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STRUCTURAL PERFORMANCE EVALUATION OF RCC STRUCTURE WITH SHEAR WALL BY USING ETABS SOFTWARE

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ABSTRACT

This study examines how buildings behave during earthquakes using equivalent Static method of analysis. Buildings with shear walls are now more common in earthquake-prone areas because they provide better resistance compared to buildings without shear walls.

The main objective of this study is to find the best location for shear walls and evaluate their effectiveness in RCC buildings. For this analysis, G+5 RCC building considered under seismic zones II with appropriate load combinations as per IS 875 part (I to v). The structures are analyzed using ETABS software. The shear walls start from the foundation and continue throughout the entire building.

KEYWORDS: RCC building, ETABS, Shear wall, G+5 RCC Building

1. INTRODUCTION

1.1.Shear Wall

A shear wall is a vertical structural element that resists lateral forces caused by wind and earthquakes. These forces act parallel to the wall, and the shear wall helps stabilize the building by preventing excessive swaying or collapse. Shear walls are typically made of concrete or masonry and are placed inside or outside a building.

A common design approach is using a shear core, where shear walls are placed around staircases or elevator shafts. This provides better resistance against seismic forces and enhances the overall stability of the structure.

When a lateral force, such as an earthquake or strong wind, acts on a shear wall, it creates compression on one side and tension on the other. The wall must be strong enough to handle both these forces and transfer them safely to the foundation. Properly designed shear walls improve a building's lateral stiffness, reducing sway and minimizing structural damage during an earthquake.

Additionally, shear walls help prevent overturning, sliding, or buckling of a structure by effectively distributing seismic and wind loads. By enhancing a building's ability to resist horizontal forces, shear walls play a crucial role in ensuring structural safety and durability.

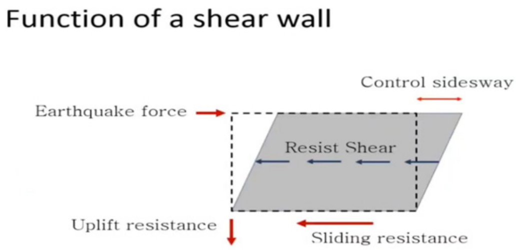

Figure 1.1: Function of Shear wall

2. OBJECTIVES

1. To model and analyzed G+5 having different locations of shear wall in the structure using ETABS software.
2. To identify the stability and Durability of structure against various supernatural events.
3. The analysis focused on storey displacement, storey drift, base shear, shear force, and bending moment, comparing different placements of Shear Wall.

3.METHODOLOGY

This paper aims to find the best location for shear walls in a G+5 reinforced concrete (RC) building—either on the inner or outer periphery. It also compares how buildings behave during an earthquake when shear walls are placed in different locations.The study follows the IS: 1893-2016 (Part I) guidelines for a G+5 building in Seismic Zone II. The key earthquake-related factors used in the analysis are:

Zone Factor (Z2) = 0.16
Importance Factor (I) = 1.5
Response Reduction Factor (R) = 5.0

Equivalent Static method of analysis is done using ETABS software to check the building's performance. The study focuses on lateral displacement (movement in the x and y directions). It also looks at how G+5 buildings behave in seismic zone II to understand earthquake effects better.

3.1.Position of shear Wall :

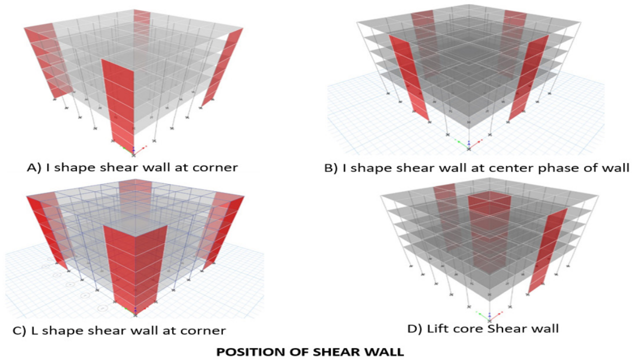

Figure 3.1: Position of shear wall

3.2. Building Detail :

Structure: - Apartment building G+5

Location: - Jalgaon.

Following table 3.2. show the building details

Dimension Of Plan	Material properties of the structure	Member Properties	Thickness of brick masonry wall	Load on building
No of Bays : X- Direction : 5 Y-Direction : 5 Spacing of each Bay : 4m Total Area- 400 square meters. Height of each storey : 3.2m	Grade of concrete for slab, beam, column, shear wall, Footing : M50 Grade of steel : Fe{415}, Fe{550}. Density of concrete : 25KN/m Density of Floor finishing material : 24KN/m	Thickness of RC slab: 150 mm Thickness of shear wall: 300 mm Column size: 400x550 mm Beam size: 300x400 Concrete Cover: 30mm Stiffness Modifier Beam: 0.35 Column: 0.7 Shear wall:0.7	External : 230mm Internal : 125mm	Live Load on slab 3KN/sq.m Dead load on slab = 1.5KN/sq.m

Table 3.2.1: building Details

4.RESULTS AND ANALYSIS

4.1 Story Drift:

Following table 4.1.show the Story drift of different model

Types of Model	Maximum Value of Story drift
RCC structure with I shape shear wall at corners	0.0252
RCC structure with I shape shear wall at center phase of walls	0.0241
RCC structure with L shape shear wall at corners	0.0265
RCC structure with U shape shear wall at Center of building	0.0131

Table 4.1: Story Drift

4.2 Story Displacement:

Following table 4.2.show the Story Displacement of different model

Types of Model	Maximum Value of Story drift
RCC structure with I shape shear wall at corners	39.723
RCC structure with I shape shear wall at center phase of walls	34.35
RCC structure with L shape shear wall at corners	39.89
RCC structure with U shape shear wall at Center of building	25.926

Table 4.2: Story Displacement

4.3 Base Shear :

Following table 4.3.1 show Base Shear of RCC structure with I shape shear wall at corners

	Fx(KN)	Fy(KN)	Fz(KN)	Mx(KNm)	My(KNm)	Mz(KNm)
Maximum	56123.23	56642.02	89316.8	1517164.22	520273.61	568036.8
Minimum	-56728.036	-57246.82	0	-339152.5	-1518747	-568641

Table 4.3.1: Base Shear of RCC structure with I shape shear wall at corners

Following table 4.3.2 show Base Shear of .RCC structure with I shape shear wall at center phase of walls

	Fx(KN)	Fy(KN)	Fz(KN)	Mx(KNm)	My(KNm)	Mz(KNm)
Maximum	60205.5	607151.3	95248.9	1629525.7	554910.6	609442.9
Minimum	-60810.35	-61356.6	0	-354740.5	-162986	-610047

Table 4.3.2: Base Shear of .RCC structure with I shape shear wall at center phase of walls

Following fig 4.3.3. show Base Shear of. RCC structure with L shape shear wall at corners

	Fx(KN)	Fy(KN)	Fz(KN)	Mx(KNm)	My(KNm)	Mz(KNm)
Maximum	22245.38	22253.30	107035.905	1267335.9	206466.81	224574.23
Minimum	-22850.199	-22858.10	0	0	-1268066	-225179.0

Table 4.3.3: Base Shear of. RCC structure with L shape shear wall at corners

Following fig 4.3.4. show Base Shear of Lift core shear wall

	Fx(KN)	Fy(KN)	Fz(KN)	Mx(KNm)	My(KNm)	Mz(KNm)
Maximum	59550.82	60100.33	94658.51	1631552.75	554956.6	603044.5
Minimum	-60155.62	-60705.13	0	-36045904	-1625228	-603649.3

Table 4.3.2: Base Shear of Lift core shear wall

4.4.Shear Force

Following table 4.4.show the shear force of all location of shear wall

Story No.	Members	I shape shear wall at corners	Lift core shear wall	L shape shear wall at corners	I shape shear wall at center
Story6	Column 6	-47.910	-42.856	-47.129	-47.971
	Beam 4	48.431	47.238	90.80	-49.103
Story5	Column 6	-35.952	-32.334	-23.946	-87.614
	Beam 4	87.097	85.990	85.097	-36.413
Story4	Column 6	-38.210	-34.062	-29.192	-87.167
	Beam 4	87.117	86.058	84.456	-31.645
Story3	Column 6	-39.283	-36.183	-26.693	-87.75
	Beam 4	86.915	85.991	83.664	-39.70
Story2	Column 6	-27.348	-23.296	-28.944	-86.721
	Beam 4	86.586	-86.112	82.575	-27.11
Story1	Column 6	-13.027	-11.967	-16.494	-54.04
	Beam 4	53.426	-53.625	81.198	-13.24

Table 4.4: shear force of all location of shear wall

4.5. Bending Moment :

Following table 4.5.1.show the Bending Moment of Different Location

Story No.	Members	I shape shear wall at corners	Lift core shear wall	L shape shear wall at corners	I shape shear wall at center
Story6	Column 6	68.032	60.175	77.941	-30.412
	Beam 4	-31.595	-29.118	-62.651	69.929
Story5	Column 6	-61.688	-54.717	-42.251	-51.667
	Beam 4	-50.906	-48.770	-58.682	-62.384
Story4	Column 6	-66.185	-56.353	-46.134	-51.062
	Beam 4	-51.603	-48.984	-57.547	-66.345
Story3	Column 6	-76.408	-66.007	-42.956	-51.581
	Beam 4	-50.666	-48.847	-56.031	-76.4003
Story2	Column 6	-53.603	-34.873	-48.992	-50.277
	Beam 4	-50.089	-49.112	-53.969	-51.8937
Story1	Column 6	-44.951	-30.236	28.555	-29.168
	Beam 4	-28.153	-28.437	-31.365	-43.514

Table 4.5: Bending Moment of Different Location

5. CONCLUSION

This study evaluated the effects of varying shear wall locations on the structural performance of a G+5 building under seismic loading in Zone 2 (Jalgaon). The analysis focused on storey displacement, storey drift, base shear, shear force, and bending moment, comparing different placements: core, edge, and corner.

Storey Displacement:

The core shear wall resulted in the least storey displacement at 25.926 mm, due to a more uniform distribution of lateral forces. In contrast, the L-shaped shear wall at the corner increased displacement by 53.86% (39.89 mm), and the I-shaped corner wall by 53.24% (39.73 mm), compared to the core. The I-shaped wall at the center phase had 32.49% higher displacement (34.35 mm) than the core wall but less than the corner configurations.

Storey Drift:

Storey drift was lowest for the core wall at 0.0131, indicating effective resistance to torsional effects. The L-shaped corner wall had a drift of 0.0265 (an increase of 102%), and the I-shaped corner wall had 0.0252 (an increase of 92.36%), compared to the core wall. The I-shaped wall at the center phase had 83.96% higher drift than the core wall.

Base Shear:

Base shear for the core wall was 59550.82. The I-shaped corner and center walls recorded 56123.23 and 60205.5, respectively. The L-shaped corner wall had the lowest base shear of 22245.38, indicating more effective load distribution.

Shear Force

For the 6th storey column, lift core shear was -42.856 kN (lowest), and I-center was highest at -47.971 kN. For beams, I-center had -49.103 kN (lowest), while L-corner had the highest at 90.8 kN.

Bending Moment

For columns, I-center had -30.412 kNm (lowest), and L-corner had 77.94 kNm (highest). Beam shear: L-corner (-62.651 kN), I-corner (-31.595 kN), lift core (-29.118 kN), and I-center (69.929 kN, positive).

Recommendation:

The central/core shear wall configuration consistently provided the best performance, minimizing displacement and drift while ensuring effective force distribution. Therefore, placing the shear wall near the building's center is recommended for optimal structural behavior under seismic loading.

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