PERFORMANCE CHARACTERSTICS ASSESSMENT OF TALL STRUCTURE UNDER LATERAL FORCES

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Abstract— Presently the Buildings are made to fulfill our basic aspects, better serviceability for fast growing population. It is not an issue to construct a building any how it is important to construct an efficient building which will serve its purpose for many years without showing any failure. Most of the countries like India, China, etc having greater ratio of population to land which leads to problem involved in expansion of structure along horizontal direction . Hence it is essential to construct high rise buildings, so it is very important to design a building which is capable to resists lateral forces. The present Paper work deals with "**PERFORMANCE CHARACTERSTICS ASSESSMENT OF TALL STRUCTURE UNDER LATERAL FORCES**". In this paper the tube in tube, Framed tube with Shear wall, Framed tube with X-Bracing are compared to each other.

Keywords— Tube in tube structure, Staad –pro, lateral force analysis, Shear wall system**,** Design Seismic Base Shear, X Bracing.

INTRODUCTION

A) INTRODUCTIONS TO TUBE IN TUBE STRUCTURE**:** Modern high-rise buildings of the framed-tube system exhibit a considerable degree of shear-lag with consequential reduction in structural efficiency. Despite this drawback, framed-tube structures are widely accepted as an economical system for high-rise buildings over a wide range of building heights. This is because in the framed-tube system the lateral load resisting elements are placed on the outer perimeter. The "tube" comprises closely spaced columns that are connected at each floor level by deep spandrel beams. Such buildings are usually equipped with service cores, which may house the lifts, emergency stairways, electrical and mechanical zones and other services. These cores referred to as the internal tubes are often designed to provide added lateral stiffness to the building; they also interact with each other as well as with the external tube. Framed-tube structures with multiple internal tubes, or tubes-in-tube structures, are widely used due to their high stiffness in resisting lateral loads and the availability of the internal tubes in supporting the vertical loads. The use of multiple internal tubes reduces the effect of shear-lag in the tubes and offers additional lateral stiffness to the overall structure. The tube-tube interaction coupled with the existence of negative shear-lag in the tubes complicates the estimation of the structural performance and the accurate analysis of tubes in framed-tube system. Existing models for approximate analysis not only ignore the contribution of the internal tubes to the overall lateral stiffness but also neglect the negative shear-lag effects in the tubes. Thus, these models cater only for the structural analysis of the external tube but fail to consider the shear-lag phenomenon of the internal tubes.

B) INTRODUCTIONS TO SHEAR WALL**:** Shear wall is one of the most commonly used lateral load resisting element in high rise building. Shear wall (SW) has high in plane stiffness and strength which can be used simultaneously to resist large horizontal load and support gravity load. The scope of present work is to study and investigate the effectiveness of RC shear wall in medium rise building. Reinforced concrete shear walls are used in Bare frame building to resist lateral force due to wind and earthquakes. They are usually provided between column lines, in stair wells, lift wells, in shafts. Shear wall provide lateral load resisting by transferring the wind or earthquake load to foundation. Besides, they impart lateral stiffness to the system and also carry gravity loads. But bare frame with shear wall still become economically unattractive. If the structural engineers consider property the non-structural element in structural design along with other elements like shear wall gives better results.

C) INTRODUCTIONS TO SHEAR WALL**:** The most effective and practical method of enhancing the seismic resistance is to increase the energy absorption capacity of structures by combining bracing elements in the frame. The braced frame can absorb a greater degree of energy exerted by earthquakes. Bracing members are widely used in steel structures to reduce lateral displacement and dissipate energy during strong ground motions. This concept extended to concrete frames. The various aspects such as size and shape of building, location of shear wall and bracing in building, distribution of mass, distribution of stiffness greatly affect the behaviors of structures. Bracing system improves the seismic performance of the frame by increasing its lateral stiffness and capacity. To the addition of bracing system load could be transferred out of the frame and into the braces, by passing the weak columns. The stiffness added by the bracing system is maintained almost up to the peak strength. Stiffness is particularly important at serviceability state, where deformations are limited to prevent damage.

Description of building model

In this paper, we have analyzed three different structure i.e. Tube in tube structure, Framed structure with Shear wall, Framed X bracing of having common geometry with G+21 storey models and there loading condition are taken from IS code. We take taken Live, Dead, Wind and seismic. The general features of the building model and beam sections used in the building are shown in the

Table No1

Sr no.	features	Tube in tube structure	Framed structure With Shear wall	Framed structure with X bracing
1.	Layout	As shown in plan	As shown in plan	As shown in plan
2.	No.of storey	G+21	G+21	G+21
3.	Total heigh of the building	91.7	91.7	91.7
4.	Floor to floor height	4.1m	4.1m	4.1m
5.	External wall	0.3m (including plaster)	0.3m (including plaster)	0.3m (including plaster)
6.	Shear wall	0.3m	0.3m	0.3m
7	Slab thickness	0.2m	0.2m	0.2m
8.	Material used	M35	M35	M35
9.	Dead load	6.5 KN/ m^2	6.5 KN/ m^2	6.5 KN/ m^2
10.	Live load	4 KN/ m^2	4 KN/ m^2	4 KN/ m^2
11.	Wind load	0.675 KN/ m^2	0.675 KN/ m^2	0.675 KN/ m^2
12.	Seismic analysis	Static base shear method	Static base shear method	Static base shear method
13.	Columns size	C1-1.5 X 1.5 C2-0.6 X0.6	C1-1.5 X 1.5 C2-0.6 X0.6	C1-1.5 X 1.5 C2-0.6 X0.6
14.	Beam size	B1-0.5 X 1(**Spandrel beam**) B2- 0.3 X 0.6	B1- 0.3 X 0.65	B1- 0.3 X 0.65
15.	Seismic zone	III	III	III

Modeling of loads

In this paper the basic loads considered are dead load, live loads, earthquake loads and wind loads. The values of Dead loads (DL) are calculated from the unit weights as specified in IS 875 (Part 1): 1987. The live load (LL) intensities for the various areas of residential buildings are obtained from IS 875 (Part 2): 1987. The summary of dead load and live loads considered for the building is given in Table 1. In load combinations involving Imposed Loads (LL), IS 1893 (Part I):2002 recommends for loads up to and including *4* KN/m^2, *50%* of the imposed load to be considered for seismic weight calculations. However to be conservative, in the present study, *50%* imposed loads are considered in load combinations. The earthquake loads are assigned *X* and Z directions as *ELx* and *ELz* respectively as per IS 1893(Part 1):2002. Load combinations for the analysis of the structure in shown in table no 2.

SR NO	LOAD COMBINATION
1	1.5 Dead Load +1.5 Live Load
2	1.2 Dead Load +1.2 Live Load+ 1.2 wind load X^+
3	1.2 Dead Load +1.2 Live Load+ 1.2 wind load X^-
4	1.2 Dead Load +1.2 Live Load+ 1.2 wind load Z^+
5	1.2 Dead Load +1.2 Live Load+ 1.2 wind load Z^-
6	0.9 Dead load +1.5 Live load
7	0.9 Dead Load +1.5 wind load X^+
8	0.9 Dead Load +1.5 wind load X^-
9	0.9 Dead Load +1.5 wind load Z^+
10	0.9 Dead Load +1.5 wind load Z^-
11	1.5 Dead Load +1.5 wind load X^+
12	1.5 Dead Load +1.5 wind load X^-
13	1.5 Dead Load +1.5 wind load Z^+
14	1.5 Dead Load +1.5 wind load Z^-
15	1.2 Dead Load +1.2 Live Load+1.2Earthqueke load X
16	1.2 Dead Load +1.2 Live Load+1.2Earthqueke Z

Analytical model considered for Analysis

In this paper we have studied the two different structure one is R.C.C tube in tube structure, Framed structure with shear wall, Framed structure with X-Bracing using same grade of the concrete and beam position. Features and plan are shown in the tables no 1. Building is modeled using STAAD-PRO. Using this software we have generated structure with beam, column and shear walls. And we also have studied different parameters of both the structures and observe the following results. Design data are used as describe in the table 1**.**

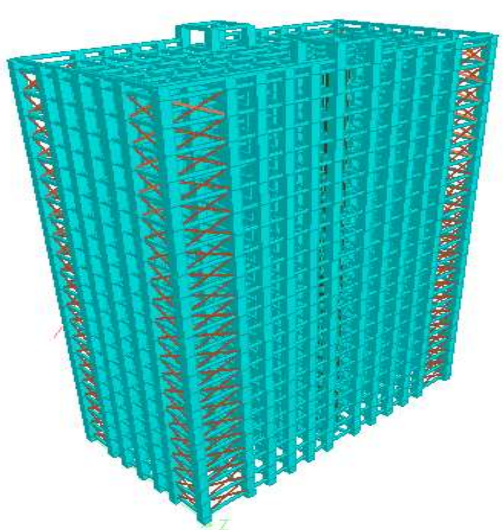

Fig. Framed structure with X-Bracing

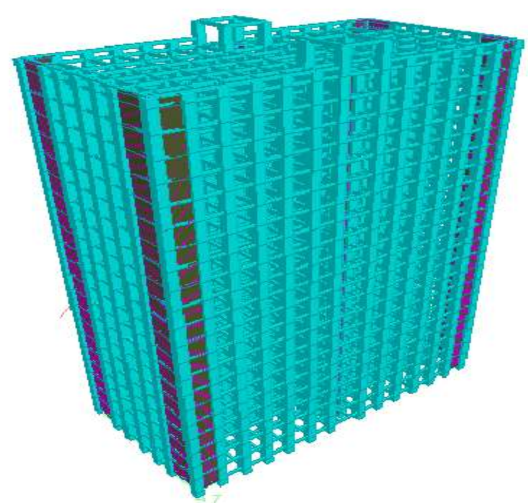

Fig. Framed structure with Shear wall

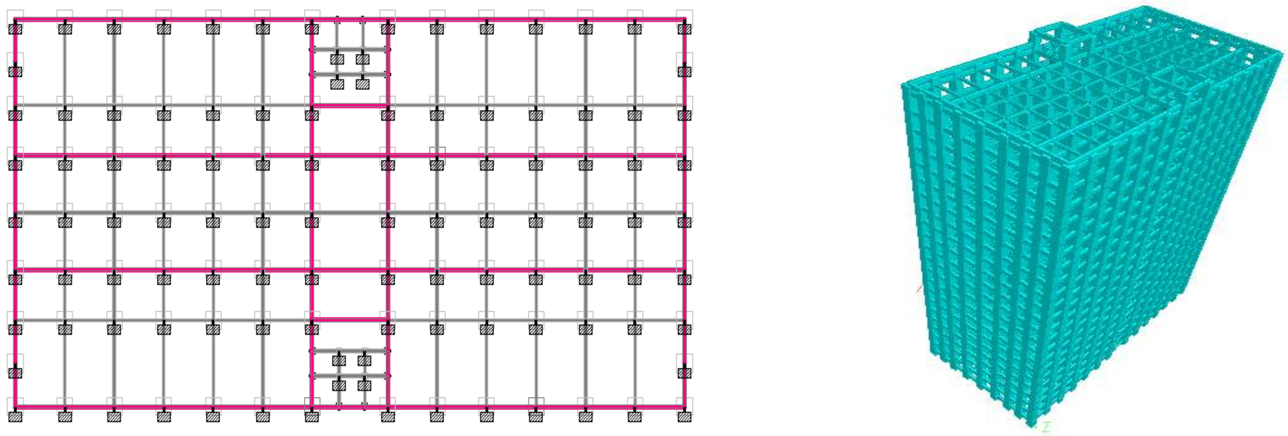

Fig. Tube forming structure

Model 1:

Tube structure constructed in outer periphery of building and also constructed internal of structure to resist lateral forces generated from earthquake and wind forces.

Model 2:

Building has RC X bracings in outrigger patterns in all corners in every storey in all the four sides.

Model 3:

Building has RC Shear wall is providing in all corners in every storey in all the four sides.

RESULT AND DISCUSSION

In this paper the results of all the building models are presented. Analysis were carried out using STAAD-PRO and different parameters studied such as storey displacement, member deflection with considering lateral forces the graph and table are shown below.

Table no.1 Comparison between Tube in tube, Shear wall, X-Bracing structure in Deflection.

Storye no.	Height from ground floor	Deflection (in mm)		
		Tube in tube structure	Framed structure with Shear wall	Framed structure with X-Bracing
1.	4.1	1.212	0.322	1.746
2.	8.2	12.745	4.362	18.412
3.	12.3	30.646	11.764	46.703
4.	16.4	51.265	21.398	81.886
5.	20.5	73.029	32.527	121.529
6.	24.6	95.245	44.628	164.002
7.	28.7	117.574	57.325	208.169
8.	32.8	139.814	70.339	253.215
9.	36.9	161.814	83.455	298.530
10.	41	183.436	96.501	343.624
11.	45.1	204.541	109.334	388.078
12.	49.2	224.987	121.826	431.508
13.	53.3	244.623	133.859	473.550
14.	57.4	263.294	145.326	513.858
15.	61.5	280.837	156.122	552.096
16.	65.6	297.087	166.150	587.944
17.	69.7	311.873	175.318	621.104
18.	73.8	325.028	183.539	651.104
19.	77.9	336.381	190.739	678.324
20.	82	345.775	196.869	702.010
21.	86.1	353.137	201.973	722.481
22.	90.2	360.642	206.420	740.569
23.	94.3	362.142	211.503	757.389

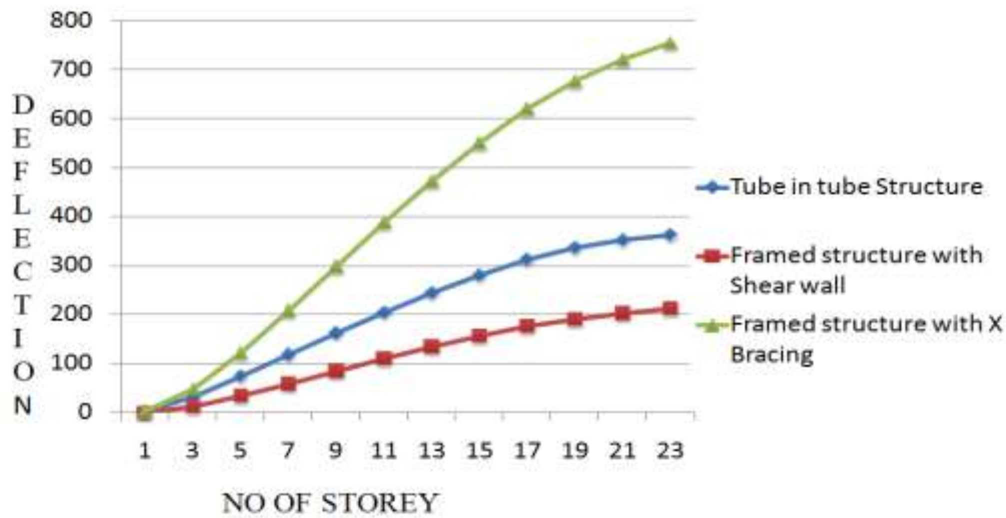

Fig. Comparison of Deflection with Tube in tube, Framed structure with Shear wall and Framed structure with X-Bracing

Table no.2 Comparison between Tube in tube, Shear wall, X-Bracing structure in Displacement.

Storye no.	Height from ground floor	shear displacement (in mm)		
		Tube in tube structure	Framed structure with Shear wall	Framed structure with X-Bracing
1.	4.1	1.450	0.317	2.083
2.	8.2	15.257	5.187	22.095
3.	12.3	36.710	14.097	55.905
4.	16.4	61.439	25.660	98.119
5.	20.5	87.552	39.012	145.701
6.	24.6	114.212	53.533	196.684
7.	28.7	141.009	68.769	249.704
8.	32.8	167.701	84.384	303.180
9.	36.9	194.103	100.123	358.179
10.	41	220.051	115.779	412.314
11.	45.1	224.380	131.177	465.680
12.	49.2	269.916	146.166	517.816
13.	53.3	293.481	160.605	568.288
14.	57.4	315.886	174.363	616.677
15.	61.5	336.937	187.313	662.581
16.	65.6	356.433	199.338	705.618
17.	69.7	374.172	210.325	745.432
18.	73.8	389.952	220.325	781.703
19.	77.9	403.579	228.797	814.159
20.	82	414.892	236.154	842.628
21.	86.1	423.860	242.332	867.276
22.	90.2	430.987	247.854	889.217
23.	94.3	434.564	253.801	909.101

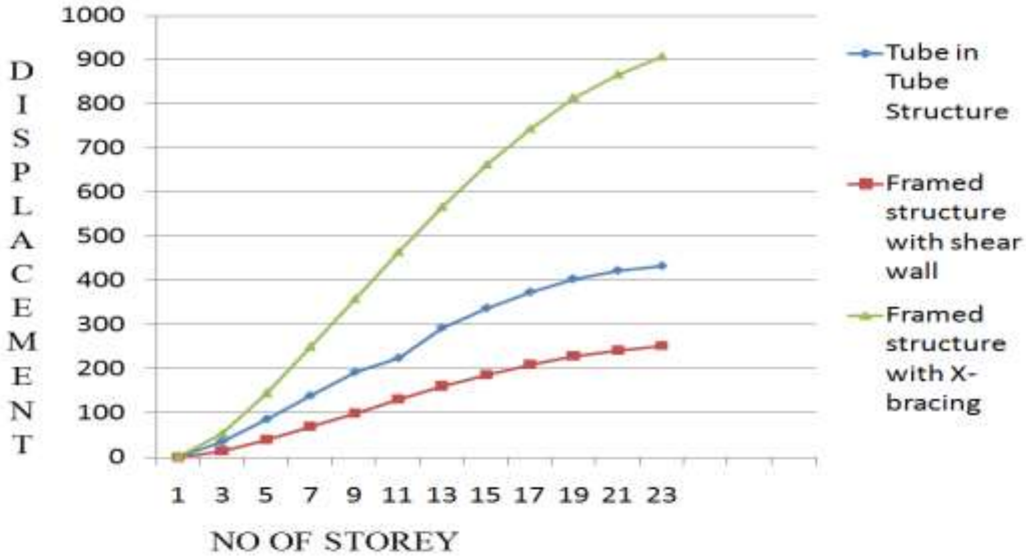

Fig. Comparison of Displacement with Tube in tube, Framed structure with Shear wall and Framed structure with X-Bracing

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CONCLUSIONS

The response of a tall building under wind and seismic load as per IS codes of practice is studied Seismic analysis with static base shear method and wind load analysis with IS code method are used for analysis of a G+21 storey RCC high rise building as per IS 1893(Part1):2002 and IS 875(Part3):1987codes respectively. The building is modeled as 3D space frame using STAAD.pro software. Below are some conclusions.

1. We have compared both the structure with same parameters; results are found as per the graphs indicating that for high-rise structure, and analyze difference between displacement and deflection.
2. A provision of deep spandrels beam in tube in tube structure gives it more strength compared to Farmed structure with X-Bracing and less than framed structure with Shear wall.
3. The lateral Displacement and Deflection of the building studied are reduced by the use of Tube and tube, Shear wall and X-bracing.

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