"The comparative Descriptive Research and Analysis of RCC Twisted and Traditional Buildings Using ETABS Software for Indian and American Codes"

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***Abstract*—** The goal of this project is to use Response spectrum analysis to investigate how a twisted building responds to earthquake and wind loads. ETABS 2018 is used to carry out the analysis. In the study, a building model with G+25, G+30, and G+35 storeys and a constant storey height of 3.5m was used. For this study, analysis and design are done in accordance with Indian Standard Code. A tall building's stiffness can be viewed as an indirect indicator of how vulnerable it is to dynamic forces. This effect is influenced by the wind speed and the building's aerodynamic characteristics. As a building's height grows, the wind load value rises. High spatial stiffness raises the natural vibration frequency, which for low values might be hazardous for construction, while reducing the acceleration linked to a structure's horizontal displacements. At certain wind speeds, the structure can enter a resonance that results in severe stresses and vertical displacement. The aerodynamic twisted design has the benefit of disrupting the direction of the wind's impact around the building, which helps to significantly lessen wind excitation. While designing all the forces that induce on the building were considered and in Post analysis of the structure, maximum shear forces, bending moments, maximum storey displacement, behaviour of building to seismic force, storey stiffness, storey drift and other reactions are computed.

Keywords: *RCC Frame Structure, Twisted Building, ETAB, Storey Drift, Storey Acceleration, Base Shear etc.*

INTRODUCTION

An earthquake is a natural tragedy that has claimed millions of lives throughout known and unwritten history. An earthquake is a disruptive disturbance that generates surface shaking owing to subsurface movement along a fault line or volcanic activity. The produced forces are irresponsible and only last a brief time. Humans are puzzled by its ambiguity in terms of occurrence time and nature. However, with the advancement of knowledge throughout the years, a degree of probabilistic predictability has been reached.
The ability to predict the recurrence and strength of earthquakes for a certain region has improved, but this only solves one half of the problem: knowing what's coming! The second phase is structural seismic design - to resist the storm! This component of the problem has evolved throughout the previous century, with advancements in design philosophy and methodology continually investigated, proposed, and implemented. This chapter introduces the notion of foundation isolation for earthquake-resistant structure design. The usefulness of seismic isolation is proved by modeling and analysis of multi-storey buildings, bridges, and pools.

The trend of RCC high rise structures has increased nowadays in India. Many different amenities, garden etc. have been provided in high story building which is very attractive from an aesthetical point of view but it is dangerous from a structural point of view.
To break for some reason and all the water rushed out, it would destroy some interior and possibly some windows. In most cases, the extra water mass will help the building resist earthquakes by acting as a liquid mass dampener. Tall buildings carry very large gravity and lateralloads.
Twisted tall buildings of various heights, height to width aspect ratios and rates of twist are designed and their structural efficiency is investigated. Due to the unique geometric configurations of twisted forms, structural buildings are quite different from that employed for tall buildings of rectangular box forms. Twisted forms involve not only structural but also architectural and constructional challenges.

- Due to the unique geometric configurations of twisted forms, structural buildings are quite different from that employed for tall buildings of rectangular box forms. Twisted forms involve not only structural but also architectural and constructional challenges.
- This project investigates about the optimum twist angle of the RCC building.
- To increase value in certain buildings there are associated risks that we take
- The amenities provided in high storey building are attractive from aesthetic point of view.
- This project represents the structural behaviour of RCC twisted building subjected to static load.
- In this project non-linear static method is being used.

Problem Statement

A twisted RCC building exposed to seismic loads utilizing ETab. The twist rate of RCC twisted buildings will be studied. Each level grows at its own rate. ETab will model. Base shear and storey displacement data will be shown. This project's goal is to find the best angle.

Aim

"To find optimum angle of twist and position of RCC twisted buildings under seismic loads."

Objectives

The objectives of this study are as the following:

- To design and analysis Symmetrical building and normal RCC frame a building model with G+25, G+30, and G+35 storeys by using ETAB Software using Indian Code
- To design & analysis of twisted building of G+25, G+30, and G+35 storeys using American Code
- To compare the technical parameter like storey drift, storey acceleration, storey stiffness etc.
- Comparatively Study Design and analysis of RCC twisted building with Normal Building for G+25, G+30 & G+35 by using ETab

RESEARCH METHODOLOGY

The Methods of Earthquake Analysis

Two broad approaches of earthquake analysis of multi – storied structures are

A. **I) Static Analysis –**
B. **II) Equivalent Static Method** – its linear static method. In this method formulas are developed to approximately represent behavior of regular structures. Base shear is calculated and distributed to various floor levels. This method is not used for irregular structures.
- **Response Spectrum Method** – It is a linear dynamic method. This method estimates peak values of response quantities. It can be

used for any type of building and at all locations.

- The work consists of G+25, 30 &35, buildingsand each building has given angleof twist using Indian and American Code. For each angle of twist there will be seven buildings considering.
- For modeling and analysis of buildings ETab will beused.
- In this project Response Spectrum Method is used for dynamic analysis of RCC twisted building as designer is not often bothered about the structure's response at every instance of time, maximum response is enough information to design thestructure.
- The parameters storey displacement, storey drift and base shear will be checked andtheir graphical representation will bemade.
    - Results
    - Conclusion

Assumption:

- Material grade m50 fe500
- Beam = 0.815X0.4m
- Colum = 0.18X0.8m
- Colum = 1.3X1.3m
- Wall = 0.3m
- Wall = 0.4m
- Load pattern :-

1) Dead load
2) Live load
3) Super red load
4 Earth quake: x direction
5) Earth quake: Y direction
6) Wind load: x direction
7) Wind load: Y direction
Response spectrum analysis
Grade of concrete M50

DESIGN & MODELLING

Design of G+25 of 1.5 Angle Degrees for RCC Building

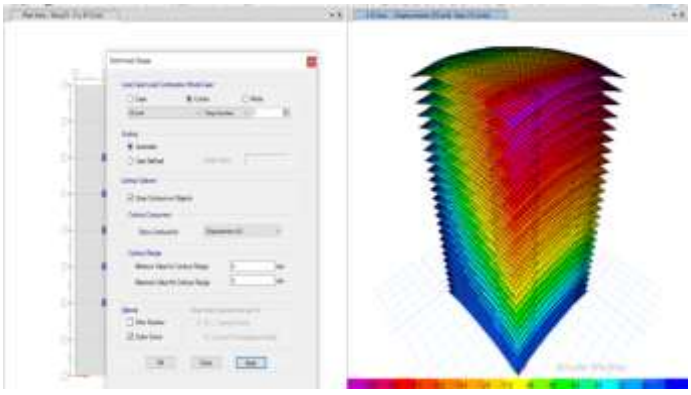


Figure1.1: Deform shape (mode1)

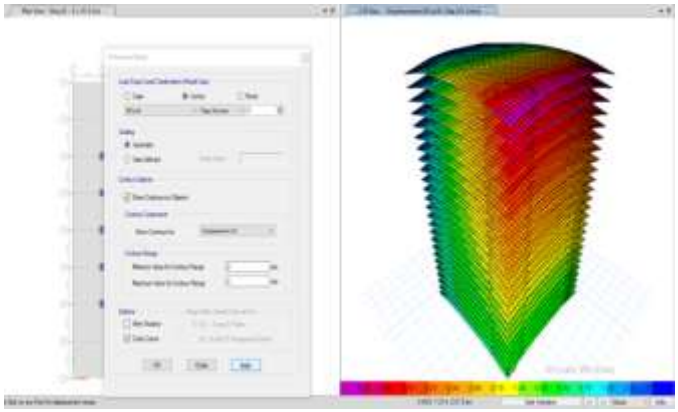


Figure1.2: Deform shape (mode2)

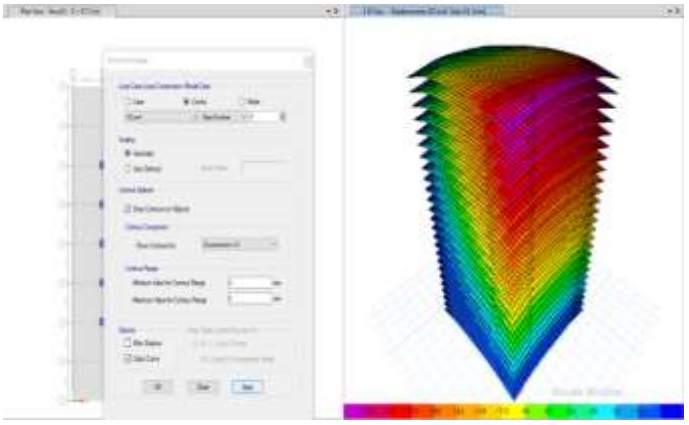


Figure1.3: Deform shape (mode3)

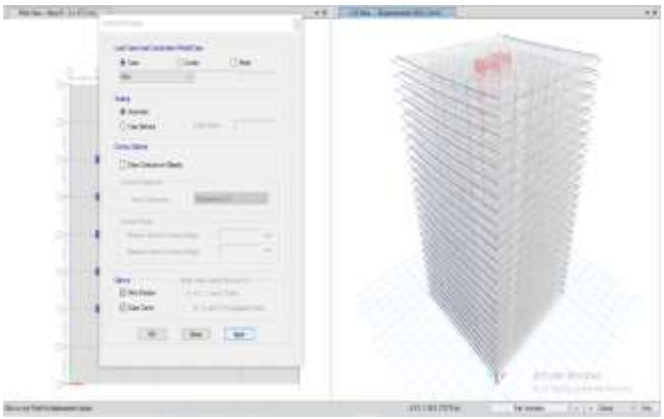


Figure1.4: Deform shape (X-Direction)

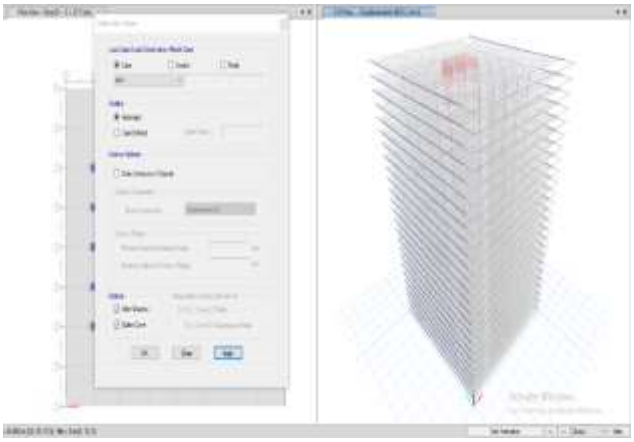


Figure1.5: Deform shape (Y-Direction)

Design of G+25 of 1.5 Angle Degrees for Twisted Building

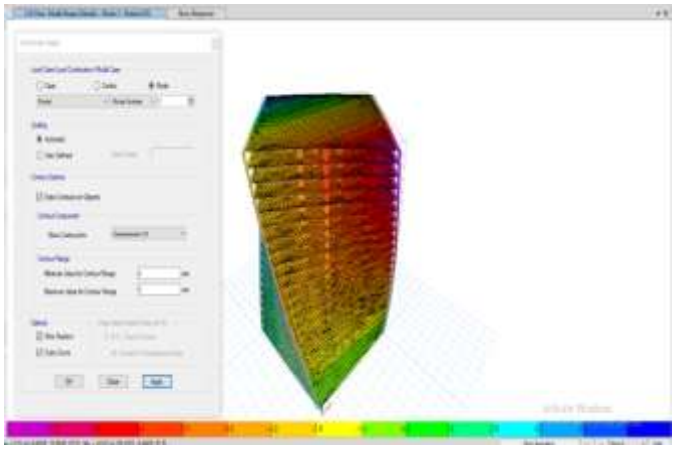


Figure1.6: Deform Shape (Mode1)

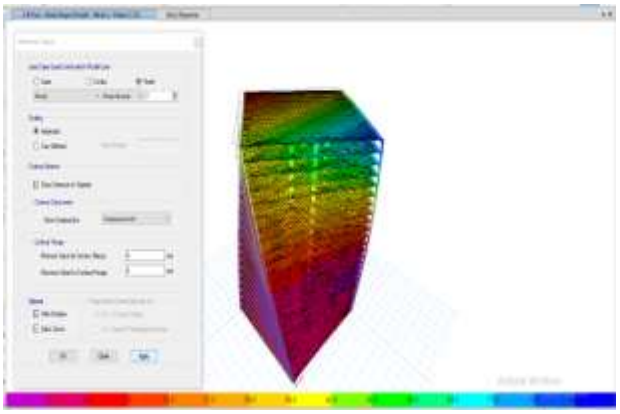


Figure1.7: Deform Shape (Mode2)

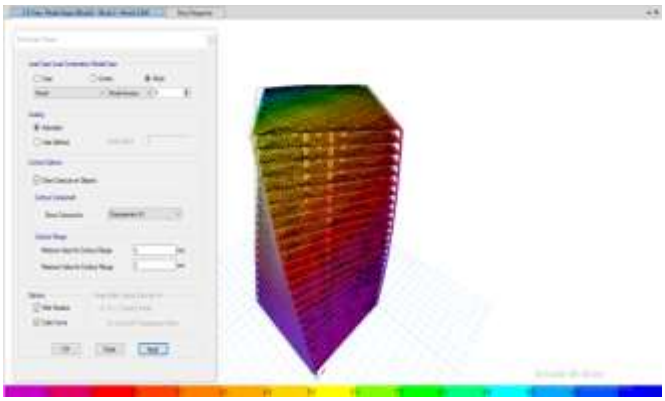


Figure1.8: Deform Shape (Mode3)

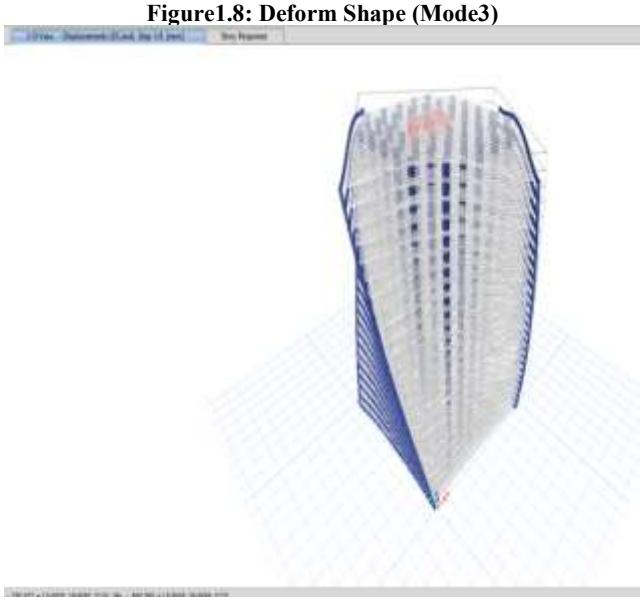


Figure1.9: Max displacement due to loading

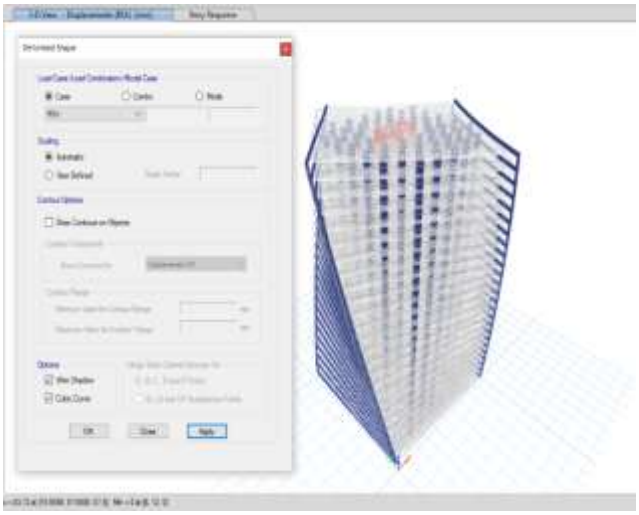


Figure1.10: Max displacement due to loading (X-Direction)

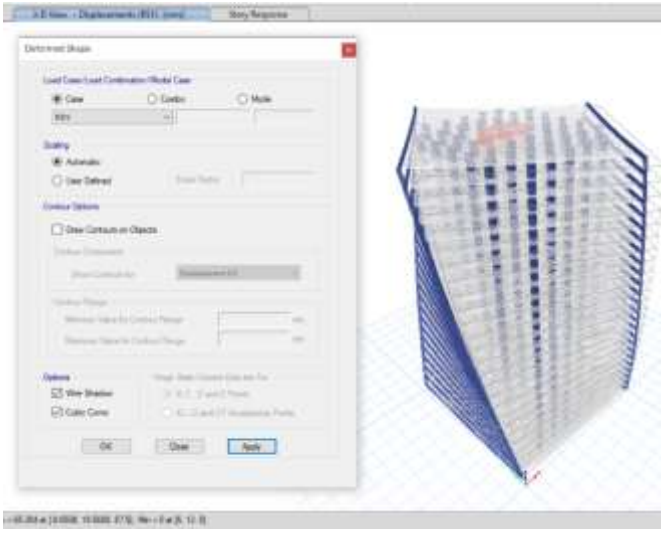


Figure5.11: Max displacement due to loading (Y-Direction)

Design of G+30 of 1.5 Angle Degrees for RCC Building

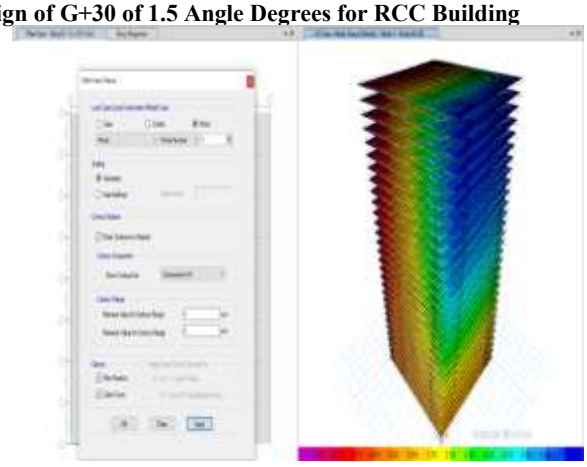


Figure5.12: Deform Shape (Mode1)

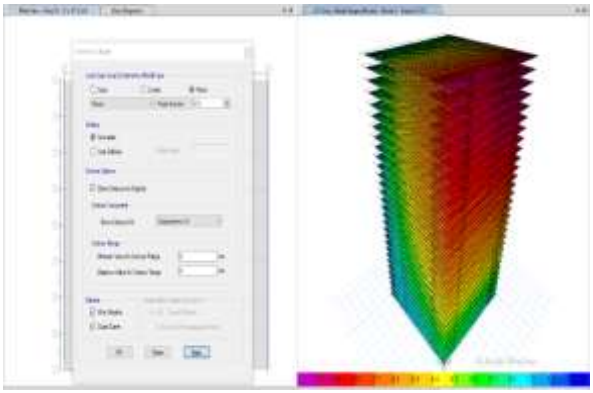


Figure5.13: Deform Shape (Mode2)

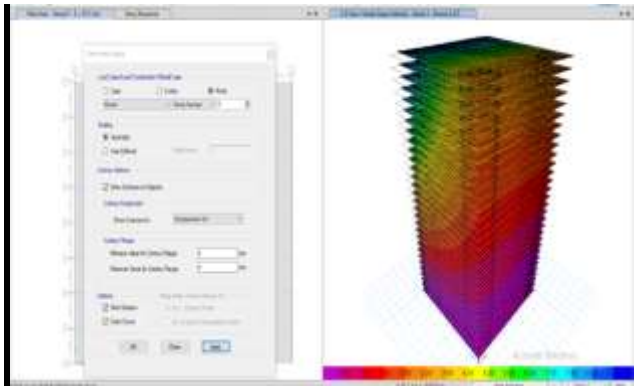


Figure5.14: Deform Shape (Mode3)

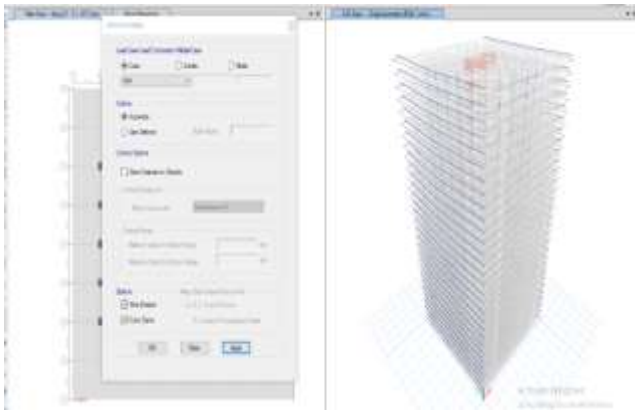


Figure5.15: Deform Shape (X-Direction)

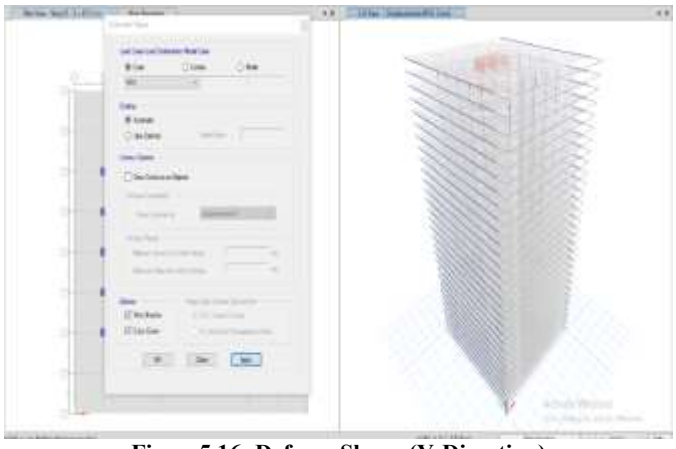


Figure5.16: Deform Shape (Y-Direction)

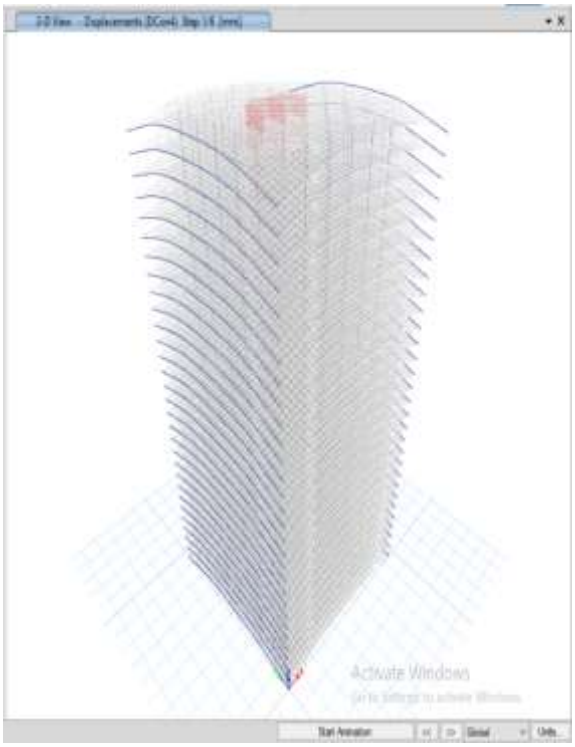


Figure5.17: Displacement due to loading

Design of G+30 Angle Degrees for Twisted Building

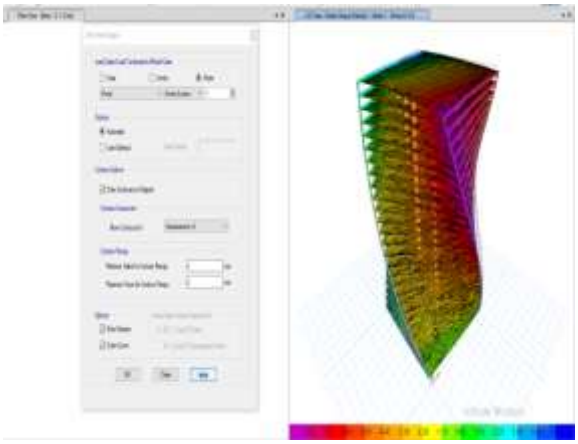


Figure5.18: Deform Shape (Mode1)

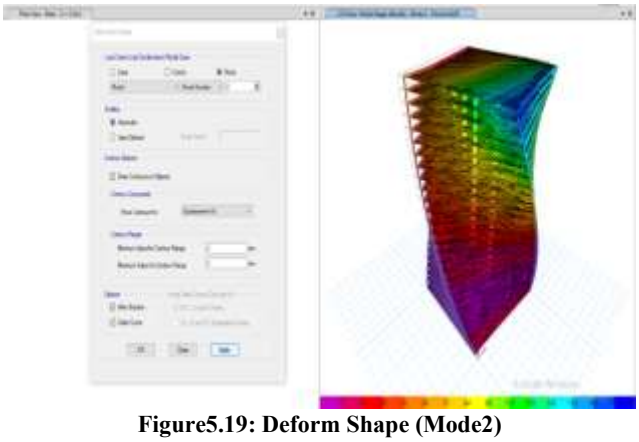


Figure5.19: Deform Shape (Mode2)

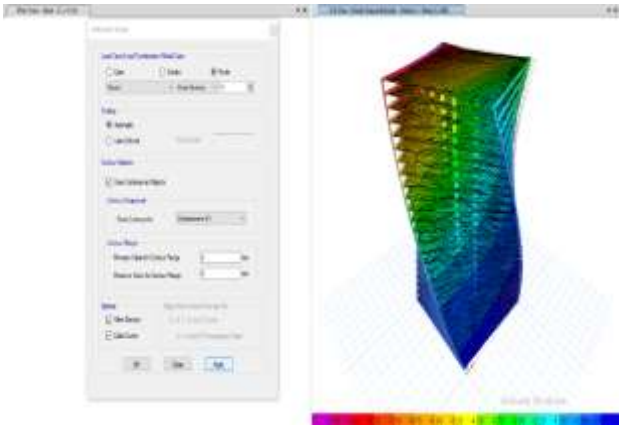


Figure5.20: Deform Shape (Mode3)

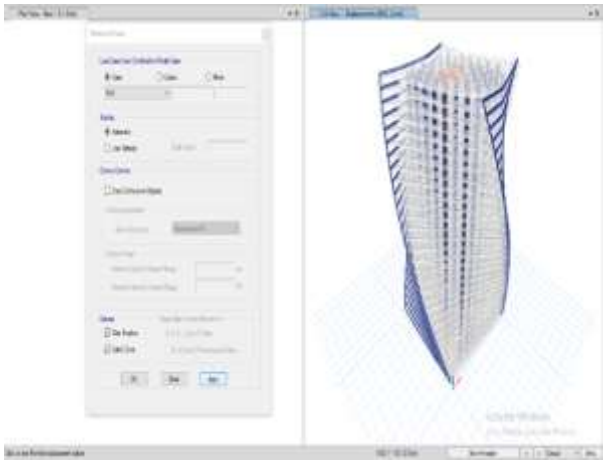


Figure5.21: Deform Shape (X-Direction)

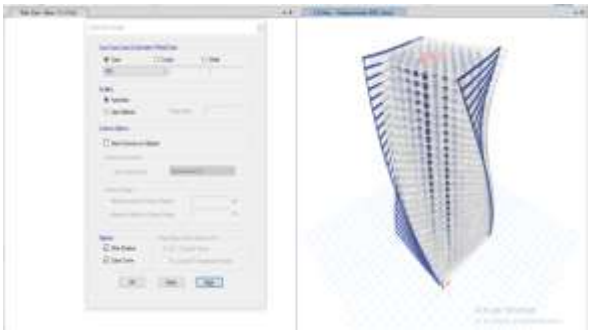


Figure5.22: Deform Shape (Y-Direction

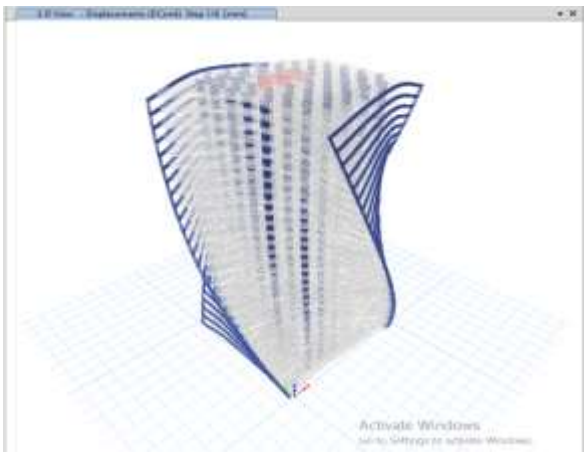


Figure5.23: Displacement due to loading

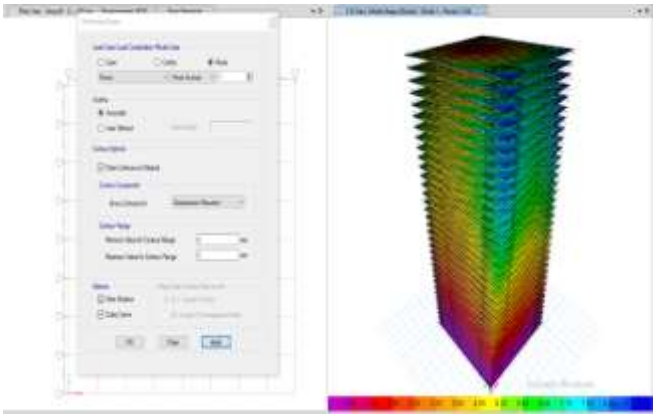
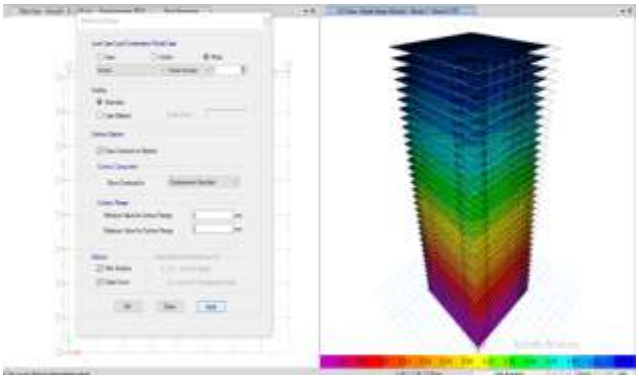


Figure5.24: Deform Shape (Mode1)



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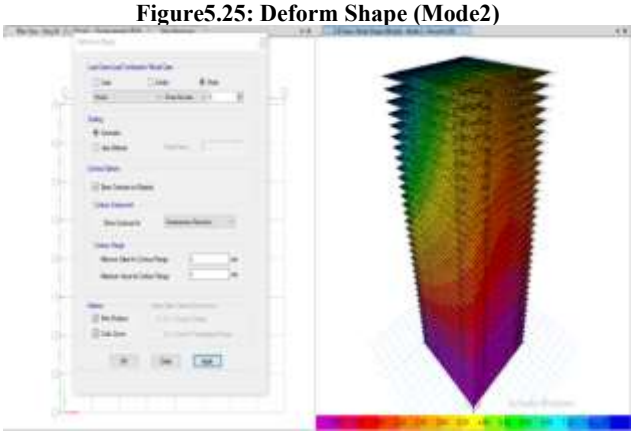


Figure5.26: Deform Shape (Mode3)

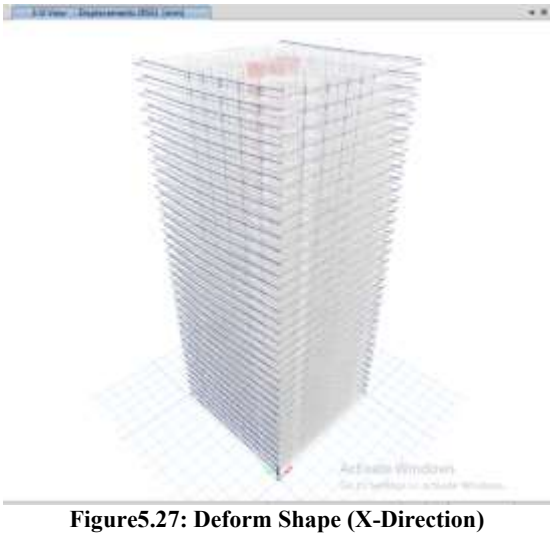


Figure5.27: Deform Shape (X-Direction)

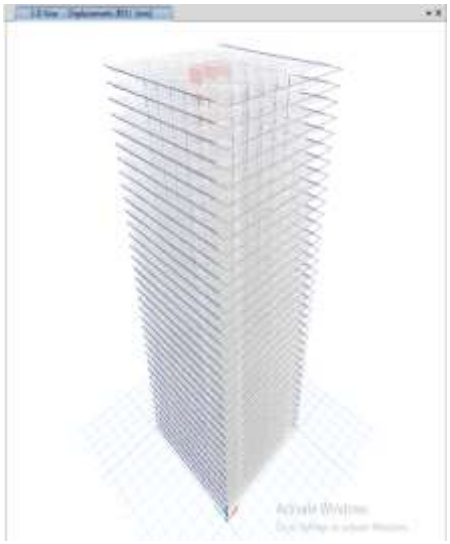


Figure5.28: Deform Shape (Y-Direction)

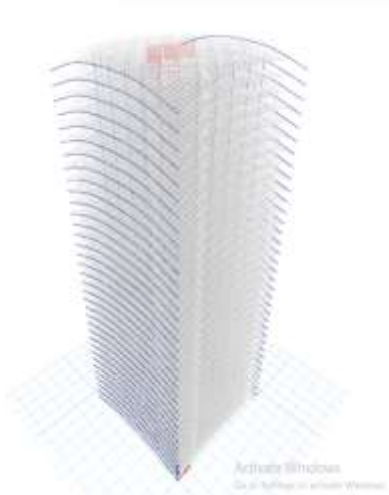


Figure5.29: Displacement due to loading

Design of G+35 of .5 Angle Degrees for Twisted Building

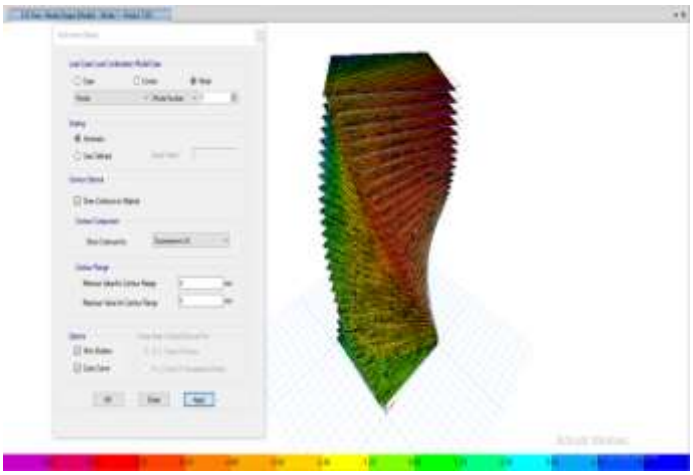


Figure5.30: Deform Shape (Mode1)

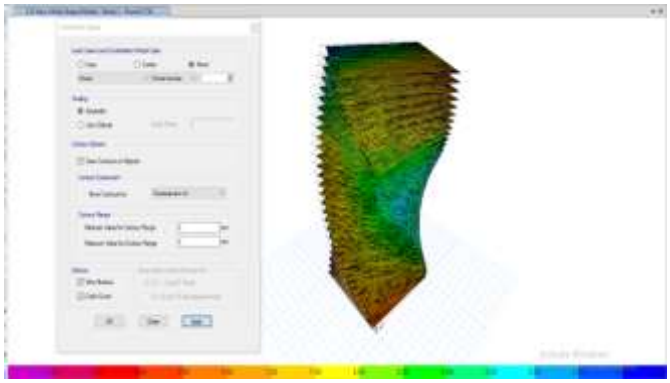


Figure5.31: Deform Shape (Mode2)

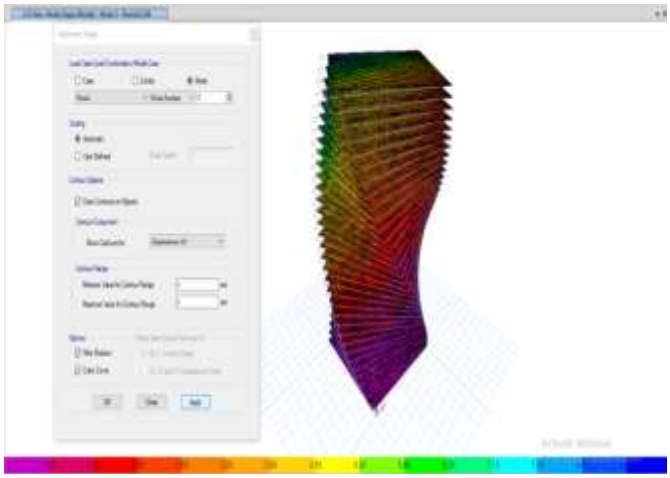


Figure5.32: Deform Shape (Mode3)

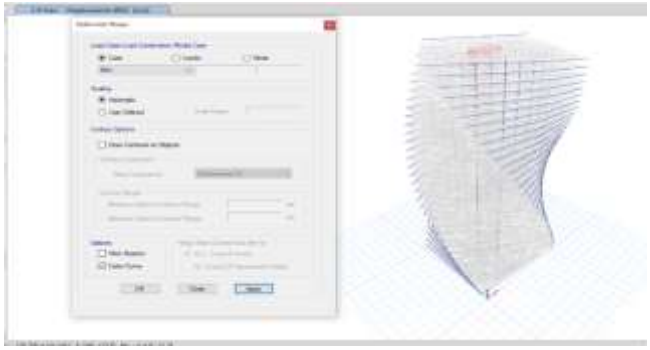


Figure5.33: Deform Shape (X-Direction)

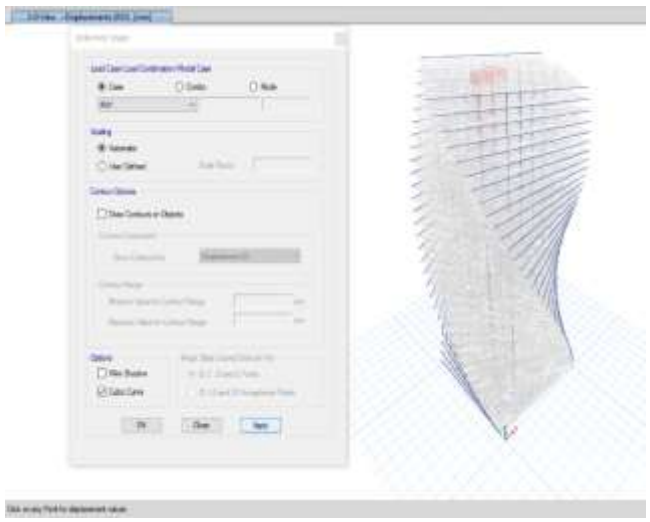


Figure5.34: Deform Shape (Y-Direction)

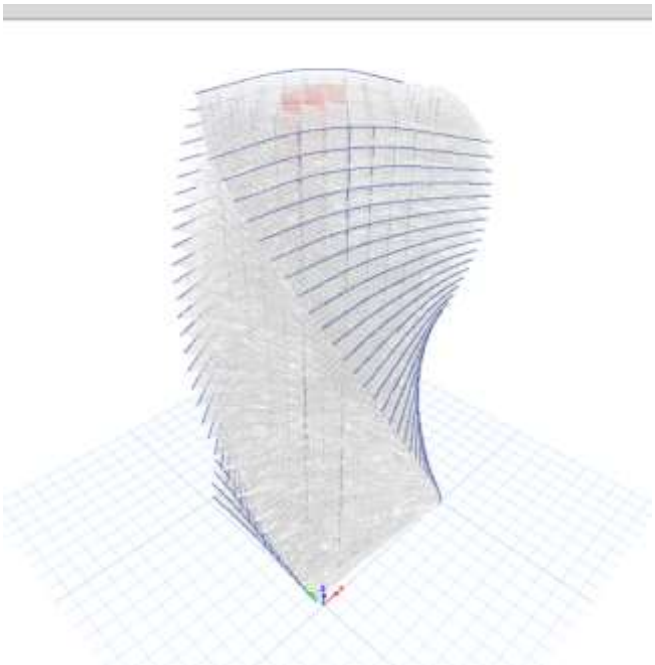


Figure5.35: Displacement due to loading

Design of G+25 of 1.5 Angle Degrees for RCC Building using American Code

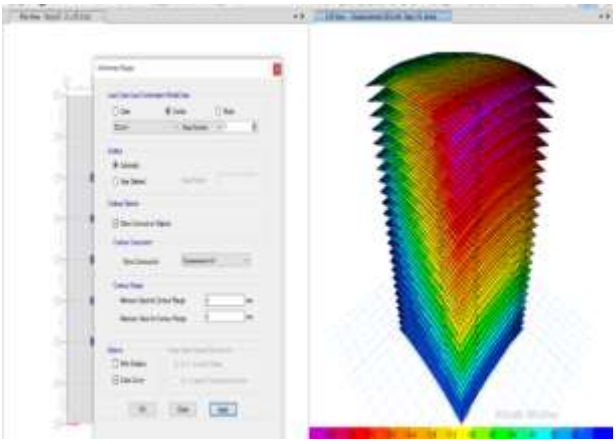


Figure5.36: Deform Shape (Mode1)

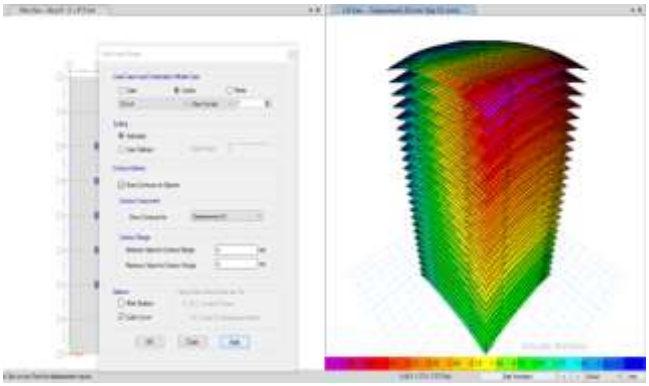


Figure5.37: Deform Shape (Mode2)

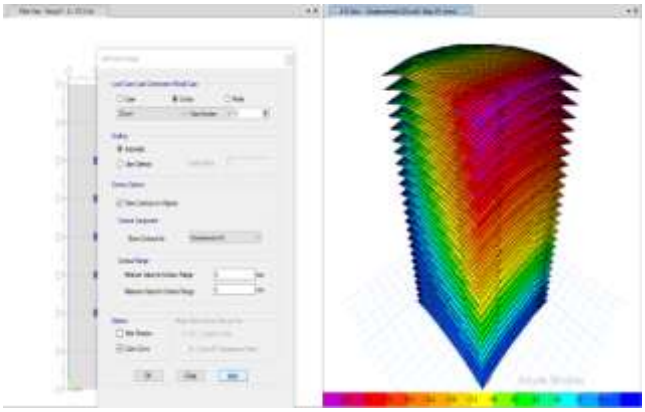


Figure5.38: Deform Shape (Mode3)

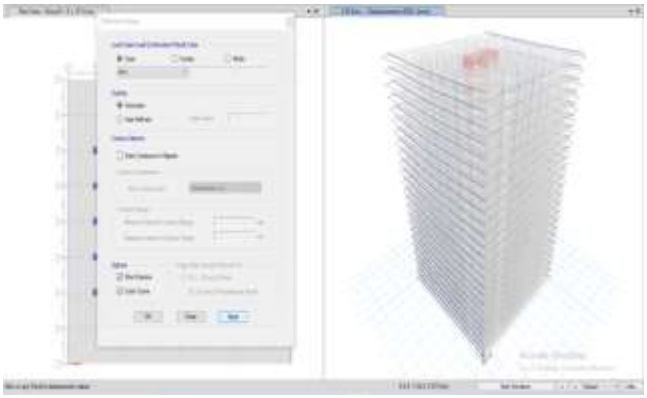


Figure5.39: Deform Shape (X-Direction)

Figure5.40: Deform Shape (Y-Direction)

Design of G+25 of 1.5 Angle Degrees for Twisted Building using American Code

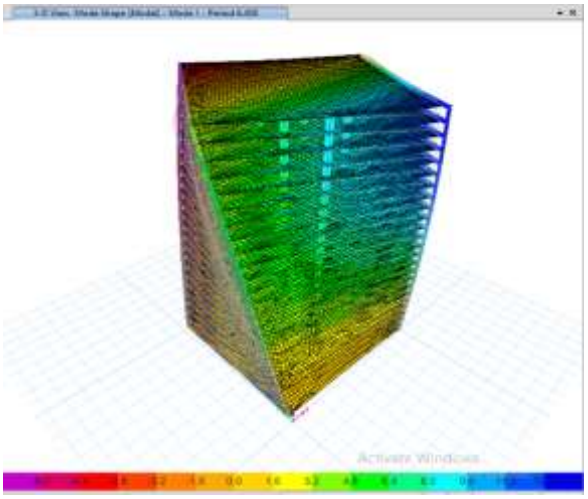


Figure5.41: Deform Shape (Mode1)

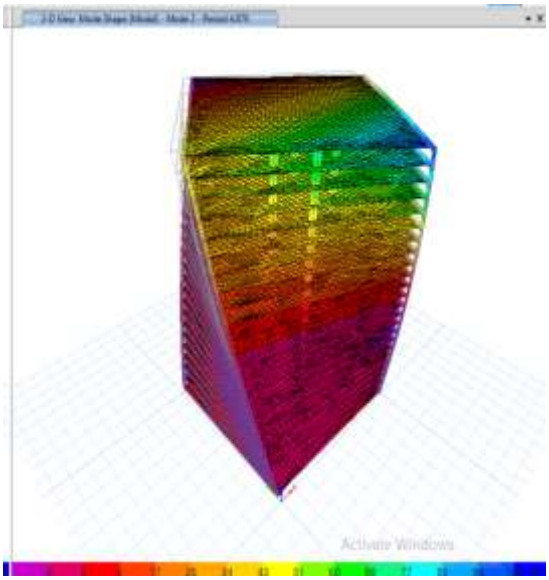


Figure5.42: Deform Shape (Mode2)

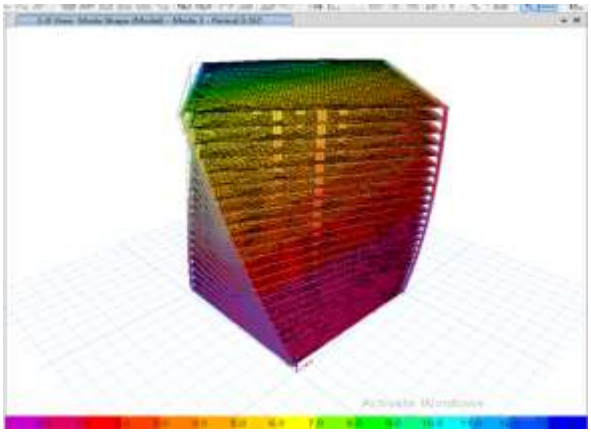


Figure5.43: Deform Shape (Mode3)

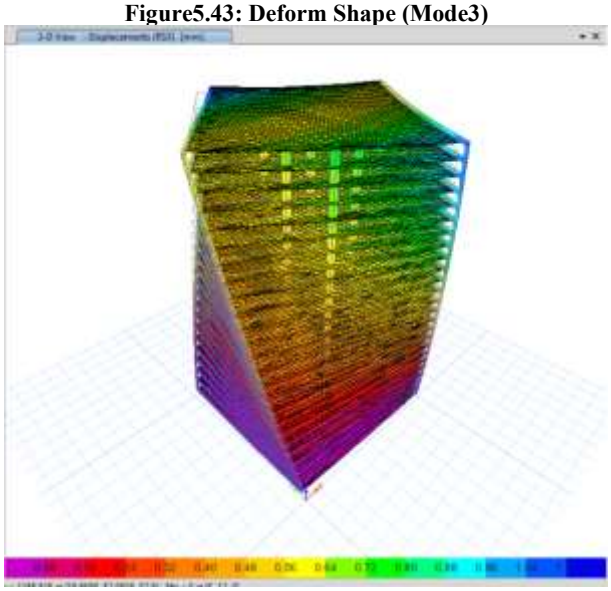


Figure5.44: Max displacement in x direction

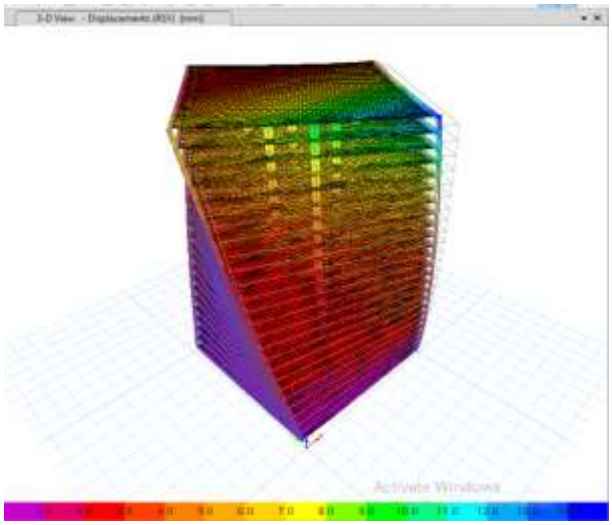


Figure5.44: Max displacement in Y direction

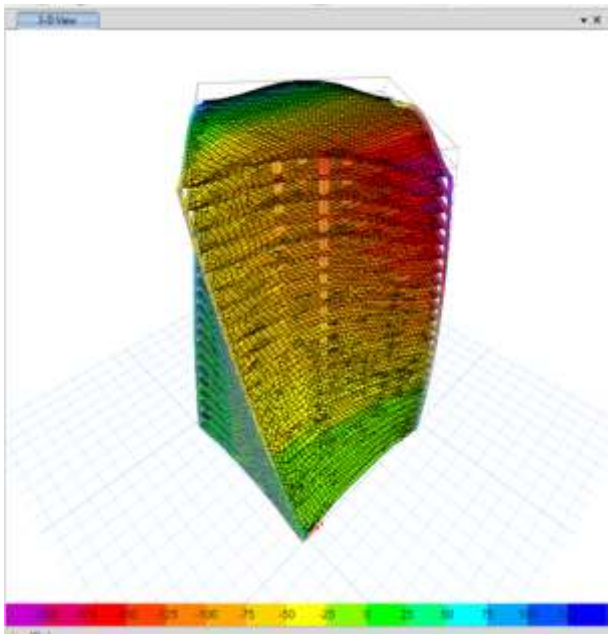


Figure5.45: Max displacement due to loading

Design of G+30 of 2.5 Angle Degrees for RCC Building using American Code

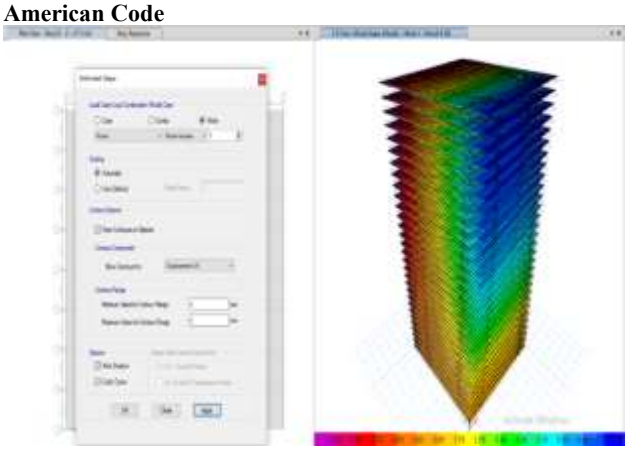


Figure5.46: Deform Shape (Mode1)

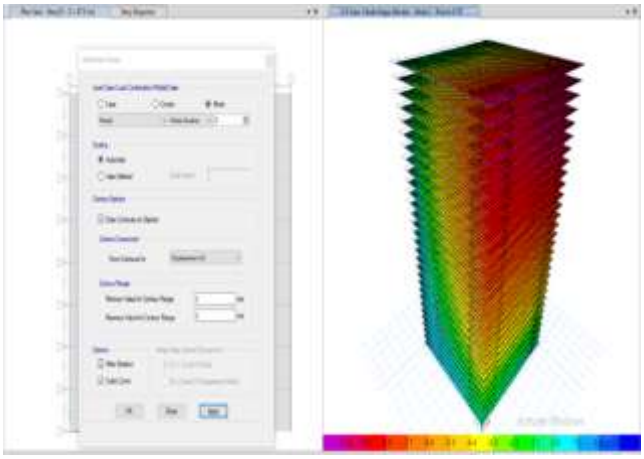


Figure5.47: Deform Shape (Mode2)

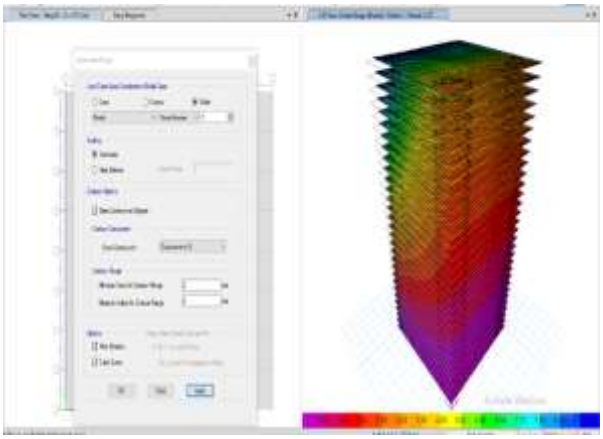


Figure5.48: Deform Shape (Mode3)

Figure5.49: Deform Shape (X-Direction)

Figure5.50: Deform Shape (Y-Direction)

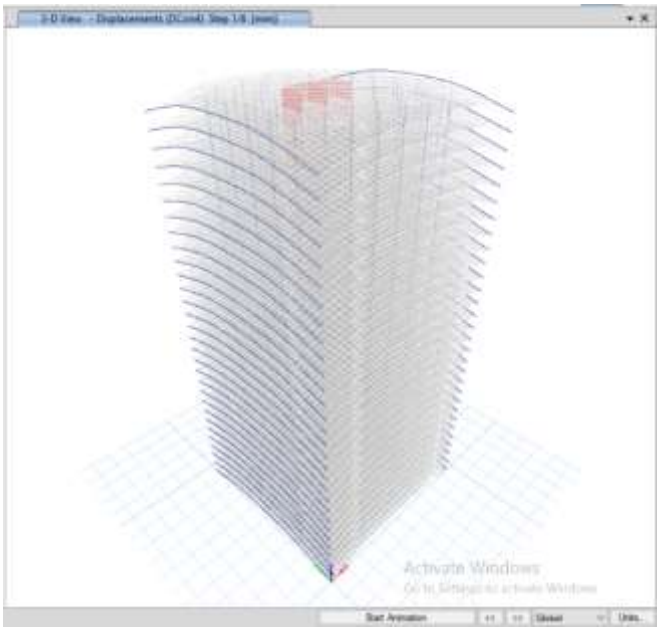


Figure5.51: Displacement due to loading

Design of G+30 of 2.5 Angle Degrees for Twisted Building using American Code

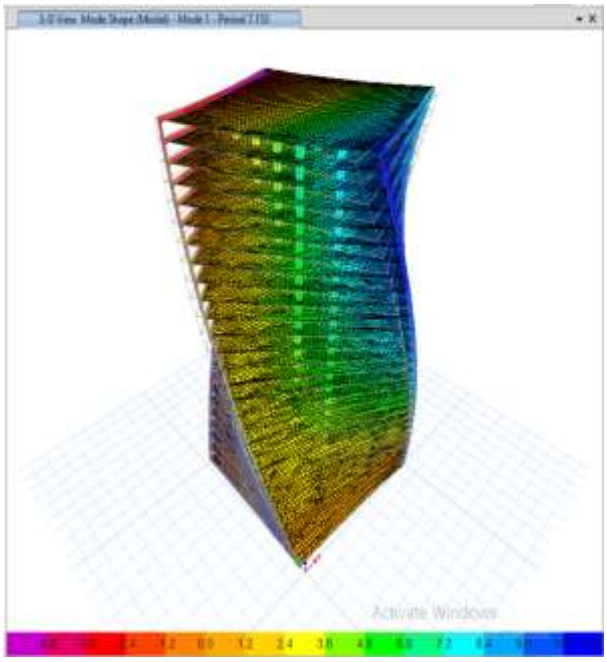


Figure5.52: Deform Shape (Mode1)

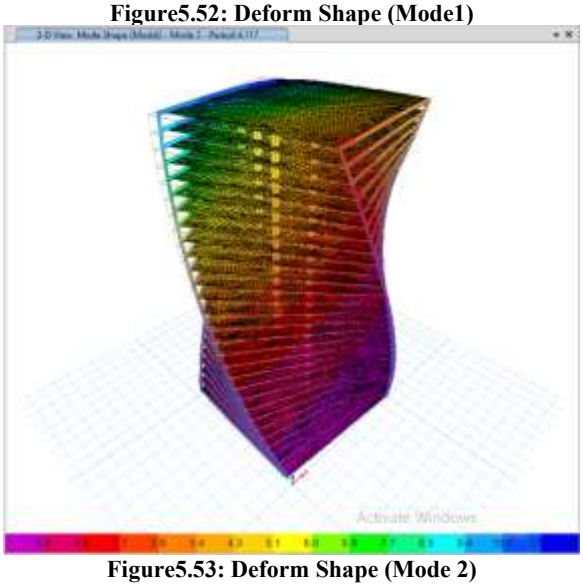


Figure5.53: Deform Shape (Mode 2)

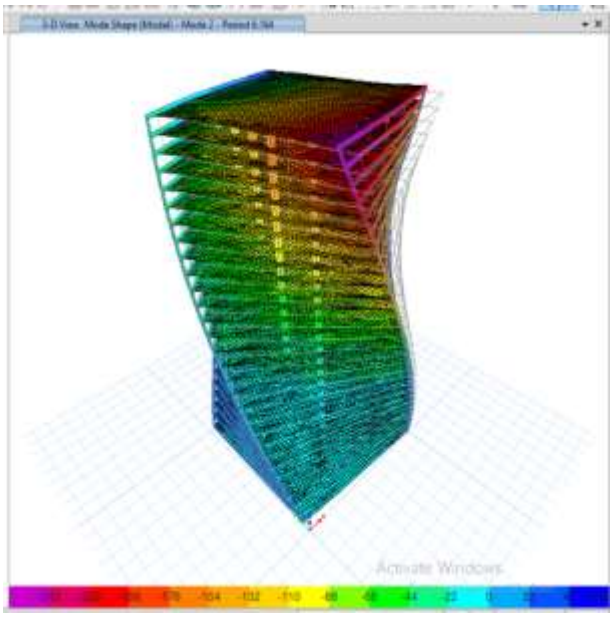


Figure5.54: Deform Shape (Mode 3)

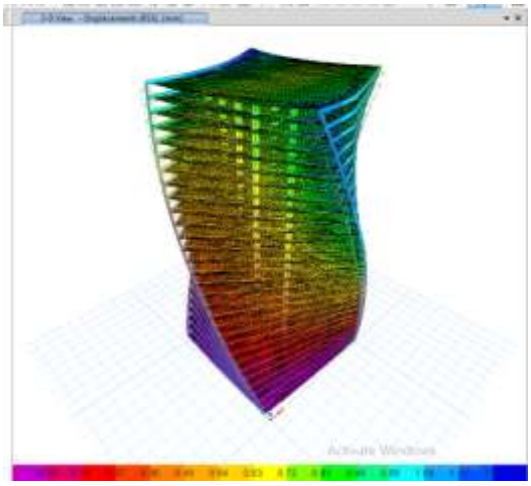


Figure5.55: Deform Shape (X-Direction)

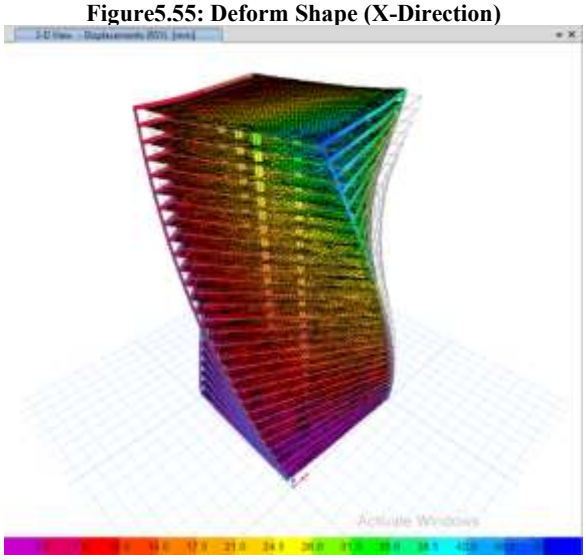


Figure5.56: Deform Shape (Y-Direction)

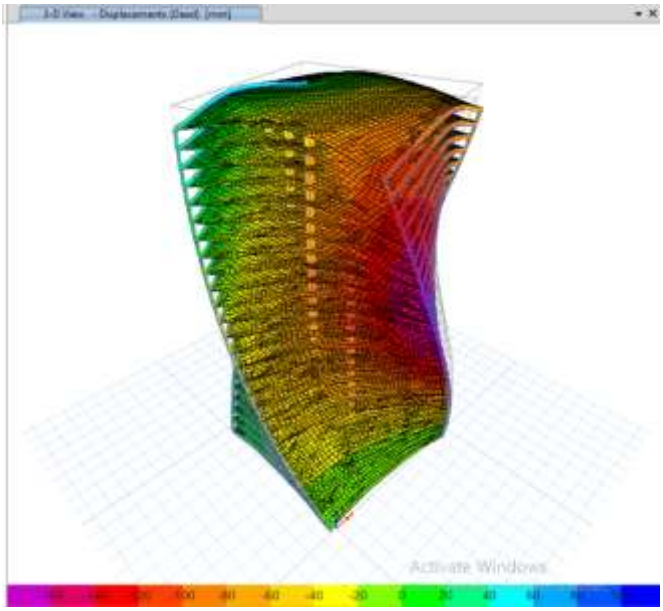


Figure5.57: Displacement due to loading

Design of G+35 of 3.5 Angle Degrees for RCC Building using American Code

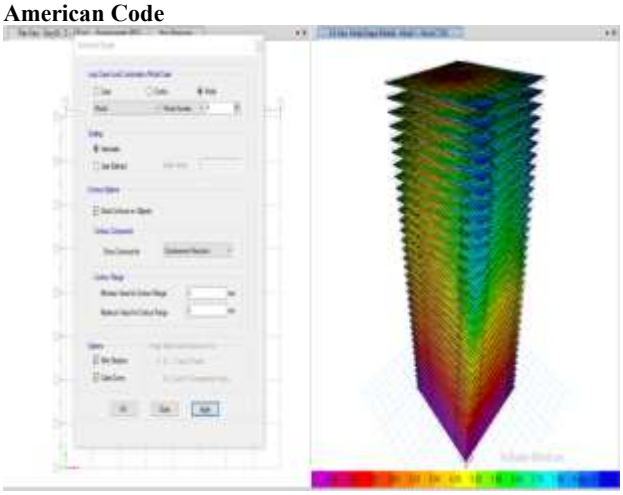


Figure5.58: Deform Shape (Mode1)

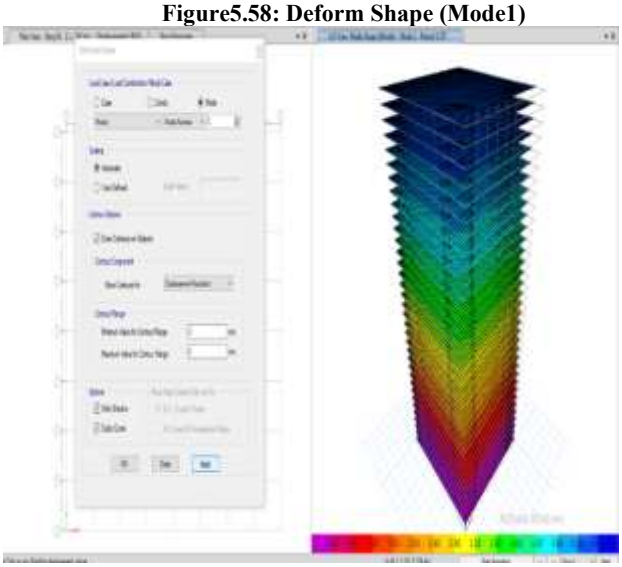


Figure5.59: Deform Shape (Mode2)

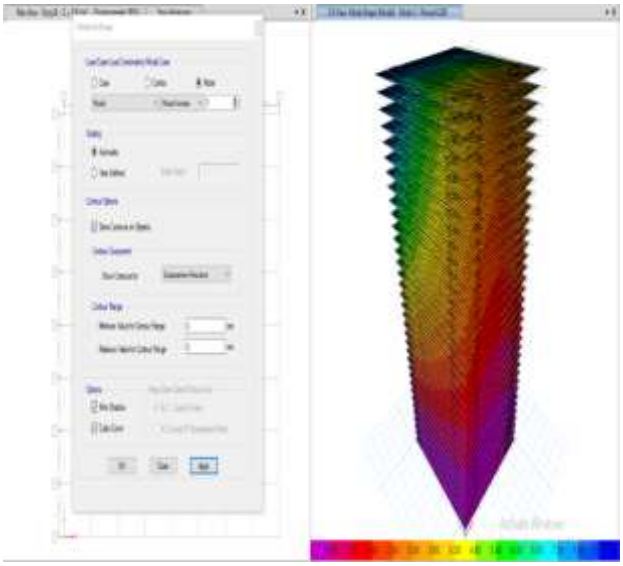


Figure5.60: Deform Shape (Mode1)

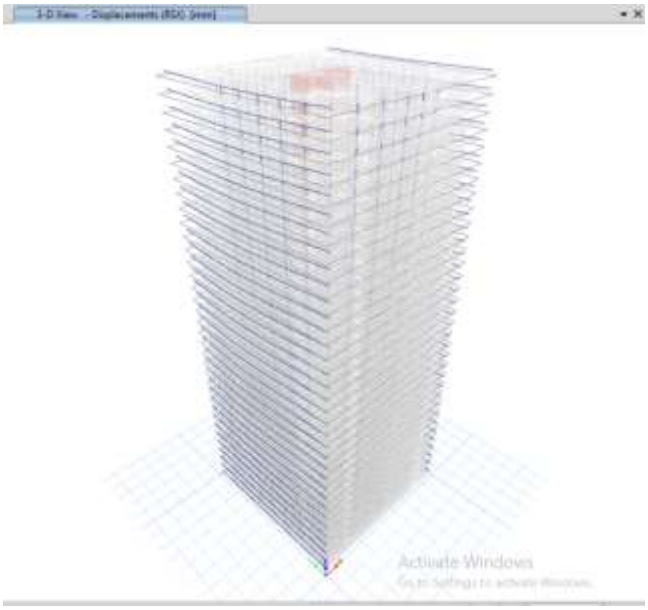


Figure5.61: Deform Shape (X-Direction)

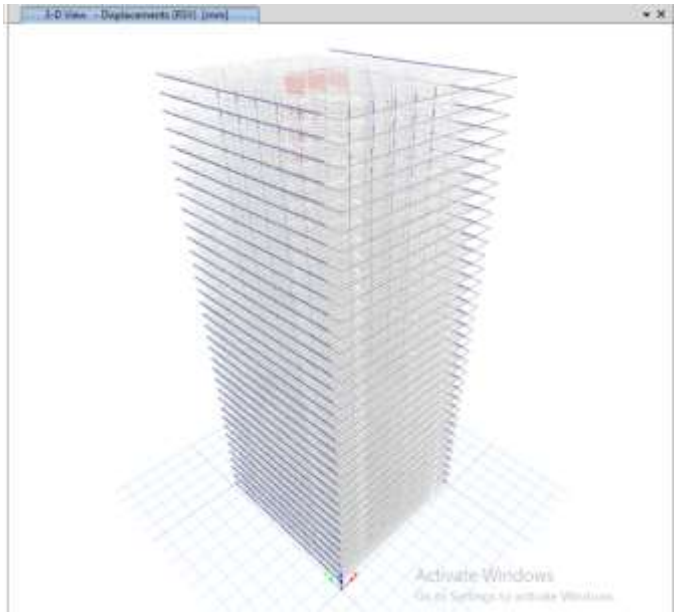


Figure5.62: Deform Shape (Y-Direction)

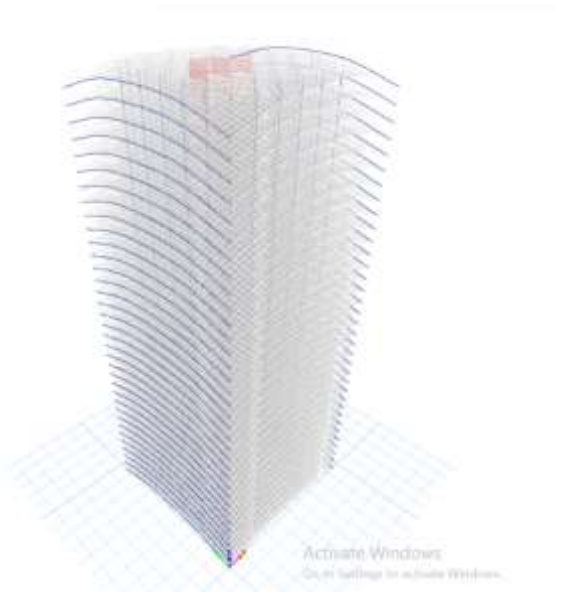


Figure6.63: Displacement due to loading

Design of G+35 of 3.5 Angle Degrees for Twisted Building using American Code

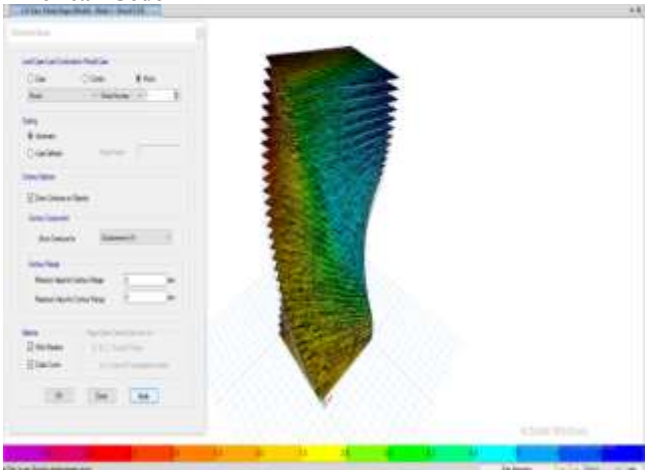


Figure6.64: Deform Shape (Mode1)

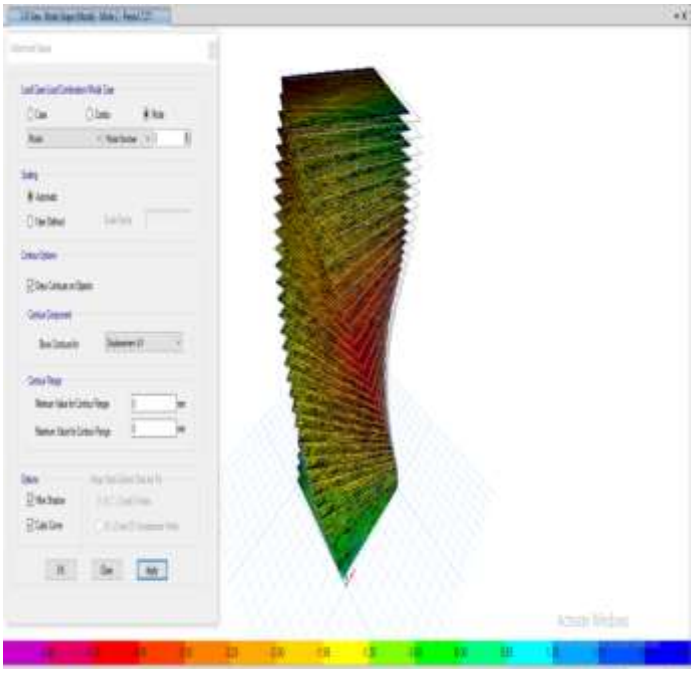


Figure6.65: Deform Shape (Mode2)

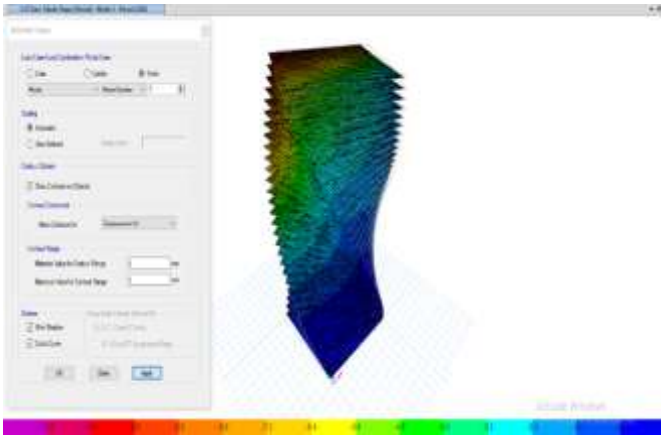


Figure6.66: Deform Shape (Mode3)

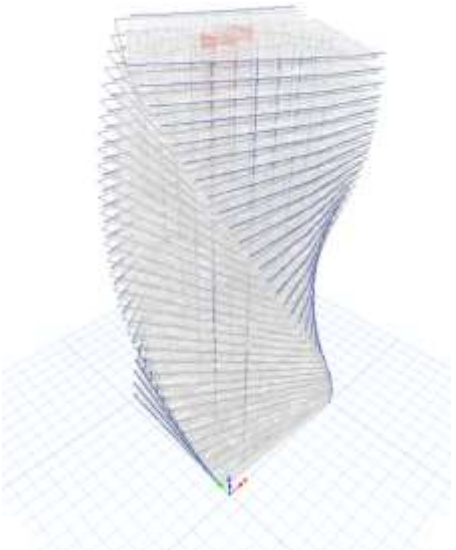
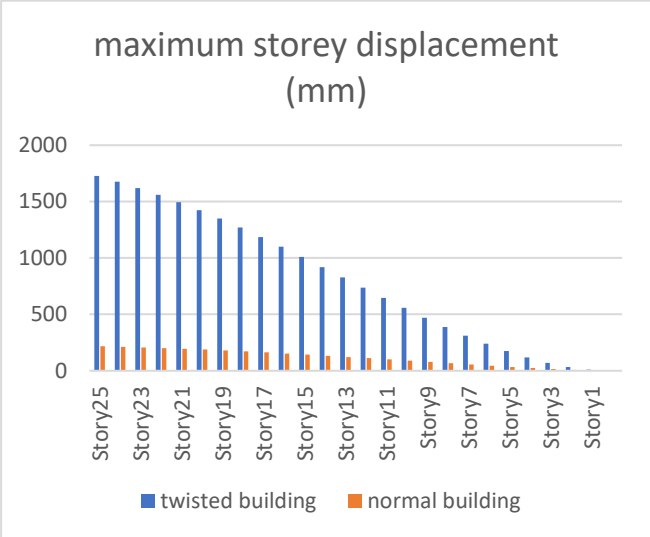


Figure6.67: Deform Shape (X-Direction)

Result and Discussion of Indian Code Results of RCC & Twisted Building

Maximum Displacement of 1.5 Degree for RCC & Twisted Building of G+25 Building

Maximum Storey Displacement (Mm)		
Storey	**Twisted Building**	**Normal Bldg.**
Story25	1728.986	216.986
Story24	1676.324	212.222
Story23	1620.454	207.054
Story22	1560.191	201.322
Story21	1495.108	194.944
Story20	1424.918	187.894
Story19	1349.891	180.181
Story18	1270.311	171.833
Story17	1186.752	162.896
Story16	1099.95	153.423
Story15	1010.661	143.473
Story14	919.761	133.109
Story13	828.004	122.397
Story12	736.292	111.403
Story11	645.593	100.198
Story10	556.845	88.855
Story9	470.92	77.456
Story8	388.789	66.09
Story7	311.506	54.866
Story6	239.927	43.918
Story5	175.048	33.419
Story4	118.261	23.603
Story3	70.602	14.785
Story2	33.587	7.405
Story1	9.72	2.144
Base	0	0



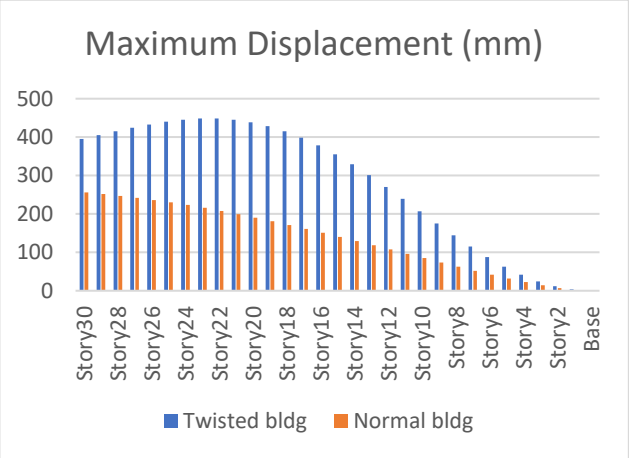
Maximum Displacement of 1.5 Degree for RCC & Twisted Building of G+25 Building

Maximum Displacement of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: Maximum Displacement of 2.5 Degree of G+ 30 Storeys

Maximum Displacement (mm)		
storey	**twisted building**	**normal building**
Story30	395.286	256.248
Story29	405.425	251.852
Story28	415.255	247.147
Story27	424.586	241.982
Story26	432.97	236.271
Story25	440.047	229.986
Story24	445.293	223.123
Story23	448.143	215.695
Story22	448.129	207.729
Story21	444.981	199.258
Story20	438.547	190.321
Story19	428.689	180.96
Story18	415.292	171.218
Story17	398.495	161.14
Story16	378.349	150.768
Story15	355.066	140.149
Story14	329.087	129.325
Story13	300.768	118.343
Story12	270.534	107.248
Story11	239.097	96.091
Story10	207.092	84.923
Story9	175.243	73.806
Story8	144.246	62.809

Story7	114.764	52.021
Story6	87.439	41.557
Story5	62.929	31.567
Story4	41.748	22.261
Story3	24.412	13.926
Story2	11.496	6.967
Story1	3.421	2.014
Base	0	0

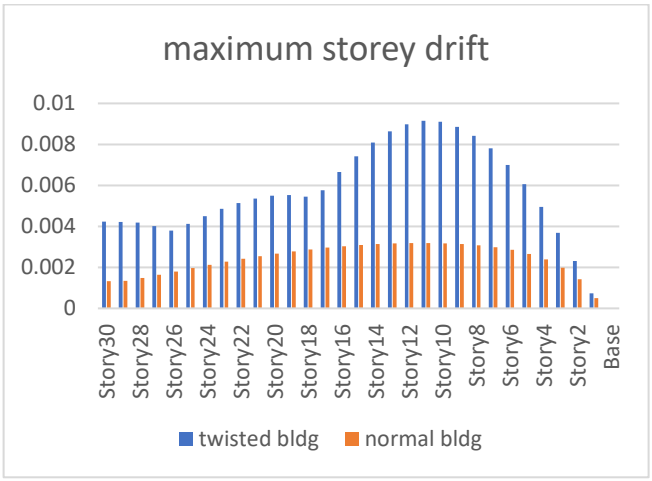


Graph: Maximum Displacement of 2.5 Degree of G+ 30 Storeys

Maximum Storey Drift of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: Maximum Storey Drift of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum Storey Drift		
Storey	**Twisted Building**	**Normal Building**
Story30	0.004238	0.001325
Story29	0.004211	0.001344
Story28	0.004182	0.001477
Story27	0.004011	0.001632
Story26	0.003792	0.001796
Story25	0.004122	0.001961
Story24	0.004499	0.002122
Story23	0.00485	0.002276
Story22	0.005142	0.00242
Story21	0.005359	0.002553
Story20	0.005496	0.002675
Story19	0.005521	0.002783
Story18	0.005451	0.00288
Story17	0.005756	0.002963
Story16	0.006652	0.003034
Story15	0.007423	0.003093
Story14	0.008091	0.003138
Story13	0.008638	0.00317
Story12	0.008982	0.003188
Story11	0.009144	0.003191
Story10	0.009099	0.003177
Story9	0.008857	0.003142
Story8	0.008423	0.003082
Story7	0.007807	0.00299
Story6	0.007003	0.002854
Story5	0.006052	0.002659
Story4	0.004953	0.002382
Story3	0.00369	0.001988
Story2	0.002307	0.001428
Story1	0.000729	0.000507
Base	0	0



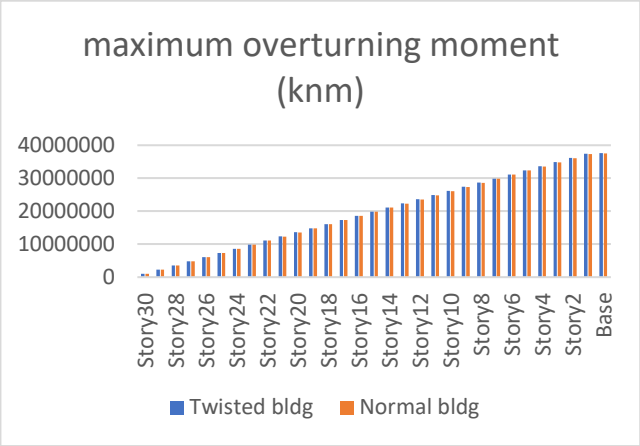
Graph: Maximum Storey Drift of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum Overturning Moment (KNM) of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: Maximum Overturning Moment (KNM) of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum Overturning Moment (KNm)		
Storey	**Twisted Building**	**Normal Building**
Story30	1064295	1064295.33
Story29	2317413	2314677.06
Story28	3570530	3565058.8
Story27	4823647	4815440.54
Story26	6076764	6065822.27
Story25	7329881	7316204.01
Story24	8582999	8566585.75
Story23	9836116	9816967.48
Story22	11089233	11067349
Story21	12342350	12317731
Story20	13595467	13568113
Story19	14848585	14818494
Story18	16101702	16068876
Story17	17354819	17319258
Story16	18607936	18569640
Story15	19861053	19820021
Story14	21114171	21070403
Story13	22367288	22320785
Story12	23620405	23571167
Story11	24873522	24821548
Story10	26126639	26071930
Story9	27379757	27322312
Story8	28632874	28572694
Story7	29885991	29823075
Story6	31139108	31073457
Story5	32392225	32323839
Story4	33645343	33574220

Story3	34898460	34824602
Story2	36151577	36074984
Story1	37404694	37325366
Base	37590781	37511452

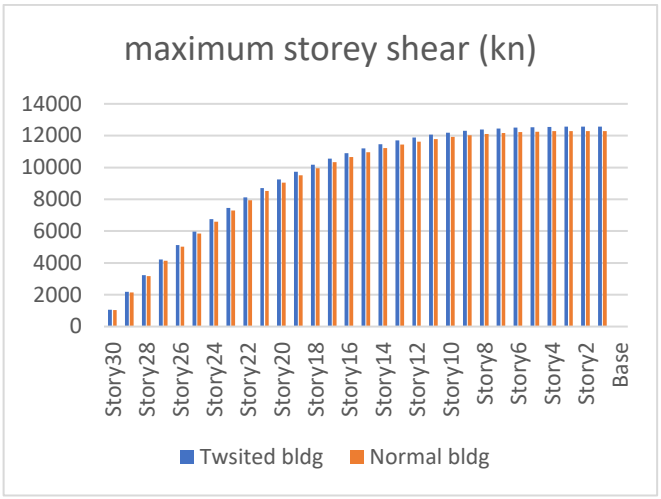


Graph: Maximum Overturning Moment (KNM) of 2.5 Degree for RCC & Twisted Building of G+30 Building

Storey Shear of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: 5 Storey Shear of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum Storey Shear (Kn)		
Storey	**Twisted Building**	**Normal Building**
Story30	1051.4467	1029.7099
Story29	2184.1222	2137.138
Story28	3240.0291	3169.5084
Story27	4221.8608	4129.455
Story26	5132.3111	5019.6112
Story25	5974.0735	5842.6106
Story24	6749.8418	6601.0869
Story23	7462.3096	7297.6736
Story22	8114.1704	7935.0044
Story21	8708.118	8515.7128
Story20	9246.846	9042.4324
Story19	9733.048	9517.7969
Story18	10169.4176	9944.4398
Story17	10558.6486	10324.9947
Story16	10903.4345	10662.0953
Story15	11206.469	10958.3751
Story14	11470.4457	11216.4677
Story13	11698.0583	11439.0067
Story12	11892.0003	11628.6258
Story11	12054.9655	11787.9585
Story10	12189.6475	11919.6384
Story9	12298.74	12026.2991
Story8	12384.9364	12110.5743
Story7	12450.9306	12175.0974
Story6	12499.4161	12222.5022
Story5	12533.0866	12255.4222
Story4	12554.6357	12276.491
Story3	12566.7571	12288.3422
Story2	12572.1444	12293.6094
Story1	12573.4886	12294.9262
Base	0	0



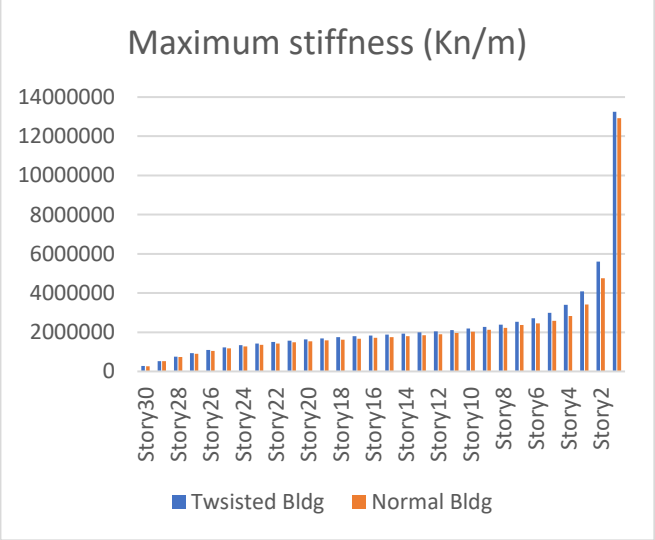
Graph: Storey Shear of 2.5 Degree for RCC & Twisted Building of G+30 Building

Storey Stiffness of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: Storey Stiffness of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum stiffness (KN/m)							
Twisted building				Normal building			
storey	shear (KN)	drift (mm)	stiffness (KN/m)	storey	shear (KN)	drift (mm)	stiffness (KN/m)
Story30	876.2056	3.224	271791.414	Story30	858.0916	3.276	261894.97
Story29	1820.102	3.426	531210.879	Story29	1780.948	3.433	518701.484
Story28	2700.024	3.591	751802.493	Story28	2641.257	3.617	730236.488
Story27	3518.217	3.745	939383.644	Story27	3441.213	3.793	907283.427
Story26	4276.926	3.901	1096291.12	Story26	4183.009	3.974	1052698.012
Story25	4978.395	4.057	1226978.529	Story25	4868.842	4.156	1171583.365
Story24	5624.868	4.21	1335956.977	Story24	5500.906	4.333	1269526.193
Story23	6218.591	4.356	1427550.949	Story23	6081.395	4.501	1351269.644
Story22	6761.809	4.491	1505751.351	Story22	6612.504	4.655	1420577.714
Story21	7256.765	4.608	1574812.327	Story21	7096.427	4.793	1480439.41
Story20	7705.705	4.709	1636501.634	Story20	7535.36	4.915	1533266.686
Story19	8110.873	4.796	1691340.218	Story19	7931.497	5.017	1581045.283
Story18	8474.515	4.863	1742687.226	Story18	8287.033	5.098	1625453.832
Story17	8798.874	4.911	1791611.592	Story17	8604.162	5.158	1667963.038
Story16	9086.195	4.944	1837743.374	Story16	8885.079	5.196	1709922.226
Story15	9338.724	4.955	1884879.402	Story15	9131.979	5.21	1752640.329
Story14	9558.705	4.939	1935281.684	Story14	9347.056	5.2	1797469.83
Story13	9748.382	4.901	1989135.002	Story13	9532.506	5.164	1845904.96
Story12	9910	4.841	2046909.367	Story12	9690.522	5.101	1899710.609

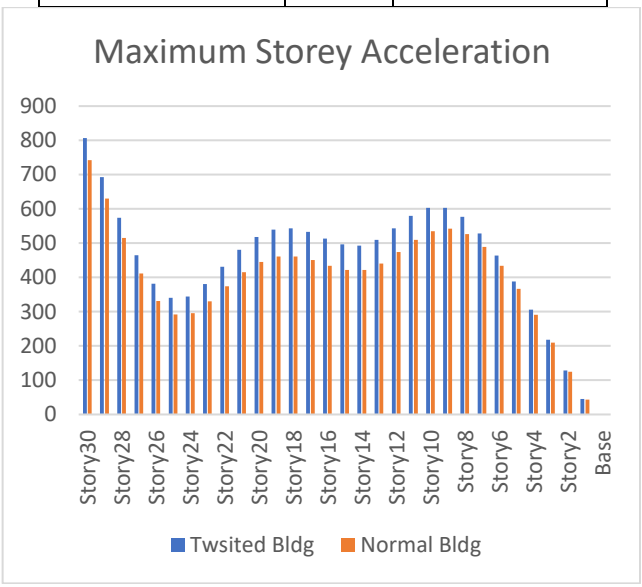
Story11	10045.8	4.759	2110988.719	Story11	9823.299	5.009	1961108.657
Story10	10158.04	4.647	2186162.61	Story10	9933.032	4.886	2033069.275
Story9	10248.95	4.502	2276450.64	Story9	10021.92	4.728	2119798.84
Story8	10320.78	4.325	2386506.036	Story8	10092.15	4.53	2227611.79
Story7	10375.78	4.103	2528773.295	Story7	10145.91	4.287	2366578.093
Story6	10416.18	3.83	2719911.208	Story6	10185.42	4.142	2459196.509
Story5	10444.24	3.493	2990016.592	Story5	10212.85	3.956	2581781.229
Story4	10462.2	3.077	3400448.871	Story4	10230.41	3.618	2827866.621
Story3	10472.3	2.559	4091989.925	Story3	10240.29	3	3413659.416
Story2	10476.79	1.872	5596451.994	Story2	10244.67	2.158	4747702.595
Story1	10477.91	0.791	13252987.76	Story1	10245.77	0.793	12915061.43



Graph: Storey Stiffness of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: Maximum Storey Acceleration of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum Storey Acceleration		
storey	Twisted Building	Normal Building
Story30	806.33	742.56
Story29	692.99	629.79
Story28	574.32	515.59
Story27	464.9	411.07
Story26	381.88	331.42
Story25	340.65	291.79
Story24	344.66	296.08
Story23	381.07	329.98
Story22	431.32	374.18
Story21	480.44	415.11
Story20	518.39	445.09
Story19	539.61	460.59
Story18	543.38	461.46
Story17	532.62	450.65
Story16	513.7	434.28
Story15	496.5	421.41
Story14	492.82	421.88
Story13	509.87	440.75
Story12	543.39	473.77
Story11	579.46	509.41
Story10	602.63	535.1
Story9	602.68	541.87
Story8	576.87	526.06
Story7	528.55	488.8
Story6	463.88	434.17
Story5	388.51	366.98
Story4	305.95	291.21
Story3	218.3	209.51
Story2	128.21	124.36
Story1	44.97	43.84
Base	0	0

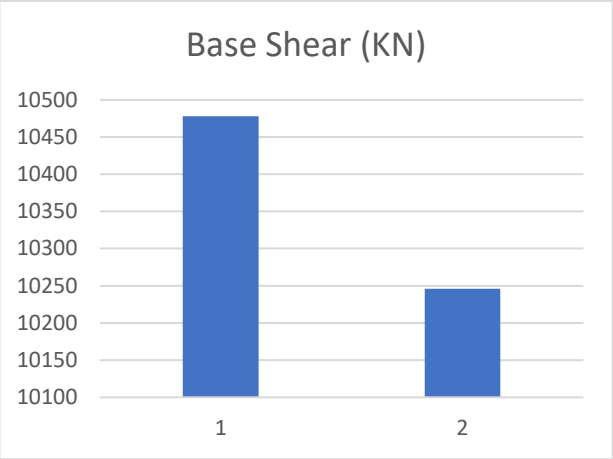


Graph: Maximum Storey Acceleration of 2.5 Degree for RCC & Twisted Building of G+30 Building

Base Shear of 2.5 Degree for RCC & Twisted Building of G+30 Building

Table: Base Shear of 2.5 Degree for RCC & Twisted Building of G+30 Building

Twisted building		
Direction	Time period	Base shear
EQX	3.408	10477.91
EQY	4.659	8927.486
Normal Building		
Direction	Time period	Base shear
EQX	3.472	10245.77
EQY	4.707	8893.771

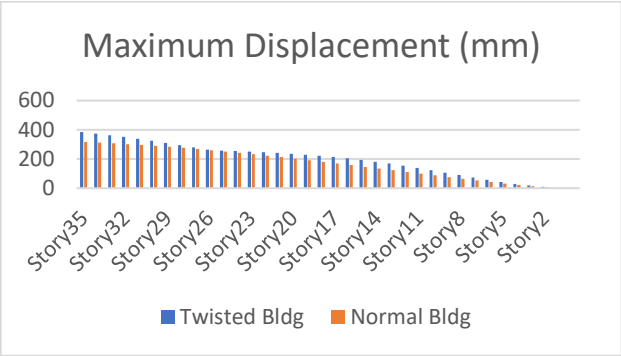


Graph: Base Shear of 2.5 Degree for RCC & Twisted Building of G+30 Building

Maximum Storey Displacement of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Maximum Storey Displacement of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum Displacement (mm)		
Storey	**Twisted building**	**Normal building**
Story35	384.336	316.328
Story34	374.334	311.894
Story33	363.305	307.193
Story32	351.3	302.078
Story31	338.356	296.461
Story30	324.577	290.309
Story29	310.11	283.612
Story28	295.138	276.375
Story27	279.803	268.617
Story26	264.239	260.36
Story25	258.029	251.634
Story24	254.976	242.471
Story23	251.228	232.904
Story22	246.833	222.966
Story21	241.784	212.693
Story20	236.034	202.119
Story19	229.504	191.279
Story18	222.126	180.206
Story17	213.77	168.934
Story16	204.245	157.497
Story15	193.506	145.928
Story14	181.58	134.263
Story13	168.487	122.535
Story12	154.28	110.782
Story11	139.136	99.043
Story10	123.258	87.363
Story9	106.852	75.794
Story8	90.226	64.402
Story7	73.775	53.267
Story6	57.897	42.5
Story5	42.966	32.248
Story4	29.419	22.719
Story3	17.78	14.201
Story2	8.542	7.1
Story1	2.354	2.049
Base	0	0



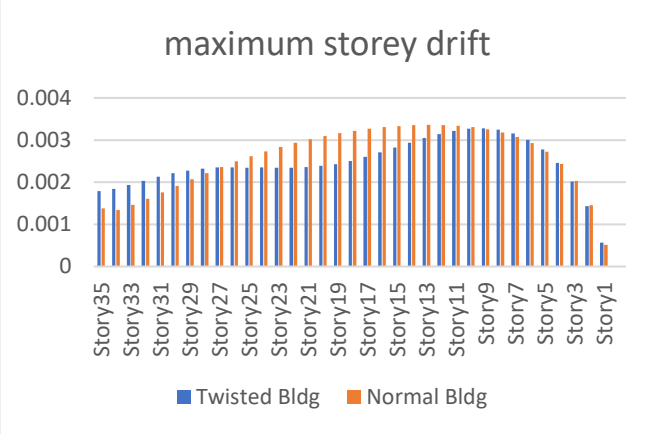
Graph: Maximum Storey Displacement of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum Storey Drift of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Maximum Storey Drift of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum storey drift		
Storey	**Twisted building**	**Normal building**
Story35	0.001788	0.001376
Story34	0.00184	0.001343
Story33	0.001937	0.001463
Story32	0.002034	0.001605
Story31	0.00213	0.001758
Story30	0.002214	0.001914
Story29	0.002273	0.002068
Story28	0.00232	0.002217
Story27	0.00235	0.002359
Story26	0.002353	0.002493
Story25	0.002346	0.002618
Story24	0.002355	0.002734
Story23	0.002347	0.002839
Story22	0.002345	0.002935
Story21	0.002358	0.003021
Story20	0.002387	0.003097
Story19	0.00243	0.003164
Story18	0.0025	0.003221
Story17	0.0026	0.003268
Story16	0.002711	0.003305
Story15	0.002822	0.003333
Story14	0.002934	0.003351
Story13	0.003049	0.003358
Story12	0.003143	0.003354
Story11	0.003216	0.003337
Story10	0.003269	0.003305
Story9	0.003281	0.003255

Story8	0.003246	0.003181
Story7	0.003153	0.003076
Story6	0.003002	0.002929
Story5	0.002779	0.002723
Story4	0.002454	0.002435
Story3	0.002018	0.002029
Story2	0.001434	0.001455
Story1	0.000569	0.000516
Base	0	0

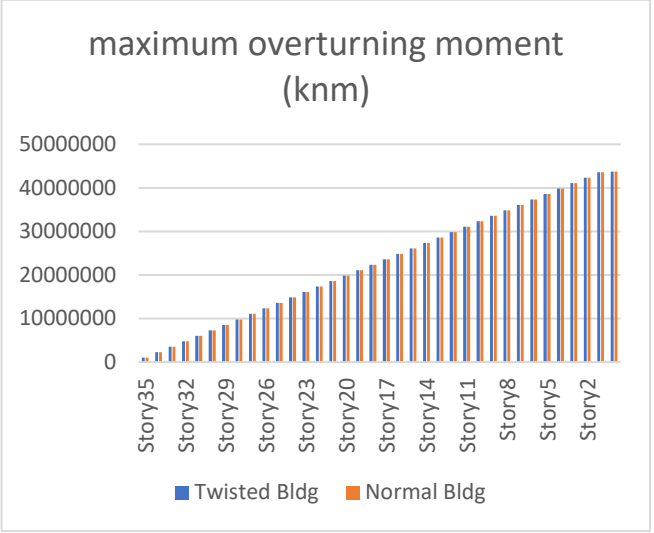


Graph: Maximum Storey Drift of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum Overturning Moment of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Maximum Overturning Moment of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum Overturning Moment (KN/m)		
Storey	**Twisted Building**	**Normal Building**
Story35	1064295	1064295.33
Story34	2314683	2314677.06
Story33	3565064	3565058.8
Story32	4815446	4815440.54
Story31	6065828	6065822.27
Story30	7316210	7316204.01
Story29	8566591	8566585.75
Story28	9816973	9816967.48
Story27	11067355	11067349
Story26	12317737	12317731
Story25	13568118	13568113
Story24	14818500	14818494
Story23	16068882	16068876
Story22	17319264	17319258
Story21	18569645	18569640
Story20	19820027	19820021
Story19	21070409	21070403
Story18	22320791	22320785
Story17	23571172	23571167
Story16	24821554	24821548
Story15	26071936	26071930
Story14	27322317	27322312
Story13	28572699	28572694
Story12	29823081	29823075
Story11	31073463	31073457
Story10	32323844	32323839
Story9	33574226	33574220
Story8	34824608	34824602
Story7	36074990	36074984
Story6	37325371	37325366
Story5	38575753	38575747
Story4	39826145	39826129
Story3	41076527	41076511
Story2	42326908	42326893
Story1	43577290	43577274
Base	43763377	43763361



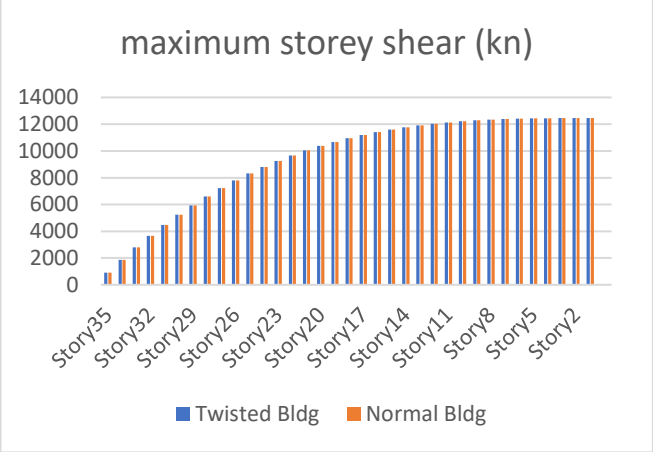
Graph: Maximum Overturning Moment of 3.5 Degree for RCC & Twisted Building of G+35 Building

Storey Shear of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Storey Shear of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum Storey Shear (KN)		
Storey	**Twisted Building**	**Normal Building**
Story35	899.0874	899.0877
Story34	1875.5908	1875.5847
Story33	2795.4912	2795.4854
Story32	3660.4848	3660.4793
Story31	4472.261	4472.2558
Story30	5232.5093	5232.5043
Story29	5942.9191	5942.9143
Story28	6605.1798	6605.1753
Story27	7220.9809	7220.9766
Story26	7792.0118	7792.0077
Story25	8319.962	8319.9581
Story24	8806.5209	8806.5172
Story23	9253.378	9253.3744
Story22	9662.2226	9662.2191
Story21	10034.7442	10034.7409
Story20	10372.6324	10372.6291
Story19	10677.5764	10677.5733
Story18	10951.2658	10951.2628
Story17	11195.3899	11195.387
Story16	11411.6383	11411.6355
Story15	11601.7004	11601.6976
Story14	11767.2656	11767.2628
Story13	11910.0233	11910.0206
Story12	12031.663	12031.6604
Story11	12133.8742	12133.8716
Story10	12218.3462	12218.3436
Story9	12286.7686	12286.766
Story8	12340.8307	12340.8281
Story7	12382.222	12382.2194
Story6	12412.6319	12412.6294

Story5	12433.7499	12433.7474
Story4	12447.2654	12447.2629
Story3	12454.8679	12454.8654
Story2	12458.2468	12458.2443
Story1	12459.0915	12459.089
Base	0	0

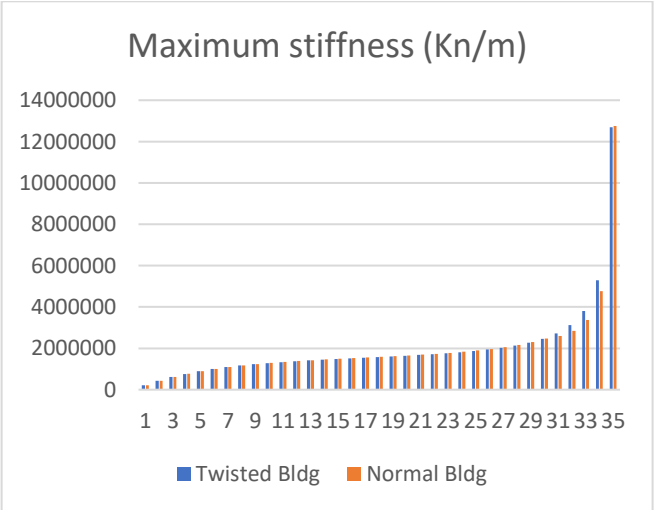


Graph: Storey Shear of 3.5 Degree for RCC & Twisted Building of G+35 Building

Storey Stiffness of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Storey Stiffness of 3.5 Degree for RCC & Twisted Building of G+35 Building

Maximum Stiffness (Kn/M)							
Twisted Bldg					Normal Bldg		
Storey	Shear (Kn)	Drift (Mm)	Stiffness (Kn/M)	Storey	Shear (Kn)	Drift (Mm)	Stiffness (Kn/M)
Story35	749.2395	3.468	216044.447	Story35	749.2397	3.429	218483.577
Story34	1562.992	3.662	426761.727	Story34	1562.987	3.641	429282.003
Story33	2329.576	3.84	606707.178	Story33	2329.571	3.816	610434.314
Story32	3050.404	4.009	760966.397	Story32	3050.399	3.984	765618.226
Story31	3726.884	4.185	890497.009	Story31	3726.88	4.16	895913.177
Story30	4360.424	4.367	998509.298	Story30	4360.42	4.341	100452 4.607
Story29	4952.433	4.552	108805 2.986	Story29	4952.429	4.521	109538 7.114
Story28	5504.317	4.727	116440 9.346	Story28	5504.313	4.697	117199 2.468
Story27	6017.484	4.893	122986 8.647	Story27	6017.481	4.864	123719 4.011
Story26	6493.343	5.051	128557 6.626	Story26	6493.34	5.021	129331 0.925
Story25	6933.302	5.201	133301 6.598	Story25	6933.298	5.165	134224 3.191
Story24	7338.767	5.341	137409 0.454	Story24	7338.764	5.297	138556 0.528
Story23	7711.148	5.46	141226 4.418	Story23	7711.145	5.413	142457 4.073
Story22	8051.852	5.564	144709 4.11	Story22	8051.849	5.513	146039 6.495
Story21	8362.287	5.652	147963 8.31	Story21	8362.284	5.597	149399 2.556
Story20	8643.86	5.719	151154 4.785	Story20	8643.858	5.664	152622 1.866
Story19	8897.98	5.769	154226 1.17	Story19	8897.978	5.712	155787 6.041
Story18	9126.055	5.801	157331 1.944	Story18	9126.052	5.741	158971 2.727
Story17	9329.492	5.812	160513 9.055	Story17	9329.489	5.75	162248 9.15
Story16	9509.699	5.805	163826 0.892	Story16	9509.696	5.739	165699 8.254
Story15	9668.084	5.771	167529 9.393	Story15	9668.081	5.707	169411 1.406
Story14	9806.055	5.714	171626 6.772	Story14	9806.052	5.652	173483 3.324
Story13	9925.019	5.637	176074 3.952	Story13	9925.017	5.575	178037 8.032
Story12	10026.39	5.536	181126 0	Story12	10026.38	5.472	183228 0.258
Story11	10111.56	5.409	186955 0.918	Story11	10111.56	5.343	189256 7.286
Story10	10181.96	5.252	193876 2.18	Story10	10181.95	5.184	196403 7.181
Story9	10238.97	5.055	202540 0.547	Story9	10238.97	4.993	205073 3.086
Story8	10284.03	4.823	213240 7.865	Story8	10284.02	4.764	215879 7.986
Story7	10318.52	4.545	227044 0.533	Story7	10318.52	4.49	229809 7.544
Story6	10343.86	4.209	245727 8.589	Story6	10343.86	4.183	247254 4.261
Story5	10361.46	3.805	272286 4.684	Story5	10361.46	3.994	259404 6.517
Story4	10372.72	3.317	312673 3.468	Story4	10372.72	3.653	283949 1.025
Story3	10379.06	2.727	380653 5.432	Story3	10379.05	3.083	336632 6.092
Story2	10381.87	1.963	528991 0.075	Story2	10381.87	2.18	476232 2.041
Story1	10382.58	0.818	126950 83.77	Story1	10382.57	0.814	127498 63.95



Graph: Storey Stiffness of 3.5 Degree for RCC & Twisted Building of G+35 Building

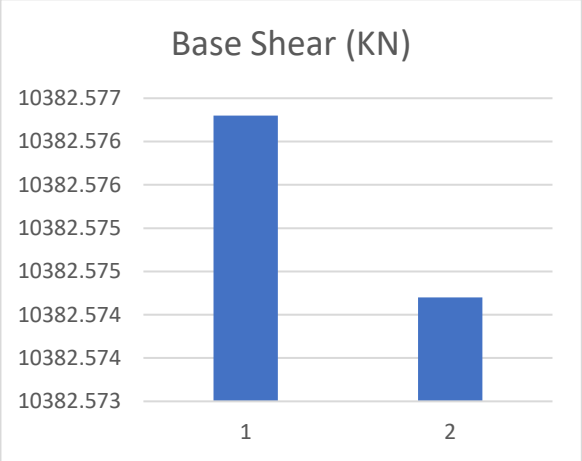
Maximum Storey Acceleration of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Maximum Storey Acceleration of 3.5 Degree for RCC & Twisted Building of G+35 Building

Base Shear of 3.5 Degree for RCC & Twisted Building of G+35 Building

Table: Base Shear of 3.5 Degree for RCC & Twisted Building of G+35 Building

Twisted Building		
Direction	**Time Period**	**Base Shear**
EQX	4.294	10382.58
EQY	5.736	10382.58
Normal Building		
Direction	**Time Period**	**Base Shear**
EQX	4.289	10382.57
EQY	5.707	10382.57



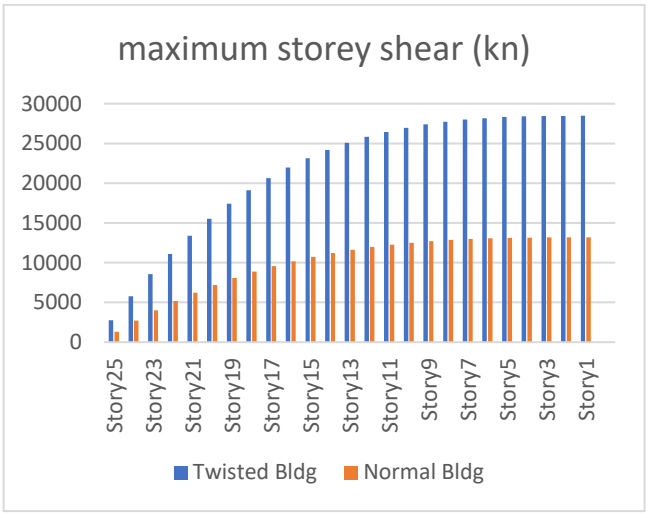
Graph: Base Shear of 3.5 Degree for RCC & Twisted Building of G+35 Building

Results & Discussion of American Code Design of RCC & Twisted Building

Maximum Storey Shear of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Table: Maximum Storey Shear of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Maximum Storey Shear (Kn)		
Storey	**Twisted Building**	**Normal Building**
Story25	2752.1406	1316.2204
Story24	5776.2673	2712.3258
Story23	8553.6338	3994.5129
Story22	11094.7403	5167.6293
Story21	13410.0874	6236.5225
Story20	15510.1754	7206.0401
Story19	17405.5049	8081.0298
Story18	19106.5762	8866.3391
Story17	20623.8898	9566.8156
Story16	21967.9462	10187.3069
Story15	23149.2457	10732.6606
Story14	24178.2888	11207.7242
Story13	25065.576	11617.3454
Story12	25821.6077	11966.3718
Story11	26456.8843	12259.6509
Story10	26981.9064	12502.0303
Story9	27407.1869	12698.3576
Story8	27743.201	12853.4804
Story7	28000.4618	12972.2464
Story6	28189.4697	13059.5029
Story5	28320.7252	13120.0978
Story4	28404.7288	13158.8785
Story3	28451.9807	13180.6927
Story2	28472.9816	13190.3878
Story1	28478.2176	13192.8116
Base	0	0

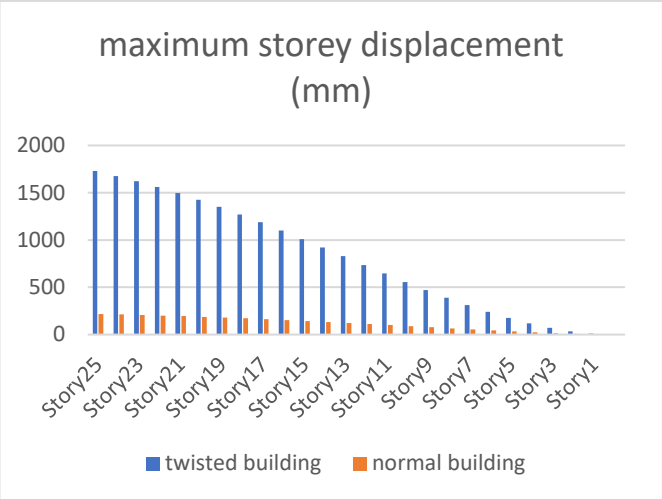


Graph: Maximum Storey Shear of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Maximum Displacement of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Table: Maximum Displacement of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Maximum Storey Displacement (Mm)		
Storey	**Twisted Building**	**Normal Building**
Story25	1728.986	216.986
Story24	1676.324	212.222
Story23	1620.454	207.054
Story22	1560.191	201.322
Story21	1495.108	194.944
Story20	1424.918	187.894
Story19	1349.891	180.181
Story18	1270.311	171.833
Story17	1186.752	162.896
Story16	1099.95	153.423
Story15	1010.661	143.473
Story14	919.761	133.109
Story13	828.004	122.397
Story12	736.292	111.403
Story11	645.593	100.198
Story10	556.845	88.855
Story9	470.92	77.456
Story8	388.789	66.09
Story7	311.506	54.866
Story6	239.927	43.918
Story5	175.048	33.419
Story4	118.261	23.603
Story3	70.602	14.785
Story2	33.587	7.405
Story1	9.72	2.144
Base	0	0

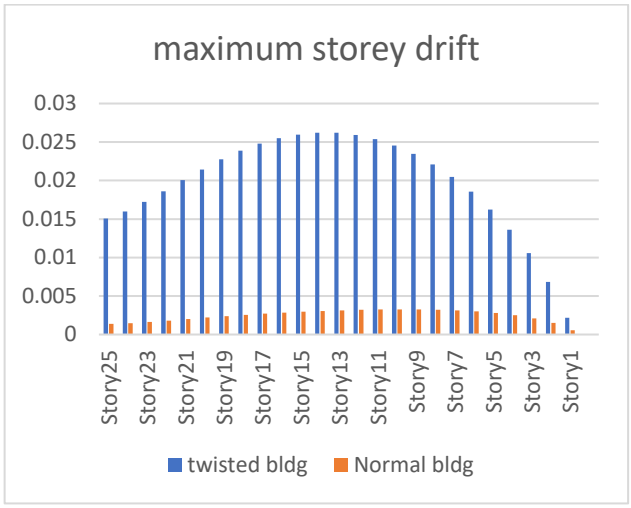


Graph: Maximum Displacement of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Maximum Storey Drift of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Table: Maximum Storey Drift of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

Maximum Storey Drift		
Storey	Twisted Building	Normal Building
Story25	0.015046	0.001396
Story24	0.015963	0.001477
Story23	0.017218	0.001639
Story22	0.018595	0.001823
Story21	0.020054	0.002014
Story20	0.021437	0.002204
Story19	0.022737	0.002385
Story18	0.023874	0.002554
Story17	0.024801	0.002707
Story16	0.025511	0.002843
Story15	0.025971	0.002961
Story14	0.026216	0.003061
Story13	0.026203	0.003141
Story12	0.025914	0.003202
Story11	0.025356	0.003241
Story10	0.02455	0.003257
Story9	0.023466	0.003247
Story8	0.022081	0.003207
Story7	0.020451	0.003128
Story6	0.018537	0.003
Story5	0.016225	0.002805
Story4	0.013617	0.00252
Story3	0.010576	0.002109
Story2	0.006819	0.001517
Story1	0.002182	0.000538
Base	0	0



Graph: Maximum Storey Drift of 1.5 Degree for RCC & Twisted Building of G+25 Building by American Code

CONCLUSION

1) When the rotation of the structure is increases then the base shear is also increasing the total 3.5D structure base is higher than the remaining the structure. The base shear is 5% to 15% increases as compare to the other structure.
2) The maximum storey acceleration of the structure is 1.5D is increased by 14 %, 14.05%, 8%, and 16% as compared to the 2D, 2.5D, 3D and 3.5D when we decreases the twisted angle then the acceleration is increases.
3) The Storey Stiffness 2.5D is increases by 6-7% around but 1.5D is decreasing by 66% around means when we increase the twist angle of floor then the Stiffness also increases.
4) The overturning moment effect of the all structure all near about the same the only 1-2% slightly increases 2.5D structure. Means no effect of floor rotation on the moment. It was increases when increases the storey height.
5) The maximum storey displacement of the structure 2.5D is increase 6% as compared to other type of structure all around displace nearly same means when we twisted the floor displacement is decreases.
6) When we increase the rotation of the floor then the modal time period is also decreases
7) The maximum storey acceleration of the structure is 1.5D is increased by 2 %, 1.5%, 3%, and 1.8% as compared to the 2D, 2.5D, 3D and 3.5D when we decrease the twisted angle then the acceleration is increases.
8) storey stiffness is for 1.5D Is increasing by 43 %, 35%, 33.5% and 26.4% as compare to the 2D, 2.5D, 3D and 3.5D model
9) The overturning moment is for 1.5D is increasing by 41 %, 33.4%, 31.5% and 24.4% as compare to the 2D, 2.5D, 3D and 3.5D model.
10) The maximum storey displacement of the structure 2.0D is increase 6% as compared to other type of structure but only 10% 1.5D type of structure. the displacement is varying for floor to floor.
11) When the rotation of the structure is increases then the base shear is also increasing the total 3.5D structure base is higher than the remaining the structure. The base shear is 4% to 12% increases as compare to the other structure.
12) When we increase the rotation of the floor then the modal time period is also decreases

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