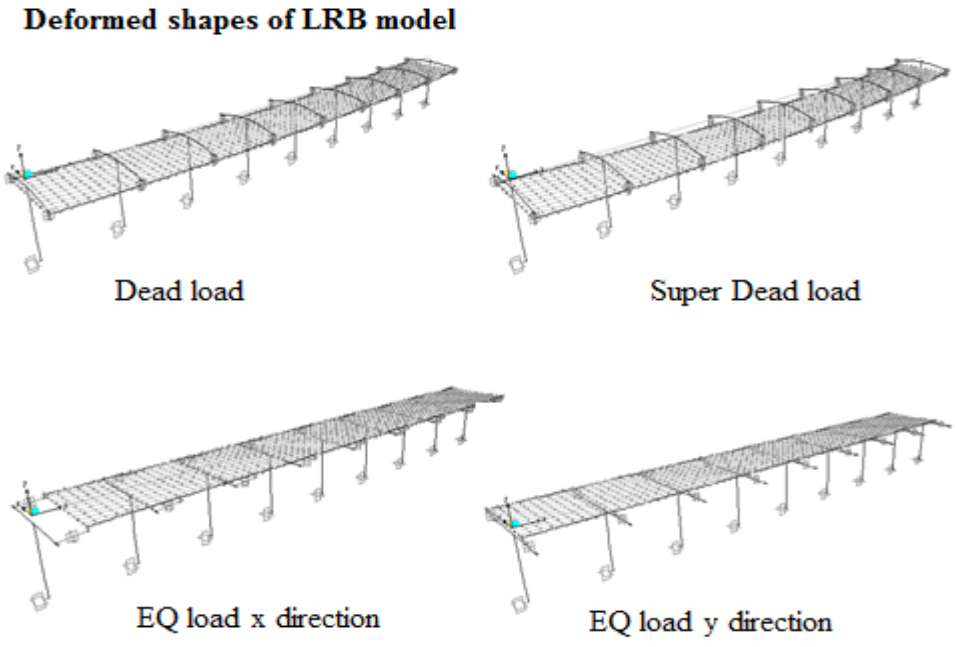

Fig 4 deformed shapes of lrb bridge

IV. RESULTS

The result has been discussed by considering following parameters

1) Time period

2) Base shear

3) Joint displacement

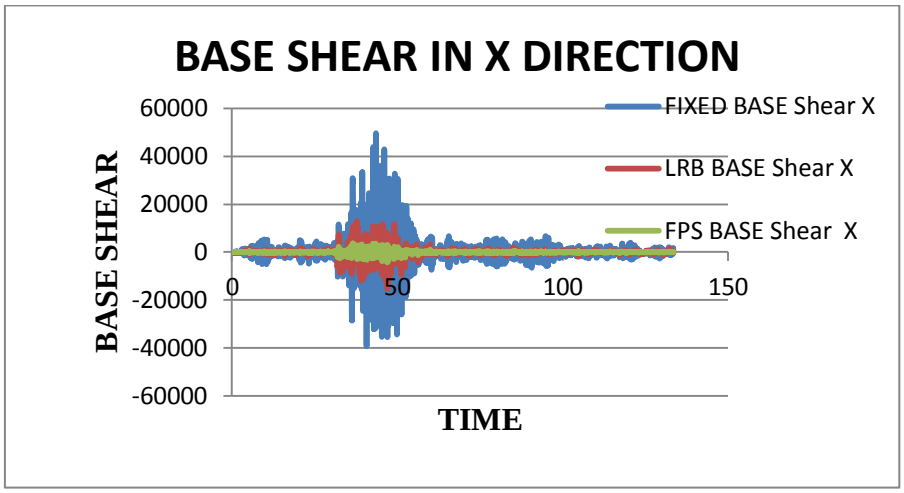

Fig 5 Base shear in X direction

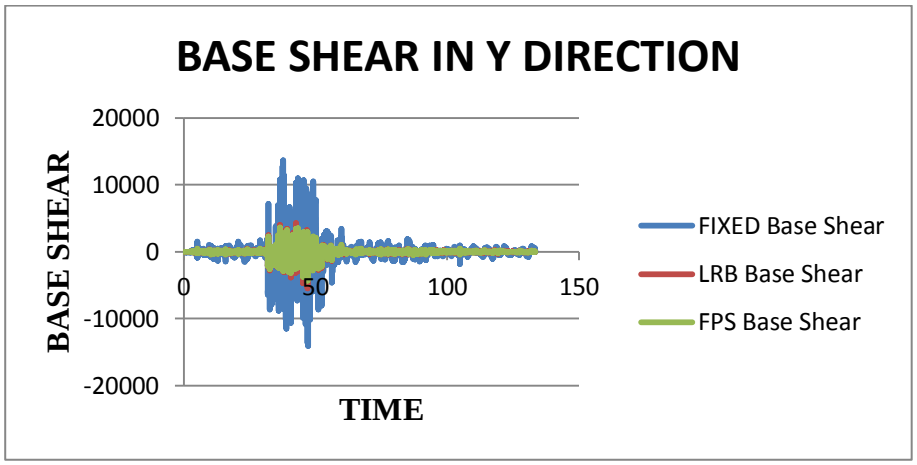

Fig 6 Base Shear in Y direction

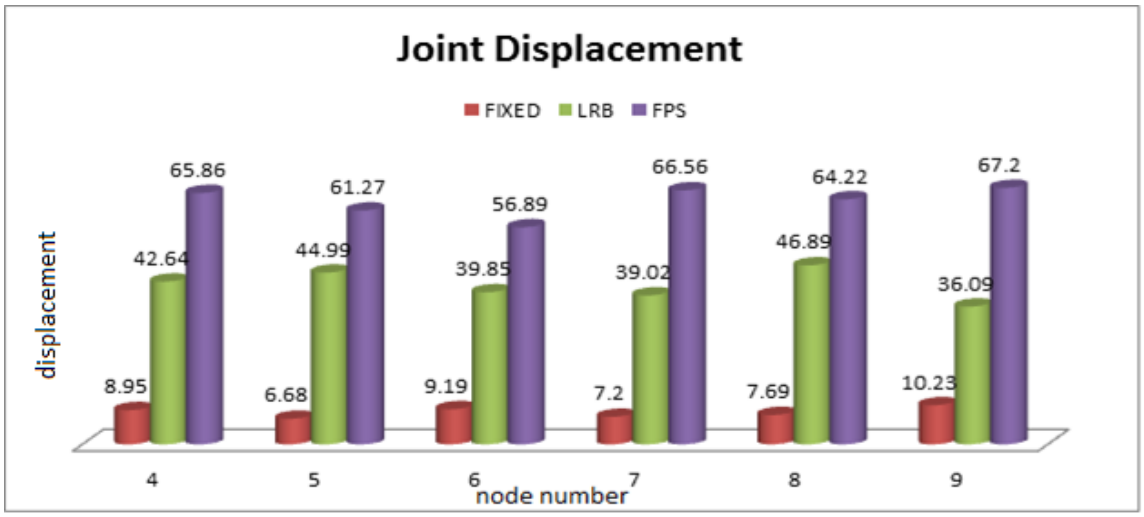

Fig 5 Displacement vs nodes

- Summary

The isolated period and the elastic base stiffness characterize a base isolated structure. The period of thes tructure has increased from a fixed-base value of 1.09 seconds to 3.62 seconds for the fundamental mode. According to the results of Time History analyses of both bridges, such period shift reduces accelerations by over 65%.

V. CONCLUSION

The following conclusions are made from the investigation carried out through the analysis:

- The series of analyses has proven the benefits of base isolation.
- The stiffness parameters of bearings were designed and analysed to maximize the seismic performance of the bridge.
- Base isolation has displayed significant positive effects by increasing the bridge's natural period and hence reducing inertia forces on the bridge structure.
- This investigation outlined the major relevant issues concerning theconceptual design of a base isolated structure.
- The FPS bearing is more effective in reducing the deck displacement than LRB.
- For the given ground motion, the isolated bridges significantly reduces the girder force than non-isolated bridge.
- The parameters of the bridge and the site conditions chosen for the study were deliberately chosen in such a way that the earthquake effects were most severe.

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