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SEISMIC BEHAVIOR OF IRREGULAR BUILDING

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Abstract: Seismic building analysis is now a day's one of the research interest, because earthquake causes lots of damage and losses too with respect to life, loss or damage of structures, with loss of economy. So it is necessary to determine seismic response of such buildings. Simply, time history analysis is one of the most important techniques for the seismic analysis of structure. Presence of irregularities is to be considered as a major deficiency in the seismic behaviour of the structures.

Keywords: Dampers, Earthquake, Irregularity, Storey drift, Frame building



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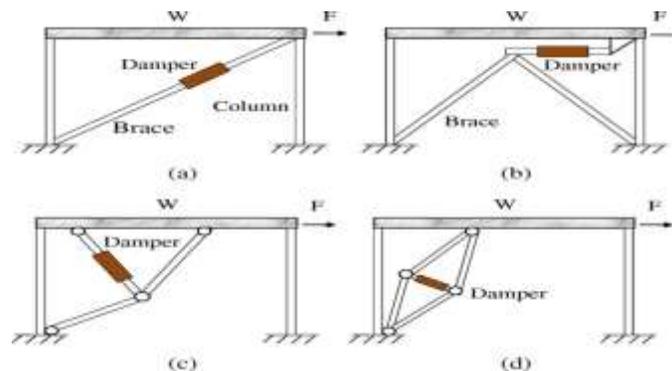
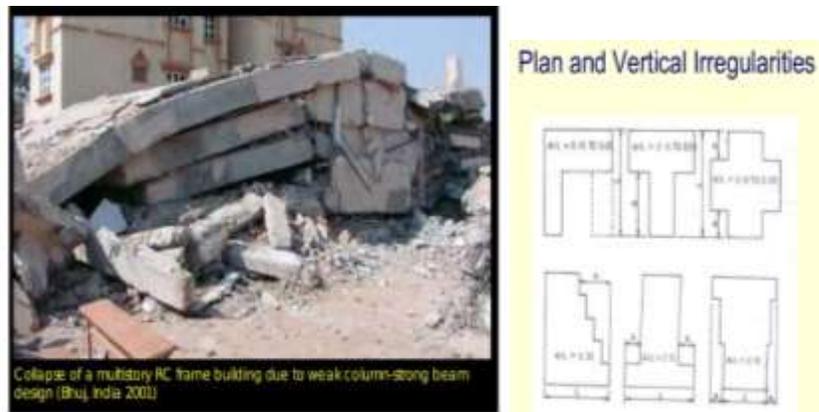
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INTRODUCTION

Introduction to Seismic Behavior of Irregular Building:

Seismic building analysis is one of the research interests now a days, it is because earthquake causes lots of damage and losses with respect to life, loss or damage of structures, loss of economy or finance. It is desired to study seismic response with real time history to prevent seismic effect by designing structure to withstand against earthquake. To dates irregular shape of building is being mostly designed by the architects; which offers more beauties. This irregularity may be plan or vertical. Plan or vertical irregularity makes structures vulnerable under seismic loading. Torsional irregularity, overturning moment can rise abruptly having irregularity in a structure. Hence, effect of irregularity is a very important issue to be considered during building design. (Effect of Plan Irregularity on RC Buildings, January 2016).



LITERATURE REVIEW

- **Effect of Plan Irregularity on RC Buildings, M.Z Habib, M.A Alam, S. Barua, M.M Islam, Volume 7, Issue 1, January 2016.**

The current study discusses the performance evaluation of RC (Reinforced Concrete) Buildings with plan irregularity. Structural irregularities are important factors which decrease the seismic performance of the structures. The parameters whose effects are regulated such as: Lateral displacement, Storey Drift, Time period, Base Shear, Torsional Irregularity Ratio, Overturning Moment. Eventually it is revealed that, the rectangular shaped building undergo maximum lateral displacement as well as drift in both direction. No change in time period is observed due to change in building plan. Base shear and overturning moment is found maximum for T-shaped building. It has been studied that rectangular shaped building is torsional irregular.

- **Study of an Irregular Plan with Different Orientation of Shear Wall in a High Rise Structure, Shivanand C. Ghule and Sudeep H.C, The International Journal of Science and Techno ledge, Volume 3, Issue 5, May 2015(ISSN 2321 – 919X).**

Presence of irregularities is considered as a major deficiency in the seismic behavior of structures. Introduction of bracings and stiff shear walls are the popular methods of strengthening the buildings against their poor seismic performance. The usefulness of shear walls in the structural planning of multi-storey buildings has long been recognized. When walls are situated in advantageous positions in a building, they can be very efficient in resisting lateral loads originating from wind or earthquakes. In this work dynamic analysis of an irregular plan with different orientation of shear wall location in the plan is carried out using ETAB software. Also attempt made to study behavior of structure with openings in shear wall.

- **Seismic Analysis of a High-rise RC Framed Building with Irregularities, Kusuma B, International Research Journal of Engineering and Technology. ISSN2395-0072, Volume 04, Issue 07, July (2017).**

Seismic analysis is carried out using response spectrum method for both symmetrical and unsymmetrical building. The extensive literature survey is carried out by referring to the

technical journal papers, books, articles, etc to familiarize with fundamental concept of the topic. The need for research is identified and the procedure to carry out the analysis is formulated. The data required for the input is collected from IS code 1893 (Part I):2002. Then the analytical work is carried out as per the procedure formulated and the results are obtained and varied conclusions are arrived at. The major part of the study includes the comparison of values of set of response parameters such as, mode period, storey lateral displacement, storey drift, base shear and the storey stiffness.

- **Seismic Analysis of Multistoried RCC Building due to Mass Irregularity by Time History Analysis, Mya Mya Aye, P.Narasimharao JETIR(ISSN 2349-5162), Volume 4, Issue 12, December 2017.**

In this seismic analysis of multistoried building with mass irregularity at different floor level are carried out. Here a G+12 stories building with mass irregularity has been modeled for seismic analysis. In this thesis design of structure for this building is carried out by using ETABS software and computer-aided analysis. One regular building and three irregular buildings are compared. They have same plan size but mass irregularity is considered at 6th floor, 8th floor and 10th floor of the building. The stability checking such as storey drift, overturning moment and sliding are also checked in the building with static analysis and also with dynamic analysis (time history analysis). And then, after the models with and without change of mass and inter-storeyed height are being analyzed, structural response (storey drift, storey shear and storey moment) and member forces are compared.

- **Seismic Analysis of Multistoried RC Building due to Mass Irregularity by Time History Analysis, Sampoth Nagod, Prof. A.J. Zende 2.5, International Research Journal of Engineering and Technology (IRJET), ISSN 2395-0072, Volume:04, Issue: 08, Aug-2017.**

Seismic analysis of the structure is done to determine seismic responses by time history analysis which is one of the important techniques for structural seismic analysis especially when the evaluated structural response is non-linear in nature. To perform such an analysis, a representative earthquake time history is required for the structure being evaluated. In this present work non-linear dynamic analysis of 12 storied RC building having mass irregularity

considering Bhuj earthquake time history is carried out using ETABS software. Then, Lead Rubber Bearing is manually designed and isolator properties are assigned to the building. Various parameters like Base shear; Time period and Storey displacement are determined for regular and mass irregular buildings with fixed base and base isolated condition and compared with each other.

- **Time History Analysis of Multistoried RCC Buildings for Different Seismic Intensities, A.S. Patil and P.D. Kumbhar International Journal of Structural and Civil Engineering Research (ISSN 2319-6009), Volume 2, No 3, August 2013.**

In the present paper study of nonlinear dynamic analysis of ten storied RCC building considering different seismic intensities is carried out and seismic responses of such building are studied. The building under consideration is modeled with the help of SAP2000-15 software. Five different time histories have been used considering seismic intensities V, VI, VII, VIII, IX and X on Modified Mercalli's Intensity scale (MMI) for establishment of relationship between seismic intensities and seismic responses. The results of the study shows similar variations pattern in Seismic responses such as base shear and storey displacements with intensities V to X. From the study it is recommended that analysis of multistoried RCC building using Time History method becomes necessary to ensure safety against earthquake force.

- **The Effectiveness of Viscous Dampers for Structures Subjected to Large Earthquakes, H. Kit Miyamoto and Amir SJ Gilani, Akira Wada, 15 WCEE, Lisboa 2012.**

The efficacy of dampers in providing seismic protection has been validated by the excellent performance of buildings fitted with dampers in the past earthquakes. However, previous studies have not accounted for the limit states of dampers. Recently, a multi-year research project was completed that investigated the seismic performance of building with dampers subject to large earthquakes. It was shown that the limit states of viscous dampers have a significant effect on the response of the building. Experimental data from laboratory tests of viscous dampers were used to calibrate a model of viscous dampers with limit states. Next,

analytical model of steel buildings with viscous dampers, incorporating damper limit states, were prepared and analyzed to determine their collapse performance. Analysis showed excellent performance and revealed that, the use of factors of safety to delay the onset of reaching limit states was beneficial.

➤ **Viscous Dampers for High Rise Buildings, Samuele Infanti, Jamieson Robinson, Rob Smith, October 2008.**

Viscous dampers (VD), when used in high-rise buildings in seismic areas, should reduce the vibrations induced by both strong winds and earthquakes. The optimal behavior in these two situations is not usually the same, thus the design requirement for VD is often that they should have two different behaviors in the different range of velocities corresponding to wind and earthquake. Recently VD has been applied in three high-rise buildings in Asia, the Taipei 101 in Taipei, Taiwan, and the twin St. Francis Shangri-La Towers in Manila, Philippines. Taipei 101 has been the world's tallest building since 2004 (508m). In this building 8 VD are used to control the motion of the Tuned Mass Damper (TMD) installed at its top. Said TMD has already been put into operation by earthquakes in March 2005 and May 2008 and by many strong typhoons. The St Francis Shangri-La Place is a residential development composed by two towers, each rising to 213m. In this case, 32 VD are installed into the towers structure according to an Arup newly developed and patented configuration. This paper describes the technology of VD installed in said high-rise buildings, and the results of the wide laboratory testing campaign aimed at verifying their behavior during both wind storms and earthquake.

➤ **Study on the Effect of Viscous Damper for RCC frame structure, Puneeth Sajjan, Praveen Biradar. Volume: 05, Issue: 09, Sep-2016.**

In modern seismic design, damping devices are used to reduce the seismic energy and enable the control of the structural response of the structure to that earthquake excitation. For the present study, an 8-story structure which is symmetrical in plan is modeled and 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 is adopted. The response

spectrum function is defined to carry out dynamic analysis. To control the seismic response and to increase the stiffness of the structure, viscous damper are provided to the structure. The structure with viscous damper is modeled and analyzed with same parameters. The mechanical properties of viscous damper used in this study are as damping coefficient $C_d = 810 \text{ kN-s/m}$ and exponent as 0.3. The results obtained and compared in the form of displacement, story drift and story shear are compared.

➤ **Seismic Performance Evaluation of Fluid Viscous Dampers, SaiChethan K., Srinivas K.S. , Ranjitha K.P, Volume: 06, Issue: 06, June 2017.**

In the present study, the effectiveness of fluid viscous dampers in reducing the responses of a structure under seismic excitations is evaluated analytically using non-linear time history analysis. A twenty story reinforced concrete structure with square plan is considered in this study. Acceleration time histories of Indian seismic zone IV and zone V are used for the analysis. The analysis is carried out using the computer package ETABS 2015. The analysis results confirmed that a significant reduction in the responses such as displacements and other forces is possible with the introduction of fluid viscous dampers and hence it can be used as an alternative to the conventional ductility based design method of earthquake resistant structures.

CONCLUSION

After reviewing the papers we find that by using dampers the structures can resist more loads of the earthquake waves and the structure gains more strength.

REFERENCES

1. Effect of Plan Irregularity on RC Buildings. M.Z Habib, M.A Alam, S. Barua, M.M Islam Volume 7, Issue 1, January 2016.
2. Study of an Irregular Plan with Different Orientation of Shear Wall in a High Rise Structure. Shivanand C. Ghule and Sudeep H. C. The International Journal of Science and Technology, Volume 3, Issue 5, May 2015.

3. Seismic Analysis of Vertical Irregular Building with Time History Analysis. Piyush Mandloi, Prof. Rajesh Chaturvedi, Volume 14, Issue 4 VER III (July – Aug. 2017).
4. Seismic Analysis of a High-rise RC Framed Building with Irregularities. Kusuma B. International Research Journal of Engineering and Technology. July (2017).
5. Seismic Analysis of Vertical Irregular Building with Time History Analysis. Piyush Mandloi, Prof. Rajesh Chaturvedi, Volume 14, Issue 4 VER III (July – Aug. 2017) p-ISSN: 2320-334X.
6. Seismic Analysis of Multistoried RC Building due to Mass Irregularity by Time History Analysis Sampoth Nagod, Prof. A.J. Zende International Research Journal of Engineering and Technology (IRJET), Volume: 04, Issue: 08, Aug-2017.
7. Time History Analysis of Multistoried RCC Buildings for Different Seismic Intensities. A.S. Patil and P.D. Kumbhar, International Journal of Structural and Civil Engineering Research (ISSN 2319-6009), Volume 2, No 3, August 2013.
8. The Effectiveness of Viscous Dampers for Structures Subjected to Large Earthquakes. H. Kit Miyamoto and Amir SJ Gilani, Akira Wada,15 WCEE, Lisboa 2012
9. Viscous Dampers for High Rise Buildings, Samuele Infanti, Jamieson Robinson, Rob Smith October 2008
10. Study on the Effect of Viscous Damper for RCC frame structure. Puneeth Sajjan, Praveen Biradar, Volume: 05, Issue: 09, Sep-2016
11. Seismic Performance Evaluation of Fluid Viscous Dampers. Sai Chethan K., Srinivas K.S., Ranjitha K.P, Volume: 06, Issue: 06, June 2017.