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Seismic Performance Evaluation Of High Rise Rcc Buildings With And Without X-Braced Friction Dampers

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Abstract: *The work is concerned with the comparison of the seismic evaluation of High Rise RCC buildings connected with and without X- braced friction dampers, the method carried out in terms of equivalent static, response spectrum and pushover analysis according to IS 1893:2002(part1) code.G+10, G+15 and G+20 storey buildings respectively are considered for the analysis. In this analysis for friction damper buildings, the dampers are connected at ground and first floor of all the buildings. The comparison of equivalent static method and response spectrum method by using finite element software package ETABS version 16.2.1 is used to perform the modeling and analysis of G+10, G+15 and G+20 storey buildings by considering the seismic zone IV as per IS 1893:2002(part 1) code. For analysis various IS codes have been referred. This paper gives an idea about various researches carried out on multistoried buildings using dampers.*

Keywords: *X- braced Friction Dampers, Fundamental Time Period, Storey Drift, Storey Displacement, Base Shear.*

I. Introduction

From the past and few present records, the world has experienced number of devastating earthquakes, increasing number of loss of human being due to structural collapse and severe damages to structure. Structural damages,during seismic (earthquake) hazards clearly explains that the buildings / structures like residential buildings, public life-linestructures, historical structures and industrial structures should be designed to seismic force design and very carefully to overcome from the earthquake hazards. Passive supplemental damping systems such as base isolation viscoelastic dampers and tuned mass dampers are widely used in structures to reduce the dynamic response. Full scale implement of active control systems is difficult as it is expensive and less reliable. Semi-active damping systems i.e. variable-orifice fluid dampers, controllable friction devices, variable- stiffness devices, smart tuned mass dampers and tuned liquid dampers, are more effective in mitigating dynamic response than active and passive damping system

II. Literature Review

[1] Laxmikant Vairagade, Vivek Thakre et al,

In this paper the pre-engineered steel building system construction has great advantages to the single storey buildings, practical and efficient alternative to conventional buildings, the System representing one central model within multiple disciplines. . The adoptability of PEB in the place of Conventional Steel Building (CSB) design concept resulted in many advantages, including economy and easier fabrication. In this study, an industrial structure (Ware House) is analyzed and designed according to the Indian standards, IS 800-1984, IS 800-2007 and also by referring MBMA-96 and AISC-89._ The economy of the structure is discussed in terms of its weight comparison, between Indian codes (IS800-1984, IS800-2007) & American code (MBMA-96), & between Indian codes (IS800-1984, IS800-2007).

[2] Sabih Ahmed, Shoeb Ahmad Khan et al,

They had studied the behaviour of every multistoried building structure which is subjected to ground motion is common problem for construction. Vibrations caused by earthquakes have led to collapse of structure and loss of precious human life and property. Recently dampers have become very popular for vibration control of structures because of their effective and economical design. They concluded that Energy dissipation devices(dampers) helps in reducing the vibration of the structure as compared to normal structure without dampers. The FVDs are capable of reducing both forces and displacements of the structure under seismic loads.

[3] M. S. Landge, Prof. P. K. Joshi.

Their work is concerned with the comparison of the seismic evaluation of RC buildings connected with and without viscous damper. Response spectrum method is used to analyse seismic behavior of G+7 storey building with and without viscous damper. Results of these analyses were discussed in terms of various parameters such as maximum absolute displacement, absolute acceleration, absolute velocity, storey shear, storey drift. The comparisons of these various parameters were done. From these comparison it was concluded that maximum absolute displacement, absolute acceleration, storey shear, storey drift values are more in case of RC building without damper as compared to RC building with damper.

[4] S S Sanghai and P Y Pawade,

Inthis paper deals with effect of position and number of friction dampers on response of 2D frame. To fulfill this objective, two bay & five storey 2D frame is analyzed using software SAP2000. The study was carried out using two, three and four number of friction dampers with different locations keeping slip load & stiffness constant. As the behavior of friction damper is elasto-plastic, the Non-Linear Time History Analysis of all the frames is done using El Centro ground motion record. To study the effect of number and position, percentage energy dissipated in accordance with energy induced in the frame, fundamental time period, base shear, joint displacement and member forces were considered. The results showed that number and placement of damper influences significantly the structural response. A large number of dampers do not always leads to best benefit in terms of energy dissipation. It was found that the location of damper which tuned the building with respect to input acceleration dissipates maximum percentage of input energy.

[5] Mohammad Abdul Hafeez, Mohd Wasee Ahmed, Syed farrukh Anwar

Extensive use of friction joints in new and retrofitted buildings has demonstrated the economic advantages of this form of device to control the amplitude of building motion due to seismic action. Here the paper addresses in particular the use of friction devices in conjunction with rigid structural frames, either steel or concrete, for which three stages of performance are identified. Elastic overall behaviour under wind loads, slipping joints with an elastic frame when acted on by the design earthquake, and slipping joints with a yielding frame under the action of the extreme earthquake that the building is capable of resisting. In the second stage, primary structural damage is avoided while secondary damage is minimized. In the third stage the energy dissipating capability of yielding members is added to that of the friction joints. Structures for which friction dampers are suitable and the choice of the slip loads and damper locations are discussed together with the quality control required for the manufactured device. The structural analysis of the high rise building of G+25 , was analyzed by using response spectrum analysis under the influence of X shaped friction damper and without dampers was compared and results are figured out like story drifts, story shear , story torsion, story displacements, etc with help of the commercial software ETABS.

[6] S. Lakshmi Shireen Banu, Kothakonda Ramesh

This paper deals with a 10 storey RCC building with square and rectangular columns with the square and rectangular shape of the structure was analyzed with and without friction damper in ETABS 2016. Four different cases of buildings with and without friction damper were been analyzed in ETABS 2016. The study performs response spectrum analysis and nonlinear time history analysis on these buildings. The time history data of Bhuj earthquake is used in the analysis. In this study the effectiveness of friction damper in reducing the responses of a structure is evaluated. The responses of the structure in terms of pseudo spectral acceleration, pseudo spectral velocity and spectral displacement have been compared with and without friction damper.

[7] Laxmikant Vairagade & Swapnil Bokade et al,

In this paper Industrial Steel truss Building of 14m x 31.50m, 20m x 50m,28m x 70m and bay spacing of 5.25m, 6.25m and 7m respectively having column height of 6m is compared with Pre-engineering Buildings of same dimension. Design is based on IS 800-2007 (LSM) Load considered in modeling are Dead load, Live Load, Wind load along with the combinations as specified in IS. Analysis results are observed for column base as hinge base. Results of Industrial steel truss buildings are compared with the same dimensions of Pre-Engineering Building

[8] Shameena Khannavar, M.H.Kolhar, Anjum Algur.

In this study they have modelled a 10-story structure which is symmetrical in plan were analyzed using the ETABs 2015 software. The earthquake loads are defined as per IS1893-2002 (Part 1). To analyze the structure, the static and dynamic analysis method were adopted. The response spectrum function were defined to carry out dynamic analysis. To control the seismic response and to increase the stiffness of the structure,

Friction dampers were provided to the structure. The results were obtained and compared in the form of displacement, story drift and story shear are compared.

[9]Madhukaran, Dr.H.Eramma, Sandeepkumar.D.S, Raghavendra.M.R

In this study they modelled symmetric and asymmetric buildings such as H-shape, L-shape, Long slender shape, Rectangular shape and T-shape buildings for G+5, G+10 and G+15 stories with and without friction dampers using ETABS 9.7 non-linear version software. Friction dampers act like fuses in the building. Just like fuses protect electrical circuit Friction dampers protect building by reducing the earthquake load on the buildings. In this study they observed that time period, lateral displacement and story drift get reduced but the story shear get increased by the use of friction dampers in the building.

[10] Mohd. Atif, Laxmikant Vairagade, Vikrant Nair et al

In this research work focuses on comparison of seismic analysis of G+15 building stiffened with bracings and shear wall. The performance of the building is analyzed in Zone II, Zone III, Zone IV, Zone V. The study includes understanding the main consideration factor that leads the structure to perform poorly during earthquake in order to achieve their appropriate behavior under future earthquakes. The analyzed structure is symmetrical, G+15, Ordinary RC moment-resting frame (OMRF). Modelling of the structure is done as per staad pro. V8i software. Time period of the structure in both the direction is retrieve from the software and as per IS 1893(part 1):2002 seismic analysis has undergone. The Lateral seismic forces of RC frame is carried out using linear static method as per IS 1893(part 1) : 2002 for different earthquake zones. The scope of present work is to understand that the structures need to have suitable Earthquake resisting features to safely resist large lateral forces that are imposed on them during Earthquake. Shear walls are efficient, both in terms of construction cost and effectiveness in minimizing Earthquake damage in structure. Also the braced frames can absorb great degree of energy exerted by earthquake.. The results of the performance and the analysis of the models are then graphically represented and also in tabular form and is compared for determining the best performance of building against lateral stiffness by arrangement of three different types of bracings with three different orientation of bracings and shear wall. A comparative analysis is done in terms of Base shear, Displacement, Axial load, Moments in Y and Z direction in columns and shear forces, maximum bending moments, max Torsion in beams.

[11] Vikas Patil G P, Dr. H Eramma, Madhukaran

Method carried out by them are in terms of equivalent static, response spectrum and pushover analysis according to IS 1893:2002(part l) code. G+10 storey buildings respectively are considered for the analysis. For the analysis for friction damper buildings, they connected dampers at corners of all the buildings. The comparison of equivalent static method, response spectrum and pushover analysis method by using finite element software package ETABS is used to perform the modelling and analysis of G+10 storey buildings by considering the seismic zone IV as per IS 1893:2002(part 1) code. For analysis various IS codes have been referred. For Gravity load combination IS 456:2000 and for 0.9, 1.2 and 1.5 seismic load combinations as per IS 1893:2002 (part 1) code is referred. In this study building model analysis carried out namely gravity, equivalent static, response spectrum and pushover analysis in longitudinal direction & transverse. Results of these analyses were discussed in terms of the storey displacement, storey drift and base shear. From these results it can be concluded that storey displacement and storey drift will be more in regular buildings compare with the friction damper buildings, whereas the base shear will be less in regular buildings compare with the friction damper buildings.

III. Conclusion

From the above literature analysis it is found that:

i. These comparison it was concluded that maximum absolute displacement, absolute acceleration, storey shear, storey drift values are more in case of RC building without damper as compared to RC building with damper.
ii. Numbers and placement of damper influences significantly the structural response.
iii. Time period and story drift get reduced but the story shear get increased by the use of friction dampers in the building.
iv. Dampers to the structure there is reduction of about 60% to 80% in drift value at top and bottom stories.
v. Base shear will be less in regular buildings compare with the friction damper buildings.
vi. Story displacements and inter story drifts are minimized most effectively by placing the friction damper along the corner atall stories.
vii. When damper are provided the story shear has been decrease linearly as height of the story increases compared to bare frame.

viii. Displacement value of the structure is reduced about 70% to 75% when dampers are appliedto the structure.
ix. The performance of friction damper devices
x. is much better for the tall buildings with slender design.

References

[1]. Laxmikant Vairagade, Vivek Thakre," Analysis and Cost Comparative study of Conventional Industrial building with PEB structure", *Journal of Information, Knowledge And Research In Civil Engineering* Issn 0975 – 6744 , Impact Factor: Gif: 00.9487 , Sif: 03.495.

[2]. Sabih Ahmed, Shoeb Ahmad Khan, "Seismic Performance of Energy Dissipation Devices", *International Journal of Engineering Research & Technology*, Vol. 7 Issue 04, April-2018, pp. 260-262.

[3]. M. S. Landge, Prof. P. K. Joshi, "Seismic Performance Evaluation of RC Building Connected with and without Viscous Damper", *International Journal for Research in Applied Science & Engineering Technology*, Volume 5 Issue III, March 2017, pp. 750-758.

[4]. S S Sanghai and P Y Pawade, "Effect of Position and Number of Friction Dampers on Seismic Response of Frame", *International Journal of Earth Sciences and Engineering*, Vol. 07, No. 05, October, 2014, pp. 1854-1859.

[5]. Mohammad Abdul Hafeez, Mohd Wasee Ahmed, Syed farrukh Anwar, "Seismic Performance Evaluation of RC Building Connected With and Without X-Braced Friction Dampers", *International Journal of Management, Technology And Engineering*, Volume 8, Issue XI, NOVEMBER 2018, pp. 1128-1134.

[6]. S. Lakshmi Shireen Banu, Kothakonda Ramesh, "Seismic Response Study and Evaluation of Vibration Control of Elevated RCC Structure using Friction Damper", *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, Volume-8 Issue-7, May, 2019, pp. 2470-2474.

[7]. Laxmikant Vairagade & Swapnil Bokade,"Design of Various Types of Industrial Buildings and Their Comparison" *International Refereed Journal of Engineering and Science (IRJES)* ISSN (Online) 2319-183X, (Print) 2319-1821 Volume 6, Issue 3 (March 2017), PP.55-71

[8]. Shameena Khannavar, M.H.Kolhar, Anjum Algur, "Seismic Analysis of RC Structures Using Friction Dampers", *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, Volume 5 Issue XII December 2017, pp. 401-410.

[9]. Madhukaran, Dr.H.Eramma, Sandeepkumar.D.S, Raghavendra.M.R, "Seismic assessment of multistory symmetric and asymmetric buildings with and without friction dampers", *International Journal of Science, Engineering and Technology Research*, Volume 6, Issue 12, December 2017, pp. 1555-1561.

[10]. Mohd. Atif, Laxmikant Vairagade, Vikrant Nair, "comparative study on seismic analysis of multistory building stiffened with bracing and shear wall" *International Research Journal of Engineering and Technology(IRJET)* e-ISSN: 2395-0056 Volume: 02 Issue: 05 | Aug-2015 www.irjet.net p-ISSN: 2395-0072.

[11]. Vikas Patil G P, Dr. H Eramma, Madhukaran, "Seismic Evaluation of RC Building Connected with and without Braced Friction Dampers", *International Research Journal of Engineering and Technology*, Volume: 05 Issue: 10 | Oct 2018, pp. 1470-1475.