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Effect of Vertical Irregularities of Multistoried Shear Frame Structure on Dynamic Response Parameters: A Review

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Abstract:- There are several number of response of multistoried RCC frame structure with shear wall depending upon the manner of external load acting, geometric design, location of building, material used for construction. So far review papers are published on shear wall concisely outline the concept and analysis and behavior of different geometry of multistoried buildings. However the researcher's work of multistoried building considering aspect ratios is compare to performance analysis is limited. So this paper present the overall review on aspect ratios such as horizontal and vertical aspect ratio, analysis results by correlation with other dependable parameter such as base shear, no. of storey, storey drift, base moment. Along with this cross sectional parameter presented in this review paper. This various parameter are grouped under regular and non-regular building frame. Overall the response parameters such as base shear and base moment increases with increase in number of span. Irregular shear wall structure should be designed and analyzed properly to avoid the failure of structure. Varying thickness of shear wall shows some positiveness and some negativeness in the value of response parameter.

Keywords:- *Horizontal and Vertical Aspect Ratio, Seismic Behavior, Storey Drift, Overturning Moment, Inter Storey Drift.*

I. INTRODUCTION

Many cities are outgrowing the capacity of roads, water supply, and sewage disposal systems to serve their inhabitants even in the vaunted homes of high-tech industries like Bangalore, India. According to the forecast shown by a World Bank and United nation report, around 200 million city dwellers in India will be exposed to storms and earthquakes by 2050.In India 60% population is staying in earthquake area. To save the life of this people, it is necessary at least to construct earthquake resistance structure with special characteristic material such as shear wall. To provide shelter for highly populated country, high rise structure becomes necessary. Use of shear wall construction are proven to be more beneficial in terms of rapid construction, lateral dynamic force resistant and safety. However the shear wall construction plays an important role in the providing earthquake resistance structure in which lateral stability and homogeneity of response of buildings towards lateral dynamic load are maintained. Performance of RCC multistoried buildings with shear wall is much better than without shear wall. Large dimension of shear wall is not effective. Shear wall is economical as well as effective in high rise building.

II. LITERATURE REVIEW

Chetan Mahajan, Dr. J.N. Vyas[1] (2019): Building model of (G+10) consist of bare frame and shear frame are taken for analysis. SAP2000 software is used for the modelling the structure. Structure is analyzed for zone four .There are four different models are considered for the analysis purpose such as bare frame model (mode1), regular shear wall structure model (model2), irregular shear wall structure model (model3) and regular shear wall with varying thickness structure model (model4). The results are interpreted on the basis of no. of parameters like base reaction, storey displacement, storey drift, storey force distribution, storey shear and stress distribution.

From the analysis it is observed that the target displacement of model 2, model 3, and model 4 are 18.5%, 20%, 17.07% of model 1. Model 2 shows relatively lesser storey drift and storey force distribution. Base shear in the model 3 is less as compared to other models.

From this paper it is emphasis that the irregular shear wall structure model displaces more but shows less base shear than other models.

Dr. S.B. Shinde, N.B. Raut[2] (2017): In this paper author analyzed (G+24) storey building in 3rd zone for Aurangabad region by changing the thickness of shear wall at interval of each five storey. Behavior of structure towards applied exciting force is expressed in terms of dynamic response parameters namely storey drift, storey shear and deflection. ETAB software is used for modelling the frame. Shear walls are provided at the corners and center of building for the vertical drift. The thickness of shear wall are 100mm, 150mm, 200mm, 250mm, 300mm. Shear wall provided up to storey of G+4, G+9, G+14, G+19 and G+24. The dynamic of a structure to a dynamic load is dependent on its stiffness.

It is concluded that the thickness of shear wall increases with increase in no. of storey. For achieving the economy of G+4, G+9 and G+14 models 150mm thick shear wall gives adequate resistance to lateral forces whereas for model G+19, 200mm thick and for model G+24, 250mm thick shear wall shows good result.

S. H. Jagadale, N.L. Shelke[3] (2016): In this paper the analysis of G+10 structure with 200mm and 300mm thick shear wall is done. The structure is assumed to locate in zone 5th. The main concern of this research is to analyze the effect of regular and staggered openings, as the openings reduces the overall seismic response of structure. 3 models are considered for the study purpose such as staggered openings in the shear wall model, regular vertical openings in the shear wall and without openings shear wall model. For earthquake analysis response spectrum method is used. Comparative study is done with respect to displacement and base shear.

It is remarked from observations that the staggered openings can gives better response during seismic action than regular vertical openings model and without openings in shear wall model. 200mm and 300mm thick shear wall shows almost same response.

G. S. Hiremath, Md. Saddam Hussain[4] (2014): The interest of study this paper is to analyze the effect of shear wall location with uniform and varying thickness of shear wall in the high rise building. G+24 storey and earthquake zone 4th is taken for study purpose. Modelling of structure is done using ETABS software. Several models are chosen for the analysis mainly with uniform and varying thick shear wall. In that four configuration of shear wall is done. Shear wall is provided at corner, mid span, middle mid span and middle mid span channel. Pushover analysis method is used.

The behavior are shown on the basis of displacement, storey drift and thickness of shear wall. Observations shows that the varying thickness shear wall model provides adequate performance. It shows less storey drift, displacement and base shear.

The author recommended further study on nonlinear dynamic analysis of varying thickness shear wall.

Hema Mukundan, S. Manivel[5] (2015): 10 storey structure with and without shear wall in 4th are used for determining the different internal movement of building due to exciting force. ETABS software for modelling and response spectrum method for analysis used. Building is designed as per Design Based Earthquake. The main purpose of this paper is to analyze the performance of vertical irregular stiffness structure. The response parameters namely top storey deflection, drift pattern, mode shape pattern, base shear and time period are considered. The necessity of this study is to get economical and efficient lateral stiffness system for high seismic prone area. Three irregular models are generated for analysis; plane, stiffness and vertical geometrical irregular. The structure is also analyzed with & without shear wall and with & without openings.

The results remarks the conclusion that the maximum storey displacement of a building is reduced by 50% and base reaction force increases 3 times as compared to without shear wall when shear wall is provided. Shear wall with uniform and varying thickness shows remarkable difference. High displacement is observed in all direction due to openings in the shear wall. Openings in shear wall increases the stress and reduces the stability.

From above study it is stated that the shear wall with openings and varying thickness is still strong and stable enough to resist seismic load. For safety of structure the thickness of shear wall should ranges between 150mm to 400mm.

Sanjay Sengupta[6] (2014): 5th, 10th, 15th storey structure models in all zones of earthquake in India is considered. Authors did work on the relation between the thicknesses of shear wall, amount of reinforcement percentage and no. storey. Location of shear wall is kept same as it for all models. 5inch, 10inch, 15inch, 20inch thick shear wall is used for analysis. ETABS software is used for analysis and design of models.

From the observation, it is concluded that the reinforcement percentage increases with increase of the severity of the seismic zone. Percentage of reinforcement will not always increase with increase in no. of storey. Reinforcement percentage is increase suddenly from zone 4th to zone 5th. Percentage of reinforcement increase from 5inch to 10inch thick shear wall and it decreases from 10inch to 20inch thick shear wall.

It is remarked that it is not necessary every time to increase thickness of shear wall for effectiveness.

III. CONCLUSION

The demand of irregular structure are going to fulfill when it is designed and analyzed properly. For minimizing the torsional effect of irregular structure care should be taken out for locating shear wall in the appropriate location. Variation in the thickness of shear wall provides adequate performance regarding storey drift, displacement and base shear. But sometimes it shows instability of structure with respect to other structural parameter. Each response parameter of irregular shear wall structure in all earthquake zones of India should be properly analyzed.

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