STATIC AND DYNAMIC ANALYSIS OF REGULAR AND IRREGULAR SHAPE BUILDING WITH OR WITHOUT SHEARWALL

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Abstract - *Construction of High-rise buildings is common in the present days due the availability of limited space, growth of population and high cost of lands. Hence to safeguard the construction, the buildings to be constructed must be designed in such a way that it should withstand both gravity loads as well as lateral loads (earthquake, wind and blast load). The present study is done by providing the lift core shear wall to the RCC building to gain the necessary stability, strength and also the stiffness to resist the loads coming horizontally i.e., Earthquake load. Here both regular and irregular shaped building is analysed by providing with or without shear wall. The results are studied for both Equivalent static method (Linear static analysis) and Response spectrum method (Linear dynamic analysis) using ETABS 2015. The proposed building is situated in the seismic Zone V and the results are tabulated for different soil types and the attempt is made to reduce the displacement with the introduction of structural shear wall system. The parameters considered in this study are storey displacement, storey drift and storey shear. The structure is studied under different soil types (Type I, Type II and Type III) as per IS 1893:2002 In this study the main focus is to determine the importance of presence of lift core shear wall.*

Key Words: Seismic Analysis, Framed Structure, Lift core shear wall, Equivalent static method, Response spectrum method

1.INTRODUCTION

Earthquake is a passage of different vibrations from ground. Earthquake is unpredictable and occurs irrespective of time and location and our country has experienced many earthquake resulting in severe damage to structure and loss of life. Hence the design engineers has to design the building in order to make it resistible for damages caused due to effects of seismic actions. These experiences have demonstrated the new developments in building up the resistance towards seismic actions and their execution must be proper to protect against seismic damages. RC frame building have become common type of construction now-a-days. The performance of frame system alone for the earthquake is not effective and it is not stiff compared to structural wall system. Hence the structural wall system should be adopted to resist the lateral load (seismic load). Thus shear wall is used and it is capable of reducing damages caused by earthquake and cost effective and also also advantageous in reducing the overall deflection. In our considered model the shear wall is continuous without any discontinuity from the base upto full height of the building and rigidly connected and its position is defined according to the building requirements and necessity aspects. Shear wall adds higher stiffness to the building and also adds less weight to the building.

1.1 Shear wall

Shear are the lateral force resisting system which supports the floor or roof diaphragm which basically transfer lateral force ultimately to the foundation system. The properly designed and constructed shear wall can have proper stiffness and strength for resisting the lateral loads. Now a days it is mandatory for tall structure in severe seismic zone. Shear walls are available in different forms, shapes and usage is based on the architectural point of view and functional point of view in high rise buildings.

2. OBJECTIVES

1.To perform the linear static analysis on considered model.

2.To perform the Dynamic analysis(RSM) on considered models

3.To examine the effect of shear wall(Lift core wall) locations in considered models.

4.To determine the storey displacements, storey drifts and base shear under earthquake loading.

3. BUILDING MODELING

In this study, a (G+29) storey building is considered with the different soil types , lift core shear wall system is considered for regular and irregular plan and comparision is done between bare frame model and the combined shear wall model using ETABS software as per code IS 1893: 2002. The four different models were studied in Zone 5 and results are tabulated for the Base shear, storey displacements and storey drifts.

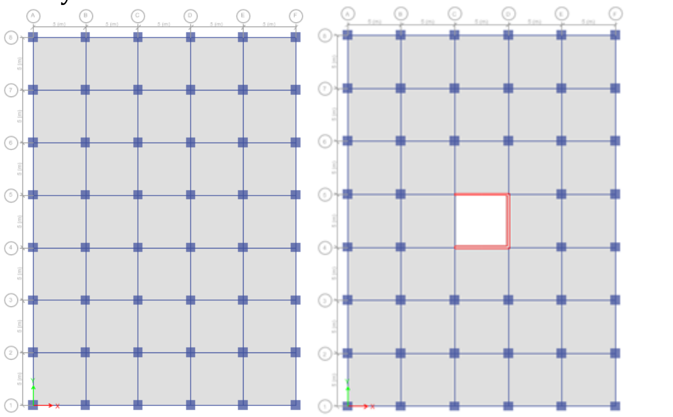

Fig -1: Plan of regular buildings (without shear wall and with lift core shear wall)

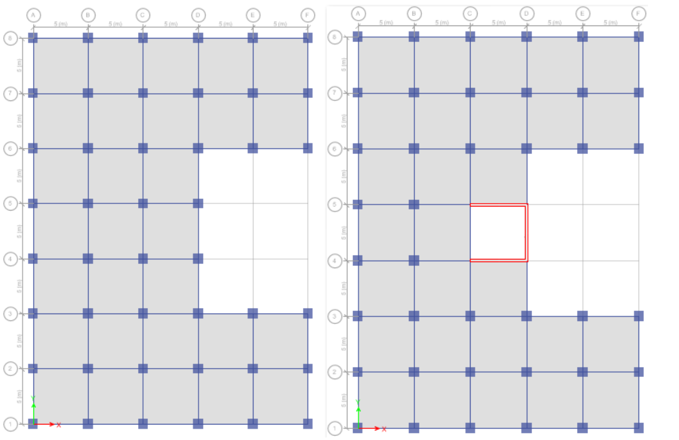

Fig -2: Plan of irregular buildings (without shear wall and with lift core shear wall)

Table -1: Preliminary Data.

Bottom storey height	4.0 m
Typical storey height	3.0 m
Size of the Column	900mmx900mm
Size of the Beam	200mmx600mm
Slab thickness	125 mm
Shear wall type	Lift core shear wall
Shear wall thickness	200 mm
Concrete density	25 kN/m³
Steel grade	500 N/mm²
Live load	3 kN/m² (on floor), 2 kN/m² (on roof)
Floor finish	1.5 kN/m² (on floor), 2 kN/m² (on roof)

Table -2: Model Description.

Model no.	**Soil type**	**Plan**	**Presence of shear wall**
M1	Type I	Regular	No
M2	Type II	Regular	No
M3	Type III	Regular	No
M4	Type I	Regular	Yes
M5	Type II	Regular	Yes
M6	Type III	Regular	Yes
M7	Type I	Irregular	No
M8	Type II	Irregular	No
M9	Type III	Irregular	No
M10	Type I	Irregular	Yes
M11	Type II	Irregular	Yes
M12	Type III	Irregular	Yes

4. RESULTS AND DISCUSSIONS

Table *3:* Equivalent static method

MAX. STOREY DISPLACEMENT(mm)			
MODEL NO.	**EQX**	**EQY**	**SOIL TYPE**
M1	113	104	TYPE I
M4	94	90.6	
M7	109	115	
M10	93	89.7	
M2	154	142.5	TYPE II
M5	128	123	
M8	148	156.4	
M11	127.1	122	
M3	189	175	TYPE III
M6	157	151	
M9	182.1	192.1	
M12	156	149	

Table *4:* Response spectrum method

MAX. STOREY DISPLACEMENT(mm)			
MODEL NO.	RX	RY	SOIL TYPE
M1	77.28	72.46	TYPE I
M4	62.168	50.585	
M7	74.84	71.57	
M10	61.121	48.7871	
M2	110.87	103.64	TYPE II
M5	89.4389	78.934	
M8	107.09	110.38	
M11	88.1934	76.774	
M3	139.76	130.3909	TYPE III
M6	114.2954	104.059	
M9	134.747	144.005	
M12	112.754	101.545	

Table *5:* Equivalent static method

INTER STOREY DRIFT			
MODEL NO.	EQX	EQY	SOIL TYPE
M1	0.00164	0.00153	TYPE I
M4	0.00137	0.00131	
M7	0.00157	0.00164	
M10	0.00135	0.00129	
M2	0.00223	0.00208	TYPE II
M5	0.00186	0.00178	
M8	0.00213	0.00225	
M11	0.00184	0.00175	
M3	0.00274	0.00256	TYPE III
M6	0.00229	0.00218	
M9	0.00262	0.00273	
M12	0.00226	0.00215	

Table *6:* Response spectrum method

INTER STOREY DRIFT			
MODEL NO.	RX	RY	SOIL TYPE
M1	0.00127	0.00122	TYPE I
M4	0.00097	0.0008	
M7	0.00122	0.00115	
M10	0.00094	0.00075	
M2	0.00182	0.00173	TYPE II
M5	0.00139	0.00125	
M8	0.00174	0.00177	
M11	0.00136	0.00117	
M3	0.00229	0.00218	TYPE III
M6	0.00178	0.00164	
M9	0.00219	0.00231	
M12	0.00173	0.00154	

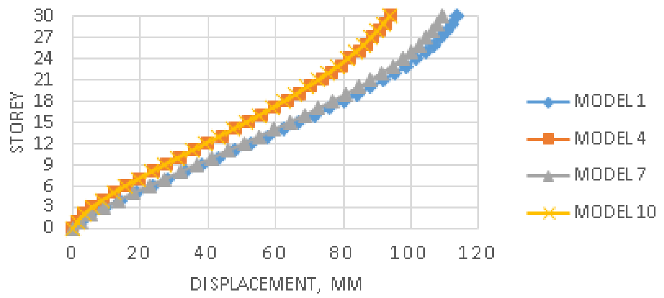

Chart -1: *Max. storey displacement , for soil type-I along X-direction(static analysis)*

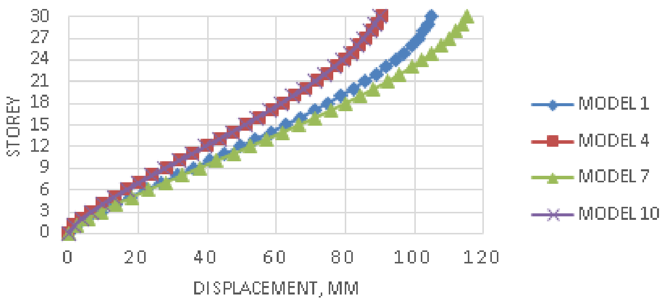

Chart -2: *Max. storey displacement , for soil type-I along Y-direction(static analysis)*

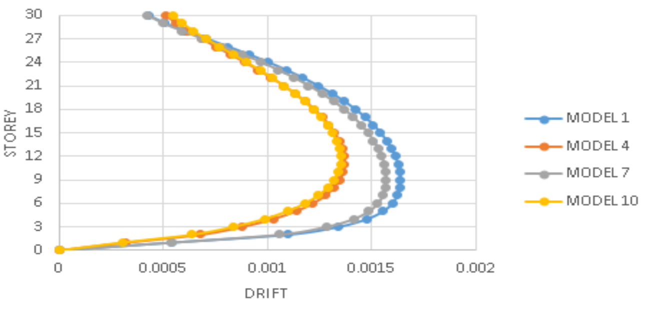

Chart -3: Max. *Inter storey drift for soil type-I along X-direction(static analysis)*

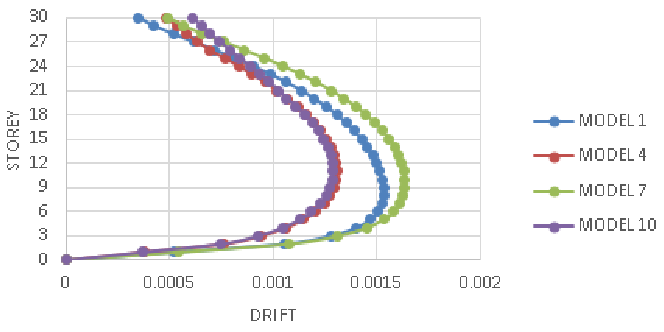

Chart -4: Max. *Inter storey drift , for soil type-I along Y-direction(static analysis)*

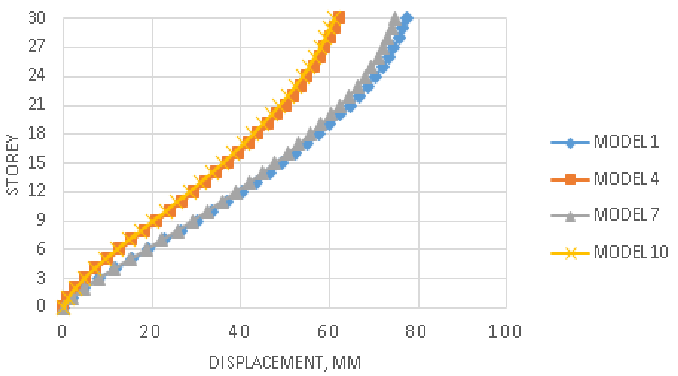

Chart -5: *Max. storey displacement , for soil type-I along X-direction(Dynamic analysis)*

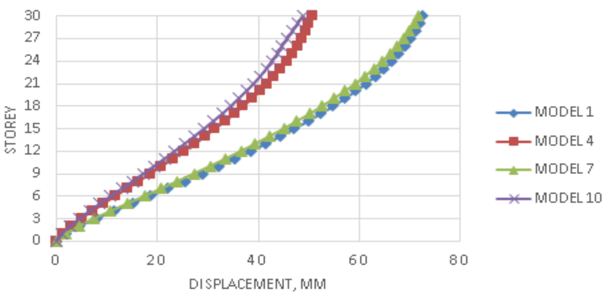

Chart -6: *Max. storey displacement , for soil type-I along X-direction(Dynamic analysis)*

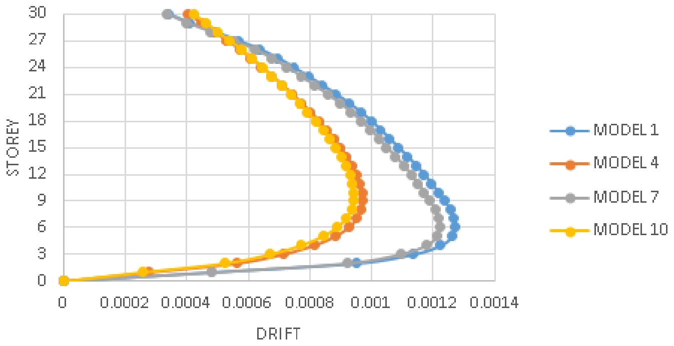

Chart -7: *Max., Inter storey drift for soil type-I along X-direction(Dynamic analysis)*

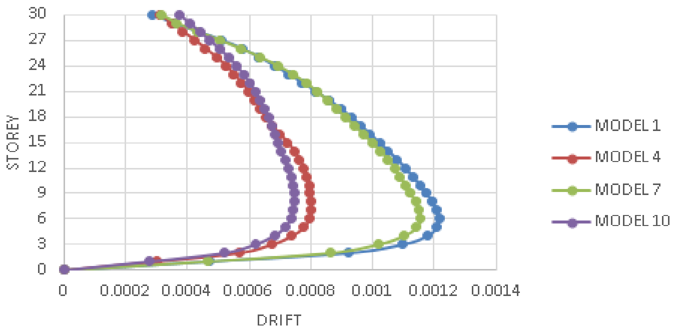

Chart -8: *Max. Inter storey drift, for soil type-I along X-direction(Dynamic analysis)*

The displacement is reduced upto 15-25% for the models with the lift core shear wall compared to the bare frame model in the both X and Y direction for equivalent static method. There is a 15-17% reduction of inter storey drift for the buildings with lift core shear wall compared to the bare frame model in both X and Y direction in equivalent static method for all the soil types. In the response spectrum method it is observed that the parameters such as storey displacements and storey shear have been minimized compared to equivalent static method. Hence proves to be economical for the construction of high rise buildings.

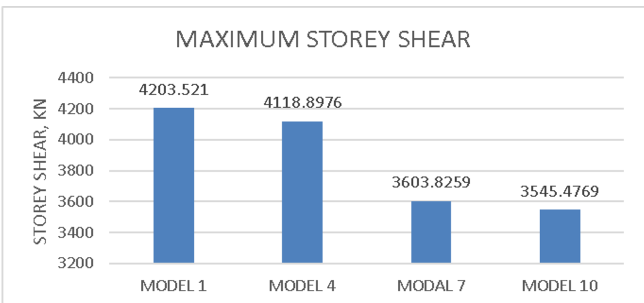

Chart -9: *Base shear, for soil type-I along X and Y-direction*

It is observed that the base shear is reduced for the Model 7 and Model 10 compared to Model 1 and Model 4 due to the less mass is considered in irregular plan building.

5. CONCLUSIONS

The following conclusion are drawn based on the observation:

1. The displacement of models in soil type II is reduced by 19-36% when compared to soil type III and the displacement of models in soil type I is reduced by 27-30% compared to soil type II in both the analysis.
2. The storey drift of models in soil type II is reduced by 19-22% when compared to soil type III and the storey drift of models in soil type I is reduced by 27-28% compared to soil type II in both the analysis. Hence the soil type I is safe.
3. Displacement increases as the height of building increases.
4. In response spectrum method the displacement values are least in both X and Y direction compared to equivalent static method.
5. Storey drift for considered models are within the maximum drift permitted acc. to Is 1893:2002
6. Reduction in the inter storey drift have been observed in frame with lift core shear wall compared to bare frame.
7. The value of base shear is less for Irregular plan building in comparision with regular due to the less mass considered.
8. Shear wall proves to be effective in high rise building.
9. The results obtained from the equivalent static method is seems to be uneconomical as the lateral displacement is more compared to response spectrum analysis and the dynamic analysis is mandatory for the high rise buildings.

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