ISSN No: 2348-4845
International Journal & Magazine of Engineering,
Technology, Management and Research
A Peer Reviewed Open Access International Journal

A Comparative Study between the Use of Framed Shear Wall System and Framed Tube System in Tall Buildings

Abbas Ali Ibrahim
M.Tech Structural Engineering Student,
Salahaddin University-College of Engineering
Department of Civil Engineering,
Hawler-IRAQ, JNTUH College of Engineering,
Hyderabad-India.

Dr. N. V. Ramana Rao
Professor & Registrar,
B.E (OU),M.Tech (IIT Delhi),
Ph.D (UK), Post Doctorate (UK),
Department of Civil Engineering,
JNTUH College of Engineering, Hyderabad-India.

Abstract:
The aim of present work is to study and compare the effect of using framed shear wall system and framed tube system in resisting lateral load for tall buildings with rectangular shapesoand to know the much effective system in resisting lateral loads for the structures up to 30 stories and for structures beyond 30 stories .

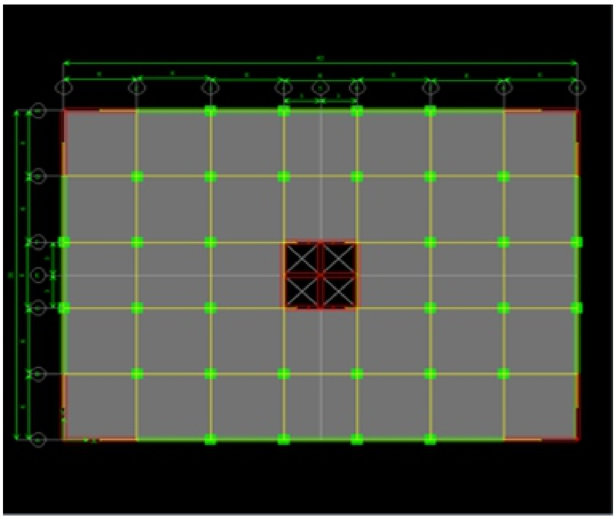
Structures with Framed Shear Wall System and Framed Tube System are considered in the work for (20, 30, 40, 50, and 60) story and the analysis to be carried out for the given problem with results of (Roof Displacements, Base Shear , support reactions and joint displacements) are to be studied and compared. Modeling and analysing of the building considered to be carried out by using the soft ware ETABS

Introduction:
Due to the increase of population in urban areas there is a need to accommodate the influx in the urban areas. However due to rapid increase of land cost, and limited availability of land the trend is to build high rise building. Various types of structural system have been used to facilitate the demand of high rise structures.In the tall structure the lateral drift is the most critical factor to be considered while designing .

To reduse the lateral deflection the stiffness of the building has to be increased considerably. We can not stop earth quakes and wind but we can prevent ourselves from them . Providing framed shear wall system or framed tube system in the building greatly helps in improving its resistance behavior to lateral loads.

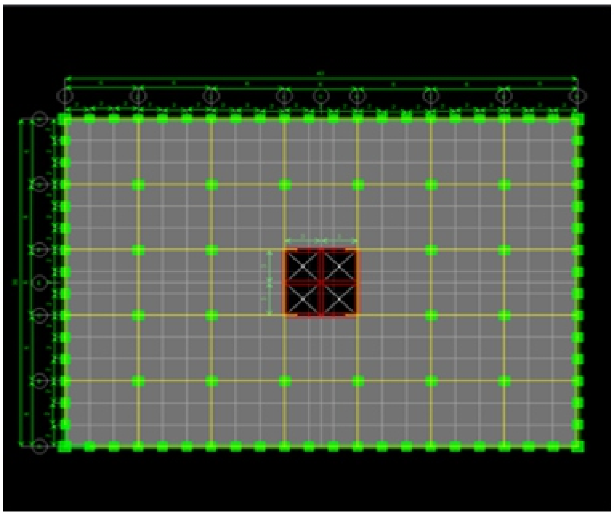
Methodology:
To study this structural behavior the soft ware ETABS 9.7.4 program has been to used. ETABS 9.7.4 is ananalyzing program that is mainly used for drift story ,support reactions, shear forces and bending moments of members under seismic loads and wind loads. The program offers general purpose structural analysis and design along with the extensive model generation and post –processing facilities.Dynamic analysis shall be performed to obtain design seismic force and its distribution to different levels along the height of the building and lateral loads are assumed to be concentrated at the floor levels for the buildings . The dynamic analysis shall be done by using response spectrum method. According to IS 1893:2002.

4.2.1 DETAIL OF STRUCTURE:
Plan Dimension : 42m x 30m, X-Dir. 7-bay * 6m =42m,
Y-Dir. 5-bay * 6m =30m



Typical plan of a framed with shear wall structure.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal



Typical plan of a framed tube structure

4.2.2 LOADS:

1-Dead Load-Self Weight of the Slab + Self Weight of beams and columns + Floor finish + Wall Load
Floor finish (ceramic floor finishing with cement mortar).Wall load (Thirmostone light weight Blocks with width of 120mm are considered).
2-Live Load-Live Load (Considered as a residential building as per IS: 875 (part 2) - 1987
3-Wind Load-Wind Load considered for the Hyderabad region for the terrain category 3 and class C from IS: 875 (part 3) - 1987
4-Earthquake Load-Earthquake load is considered in the form of Spectrum load for Zone – 2, Response reduction factor – 5, Importance factor – 1.5, Soil Type –medium values taken from IS : 1893 - 2002

4.2.3 Lateral Load Resisting Structural Systems Consideredare:

Framed Shear Wall System The shear wall system is considered here to resist lateral resisting system.
Framed Tube System Column in the Tube System in the outer periphery are 2m center to center.

Analyzing:

Structures with Framed Shear Wall System and Framed Tube System are considered in the work for (20, 30, 40, 50, and 60) story and the analysis to be carried out by using the software ETABS 9.7.4 for the given problem with results of (Roof Displacements, Base Shear , support reactions and joint displacements) are to be studied and compared.

Results and Discussion:

5.1 Base Shear due to Lateral Loads:

The Base Shear (Story Shear) in KN due to lateral loads is calculated for the (20, 30, 40, 50 and 60) story structure with different lateral structural systems and graph for base shear and number of stories have been presented in this chapter.

Story shear in X-direction

	STORY SHEAR				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	4340.91	4423.86	4478.94	4540.2	4592.37
FRAMED TUBE SYSTEM	5301.83	5383.25	5432.98	5464.42	5495.92

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

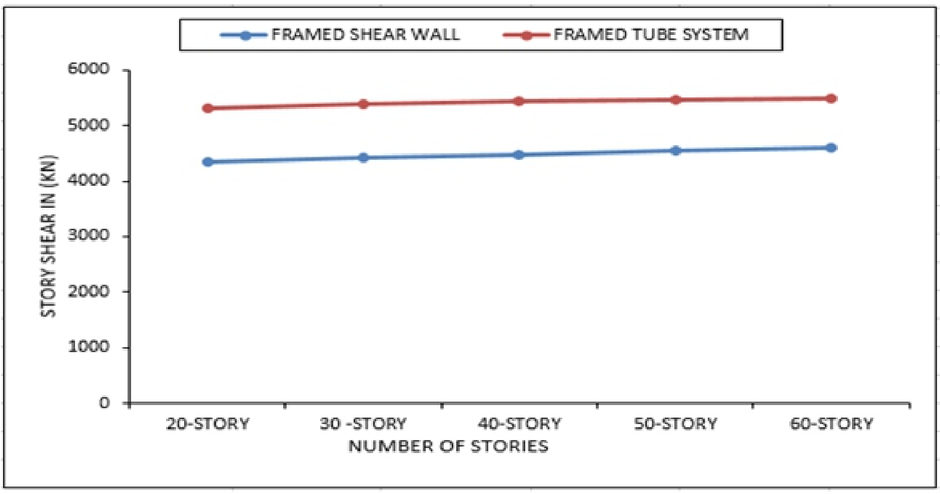


Fig. 5.1 Graph – Base Shear (Story Shear) in KN with Number of stories for Framed Shear Wall System and Framed Tube System in X- direction.

Story shear in Y-direction

	STORY SHEAR				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	3670.17	3727.5	3783.47	3837.27	3881.81
FRAMED TUBE SYSTEM	4482.61	4537.75	4589.85	4622.51	4646.64

Table 5.2 Results obtained for Base Shear (story shear) in KN due to lateral load for the (20, 30, 40, 50 and 60) story structures in Y-direction.

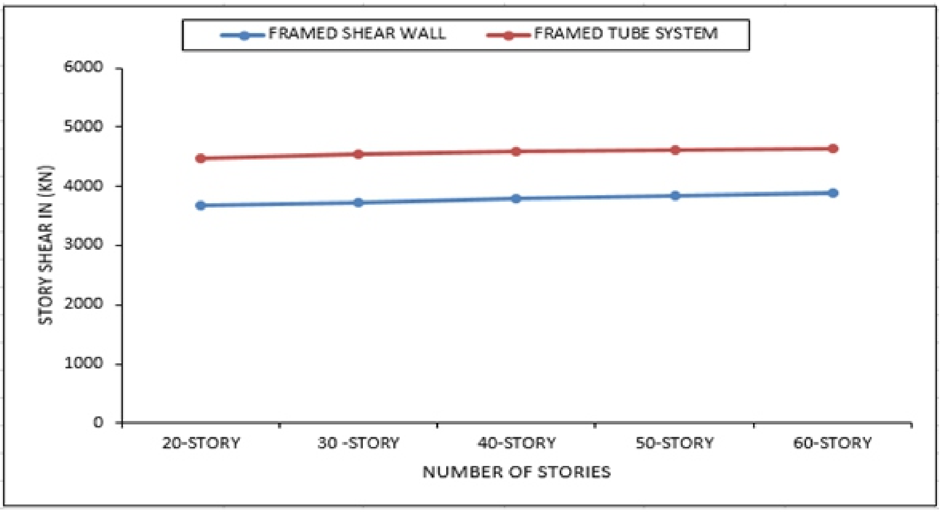


Fig. 5.2 Graph – Base Shear (Story Shear) in KN with Number of stories for Framed Shear Wall System and Framed Tube System in Y- direction.

5.2 Base Reaction at service combinations:

The Base Reactions in KN at service combinations loads is calculated for the (20, 30, 40, 50 and 60) story structure with different lateral structural systems and graph for reaction shear and number of stories have been presented in this chapter (maximum support reactions for the central supports and the outer peripheral supports).

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

REACTION AT SERVICE COMBINATIONS

	BASE REACTION IN (KN)				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	11821.31	20057.82	28935.51	39238.54	49313.07
FRAMED TUBE SYSTEM	9672.96	16533.75	23191.66	29483.07	35401.72

Table 5.3 Results obtained for maximum base reactions at service combinations for the (20, 30, 40, 50 and 60) story structures.

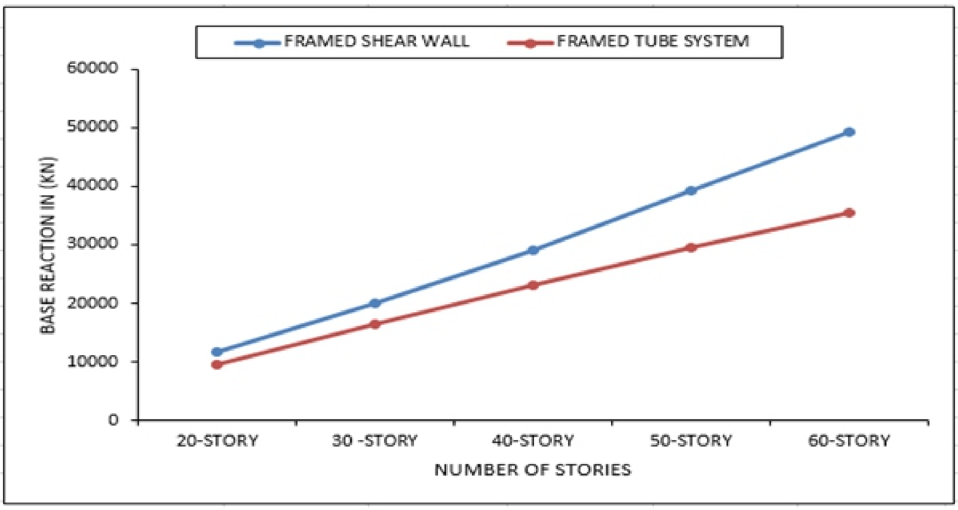


Fig. 5.23 Graph – Maximum Base Reactions in KN with Number of stories for Framed Shear Wall System and Framed Tube System

5.3 Roof Displacement at service combinations:

The Roof Displacement in mm at service combinations loads is calculated for the (20, 30, 40, 50 and 60) story structure with different lateral structural systems and graph for roof displacement and number of stories have been presented in this chapter.

	ROOF DISPLACEMENTS IN (mm)				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	14.2	24.9	37.1	50.8	69.9
FRAMED TUBE SYSTEM	12.6	20.8	30.1	40.8	53.5

Table 5.14 Results obtained for Maximum Roof Displacement at service combinations for the (20, 30, 40, 50 and 60) story structures.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

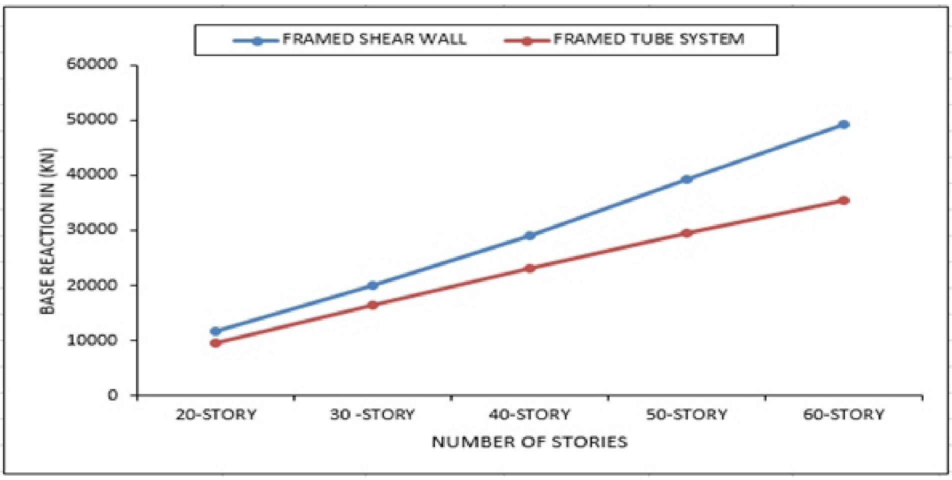


Fig. 5.24 Graph – Maximum Roof Displacement in mm with Number of stories for Framed Shear Wall System and Framed Tube System.

5.4 Lateral Roof Displacement due to Wind load combinations:

The Lateral Roof Displacement in mm due to the wind load is calculated for the (20, 30, 40, 50 and 60) story structure with framed shear wall system and framed tube system and graph for Joint displacement and number of stories have been presented in this chapter. The Displacement due to the Wind load for the (20, 30, 40, 50 and 60) story structure have been presented in this chapter.

Lateral Displacement due to wind load combinations in X-direction

	LATERAL DISPLACEMENT IN (mm)				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	11.9	33.7	72.2	127	205.9
FRAMED TUBE SYSTEM	4.5	12	25.7	47.7	77.4

Table 5.25 Results obtained for Maximum Lateral Roof Displacement due to wind load combinations for the (20, 30, 40, 50 and 60) story structures in X-direction.

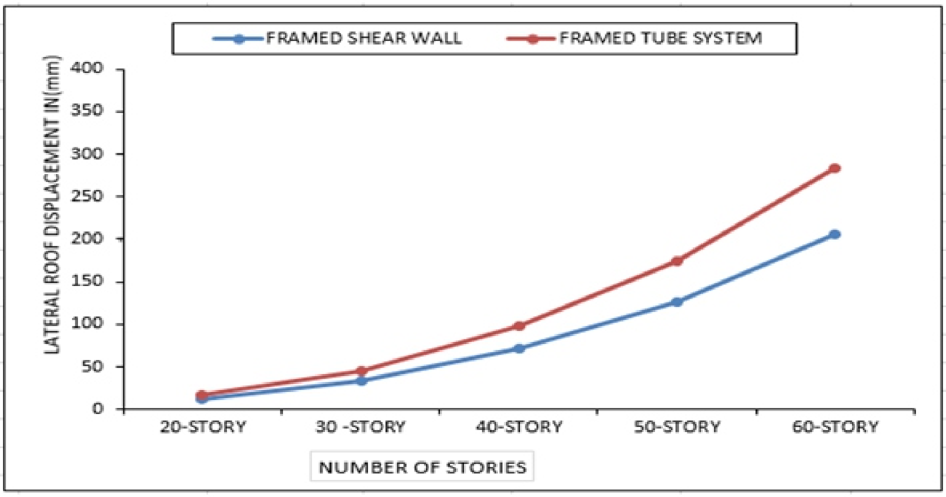


Fig. 5.25 Graph – Maximum Lateral Roof Displacement due to wind load combinations in mm with Number of stories for Framed Shear Wall System and Framed Tube System in X-direction.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Lateral Displacement due to wind load combinations in Y-direction

	LATERAL DISPLACEMENT IN (mm)				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	17.3	53.4	112.6	205.4	335
FRAMED TUBE SYSTEM	8	22.4	49.5	94.3	163.2

Table 5.26 Results obtained for Maximum Lateral Roof Displacement due to wind load combinations for the (20, 30, 40, 50 and 60) story structures in Y-direction.

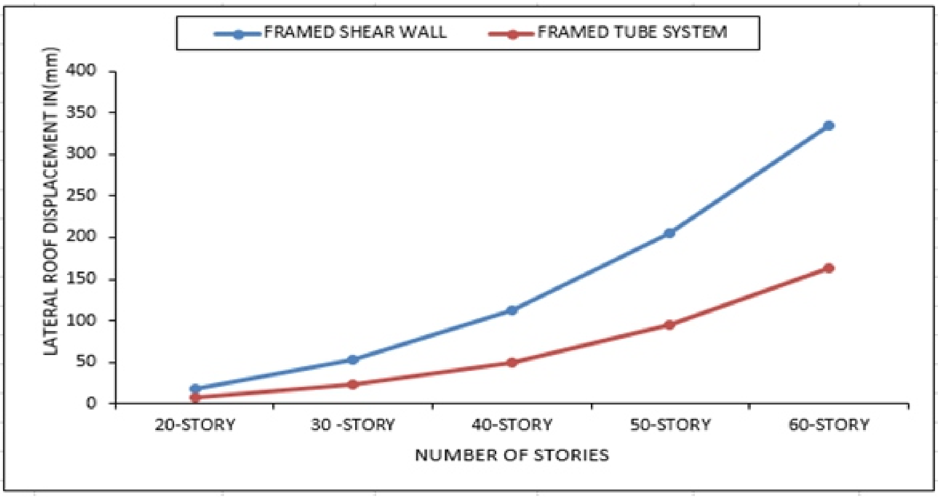


Fig. 5.26 Graph – Maximum Lateral Roof Displacement due to wind load combinations in mm with Number of stories for Framed Shear Wall System and Framed Tube System in Y-direction.

5.4 Lateral Roof Displacement due to Earthquake load combinations:

The Lateral Roof Displacement in mm due to the earthquake load is calculated for the (20, 30, 40, 50 and 60) story structure with framed shear wall system and framed tube system and graph for lateral roof displacement and number of stories have been presented in this chapter . The Displacement due to the earthquake load for the (20, 30, 40, 50 and 60) story structure have been presented in this chapter.

LATERAL DISPLACEMENT DUE TO E.Q LOAD COMBINATIONS IN X-DIRECTION (mm)

	LATERAL ROOF DISPLACEMENT IN (mm)				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	31	87	187	329	534
FRAMED TUBE SYSTEM	12	31	67	124	201

Table 5.37 Results obtained for Maximum Lateral Roof Displacement due to earthquake load combinations for the (20, 30, 40, 50 and 60) story structures in X-direction

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

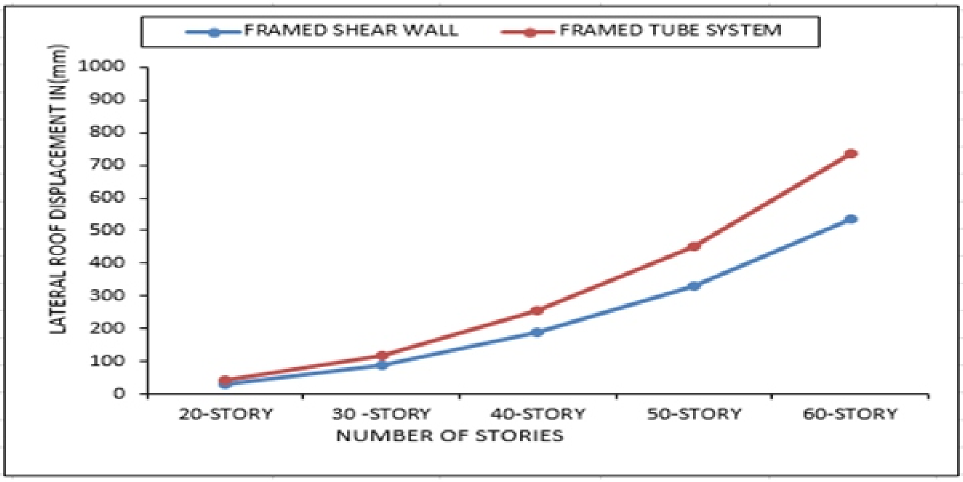


Fig. 5.27 Graph – Maximum Lateral Roof Displacement due to earthquake load combinations in mm with Number of stories for Framed Shear Wall System and Framed Tube System in X-direction.

LATERAL DISPLACEMENT DUE TO E.Q LOAD COMBINATIONS IN Y-DIRECTION (mm)

	LATERAL ROOF DISPLACEMENT IN (mm)				
	20-STORY	30 -STORY	40-STORY	50-STORY	60-STORY
FRAMED SHEAR WALL	45	138	292	532	868
FRAMED TUBE SYSTEM	21	58	128	244	423

Table 5.38 Results obtained for Maximum Lateral Roof Displacement due to earthquake load combinations for the (20, 30, 40, 50 and 60) story structures in Y-dire

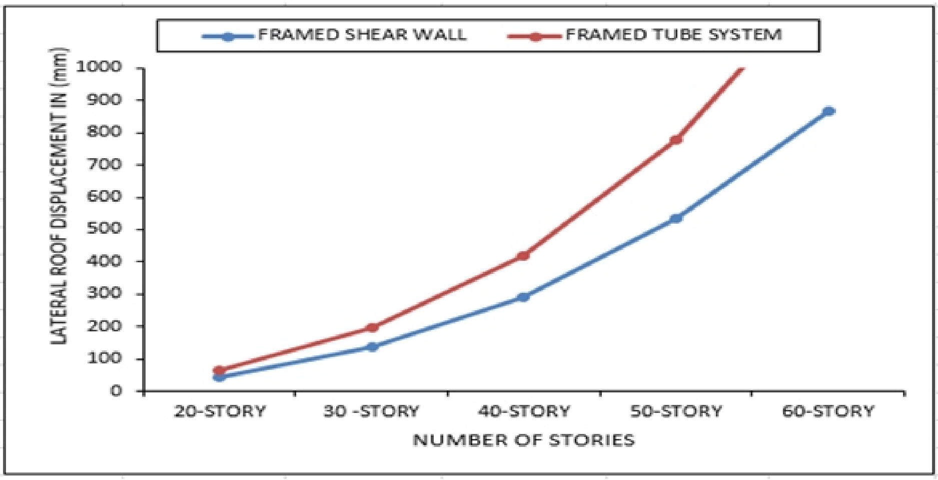


Fig. 5.28 Graph – Maximum Lateral Roof Displacement due to wind load combinations in mm with Number of stories for Framed Shear Wall System and Framed Tube System in Y-direction.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Conclusions:

- It is evident from the observing result that the lateral roof displacements in the (20) story structures Framed Shear Wall System and Framed Tube System are very close (difference of nearly 7.3mm for wind load and 19mm for E.Q. load in X-direction and 9.3mm for wind load, 24 for E.Q. load in Y-direction) As the Framed Shear Wall System is economical compared to the Framed tube system Framed Shear Wall System is preferred. The shear wall acts as a vertical cantilever for the building, the wall is stiff for shorter lengths but as the length goes on increasing stiffness of the wall decreases, hence it gets ineffective for much higher heights.

For the (30, 40, 50 and 60) story structures the Framed Tube is very much effective in resisting lateral loads (both Wind and Earthquake loads) compared to the Shear Wall Structures.- For the structure with Framed Tube System, the maximum support reactions for outer periphery supports are much less compared to that of the Shear wall structure as the columns are very close to each other this will help its stiffness participation as a result the amount of reactions will be less in Tube System when compared to Shear Wall System.- Maximum Base Shear for (30,40, 50 and 60) story structures is observed for structure with Framed Tube System.

References:

1-ABBAS ALI IBRAHIM M.Tech structural Eng. Thesis "A Comparative Study Between The Use of Framed Shear Wall System and Framed Tube System in Tall Buildings" JNTUH college of EngineeringHyderabad-INDIA- 2015.

2-" Lateral Load Resisting Systems for Multi-Story Buildings" by Yogendra Singh - professor, Department of Earthquake Engineering, IIT Roorkee.

3-Classification of tall building systems by Daniel W. Falconer A Thesis presented to the graduate committee of Lehigh University May 1981.

4-Mir. M. Ali and Kyoung Sun Moon "Structural Developments in tall buildings.

Author 1:

Abbas Ali Ibrahim,
M.Tech Structural Engineering Student,Salahaddin University-College of Engineering Department of Civil Engineering, Hawler-IRAQ, JNTUH College of Engineering,Hyderabad-India.

Author 2:

Dr. N. V. Ramana Rao,
Professor & Registrar,B.E (OU),M.Tech (IIT Delhi), Ph.D (UK), Post Doctorate (UK),Department of Civil Engineering,JNTUH College of Engineering, Hyderabad-India.