

Base Isolation Techniques a Effective Approach

Bhupali Deshpande

Rungta Engineering College and
Technology
Raipur, India

Email: Bhupali.deshpande@rungta.ac.in

Abstract: The concept of base isolation as an effective method of providing earthquake resistance to structural system. The intention base isolation is to provide seismic protection system to decouple the building structure from the damaging elements of earthquake input motion. It is now generally accepted that a base isolated building will perform better than a fixed base building in moderate or strong earthquake. In the structure in which is used so far, the major benefit has been to reduce the effect of seismic forces on content and internal equipment. More than justifying the increased cost of isolated construction. In this paper it is reviewed that the base isolation technique is use by many countries like US, Japan, and its benefits for many old monuments and rehabilitation and preservation of important structures.

Keywords: Base-isolated structure, Elastomer, Mausoleum of cyrus.

I. INTRODUCTION

The use of seismic isolation devices for buildings and bridges has been gaining worldwide acceptance and a well recognized approach to anti-seismic design. Base isolation systems have been demonstrated to be able to reduce seismic forces which rely mainly on strengthening of structural elements. This innovative technology reduces the earthquake forces transmitted to the superstructure and therefore eliminates permanent damage to the structure itself, protecting contents and secondary elements. The base-isolation techniques prove to be very effective for the seismic protection of new framed buildings as well as for the seismic retrofitting of existing ones. Design guidelines have been developed in many countries with a high seismic hazard (e.g. United States, Japan, New Zealand) and lately, suitable code provisions have been drafted also in Europe (Euro code 8 [1]). However, under near-fault ground motions, even base-isolated structures designed according to recent seismic codes can undergo unforeseen structural damages. The idea of base isolation was originally conceived over 100 of years ago however until recently; it has not been put into wide practice. With the last 30 years research in this base isolation

has matured and led to its adoption in full scale buildings. The effectiveness of base isolation is investigated for retrofitting the existing structure such as historical structures. Buildings bridges and liquid storage tanks the analytical seismic response of retrofitted structure for significantly reduced when compared with the corresponding structures. The ideas behind the concept of base isolation are quite simple. There are two basic types of isolation systems the system that has been adopted most widely in recent years by the use of elastomeric bearing, the elastomer made up of either natural rubber or neoprene in this approach building or structure is decoupled from the horizontal components of the earthquake ground motion by interposing a layer with low horizontal stiffness between the structure and the foundation these layers gives the structure of a fundamental frequency that is much lower than its fixed base frequency and also much lower than the predominant frequency of the ground motion. The first dynamic mode of the isolated structure involves deformation only in the isolation system, the structure above being to all intents and purposes rigid. The higher modes that will produce deformation in the structure are orthogonal to the first mode and consequently also to the ground motion. These higher modes do not participate in the motion, so that if there are high energy in the ground these higher frequencies, this energy cannot be transmitted into the structure. The isolation system does absorb the earthquake energy, but rather deflects it through of the system. This type of isolation works when the system is linear and even when undamped; however, some damping is beneficial to suppress any possible resonance at the isolation frequency.

The second type of isolation system is typified by the sliding system. This works by limiting the transfer of shear across the isolation interface. Many sliding systems have been proposed and some have been used. In China there are at least three buildings on sliding systems that use specially selected sand at the sliding interface. A type of isolation containing a lead-bronze plate sliding on stainless steel with an elastomeric bearing has been used for a nuclear power plant in South Africa. The friction pendulum system is a sliding system using a special interfacial material sliding on the stainless steel and has been use for several projects in United States, both new and retrofit constructions.

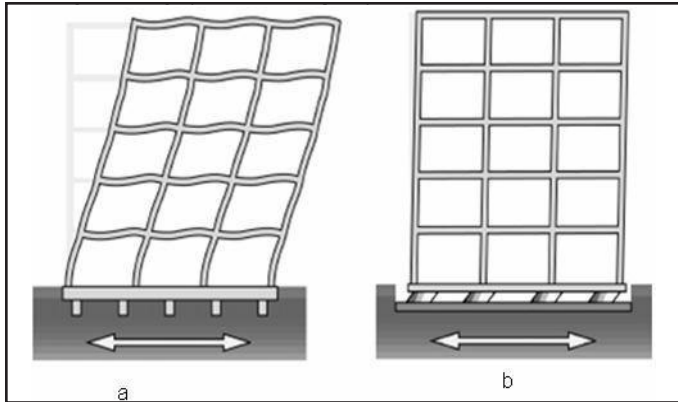


Fig. 1: Behavior change while using isolator (a) Conventional structure (b) Base – isolated structure



Fig. 2: Mausoleum of cyrus, the oldest base-isolated structure in the world

Types of Base Isolation System

A) Elastomeric Bearing B) Sliding Bearing C) Friction Pendulum Bearing.

II. LITERATURE REVIEW

Xiao et al 2004 also proposed using low friction layer beneath the foundation to act as base isolation layer but stated that this was only for heavy building made from weak building materials. The proposed construction method suggests that isolation material with corresponding measured friction levels are given in tables. A polythene membrane is must be used beneath pebbles. The thickness of the floor slab is large and

therefore expensive. The writer considers that if this isolation was used for brick veneer, masonry or timber walls, rather than a concrete wall construction.

Most new retrofitted base isolation project have made use of elastomeric isolation bearings and their most in the form of lead rubber bearing (LRB). The first type of bearing used for building in the United States was the high damping rubber bearing (HDR). Elastomeric systems are also widely used in other countries.

III. ADVANTAGES OF BASE ISOLATION

- Reduce floor acceleration and story drift.
- Less or no damage to structural members.
- Better protection of secondary systems.
- Prediction of response is more reliable and economical.
- It also protects non structural elements and equipment by reducing the entire structure's acceleration during an earthquake, as opposed to reinforcement alone.

IV. FORMULATION OF PROBLEM

There are mainly two methods of analysis

- Seismic coefficient method
- Response spectrum method

The seismic coefficient method is an approximate method which usually involves long hand calculation and results are approximate.

Response spectrum method involves good approach and it gives all the possibilities of prediction of response of structure and frequencies. In method response spectrum method is used.

In this research work, six storey building for a commercial complex having plan dimensions of 18mx18m. The building is located seismic zone III on a site with medium soil. Designed as per IS 1893 (part 1) 2002. For this building seismic analysis is done with and without base isolation for standard load combinations in staadpro and according results get tabulated and compared. Both static and dynamic analysis was done. The load combination was same in both the analysis only the difference in support condition. For static analysis the supports were fixed and for base isolated condition FX and FZ were released as well as MX, MY, MZ released. Maximum axial load was calculated from which stiffness determined. The sizing of bearings (LRB) was selected as per stiffness calculations.

V. RESULTS AND COMPARISON

For spectral accelerations

For story shear

TABLE I

Mode shape	Fixed Base structure	Base Isolated Structure	Mode shape	Fixed Base structure		Base Isolated Structure	
				Along -x	Along -z	Along -x	Along -z
1	0.60	0.00	6	116.32	0	0.01	0
2	0.61	0.002	5	166.08	0	0.03	0
3	0.67	0.00059	4	197.87	0	0.06	0
4	1.78	0.51	3	224.9	0	0.08	0
5	1.86	0.51	2	254.35	0	0.10	0
6	1.89	1.43	1	278.59	0	0.12	0

VI. CONCLUSION

From the above results of Staapro for both static as well as dynamic analysis for all load combination it is concluded that after providing base isolation system spectral ace relation was decreased up to large extent. Also most important is the peak story shear as well as the base shear is almost nearly equal to zero.

REFERENCES

- [1] L. Li, "Base isolation measure buildings in China," *Proceedings of 8th World Conference on Earthquake Engineering*, San Francisco, vol. 6, pp. 791–798, 1984.
- [2] C. Devore, C. M. Chang, and B. F. Spencer, "Active base isolation of building structures in two dimensions," *Proceedings of the 2007 Earthquake Symposium for Young Researchers*, Seattle, Washington, 8-12 Aug. 2007.
- [3] J. K. Biswas, "Study of seismic responses of CANDU3 reactor building using isolator bearings," *For Presentation at the IADA Specialists Meeting on Isolation Technology*, San Jose, California, March 1992.
- [4] J. M. Kelly, "Base isolation in Japan, 1988," *Report No. UCB/EERC-88/20*, Earthquake Engineering Research Centre, University of California, U.S.A, 1988.
- [5] F. Jolivet, and M. Richli, "A seismic foundation for nuclear power station," *Transactions of the 4th International Conference of Structural Mechanics in Reactor Technology*, Paper K 9/2, Aug. 1977.
- [6] C. A. Kircher, "Overview on seismic isolation and application to nuclear facilities," *Proceedings of the Third Symposium on Current Issues Related to Nuclear Power Plant Structure, Equipment and Piping*, Dec. 1990, Orlando, Florida.
- [7] I. G. Buckle, and R. L. Mayes, "Seismic isolation history, application and performances – A world view," *Earthquake Spectra*, Earthquake Engineering Research Institute, vol. 6, no. 2, pp. 161-201, May 1990.