International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 11 | Nov 2020 www.irjet.net p-ISSN: 2395-0072

To Study on Effect of Base Isolation on Multi – Storeyed Steel Structure

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Abstract - *When designing buildings and structures in areas with seismic activity, a designer has to provide a predetermined level of reliability and earthquake resistance of building structures. The use of traditional seismic methods to enhance earthquake resistance of building structures is not economically feasible and not enough effective in terms of improving the construction effectiveness. Now, to enhance seismic resistance, various seismic isolation systems, including lead rubber bearings, which occupy a leading position in the construction practice utilization, are being increasingly applied. In such systems, decrease in seismic impact magnitude is due to the increase in specific periods of natural oscillations of the system and oscillation withdrawal out of the resonance zone.*

***Key Words*: Base isolation, seismic design, Etabs, Time history function etc.**

1. INTRODUCTION

This chapter contains introduction to Steel Structures, Base Isolation and their characteristics, introduction to ETABs, objectives, methodology followed and the thesis layout.

1.1 Steel structure

Steel structures require less time for construction, hence they are very preferred in the construction industry. In many situations, lighter steel structures are always prepared than heavier alternatives such as reinforced concrete or pre-stressed concrete. The main advantages of steel structures are its strength, prefabrication, quicker transportability to the worksite and faster erection. Steel structures can be easily dismantled and erected in another place without damaging the strength of the original structure. Most structural steel units are prefabricated in a workshop with superior quality. The main advantage of prefabricated structures is quality control achieved as compared to in-situ construction. The additional advantages of steel structure is tolerance specified in the Indian Standard codes for a structural component are small compared to the similar reinforced concrete structures. Steel also plays an important role in composite construction in combination with a reinforced and pre-stressed concrete structure. With the development of steel as a construction material, the varieties of steel sections were also increased.

1.2 Types of Base Isolators:

1. High Damping Rubber Bearing –
2. Friction Pendulum System –
3. Lead Rubber Bearing –
   - **Lead Rubber Bearing –**

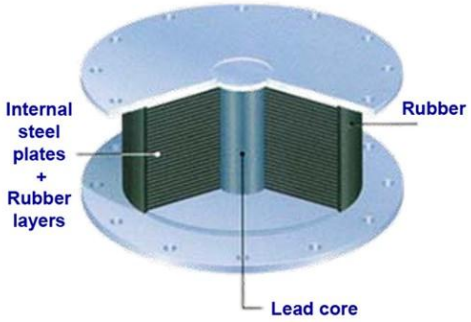

Fig – 1: Lead rubber bearing

2. BEHAVIOUR OF STRUCTURE WITH AND WITHOUT BASE ISOLATION

Table -1: Properties and Loading

Particulars	Self-Weight
UC 356 x 406 x 340	3.334 kN/m
UB 356 x 171 x 51	0.500 kN/m
Floor Finish	2 kN/m^2
Live/Imposed Load	4 kN/m^2

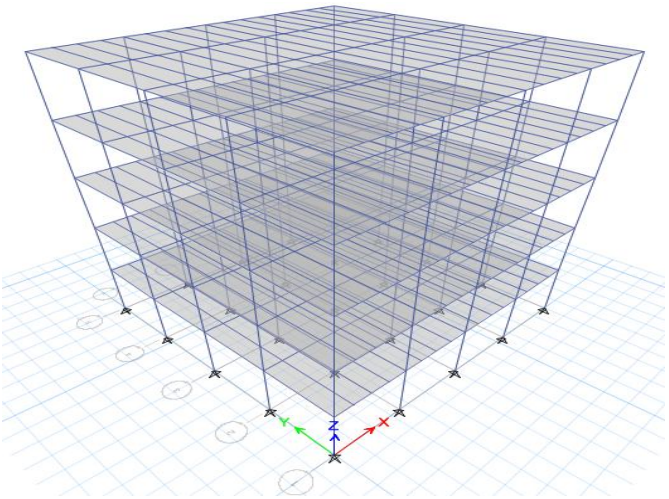

Fig – 2: G + 4 Steel Structure with Fixed Base

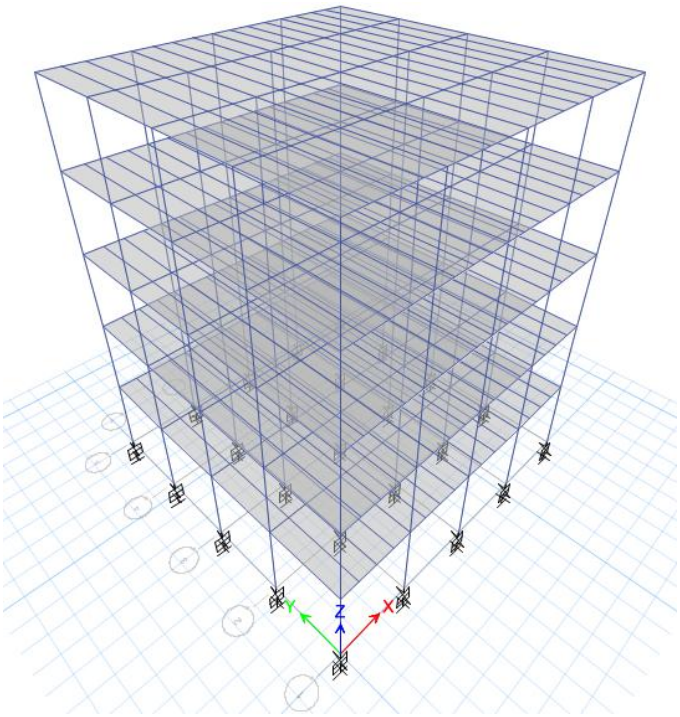

Fig – 3: G + 4 Steel Structure with Base Isolated

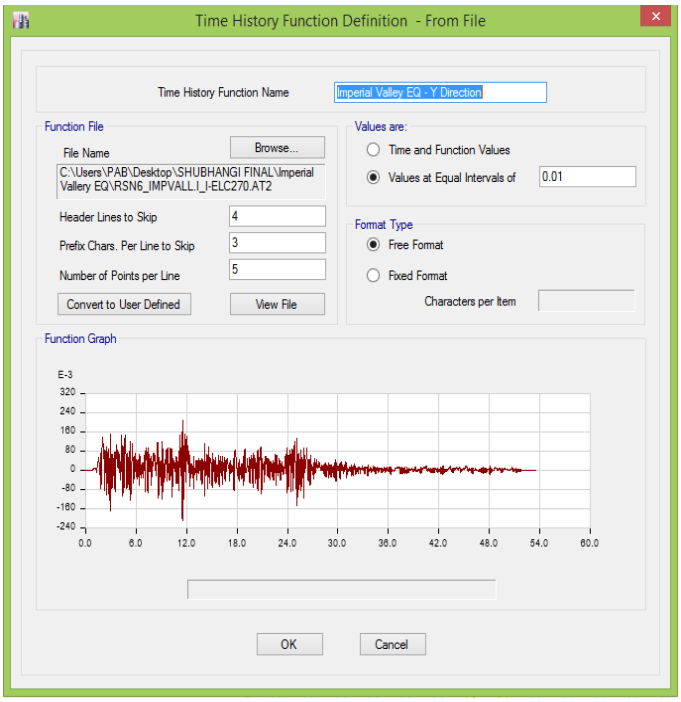

Fig- 4: Time History function in Y – direction

3. LITERATURE REVIEW

Mahmoud S.et.al. (2012) had studied steel building with structural rubber bearing. The analysis performed to check for the adequacy of the base isolation against building lateral drift and inter-story drift as per allowance in National Building Code of Canada 2010. Two buildings were analysed using the nonlinear time-history response analysis using the dynamic modal analysis for fixed-base building, and Isolated base building with rubber bearing. The analysis represents a case study for an asymmetric steel building to show the ultimate capacity of the selected structural bearing, and to make a comparison for the difference between the isolated base and the fixed base buildings.

Patel A.et.al., (2013) the work aims to analyze a multistory and multi-bay (G+5) moment resisting building frame for earthquake forces following IS 1893 and then designs it as per IS 800:2007. Comparative studies of the results obtained from both these methods have been made in terms of story displacement; inter-story drift and base shear. The software used for analysis and design in stadd- pro. Both during design and analysis sufficient manual calculations have been made and compared.

Junhe P.et.al., (2014) has studied the effects of variability of the mechanical properties of lead rubber bearings on the response of a seismic isolation system are investigated. Material variability in manufacturing, ageing, and operation temperature is assumed, and two variation models of an isolation system are considered. To evaluate the effect of ground motion characteristics on the response, 27 earthquake record sets with different peak A/V ratios were selected, and three components of ground motions were used for seismic response analysis.

Mohammed Naguib.et.al., (2015) has studied understanding, the structures of a fixed-base office building and a base-isolated office building of similar size and layout were designed; their seismic performance was compared in both response spectrum analysis and time history analysis.

Ghodke R. B. et.al. (2015) has reported that base-isolation is best technique to prevent or minimize damage to buildings during an earthquake disaster. In the present study of base isolation in structural analysis for five storied moment resisting frame with lead rubber seismic isolation has been studied using SAP2000 software.

Govardhan A. et.al., (2016) Reported that Seismic base isolation is a technique that mitigates the effects of an earthquake by essentially isolating the structure and its contents from potentially severe ground motion, especially in the frequency range where the building is most affected. Having designed seismic isolation system, the next step was to explore the fabrication of Laminated Lead Rubber Bearings (LLRB). It should be affordable and suitable for high seismic zones. Because isolators are subject to extreme

deformations and loads during major earthquakes, most design codes require they be tested to demonstrate conformance with design expectations. At some point in time isolator devices may be required to be removed and replaced. One reason for this may be that the isolators get damaged during a severe earthquake.

Shah A.et.al., (2017) has reported that base isolation was one of the promising and widely accepted passive control devices to resist these forces by isolating the superstructure from the substructure, further he evaluation the response of Base isolated building and the fixed base building was having irregularity in a plan at Storey level. Response spectrum analysis and time history analysis was carried out in terms of Storey displacement, Base shear, Time period and Storey drift using Etabs software.

Hossein N. et.al, (2017) reported that the pushover analysis was mainly used for the seismic evaluation of fixed-base structures, whereas a limited number of research investigations have focused on the applicability of pushover analysis to base-isolated buildings. Therefore, this study attempts to extend the modal pushover analysis (MPA) and the extended N2 (EN2) method to medium-rise base-isolated building frames to account for the effect of higher modes in predicting the seismic demands of these structures. Since the displacement at the isolation level and subsequently the effective stiffness of the isolation system was not predetermined at first, an iterative process was used to fulfil the MPA method for base-isolated frames.

Winn S. et.al. (2017) has studied lead rubber bearing (LRB) as an isolation device and then to compare various parameters between fixed base condition and isolated base condition. Has studied, comparative advantages for using lead rubber bearing (LRB) isolation systems are mainly investigated by performing nonlinear dynamic time-history analyses for design basic earthquake (DBE) seismic demand level. The comparison process has been carried out on the structural performance of the structure with storey displacement, storey acceleration, and storey drift ratio.

4. CONCLUSIONS

1. From the analytical study, it is observed that fixed base building have zero displacements at the base of the building whereas, base-isolated building models shows the appreciable amount of lateral displacements at the base.

2. It has been observed that maximum base shear in multi-storey steel structure decreases; whereas an increase in storey displacements was observed for the bottom storey then gradually decreases for top storey of the base-isolated building as compared with fixed base building model.

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