A Literature Review on Seismic Performance of Different Shaped Multi-Storey Building With Different Locations of Shear Wall

Gourav Mandniya[1], Dr. Savita Maru[2]
[1] Dept of Civil Engineering
[2]PG Coordinator, Dept of Civil Engineering
[1, 2] Ujjain Engineering College, Ujjain, M.P., India

Abstract- *As per the previous records of earthquakes, there is an increase in the demand of use of earthquake resisting structures. So it is necessary to design and analyze the structures by considering seismic effect. To resist the seismic forces shear wall systems are one of the most commonly used in multi-storey buildings.*

The present paper gives an overview of different research works to be done regarding the study of RC frame multi-storey structure with lateral load resisting systems such as shear wall. A behavior of RC frame structure with different optimum location of shear wall in different structural shapes has been studied and conclusions are made.

Keywords- Shear Wall, Shape of Shear wall, Shape of Building, Dynamic Method (Response Spectrum Method and Time History method), Story drift, Displacement, torsion, ETABS

I. INTRODUCTION

The population in past few decades has been increased rapidly with a geometrically growth rate. This increase in population has increased the demand of land for both residential and industrials purpose. As the scarcity and high price of available land we have to move on multi-stored structures which come with lots of structural problems. As the height of structure increases then the consideration of lateral load and shape of building structures very much important. For that the lateral load resisting system becomes more important in rigid frame multi-storey building system that resists the lateral loads. The lateral load resisting systems that are widely used are rigid frame, shear wall, diagrid structural system, wall frame, braced tube system, outrigger system and tubular system. Recently shear wall systems is the most commonly used in lateral load resisting systems. Shear walls have very high in plan stiffness and strength, which can be used to simultaneously resist large horizontal loads. For the shape of building structure also become more important to resist the seismic and gravitational loads. The structure shapes like square shape, Rectangle shape, T shape, H shape, U shape and I shape with shear wall are widely used in rigid frame multi-storey building to resist the seismic loads.

In present study, eighteen researches related to seismic performance of different shaped multi-storey building with different locations of shear wall has been studied and comparative concluding remarks are made.

II. LITERATURE REVIEW

1) Saurabh Mishra, V.k. Singh et.al.(2018)conducted time history analysis of frames to identify effective position of shear wall in multi storey building. An earthquake load was applied to H-shaped twenty one storey structure of four models with shear wall at different location in all seismic zones IV in ETABS 2016 software. Displacement, story drift, torsion results were developed for all four models and compare them and get the most effective location of shear wall in square shaped six storey building.

2) M.K. Akhil Krishnan et.al. (2016)conducted non-linear static analysis of frames to identify effective position of shear wall in multi storey building. An earthquake load was applied to a square shaped six storey structure of four models with shear wall at different location in all seismic zones IV in SAP2000 software. Displacement, story drift, ductility results were developed for all four models and compare them and get the most effective location of shear wall in square shaped six storey building.

3) Azeez Ur Rahman Mohammad (2016) analyzed 24 midrise building models that have five and eight stories and shear wall ratios ranging between 0.51 and 2.17% in both directions are generated. Then, the behavior of these building models under earthquake loading is examined by carrying out nonlinear time history analyses. The analytical results indicate that at least 1.0% shear wall ratio should be provided in the design of midrise buildings to control thee drift.

4) Umamaheshwara. B, Nagarajan. P (2016)analyzed 15 storey irregular shaped building four model with different location of shear wall located in zone V by performing Seismic Coefficient Method (static method) and Response Spectrum Method on ETABS to calculate and compare base shear of all four models. From the analysis, it is concluded that the mosteffective location of shear wall for 15 storey RC irregular shaped building

.

5) Tarun Magendra ea.al. (2016) analyzed 11 storey square shaped building four model with different location of shear wall located in zone V by performing Response Spectrum Analysis on ETABS to calculate and compare displacements storey drift, overturning moment and story shear of all four models. From the analysis, it is concluded that the most effective location of shear wall for 11 storey RC frame building.

6) Maulik Joshi ea.al. (2016) analyzed 11 storey irregular shaped building four model with different location of shear wall located in zone III by analysis on STRUD software to calculate strength and safety with provision of less steel and concrete as compare in all four model with different locations of shear walls. From the analysis, it is concluded that the most effective location of shear wall for 11 storey RC frame building.

7) UgaleAshish, RautHarshlata (2015) conducted an analysis on behavior of steel plate shear wall in seven storey RC building frame located in seismic zone III using STAAD Pro and compared it with a Building frame without shear wall. The building with steel plate shear wall showed very less deflection, shear force and bending moment and overall stiffness was found to be increased. It was found that Steel plate shear walls occupy less space than RCC Shear wall.

8) A.B. Karnale et.al. (2015)analyzed different configurations of shear wall for six storey and fourteen storey. Presented the results for different configurations of shear walls for 6 storey (Low Rise) and 14 storey (High Rise) building using ETABs software. A comparison was done between the effects observed due to height of structure and it was found that shear wall is more effective in high rise buildings than in low rise buildings.

9) SuchitaTuppad, R.J. Fernandes (2015) made the comparison based on equivalent static analysis and genetic algorithm using two softwares ETABS 2015 and MATLAB. For analysis, a eleven storey RCC building located in zone-V have been considered for determining the best location of shear wall in multi-storied building, Displacement were computed of all six models and compared based on the results obtained by using ETABS 2015 and MATLAB softwares.

10) M. Pavani ea.al. (2015)has performed seismic analysis of multi-storey building shear wall. The analysis has been carried out to study different techniques for resisting lateral forces acting on the G+44+Terrace structure with shear wall. The analysis of building is carried out using response spectrum method on ETAB software. This paper is focused on check all the permissible limits as per IS 1893 2002 code like displacement, story drift etc.

11) Mr.K.LovaRaju et.al. (2015)considered eight story building which are located in different zones such as zone-II, III, IV and V as per IS 1893-2002 provisions. Pushover analysis have been conducted using software ETABS and the pushover curves are obtained to compare the effects of earthquakes loads on displacements as well as base shear of these models, in which one model taken as bare frame structure while other three are the dual type structural systems. The non-linear analysis conducted in this paper gives the effective location of shear wall.

12) A.Murali Krishna, Dr. E.Arunakanthi (2014)considered thirty story building which are located in zones IV and as per IS 1893-2002 provisions. Time History Analysis have been conducted using software ETABS 2016 and the time history curves are obtained to compare the effects of earthquakes loads on displacements as well as storey drift, storey torsion and time period of T-shaped eight models. The time history analysis conducted in this paper gives the effective location of shear wall of T-shaped thirty story building.

13) Mrs. Sujatha ea.al. (2014)performed a comparative study on multi-storey RC frame building with different location of shear wall. U-shaped five models were prepared for study using equivalent static later force method (pseudo static method). ETABS 2013 software is used for design and analysis of RC frame. The behavior of the structures in soft, medium and hard soil studied based on the maximum displacement, maximum drift, maximum storey shear and torsion.

14) Rajesh JayarambhaiPrajapati et.al. (2013) have studied effect of different positions shear wall on deflection in high rise building. The 4 models 30 storey buildings with different locations of shear wall, width of building was too small compare to length of building in plan have developed using ETABS software. The effect of shear wall on deflection is studied in models, Seismic zone III is considered for analysis. Compare the results of deflection of all models and concluded that the shear wall at corner are most effective.

15) G.S. Hiremath et.al. (2012) analyzed 25- storey building located in zone IV by performing pushover analysis on ETABS V 9.7.1 to calculate displacements and storey drift. From the analysis, it is concluded that shear walls can reduce effects of earthquakes and improving seismic response of RCC building. In this paper studies have been made on effects of shear walls added at different locations and configuration along with varying thickness of shear walls.

16) Dr.B.Kameshwari et.al. (2011) analyzed the influence of drift and inter storey drift of the structure on various configurations of shear wall panels on high rise structures. The bare frame was compared with various configurations like conventional shear wall, alternate arrangement of shear wall, diagonal arrangement of shear wall, zigzag arrangement of shear wall and influence of lift core shear wall. From the study it was found that zigzag shear wall enhanced the strength and stiffness of structure compared to other types. In earthquake prone areas diagonal shear wall was found to be effective for structures.

17) Anshuman.S. et.al. (2011) made the comparison based on elastic and elasto-plastic analysis using two softwares STAAD Pro 2994 and SAP V 10.0.5 (2000).For analysis, a fifteen storey RCC building located in zone-IV have been considered for determining the best location of shear wall in multi-storied building, few factors such as shear forces, bending moment, storey drift were computed and compared based on the results obtained by using STAAD Pro 2004 and SAP V 10.0.5 (2000) softwares.

18) Shahabodin. Zaregariziconducted comparative investigation on using shear wall and infill to improve seismic performance of existing buildings. Static nonlinear analysis was done to compare the effectiveness of both methods. From the results, observed that concrete infills have considerable strength while brick infills lower strength. The combination of brick and concrete infills reduced the negative effects when they both used individually.

III. CONCLUSIONS

In this review paper study which is about the different criteria and parameter used by different researchers on human comfort condition of a tall building under wind excitation. The following conclusions can be made from the studies:-

- Shear wall generally results in reducing the displacement because the shear wall increase the stiffness of building.
- Structure with shear wall at appropriate location is more important while considering displacement and base shear.
- Shear walls placed at central core of square and rectangular shaped multi-storey building has significant influence on performance of structure such as maximum displacement of structure can be reduced.
- Shear walls placed at corners of H-shaped multi-storey building has results gives more less maximum displacement and story drift then other locations of shear wall.
- H-shape Shear walls placed at center of U-shaped multi-storey building has perform most effectively or optimum location of shear wall.
- As the shear wall ratio increases, the observed drift decreases. The analytical results indicate that at least 1.0% shear wall ratio should be provided in the design of midrise buildings to control the drift.

IV. FUTURE WORK

In this above study seen that the different shaped multi-storey RC frame structures with different location of shear wall are analyzed and determine the most effective location of shear wall of respective different shaped multi-storey structure.

In future work May analysis the different shapes (like square shape, rectangular shape, T shape, H shape and U shape etc.) multi-storey structure with their optimum location of shear wall in different earthquake zones as per IS 1893 (part 1):2016. The plan area of above mentioned different shapes and their optimum shear wall area should be same and determine the most effective shape of RC frame multi-story building with their optimum location of shear wall for required plan area.

REFERENCES

[1] Saurabh Mishra, V.K. Singh, “Optimum Location of Shear Wall in Irregular Multi-Storey Building”, International Journal of Engineering Research in Mechanical and Civil Engineering, Vol. 3, ISSN: 2456-1290, April 2018.

[2] M.K. Akhil Krishnan, Dr. C. Justine Jose “Optimum Location of RC Shear Wall for A Five Storey Symmetrical Framed Structure for Efficient Seismic Design Using Pushover Analysis”, International Journal of Current Engineering and Scientific Research, Vol. 3, ISSN: 2393-8374, December 2016.

[3] Azeez Ur Rahman Mohammad, DivyaBharathi, “Effect of Shear Wall Area to Floor Area Ratio on the Seismic Behavior of Reinforced Concrete Buildings”, International Journal and Magazine of Engineering, Technology, Management and Research, Vol. 3, ISSN: 2348-4845, October 2016.

[4] Umamaheshwara.B, Nagarajan.P,“Design Optimization analysis of Shear Wall in High Rise Building Using Etabs”, International Journal for Research in Applied Science and Engineering Technology, Vol. 4, ISSN: 2321-9653, August 2016.

[5] TarunMagendra, AbhyudayTitiksh and A.A. Qureshi, “Optimum Positioning of Shear Walls in Multistrorey-Building”, International Journal of Trend in Research and Development, Vol. 3, ISSN: 2394-9333, May-June 2016.

[6] Maulik Joshi, SagarNaik, Yati Tank, “Structural Configuration Optimization of Multi-Storey Building Optimum Positioning of Shear Wall”, Global Research and Development Journal for Engineering, ISSN: 2455-5703, March 2016.

[7] UgaleAshish, RautHarshalata, “Effect of Steel Plate Shear Wall on Behavior of Structure” International Journal of Civil Engineering Research, Vol. 5, ISSN: 2278-3652, November 2014.

[8] A.B. Karnale, Dr. D. N. Shinde, “Comparative Seismic Analysis of High Rise and Low Rise RCC Building with Shear Wall”, International Journal of Innovative Research in Science, Engineering and Technology, September 2015.

[9] SuchitaTuppad, R.J. Fernandes, “Optimum Location of Shear Wall in A Multi-Strorey Building Subjected to Seismic Behavior Using Genetic Algorithm”, International Journal of Engineering and Technology, Vol. 2, ISSN: 2395-0056, June 2015.

[10] M. Pavani, G. Nagesh Kumar, Dr. SandeeepPingale, “Shear Wall Analysis and Design Optimization in Case of High Rise Building Using Etabs”, International Journal of Scientific and Engineering Research, Vol. 6, ISSN: 2229-5518, January 2015.

[11] Mr.K.LovaRaju1, Dr. K.V.G.D. Balaji, “Effective location of shear wall on performance of building frame subjected to earthquake load”, International Advanced Research Journal in Science, Engineering and Technology, Vol. 2, January 2015.

[12] A Murali Krishna, Dr. E Arunakanthi, J. Supriya, “Optimum Location of Different Shapes of Shear Wall in Unsymmetrical High Rise Building”, International Journal of Engineering Research and Technology, Vol. 3, ISSN: 2278-10181, September 2014.

[13] V.V.B.L.N.D. Vara Prasad, T. Sujata, J. Supriya, “Optimum location of shear wall in High rise U-shape building”, International Journal of Engineering Research and Technology, Vol. 3, ISSN: 2278-0181, August 2014.

[14] Rajesh JayarambhaiPrajapati, Vinubhai. R. Patel, “Effect of Different Position of Shear Wall on Deflection in High Rise Building” International Journal of Advances in Engineering & Technology, Vol. 6, ISSN: 2231-1963, September 2013.

[15] G.S Hiremath, Md Saddam Hussain, “Effect of Change in Shear Wall Location with Uniform and Varying Thickness in High Rise Building”, International Journal of Science and Research, ISSN: 2319-7064, 2012.

[16] Dr. B. Kameshwari, Dr. G. Elangovan, P. Sivabala, G.Vaisakh, “Dynamic Response Of High Rise Structures Under the Influence Of Discrete Staggered Shear Walls”, International Journal of Engineering Science and Technology, ISSN : 0975-5462, Vol. 3, October 2011.

[17] Anshuman. S, DipenduBhunia, BhavinRamjiyani, “Solution of Shear Wall Location in Multi-Storey Building”, International Journal of Civil and Structural Engineering, Volume 2, 2011

[18] Shahabodin. Zaregairizi,"Comparative investigation on using shear wall and infill to improve seismic performance of existing buildings", 14th World Conference on Earthquake Engineering.

[19] Earthquake Tips Learning Earthquake Design and Constructions By IIT Kanpur.

[20] IS 1893 (Part1):2002 "Criteria for earthquake resistant design of structure,"

[21] IS 13920.1993, "Ductile detailing of reinforced concrete structure subjected to seismic forces".

[22] IS-456(2000), “Plain and Reinforced Concrete Code of Practice”.