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Study on Dynamic Behaviour of Shear walls with Staggered Openings in Irregular R.C. Framed Structures

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ABSTRACT

In this paper, an attempt is made to discovering the behavior of shear wall with a different pattern of openings under earthquake loads. Many buildings now a day's have irregular arrangements, both in plan and elevation. That courses the structures with undesirable distributions in their stiffness of the building. These unpremeditated changes in structural stiffness are courses bad impact to the buildings. The reason behind the lack of the seismic behavior of the structure is the plan irregularity or vertical irregularity present in it. The shear walls are the best and simple methods to sustain these lateral forces. And they provide required strength against seismic forces. Sometimes a shear wall may include openings due to the functional needs such as doors and windows. This study is carried out on plan irregular structures with shear wall contain staggered and regular openings. Analysis has been done to estimate the behavior of plan irregular structures when introducing the different pattern of openings in shear walls, at an advantageous position. The parameters considered are storey displacement, storey drift, storey shear and stress distributions that concern with the pattern of the openings. The dynamic analysis is carried out with the help of ETABS v 15 by using response spectrum method.

Keywords: Shear wall, Base shear, staggered opening, Regular opening, ETABS

I. INTRODUCTION

The earthquake and wind are nowadays major topic of study of structural engineering. Most of the buildings in the present days have asymmetrical configurations to satisfy architecture requirements or some other reasons .The irregularity may be plan or vertical, so that's why the structure courses irregular distributions in their mass, stiffness and strength along the height of the building. Shear walls are the best earthquake resistance structural system used to increases the strength and sufficient amount of stiffness to concrete building. Which considerably decreases the lateral sway of the structure and so that lower the damages to the structure. By introducing shear wall the building become safe, durable and also more stable the main role of shear wall is to enhance rigidity for the lateral loads that may be induced by the effect of wind and earthquakes.

Shear walls generally beginning from the foundation level and are continuous throughout the building height. They are generally provided along both length and width of the building and are located at the sides of the buildings or arranged in the form of core. Shear walls can easily implemented at site and which also a cost effective technique to minimizing the earthquake injury. The position and size of shear walls is extremely critical. Properly designed and detailed structures with shear walls have shown good performance in past seismic actions.

Shear walls in high rise structures will be perforated with many openings that are essential for windows in external walls or corridors and door openings for internal walls. The location and size of opening depends on the role of the openings. However the size of the opening may affect the overall seismic response of the system. The openings may arrange staggered or vertically ordered manner. In this present work attempt is made to study and investigate the RC framed different plan irregular structures by introducing staggered and regular opened shear wall on different positions. For this study G+15 buildings are considered and finding which opened shear wall is more advantageous and also their positions, by using finite element software ETAB v 15 at seismic zone V.

II. METHODS AND MATERIAL

A. Modelling and Analysis

A 16-storeyed (G+15) reinforced concrete structure with irregular plan shape "L", "T", and "I" with staggered and regular opened shear wall in Seismic Zone V has been considered for the current study the models are shown in figure 1 to figure 12. The shear wall having 10% opening compared to the area of wall in that storey. The structures considered for the present work is plan with 10 bays of 5m each in X-direction &Y-direction. The plan area of building is 50m× 50m.

Table1.Building Configuration:

No of stories	16
Size of Column	600 x 600 mm
Size of Beam	300 x 300 mm
Depth Of Slab	150 mm
Thickness of Shear Wall	200 mm
Opening Size	140 x 120 mm
Height of each storey	3.5 m
Support condition	Fixed at base
Grade of concrete	M25
Grade of steel	Fe415

Table2. Loads

Unit weight of concrete		25kN/m3
Dead load		As per structure
Live load	On Floors	4 kN/m^2
	On Roof	1.5 kN/m^2
Floor finish	1kN/m^2	

Table3. Seismic data

Seismic zone	V
Zone factor (Z)	0.36
Type of soil	Medium
Damping	5 %
Response reduction factor (R)	5
Importance factor (I)	1.5

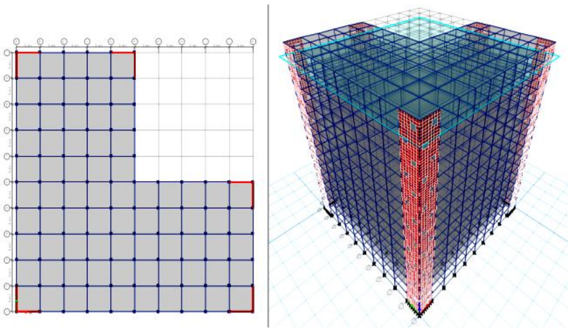

Figure 1: L frame with staggered opened shear wall at corner

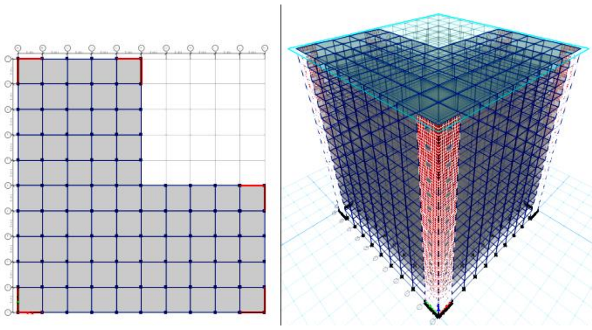

Figure 2: L frame with regular opened shear wall at corner

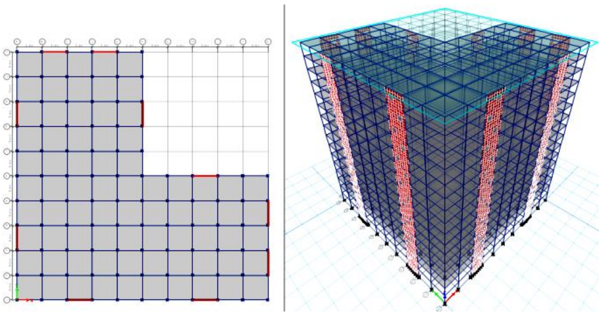

Figure 3: L frame with staggered opened shear wall at periphery

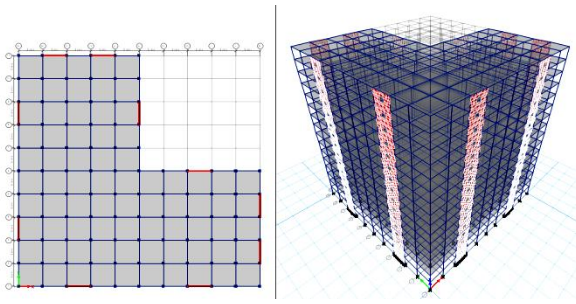

Figure 4: L frame with regular opened shear wall at periphery

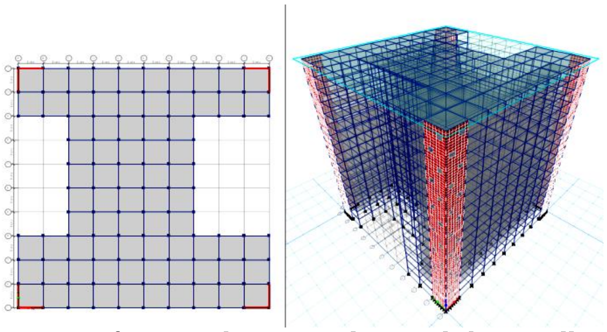

Figure 5: I frame with staggered opened shear wall at corner

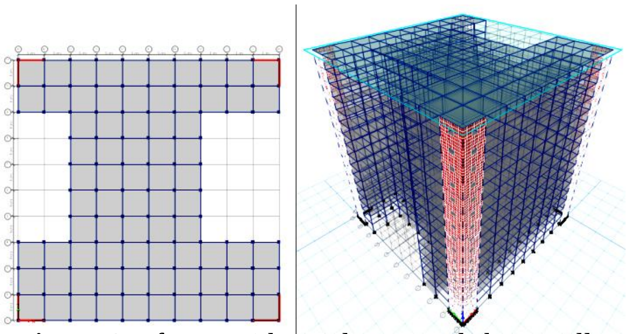

Figure 6: I frame with regular opened shear wall at corner

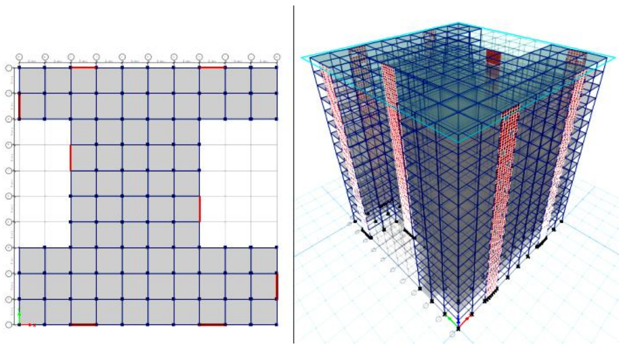

Figure 7: I frame with staggered opened shear wall at periphery

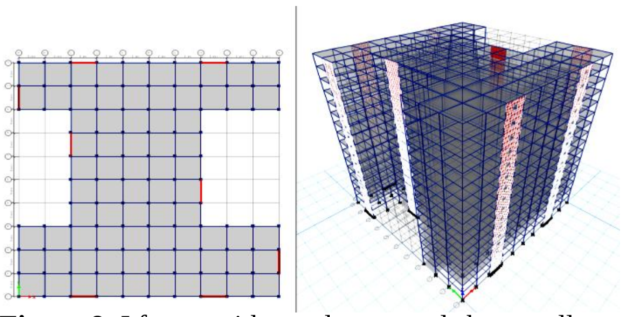

Figure 8: I frame with regular opened shear wall at Periphery

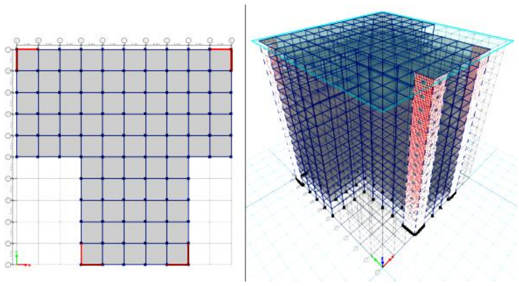

Figure 9: T frame with staggered opened shear wall at corner

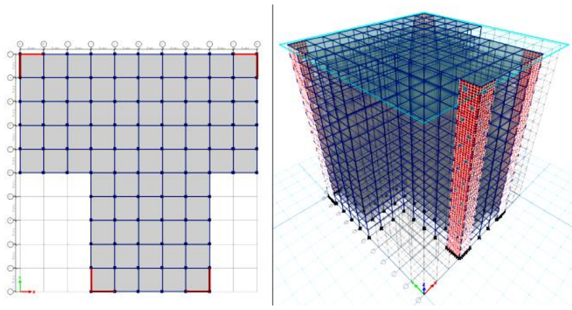

Figure 10: T frame with regular opened shear wall at corner

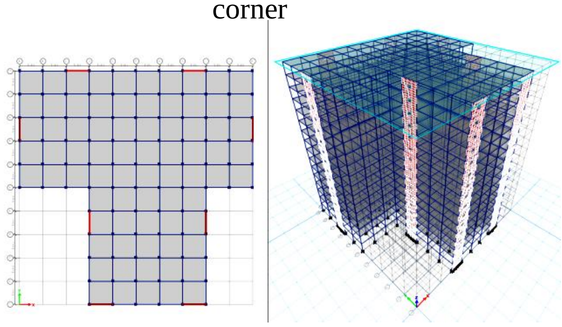

Figure 11: T frame with staggered opened shear wall at periphery

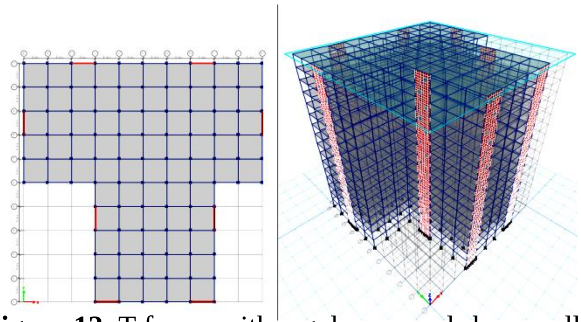

Figure 12: T frame with regular opened shear wall at periphery

III. RESULTS AND DISCUSSION

A. Storey Displacement:

Storey displacement is the lateral movement of the structure caused by lateral force. Storey levels versus displacements of models are shown in figure 13 to figure 15.

Notations:

- Staggered opened shear wall at corner (SC)
- Staggered opened shear wall at periphery(SP)
- Regular opened shear wall at corner (RC)
- Regular opened shear wall at periphery (RP)

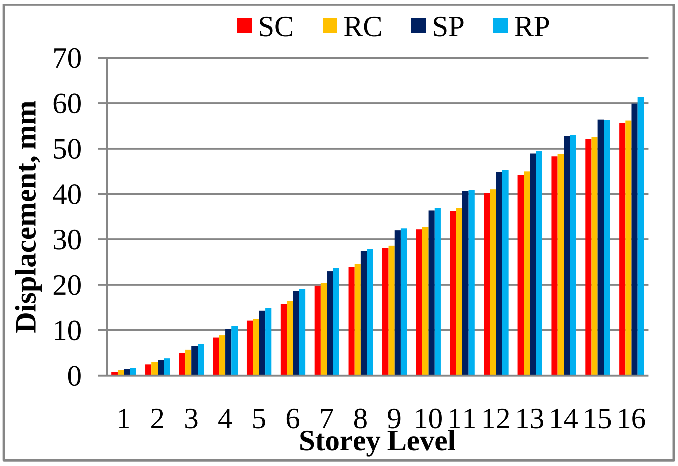

Figure 13: Story Level versus Story Displacement diagram ofL frame

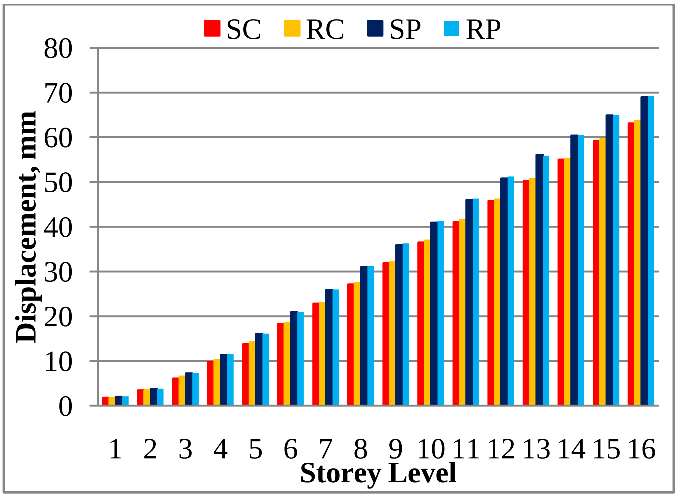

Figure 14: Story Level versus Story Displacement diagram ofI frame

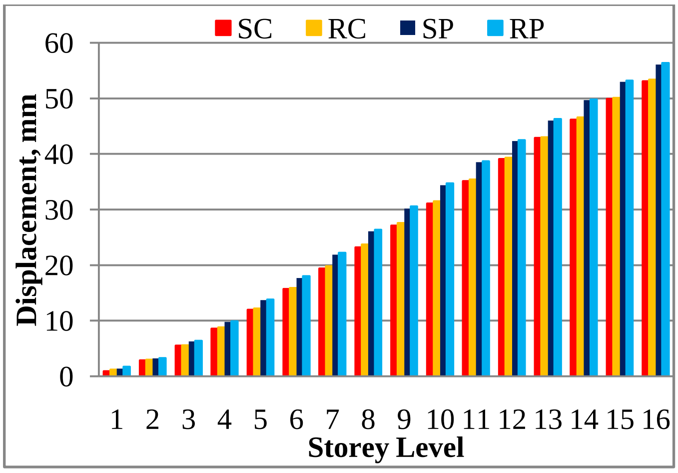

Figure 15: Story Level versus Story Displacement diagram of T frame

From results it is observed that due to the presence of staggered opened shear wall, it has less displacement compared to regular opened shear wall. By comparing the position of shear wall, the staggered opened shear wall at corner will shows the less displacement compared to shear wall at periphery for all models. The results shows that I frame have higher displacement compared to other models. From the results obtain T frames shows less displacement compared to other models.

B. Storey Drift

Story drift is the displacement of one level relative to the other level above or below. The storey Level versus Storey drifts diagrams of plan shapes are shown in figure 16to figure 18

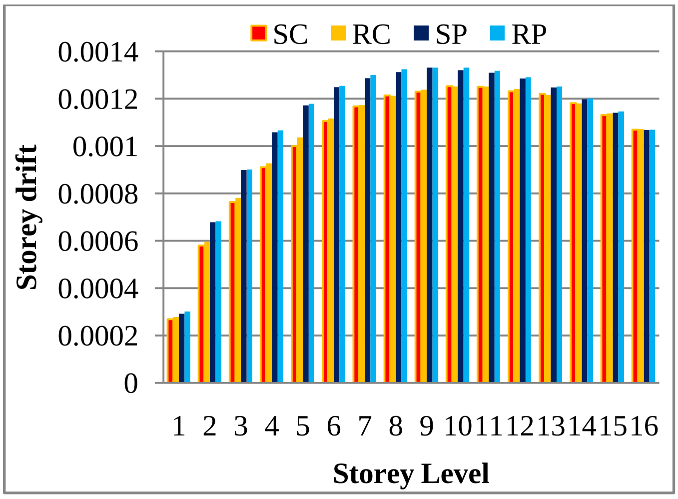

Figure 16: Story Level versus Story Drift diagram of L frame

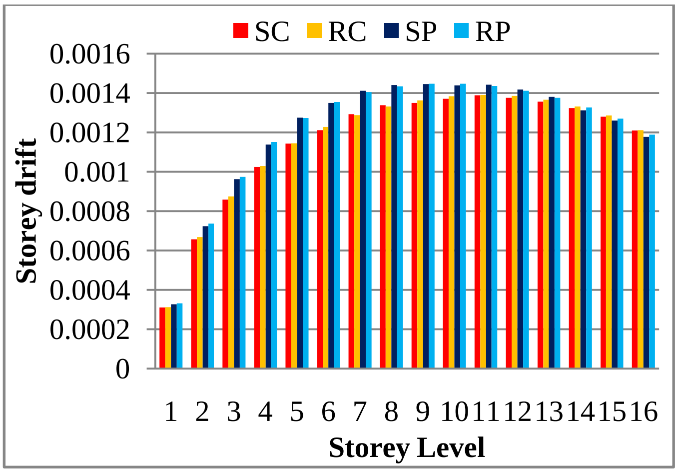

Figure 17: Story Level versus Story Drift diagram of I frame

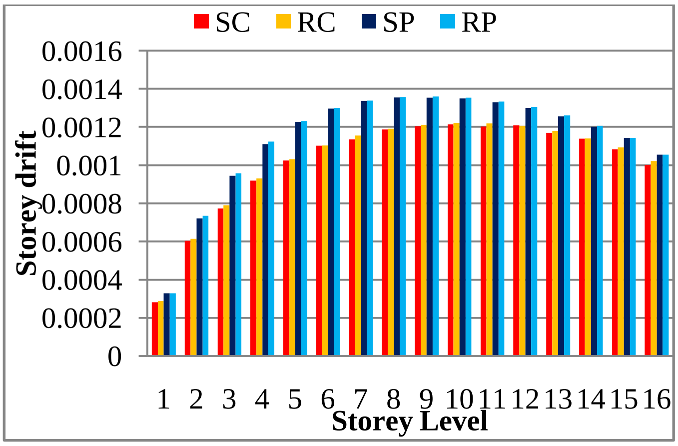

Figure 18: Story Level versus Story Drift diagram of T frame

From the results, it is observed that the storey drift is increase in ground and first floor and from second storey itself it gradually increases and has a tendency to decrease to top storey. Model with staggered opened shear wall shows lesser drift value compared to regular opened shear wall. There is considerable reduction in drift for models with shear wall at corner. The 'I' shaped model shows high drift value.

C. Base Shear:

It is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. Figure 19 shows the plan shapes versus base shear diagram

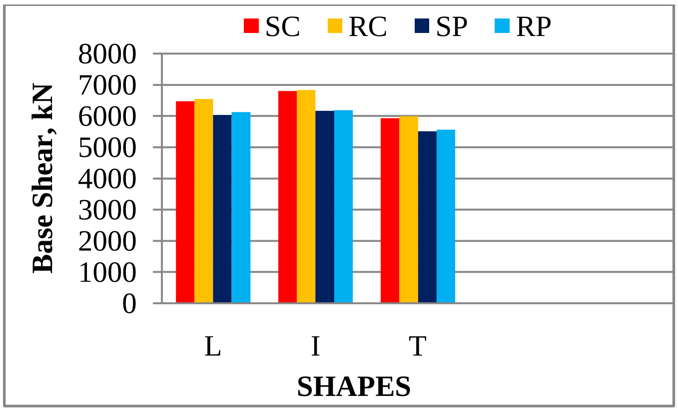

Figure 19: Plan shapes versus Base shear

The base shear is found to be much lesser for shear wall with staggered openings when compared to shear wall with vertical openings. The base shear is high for I framed structures and less for T framed structures. The base shear is low at shear wall on periphery.

D. Stress Distribution

The stress accumulated on the shear wall with staggered and regular openings was studied from the stress pattern diagram from the software. Figure 20 and figure 21 shows the stress distribution on shear wall of staggered and regular opened shear wall respectively.

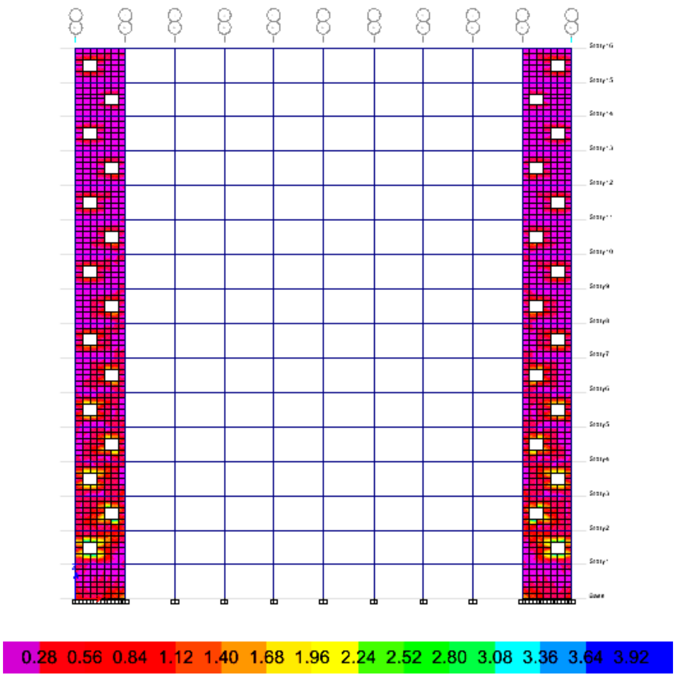

Figure 20: Stress distribution in shear wall with staggered openings

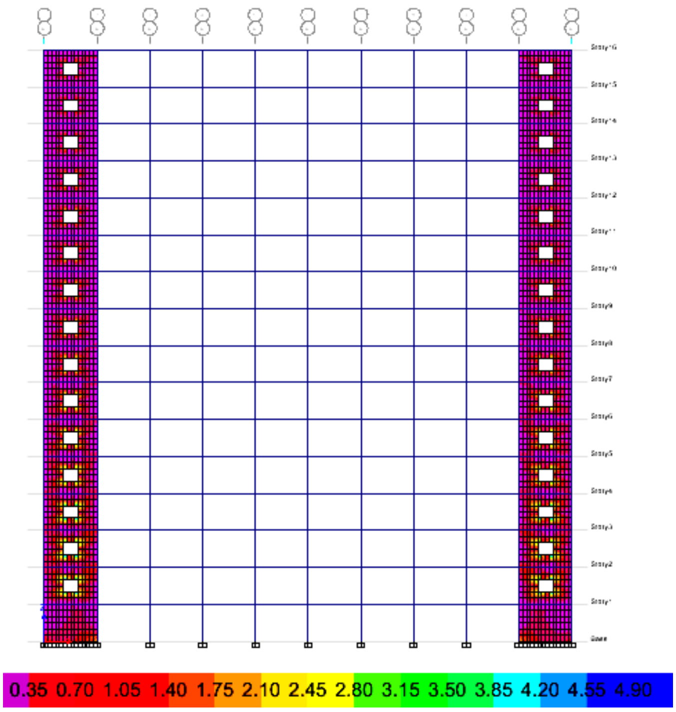

Figure 21: Stress distribution in shear wall with vertical openings

From the shell stress diagram clearly observed that the stress around the opening in staggered shear wall is less compared to vertically ordered opening.

IV.CONCLUSION

1. From this study obtain the position of opening cause the seismic behavior of the structure.
2. The staggered opened shear wall structures have less displacement compared to regular opened shear wall structures, can reduce 4% of displacement compared to regular opened shear wall.
3. The models with 'T' shape plan perform better in controlling displacement value, with least storey drift when compared to other irregular models.
4. By comparing the position of shear wall, the staggered opened shear wall at corner can reduce 10% displacement compared to shear wall at periphery for all models.
5. The staggered opened shear wall at corner shows lesser drift value compared to shear wall at periphery.
6. The I shaped model shows high displacement and drift compared to other models
7. The base shear is found to be much lesser for shear wall with staggered openings compared to regular opening.
8. The base shear is less for 'T' shaped plan structure and more for 'I' shaped structure
9. And the base shear is less for shear wall at periphery of the structure.
10. Shell stress around the staggered openings is 18% less when compared with the stress around the vertical ordered opened shear wall.
11. Thus the staggered openings in shear wall shows highly advantageous and they were provide better lateral resistance strength to the structure compared to regular opened shear wall.
12. The structure with irregularity when provided with shear wall, the overall performance is enhanced. Especially the shear wall provided at corner will perform better in resisting lateral load in high rise structures.

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VII. REFERENCES

[1] Mosoarca Marius,(2012),Seismic Energy Dissipation in Structural Reinforced Concrete Walls with Staggered Openings, Journal of Applied Engineering Sciences, Volume 2(15), Issue 1(2012), pp 71-78

[2] AarthiHarini T, (2015), Behavior of R.C. Shear Wall with Staggered Openings under Seismic Loads, International Journal for Research in Emerging Science and Technology, Volume-2, Issue-3, pp 95-96

[3] S.H.Jagadale,(2016), Analysis of Various Thicknesses of Shear Wall with Opening and without Opening and their Percentage Reinforcement, International journal of Research in Engineering, Science and Technologies, Volume 2, pp 212-218

[4] Anand S. Attal and Jyoti P. Bhusari,(2016), Effect of Opening in Shear Wall, International Journal of

Engineering Research, Volume No.5 Issue: Special 3, pp: 572-577

[5] Hamdy H.A and Abd-el-rahim, (2010), Influence Of Requisite Architectural Openings On Shear Walls Efficiency, Journal of Engineering Sciences, Vol. 38, No. 2, pp. 421-435

[6] F.V Yanez and R. Park andT.Paulay,(1992), Seismic Behavior of Walls with Irregular Openings, Earthquake Engineering Tenth World Conference, pp 3303-3308

[7] RaadDheyabKhalaf, (2016), Study of Plan Irregularities with Different Shear Wall Location in a High Rise Reinforced Cement Concrete Structure under Dynamic Loads, International Journal of Engineering Science and Computing, Volume 6 Issue No. 4, pp 4513-4520

[8] Rahul RavindraNaik and Rajesh H. B, Mukul S(2015), Study of an Irregular Plan with Different Orientation of Shear Wall in a High Rise Structure, The International Journal Of Science &Technoledge, Vol 3 Issue 5, pp 181-188

[9] Murali Krishna and Dr. E Arunakanthi,(2014), Optimum Location of Different Shapes of Shear Walls in Unsymmetrical High Rise Buildings, International Journal of Engineering Research & Technology, Vol. 3, Issue 9 pp 1099-1106

[10] Arvind R. Patel,(2015), Effect on Location of Shear Wall with Opening in RC Irregular Structure Subjected to Seismic Load & blast load, International Journal of Innovative Research In Technology,Volume 2, Issue 1, pp 211-218

[11] Saleem Malik Yarnal andSagar S Allagi(2015), Non-Linear Analysis of Asymmetric Shear Wall with Openings, International Journal of Engineering Research & Technology Vol. 4, Issue 08, pp 467-471

[12] Harikapriya N, (2016), Study on Shear walls With and Without Openings, International Journal of Scientific Research in Science, Engineering and Technology, Volume 2, Issue 2, pp 49-55

[13] Tejus S, (2015), Numerical Investigation on Concrete Shear Wall with Different Percentages of Openings, International Research Journal of Engineering and Technology, Volume 2, Issue 4, pp1407-1414

[14] M R Suresh1 and AnanthShayanaYadav,(2015), The Optimum Location Of Shear Wall In High Rise R.C Buildings Under Lateral Loading, International Journal of Research in Engineering and Technology, Volume 4, Issue 6, pp 184-190

[15] Varsha R. Harne, (2014), Comparative Study of Strength of RC Shear Wall at Different Location on Multi-storied Residential Building, International Journal of Civil Engineering Research, Volume 5, Number 4, pp 391-400

[16] Merin Mathews, (2016), Structural Behavior Of Coupled Shear Wall Based On Nonlinear Finite Element Analysis, International Conference on Structural Engineering &Construction Management, Volume 3, No 1, pp 100-104

[17] PoojaHegde, (2014), Effect of Base Opening in Reinforced Concrete Shear Wall, Civil and Environmental Research, Vol.6, No.8, pp 72-82

[18] Lakshmi K.O and Prof. JayasreeRamanujan, (2014), Effect of shear wall location in buildings subjected to seismic loads, ISOI Journal of Engineering and Computer science, Volume 1, Issue 1, Page No. 07-17

[19] Ashok Kankuntla, (2016), Effects of Openings in Shear Wall, IOSR Journal of Mechanical and Civil Engineering, Volume 13, Issue 1, pp 1-6

[20] Vishal A. Itware,(2015), Effects of Openings in Shear Wall on Seismic Response of Structure, International Journal of Engineering Research and Applications, Vol. 5, Issue 7, pp 41-45