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SIGNIFICANCE OF SHEAR WALL IN MULTISTORY BUILDING WITH SEISMIC ANALYSIS USING ETABS

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Abstract - *: In the past decades shear wall is one of the most appropriate structural components in multi storied building. Shear wall contributes large stiffness and strength to the building in the direction of its orientation during earthquake which is often neglected during the design of multi storied building. Shear wall is one of the most commonly used lateral load resisting system in raised building. Shear wall significantly reduces lateral sway and thereby reduces damage to structure. When the buildings are tall and consist of heavy components such as beams, columns, slabs of heavy materials and have congestion due to their large size based on the materials used and to overcome this we use shear wall which reduces the size by replacing materials such as stones, bricks etc by reinforced concrete, which is strong in nature as compared to framed structures. For modelling, analysis and design of shear walls in multi-storeyed building AUTO CADD and E-TABS were used*

1. INTRODUCTION

Shear walls are vertical elements of the horizontal force resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsion) forces. These forces can literally tear (shear) a building apart. Reinforcing a frame by attaching or placing a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints. Shear walls are especially important in high-rise buildings subjected to lateral wind and seismic forces. Shear wall buildings are usually regular in plan and in elevation. However, in some buildings, lower floors are used for commercial purposes and the buildings are characterized with larger plan dimensions at those floors. In other cases, there are setbacks at higher floor levels. Shear wall buildings are commonly used for residential purposes and can house from 100 to 500 inhabitants per building

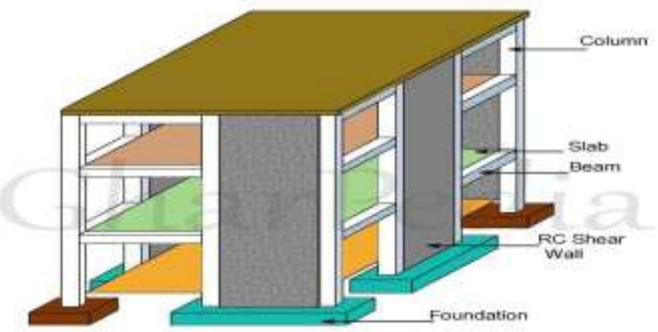


Fig 1: OVERVIEW OF THE SHEAR WALL

2. OBJECTIVES OF THE PROJECT

- To calculate the safe bearing capacity of soil
- To analysis and compare the results of story drift and story displacement for with and without shear wall
- Performance of shear wall in earthquake zones.
- Location of shear walls at appropriate locations based on the elastic and inelastic analysis
- To reducing structural area and increasing the utilization area by providing shear wall instead of RCC framed structure.
- To prepare all the structural details of element of structure by using AUTO CADD 2007 and E-TABS 2016

3. METHODOLOGY

Analysis is carried out in Manual method by Kani's method and also by using software i.e. ETABS and are compared and seen that there is an error of 5 to 10%,

Linear Static: The linear static analysis method is adopted for the building analysis in a seismic zone and is based on the assumption that the building is responding in its fundamental mode. The analysis method represents the behavior of the building during the earthquake ground motion; typically it's defined by a seismic design response spectrum analysis where a series of forces are acting on the building. In the state where the behavior of the building is in its fundamental mode, the building should not twist and it should be a low rise structure. Many building codes have extended the applicability of this method to make sure it holds good for the high rise structures with low levels of twisting. To analyze the effects of a structure due to "yielding", the modification factors also known as reduction factors are used as an aid for many building codes that reduce the design forces.

4. PRELIMINARY TEST RESULTS

4.1. CORE CUTTER TEST:

Field density of soil = W/V=21.47KN/cum

Field moisture content =m =9.94%

Field dry density=19.52KN/cum

4.2 DIRECT SHEAR TEST:

TABLE 1: SHEAR TEST VALUES

NORMAL LOAD/STRESS(N/mm²)	DIVISIONS	SHEAR STRSS(Kg/ cm²)
0.4	34	0.3
0.9	57	0.4907
1.4	84	0.722
1.9	95	0.817
2.4	121	1.04

Proving ring weight=25Kg

Total number of divisions = 88

1div = 25/88 = 0.2840 Kg/div

1div = 0.2840/6*6 = 0.00789Kg/ cm²

Shear stress = 34 X 0.00789

= 0.3Kg/ cm²

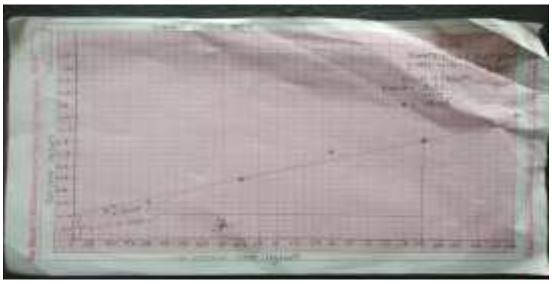


PLATE 1: SHEAR TEST GRAPH

4.3. SAFE BEARING CAPACITY OF SOIL: 154KN/m²

5. MODELLING

5.1. MODELLING OF STRUCTURE WITOUT SHEAR WALL

The architectural plans and elevation of the Residential building are enclosed in annexure. Suitable sizes for beams and columns are assumed initially and the three dimensional structural frame corresponding to the Residential building is taken. The bottom ends of the columns are assumed to be fixed for the purpose of analysis .tie beams are provided for the basement level to make the columns short and also to take the wall loads if any. The loads considered in the analysis are 1) dead loads 2) live loads 3) wall loads and 4) earthquake loads. All these loads have been calculated as per IS 875. The live load assumed for floors and roof slabs are 3KN/m². The dead loads due to self weight, floor finishes and partitions are also calculated.

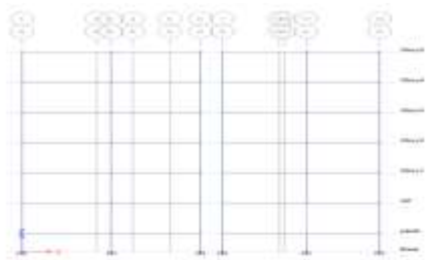


PLATE 2: ELEVATION

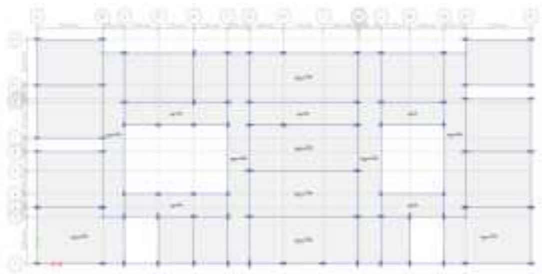


PLATE 3: PLAN

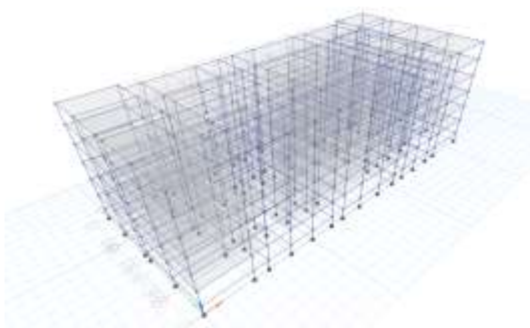


PLATE 4:3D MODEL

5.2. MODELLING OF THE STRUCTURE WITH SHEAR WALL

5.2.1. SHEAR WALL PROPERTY:

Wall material : m30 grade

Modeling type : shell thick

Thickness of shear wall : 200mm

Position of shear wall : at the centre of the building (lift purpose)

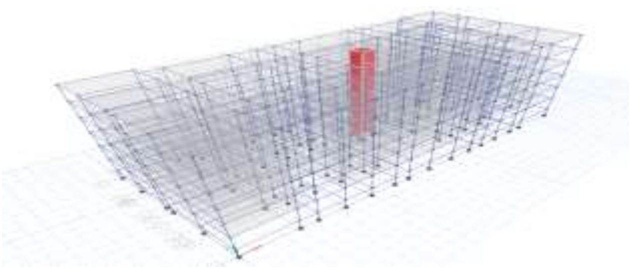


PLATE 5: 3D MODEL

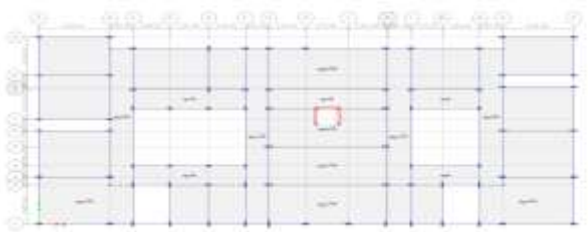


PLATE 6: PLAN WITH SHEAR WALL

6. ANALYSIS WITH DEFINED LOAD PATTERNS AND LAOD COMBINATIONS

6.1 LOAD PATTERNS

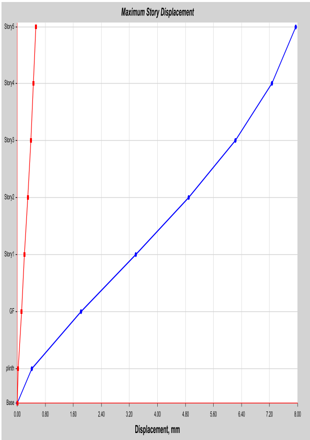
The load acting on the structure is considered as follows:
1. Dead loads
2. Live loads
3. Wind load: [IS 875 1987]
4. Earthquake loads: [IS 1893 2002]
5. Wall loads
6. Floor finish

6.2 LOAD COMBINATIONS

1. 1.5[DL+LL]
2. 1.5[DL+EQX]
3. 1.5[DL+EQY]
4. 1.5[DL-EQX]
5. 1.5[DL-EQY]
6. 1.2[DL+LL+EQX]
7. 1.2[DL+LL+EQY]
8. 1.2[DL+LL-EQX]
9. 1.2[DL+LL-EQY]

7. RESULTS

7.1 STORY DISPLACEMENT ALONG EQX



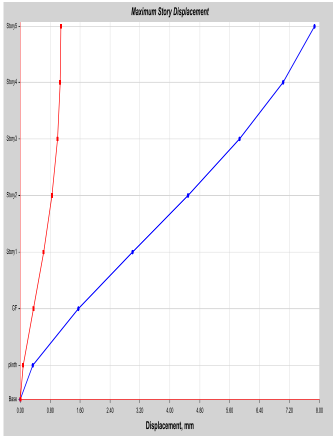
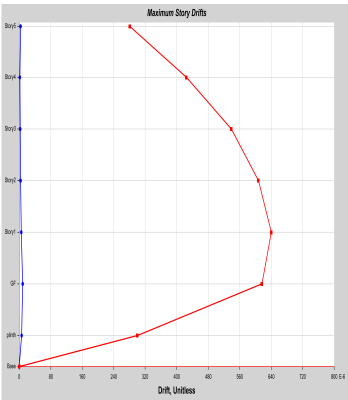


PLATE 7: WITHOUT SHEAR WALL PLATE 8: WITH SHEAR WALL

7.2 STORY DRIFT ALONG EQY



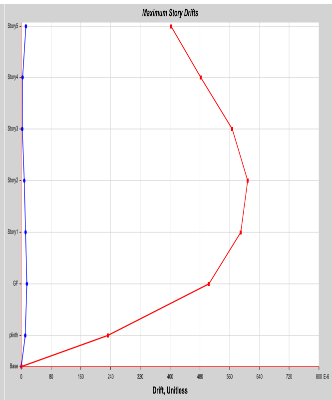


PLATE 9: WITHOUT SHEAR WALL PLATE 10: WITH SHEAR WALL

8. COMPARISION AND DISCUSSION

Storey drift and storey displacement of building with shear wall is less than that of without shear wall. The building will get the more stiffness by providing shear wall than building without shear wall. The shear wall location should be at center than the edges. Shear wall buildings gives less shear force and bending moment. Cost of shear wall construction is more than the normal buildings. Shear walls are most used now a day in high rise buildings because of its various advantages. By providing shear wall lateral forces can be resisted than normal buildings.

9. CONCLUSION

Thus shear walls are one of the most effective building elements in resisting lateral forces during earthquake. Shear wall construction will provide larger stiffness to the building there by reducing the damage to the structure. Not only its strength, in order to accommodate huge number of population in a small area tall structure with shear wall considered to be most useful. Hence developing countries like India, shear wall will be a backbone to our construction industry. Shear walls are easy to construct because reinforcement detailing of walls is relatively straight forward and therefore easily implemented at site.On the other hand shear walls present barriers, which may interfere with architectural and services requirement. Requires good fixing skills and concreting. Duration of construction is less compared to normal building because of skilled labours. It is economical in case wastage & storage materials.

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