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Analysis of G+25 RCC Bare Framed Structure with Shear Wall Under the Effect of Seismic Loads

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Abstract - Before 1960's the buildings were designed for the gravity loads and check the resistance against it. Due to the increasing population and the unavailability of the space for the people, there is rapid growth in the field of the tall structures. Usually the structures are designed for the gravity loads and the lateral loads. Due to the increasing growth of the height of the structures now a day, they are not able to withstand the seismic forces. To increase the strength and stability of the structures shear wall is introduced. Shear walls are having very high in-plane strength and stiffness resisting large gravity loads and also there is fact saying that "stiffer the structure it attracts large seismic forces". In the tall structure the main aim is to give the lateral stability to the structure. In this project G+ 25 RCC framed structures asymmetric in its plan with the shear wall is used. The shear wall is placed at different locations i.e. at center, intermediate, corner and core. The results analyzed are shear force and bending moment. Models are studied in comparison with the conventional building that is without shear wall. Comparing all the results tabulated it is seen that shear wall placed at corner gives the best result and is capable to resists larger seismic forces compared to other locations.

***Key Words*: Shear wall, unsymmetrical, Bending moment and shear force etc.…**

1. INTRODUCTION

Shear wall is a vertical structural member resisting combined effect of shear moment and axial load produced by gravity and earthquake load transfer to the wall from other structural member. Multistoried building requirement is RCC wall with shear wall. It is a structural member placed at different positions in a building from the top parapet level to the foundation to resist seismic forces which are parallel to the plane of the wall. They are provided both along the length and breadth of the building. The wall play important role in active seismic zones. Shear forces during earthquake increases on the structure. [1]

Shear wall have more stiffness and strength and control the lateral displacement during earthquake. Shear wall are provided to the structure, shear wall placed dual action, resisting both gravity as well as lateral loads. These are regular in plan and elevation. Shear wall minimize earthquake damage to structural damage and non-structural damages. RCC shear wall is easy to construct and for reinforcement detailing.

2. OBJECTIVE OF THE PROJECT

In this project G+25 RCC framed structure with shear wall is analyzed under the effect of seismic loads such as seismic forces for zone III considered.

2.1 Type of structure analyzed

1. RCC Bare frame without shear wall
2. RCC Bare frame with shear wall

2.3 Locations of shear wall

1. Structure with shear wall at intermediate
2. Structure with shear wall at corner
3. Structure with shear wall at middle
4. Structure with shear wall at core

In this project analysis of structure is done using STAAD PRO V8i, the comparison of structural behavior is observed such as bending moment and shear force. Providing perfect model with perfect shear wall to this type of building after results and discussion.

3. LITERATURE REVIEW

3.1 Gagadeep and Adity Kumar (June 2018) [3].

An earthquake area thought the globe it cause effect to the structures. It leads to damage of social life. Losses can be found out due improper design of the structures. This paper is having unsymmetrical building. The placement of external and internal shear wall fewer than two support condition at the end that is rigid and spring, it is analyzed with elastic half space approach. So Staad.pro V8i is used for results when analyzed terms of shear force, bending moment, settlement, and axial load, in beams and columns. Interactive analysis it shows that axial load in externally placed columns increases comparison to fixed base. Whereas the axial load in the internal column shows decreasing and bending moment increasing up to 65% and decreasing 78%. The storey drift 25% for the internally placed columns when soil structure interaction was incorporates in the analysis.

3.2 Manjeet Dua, Er Sumit Rana and Nitin Verma (September 2018) [4].

The structure used for analysis is G+15 and the loading applicable to all the building is same and also same geometry, same zone and also soil condition will be same. The main difference is use of shear wall with concern about all the forces acts on a building, its own weight and also soil bearing capacity. The external forces act on a column, beam and reinforcement .It should be good enough to sustain these forces and soil passes the foundation for a loose soil so we prefer the pile foundation. Sometime manual calculation take much time so we used STAAD PRO V8i will make it easily able because this software solved typical problems like natural period or frequency, seismic analysis and static analysis along with code used. Staad.pro V8i main advantage is to the point results obtained.

The structural vertical member that is able to resist combination of moment, shear and axial load it induced by lateral load and gravity load

3.3. Sachdeva Gourav ME Scholar, Jain Rajesh (October 2015) [5].

The main point of this work is to analyze RC framed structures with shear wall of different locations. To know the ability of shear wall resisting the loads at various locations study is carried out. It is a designed structural wall to withstand the forces in the plane of wall. Seismic and other forces. 6 Storey is used and seismic zone 3, Rock type used id hard, and SMRF building (Special Moment Resisting Frame) Staad.pro V8i is used for calculating for some parameters. Like nodal displacement, maximum reaction and total weightage of reinforcement to compare with others. From all we model 4 is most efficient compare to other models.

4. METHODOLGY

For the purpose of analysis of the given structure are G+25. The difference between each floor is 3m.The plan is unsymmetrical in C shape dimension will be 17.50X14.50 .The grid spacing in X direction 3.5m and in Z direction is 4.5m.using STAAD PROV8i four models are taken for the analysis with shear wall at corner, Intermediate, core, middle and it is analyzed with structure without shear wall that is conventional building.

Results in parameter taken are Bending moment and Shear force from software. T he IS codes used for the seismic analysis is IS 456-2000 for the gravity load ,IS 1893-2002 for the earthquake load (lateral load) and IS 875 part I and part II IS used for the design purpose.

Model 1 : Conventional building

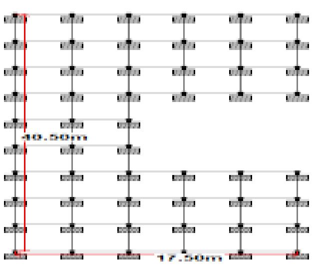


Fig 1: Conventional building plan

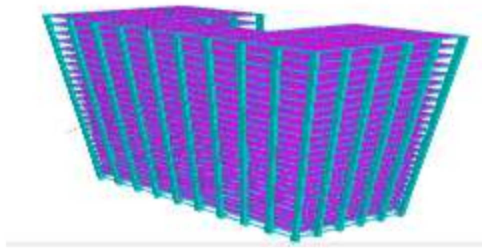


Fig 2: 3D view of conventional building

Model 2 : Bare frame with shear wall at intermediate

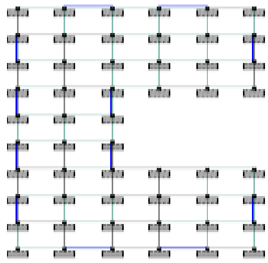


Fig 3: Bare frame with shear wall at intermediate plan

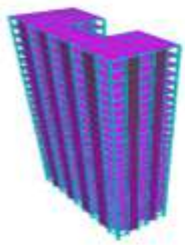


Fig 4: 3D view of shear wall at intermediate building

Model 3: Bare frame with shear wall at corner

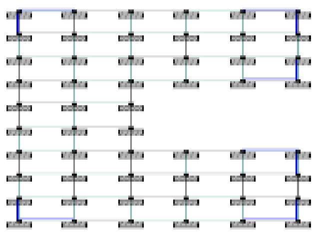


Fig 5: Bare frame with shear wall at corner plan

Fig 6: 3D view of shear wall at corner building

Model 4: Bare frame with shear wall at middle

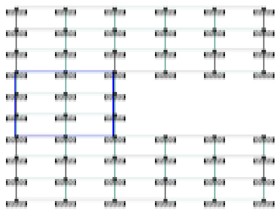


Fig 7 :Bare frame with shear wall at middle plan

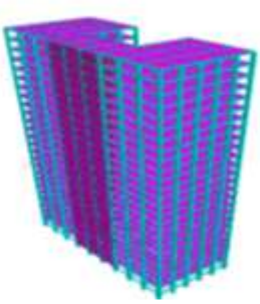


Fig 8: 3Dview of shear wall at middle building

Model 5: Bare frame with shear wall at core

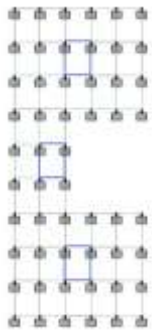


Fig 9: Bare frame with shear wall at core plan

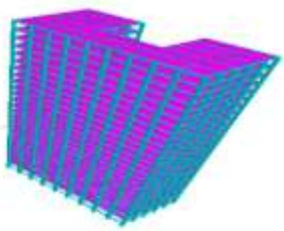


Fig 10: 3D view of shear wall at core building

4.1 LOAD AND LOAD COMBINATION

1. Number of stories = G+ 25
2. Height of building = 75m
3. Floor to Floor height = 3m
4. Total depth of the slab =150mm
5. Unit weight of RCC is assumed = 25kN/m^3

SIZE OF BEAMS, COLUMNS.

SI NO	PARTICULARS	SIZE(m)	NO OF FLOORS
1	BEAM	0.3X0.3	0 - 25
2	BEAM	0.3X0.65	3 - 25
3	COLUMN	0.45X0.65	0 - 3
4	PLATE THICKNESS	0.15	0- 25

4.1.1LOADING ON STRUCTURE

- **Dead load:**
  - Assuming slab thickness is 150mm
  - Self-weight of beam, column will be applied directly in software
  - Floor load and ceiling finish = 2kN/m^2(floor load)
- **Live Load**
  - Live load = 3kN/m^2
- **Seismic forces**

Consuming zone 3 as per IS 1893-2002 applied on structure

Time period = 0.075 X h $^{(0.75)}$ = 0.075X (75) $^{(0.75)}$ = 1.91000 sec

SI NO	SEISMIC PARAMETERS	
1	Zone	III
2	Zone factor	0.16
3	Reduction factor	5
4	Importance factor	1
5	Soil condition	Hard
6	Time period	1.91 sec

4.1.2 LOAD COMBINATION (IS 875 Part 5)

- 1.2(DL+LL+EQ+X)
- 1.2(DL+LL+EQ-X)
- 1.2(DL+LL+EQ+Z)
- 1.2(DL+LL+EQ-Z)

5. RESULTS

5.1 BENDING MOMENT RESULTS

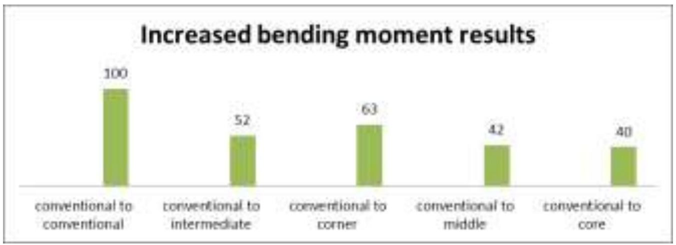
5.1.1 REDUCED BENDING MOMENT RESULTS +X = (A-B)/A

A – Conventional building bending moment results

B – All other locations

BEAM NO 78

COMPARING BENDING MOMENT RESULTS TO ALL OTHER LOCATION IN + X DIRECTION		
conventional to conventional	100	%
conventional to intermediate	52	%
conventional to corner	63	%
conventional to middle	42	%
conventional to core	40	%



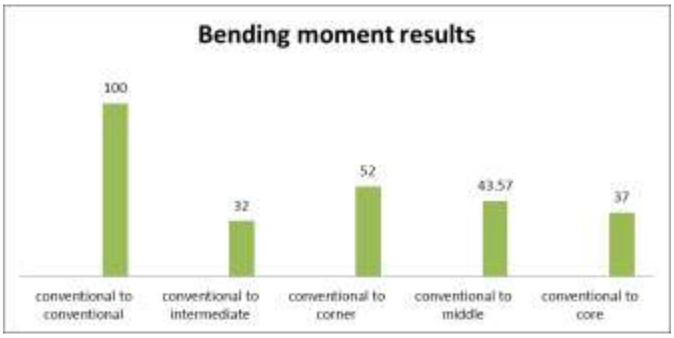
5.1.1.1Bending moment results comparison between conventional to all other locations

5.1.2REDUCED BENDING MOMENT RESULTS -X = (A-B)/A

A – Conventional building bending moment results

B – All other locations

COMPARING BENDING MOMENT RESULTS TO ALL OTHER LOCATION IN -X DIRECTION		
conventional to conventional	100	%
conventional to intermediate	32	%
conventional to corner	52	%
conventional to middle	43.57	%
conventional to core	37	%



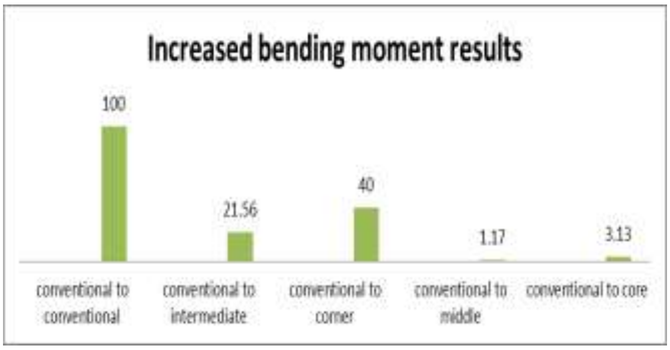
5.1.2.1Bending moment results comparison between conventional to all

5.1.3REDUCED BENDING MOMENT RESULTS +Z = (A-B)/A

A – Conventional building bending moment results

B – All other locations

COMPARING BENDING MOMENT RESULTS TO ALL OTHER LOCATION IN +Z DIRECTION		
conventional to conventional	100	%
conventional to intermediate	21.56	%
conventional to corner	40	%
conventional to middle	1.17	%
conventional to core	3.13	%



5.1.3.1 Shear force results comparison between conventional to all other locations

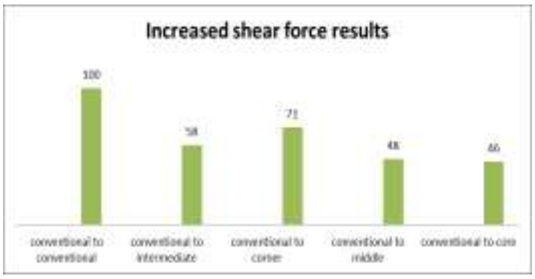
5.2 SHEAR FORCE RESULTS

5.2.1REDUCED SHAER FORCE RESULTS +X = (A-B)/A

6. A – Conventional building shear force results
7. B – All other locations

BEAM NO 78

COMPARING SHEAR FORCE RESULTS TO ALL OTHER LOCATION IN + X DIRECTION		
conventional to conventional	100	%
conventional to intermediate	58	%
conventional to corner	71	%
conventional to middle	48	%
conventional to middle	46	%



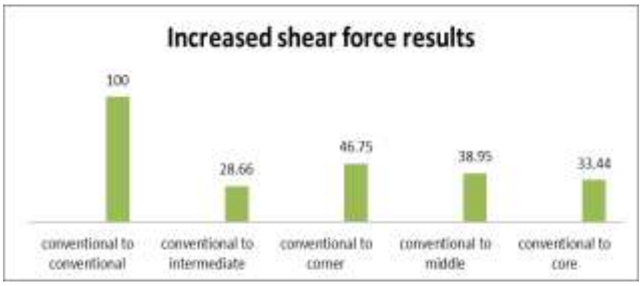
5.2.1.1 Shear force results comparison between conventional to all other locations

5.2.2 REDUCED SHEAR FORCE RESULTS -X = (A-B)/A

A – Conventional building shear force results

B – All other locations

COMPARING SHEAR FORCE RESULTS TO ALL OTHER LOCATION IN - X DIRECTION		
conventional to conventional	100	%
conventional to intermediate	28.66	%
conventional to corner	46.75	%
conventional to middle	38.95	%
conventional to middle	33.44	%



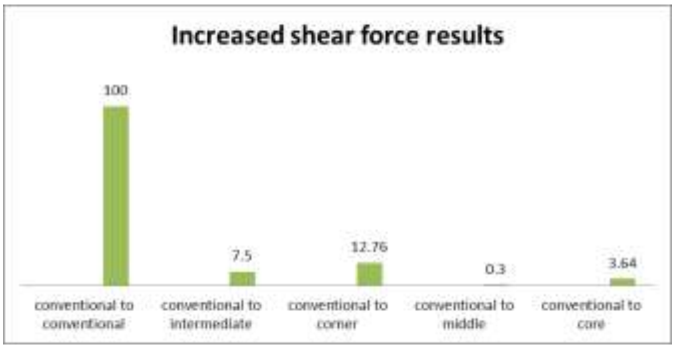
5.2.2.1Shear force results comparison between conventional to all other locations

5.2.3REDUCED BENDING MOMENT RESULTS +Z = (A-B)/A

A – Conventional building shear force results

B – All other locations

COMPARING SHEAR FORCE RESULTS TO ALL OTHER LOCATION IN +Z DIRECTION		
conventional to conventional	100	%
conventional to intermediate	7.5	%
conventional to corner	12.76	%
conventional to middle	0.3	%
conventional to middle	3.64	%



5.2.3.1 Shear force results comparison between conventional to all other locations

6. CONCLUSIONS

6.1 BENDING MOMENT

- When bending moment is considered, having shear wall at corner it is reduced by 63% in +X direction, 52 % in – X direction and 40% in +Z direction when compared with conventional building.

6.2 SHEAR FORCE

- When Shear force is considered , having shear wall at corner it is reduced by 71% +X direction, 52% in – X direction and +Z direction when compared with conventional building.

Comparing all the results tabulated it is seen that shear wall placed at corner gives the best result and is capable to resists larger seismic forces compared to other locations.

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