

REVIEW PAPER ON SEISMIC ANALYSIS OF MULTISTORIED RCC BUILDING DUE TO MASS IRREGULARITY

¹Mr. Pathan Irfan Khan, ²Dr. Mrs. N.R.Dhamge

¹PG student, ²Associate Professor
Department Of Civil Engineering
KDK College of Engineering, Nagpur, India

ABSTRACT - Due to fast urbanization construction of a large number of multi-storeyed buildings, many existing RCC buildings located in seismic zones are deficient to withstand earthquakes. In order fulfil the requirement of this increased population in the limited land the height of building becomes medium to high-rise. But during Bhuj earthquake, in Ahmedabad two buildings which were designed as per IS:1893-1984 and were found to be seriously damaged due to mass irregularity as a swimming pool was located at the 10th floor. During an earthquake, failure of structure starts at points of weakness. Generally weakness is due to geometry, mass discontinuity and stiffness of structure. Hence structures fail during earthquakes due to vertical irregularity. Vertical Mass irregularity is an important factor which is to be considered while designing multi-storeyed building. In this project work seismic analysis of RCC buildings with mass irregularity at different floor level are carried out. This paper highlights the effect of mass irregularity on different floor in RCC buildings with as Response Spectrum analysis was performed on regular and various irregular buildings using Staad-Pro.

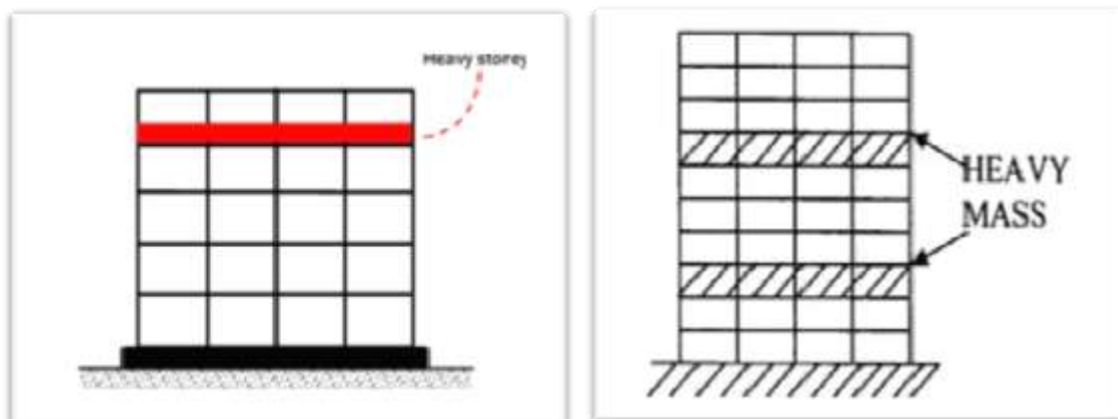
KEYWORDS - Multi-storey building, Seismic Analysis, Vertical Irregularity, Mass Irregularity, Storey drift, Storey Shear, Story Displacement.

INTRODUCTION -

The structures having this discontinuity are termed as Irregular structures. These structures contain a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes. Height-wise changes in stiffness and mass render the dynamic characteristics of these buildings different from the 'regular' building.

Seismic zone map is revised with only four zones instead of five (IS: 1893- 2002). Earthquake causes different shaking intensities at different locations and the damage induced in buildings at these locations is also different. Buildings are designed as per Design Based Earthquake (DBE), but the actual forces acting on the structure is far more than that of DBE. So, in higher seismic zones Ductility based design approach is preferred as ductility of the structure narrows the gap.

The primary objective in designing earthquake resistant structures is to ensure that the building has enough ductility to withstand the earthquake forces, which it will be subjected to during an earthquake. Analyzing the structure for various Indian seismic zones and checking for multiple criteria at each level has become an essential. This paper shows the effect of different seismic zone on the performance of G+10 residential multi-storeyed RC building. The main parameters consider in this study to compare the seismic performance of base shear, storey shear and storey displacement with method of seismic analysis.



. Figure 1: Mass irregularity in structure

As per IS 1893 (Part 1)-2002 (BIS, 2002) –

Types of vertical irregularity have been listed below:

(i) Stiffness Irregularity:

a) Stiffness Irregularity - Soft Storey : A soft storey is one in which the lateral stiffness is less than 70 percent of the storey above or less than 80 percent of the average lateral stiffness of the three storey's above.

b) Stiffness Irregularity - Extreme Soft Storey : An extreme soft storey is one in which the lateral stiffness is less than 60 percent of that in the storey above or less than 70 percent of the average stiffness of the three storey's above.

(ii) Mass Irregularity-Mass irregularity shall be considered to exist where the seismic weight of any storey is more than 200 percent of that of its adjacent storey's. In case of roofs irregularity need not be considered.

(iii) Vertical Geometric Irregularity- A structure is considered to be Vertical geometric irregular when the horizontal dimension of the lateral force resisting system in any storey is more than 150 percent of that in its adjacent storey.

OBJECTIVES –

- To analyze the multi storied building with mass irregularity during seismic forces for safety of structure.
- Modeling and analyzing effect of mass irregularity for different stories location of multistoried R.C.C. building.
- To analyze multistoried R.C.C. building by using STAAD PRO software as per IS 1893(Part 1):2002¹¹ and IS 456-2000¹² codes.
- Comparative study of structural parameters like base shear, storey drift, displacement of R.C.C. building.

LITERATURE REVIEW –

The seismic response of vertically irregular building frames, which has been the subject of numerous research papers, started getting attention in the late 1970s. A large number of papers have focused on plan irregularity resulting in torsion in structural systems. Vertical irregularities are characterized by vertical discontinuities in the distribution of mass, stiffness and strength.

Devesh p. soni and Bharat b. mistry (2006)¹ have observed that increase in drift demand in the tower portion of set-back structures and on the increase in seismic demand for buildings with discontinuous distributions in mass, stiffness, and strength. The largest seismic demand is found for the combined-stiffness-and-strength irregularity.

Humar and Wright (1977)² studied seismic response of steel frames with set-backs by using one ground motion. They found story drifts to be larger in the tower parts of set-back structures than those for the regular structures. On the other hand, smaller story drifts were found in the base parts of set-back structure as compared to the regular structures. They concluded that the difference in elastic and inelastic story drifts between set-back and regular structures depends on the level of story considered. Most notable observations were altered displacements and high ductility demands in the vicinity of the irregularities.

Aranda (1984)³ made a comparison of ductility demands between set-back and regular structures by using ground motions recorded on soft soil. He observed higher ductility demands for set-back structures than for the regular ones and found this increase to be more pronounced in the tower portions.

Shahrooz and Moehle (1990)⁴ observed based on their analytical study that damage is concentrated in the tower portion of a set-back structure due to high rotational ductilities. They also performed experimental studies and concluded that fundamental mode dominates the response in the direction parallel to the set-back.

During the experimental study on two models of set-back frames by Wood (1992)⁵, noticed that the response of set-back structures did not differ much from that of the regular structures.

Wong and Tso (1994)⁶ studied the response of set-back structures by using elastic response spectrum analysis. They observed that the modal masses of higher modes are larger for the set-back structures resulting in different seismic load distributions as compared to those from the static code procedure.

In this work Dynamic analysis of G+12 multistoried RCC building considering Koyna and Bhuj earthquake is carried out by Mayuri D. Bhagwat (2014)⁷ by using time history analysis and response spectrum analysis. Seismic responses of such building are comparatively studied and modeled with the help of ETABS software. Two time histories (i.e. Koyna and Bhuj) have been used to develop different acceptable criteria (base shear, storey displacement, storey drifts).

In the study by Himanshu Bansal (2012)⁸ the storey shear force was found to be maximum for the first storey and it decreased to a minimum in the top storey in all cases. It was found that mass irregular building frames experience larger base shear than similar regular building frames. The stiffness irregular building experienced lesser base shear and has larger inter storey drifts.

In the study analyses by B. M. Saiful Islam (2011)⁹ results show that isolation system considerably reduce earthquake induced load on building. Furthermore, method of analysis has been found to have considerable effect on the response of low to medium rise buildings. Time history analysis shows significant less base shear than that from response spectrum analysis. Also, less isolator displacement is obtained from time history analysis than that from response spectrum analysis.

Seismic analysis of high rise building by S.S. Patil (2013)¹⁰ by using program in STAAD Pro. with considering different conditions of the lateral stiffness system. Analysis is carried out by response spectrum method. This analysis gives the effect of higher modes of vibration and actual distribution of force in elastic range in good way. These results include base shear, storey drift and storey deflection are presented.

METHODOLOGY –

If the structure not properly designed and constructed with required quality they may cause large destruction of structures due to earthquakes. Response spectrum analysis is an useful technique for seismic analysis of structure when the structure shows linear response.

- Extensive literature survey by referring books, technical papers carried out to understand basic concept of topic.
- Selection of an appropriate plan of G+10, story building.
- Computation of loads and selection of preliminary cross-sections of various structural members.
- Geometrical modeling and structural analysis of building for various loading conditions as per IS Codal provisions.
- Interpretation of results include base shear, storey drift and storey deflection.

In the present work it is proposed to carry out seismic analysis of multi-storey RCC buildings using Response spectrum analysis method considering mass irregularity at different floor levels with the help of STAAD PRO software.

CONCLUSION –

Many of the studies have shown seismic analysis of the RCC structures with different irregularities such as mass irregularity, stiffness and vertical geometry irregularity. Whenever a structure having different irregularity, it is necessary to analyse the building in various earthquake zones. From many past studies it is clear that effect of earthquake on structure can be minimize by providing shear wall, base isolation etc.

The lateral displacement of the building is reduced as the percentage of irregularity increase. As the percentage of vertical irregularity increases, the story drift reduces and go on within permissible limit as clause no. 7.11.1 of IS 1893-2002 (Part I). It was found that mass irregular building frames experience larger base shear than similar regular building frames.

REFERENCES –

- [1] Soni D.P. and Mistry B.B. (2006) “*Qualitative review of seismic response of vertically irregular building frames*”, ISET Journal of Earthquake Technology, Technical Note, Vol. 43, No. 4, December 2006, pp. 121-132.
- [2] Humar, J.L. and Wright, E.W. (1977). “*Earthquake Response of Steel-Framed Multistorey Buildings with Set-Backs*”, Earthquake Engineering & Structural Dynamics, Vol. 5, No. 1, pp. 15-39.
- [3] Aranda, G.R. (1984). “*Ductility Demands for R/C Frames Irregular in Elevation*”, Proceedings of the Eighth World Conference on Earthquake Engineering, San Francisco, U.S.A., Vol. 4, pp. 559-566.
- [4] Shahrooz, B.M. and Moehle, J.P. (1990). “*Seismic Response and Design of Setback Buildings*”, Journal of Structural Engineering, ASCE, Vol. 116, No. 5, pp. 1423-1439.
- [5] Wood, S.L. (1992). “*Seismic Response of R/C Frames with Irregular Profiles*”, Journal of Structural Engineering, ASCE, Vol. 118, No. 2, pp. 545-566.
- [6] Wong, C.M. and Tso, W.K. (1994). “*Seismic Loading for Buildings with Setbacks*”, Canadian Journal of Civil Engineering, Vol. 21, No. 5, pp. 863-871.
- [7] Bhagwat M.D. and Patil P.S., (2014) “*Comparative Study of Performance of Rcc Multistory Building For Koyna and Bhuj Earthquakes*”, International Journal of Advanced Technology in Engineering and Science www.ijates.com Volume No.02, Issue No. 07, July 2014 ISSN (online): 2348 – 7550.
- [8] Bansal H. (2013) “*Seismic Analysis and Design of Vertically Irregular RC Building Frames*” International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064, Impact Factor (2012): 3.358

- [9] Islam B.M.S. (2011), "*Study on optimal isolation system and dynamic structural responses in multi-storey buildings*" International Journal of the Physical Sciences Vol. 6(9), pp. 2219-2228, 4 May, 2011 Available online at <http://www.academicjournals.org/IJPS> DOI: 10.5897/IJPS10.441 ISSN 1992 - 1950 ©2011 Academic Journals
- [10] Patil S.S. (2013), "*Seismic Analysis of High-Rise Building by Response Spectrum Method*" International Journal Of Computational Engineering Research (Ijceronline.Com) Vol. 3 Issue. 3.

