Study of Seismic Response of Structure with Single Core

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Abstract: ***Earthquake is caused by sudden release of stored energy in the Earth's crust that creates seismic waves. Over the decades they have been responsible for millions of deaths and huge damage to property. Over thepast years of the tremendous developments in design strategies have been made, which incorporate, earthquake protective systems in the structures. In this paper outriggers and Shear walls are studied so as toresist the seismic waves of earthquake and heavy winds actions.Failure of the structures that has occurred in the past due to seismic waves may be avoided with the use of shear wall in the structure. The study is concerned with the use of outriggers and shear wall as a single core in structure that will resist the seismic waves of earthquake.***

Keywords: Seismic Waves, shear wall, outriggers.

I. INTRODUCTION

The Lateral Displacement of a tall building caused by lateral forces due to wind or earthquake can be reduced by the provision of shear wall in combination of outriggers as acting in a structure as single core. The core is the main lateral force-resistant component. The maximum horizontal displacement occurred in a structure is limited by codes for the stability of the building and for the comfort of its occupants. Also, the codes limit the inter storey drift ratio, defined as the difference of drift in two consecutive floors divided by the vertical distance between them. The sum of the moments at the ends of a column at a floor level is a couple transferred, in the opposite direction, to the floor; the floor must be designed for the flexural and shear stress caused by the transfer. The moments transferred between the columns and the floors are mainly dependent on the inter storey drift ratio.

The primary purpose of different types of structural system in buildings is to resist gravity loads like dead, live loads. Besides these vertical loads, lateral loads caused by wind, earthquake also acts on buildings. It is very important that structure should resist both vertical loads and lateral loads. The shear wall-frame system is the most commonly used structural system in reinforced concrete buildings to counteract the effect of both gravity and horizontal loads. These shear wall-frame system with combinations of outriggers have high lateral resistance against horizontal loads by placing shear walls in an advantageous location in the plan of building.

II. LITRATURE REVIEW

Vinay Agrawal, Rajesh Gupta, Manish Goyal(2017) The primary objective of any structural system is to support various types of loads acting either vertically or Horizontal or acting jointly with adequate safety. Any structural system should be designed in such a way that each and every element of the system should have ample rigidity, stiffness and strength against the anticipated loads. Any Structural frame system with a provision of Reinforced Concrete shear wall shows a recommendable safety and stability up to 30 stories building height in lateral loads resistance. A RC framed shear wall is a combination of beams, columns interacting with reinforced concrete shear wall. Shear wall provide lateral stiffness to the building by cantilever action.

T.G.N.C.Vamsi Krishna, S.V.Surendhar (2019) Shear wall columns stronger than the RCC Columns, it can increase usable floor area in the structure and also it can decrease the deflections than the RCC Columns. Considered a geometry of irregular residential structure (G+18 Storey) in the seismic zone-III, Medium type of soil condition. There concluded that stiffness of the structure more means it can stand to control or resist the earthquake forces in the structure. Here, the shear wall structure has better stiffness than the RCC structure. Finally, the shear wall type of column structures can give more space, high strength and cost of construction also will decrease when compared to the Normal Columns in RCC structure.

Prathamesh Ghare, Nikhil Khandare (2018) this paper aims in designing, which is not only innovative but also endeavors to explore a new facet of civil engineering. The design process involves determining the size of the different components of the building and checking the stability of the building for various external forces to which it is subjected. This paper comprises of RCC building having G+4 floors which have been elevated from the ground floor to further top four floors. The proposed building is a commercial building. The shear wall will used as a single core. The shear wall will be connected to each other with a network of beams/ slabs with the slabs acting as in plane rigid diaphragms for each of the floors. As the structure is resisting only on a single core the shear

wall will be provided in such a way to control deflections and resist lateral forces. Provision is done in design in such a way that services can be laid without major obstructions and maximum headroom is achieved.

N. Vinay Kumar (2017) the present study focuses on the evaluation of the seismic execution of reinforced concrete buildings with circular core wall and square core wall according to Indian Codes (IS 1893:2002). In this analysis, five square building with 20 stories having circular core wall and rectangular core wall and one circular building with 20 stories having circular core wall is considered. By time history analysis and response spectrum the dynamic behavior of the structure has been found. Overall analysis was performed in ETABS software, from the analysis results a study of storey deflection, storey drift and base shear have been made.

Fasil Mohi-ud-din, Pavithra.C (2017) In this paper instead of shear wall, Concrete Core has been used; the displacement was calculated by default procedure and the yield of the structure in both the direction caused into the development of plastic hinge under push over loads. The outcomes would lead to develop the most efficient and most economical frame which can withstand the major earthquake. It also lead to motivate advances in seismic design practice. The core which is provided within the structure resulted in the less lateral displacement and restricted the development of the plastic hinges at the initial stages hence making the design robust and acts as an energy dissipater.

Shashwati Sanjay Vahadane (2016) this paper deals with use of lift cores to resist the seismic forces and its effect by changing the lift core location. The study for G+5 and G+10 type frame buildings are considered. These buildings are further divided as per soil strata i.e. hard, medium, and soft. Here two locations of lift core considered for studies i.e. center core and corner core. The seismic Zone V is considered for all buildings which will cause maximum base shear to the structure. Study is focused on dynamic analysis and comparative static which will show graphical representation of G+5 and G+10 building along with soil type.

Sreedevi Lekshmi and Lekshmi Soman (2017) studied the performance of G+40 RC framed structure having outrigger system. This paper represents the alteration in percentage in storey drift in RC shear wall in comparison to braced framed core with an outrigger system. The Response Spectrum Analysis method had been adopted using ETABS 2015. Results showed approximately 39 percent reduction in storey drift

A GowriSamkarand E K Mohanraj, S NisarAhmad (2002) studied the STRAP (Structural Analysis Package) software by which Analysis and Design of a Monocolumn office building had done with the aim to attain the goal of maximum utilization of space and maximum serviceability. Stiffness Matrix method has been used in STRAP (Structural Analysis Package) and also the estimation of the designed structure is done by Rate Analysis method.

Azzam Katkhoda and Rana Knaa (2012) investigated on the optimization in the selection of a structural system for the reinforced concrete buildings to resist earthquake forces. Three types of structural systems (frame system, shear wall system, and couple system) consider for the study, ETABS software is used to model and analyze the structure. From the analysis results, he found that coupled system having core walls and shear walls is giving good results.

Mohamed A. dahesh and tuken (2015) evaluated the effect of the shear wall in RC building to control the lateral displacement caused by the earthquake. For this study, they modeled square building in STADD.PRO software. The results have been carried for the parameters including the area of the shear wall, shear wall height, and openings in the shear wall. From the analysis outcome, he found that increasing area of shear wall to area of floor ratio from 0.56 to 1.29% decreases the displacement by 38 to 72%.

Manuchehr Behruyan and Mehdi Mohammadi (2014) conducted a study to compare the Performance of circular core shear wall to conventional shear wall. Different types of building models with the circular shear wall at the core and square shear wall at the core are analyzed to find out the relative movement of the structure. From the analytical results, he found that relative movement of circular core building is decreased 27% compared to square core building.

Mahdi Hosseini and N.V .Rama Rao (2015) conducted a study to find the seismic performance of a building with the shear wall at core and center of the outer frame. For this study, a forty storey RC building is modeled and analyzed in ETABS Software. From the results, he found that building with core wall and external shear wall shows better performance in terms of lateral displacement and storey drift. Also, the stress concentration in shear wall increases when the opening is provided.

Kuang and Chan (1989) had conducted studies on the effect of an intermediate stiffening beam at an arbitrary level along the height of the walls and indicated that the structural behavior of the structure could be significantly affected by the particular positioning of this stiffening beam. In preliminary analysis of outrigger braced structures, simple approximate guidelines for the location of the outriggers were given.

Moudarres Alex Coull and W. H. Otto Lau (1984) conducted a study of a multi outrigger-braced structure

based on the continuum approach in which the set of outriggers is smeared over the height to give an equivalent uniform bracing system. After their detail analysis they concluded that, Continuum analysis can give reasonably accurate results for even a very small number of Outriggers. They also presented Design Curves for assessing the lateral drift and the core base moments for any structural configuration defined in terms of two controlling structural parameters. The curves allow a direct assessment of the effectiveness of any number of outriggers.

R. Shankar Nair has presented a paper on the detail study of various types of outriggers and their relative behavior and performance subjected to lateral loading along with their advantages and disadvantages. He also performed an analysis for a typical steel structure employing various types of Outriggers.

III. CONCLUSION

From the study of past literature conducted on structural system which comprises of shear wall and outriggers it has proved that it increases ample rigidity, stiffness and strength against the earthquake, wind and gravity loads. The structural system resist deflections, resist lateral forces, reduces story drift and lateral displacement. Any structural frame system with a provision of reinforced concrete shear wall shows recommendable safety and stability up to 30 stories building height in lateral load resistance. Shear wall provide lateral stiffness to the building by cantilever actions. Shear wall structure has better stiffness than the RCC structure. The core which is provided within the structure resulted in the less lateral displacement and restricted in the development of the plastic hinges at the initial stages hence making the design robust and acts as energy dissipater.

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