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# ANALYSIS OF MULTISTORY BUILDING WITH SHEAR WALL USING ETABS SOFTWARE

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**Abstract -** *Recent days, structures are becoming more and more slender and susceptible to sway and hence dangerous in the earthquake. Researchers and engineers have worked out in the past to make the structures as earthquake resistant. After many practical studies it has shown that use of lateral load resisting systems in the building configuration has tremendously improved the performance of the structure in earthquake. Shear walls are mainly flexural members and usually provided in high rise buildings to avoid the total collapse of the high rise buildings under seismic forces.*

*In seismic design of multistoried building, shear walls are most common structure adopted to make the structure earthquake resistant. These are constructed to counteract the lateral loads caused by wind load and seismic loads. Shear walls provide adequate stiffness to the structure. So that the lateral drift will be in limits. Generally shear walls are the vertical cantilever which acts as a Column.*

***Key Words***: **Analysis, ETABS Software, Multistory Building, Shear Wall.**

## 1. INTRODUCTION

The Buildings, which appeared to be strong enough, may crumble like hours of cards during earthquake and deficiencies may be exposed. Experience gain from the recent earthquake of Bhuj, 2001 demonstrates that the most of buildings collapsed were found deficient to meet out the requirements of the present day codes. In last decade, four devastating earthquakes of world have been occurred in India, and low to mould intensities earthquake of world frequently. Due to wrong construction practices and ignorance for earthquake resistant design of buildings in our country, most of the existing buildings are vulnerable to future earthquakes. The first, and usually most important one, is the conception of an effective structural system that needs to be configured with due regards to all important seismic performance objectives, ranging from serviceability consideration to life safety and collapse prevention.

### 1.1 What is Shear wall?

Shear wall is a structural member in a reinforced concrete framed structure to resist lateral forces such as wind forces. Shear wall are generally used in high-rise building subject to lateral wind and seismic forces. In reinforced concrete framed structures the effects of wind forces increase in significance as the structure increases in height. Wind and seismic loads are the most common loads that shear walls are designed to carry.

### 1.2 Classification of shear wall

- simple rectangular types and flanged walls
- coupled shear walls
- rigid frame shear wall
- framed wall with in filled frames
- column supported shear walls
- core type shear wall

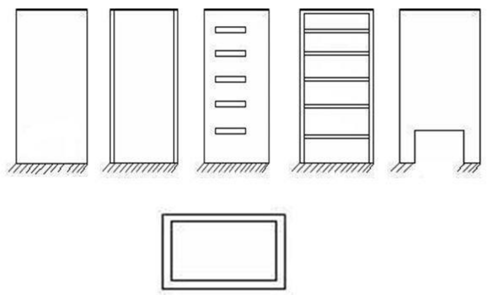

Figure 1:- Classification of Shear Wall

### 1.3 Types of Shear wall

- RC Shear Wall
- Plywood Shear Wall
- Mid ply Shear Wall
- RC Hollow Concrete Block Masonry Wall
- Steel Plate Shear Wall

## 2. METHODOLOGY

To determine the basic components like displacement and base shear this analysis has been carried using the software ETABS for the analysis purpose Equivalent static method, Response spectrum method and time history methods are adopted.

### 2.1 Equivalent static force method:

Depending on the location of the building site, identify the seismic zone and assign Zone factor (Z). Compute the seismic weight of the building (W). After that to determine the natural period of the building ($T_a$) by using code IS-1893 (2002), Using Ta and soil type (I / II / III), compute the average spectral acceleration ($S_a$/g).knowing Z, Sa/g, R and I compute design horizontal acceleration coefficient ($A_h$) using the relationship, From that we determine the seismic base shear($V_b$) by the following expression:

$$V_b = A_h W$$

Where,

$A_h$= Design horizontal acceleration spectrum value using the fundamental natural period Ta in the considered direction of vibration.

W = Seismic weight of the building the design horizontal seismic coefficient Ah shall be determined by the following expression:

$$A_h = \frac{Z\ I\ S_a}{2\ R_g}$$

Where Z = Zone factor as per table 2 of code; I = Importance factor as per table 6 of code:

R = Response reduction factors: R=3 for OMRF [ordinary RC moment-resisting frame] and R=5 for SMRF [special RC moment-resisting frame] are taken from code.

## 2.2 Building Dimension and Plan Details

Table 1:- Building Dimensions

| | |
|---|---|
| Height of storey | 3m |
| area of the building | 376m² |
| Height of the building | 60m |
| Number of stories | 20 Floor |
| Slab Thickness | 150mm |
| Grade of the concrete | M25 |
| Thickness of shear wall | 230mm |
| Grade of the steel | Fe-415 |
| Column size | 900X600mm |
| Beam size | 400x600mm |
| Seismic zone(Z) | III |
| Type of soil | II |
| Importance factor (I) | 1 |
| Response reduction factor (R) | 5 |
| Diameter of Bar in Column | 16mm |
| Diameter of Bar in Beam | 16mm |

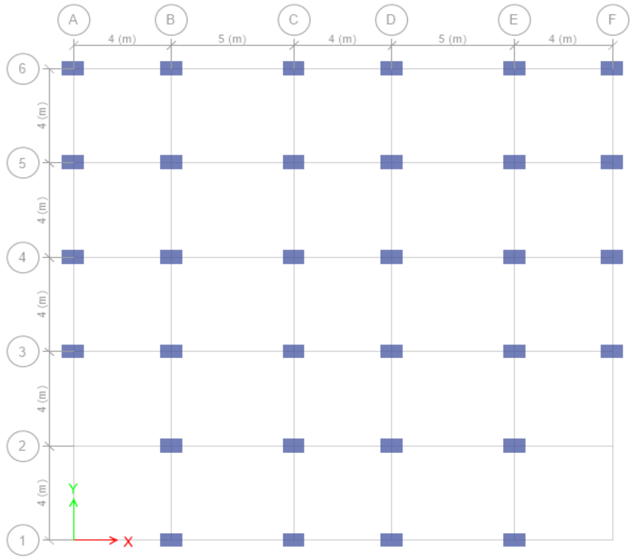


Figure 2:- Plan of Building

## 3. Model

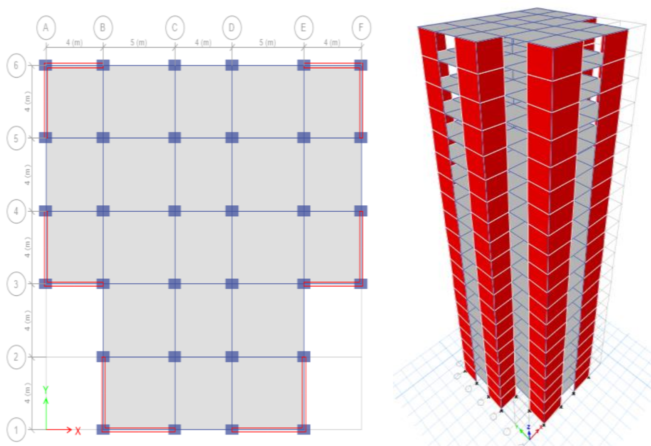

Figure 3:- shear wall at corner in building

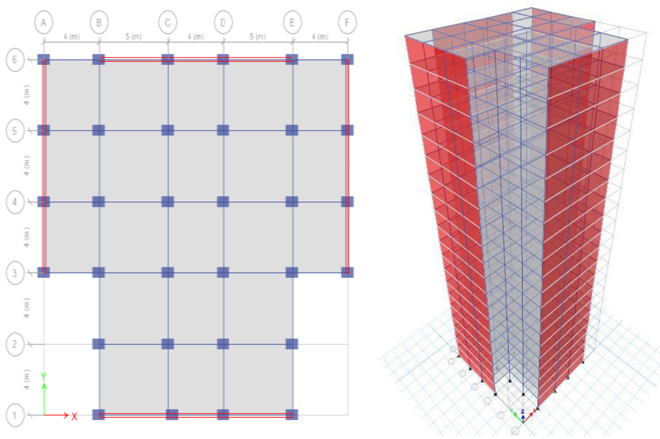

Figure 4:- shear wall at opposite direction in building

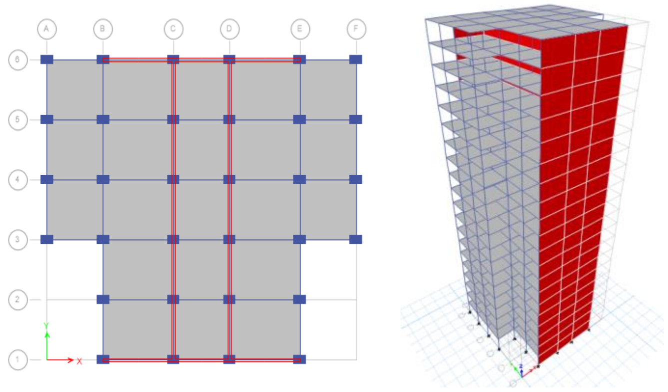

Figure 5:- "I" Shaped Shear wall in building

### 3.1 Define Loads and Load combinations

**Load combination:**

1. DL+LL
2. DL+EQ
3. DL+0.8LL+EQ
4. 1.5(DL+LL)
5. 0.9DL+1.5EQ
6. 1.5 (DL+EQ)
7. 1.2(DL+LL+EQ)

**Assign Load**

1. Dead Load: - 3.75 KN/m$^2$
2. Live Load: - 2 KN/m$^2$
3. Floor Finish: - 1.5 KN/m$^2$

## 4. RESULTS

Table 2: Maximum Displacement of Corner Shear Wall in building

| STORY NO | MAXIMUM DISPLACMENT IN MM |
|---|---|
| 20 | 101.129 |
| 19 | 93.640 |
| 18 | 87.292 |
| 17 | 80.773 |
| 16 | 74.257 |
| 15 | 67.787 |
| 14 | 61.390 |
| 13 | 55.092 |
| 12 | 48.926 |
| 11 | 42.927 |
| 10 | 37.137 |
| 09 | 31.598 |
| 08 | 26.357 |
| 07 | 21.462 |
| 06 | 16.966 |
| 05 | 12.929 |
| 04 | 9.418 |
| 03 | 6.493 |
| 02 | 4.235 |
| 01 | 3.016 |

Table 3: Maximum Displacement of Opposite direction Shear Wall in building

| STORY NO | MAXIMUM DISPLACMENT IN MM |
|---|---|
| 20 | 17.706 |
| 19 | 13.002 |
| 18 | 12.689 |
| 17 | 11.740 |
| 16 | 10.963 |
| 15 | 10.138 |
| 14 | 9.378 |
| 13 | 8.685 |
| 12 | 8.063 |
| 11 | 7.515 |
| 10 | 7.043 |
| 09 | 6.728 |
| 08 | 6.728 |
| 07 | 6.728 |
| 06 | 6.728 |
| 05 | 6.728 |
| 04 | 6.728 |
| 03 | 6.728 |
| 02 | 6.728 |
| 01 | 6.250 |

Table 4: Maximum Displacement of "I" Section Shear Wall in building

| STORY NO | MAXIMUM DIAPLACMENT IN MM |
|---|---|
| 20 | 30.936 |
| 19 | 25.727 |
| 18 | 23.872 |
| 17 | 22.326 |
| 16 | 20.664 |
| 15 | 19.003 |
| 14 | 17.376 |

| | |
|---|---|
| 13 | 15.795 |
| 12 | 14.270 |
| 11 | 12.812 |
| 10 | 11.431 |
| 09 | 10.140 |
| 08 | 8.949 |
| 07 | 7.870 |
| 06 | 6.918 |
| 05 | 6.106 |
| 04 | 5.505 |
| 03 | 4.963 |
| 02 | 4.639 |
| 01 | 3.675 |

## 5. CONCLUSION

In the present work the lateral structural system i.e., shear wall system considered for 20 story structure. Conclusions that can be made from the above study is by comparing the different location of shear wall in multi-story building. Form the study it is clear that gives less displacement value in opposite direction in shear wall building for moderate seismic zone. Providing shear wall at opposite direction performing better and more efficient than all other cases. The provision of shear wall position in an appropriate location is advantageous and the structure performs better for an existing or a new structure.

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**INDIAN STANDARD CODES OF PRACTICE**

[1]IS: 875(part 1) -1987 Dead Loads on Buildings and Structures, New Delhi, India.

[2]IS: 875(part 2) -1987 Live Loads on Buildings and Structures, New Delhi, India.

[3] IS-1893(part 1):2002, Criteria for Earthquake Resistant Design of Structures