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Analysis of G+25 RCC Structure with shear wall under the effect of seismic loads using STAAD Pro V8i

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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 RC 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 base shear, displacement, story drift, 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, Displacement, Base shear, Story drift 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 place important role in active seismic zones. Shear forces during earthquake increases on the structure.

Shear wall have more stiffness and strength. To control 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.

1.1 LITERATURE REVIEW

1.Venkata Sairam Kumar, Surendra Babu, Usha Kranti Asst. Professor Dept of Civil Engineering, RVR and JC college of engineering , Guntur-19, AP India (February 2014).

The structural systems which provide stability to structure from lateral loads like seismic and wind load is called shear walls. These are constructed by unreinforced masonry, reinforced concrete, plywood. These systems are divided into coupled shear wall, shear wall frames, shear panels and staggered walls. This shear wall resists lateral loads in the lower portion of the building and frame supports. The lateral loads in upper portion of building which is suitable for soft storey high rise building.

2. Bhalchandra P. Alone and Dr. Ganesh Awchat Dept. of Civil Engineering. Gurunanak Institute of engineering and management Kalmeshar Nagpur Maharashtra (August 2017).

This is the case study on seismic analysis of high rise building system (G+3basement+50) storey RCC by Staad.pro V8i with using IS codes. It is one of the most destructive phenomenon of nature is a severe earthquake and this highly impossible to prevent an earthquake from occurring, but the damaged to the buildings it can be controlled through a proper design and detailing therefore it is seismic analysis and design to structures against collapse.

Structural designing is a reducing damage during an earthquake it makes the structure quite uneconomical. This study understanding the result from Staad.pro V8i software under gravity load and IS code IS456-2000 and IS1893-2002.

3. Mohit Sheode (September 2013).

Stress analysis is the analysis of strength of solids if is based on theories of failure as proposed by researches like Gust, Misses Henks, Hais and Mohr. There is no great uniformly of opinion in determining elastic failure due to complex nature of failure. This paper use for design purpose IS456-2000 using Staad.pro software finally concludes with results of of maximum tresca stress are found to be desire as for analyzing the stress of shear wall is a concerned for the frame. It is designed as per IS456-2000 it is used for low height building. Leeward facing one is stressed higher, particularly at mid height level in comparing with windward facing shear wall.

4. Prof.Rahul T Pardeshi, Prof.Pratiksha M.Bhadange Somesh V Hasija, Saddam Hussain I Khan, Mayar B Marade, Ramesh H Pansare, Krishna M. Rupchandan (2017).

The study is based on the study of without and with shear wall. Little work founded to analysis of with shear wall at various locations.. So we use the Staad.pro V8i to analyze the structure The experiment investigation in present work is the reduction the size of the member to make structure economical and efficient .The main aim of the study is to study the effects of the bending moment and shear force distribution . From outer side it was most efficient and resulting 24.6% reduction in base shear as comparison to original building. Shear wall located towards the shorter column are more effective with reference to other locations.

2. METHODOLGY

For the purpose of analysis of the given structure are G+25. The difference between each floor is 3m.the plan is irregular 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 Pro V8i 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 Base shear, Displacement, Storey drift, 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.

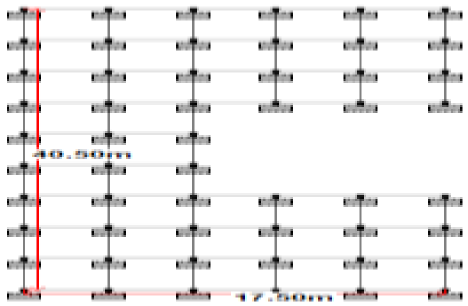


Fig 1: Conventional building plan

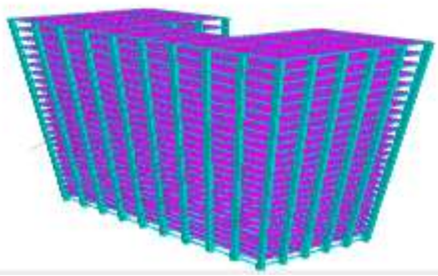


Fig 2: 3D view of conventional building

Model 2 : Bare frame with shear wall at intermediate

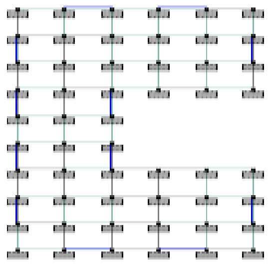


Fig 3: Bare frame with shear wall at intermediate plan

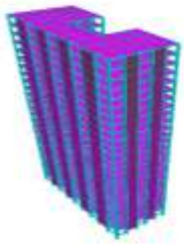


Fig 4: 3D view of shear wall at intermediate building

Model 3: Bare frame with shear wall at corner

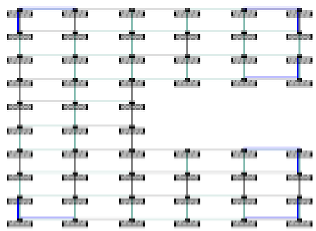


Fig 5: Bare frame with shear wall at corner plan

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

Model 4: Bare frame with shear wall at middle

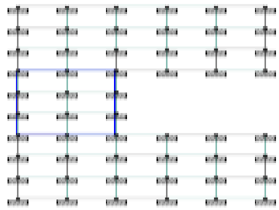


Fig 7 :Bare frame with shear wall at middle plan

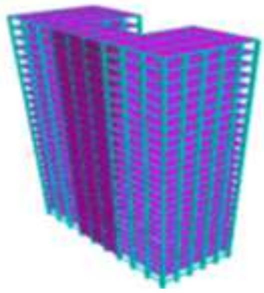


Fig 8: 3Dview of shear wall at middle building

Model 5: Bare frame with shear wall at core

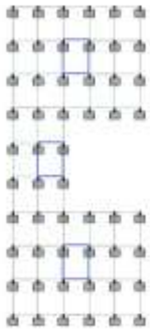


Fig 9: Bare frame with shear wall at core plan

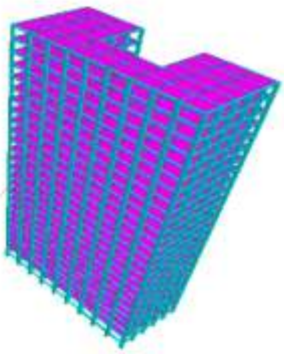


Fig 10 : 3D view of shear wall at core building

LOAD AND LOAD COMBINATION

- PRELIMINARY DATA :
  - structure = Tall structure
  - Layout = as shown below
  - Zone = III Response
  - Zone factor = 0.16
  - Reduction factor = 5
  - Importance factor = 1
  - Soil condition = Hard
  - Number of stories = G+ 25
  - Height of building = 75m
  - Floor to Floor height = 3m
  - Total depth of the slab = 150mm
  - Size of all beam = 300mmx300mm
  - Size of columns = 300mmx450mm
  - and 300mmx650mm
  - Size of shear walls = 3000x200mm
  - Unit weight of RCC is assumed = 25kN/m^3
  - Self weight of slab = 3.75 kN/m^2
  - Weight of floor finish(FF) = 2kN/m^2 and ceiling finish
  - Live load on floor = 3kN/m^2
  - Live load on roof = 1.5kN/m^2
  - seismic force = considering zone III as per IS1893-2002 Applied on structure
  - Elastic modulus of concrete = 21718Mpa

LOADING ON STRUCTURE

Dead load

- Assuming slab thickness is 150mm
- Self-weight of different members (will be applied directly in software)
- Floor load
- Self-weight of slab = 1x0.15x25 = 3.75kN/m^2
- Floor load and ceiling finish = 2kN/m^2

Total load = 5.7kN/m^2

1. LIVE LOAD (IS 875 part 2)
2. SEISMIC FORCES
   Consuming zone 3 as per IS 1893-2002 applied on structure.

LOAD COMBINATION (IS 875 Part 5)

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

2.1RESULTS

- Considering all location results are obtained reduced displacement results in shear wall at middle in +Z direction when compared to conventional building.

Conventional tomiddle	DIsplacement	percentage
G	29.4	%
5	61.22	%
10	64.86	%
15	66.29	%
20	66.33	%
25	64.63	%

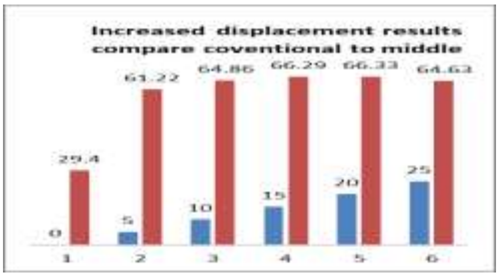
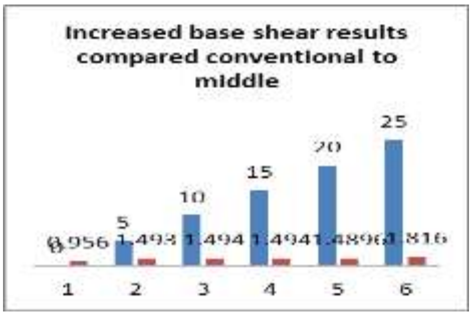


Fig 11: Increased displacement results compare conventional building

- When base shear is consider, having shear wall at middle it is less increased by 0.956% compared to conventional building and maximum base shear obtained shear wall at intermediate increased base shear 3.4 % when compared to conventional building.

Conventional to middle	Base shear	percentage
G	0.956	%
5	1.493	%
10	1.494	%
15	1.494	%
20	1.4896	%
25	1.816	%



Conventional to Intermediate	Base shear	percentage
G	1.156	%
5	1.486	%
10	1.812	%
15	1.814	%
20	1.811	%
25	3.6	%

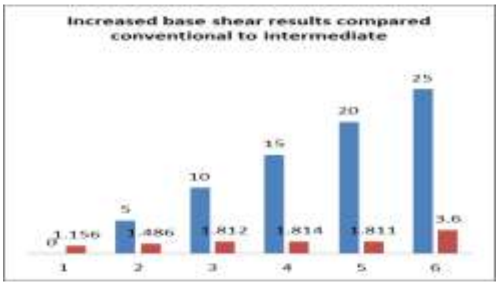


Fig 11: Increased base shear results compare conventional building

- Shear wall placed at middle is giving maximum storey drift 64.47% compared to other loactions.

No of floors	Storey drift	percentage
G	41.52	%
5	64.47	%
10	54.38	%
15	43.84	%
20	23.45	%
25	19.81	%

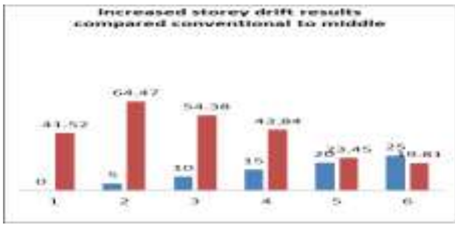


Fig 11: Increased storey drift results compare conventional building

3. CONCLUSIONS

3.1 DISPLACEMENTS

- Considering shear wall at middle, it is reduced by 66.33% comparing with conventional in +Z direction.

3.2 BASE SHEAR

- When base shear is consider, having shear wall at middle it is less increased by 0.956% compared to conventional building.
- Comparing with all the locations of the shear wall, shear wall when placed at intermediate gives maximum result ie; Maximum base shear is increased by 3.4% compared with conventional building

3.3 STOREY DRIFT

- Shear wall placed at middle is giving higher result in case of storey drift when compared with other locations
- It will be reduced by 64.47% when compared to conventional building.

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

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