National Conference on 'Advances in Engineering, Technology and Applied Sciences' - NCAETAS-2019
© 2019 IJSRSET | Volume 5 | Issue 6 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099

A Review : On Base Isolation Techniques

P. A. Deotale[1], R. S. Naranje[2], N. V. Dhakde[3], R. J. Meshram[4], P. V. Lakadey[5], P. S. Amborkar[6], R. D. Yadav[7]
[1]Assistant Professor, Department of Civil Engineering, RTMNU/DBACER, Nagpur, Maharashtra, India
[234567]Department of Civil Engineering, RTMNU/DBACER, Nagpur, Maharashtra, India

ABSTRACT

An earthquake represents one of natural hazards human society has to face, often without any kind of warnings. An earthquake can cause many damages or losses to the structure due to seismic forces, which can cause the settlement and displacement of the structure or buildings to protect the structure from the displacement of isolator. An isolator is the system which separates the substructure and superstructure of the building which can be of various types. Isolation must be chosen depending upon its results, materials and its outputs and considering all the aspects. There are different types of isolationsystem, in this paper it gives basic information about the base isolation system and it also describes suitability and application. The building is to be designed on SAP2000 software. The main aim of this paper is to determine the base shear of building and providing a suitable isolation.

Keywords: Earthquake Engineering, Base Isolation System, Lateral Displacement, SAP2000

I. INTRODUCTION

An Earthquake is the result of the sudden release of energy in the Earth's crust created seismic waves that cause vibrations; the ground may develop cracks, fissures, and settlements. Shaking and ground rupture are the main effects, resulting mainly in more or less damage to building and other rigid structures. The potential risk of loss of life adds a very serious dimension to seismic design putting structural engineers a moral responsibility.

The main objective of earthquake resistant design is to make such buildings that can resist the effect of ground movement and would not collapse during the strong earthquake. Recently, many new systems have been developed to either reduce the earthquake forces acting on the structure or to absorb a portion of seismic energy.

Base isolation is one of the most widely researched, implemented and accepted seismic protection. The structures performance during an earthquake depends on the type and characteristics on the base isolation. It needs proper modelling to study the isolations nonlinear behaviour. A typical LRB's force displacement relationship is nonlinear. The simple friction isolator consists of a large surface deformation. Therefore, it is good to introduce any recovery mechanism for better performance of friction sliding bearings. For example, a restoration mechanism is provided by the mid and outer rubber cores in resilient friction bearings (R-FBI).

A brief review of some papers is given in this article to understand the difference between the fixed base responses and the isolated base structure, to determine the effectiveness of the different isolators and to study the properties of the isolator in details.

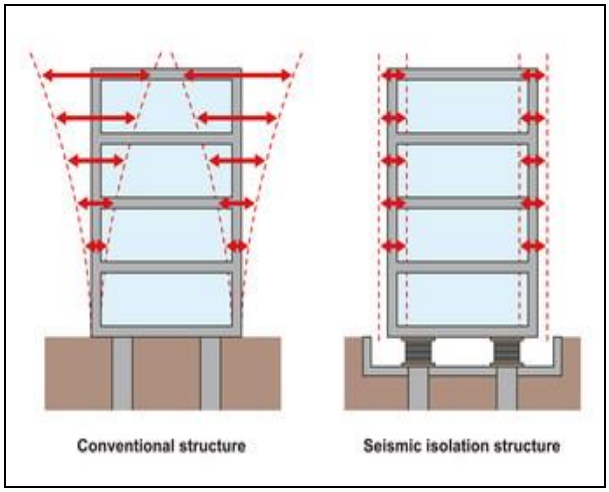

Fig. (i) Figure shows the seismic behaviour of the building with and without base isolation

II. LITERATURE REVIEW

The brief review of various base isolated buildings by different researchers is discussed below:

H.W.Shenton[1], discuss the relative results of a fixed and
isolated structure have been compared and analyzed. The Concrete Fix Base Structure was designed by refer ring California Association of Structural Agencies (SE AOC).The base isolated response was compared to a fi xed base response. The base shear varied according to the SEAOC recommendation.
Three different types of time Historey, post-earthquake record were selected to perform nonlinear dynamic analysis for fixed base and isolated base structure.
Results were compared to SEAOC's 25 percent and 50 percent of the Specified Lateral Force. Building perfor mance was checked for different lateral forces.
N. Torunbalci and G. Ozpalanlar[2], studied and compared six storey building with five different seismic protection alternative with fixed based building. In this analysis, total base shear forces, storey shear forces, maximum absolute acceleration and relative storey are compared and result are discussed.

The result was on the basis of natural period. The natural period of fixed base building was 0.58 sec, which was further increased to 2 sec by using base isolators. When storey shear, relative drift and acceleration values are examined after application of seismic protection alternatives, the results were similar to zone which is out of resonance range of earthquake. Results were found adequate and safe from earthquake.

Dia Eddin Nassani, Mustafa Wassef Abdulmajeed[3], have studied advanced seismic resistance methods, and the effect of this system on the seismic response on the structures. To verify the effect of base isolation system two different buildings are taken into account, one with base isolated and other with fixed base. Both buildings were compared with the help of SAP2000. The base shear in x direction in base isolated condition was 3557 KN and for fixed base condition it was 13940 KN. Result were similar in condition of y direction. The drift ratio for base isolated condition was 0.0007 while that for fixed base was 0.003. Comparing result it was found that base isolation system reduces the base shear force & storey drift as compared to fixed base.

Sameer S. Shaikh, P.B. Mrunal.[4], discuss the base isolation at different levels in building. They made up three storey building without base isolation and with base isolation at the different levels of the building, because they found that if the isolators are fixing to above floors, acceleration are decreasing hence there is less failure occurs to above floors as compared to isolators at footing. So they used laminate rubber bearing as a isolators in building. Because LBR is made up of alternating layers of ruuber and steel. They study both building under the time historey motion because time historey is the best way to represent the earthquake actions. After performing time historey analysis it is found that when base isolators are shifting at plinth level and first floor level acceleration was reduced.

R. B. Ghodke, Dr. S. V. Admane[5], studied the effect of the earthquake study may lead to horizontal

components of the earthquake movement that mainly damage the structure rather than the vertical component and may also face major economic losses. Base isolation is an effective system for reducing dama ge to buildings caused by the earthquake.
Observations are made on the SAP2000 software study of 5 storied buildings with base isolation and without base isolation. The building plan area is 12 m x 10 m with each typical storey having height of 3.0 m. The building is analysed and designed using SAP2000 software. Two different observations are being made. Two different observations are being made. One design with a fixed base and the other with a base isolation system; and two results are compared, and with base isolation and without base isolation there is a very huge and remarkable difference. Building displacement with fixed base is more than building with base isolation.

A. Swetha, Dr. H. Sudarsana Rao[6], studied dynamic analysis of the G+4 storey building. The dynamic analysis was done using a new beta mark method. Records of the values of the EI Centro Earthquake were taken to accelerate ground motion. Static analysis was performed and comparison was made for peak lateral force, shear force and displacement of each force. The design was done in accordance with IS 1893 (part 1): 2002. The comparison was made and interferences were drawn to the effectiveness of ground storey and week buildings due to the critical effect of an earthquake.

Sekar and Kadappan[7], carried out experimental work on base isolated bearing and rigid base reinforced concrete building were compared with the effects of the soil, earthquake zone and normal and sloping soil. He took a multi-storey RC building with a normal and sloping ground surface for this study and designed it with and without an isolator. Various storey height ranges from 1 to 10 were taken with different seismic zones and the building's plan was rectangular with a size of 12x16 m and a seismic zone. The linear dynamic analysis was carried out using the response spectrum method. The different results were obtained with the different terrain and zone conditions. As with the introduction of the isolator, the basic natural time of the structure increases but reduces the base shear. Building drift also increases in the storey. Since the results were changed due to different terrain conditions, the base isolator makes the building as a rigid building with a longer period of time.

Sushma. G. Sawadatkar, Mandar. M. Joshi[8], studied an earthquake represents one of the natural hazards human society has to face, often without any kind of warnings. It involves a severe, shaking of the earth below out feet affecting all systems and structures standing on it. The need to minimize earthquake damage is important. This leads to use of seismic base isolation strategy on a large scale in several earthquake prone developed countries. The base isolation works by decoupling of building or structure between the substructure and superstructure. It is the flexible layer between foundation and superstructure. There are different types of base isolators and materials used for base isolators which give basic information in this paper. The different types of base isolators are lead rubber bearings, high density rubber bearings and friction pendulum system. Out of which it is found most effective and most widely used is lead rubber bearing which has many advantages as compared to others. The various materials used for lead rubber bearings are rubber, lead, and steel. In lead rubber bearings there are alternate layers of rubber and steel. Lead rubber bearings are found to be most effective in every aspect on the seismic prone structures. It is applicable to low to medium of buildings. It protects from horizontal movements and gives better vertical stiffness to the structures as compared to others.

H. R. Tavakoli F. Naghaviand A. R. Goltabar[9], studied dynamic responses of multistorey base-isolated and fixed base buildings are investigated in near and far reaching ground movements. The lead

rubber insulation bearing (LBR) is used in the examination. First, the mechanical properties of the LRB insulation system are calculated. The seismic analysis of the building is performed using a non linear time historey method for two dimensional reinforced concrete building frames. For analytical purposes, three far field records and three near fault ground motions records from the same components are selected at different stations and performed on frames. The analytical results for isolated and fixed base frames are compared in low and low ground movements. The results of the analysis are examined as the drift of the storey, acceleration of each storey, base shear and displacement of the base.

A. Sai Greeshma, M. S. Anantha venkatesh[10], studied and discussed the base control of high rise building using fixed isolators. The aim of the study was to determine the effectiveness of base isolators under the vibrations. For these purpose they studied building structure of different storey levels i.e.10 storey, 20 storey, 30 storey buildings are analysed with fixed base and isolated base. Then the seismic response of analysed building, both fixed base and base isolated under 2001 Bhuj earthquake by using passive base isolators was studied. The reduction in lateral response was measured by comparing the storey displacement, storey shear, storey over turning moment of both building. It has been observed that maximum storey displacement was decreased about 40%, maximum storey shear and base shear was decreased about 50%, maximum moment and base moment was decreased of about 50% by providing base isolators.

III. CONCLUSION

The conclusion on the above study can be noted that, when the comparison between the non-isolated and with isolated building is done, then the isolation technique is more effective. Application of base isolation is an extraordinary and widely used technique which can be used to save innumerable lives and money spend destruction made by earthquakes. Also this paper can be concluded that the, time period can be increase with the application of different base isolation as compared to fixed base system.

IV. REFERENCES

[1]. Consstantinou and Tadjbakhsh, "Optimum characteristic of isolated structures", Journal of Structural Engineering, ASCE, May 1985, Vol. 111, (pp. 2733-2750).

[2]. Makris and Constantinou, Himanshu S. Deoskar, "Studies on seismic isolation of buildings", Journal of Structural Engineering, ASCE, June 1991, Vol. 117, (pp. 27080).

[3]. Kelly J.M. Naeim, "Design of seismic isolated structures" , Journal of Earthquake Engineering & Structural Dynamics, 1999, ISSN 2075-5309 Nueva York

[4]. Heaton T.H., Hall J.F. ald D.J , Halling M.W."Response of high-rise and base-isolated buildings to a hypothetical Mw 7.0 blind thrust earthquake", Science 267(5195), 206–211 (1995).

[5]. Pourzeynali.s, Zarif.M, "Multi-objective optimization of seismically isolated high-rise building structures using genetic algorithms", Elsevier, Journal of Sound and Vibration 311(2008) 1141–1160.

[6]. Swathirani.K.S , Muralidhara.G.B , Santoshkumar.N.B, "Eatrhquake Response Of Reinforced Cocrete Multi Storey With Based Isolation", International Journal of Research in Engineering and Technology Volume: 04 Issue: 10,pg 158-167,2015.

[7]. Sekar and PL Kadappan, "Seismic analysis of multi-storey buildings resting on normal and sloping grounds in different seismic zones with and without base isolator" , I-manager's Journal on Structural Engineering, Vol. 4 l No. 1,(2015).

[8]. Farzad Hatami, Hamed Nademi, Mohammad Rahaie, "Effects of Soil-Structure Interaction on the Seismic Response of Base Isolated in High-

Rise Buildings", International Journal of Structural and Civil Engineering Research Vol. 4, No. 3, (2015).

[9]. A.Swetha, Dr. H. Sudarsana Rao, "Non-linear analysis of multistorey g + 4 building by time historey method using newmark's linear and average acceleration method", international journal of engineering sciences & research technology, issn: 2277-9655, (2015).

[10]. Shu-lu Wang, Hong-bai Bai & Ghun-hong Lu, "The Research Progress and Application Expectation of Metal Rubber Vibration Isolator", International Conference on Materials, Environmental and Biological Engineering, (2015)

[11]. A. B. M. Saiful Islam, Mohammed Jameel and Mohd Zamin Jumaat, "Seismic isolation in buildings to be a practical reality: Behavior of structure and installation technique", Journal of Engineering and Technology Research Vol. 3(4), pp. 99-117, April 2011.

[12]. Donato Cancellara, Fabio De Angelis, "Assessment and dynamic nonlinear analysis of different base isolation systems for a multi-storey RC building irregular in plan" , ELSEVIER, Computers and Structures, (2016).

[13]. Fabio Mazza n, Daniela Pucci, "Static vulnerability of an existing r.c. structure and seismic retrofitting by CFRP and base-isolation: A case study", ELSEVIER, Soil Dynamics and Earthquake Engineering, (2016).

[14]. Jared Weisman and Gordon P. Warn, "Stability of Elastomeric and Lead-Rubber Seismic Isolation Bearings", Journal of structural engineering, ASCE, February 2012, Vol. 138, (pp. 215-223).

[15]. Jia Gaofeng and Shi Zhiferi, "A new seismic isolation system and its feasibility study", Earthquake engineering and engineering vibration, SPRINGER, March 2010, Vol. 9, (pp. 75- 82).

[16]. S.D.Darshale and N.L.Shelke, "seismic Response Control of R.C.C. Structure using Base Isolation", International Journal of research in Engineering science and Technology, vol.2, No.1, (2016).

[17]. Sayani Prayag J, Ryan Keri L. "Comparative evaluation of base-isolated and fixed-base buildings using a comprehensive response index", J Structural Engg 2009; 135(6):698–707.

[18]. Erduran E, Dao ND, Ryan KL. "Comparative response assessment of minimally compliant low-rise conventional and base-isolated steel frames", Earthquake Eng Struct Dyn 2011;40(10):1123–41.

[19]. Furukawa T, Ito M, Izawa K, et al. "System identification of base isolated building using seismic response data", Eng. Mech-ASCE, 2005, 131: 268–275.