

**STUDY OF TALL STRUCTURAL SYSTEM
(SOFTWARE APPROACH)**Rohit Shah¹, Tejas Patil²¹ Post-graduation Student, Department of Civil Engineering, Parul Institute of Technology, Vadodara.² Assist. Professor, Department of Civil Engineering, Parul Institute of Technology, Vadodara.

Abstract Due to heavy urbanization and population growth, vertical growth in the construction industry has become challenging. This challenge is controlled by using high power and light weight material. In addition to applying advanced efficient structural form for gravity and lateral load, there is constant development to control structural distortion, in this connection the system is responsible for controlling the reaction of the side, because as we know that in height There is a large amount of wind forces which are more effective because we have to control the side effect. The current investigation involves the study of structural systems and it can be concluded that with the help of ETAB, which system is more efficient about various factors.

Keywords- Tall structure, Structural Systems, Outrigger System, Dynamic Analysis, ETABs

I. INTRODUCTION

Reinforced concrete construction started around the turn of the century. It does not seem to have been used for multi-storey buildings until after the end of First World War I. the natural advantage of composite material, which could be radially formed at the same time, satisfy both aesthetic and load carrying requirements. Progress of reinforced concrete was slow and irregular and at the time the steel framed Empire State Building was completed, the tallest concrete building, the exchange building Seattle, had attained a height of only 23 stories. The economic depression of the 1930s put an end to the great skyscraper period, and it was not until some years after the World War II that the construction of tall structure recommended, with very new structural and architectural solution. Rather than bringing major increases in height, however, these modern developments included new structural system, improved material qualities and services, and better design and construction technique.

II. METHOD OF ANALYSIS:

In this chapter, the analysis and the design of 100-story buildings of Outrigger structural systems have been presented. Demonstrate structure, analysis, design and modeling in ETABS software. All member design using IS 456:2000, for seismic analysis using IS 1893(Part 1): 2002 and perform wind analysis using IS 875(part 3): 1987. Analysis was performed and results are obtained in case of Story Drifts and Story Displacement. In this research model is analyzed which is based on Outrigger structural systems which is mentioned earlier.

The 100-story building has a 54 meter x 54 meter square grid. The side of the building shown in the grid figure-1 and the difference between the columns is taken as 4 meters.

A) Design Data:

No of storey	= 100 nos.
Plan area of building	= 60 m X 60 m
Total height of building	= 300 m
Floor height	= 3 m
Size of Column	=1.5 x 1.5 m(up to 30) =1.2 x 1.2 m(31 to 60) =0.8 x 0.8 m(61 to 90) =0.5 x 0.5 m(91 to 100)
Size of Beam	= 800 x 600 mm (upto 30) =700 x 500 mm (31 to 60) =550 x 450 mm (61 to 90) =450 x 350 mm (91 to 100)
Dimension of Slab	= 6 m x 6 m
Thickness of slab	= 180 mm
Size of Shear wall	= 300 mm

Size of Outrigger: =0.8 X 0.6 m
 Type of Bracing section = ISMB350
 Grade of Concrete = M50
 Grade of Steel = HYSD415

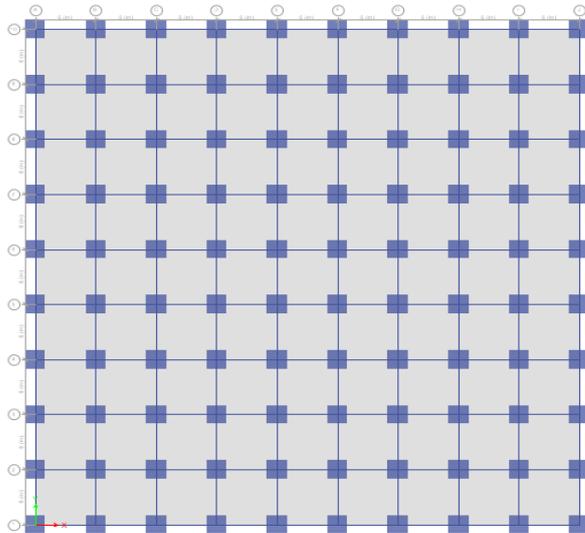


Fig.1 Story floor plan

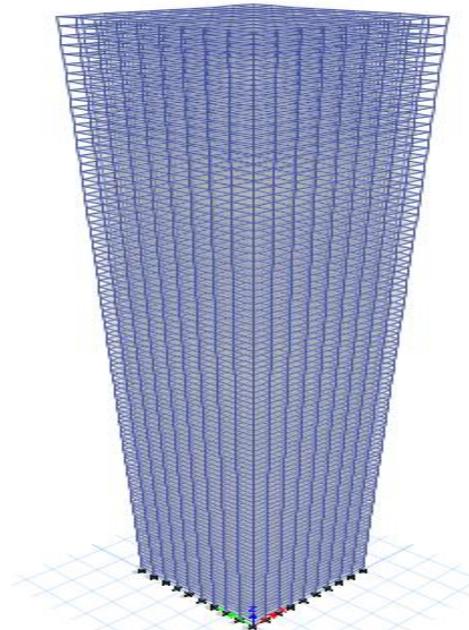


Fig. 2 side view of building

B) Loading data:

Live load = 2 KN/m²
 Dead load = consider only self-weight
 Wind load = speed: 44 m/s
 Terrain category: = 3
 Structure class: =C
 Risk coefficient(K₁): = 1.07
 Topography Factor(K₃): =1
 Seismic load = Zone(Z): =0.16 (Zone 3)
 Site type = II
 Importance Factor(I) = 1.5
 Time period(T) = Programme Calculated

C) Load Combination:

No.	COMBINATION	No.	COMBINATION
1	1.5 (D.L)	11	1.2 (D.L + L.L + E _Y)
2	1.5 (D.L + L.L)	12	1.2 (D.L + L.L - E _Y)
3	1.2 (D.L + L.L + Wind)	13	1.5 (D.L + E _x)
4	1.2 (D.L + L.L - Wind)	14	1.5 (D.L - E _x)
5	1.5 (D.L + Wind)	15	1.5 (D.L + E _Y)
6	1.5 (D.L - Wind)	16	1.5 (D.L - E _Y)
7	0.9 D.L + 1.5 L.L	17	0.9 D.L + 1.5 E _x
8	0.9 D.L - 1.5 L.L	18	0.9 D.L - 1.5 E _x
9	1.2 (D.L + L.L + E _x)	19	0.9 D.L + 1.5 E _Y
10	1.2 (D.L + L.L - E _x)	20	0.9 D.L - 1.5 E _Y

III. RESULT AND DISCUSSION

Following are the few types of Structural systems which is analysis with the Help of ETABS. Each system has a different type of configuration because of their working or behaviour properties and in analysis two type of analysis performed namely wind analysis and seismic analysis through static linear analysis. In result data consider only Storey Displacement, Storey Drift and Storey Shear. Result data shown in following tables of various systems.

Outrigger System:

Outrigger system has a bracing at different height. In this system bracings are tied to outer core to inner core. Inverted V shape bracings are using at different height. no of 3 Outrigger use in outer core at 1st,50th and 100th floor and same way at inner core in L Shape. Plan of outrigger system has shown in fig. Size of section is ISMB350 which is used in outriggers.

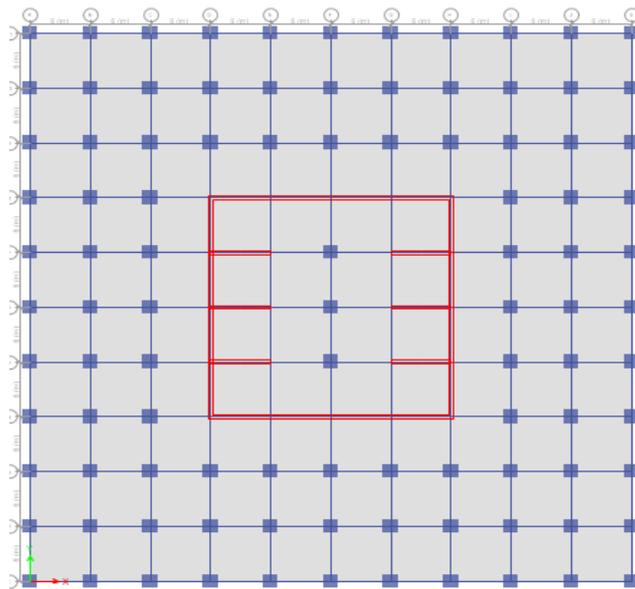


Fig. 3 plan of Outrigger systems

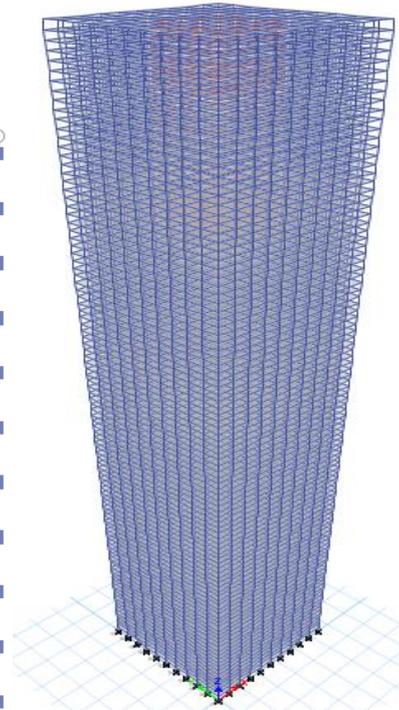


Fig.4 3-D view of O-T

A) Results

Table.1 Seismic analytical result of Outrigger

STORY	displacement(mm)		story drift		story shear(KN)	
	x	y	x	y	x	y
Story100	124	132	1.6	1.7	575.3182	575.3182
Story90	108	115	1.6	1.7	6629.603	6629.603
Story80	92	97	1.7	1.8	12215.7	12215.7
Story70	75	80	1.7	1.8	16559.32	16559.32
Story60	59	63	1.4	1.4	19903.82	19903.82
Story50	47	50	1.2	1.2	23387.31	23387.31
Story40	35	37	1.2	1.3	25651.22	25651.22
Story30	23	25	1.1	1.2	27015.72	27015.72
Story20	13	14	0.9	1.0	27708.5	27708.5
Story10	5	5	2.439	2.297	47649.88	47649.877

Table.2 Wind analytical result of Outrigger

STORY	displacement(mm)		story drift		story shear(KN)	
	x	y	x	y	x	y
Story100	295	315	3.4	3.6	575.0257	575.0257
Story90	261	278	3.4	3.7	11964.46	11964.46
Story80	226	241	3.6	3.8	23140.24	23140.24
Story70	190	202	3.6	3.9	34104.41	34104.41
Story60	154	164	3.1	3.3	44832.24	44832.24
Story50	125	134	2.8	3.0	55253.88	55253.88
Story40	96	103	3.0	3.1	65314.55	65314.55
Story30	67	72	2.9	3.1	74954.08	74954.08
Story20	39	42	2.6	2.8	83969.84	83969.84
Story10	15	16	2.0	2.2	92143.56	92143.56

B) Graph of analytical result of Outrigger:

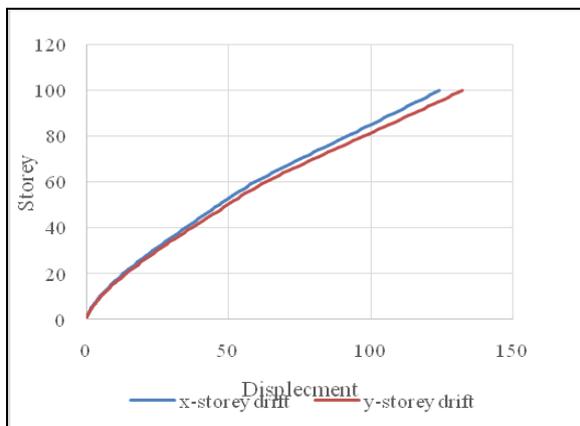


Fig.5 Displacement of O-T System due to E_x & E_y

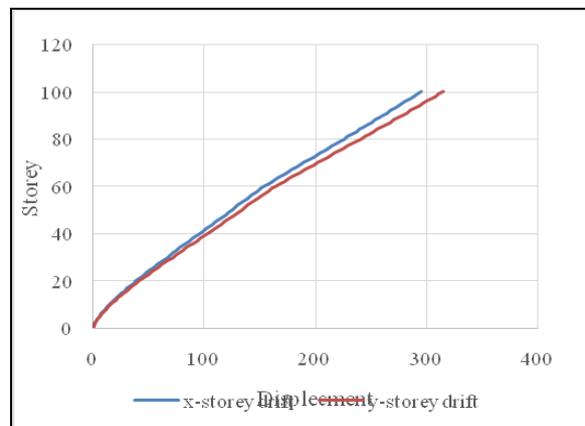


Fig.6 Displacement of O-T System due to wind

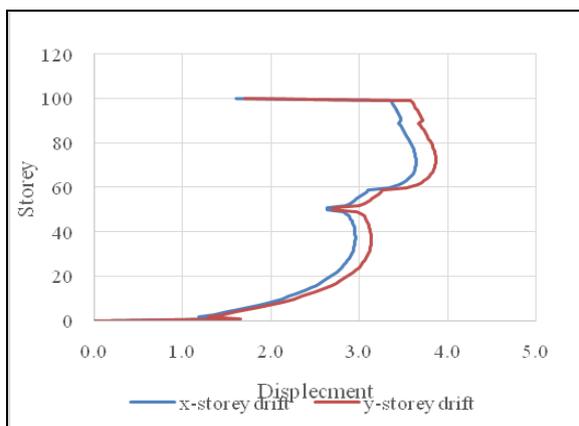


Fig.7 Storey Drift of O-T due to E_x & E_y

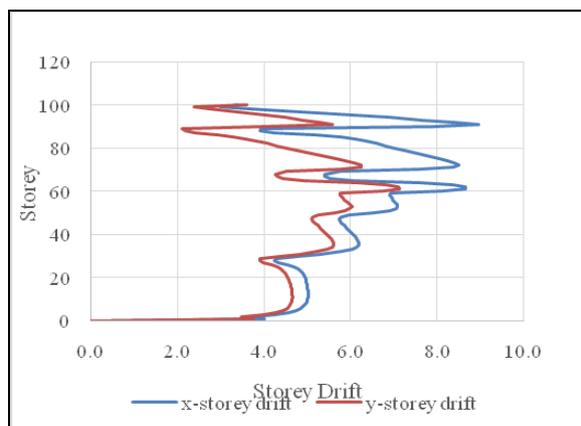


Fig.8 Storey Drift of O-T due to Wind

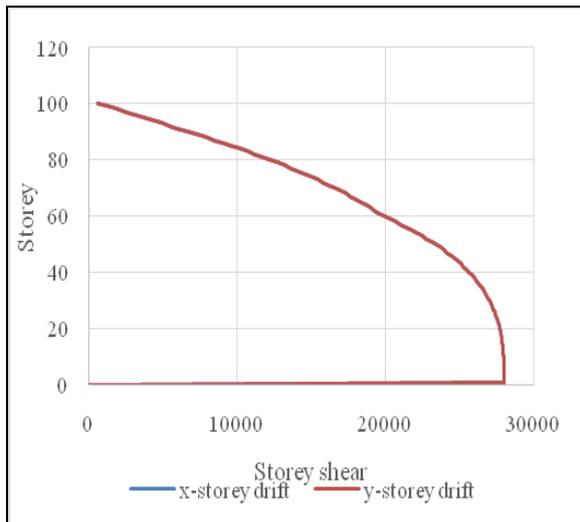


Fig.9 Storey shear of O-T sys.due to E_x & E_y

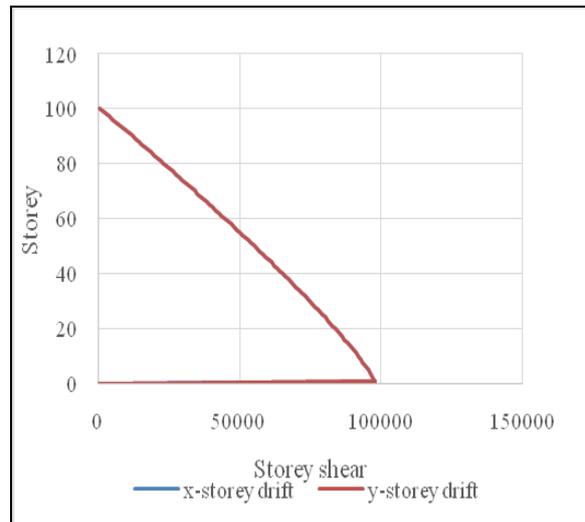


Fig. 10 Storey shear of O-T sys. due to wind

IV. CONCLUSION:

As a result of study of Story displacement and Story drift, it is observed that the outrigger system shows the better stability for the tall structures. The analysis of wind and seismic was performed using ETABS software. The outrigger system shows the story displacement and story drift within limit, that can be shown the stability using outrigger system is more compare to normal building system.

REFERENCES

- [1] Alan H. Mattock, Jun Yamazaki And Basil T. Kattula "Comparative Study Of Pre-Stressed Concrete Beams, With And Without Bond" .ACI Structural Journal ,Vol. 68,Pp.116-125, January 1971.
- [2] Yamane, T., Tadros, M., Badie, S., And Baishya, M., "Full Depth Precast, Prestressed Concrete Bridge Deck System", PCI Journal, Vol. 43, No. 3, Pp. 50-66. May-June 1998.
- [3] Yun, Y. M., "Evaluation of ultimate strength of posttensioned anchorage zones". Journal of Advanced Concrete Technology, vol. 3, pp. 149-159. March 2005.
- [4] Bijan Aalami "Bonded And Unbonded System Of Post Tensioning - A Design And Performance Review".Phonix,Arizona,Oct. 1993
- [5] Garlock Maria M, Ricles James M., Sause Richard, "Influence Of Design Parameters On Seismic Response Of Post-Tensioned Steel Mrf Systems", Engineering Structures, 31st May 2007.
- [6] Ezzeldin Y. Sayed-Ahmed And Nigel G. Shrive , "A New Steel Anchorage System For Post-Tensioning Applications Using Carbon Fibre Reinforced Plastic Tendons"Department Of Structural Engineering,Pg.113.127 June 1998.
- [7] F.M.Alkhalairi,A.E.Naaman "Analysis Of Beam Prestressed With Unbonded Internal Or External Tendons" Journal Structural Engineering ,ASCE,Vol.119,Issue 9,September 1993.
- [8] Yong, Y. K., Gadugbeka, C. & Nawy, E., 1987. Anchorage Zone Stresses Of Post-Tensioned Prestressed Beams Subjected To Shear Force. Journal Of Structural Engineering, ASCE, Vol. 113, Issue. 8, Pp. 1789-1805.August 1987.
- [9] Tan KH, Ng CH., (1998),"Effect Of Shear In Externally Prestressed Beams". ACI Structural Journal Pp. 116-128,Vol 95,Pp.116-128,January 1998;
- [10] Webster, N.R., "Unbonded Monostrand Post-tensioned Construction – A Question of Durability", Presentation to Canadian Society of Civil Engineers, Vancouver, B.C., June 21, 1989