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Parameters comparison for different structural system

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Abstract - Tall building developed have been rapidly increase worldwide because of rapid growth of the population. For lateral load consideration there is different structural system to be used for tall structure like Rigid frame structure, Shear wall structure, and braced structure. which give more ductility and energy dissipation capacity. In this paper gives economical study of structural system with different parameters.

Key Words: Static linear method, Storey shear, storey force. Bending moment, overturning moment, Torsional irregularity, Mode shape, Etab etc

1.INTRODUCTION

Population of India is increasing at an alarming rate (about 1.2% per year) and now we are 1.252 billion people. This large population not only needs jobs but also needs housing and other infrastructure facility. So tall structure fulfill the requirement in metropolitan cities. As the height of the building increase, the lateral resisting system becomes more important than the structural system that resists the gravitational loads. There is various types of structural system are use in Hi-rise structure.

The lateral resisting systems that are widely used. These systems are Rigid frame system, Shear wall system, braced structure, Tubular system, Core system, Outrigger system generally use. This systems are provide to achieve more higher and higher. This article work focuses on study of various parameters compare with different structural system in Etab Software. Analysis of building involves parametric study of displacement, Storey drift, Storey force, Storey shear, Bending moment, Overturning moment, Mode shape, Mass participation.

2. OBJECTIVE

1) To understand behavior of various structural system used in high rise building.
2) Comparative study on various structural system used in conventional practice approach.
3) Parametric study and its responds comparison for considered structural system.
4) To study of performance on different structural system used in tall structure.

3. BUILDING DESCRIPTION

The main intention of modeling is the reaction on various parameters with different structural system used in tall structure.

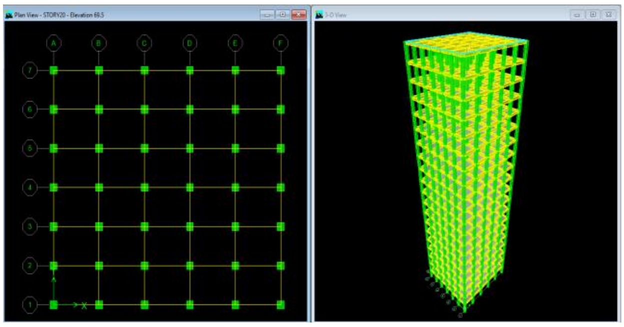

Figure 1: Plan and Elevation of building

Table -1: Building Data

Plan dimension	20 m x 18 m
Height of typical storey	3.5 m
Height of base storey	3 m
Slab thickness	125 mm
Column size	600 x 600 mm
Main beam size	300 x 500 mm
Brick wall thickness	230 mm thick at periphery
Shear wall thickness	230 mm thick L- shape

Bracings	230x300 mm X- Bracings
Live load	5 KN/m^2
Floor finish	1.2 KN/m^2
Location	Ahmadabad
Earthquake data	IS 1893 (Part 1)-2002
Type of soil	Medium Soil
Importance factor	1
Response reduction factor	5
Grade of concrete	25 KN/m^2
Grade of steel	Fe 415
Density of concrete	25 KN/m^2
Damping ratio	5%
Density of brick masonry	20 KN/m^2

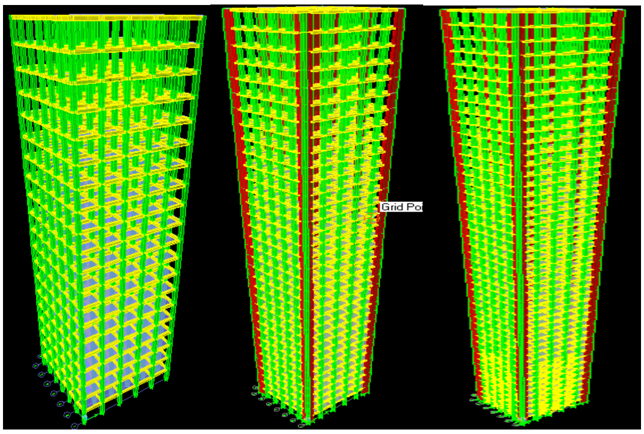

Fig.2 Elevation of frame, shear wall and dual structural system

4. PROCEDURE OF MAJOR WORK AND ANALYSIS

The above detail are take hypothetical case for analysis which 20 storey frame structure analyze and then increase the height up to 35 storey. At this time frame structure fail at base column so new structural system provide at 35 storey structure. Shear wall structure provide at 35 storey structure and its goes up to 47 storey shear wall structure and that time its fail in shear wall structural system. So for make stiffer structure its provide braced structural system.

In this article all this different height achieve compare all different parameters like Displacement, Storey drift, Storey shear, Storey force, Axial force, Overturning moment, Bending moment, Torsional irregularity, Mode shape and Mass Participation.

6. RESULTS AND DISCUSSION

6.1 Displacement

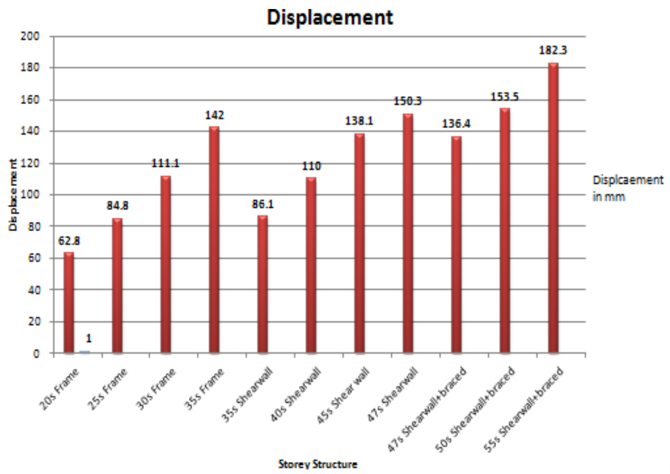

Figure 3: Displacement

Table 1: Displacement

Storey Structure	Displacement(mm)	%
35 Storey frame	142	36.36
35 Storey Shear wall	86.1	
47 Storey shear wall	150.3	9.24
47 Storey shear wall + braced	136.4	

6.2 Storey drift

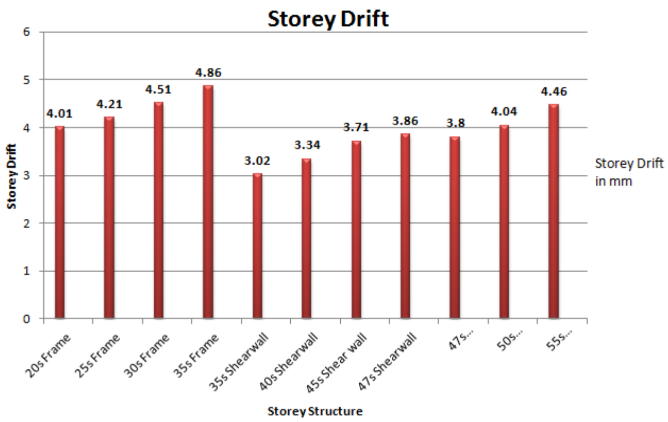

Figure 4: Storey drift

Table 2: Storey drift

Storey Structure	Storey drift(mm)	%
35 Storey frame	4.86	37.86
35 Storey Shear wall	3.02	
47 Storey shear wall	3.86	1.55
47 Storey shear wall + braced	3.8	

6.3 Storey force

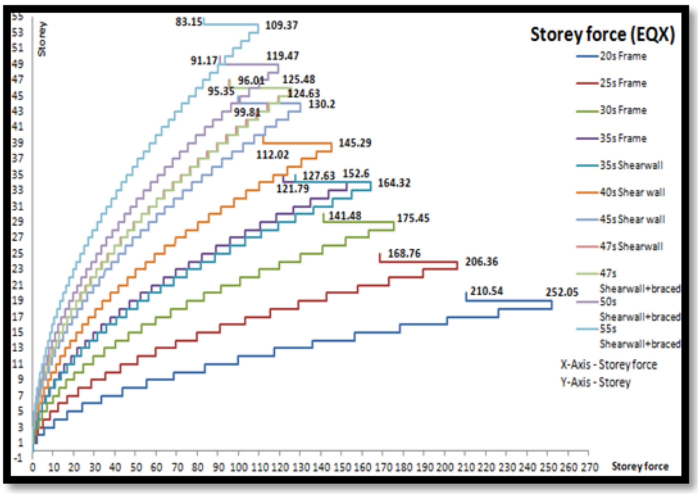

Figure 5: Storey force

Table 3: Storey force

Storey Structure	Storey force(KN)	%
35 Storey frame	127.63	19.56
35 Storey Shear wall	152.6	
47 Storey shear wall	124.63	0.67
47 Storey shear wall + braced	125.48	

6.4 Storey shear

Table 4: Storey shear

Storey Structure	Storey Shear(KN)	%
35 Storey frame	1920.25	7.54
35 Storey Shear wall	2065.05	
47 Storey shear wall	2063.18	0.71
47 Storey shear wall + braced	2077.99	

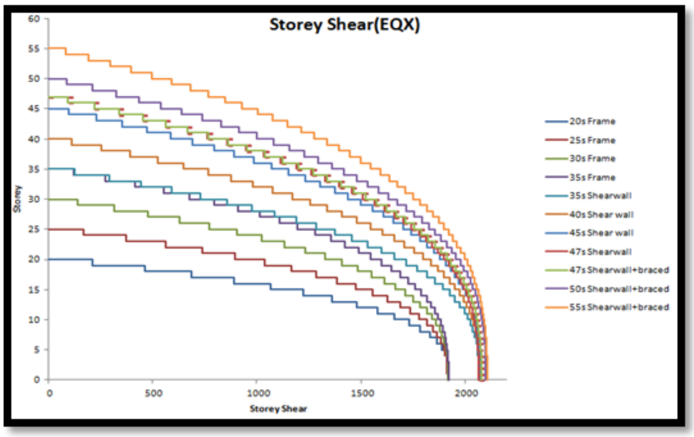

Figure 6: Storey shear

6.5 Axial force

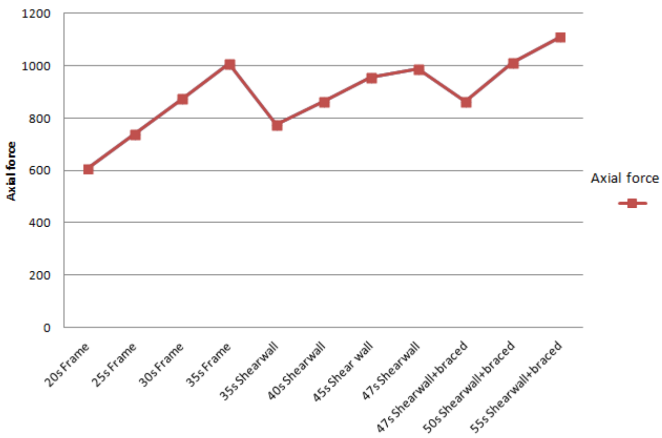

Figure 7: Axial force

Table 5: Axial force

Storey Structure	Axial force(KN)	%
35 Storey frame	1126.08	29.94
35 Storey Shear wall	788.93	
47 Storey shear wall	1015.64	6.21
47 Storey shear wall + braced	952.48	

Table 6: Stiffness

Storey Structure	K1	K2	K3	K4
20-35 Storey frame	7364	5852	5852	5852
35-47 Storey Shear wall	37160	33288	33288	33288
47-55 Storey shear wall + braced	41981	37664	35435	33288

6.5 Bending moment

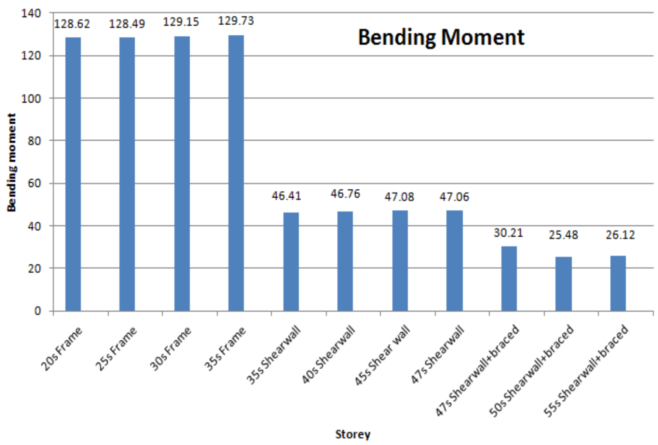

Figure 8: Bending moment

Table 6: Bending moment

Storey Structure	Bending moment(KN.m)	%
35 Storey frame	129.73	64.22
35 Storey Shear wall	46.41	
47 Storey shear wall	47.06	35.80
47 Storey shear wall + braced	30.21	

6.6 Torsional Irregularity

Table 7: Torsional irregularity

Storey Structure	Δ1	Δ2
35 Storey frame	142	142
35 Storey Shear wall	85.98	85.98
47 Storey shear wall	150.18	150.32
47 Storey shear wall + braced	136.29	136.46

7. CONCLUSIONS

1) Under the seismic loads as the height of the structure increase the lateral deflection, storey drift, storey force, storey shear, Axial force, Bending moment.
2) The key idea in limiting the seismic effect in a tall building is by changing the structural system of the building into something more rigid and stable to confine the deformation and increase stability.
3) Rigid frame structure is recommended up to 35 stories then shear wall structure is provide up 47 stories structure and then bracings are provide up to 55 stories.
4) The lateral displacement of the building is reduced 40% by the use of shear wall and X type bracings system.
5) Shear wall has more displacement (8% to 10%) as compared to dual structural system but there is 1% to 2% storey shear.
6) Storey drift, Soft storey, Torsional irregularity of the Frame structure, Shear wall and Dual structural model is within the limit as clause no.7.11.1 of IS-1893:2002.

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