Comparative Seismic Analysis of Multistorey Building Using Steel Beam and Concrete Column In E-Tabs

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Abstract - The rapid increase in urban population has necessitated the construction of high-rise buildings capable of efficiently resisting seismic forces while maintaining structural economy. Conventional reinforced concrete (RCC) systems, though widely used, often exhibit limitations in stiffness, displacement control, and material efficiency when subjected to strong earthquakes. In recent years, steel–concrete hybrid structural systems have gained attention due to their ability to combine the ductility and tensile strength of steel with the compressive strength and durability of concrete.
In this study, the seismic behaviour of a G+20 multistorey building incorporating steel beam–concrete column hybrid framing is investigated. Four analytical models are developed using ETABS software: a conventional RCC framed structure and three hybrid configurations with selective replacement of reinforced concrete beams by steel beams. Linear dynamic analysis is carried out using the Response Spectrum Method and Linear Time History Analysis based on Bhuj earthquake ground motion. Key seismic response parameters such as storey stiffness, storey displacement, storey drift, storey shear, and overturning moment are evaluated for Seismic Zones III, IV, and V.
The results indicate that hybrid structural systems exhibit significantly higher stiffness and reduced lateral displacements compared to conventional RCC frames. The replacement of all RC beams with steel beams demonstrates the maximum improvement in seismic performance; however, partial replacement schemes also achieve comparable reductions in displacement and drift. The study concludes that steel beam–concrete column hybrid systems offer an efficient and practical alternative for high-rise buildings in seismic regions

Key Words: Hybrid Structure, Steel Beam–Concrete Column, Seismic Analysis, High-Rise Building, Response Spectrum, Time History Analysis, E-Tab

1.INTRODUCTION

Urbanisation and limited land availability have led to the vertical expansion of cities, resulting in the widespread construction of high-rise buildings. As building height increases, structural systems are subjected to higher lateral forces due to earthquakes and wind, making seismic performance a critical design consideration. Traditional reinforced concrete framing systems often require increased member sizes to meet strength and serviceability requirements, which leads to higher self-weight and construction cost.
To overcome these limitations, hybrid structural systems that combine steel and concrete have emerged as an effective solution. Steel provides high tensile strength, ductility, and energy dissipation capacity, while concrete offers excellent compressive strength, stiffness, and fire resistance. When integrated properly, steel–concrete hybrid systems improve overall structural efficiency and seismic performance.
Among various hybrid configurations, steel beam–concrete column systems have shown promising results in controlling lateral displacement and improving storey stiffness in tall buildings. Despite their advantages, limited comparative studies are available that evaluate different beam replacement patterns under Indian seismic conditions. Therefore, the present study focuses on analysing and comparing the seismic performance of RCC and hybrid framed structures using linear dynamic analysis techniques.

1.1 Necessity of Present Work

Steel beam-concrete column hybrid structures offer multiple technical advantages that make them a compelling choice in modern construction. Their enhanced seismic performance, characterized by reduced lateral displacement and storey shear forces, significantly bolsters the safety of occupants during seismic events. Moreover, these structures are known for their efficiency, as they manage to bear substantial loads while maintaining a lower self-weight, resulting in cost savings and reduced foundation requirements. The synergy of steel's strength and concrete's compressive capacity allows for optimal material utilization, promoting both strength and durability. Their design flexibility enables architects and engineers to innovate with open floor plans and creative architectural layouts, facilitating unique and aesthetically pleasing designs. Rapid construction, environmental sustainability, durability, high load-carrying capacity, adaptability for renovations, and reduced life-cycle costs further underscore the advantages of these structures. With global applicability and successful use in diverse conditions, steel beam-concrete column hybrid structures stand at the forefront of modern construction practices, offering multifaceted benefits to the industry and society at large.

1.2 Objective of Study

The specific, measurable goals that the study aims to achieve to address its broader purpose.
1. To evaluate and compare key seismic parameters such as storey stiffness, storey displacement, storey drift, base shear, and overturning moment for all structural configurations.
2. To develop multiple analytical models for comparative study including: Model-1: Conventional RCC framed structure (baseline). Model 2: Hybrid frame with internal RC beams replaced by steel beams. Model-3: Hybrid frame with external RC beams replaced by steel beams. Mode-l 4: Hybrid frame with all RC beams replaced by steel beams.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 12 | Dec - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

3. To study the influence of beam replacement patterns (internal, external, and full replacement) on overall seismic performance and structural response.
4. To provide recommendations for the potential application of steel–concrete hybrid systems in the design of future high-rise buildings for improved safety, economy, and sustainability.

2. METHODOLOGY

A G+20 multistorey building with a regular plan is modelled using ETABS software in accordance with IS 1893:2016 and IS 16700:2017. The building is designed as a Special Moment Resisting Frame (SMRF) with a typical storey height of 3.5 m and a total height of 73.5 m.
Four structural models are considered:

- **Model 1:** Conventional RCC framed structure
- **Model 2:** Hybrid structure with internal RC beams replaced by steel beams
- **Model 3:** Hybrid structure with external RC beams replaced by steel beams
- **Model 4:** Hybrid structure with all RC beams replaced by steel beams

Seismic analysis is carried out using:

- Response Spectrum Analysis for Zones III, IV, and V
- Linear Time History Analysis using Bhuj earthquake data

All models are analysed under identical loading conditions to ensure uniform comparison.

2.1 Building Data

Category	Parameter	Specification / Value
Structural System	Type of structure	Special Moment Resisting Frame (SMRF)
	Number of storeys	G + 20
	Total building height	73.5 m
	Plan dimensions	22 m × 22 m
Material Properties	Grade of steel	Fe 500
	Grade of concrete	M40
Member Dimensions	Column size	500 mm × 650 mm and 500 mm × 500 mm
	RC beam size	300 mm × 650 mm and 300 mm × 700 mm
	Steel beam section	ISLB 550
	Slab thickness	150 mm
	Shear wall thickness	230 mm
	External wall thickness	230 mm
	Internal wall	150 mm
Storey Configuration	Bottom storey height	4.5 m
	Typical storey height	3.5 m
Dead Loads *(IS 875 Part 1:2015)*	Self-weight of structural members	Considered automatically by software
	Floor finish load	1.0 kN/m²
	Terrace waterproofing load	1.0 kN/m²
	External wall load	13.0 kN/m²
	Internal wall load	9.0 kN/m²
Live Loads *(IS 875 Part 2:2015)*	Live load on typical floors	4.0 kN/m²
	Live load on top floor	2.0 kN/m²
Seismic Parameters *(IS 1893:2016)*	Seismic zone	Zone-III, IV & V
	Importance factor (I)	1.0
	Response reduction factor (R)	5.0
	Soil type	Medium soil

2.1 Model Used For Analysis

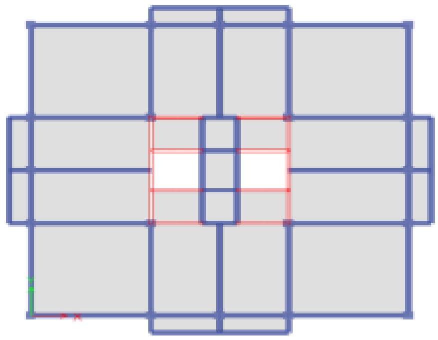

Figure 2.1: Floor plan of RCC framed structure

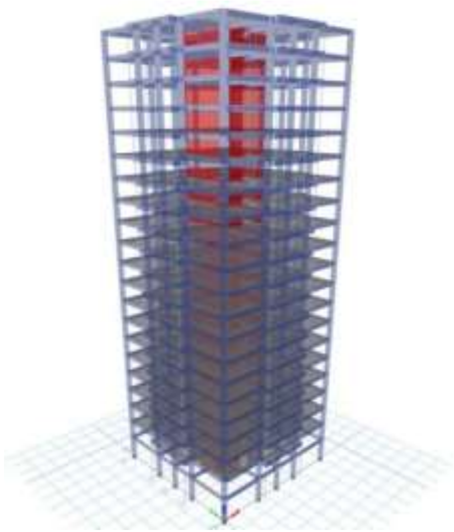

Figure 2.2: 3D view of RCC framed structure

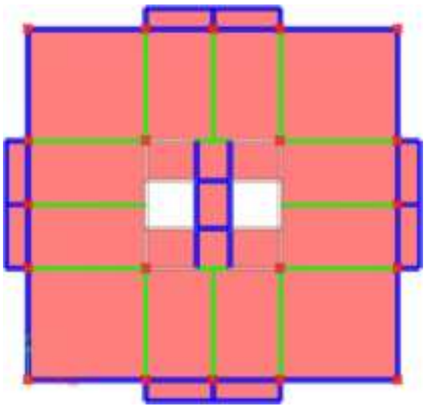

Figure 2.3: Floor plan of internal steel beam-concrete column hybrid structure

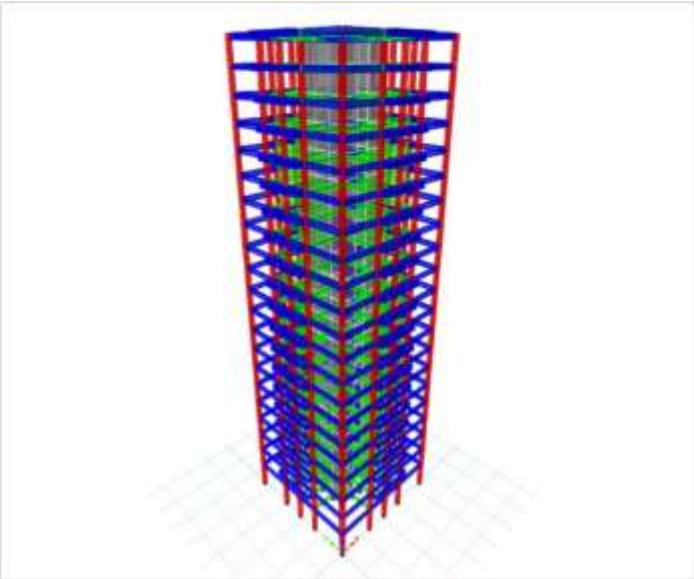

Figure 2.4: 3D view of internal steel beam-concrete column hybrid structure

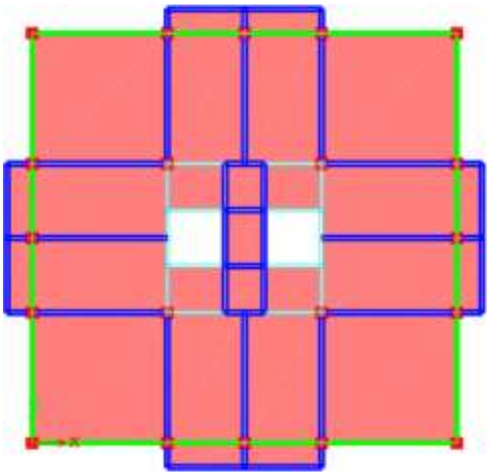

Figure 2.5: Floor plan of external steel beam-concrete column hybrid structure

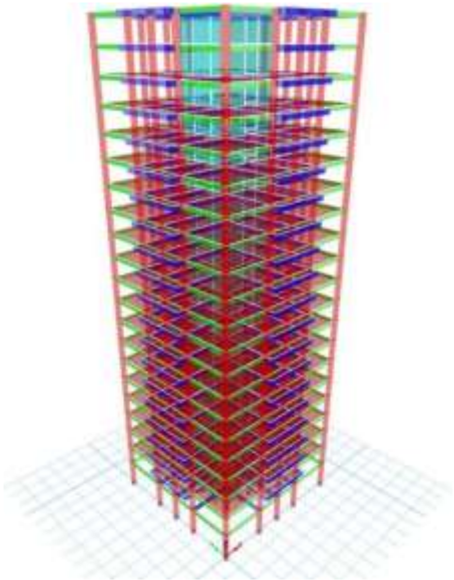

Figure 2.6: 3D view of external steel beam-concrete column hybrid structure

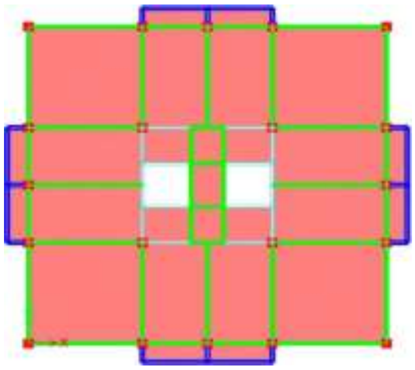

Figure 2.7: Floor plan of all steel beam-concrete column hybrid structure

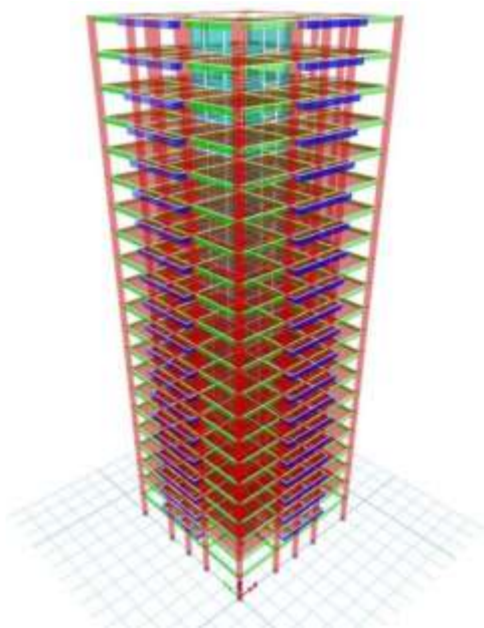

Figure 2.8: 3D view of all steel beam-concrete column hybrid structure

3. RESULTS AND DISCUSSION

3.1 Storey Displacement

The storey displacement of RCC and HYBRID structures in X direction in different zone are compared and presented in tabulated form and also represented in graphical format. The tabulated result and graphical representation are shown in table and figure respectively.

Storey Displacement In X Direction Zone III				
Story	Model 1	Model 2	Model 3	Model 4
BASE	0	0	0	0
GF	0.91	0.54	0.827	0.58
1	2.20	1.32	1.837	1.28
2	3.93	2.36	3.262	2.29
3	5.95	3.63	4.914	3.52
4	8.19	5.10	6.745	4.93
5	10.62	6.73	8.719	6.52
6	13.19	8.52	10.807	8.25
7	15.87	10.42	12.983	10.09
8	18.63	12.43	15.226	12.04
9	21.45	14.53	17.515	14.06
10	24.31	16.68	19.831	16.14
11	27.17	18.88	22.153	18.27
12	30.01	21.10	24.466	20.41
13	32.81	23.33	26.75	22.57
14	35.56	25.56	28.99	24.72
15	38.22	27.78	31.17	26.85
16	40.79	29.97	33.278	28.96
17	43.24	32.12	35.303	31.03
18	45.59	34.24	37.239	33.06
19	47.83	36.31	39.088	35.05
20	49.97	38.33	40.856	36.99

Table 3.1: Storey displacement in X direction

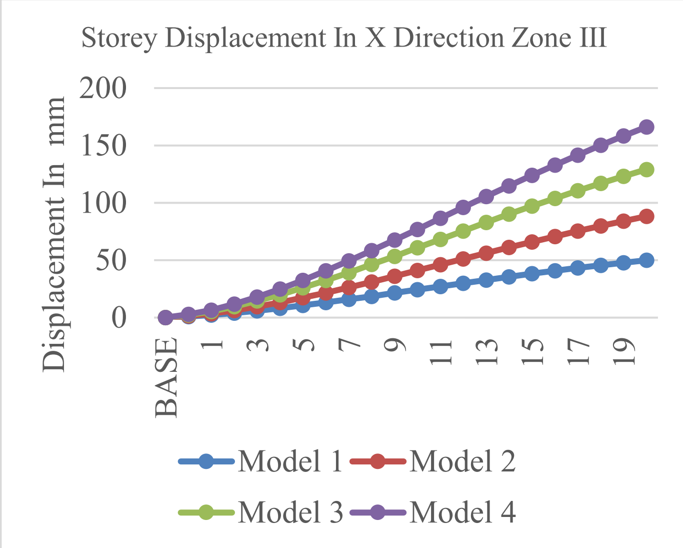

Figure 3.1: Storey displacement in X direction in zone III

Storey displacement in X direction zone IV				
Story	Model 1	Model 2	Model 3	Model 4
BASE	0	0	0	0
GF	1.39	0.85	1.298	0.89
1	3.34	2.00	2.783	1.97
2	5.97	3.58	4.928	3.52
3	9.03	5.52	7.416	5.40
4	12.43	7.76	10.177	7.58
5	16.11	10.27	13.156	10.02
6	20.01	13.01	16.309	12.67
7	24.07	15.94	19.599	15.51
8	28.26	19.04	22.992	18.49
9	32.54	22.26	26.457	21.60
10	36.86	25.59	29.964	24.79
11	41.20	28.98	33.485	28.05
12	45.51	32.42	36.992	31.35
13	49.76	35.88	40.458	34.65
14	53.91	39.34	43.861	37.95
15	57.95	42.79	47.175	41.22
16	61.83	46.19	50.383	44.45
17	65.55	49.55	53.467	47.63
18	69.09	52.85	56.42	50.74

19	72.48	56.09	59.245	53.79
20	75.71	59.26	61.95	56.76

Table 3.2: Storey displacement in X direction in zone IV

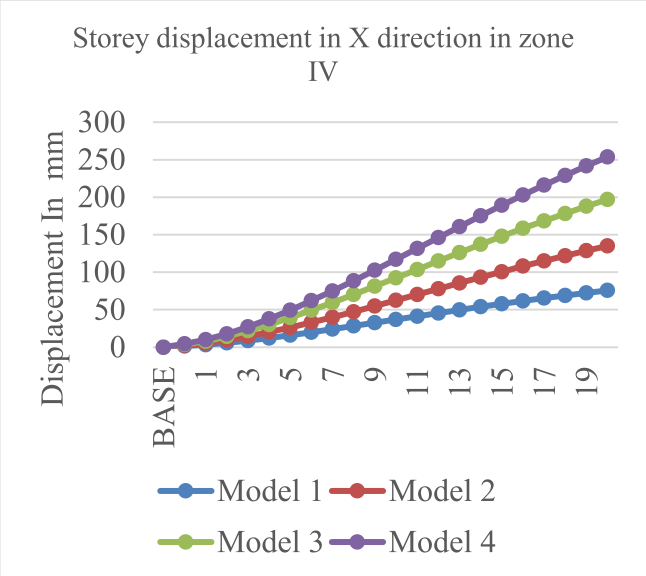

Figure 3.2: Storey displacement in X direction in zone IV

Storey displacement in X direction zone V				
Story	Model 1	Model 2	Model 3	Model 4
BASE	0	0	0	0
GF	2.06	2.07	2.14	2.09
1	5.05	3.54	3.54	3.46
2	9.04	6.56	6.57	6.35
3	13.69	9.02	9.06	9.70
4	18.86	12.88	12.96	12.41
5	24.44	17.08	17.21	16.44
6	30.34	21.57	21.77	20.74
7	36.50	25.31	25.58	24.27
8	42.83	29.25	29.61	28.00
9	49.29	33.35	33.81	31.87
10	55.82	37.58	38.15	35.85
11	62.35	41.90	42.58	39.91
12	68.85	46.27	47.08	44.02
13	75.25	50.66	51.61	48.14
14	81.52	55.06	56.15	52.26
15	87.60	59.42	60.67	56.36
16	93.47	63.75	65.15	60.40
17	99.09	68.01	69.58	64.39
18	104.45	72.20	73.94	68.30
19	109.57	76.32	78.23	72.14
20	114.45	81.34	83.43	76.89

Table 3.3: Storey displacement in X direction in zone V

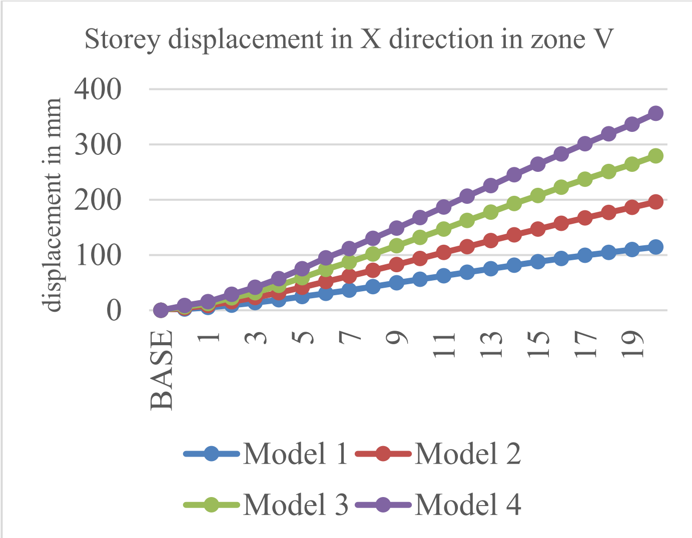

Figure 3.3: Storey displacement in X direction in zone V

3.2 Storey drift

The storey drift responses of the RCC and hybrid structural models in the X-direction for Seismic Zones are analyzed and compared using both tabular data and graphical representation.

Storey drift in X direction zone III				
Story	Model 1	Model 2	Model 3	Model 4
BASE	0	0	0	0
GF	0.000148	0.000112	0.000132	0.000114
1	0.000278	0.000205	0.000225	0.000195
2	0.000347	0.000247	0.000275	0.000236
3	0.000394	0.000276	0.000308	0.000263
4	0.000426	0.000296	0.000331	0.000282
5	0.000449	0.000309	0.000347	0.000295
6	0.000465	0.000320	0.000359	0.000304
7	0.000479	0.000328	0.000368	0.000312
8	0.000489	0.000335	0.000375	0.000318
9	0.000498	0.000341	0.000382	0.000323
10	0.000505	0.000346	0.000388	0.000327
11	0.000511	0.000350	0.000392	0.000331
12	0.000514	0.000353	0.000396	0.000333
13	0.000515	0.000354	0.000397	0.000333
14	0.000512	0.000352	0.000395	0.000331

15	0.000505	0.000348	0.00039	0.000326
16	0.000493	0.000341	0.000382	0.000319
17	0.000479	0.000330	0.000371	0.000308
18	0.000461	0.000317	0.000356	0.000296
19	0.000442	0.000303	0.000341	0.000282
20	0.000424	0.000290	0.000327	0.000269

Table 3.4: Storey drift in X direction in zone III

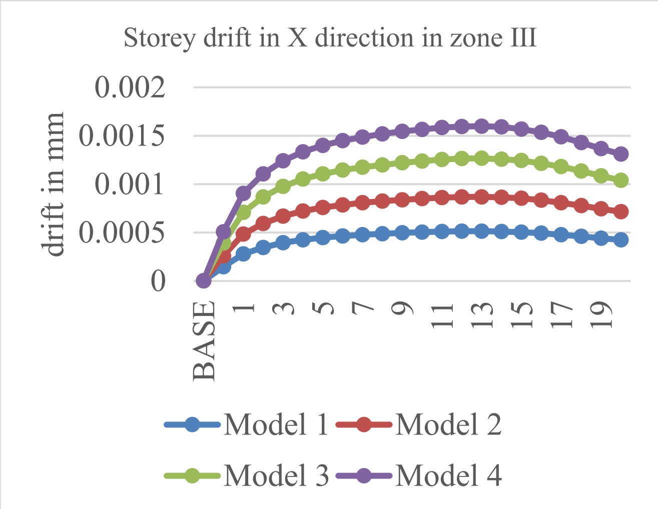

Figure 3.4: Storey drift in X direction in zone III

Storey drift in X direction zone IV				
Story	Model 1	Model 2	Model 3	Model 4
BASE	0	0	0	0
GF	0.000231	0.000189	0.000215	0.000193
1	0.000428	0.000325	0.000352	0.000318
2	0.000529	0.000395	0.000429	0.000386
3	0.000597	0.000442	0.000481	0.000431
4	0.000645	0.000474	0.000517	0.000461
5	0.000678	0.000496	0.000543	0.000482
6	0.000704	0.000512	0.000561	0.000497
7	0.000724	0.000526	0.000576	0.00051
8	0.000741	0.000536	0.000589	0.000519
9	0.000754	0.000546	0.0006	0.000528
10	0.000766	0.000554	0.00061	0.000535
11	0.000775	0.000561	0.000617	0.000541
12	0.00078	0.000565	0.000623	0.000545
13	0.000781	0.000566	0.000625	0.000545
14	0.000777	0.000564	0.000622	0.000542
15	0.000766	0.000557	0.000616	0.000535
16	0.000749	0.000545	0.000603	0.000523
17	0.000727	0.000528	0.000586	0.000506
18	0.000699	0.000508	0.000564	0.000486
19	0.00067	0.000485	0.00054	0.000464
20	0.000643	0.000465	0.000519	0.000443

Table 3.5: Storey drift in X direction in zone IV

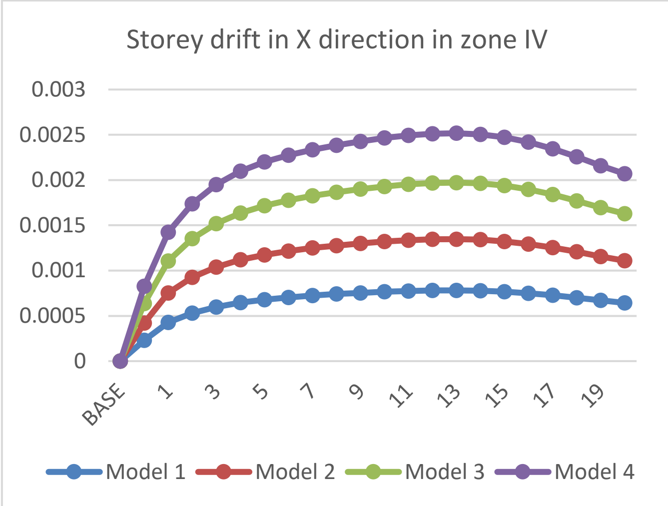

Figure 3.5: Storey drift in X direction in zone IV

Storey drift in X direction zone V				
Story	Model 1	Model 2	Model 3	Model 4
BASE	0	0	0	0
GF	0.000343	0.000275	0.000306	0.000281
1	0.000651	0.000497	0.000521	0.000475
2	0.000805	0.000608	0.000642	0.000579
3	0.000909	0.000683	0.000724	0.00065
4	0.000981	0.000736	0.000782	0.000699
5	0.001032	0.000773	0.000822	0.000733
6	0.00107	0.0008	0.000851	0.000757
7	0.001099	0.000821	0.000874	0.000776
8	0.001123	0.000837	0.000892	0.000791
9	0.001143	0.000851	0.000906	0.000802
10	0.001159	0.000862	0.000918	0.000811
11	0.001171	0.00087	0.000927	0.000818
12	0.001179	0.000875	0.000933	0.000822
13	0.00118	0.000876	0.000934	0.000822

14	0.001174	0.000871	0.000929	0.000816
15	0.00116	0.000859	0.000917	0.000804
16	0.001136	0.00084	0.000897	0.000784
17	0.001103	0.000813	0.00087	0.000758
18	0.001062	0.000781	0.000836	0.000727
19	0.001017	0.000747	0.000801	0.000694
20	0.000976	0.000716	0.000769	0.000664

Table 3.6: Storey drift in X direction in zone V

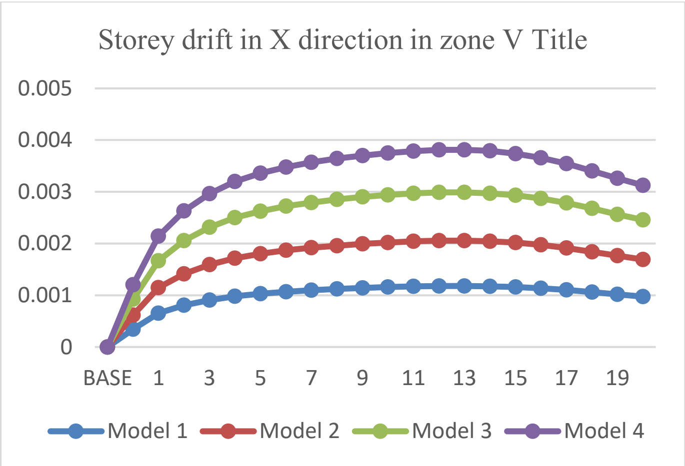

Figure 3.6: Storey drift in X direction in zone V

3.3 Storey Shear

The comparison of storey shear in RCC and HYBRID structure in X direction in Different zones is presented in tabulated format and also represented the same in graphical form.

Storey shear in X direction zone III				
Story	Model 1	Model 2	Model 3	Model 4
GF	1885.31	1699.03	1719.43	1666.28
1	1871.34	1685.85	1707.17	1655.38
2	1815.28	1635.99	1657.36	1609.48
3	1732.77	1561.45	1583.95	1541.71
4	1636.38	1467.29	1497.10	1460.72
5	1538.51	1361.49	1407.04	1375.36
6	1446.41	1253.18	1320.40	1291.88
7	1362.30	1150.76	1240.42	1214.05
8	1287.16	1060.60	1169.51	1145.04
9	1223.75	986.66	1110.99	1088.34
10	1175.12	931.03	1067.54	1046.26
11	1140.65	894.54	1038.07	1017.33
12	1114.62	876.34	1016.79	995.84
13	1089.14	872.34	995.97	974.22
14	1058.11	873.94	969.09	945.81
15	1017.35	868.42	931.13	905.21
16	960.67	841.09	875.95	846.38
17	876.82	777.76	794.00	761.05
18	749.92	666.88	673.14	639.37
19	564.89	500.68	502.38	472.80
20	312.57	275.53	275.51	256.94

Table 3.7: Storey shear in X direction in zone III

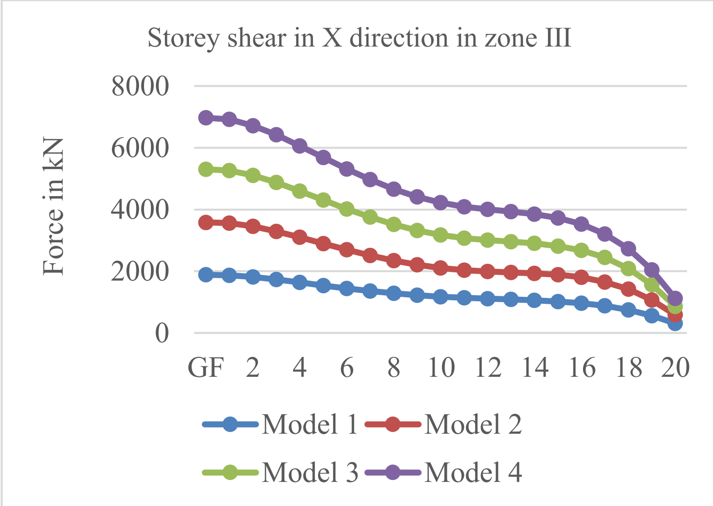

Figure 3.7: Storey shear in X direction in zone III

Storey shear in X direction zone IV				
Story	Model 1	Model 2	Model 3	Model 4
GF	2709.59	2531.27	2609.85	2480.97
1	2689.02	2511.38	2591.381	2464.90
2	2606.23	2435.65	2514.94	2395.44
3	2485.70	2322.33	2402.46	2292.86
4	2346.36	2178.95	2269.69	2170.74
5	2206.37	2017.53	2132.36	2042.89
6	2075.80	1851.91	2000.56	1918.70
7	1957.07	1694.98	1879.01	1803.36
8	1850.93	1556.72	1771.17	1701.04
9	1760.82	1443.60	1682.01	1616.74
10	1690.88	1359.33	1615.69	1554.04
11	1640.28	1305.59	1570.6806	1511.01
12	1601.11	1281.22	1538.31	1479.24
13	1562.72	1279.78	1506.94	1447.53
14	1517.07	1287.68	1466.78	1406.22
15	1458.55	1285.12	1410.35	1347.63

16	1378.14	1249.45	1328.27	1262.91
17	1259.06	1159.04	1205.72	1139.18
18	1077.87	996.33	1023.78	960.60
19	812.68	749.55	765.22	713.10
20	450.70	413.21	420.25	389.00

Table 3.8: Storey shear in X direction in zone IV

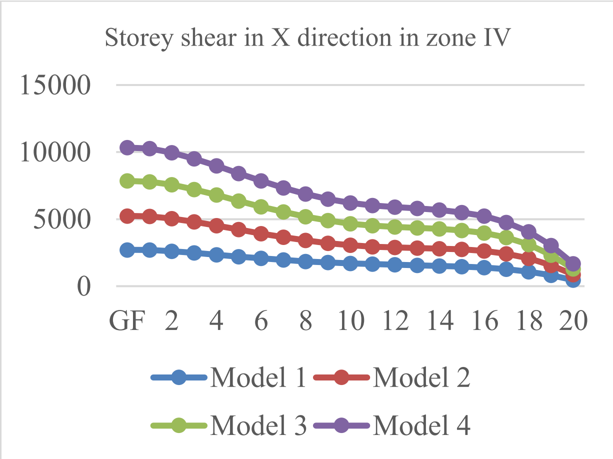

Figure 3.8: Storey shear in X direction in zone IV

Storey shear in X direction zone V				
Story	Model 1	Model 2	Model 3	Model 4
GF	4082.29	3750.70	3773.20	3654.06
1	4051.54	3734.99	3756.98	3640.74
2	3927.65	3641.66	3661.99	3552.41
3	3747.35	3500.83	3518.48	3418.78
4	3539.55	3328.82	3343.47	3254.87
5	3331.80	3143.89	3156.01	3077.73
6	3138.94	2960.20	2970.57	2900.88
7	2963.78	2786.71	2795.92	2733.25
8	2806.48	2629.81	2638.05	2581.31
9	2671.50	2495.48	2502.77	2450.84
10	2564.88	2387.80	2394.34	2345.53
11	2485.59	2289.11	2295.96	2245.98
12	2422.31	2245.41	2252.77	2201.57
13	2359.71	2198.64	2206.87	2153.34
14	2286.56	2133.83	2143.40	2086.73
15	2195.37	2038.64	2050.22	1989.58
16	2073.37	1899.91	1914.18	1849.27
17	1894.75	1700.67	1717.62	1650.11
18	1623.43	1421.44	1439.71	1374.45
19	1225.39	1045.42	1062.10	1007.33
20	680.40	563.76	574.61	541.05

Table 3.9: Storey shear in X direction in zone V

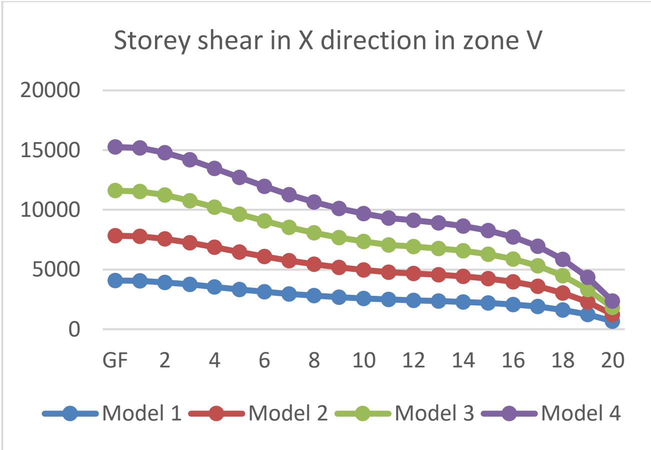

Figure 3.9: Storey shear in X direction in zone V

3.4 Overturning moment

The overturning moment in RCC framed structure and HYBRID framed structure in X direction under zone is shown in tables

Moment in X direction zone III				
Story	Model 1	Model 2	Model 3	Model 4
BASE	73197.61	65451.56	67032.48	67442.51
GF	66523.00	59518.06	60940.64	61363.84
1	61643.12	55172.03	56484.62	56897.72
2	57093.42	51111.98	52328.01	52710.96
3	52880.71	47346.17	48478.51	48813.42
4	48976.89	43853.30	44912.51	45186.31
5	45331.54	40590.75	41584.60	41789.38
6	41884.98	37504.10	38438.16	38569.77
7	38575.22	34533.85	35412.29	35468.75
8	35340.63	31620.34	32446.13	32427.16
9	32123.64	28709.53	29484.17	29391.61
10	28878.01	25760.40	26483.61	26322.09
11	25576.51	22751.41	23421.16	23198.45
12	22213.92	19682.91	20295.59	20022.95
13	18804.57	16575.50	17125.81	16818.79
14	15379.37	13467.69	13948.31	13627.58

15	11988.94	10417.11	10818.83	10509.98
16	8714.70	7506.34	7819.70	7550.53
17	5682.53	4849.71	5068.50	4863.51
18	3069.08	2595.10	2721.07	2594.40
19	1094.00	916.65	964.29	913.06
20	0	0	0	0

Table 3.10: Overturning moment in X direction in zone III

Moment in X direction zone IV				
Story	**Model 1**	**Model 2**	**Model 3**	**Model 4**
BASE	105121.39	97596.02	99354.65	98038.87
GF	95536.56	88738.85	92120.07	89184.10
1	88530.80	82256.78	85369.38	82688.41
2	81999.74	76207.15	79077.47	76609.68
3	75950.25	70601.23	73255.83	70960.32
4	70339.51	65405.26	67867.92	65709.72
5	65094.46	60553.92	62844.08	60796.32
6	60130.84	55965.23	58097.88	56141.49
7	55362.63	51550.63	53536.62	51659.35
8	50704.71	47221.61	49067.63	47263.82
9	46077.35	42897.67	44606.10	42876.92
10	41416.02	38517.13	40086.23	38439.55
11	36681.93	34046.88	35471.55	33920.96
12	31866.21	29486.07	30758.86	29322.46
13	26986.47	24863.38	25975.28	24675.00
14	22083.32	20233.38	21174.42	20035.61
15	17226.08	15678.79	16439.26	15489.08
16	12529.80	11320.53	11893.80	11156.60
17	8175.60	7329.48	7716.81	7206.10
18	4419.02	3930.41	4146.79	3855.30
19	1577.46	1391.23	1470.88	1361.49
20	0	0	0	0

Table 3.11: Overturning moment in X direction in zone IV

Moment in X direction zone V				
Story	**Model 1**	**Model 2**	**Model 3**	**Model 4**
BASE	159333.03	150954.16	151068.00	148531.24
GF	144834.63	137313.13	137385.40	135163.78
1	134221.84	127246.26	127298.60	125278.22
2	124310.58	117772.10	117817.41	115953.39
3	115110.63	108922.78	108973.95	107221.44
4	106558.61	100671.72	100739.76	99059.62
5	98547.87	92945.70	93038.79	91400.87
6	90957.12	85642.34	85765.98	84149.78
7	83663.92	78645.14	78802.62	77196.79
8	76547.38	71835.13	72027.72	70429.85
9	69493.44	65102.86	65329.59	63746.16
10	62408.80	58362.56	58619.92	57065.91
11	55236.57	51358.80	51636.95	50141.22
12	47962.50	44243.98	44534.73	43122.96
13	40609.84	37078.10	37371.14	36072.63
14	33234.19	29961.97	30244.48	29091.55
15	25932.99	23037.70	23294.45	22320.81
16	18873.18	16496.83	16711.64	15947.81
17	12323.03	10590.24	10749.22	10214.32
18	6665.83	5629.52	5725.66	5416.88
19	2381.38	1973.17	2011.15	1893.66
20	0	0	0	0

Table 3.12: Overturning moment in X direction in zone V

3. CONCLUSIONS

Based on the seismic evaluation of the G+20 multistorey building carried out primarily using Response Spectrum Analysis and supported by Linear Time History Analysis for validation, the following conclusions are drawn:

1. The incorporation of steel beams in reinforced concrete framed buildings significantly enhances the lateral stiffness of the structure. All hybrid configurations exhibit improved stiffness characteristics compared to the conventional RCC

frame, leading to better seismic resistance across Seismic Zones III, IV, and V.

2. Storey displacement increases progressively with height and seismic zone intensity for all structural models. However, hybrid structural systems demonstrate a considerable reduction in maximum storey displacement compared to the RCC model in all seismic zones considered.

3. Among the hybrid configurations, the model with complete replacement of RC beams by steel beams (Model 4) shows the maximum reduction in storey displacement. Nevertheless, the marginal difference between full replacement and partial replacement (internal steel beam configuration) indicates that partial hybridisation can achieve comparable seismic performance with improved construction economy.

4. Storey drift values are significantly reduced in hybrid structures due to improved stiffness distribution and enhanced energy dissipation capacity of steel beams. For all seismic zones, storey drift values remain within the permissible limits specified by IS 1893:2016, confirming the structural safety of both RCC and hybrid systems.

5. The storey shear demand is consistently lower in hybrid models compared to the conventional RCC frame. This reduction is mainly attributed to the decreased self-weight of the structure and the improved lateral load-resisting mechanism provided by steel beams.

6. Overturning moment values along the height and at the base of the structure are reduced in hybrid systems, particularly in higher seismic zones, indicating improved global stability and reduced demand on foundation systems.

7. The seismic response trends obtained from Response Spectrum Analysis are found to be consistent with those obtained from Linear Time History Analysis, which was carried out as a validation check using Bhuj earthquake ground motion.

8. Overall, steel beam–concrete column hybrid structural systems provide an efficient and practical alternative to conventional RCC frames for high-rise buildings in earthquake-prone regions, offering improved seismic performance, reduced structural demand, and potential material and construction cost benefits.

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