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Study on RC Building with Friction Pendulum Base Isolation System – A Review

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Abstract*: Buildings are very important after the natural hazards such as earthquake. Introducing base isolation techniques to improve the performance of buildings. Friction pendulum or Friction bearing is one of the best base isolation techniques .The main aim of these papers investigates the seismic response of multi story buildings with friction pendulum base isolation. FPS with different radius and co-efficient of friction are included in each papers. There different past recorded earthquake are used for time history analysis and SAP 2000 software is used for modeling and analysis.
Keywords*: Base isolation, Friction pendulum, Earthquake, Non Linear Dynamic Analysis, Time History Analysis, Friction Co-efficient

I. INTRODUCTION

The past decades buildings are damaged and collapsed during earthquake. Now a day it can be reduced by providing friction pendulum base isolation on building foundation. FPS best method to reduce the effect of ground motions and use of FPS will give the safety of building and economical in midrise buildings. FPS given the flexible interface provide between the foundation and super structure.

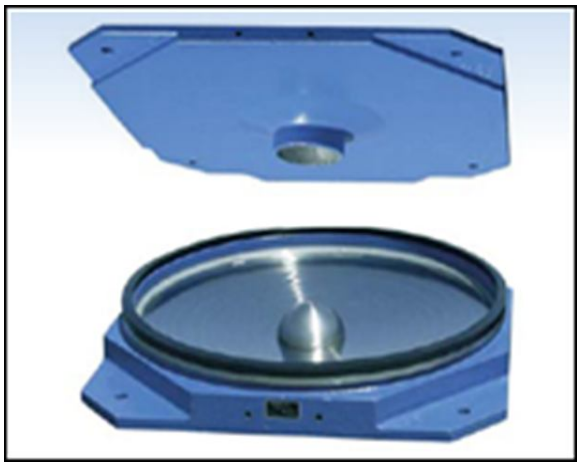


Fig 1: friction pendulum isolation

It is use the characteristics of a pendulum to lengthen the natural period of the isolated structure so as to avoid the strongest earthquake forces. During an earthquake, the supported structure moves with small pendulum motions. Since earthquake induced displacement occur primarily in the bearings, lateral loads and shaking movements transmitted to the structure are generally reduced.

II. ANALYSIS

Seismic analysis is a subset of structural analysis and is the calculation of the response of a building structure subjected to earthquakes. It is part of the process of structural design, earthquake engineering or structural assessment, retrofit in regions where earthquakes are prevalent and the vulnerability of structures. FEMA 356(ASCE 2000) outlines four different analysis procedures for a performance-based evaluation of a structure: 1. Linear static procedure 2.Linear dynamic procedure 3.Non-linear static procedure (Push-over analysis) 4 Non-linear dynamic procedure (Time history analysis).

III. LITERATURE REVIEW

Various literatures reviewed on friction pendulum isolations are carried out below

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A. Fabio Mazza, Mirko Mazza (2016).This paper study to conduct the non-linear analysis of irregular r c building with friction pendulum base isolation system under near fault excitations. In this structure subjected to near fault earthquake induced the variation of friction force and lateral stiffness of the friction pendulum system. Near fault earthquake is the main reason of torsional effect with residual displacement and uplift in the base isolated building. To investigate this effect a non-linear analysis carried out considering an r c building. A six-story r c building with L-shaped plan with wings of different length and setbacks at different height are provided. Three radius of curvature of friction pendulum system and two frictions co-efficient are taken for the friction pendulum bearings. These paper 12 base isolators are used for this study. Two series of analysis are carried out on the selected earthquake and find out the residual displacement and torsional effect of the building under the different earthquake.

B. Ashish R. Akhara, Tejas R. Wankhade (2014). This paper investigates the seismic performance of the r c structure with different base isolators. The main aim of this study to compare the various parameters of friction pendulum system (FPS), high density rubber bearing (HDRB) and fixed base system. SAP2000 software is used for this study and G+12 storey hospital building used as test model and Elcentro earthquake used for non-linear time history analysis. The result obtained shows the reduction in base shear and increase the displacement and time period in both directions for the base isolated structure.

C. Gianluca Grazi, Luca Landi (2015). This research study on seismic response of the multi-story building with different models of friction pendulum system subjected to horizontal and vertical earthquake motions. Time history analysis is carried out by taking different past recorded earthquakes. The results are given by compare the different models of friction pendulum system and to study the effect of the vertical seismic response of the isolators.

D. John W. Van de Lindt, Yumei Jiang (2014). Base isolation is mostly used in concrete structures; In Japan wood frame buildings with base isolations are used. In this paper study on seismic response of wood frame with friction pendulum system using non-linear time history analysis. Six story wood frame buildings are analysed and six models are taken for analysis to develop the design equation. This paper focuses on to develop a regressive equation to select the bearing radius of the friction pendulum system.

E. R.S Jangid (2004). In this paper aim to investigate the analytical modelling of multi-story building with friction pendulum system. In this case six recorded near fault motion is taken for the analysis and to study the variation of acceleration and bearing displacement of the top floor in the isolated building. Find out the parameters such as super structure flexibility, isolation period and friction co-efficient of the isolated building. The range of friction co-efficient 0.05-0.15 under near fault motions will found out. Decrease in the value of friction co-efficient will develop significant displacement in the FPS under near fault motion. The increase in the value of friction co-efficient will reduce the bearing displacement.

F. G.V. Sowjanya, Vindhya Bhagavan (2008). The main use of base isolators is decoupling the base from superstructure during ground motion. In this paper assume a three model of G+4 story building. First model is base frame, second model is infill structure and third model indicate the friction pendulum base isolation. These models are modelled by ETABS and objective of this study to compare the story drift and lateral displacement of these 3 models. After the study the base isolated structure minimizes the story drift and lateral load effects. According to IS 1893-2002 the value of story drift with in the permissible limit .04 times of height of story. Use of base isolation is the best retrofitting techniques.

G. D.K. Paul, Nitish Takalkar (2012). Base isolation provides a flexible interface between the foundation and superstructure of the building and a decoupling the superstructure and foundation during ground motion. Use of friction pendulum is the best method to study the seismic response of multi-story building. In this paper study the modelling and analysis of multi-story building with FPS subjected to earthquake force. In this study indicate the safety of building with the use of FPS. FPS is suitable and economical in medium rise building. Time history analysis is carried out by using different past recorded earthquake. The value of bearing displacement and roof acceleration of isolated building is depending upon the per cent damping. The result of this study, the time period is increase with the use of FPS and it will reduce response of the structure subjected to ground motion.

H. Lyan Ywan LU, Shiang Yu Juang, (2013). In this study conduct the Comparison of the three base isolation, such as structural base isolation, equipment isolation and floor isolation. Find out floor isolation is the best isolation .Polynomial friction

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pendulum isolators are used for floor isolation system and it consist of variable stiffness sliding isolators. In this paper to investigate the PFPIS for building floor isolation experimentally and numerically. Use of PFPIS achieves multiple design or dual performance objective. In this case two level seismic loads are applied to determine the parameter of PFPIS. Design a prototype PFPIS and conduct an experimental test by using shaking table test. Two shaking table test are conducted, first is design to test the hysteretic property and second is actual seismic load is applied to the PFPIS. Ten ground motions at different intensity are applied for test.

I. Eurocode8 (2004). Part1 In seismic action a set of at least three ground motion records should be used. Properties of isolators are depends on the rate of loading, magnitude of the simultaneous vertical load, magnitude of the simultaneous horizontal load in the transvers direction, temperature, change of properties over projected service life.

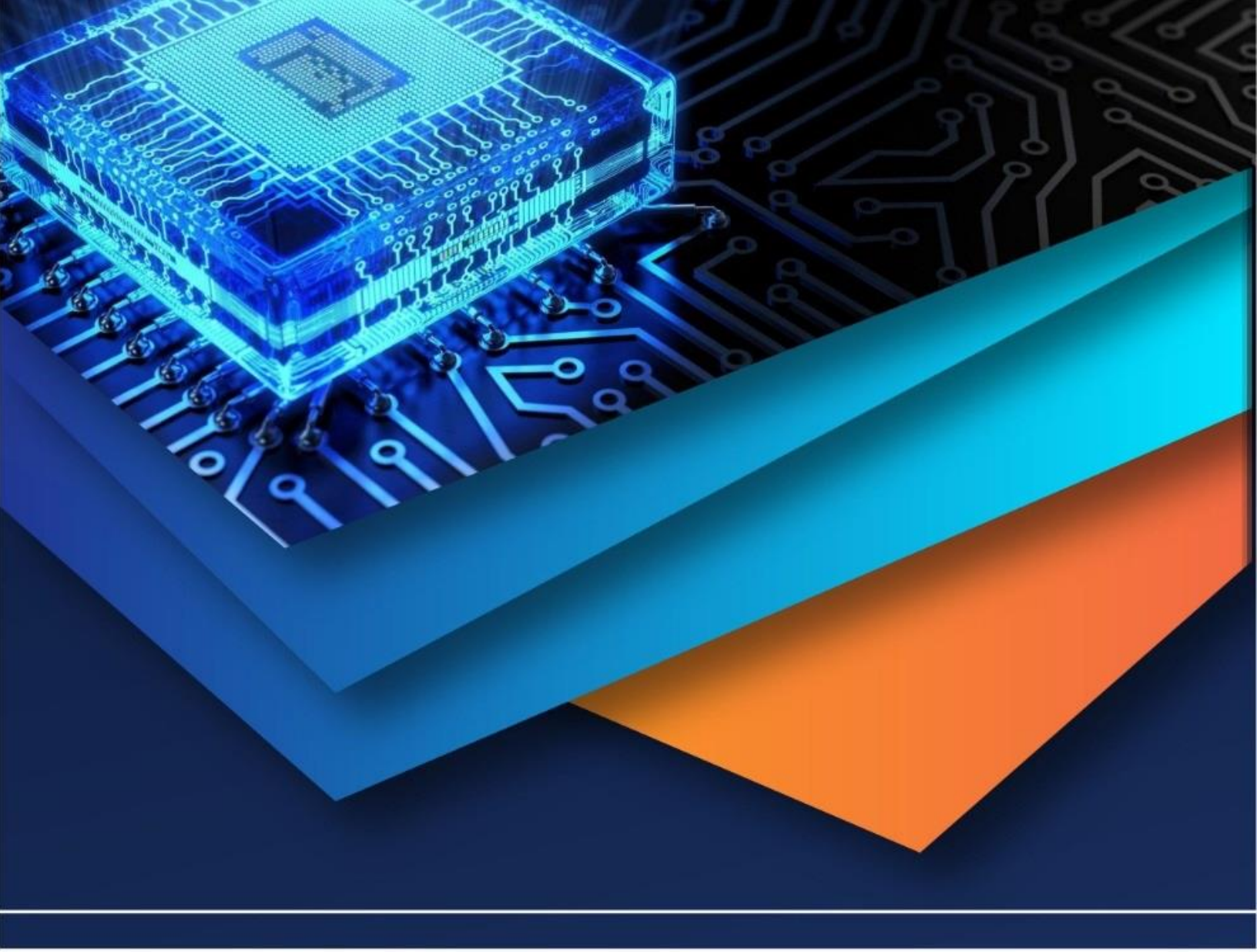
IV. CONCLUSIONS

Study of various literature paper the friction pendulum isolation is the best retrofitting techniques to reduce the strongest ground motions. Friction pendulum base isolation is decoupling the base and superstructure of the building. Use of FPS is to increase the time period and reduce the building response subjected to strongest earthquake. Compare to fixed base system 30% earthquake demand will reduce the FPS and it will also minimize the need of strengthening meshes like bracings, frames, and shear wall. FPS modelled by link element. Friction pendulum system is suitable for medium rise building and use of FPS in increase the safety of building and peoples.

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