Dynamic analysis of soft storey R.C frame with carbon strands in different seismic zones

[1]Astik M. Velani, [2]Nirav Katarmal, [3]Narendra R. Pokar,
[1]P. G. Student of structural Engineering HJD ITER - Kutch, [2]Asisstant professor of Civil Engineering Department HJD – ITER - Kutch, [3]Structure Engineer - Bhuj.

Abstract: In urban India many such buildings constructed in recent times have a special feature open ground storey for the purpose of parking. In the upper storey have walls makes building many times stiffer in the upper stories than in the open ground storey which create soft storey. During past earthquake several collapse had been observed due to soft storey effect. To strengthen the soft storey generally shear wall and bracing are used but it increases base shear of structure. So the Alternative method to strengthen the soft storey carbon strands is used. In the present studied, the performance of carbon strands and bracing is analyzed for G+4, G+9, G+14 R.C Frame building. The response of building is analyzed with structural parameters i.e. Displacement and Base shear.

***Index Terms* – Soft storey, carbon strands, bracing, response spectrum analysis, time history.**

I. INTRODUCTION

Many structures having parking or commercial areas at their ground storey suffered major structural damage and collapsed in the recent earthquakes. Large open areas with less infill and exterior walls and higher floor levels at the ground level result in soft stories and hence damage. In such buildings, the stiffness of the lateral load resisting systems at those stories is quit less than the stories above.

During earthquake many damages and collapse of building occur due to the soft storey at ground. Many building were damage and collapse during Bhuj earthquake 2001 of magnitude 7.2 are due to soft storey effect in the building, After Bhuj earthquake the Indian seismic code 1893(part 1) 2002 “criteria for earthquake resistant design of structures” has added special design provisions related to soft story building.

II. OBJECTIVES

- To find Response of soft storey structure under seismic load for seismic zone IV, V.
- To analysis the influence of carbon strands.
- To optimize the best suitable angle of carbon strands.

III. LITERATURE REVIEW

[15]Sujith velloor Sudarsana kumar investigated that base shear is slightly decreased by 2% using carbon strands than shear walls. Maximum Moment for corner columns are higher in steel strands is about 12% than carbon strands & shear forces for steel strands is about 3% higher than carbon strands. Thus during earthquake, the seismic performance of carbon strands is more effective.

[14]Sourabh Rajoriya investigated that the maximum deflection of building in zone III is 54% less than zone V. Bending moment for zone III is 55.4% less than zone V. It was observed that shear force is critical at the junction of soft storey and also for second floor and the value of shear force for zone III is 54.5% less than zone V.

[12]Sachin kulkarni investigated that storey drift reduce by using shear wall and cross bracing compare to bare soft storey. The base shear of the structure heavily increases. The shear wall has better performance compared cross bracing system.

[13]Shamshad ali investigated that building without soft storey is found to be safer during earthquake as compared to building having soft storey at any floor.

IV. METHODOLOGY

For dynamic analysis of soft storey structure, 5, 10 & 15 storey building is considered with rectangular in plan. Also carbon strands is provided at 30^0, 45^0 & 60^0. X type of bracing is used at the base to compare the response of the carbon strands in soft storey structure.

Lateral Maximum displacement and Base shear is considered for the seismic behavior of soft storey buildings. Seismic Zone IV & V is taken for Response spectrum analysis and for time history analysis Bhuj time history is considered.

V. STRUCTURAL SECTION DETAILS

Plan area	20m x 16m
No. of bay in x-direction	5
No. of bay in y- direction	4
Floor height	3m
Plinth height	2m
Size of column	300mm x 600mm
Size of beam	300mm x 450mm

Slab thickness	115mm
Grade of concrete	M20
Grade of steel	Fe415
Type of soil	Medium
Carbon strands	**Description(As per Tokyo rope ltd.Japan)**
Diameter	40mm
Tensile strength	2690 Mpa
Elastic modulus	155 Gpa
Poisson ratio	1.5 g/cm^3
Coefficient of linear expansion	0.6 x 10^{-6}/°c
Bracing	**Thickness x depth**
External wall	300 x 300
Width of equivalent diagonal struts	**Thickness x depth**
External wall	230mm x 454.29mm
Internal wall	115mm x 345.98mm

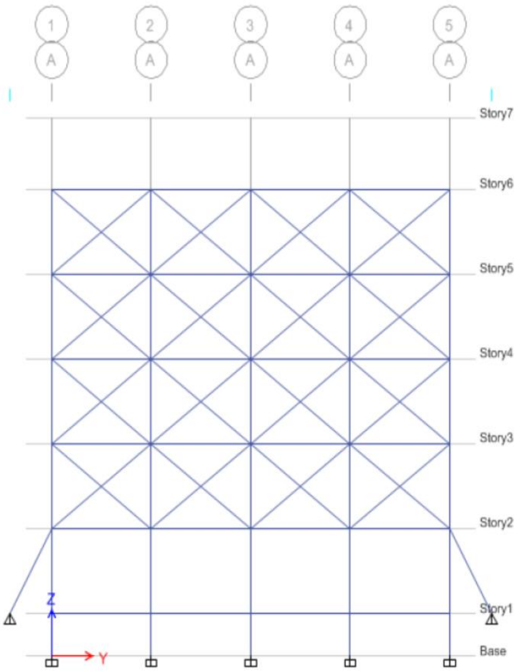


Fig. 1 Elevation view with Carbon strands

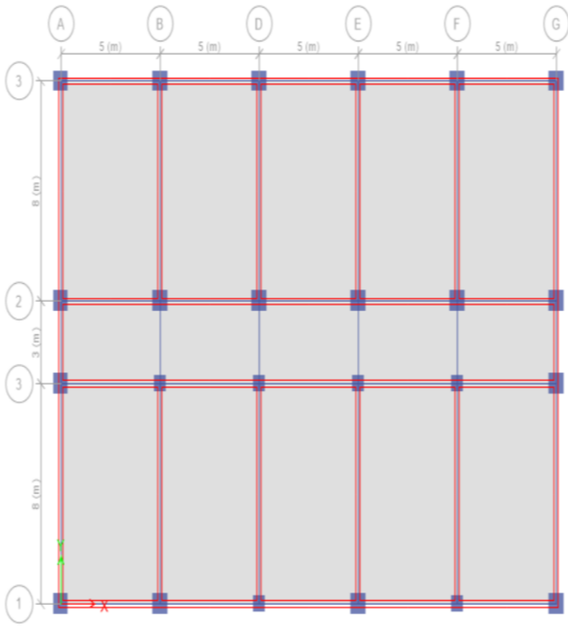
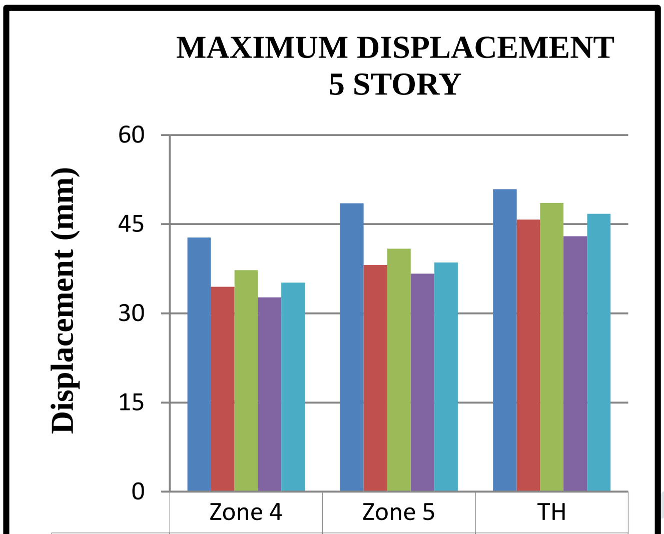


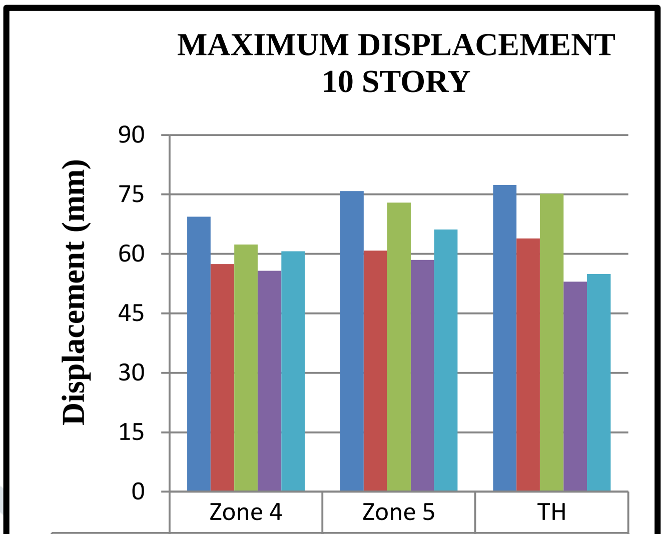
Fig. 2 Plan view

VI. RESULTS



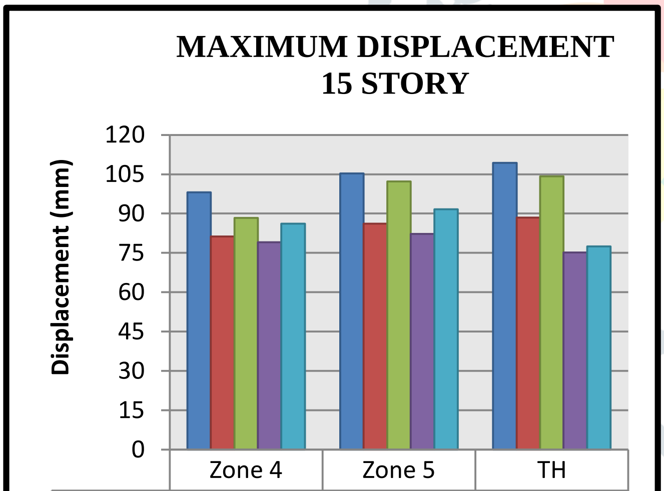
	Zone 4	Zone 5	TH
Bare	42.78	48.50	50.90
Bracing	34.48	38.13	45.78
30°	37.25	40.86	48.56
45°	32.68	36.68	42.99
60°	35.17	38.57	46.72

Fig. 3 Maximum Displacement 5 storey



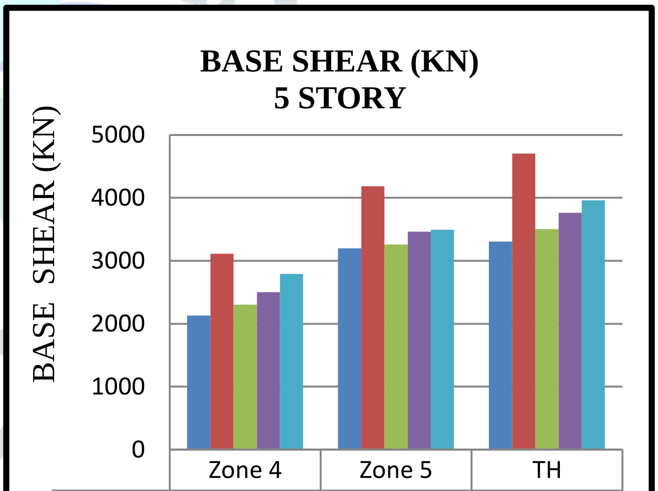
	Zone 4	Zone 5	TH
Bare	69.37	75.88	77.35
Bracing	57.47	60.80	63.89
30°	62.34	72.91	75.19
45°	55.78	58.49	52.98
60°	60.70	66.18	54.91

Fig. 4 Maximum Displacement 10 storey



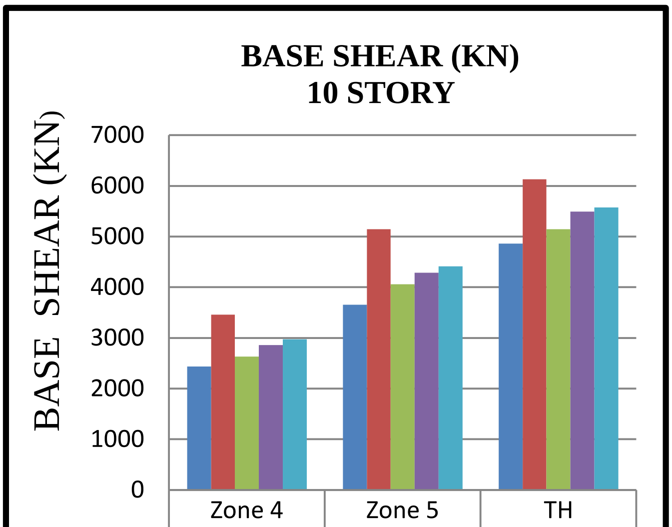
	Zone 4	Zone 5	TH
Bare	98.12	105.26	109.28
Bracing	81.29	86.15	88.42
30°	88.29	102.25	104.22
45°	79.05	82.27	75.15
60°	86.17	91.68	77.49

Fig. 5Maximum Displacement 15 storey



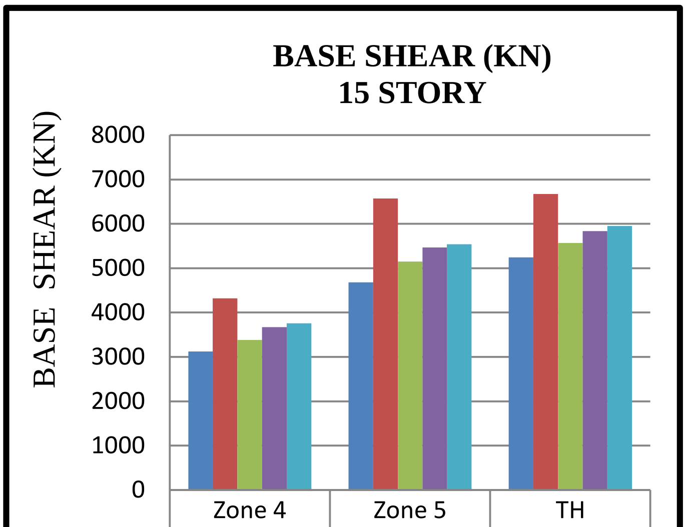
	Zone 4	Zone 5	TH
Bare	2132.00	3198.00	3304.32
Bracing	3114.32	4187.00	4704.32
30°	2304.32	3257.32	3504.32
45°	2499.32	3464.32	3760.32
60°	2792.32	3495.32	3959.32

Fig. 6 Base shear 5 storey



	Zone 4	Zone 5	TH
Bare	2437.00	3656.00	4862.00
Bracing	3458.12	5147.47	6128.27
30°	2633.98	4058.19	5146.28
45°	2858.01	4284.56	5489.96
60°	2974.37	4409.14	5574.41

Fig. 7 Base shear 10 storey



	Zone 4	Zone 5	TH
Bare	3121.00	4682.00	5248.00
Bracing	4317.98	6574.18	6674.40
30°	3379.26	5150.47	5567.64
45°	3670.18	5468.34	5835.05
60°	3754.82	5538.67	5948.90

Fig. 8 Base shear 15 storey

VII. CONCLUSION

- Maximum storey displacement reduce more in Bracing with respect to carbon strands
- Maximum storey displacement reduce more in carbon strands at 45° angle with respect to carbon strands at 30° & 60 ° angle
- Base shear is less in bare frame model compare to bracing and carbon strands
- Base shear is less in carbon strands at 30° angle with respect to carbon strands at45° & 60° angle
- Drift is reduce in bracing compare to carbon strands
- So overall performance of strands at 45° angle is more efficient alternative structural element in lateral load resistance with less base shear, especially in soft storey structure

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