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An Overview on Seismic Analysis of Multistoried Building using Equivalent Static Load Method & Response Spectrum Method: A Literature Survey.

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Abstract: **-- Performance based seismic design in the context of prediction of inelastic seismic responses and seismic performances of a building structure is very important topic to be a concern. Various forces act on a building but earthquake force is one of the most critical force and must be considered while analysis and design of the multi-storeyed building, as per, IS: 1893-2016 recommendations. Various software nowadays are available for analysis and designing of a building by considering the earthquake forces and to review or study the behaviour of multi-storeyed buildings by equivalent static lateral force method and response spectrum method and literature reviews of various papers considering this method are studied. Alternative survey of the research paper is done and it is observed that the response spectrum method is used for analysis of multi-storeyed building and incorporated in most of the course related to earthquake analysis of the building. The equivalent static load method is used often for regular buildings.**

.*Key Words*: - Multi-storey building, seismic analysis, response spectrum method, equivalent static lateral force method, STAAD –PRO,ETABS.

I. INTRODUCTION

Now a day many mulit-storeys building in cities are in the high demand because of limited land available in country specially in cities. When earthquake occur, a building undergoes dynamic motion. These are because the building is subjected to inertia forces that act in opposite direction to the acceleration of earthquake excitation. An earthquake is a phenomena in which earth surface shakes due to the release of seismic energy from large blocks of the crust along a fault. These fault are cracks in the crust. The point under crust where the processes of earthquake begins, it is a source of earthquake and it is termed as focus. The main objective of this paper is to study the seismic behaviour of the building against the earthquake. Also analysis of structure by Equivalent static analysis and response spectrum method. Seismic loading requires an understanding of the structural performance under large inelastic deformations. Building and other structure are composed of horizontal and vertical structural elements that resist the lateral forces. The structure must include complete lateral and vertical force resisting systems, capable of providing adequate stiffness within permissible limits, deformation and strength demands.

Methodology:

The basic methodology followed during the course of the study are as follows. If the structure was not properly designed and constructed with required quantity they may cause large destruction of structures due to earthquakes. The most commonly used methods of analysis for determining the seismic forces acting on the structure are equivalent static method and response spectrum method etc. Such analysis can be carried out by static analysis and dynamic analysis.

Equivalent Static Method:

It is an analysis of the dynamic response of the structure. It is also known as nonlinear dynamic analysis. All designs against seismic loads must consider the dynamic nature of the load. For simple regular structures, analysis Equivalent Static Method is often sufficient. This is permitted in IS 1893¬-2016 for regular, low to medium rise buildings. Equivalent Static Method can therefore work well for low to medium-rise buildings without significant coupled lateral-torsional modes, in which only one mode in each direction is considered. High rise building over 75m, or building with torsional effect ,where the second and higher mode is important are nor suitable for this method, require more complex method to be used in this situations

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Response Spectrum Method:

The representation of the maximum response of idealized single degree of freedom (SDOF) having certain period and damping during earthquake ground motion. It is also known as linear dynamic analysis. This method is an elastic dynamic analysis on the assumptions that dynamic response of the structure may be found by considering the independent response of natural mode of vibration and then combining the response of each in same way. In this, peak response of the structure during an earthquake is obtained directly from earthquake response. The peak response is then combine to estimate a total response.

The values of total response plotted against un-damped natural period and for various damped values can be expressed in terms of maximum absolute acceleration, maximum relative velocity or relative displacement. For this purpose, Response Spectrum Method have been performed according to IS 1893-2016.

II. LITERATURE REVIEW:

Seismic behavior of a 10 storey frame with external shear wall as lateral load resisting system by S V Venkatest , H Sharada Bai, Ramya, they observed that between the two seismic methods of analysis considered, namely Equivalent Static Lateral Force Method" and "Response Spectrum Method", not much difference in the results obtained are observed. The range of difference is generally about 2% in most of the parameters and maximum about 20%. Comparative Study of Static and Dynamic Seismic Analysis of a Multistoried Building under Pushover Analysis by V.B.S.Purna Nath, Dr. Shaik Yajdani they observed that the maximum displacements of building obtained from equivalent static method are higher as compared to response spectrum and response spectrum method gives good hinge formation result. Seismic analysis of RC regular and irregular frame structures by Arvind reddy, R.J.Fernandes they observed that the results obtained from static analysis method show lesser storey displacement values as compared to response spectrum analysis.

Comparative Study of Static and Dynamic Seismic Analysis of Multistoried RCC Building by ETAB: A Review by Gauri G. Kakpure, Ashok R. Mundhada they observed that Static analysis is not sufficient for high rise buildings and it's necessary to provide dynamic analysis and the results of equivalent static analysis are approximately uneconomical because values of displacement are higher than dynamic analysis . Static and Dynamic Seismic Analysis of a Multi Storied Building by Pushover Analysis by Palli Naveen, Dr. Shaik Yajdani they conclude that at lower story structures the structures are safe under the design of Equivalent Static Pushover Earthquake Analysis. The hinge formed in the Response Spectrum Method is more when compared to Equivalent Static Method formed hinges. So it can be concluded that Response Spectrum Method is giving the good hinge formation results

Comparative Study of Equivalent Static Analysis and Response spectrum analysis on Flat Slab Using Etabs by Raghavendra Rao, Dr.M Rame Gowda observed that the drift and displacement result obtained by equivalent static analysis are higher than the results obtained by response spectrum analysis.

Comparative study of seismic analysis of 3 storey RC frame by Akshay Mathane, Saurabh Hete, Tushar Kharabe they observed that the results obtained from static analysis method shows lesser storey displacement values as compared to response spectrum analysis and Equivalent static method is simpler than Response Spectrum method .

Response Analysis of Multi-Storey RC Buildings under Equivalent Static and Dynamic Loads According to Egyptian Code by Sayed Mahmoud, Waleed Abdullah they observed that the dynamic response spectrum analysis produces storey shear in both directions regardless the loading direction while static analysis only produce storey shear in the direction of loading.

Seismic Analysis of Multi Storied Building for SMRF and SMRF with Shear Wall by using Static and Dynamic Methods by Akshay Agrawal , Vinita Gavanang , Shilpa Gaikwad , Shruti Patare , Pravina Mithe, Pallavi Sonavane observed tha static coefficient method is a approximate approach as it take seismic load as static and response spectrum method is more accurate as it consider dynamic nature of seismic load, and static coefficient method is easy to apply as compare to response spectrum method . Comparative study has shown that static coefficient method show linear distribution of base shear whereas response spectrum method shows non linear distribution. Dynamic analysis of multistory building using response spectrum method and seismic coefficient method by Suchi Nag Choudhary , Dr. P.S. Bokare observed that the response spectrum method for both elastic and inelastic can also be calculated by artificial modeling structure under combine quadratic combination. Static coefficient method is used to estimate maximum roof displacement I any inelastic structure and accurate result is obtained when compared to static method using software related to seismic analysis makes analysis more accurate and easy and take less time to find result. Response spectra as a useful design and analysis tool for practicing structural engineering by Sigmund Freeman he observed that response spectrum techniques allow engineer to visual imagine how building will performs during major

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damaging earthquake. However, response spectra, as in any other technique, must be used with caution and a good understating of the process. For single-degree-of-freedom system responding in a linearly elastic manner, response spectrum with sharp peaks and valleys, the variation due to uncertainty in actual structural period of vibration is visually apparent.

Comparative study of the static and dynamic analysis of muli-storey irregular building by Bahador Beghari, Ehsan Salimi Firoozabad, Mohammadreza Yahyaei conclude that displacement obtained by static analysis are higher than the dynamic analysis including response spectrum and time history analysis. Static analysis is not sufficient for high rise building and it is necessary to provide dynamic analysis. For important structure time history analysis is performed as it predicts the structural response more accurately in comparison with equivalent static analysis and response spectrum method.

Seismic analysis of high-rise building by response spectrum method by Prof. S .S. Patil, Miss. Ghadge, Prof. C.G. Konapure, Prof. Mrs. C.A. Ghadge observed that more accurate values of response may be obtained for building by the model analysis method, using modified response spectra for inelastic analysis, building with a short time period tends to suffer higher acceleration but small displacement. Analysis and Design of G+5 residential building with seismic load using STAAD-PRO by Deepmala Pandey, observed that the support reaction in exterior columns and in edge columns increasing in seismic zone II to zone V. However the variations of support reaction are very small in interior columns. Seismic analysis and design of building structure in STAAD PRO by Anoop Singh, Vikas Srivastava, N.N. Harry observed that the fundamental natural period calculated by STAAD PRO matches with that calculated by IS 1893-2002. The maximum beam displacement of 3m span beam is 0.44mm and allowable displacement is 12mm.

Seismic Analysis & design of G+5 residential building by K Aparna Srivastav observed that in earthquake resistance design the steel quantity increased by 1.517 % to conventional concrete design. In this study of G+5 building, seismic load dominates the wind load under seismic zone III. Mahesh N. Patil, Yogesh N Sonawane made a comparison of the earthquake response of symmetric multistoried building studied by manual calculation and with the help of ETABS 2016 software. There is slight variation in the values of base shear in manual analysis as well as software analysis

Khaldoon A.et.al, 2017, compared time history method and response spectrum method and explained that for non linear dynamic analysis response spectrum method is adopted. The paper concluded that various modifications are required under time history analysis and accelerograph.

III. CONCLUSION

Many of studies have been conducted on a topic seismic analysis, from which we studied some of them. So we conclude that, it necessary to analyse the building in various earthquake zones an it is clear that effect of earthquake on structure can be minimize by providing shear wall, base isolation etc.

The results of equivalent static analysis are uneconomical because values of displacement are higher than dynamic analysis. Equivalent static analysis is not sufficient for high rise building there is need to provide response spectrum analysis to ensure the safety against seismic forces.

REFERENCES

1. Arvind reddy, R.J.Fernandes."Seismic analysis of RC regular and irregular frame structures" International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 05 | Aug-2015.

2. Akshay Mathane, Saurabh Hete, Tushar Kharabe."Comparative study of seismic analysis of 3 storey RC frame" ISSN: 2278 – 7798 International Journal of Science, Engineering and Technology Research (IJSETR) Volume 5, Issue 4, April 2016.

3. Akshay Agrawal , Vinita Gavanang , Shilpa Gaikwad , Shruti Patare , Pravina Mithe, Pallavi Sonavan."Seismic Analysis of Multi Storied Building for SMRF and SMRF with Shear Wall by using Static and Dynamic Methods." August 2016 | IJIRT | Volume 3 Issue 3 | ISSN: 2349-6002

4. Bahador Beghari, Ehsan Salimi Firoozabad, Mohammadreza Yahyaei "Comparative study of the static and dynamic analysis of muli-storey irregular building" World Academy of Science, Engineering and Technology International Journal of Civil and Environmental Engineering Vol:6, No:11, 2012 .

5. Anoop Singh, Vikas Srivastava, N.N. Harry."Seismic analysis and design of building structure in STAAD PRO" International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 7, July 2016.

6. Deepmala Pandey "Analysis and Design of G+5 residential building with seismic load using STAAD-PRO".

All Rights Reserved © 2018 IJERMCE

Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-8, 2016 ISSN: 2454-1362.

7. Gauri G. Kakpure, Ashok R. Mundhada. "Comparative Study of Static and Dynamic Seismic Analysis of Multistoried RCC Building by ETAB: A Review" International Journal of Emerging Research in Management &Technology ISSN: 2278-9359 (Volume5, Issue-12) December 2016.

8. K Aparna Srivastav. "Seismic Analysis & design of G+5 residential building" International journal latest trend in engineering and technology" vol 6. Issue 4 march 2016.

9. Khaldoon A.et.al, 2017,"compared time historymethod and response spectrum method" International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 5 Issue III, March 2017 IC Value: 45.98 ISSN: 2321-9653.

10. Mahesh N. Patil, Yogesh N Sonawane."A comparison of the earthquake response of symmetric multistoried building" ISSN: 2277-3754 ISO 9001:2008 Certified International Journal of Engineering and Innovative Technology (IJEIT) Volume 4, Issue 9, March 2015.

11. Palli Naveen, Dr. Shaik Yajdani. "Static and Dynamic Seismic Analysis of a Multi Storied Building by Pushover Analysis" International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 10, October 2016

12. Raghavendra Rao, Dr.M Rame Gowda."Comparative Study of Equivalent Static Analysis and Response spectrum analysis on Flat Slab Using Etabs" International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 08 | Aug -2016.

13. Sayed Mahmoud, Waleed Abdullah " Response Analysis of Multi-Storey RC Buildings under Equivalent Static and Dynamic Loads According to Egyptian Code" International Journal of Civil and Structural Engineering Research ISSN 2348-7607 (Online) Vol. 2, Issue 1, pp: (79-88), Month: April 2014 - September 2014

14. Suchi Nag Choudhary , Dr. P.S. Bokare."Dynamic analysis of multistory building using response spectrum method and seismic coefficient method" International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 5 Issue III, March 2017 IC Value: 45.98 ISSN: 2321-9653.

15. Sigmund Freeman."Response spectra as a useful design and analysis tool for practicing structural engineer" ISET Journal of Earthquake Technology, Paper No. 475, Vol. 44, No. 1, March 2007, pp. 25–37.

16. S .S. Patil, Miss. Ghadge, Prof. C.G. Konapure, Prof. Mrs. C.A. Ghadge ."Seismic analysis of high-rise building by response spectrum method" International Journal Of Computational Engineering Research (Ijceronline.Com) Vol. 3 Issue. 3, Issn2250-3005March2013

17. V Venkatest , H Sharada Bai, Ramya. "Seismic behavior of a 10 storey frame with external shear wall as lateral load resisting system" UKIERI Concrete Congress - Innovations in Concrete Construction.

18. V.B.S.Purna Nath, Dr. Shaik Yajdani."Comparative Study of Static and Dynamic Seismic Analysis of a Multistoried Building under Pushover Analysis" International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 8, August 2016

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