

Review Paper on Seismic Base Isolation

Prajakta Jawale¹, Shruti Bagmare², Aishwarya Shinde³, Vedant Khedekar⁴, Prof. G Arya⁵

^{1,2,3,4}B.E. (Civil) Student, Dr. D. Y. Patil School of Engineering & Technology, Lohegaon, Pune, 412105 India.

⁵ Professor, Dr. D.Y. Patil School of Engineering & Technology, Lohegaon, Pune, 412105 India.

Abstract - The seismic hazards are found to be the prime matter of concern in Earthquake prone zones or the seismic zones worldwide. Over the period of time researchers have carried out the analysis on structural dynamics, using varying earthquake zones and seismic intensity. These analyses were being performed on fixed based structures and it could also be performed on isolated structures. As per these analyses it was found that the isolators minimize the lateral load imposed on the structure as compared to fixed base structures and also reduce the size of the building components. The present review includes literature and theoretical content related to isolation systems. The main objective of the present paper is to provide information o effectiveness of isolators.

Key Words: seismic, fixed base, isolation, stiffness, drifts, accelerations, etc.

1. INTRODUCTION

Earthquakes are perhaps most unpredictable and devastating of all natural disasters. They not only cause great destruction in terms of human casualties, but also have tremendous economic impact on affected area. The structures are made resistant to vibrations by improving their strength by the use of shear walls, braced frames, or moment-resistant frames. However, these traditional methods often result in high floor accelerations for stiff buildings, or large inter-storey drifts for flexible buildings. Because of this, the building performance may get severely affected during a major earthquake, even if the structure itself remains basically intact. To overcome these difficulties the concept of base isolation is increasingly being adopted. Seismic base isolation is the most popular response-control structure technique, a device having some damping properties and sufficient bearing strength is used in the structure.

1.1 Seismic Base Isolation

Base Isolation is the technique in which the whole structure is separated from the ground by the isolating devices. The seismic base isolation is the technique within which the device having some damping properties and sufficient bearing strength is used within the structure. Hence, seismic waves are absorbed by isolation units situated at the bottom.

It minimizes inter-storey drifts, also helps to reducing floor accelerations. The thought of Base Isolation is progressively adopted all over the world.

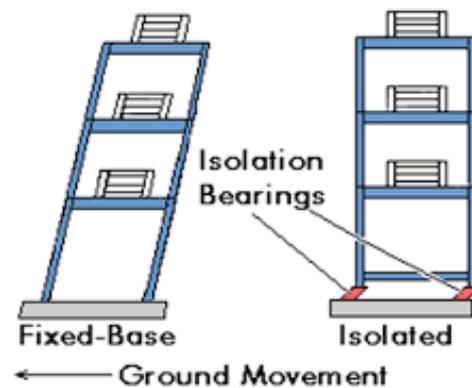


Fig -1: Behavior of Fixed base and Base Isolated structure.

2. LITERATURE REVIEW

To distinguish between the responses of the fixed base and the isolated base structure and to know the effectiveness of isolators, review of some papers is given:

Sarvesh K Jain and Sashi K Thakkar (2004) In this study the application of base isolation for flexible buildings is reported. In this research the buildings which are considered for the analytical study are ten storey building, fourteen storey and twenty storey building. The study has been analyzed by comparing isolated buildings with fixed buildings. In this study it has been comprehensively stated that the Effectiveness Ratio (ER), which is the ratio of fixed base to that of base isolated building, is considered as the parameter for studying the effectiveness of isolation. The effectiveness of base isolation is more if the value of ER is greater. An attempt is made to investigate the strategies that may result base isolation is effective for the buildings having the fundamental time period ranging from 1 to 3 seconds.

Pallavi Wamanrao Taywade and Madhuri Narayan Savale (2015) In this study the sustainability of the structure is calculated using base isolation techniques for seismic protection. Every structure is subjected to some kind of dynamic loading during its lifespan. Various dynamic

loads include wind, waves, traffic, earthquake, blasts etc... To cope with this, it has been proved that seismic base isolation is the most reliable method for earthquake resistant design. A case study has been done on the only base isolation project in India In Bhuj. It has been done to a District Hospital constructed post 2001 Bhuj earthquake incorporating lead rubber system. But however, some low-cost isolation devices can be incorporated to ordinary structures situated in high seismic zones, especially to structures from ruler regions where maximum part of India's population dwells. In conclusion, it has been found that Base Isolation can serve the purpose for almost all types of conditions. Besides, the existing devices are expensive and to make isolation feasible for ordinary buildings, efforts are required to develop cost-effective devices

Stefno Sorace, Gloria Terenzi (2014) In this paper Stefno and Gloria have discussed about the design and analysis of one base isolated building. The building includes 26 flats and is situated in Italy. The RCC structure and the base isolation system were designed by the practicing engineers there. Double Friction Pendulum (DFP) sliders are provided as isolators. After analyzing and after going through the details of construction it is concluded that very high performance objectives are achieved. It is found that the cost of construction is much less as compared to conventional fixed based design. The reinforcement details were simplified.

Mahmoud Sayed-Ahmed (2012) Mahmoud Sayed-Ahmed studied the effect of the base isolation on the joints in the structure and compared it with that of the fixed base structure. He performed the analysis of a two storey steel structure with reinforced slab using SAP2000. According to result base isolated structure exhibits less lateral deflection and less moment values as compared to fixed base structure. Also, the base isolated structure maintains longer fundamental lateral period than the fixed one. Hence, it is found that the base isolation system is effective for the joints in the structure.

R. B. Ghodke, S. B. Admane (2015) In this paper, R B Ghodke and S B Admane discussed base isolation technique used to minimize the damage to building during an earthquake disaster. The study is based on comparative analysis of base isolated structure and fixed base structure. The analysis is carried out on SAP2000 considering the earthquake motions recorded at different sites in India for the 5-storey building situated in Zone IV. It is concluded that with increase in height of building displacement is decreased for base isolated buildings. But in case of fixed base building, displacement increases with the height of building. By the

obtained reasons Base Isolation is the best technique to minimize damage to building during earthquake disaster.

Tejas Jitendra Chordiya and Vaishnavi Yogesh Totla (2018) The main function of base isolation is to reduce the damage in structures exposed to strong ground motions, by increasing the fundamental period of vibration and adequate addition of damping. Under this project a low rise structure is analyzed using ETABS software. The study of earthquake engineering and of the base isolation technique is also done which helps in enhancing knowledge in this particular field. Fixed base model and base isolated model by providing lead rubber bearing was analyzed by response spectrum method. Finally it is concluded that when LRB is provided as base isolation system it increases the structure's stability against earthquake.

Dhaval V Shankhpal, Ankit Pal (2013) Both Dhaval V Shankhpal and Ankit Pal designed and analyzed an elevated water tank in SAP2000. They discussed different literatures about the base isolation system for buildings and the elevated water tank. When designed and analyzed using the response spectrum, base isolation system was found to be an effective tool for the earthquake resistance of structure as it decreases the base shear and the displacements due to earthquake.

Shameena Khannavar and M H Kolhar (2016) In present research paper Modeling and the analysis of 10 storey RC building is done in ETABS software one with the fixed base and the another one base isolated. Two vertical irregular and two plan irregular models are considered and the analysis is done by the equivalent static and the response spectrum method. Using UBC 97 code the Lead rubber bearing (LRB) was designed and the same was used for analysis of base isolation system. Storey displacement, Storey shear, storey acceleration, and Inter storey drift were obtained from the analysis. From analysis results it is observed that the base isolation technique is very significant to reduce seismic response of both plan irregular and vertical irregular models as compared to fixed base fixed base building.

Michael D Symans Symans studied the ability of an adaptive seismic isolation system to protect structures subjected to a variety of earthquake ground motion. The isolation system consists of sliding isolation bearing along with an adaptive hydraulic damper. The damping capacity of the hydraulic damper can be modified in real time to respond to the effect of the earthquake ground motion the result shows that, for earthquake ground motion of different intensities; the sliding base isolation system is capable to limit the response of the isolation system and the structure simultaneously.

Sushma.G.Sawadatkar (2017) In this paper author studied different techniques of base isolation to avoid the damage to the property especially civil structures. The concept of the base isolation is explained through an example of building resting on frictionless rollers when the ground shakes the rollers freely rolls, but the building above does not move, no force is transferred to the building due to shaking of ground. Basically, The base isolation is nothing but to insert a discontinuity at the base of the structure such that the structure whole earthquake load is taken by the isolators. It is concluded that the lead rubber bearing method is most effective as compared to the high density rubber bearing method and the friction pendulum method.

3. CONCLUSIONS

After going through various literatures out there it is found difficult to safeguard the structures from unpredictable earthquakes by the use of conventional methods which includes strengthening of the structure. Though the building is protected by conventional methods it results in high floor accelerations and high floor drifts which severely affect the building performance. Instead of that, the use of devices having some damping property which can absorb the vibrations due to earthquakes is found to be effective. This technique is nothing but the base isolation.

Following are some advantages of Base Isolated structure over fixed base structure:

1. The earthquake energy is prevented from entering the structure by decoupling the later from the ground motion, thereby reducing both the ductility demand and inter-storey drifts.
2. The natural frequency of structure depends on the factors like mass, height and stiffness of the structure. If the earthquake frequency is high or matches with the natural frequency of the structure, the building may oscillate violently. Base isolators reduce the stiffness of structure there by reducing the natural frequency which minimizes the oscillations due to earthquake.
3. As Base Isolation reduces the earthquake forces transmitted to the structure, there is no need of strengthening the structure by providing the frames, shear walls, bracings, etc.

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