International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-2S, December 2018

Seismic Behaviour of a Multi-storeyed Reinforced Concrete Irregular Building with Outrigger Belt truss System

Premalatha J, Mrinalini M

***Abstract:** Lateral forces in tall structures produce structural and non-structural damages. In tall structures lateral forces are induced and moments are created, which is very large when compared to gravity load and these moment leads to overturning of the structure. The outrigger system is one of the most common and efficient system that can be used to improve the performance of tall buildings under wind and seismic forces. An Outrigger is a horizontal projection attached to any member and helps in increasing its stability. The provision of outrigger trusses helps in connecting the core wall of the building to external columns along the height of the structure and they act like spreaders. In the present work, a 7×7 bay RC irregular building is taken for the study and its performance with different configuration of belt truss system under wind forces and seismic forces is investigated. The response of the RC frame under Time history analysis, Response spectrum analysis, due to seismic forces found out using IS 1893 (Part-1): 2002, and wind forces are found out for the 30 storey RC model frame with various configuration of belt truss systems using the ETABS software. The performance of the frame under lateral loads such as maximum storey displacements, maximum storey drifts were found out.*

Keywords— Time history Analysis, response spectrum analysis, storey drift, storey accelerations

I. INTRODUCTION

A. Virtual Outrigger System

Belt trusses and basement walls are used as virtual outriggers.

Abhishek Arora, Ravi Kumar (2016)[1] has studied the behavior of a thirty storey structure present in earthquake zone 5 for different depth of outriggers. They computed the drift capacity of stories and compared the conventional system with the outrigger system at the top most storey. The study revealed that with reduction in depth of outriggers will increase the drift of the storey.

Viren P. Ganatra et al. (2017) [2]discussed the vulnerability of a 50 storey structure to seismic and wind loads with help of the outriggers by varying its depth. A comparison of the structure with shear walls was also done. The story displacement and story drift were appreciably reduced for full story height with the presence of outriggers.

AnilakumarMashyal and Chitra D M (2017)[3] compared forty storied RCC structure with an RCC and Steel outrigger system (X and V type).

The natural time period decreased as the outriggers came into picture and was much reduced for RCC belt system. He reported that the reduction in storey displacement and drift is found to be higher for concrete outrigger than that of the steel outriggers.

Kiran Kamath and Divya, Asha U Rao (2012)[4] investigated the RCC structure with and without outrigger by varying its position along height of the structure and relative flexural rigidity. Outrigger was positioned at the top storey, where, 30% reduction in peak acceleration and 50% reduction in drift was witnessed.

Shivacharan, Chandrakala and Karthik (2015)[5] reported that increase in stiffness observed was with the provision of outrigger systems.

Raj Kiran Nanduriet al. (2013) [6] studied about the optimum positioning of outriggers and belt truss in a thirty storeyed tall building. A detailed comparison for various positioning of outrigger with and without belt truss along with a center and offset core was analyzed and their behaviour for same seismic excitation was studied. A desirable increase in stiffness in buildings with outrigger systems was witnessed thereby decreasing the displacement.

Objectives

- To investigate the performance of a irregular building with outrigger and belt truss system using Time history Analysis and static analysis and due to wind forces.
- To investigate the performance of asymmetrical building with outrigger and belt truss system using Response spectrum analysis.

II. MODEL DIMENSIONS

The study is based on three dimensional RC building which is considered.

- Height of building : 90 m
- No of storey : 30 Nos
- Column spacing : 3.0 m

Manuscript published on 30 December 2018.
* Correspondence Author (s)
Premalatha J, Professor/Department of Civil Engineering Kumaraguru College of Technology Coimbatore, India
Mrinalini M, PG student, Department of Civil Engineering, KumaraguruCollege of Technology, Coimbatore, India

III. DESCRIPTION OF THE BUILDING

The plan of the RC frame at different storey are given in Figure 1, Figure 2 and Figure 3. The elevation of the frame with various configuration of belt truss system under this study are shown in Figure 4.

The 30 storey RC space frame is modelled with the following dimensions :

Plan dimension : 21m × 21m
No of Storey : 30 storey of each 3m height
Grade of concrete : M40
Grade of steel : Fe 500
Beam size : 250mm × 450mm

Column size :
For 1^{st} to 10^{th} Floor : 800mm×800mm
For 11^{th} to 20^{th} Floor : 600mm × 600mm
For 21^{st} to 30 th floor : 500mm × 500mm
R.C slab thickness : 150 mm
Shear wall thickness: 300 mm
Steel section for belt truss : ISLB600 (Fe250)

Loads

Load of Floor finish : 1 kN/m^2
Live load : 3 kN/m^2
Superimposed dead load : 5.75 kN/m
(i).Wind load: (IS: 875(Part 3) -1987) – Bhuj
Design Speed 50m/s
Terrain Category 3
Class B
Diaphragms Rigid
(ii).Earthquake load: (IS: 875(Part 1) -2002) – Bhuj
Linear Static Analysis (as per IS code)
Zone V 0.36
Importance factor 1
Type of soil : medium soil
Response reduction factor : 5

The Non linear time history analysis (El centro) considered for the present study is shown in Fig 5.

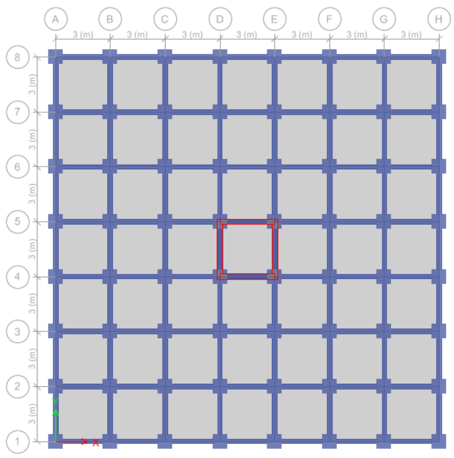


Fig 1 Plan of the Building (1st to 10th storey)

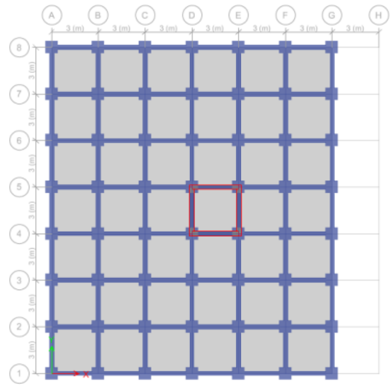


Fig 2 Plan of the Building (11th to 20th storey)

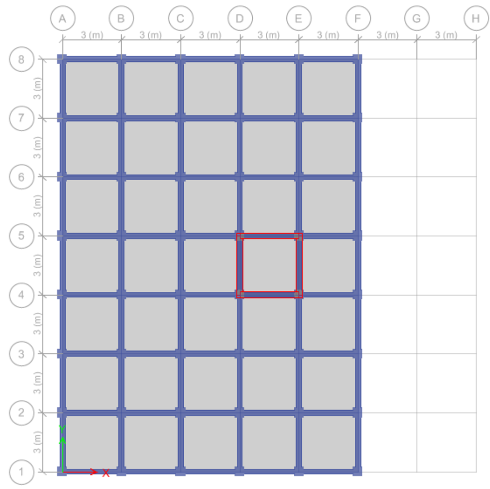
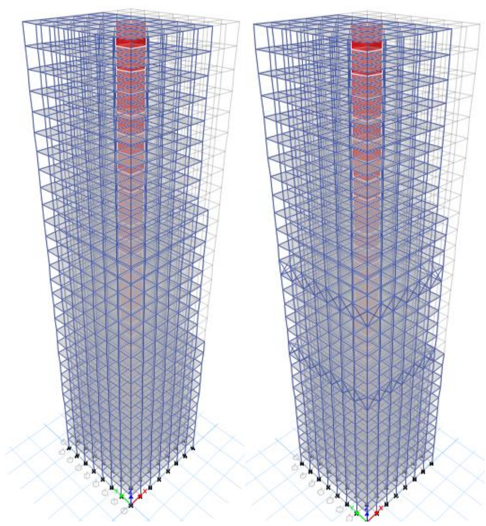
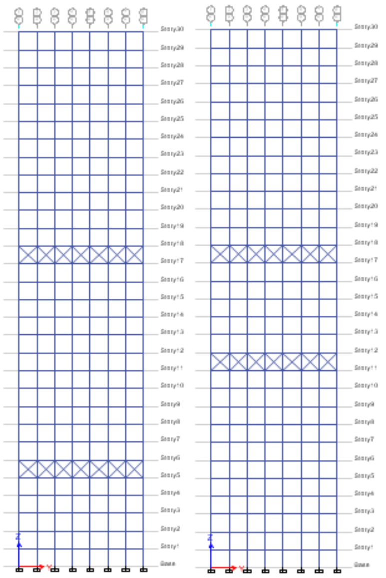


Fig 3 Plan of the Building (21st to 30th storey)

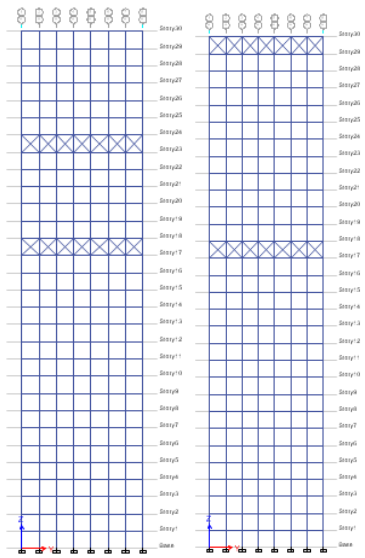


(a)without belt truss **(b) with belt truss at 0.4h and 0.6h**

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)



a) truss at 0.6h and 0.2h   b) truss at 0.6h and 0.4h



(a) truss at 0.6h and 0.8h   (b) truss at 0.6h and 1.0h

Fig. 4 Elevation Of The Structure With 2 Belt Trusses

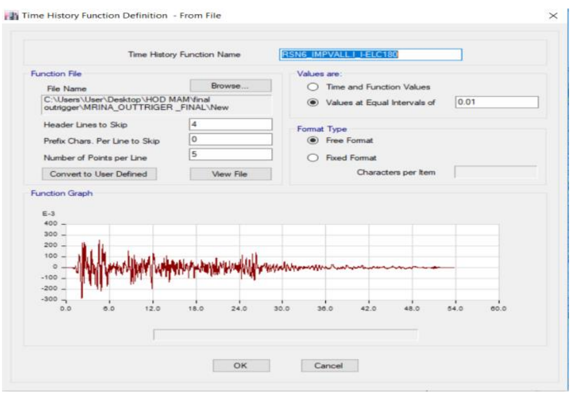


Figure 5 Time History Function - elcentro__NS.dat

Table 1 Maximum storey Accelerations with a single Truss system

Storey No	No Belt truss	Belt truss at 0.2h	Belt truss at 0.4h	Belt truss at 0.6h	Belt truss at 0.8h	Belt truss at 1.0h
30	857.86	878.94	813.87	841.62	866.34	726.36
29	656.51	703.39	625.61	647.23	676.38	669.38
28	525.83	577.53	520.34	518.64	554.15	551.69
27	479.06	498.26	472.5	471.37	503.04	489.77
26	470.0	447.53	469.15	461.94	478.89	476.35
25	466.19	426.61	466.07	458.67	462.33	472.09
24	460.61	441.79	460.42	459.24	463	465.3
23	459.79	467.95	458.91	464.83	454.2	464.13
22	462.96	485.15	456.92	469.02	419.84	510.76
21	508.13	493.66	492.35	512.87	465.55	498.3
20	494.84	490.74	457.9	487.14	463.28	490.1
19	483.49	483.21	431.86	472.68	458.66	486.23
18	473.89	473.09	430.03	480.26	456.38	475.81
17	458.36	461.28	435.86	468.95	451.52	477.1
16	437.65	449.94	428.38	429.67	442.38	458.94
15	414.18	436.69	411.72	404.1	428.51	431.51
14	394.82	425.74	393.98	380.31	417.27	406.34
13	388.25	425.95	397.99	374.62	417.41	396.1
12	396.76	431.33	414.08	386.31	418.57	413.4
11	413.03	438.51	408.32	405.94	444.54	404.54
10	426.09	444.87	399.48	426.2	430.51	421
9	427.35	451.88	405.04	433.76	428.82	418.58
8	417.42	455.63	406.35	438.42	436.15	430.16
7	428.71	454.06	402.17	445.86	443.28	443.1
6	434.88	449.79	415.27	440.98	443.47	445.48
5	428.5	424.79	417.45	428.47	434.31	435.34
4	409.29	390.87	407.57	408.79	413.12	413.16
3	371.19	362.75	376.8	371.65	373.13	373.43
2	302.53	307.72	310.25	303.13	303.49	303.83
1	189.51	197.04	193.32	191.74	190.16	189.91
0	0	0	0	0	0	0

Table 2 Maximum Displacements (EQY) with a single Truss system

Storey No	No truss	0.2h	0.4h	0.6h	0.8h	1.0h
30	91.562	88.485	84.882	82.914	83.784	88.229
29	89.919	86.699	83.113	81.345	82.522	87.582
28	88.069	84.685	81.116	79.569	81.095	86.359
27	86.02	82.451	78.899	77.597	79.518	84.765
26	83.76	79.986	76.453	75.427	77.81	82.857
25	81.288	77.29	73.781	73.068	76.02	80.659
24	78.612	74.37	70.893	70.539	74.372	78.193
23	75.743	71.241	67.808	67.867	73.477	75.484
22	72.695	67.919	64.545	65.089	71.407	72.557
21	69.46	64.399	61.105	62.23	68.774	69.414
20	65.977	60.613	57.437	59.308	65.753	66.004
19	62.49	56.835	53.816	56.613	62.589	62.569
18	58.898	52.954	50.145	54.351	59.229	59.012
17	55.221	48.997	46.471	53.209	55.71	55.358
16	51.472	44.986	42.845	50.73	52.06	51.622
15	47.643	40.92	39.332	47.566	48.281	47.797

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

14	43.887	36.969	36.128	44.22	44.543	44.041
13	40.091	33.013	33.182	40.707	40.744	40.241
12	36.267	29.078	30.857	37.061	36.9	36.411
11	32.41	25.18	29.521	33.304	33.009	32.544
10	28.525	21.351	27.152	29.458	29.078	28.648
9	24.678	17.697	24.155	25.596	25.177	24.789
8	20.908	14.312	20.9	21.766	21.345	21.005
7	17.25	11.328	17.535	18.015	17.621	17.332
6	13.742	9.09	14.162	14.392	14.045	13.809
5	10.431	7.981	10.876	10.951	10.667	10.483
4	7.377	6.186	7.77	7.762	7.547	7.415
3	4.659	4.121	4.952	4.913	4.769	4.684
2	2.387	2.201	2.559	2.522	2.444	2.4
1	0.723	0.693	0.783	0.766	0.741	0.727

Table 3 Maximum Displacements (WIND X) with a single Truss system

Storey No	No truss	0.2h	0.4h	0.6h	0.8h	1.0h
30	97.339	83.729	80.128	82.422	87.737	93.379
29	95.515	81.935	78.373	80.802	86.371	92.519
28	93.571	80.022	76.502	79.076	84.926	91.207
27	91.488	77.972	74.498	77.232	83.402	89.613
26	89.233	75.752	72.333	75.249	81.797	87.747
25	86.789	73.346	69.993	73.121	80.126	85.611
24	84.144	70.745	67.471	70.854	78.463	83.212
23	81.299	67.949	64.772	68.466	77.25	80.56
22	78.257	64.964	61.909	65.986	75.154	77.672
21	75.042	61.818	58.915	63.466	72.638	74.578
20	71.674	58.53	55.82	60.966	69.802	71.303
19	68.204	55.155	52.684	58.555	66.733	67.905
18	64.572	51.639	49.47	56.357	63.419	64.332
17	60.794	48.003	46.216	54.985	59.889	60.6
16	56.878	44.263	42.964	52.454	56.166	56.722
15	52.808	40.416	39.752	49.344	52.243	52.681
14	48.721	36.598	36.712	45.987	48.27	48.617
13	44.55	32.747	33.81	42.412	44.193	44.466
12	40.329	28.914	31.328	38.67	40.049	40.262
11	36.101	25.156	29.694	34.822	35.883	36.047
10	31.904	21.534	27.167	30.926	31.735	31.862
9	27.717	18.056	24.167	26.979	27.588	27.684
8	23.57	14.792	20.95	23.023	23.474	23.545
7	19.501	11.838	17.613	19.105	19.43	19.482
6	15.56	9.492	14.245	15.283	15.51	15.547
5	11.813	8.188	10.94	11.629	11.78	11.804
4	8.344	6.241	7.806	8.231	8.324	8.339
3	5.261	4.119	4.967	5.198	5.249	5.257
2	2.696	2.2	2.568	2.669	2.691	2.694
1	0.826	0.703	0.794	0.819	0.824	0.825

Table 4 Maximum Displacements (Response spectrum) with a single Truss system

Storey No	No truss	0.2h	0.4h	0.6h	0.8h	1.0h
30	53.76	49.58	49.782	49.897	50.582	52.38
29	52.938	48.675	48.915	49.156	49.984	52.069
28	52.006	47.647	47.922	48.305	49.298	51.453
27	50.966	46.502	46.805	47.348	48.528	50.639
26	49.816	45.24	45.565	46.286	47.682	49.66
25	48.558	43.865	44.205	45.127	46.786	48.531
24	47.196	42.386	42.732	43.878	45.971	47.264
23	45.736	40.809	41.156	42.553	45.563	45.871
22	44.182	39.143	39.489	41.165	44.485	44.364
21	42.534	37.387	37.739	39.729	43.088	42.747
20	40.766	35.515	35.888	38.261	41.492	40.999
19	38.988	33.645	34.062	36.9	39.818	39.232
18	37.137	31.711	32.198	35.782	38.024	37.384
17	35.215	29.716	30.31	35.261	36.12	35.458
16	33.219	27.66	28.416	33.908	34.113	33.454
15	31.13	25.525	26.545	32.077	31.988	31.353
14	29.041	23.408	24.82	30.104	29.85	29.249
13	26.891	21.25	23.234	28.005	27.643	27.084
12	24.678	19.054	22.012	25.791	25.364	24.854
11	22.398	16.83	21.343	23.477	23.015	22.556
10	20.053	14.597	19.93	21.076	20.6	20.193
9	17.663	12.405	18.012	18.609	18.141	17.785
8	15.247	10.318	15.834	16.098	15.656	15.351
7	12.824	8.442	13.502	13.568	13.166	12.911
6	10.422	7.044	11.093	11.049	10.7	10.493
5	8.076	6.374	8.674	8.58	8.293	8.132
4	5.835	5.087	6.315	6.213	5.995	5.876
3	3.766	3.476	4.104	4.02	3.872	3.794
2	1.97	1.895	2.16	2.107	2.027	1.985
1	0.607	0.604	0.669	0.65	0.625	0.612

Table 5 Maximum storey drifts with a single Truss system

Storey No	No truss	0.2h	0.4h	0.6h	0.8h	1.0h
30	2.034	2.216	2.216	1.979	1.592	0.923
29	2.167	2.361	2.36	2.107	1.683	1.454
28	2.308	2.515	2.512	2.237	1.763	1.768
27	2.474	2.695	2.688	2.383	1.833	2.053
26	2.647	2.883	2.87	2.523	1.877	2.322
25	2.818	3.068	3.044	2.647	1.826	2.568
24	2.978	3.239	3.201	2.739	1.282	2.788
23	3.121	3.391	3.332	2.79	2.182	2.979
22	3.23	3.502	3.417	2.775	2.564	3.126
21	3.312	3.583	3.46	2.691	2.831	3.239
20	3.344	3.606	3.44	2.535	3.006	3.294
19	3.433	3.688	3.464	2.26	3.189	3.399
18	3.499	3.739	3.44	1.365	3.332	3.478
17	3.55	3.768	3.37	2.437	3.445	3.538
16	3.606	3.792	3.254	2.92	3.551	3.603
15	3.547	3.69	3.015	3.087	3.527	3.549
14	3.56	3.664	2.828	3.233	3.561	3.566
13	3.537	3.585	2.372	3.326	3.556	3.546
12	3.477	3.452	1.522	3.358	3.51	3.487
11	3.382	3.265	2.263	3.337	3.426	3.395
10	3.31	3.077	2.624	3.319	3.362	3.324
9	3.214	2.833	2.752	3.265	3.272	3.229
8	3.093	2.514	2.797	3.174	3.153	3.107
7	2.937	1.957	2.769	3.039	2.998	2.951
6	2.738	1.06	2.666	2.852	2.799	2.753
5	2.487	1.521	2.482	2.603	2.544	2.5
4	2.169	1.619	2.209	2.28	2.221	2.181
3	1.769	1.432	1.832	1.866	1.812	1.779
2	1.261	1.09	1.326	1.336	1.293	1.269
1	0.542	0.499	0.579	0.576	0.556	0.545

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

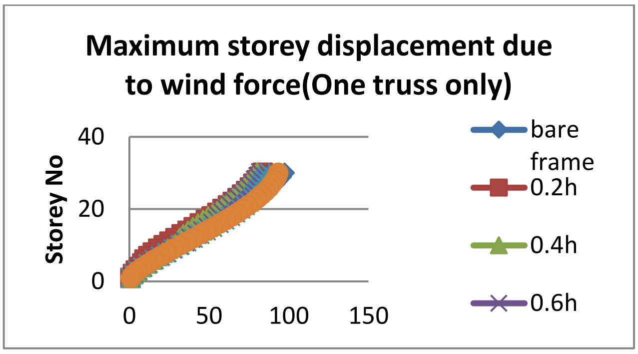


Figure 6 Storey Maximum Displacement

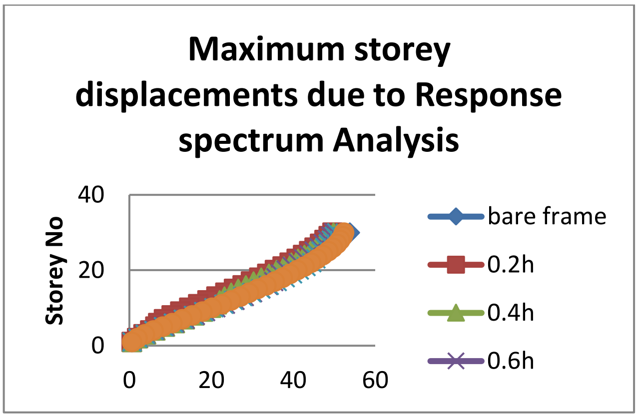


Figure 7 Maximum Storey Displacements In mm

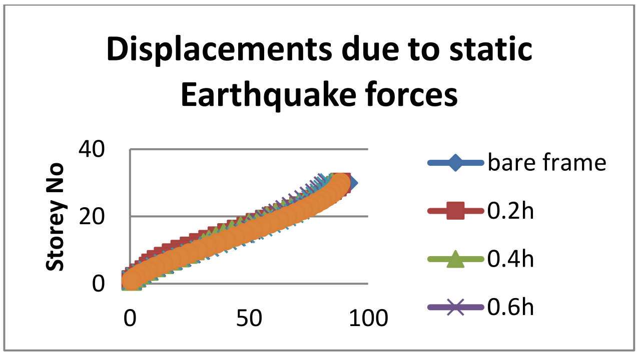


Figure 8 Storey Displacements In mm

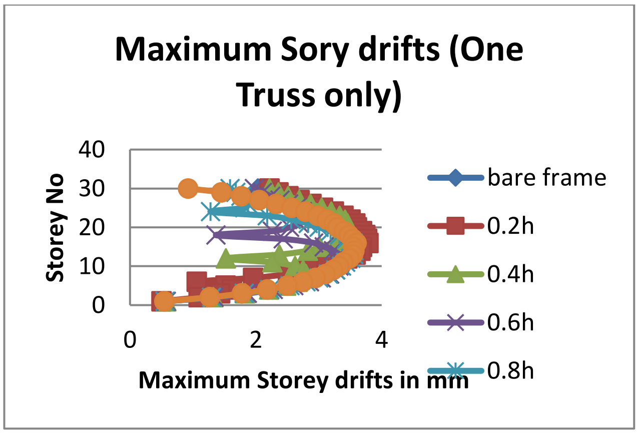


Figure 9 Maximum Storey Drifts In mm

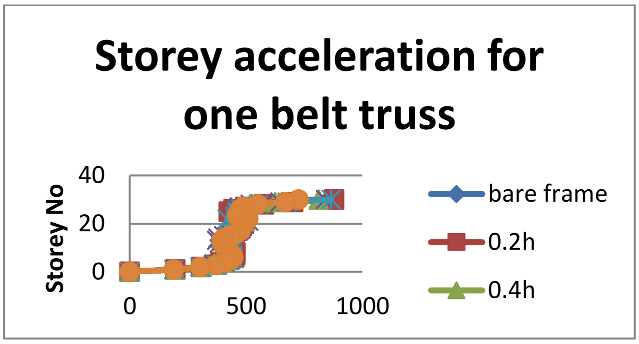


Figure 10 storey accelaration in mm/sec

Table 6 Maximum Storey displacements with 2 Trusses (Response Spectrum Analysis)

Storey No	Without belt truss	Belt truss at 0.6h and 0.2h	Belt truss at 0.6h and 0.4h	Belt truss at 0.6h and 0.8h	Belt truss at 0.6h and 1.0h
30	53.76	46.745	46.643	47.114	48.687
29	52.938	45.896	45.836	46.553	48.394
28	52.006	44.92	44.905	45.901	47.814
27	50.966	43.822	43.852	45.164	47.047
26	49.816	42.607	42.679	44.353	46.129
25	48.558	41.285	41.396	43.493	45.076
24	47.196	39.867	40.014	42.722	43.905
23	45.736	38.37	38.55	42.354	42.635
22	44.182	36.811	37.022	41.377	41.283
21	42.534	35.21	35.453	40.139	39.871
20	40.766	33.582	33.866	38.8	38.418
19	38.988	32.085	32.417	37.512	37.063
18	37.137	30.864	31.254	36.435	35.948
17	35.215	30.301	30.734	35.928	35.429
16	33.219	28.846	29.435	34.569	34.072
15	31.13	26.89	27.76	32.711	32.23
14	29.041	24.804	26.097	30.701	30.245
13	26.891	22.607	24.522	28.559	28.132
12	24.678	20.324	23.294	26.298	25.905
11	22.398	17.982	22.62	23.934	23.578
10	20.053	15.618	21.151	21.481	21.163
9	17.663	13.282	19.136	18.963	18.684
8	15.247	11.051	16.835	16.401	16.161
7	12.824	9.047	14.367	13.821	13.621
6	10.422	7.566	11.814	11.255	11.092
5	8.076	6.873	9.248	8.742	8.615
4	5.835	5.507	6.742	6.333	6.24
3	3.766	3.773	4.388	4.099	4.038
2	1.97	2.059	2.312	2.15	2.118
1	0.607	0.656	0.716	0.663	0.654

Table 7 Maximum Storey Drifts due to wind forces for frame with 2 Trusses

Storey No	Without belt truss	Belt truss at 0.6h and 0.2h	Belt truss at 0.6h and 0.4h	Belt truss at 0.6h and 0.8h	Belt truss at 0.6h and 1.0h
30	2.034	2.189	2.172	1.588	0.946
29	2.167	2.331	2.312	1.679	1.448
28	2.308	2.476	2.454	1.756	1.74

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

27	2.474	2.637	2.612	1.818	1.997
26	2.647	2.793	2.763	1.845	2.228
25	2.818	2.929	2.893	1.774	2.422
24	2.978	3.03	2.986	1.243	2.57
23	3.121	3.083	3.03	1.973	2.666
22	3.23	3.064	2.999	2.211	2.688
21	3.312	2.965	2.885	2.301	2.633
20	3.344	2.786	2.688	2.284	2.501
19	3.433	2.475	2.367	2.112	2.242
18	3.499	1.49	1.427	1.339	1.367
17	3.55	2.621	2.341	2.41	2.44
16	3.606	3.104	2.642	2.914	2.926
15	3.547	3.244	2.627	3.099	3.096
14	3.56	3.359	2.576	3.256	3.244
13	3.537	3.403	2.25	3.359	3.338
12	3.477	3.366	1.522	3.398	3.371
11	3.382	3.252	2.296	3.381	3.35
10	3.31	3.116	2.689	3.367	3.332
9	3.214	2.908	2.846	3.315	3.279
8	3.093	2.61	2.912	3.225	3.187
7	2.937	2.053	2.896	3.089	3.051
6	2.738	1.13	2.799	2.9	2.864
5	2.487	1.629	2.613	2.649	2.615
4	2.169	1.738	2.33	2.321	2.29
3	1.769	1.541	1.936	1.9	1.875
2	1.261	1.177	1.404	1.36	1.341
1	0.542	0.54	0.614	0.587	0.579

Table 8 Maximum Storey displacements due to wind forces for frame with 2 Trusses

Storey No	Without belt truss	Belt truss at 0.6h and 0.2h	Belt truss at 0.6h and 0.4h	Belt truss at 0.6h and 0.8h	Belt truss at 0.6h and 1.0h
30	97.339	69.827	69.175	75.656	79.371
29	95.515	68.227	67.582	74.392	78.55
28	93.571	66.522	65.885	73.055	77.346
27	91.488	64.7	64.072	71.647	75.903
26	89.233	62.74	62.125	70.171	74.237
25	86.789	60.636	60.038	68.648	72.358
24	84.144	58.396	57.819	67.15	70.287
23	81.299	56.036	55.489	66.053	68.051
22	78.257	53.588	53.08	64.301	65.688
21	75.042	51.104	50.647	62.299	63.257
20	71.674	48.646	48.254	60.171	60.82
19	68.204	46.283	45.977	58.014	58.453
18	64.572	44.137	43.927	55.98	56.283
17	60.794	42.8	42.647	54.653	54.918
16	56.878	40.381	40.497	52.187	52.399
15	52.808	37.446	38.013	49.132	49.298
14	48.721	34.319	35.492	45.816	45.949
13	44.55	31.03	32.976	42.277	42.382
12	40.329	27.644	30.741	38.564	38.645
11	36.101	24.237	29.197	34.739	34.802
10	31.904	20.885	26.773	30.861	30.91
9	27.717	17.618	23.868	26.93	26.967
8	23.57	14.512	20.729	22.986	23.014
7	19.501	11.671	17.453	19.078	19.098
6	15.56	9.395	14.133	15.264	15.278
5	11.813	8.113	10.865	11.616	11.626
4	8.344	6.19	7.76	8.223	8.229
3	5.261	4.091	4.941	5.194	5.197
2	2.696	2.188	2.557	2.667	2.668
1	0.826	0.7	0.791	0.818	0.819

Table 9 Maximum Storey displacements due to static earthquake forces for frame with 2 Trusses

Storey No	Without belt truss	Belt truss at 0.6h and 0.2h	Belt truss at 0.6h and 0.4h	Belt truss at 0.6h and 0.8h	Belt truss at 0.6h and 1.0h
30	91.562	80.066	77.362	76.436	79.982
29	89.919	78.33	75.647	75.191	79.339
28	88.069	76.363	73.703	73.776	78.137
27	86.02	74.176	71.542	72.209	76.577
26	83.76	71.768	69.164	70.514	74.723
25	81.288	69.149	66.58	68.745	72.607
24	78.612	66.342	63.813	67.135	70.262
23	75.743	63.377	60.896	66.281	67.73
22	72.695	60.294	57.869	64.371	65.053
21	69.46	57.125	54.768	62.016	62.27
20	65.977	53.889	51.617	59.462	59.404
19	62.49	50.912	48.739	57.002	56.744
18	58.898	48.423	46.355	54.881	54.502
17	55.221	47.176	45.172	53.773	53.364
16	51.472	44.491	42.764	51.322	50.887
15	47.643	41.088	39.853	48.162	47.719
14	43.887	37.524	36.993	44.803	44.366
13	40.091	33.818	34.265	41.267	40.844
12	36.267	30.022	32.047	37.589	37.189
11	32.41	26.181	30.717	33.792	33.42
10	28.525	22.347	28.316	29.901	29.563
9	24.678	18.635	25.246	25.989	25.688
8	20.908	15.156	21.886	22.107	21.846
7	17.25	12.061	18.39	18.302	18.082
6	13.742	9.721	14.872	14.624	14.446
5	10.431	8.547	11.434	11.13	10.993
4	7.377	6.635	8.177	7.891	7.793
3	4.659	4.427	5.217	4.995	4.932
2	2.387	2.368	2.698	2.564	2.532
1	0.723	0.747	0.826	0.779	0.769

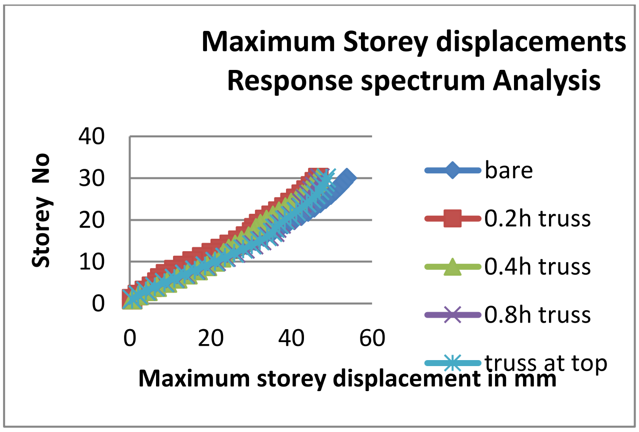


Figure11 Maximum Storey Displacements In mm

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-2S, December 2018

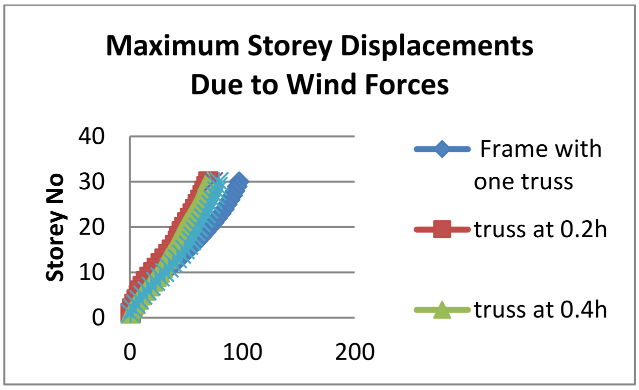


Figure 12 Storey Displacements In mm

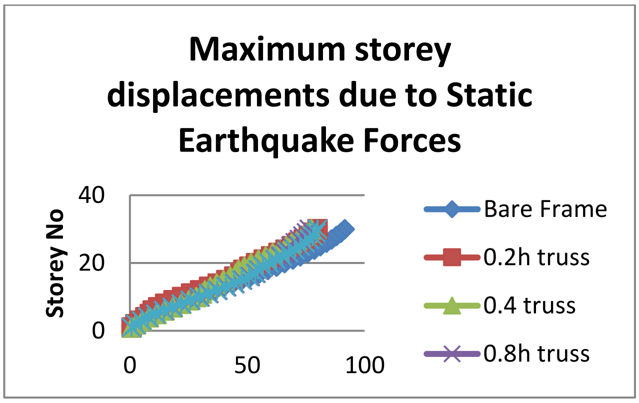


Figure 13 Storey Displacements In mm

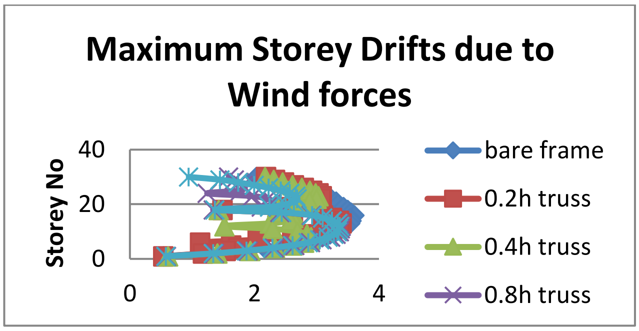


Figure 14 Maximum Storey Drift In mm

IV. RESULTS AND DISCUSSIONS

Time history analysis, Response spectrum analysis and static earthquake analysis as per IS 1893 (part1) code book are carried out on the 30 story RC irregular frame with various configuration of belt truss systems and the results are presented in this paper. RC frame Models with belt truss at 0.2h, 0.4h , 0.6h, 0.8h and 1.0h and without belt truss are analysed using ETABS software. The maximum storey displacements, maximum storey drift, maximum storey accelerations are found ot for all the model frames. Among these frames, the performance of the RC frame with belt truss system at 0.6h is found to be efficient.

With one truss system at a constant height of 0.6h, various frame models are considered with an additional truss system at a height of 0.2h, 0.4h,0.8h and at 1.0h of the frame. The optimum position of 2 truss systems for the RC frame is arrived by Time history analysis

Response spectrum analysis, under wind forces and earthquake forces calculated using IS 1893 (Part-1): 2002. The analysis results of various belt truss system obtained using the ETABS software are presented in the Table 1 to Table 9 and also in the Figure 6 to Figure 14

V. CONCLUSION

Time history analysis and Response spectrum analysis was carried out to find the optimum positioning of outrigger belt truss system in a 30 storey RC irregular building. The performance of the building like storey displacements, storey drifts and storey accelerations were found out for all the frame models. The RC frame with two belt trusses i.e. one at 0.6h and another truss at 0.4h performed better than the other models considered in the study. When compared with the bare frame, the Maximum displacement due to wind forces, response spectrum analysis and static earthquake forces for this frame with trusses at 2 levels are found to be reduced by 28.93%, 13.23% and 15.5%. The storey drifts of this frame also is found to be reduced and indicates the increase in stiffness of the building frame.

REFERENCES

1. Abhishek Arora, Ravi Kumar, (2016), "Strengthening of High Rise Building with Outrigger System", The International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Volume 2, Issue 3, pp. 591-593.
2. Viren P. Ganatra et al., (2017), "Study on Behaviour of Outrigger System on High Rise Structure by Varying Outrigger Depth", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 5, Issue IX, pp.2017-2022.
3. AnilakumarMashyal, Chitra D M (2017), "Comparative Study on RC and Steel Outrigger with Vertical Irregularity Subjected to Lateral Load", International Journal for Scientific Research & Development (IJSRD), Volume 5, Issue 4, pp.2038-2041.
4. Kiran Kamath, Divya, Asha U Rao (2012), "A Study on Static and Dynamic Behavior of Outrigger Structural System for Tall Buildings", Bonfring International Journal of Industrial Engineering and Management Science, Volume 2, Issue 4, pp.15-20.
5. Shivacharan, Chandrakala, Karthik (2015), "Optimum Position of Outrigger System for Tall Vertical Irregularity Structures", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 12, Issue 2, pp. 54-63.
6. Raj Kiran Nanduri et al. (2013), "Optimum Position of Outrigger System for High-Rise Reinforced Concrete Buildings Under Wind And Earthquake Loadings", American Journal of Engineering Research (AJER) Volume 2, Issue 8, pp-76-89.