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"ANALYSIS AND DESIGN OF RCC TWISTED BUILDING USING ETAB SOFTWARE"

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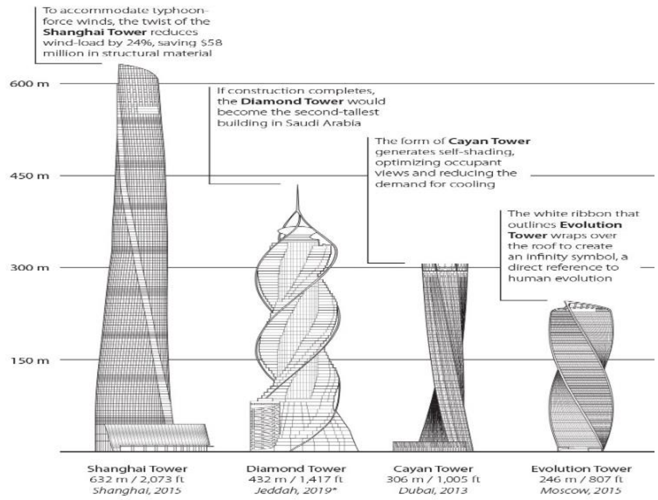
Abstract: this paper represents the structural behaviour of RCC twisted building subjected to seismic loads with the high rise twisted building using ETab. In a twisted tall building various rate of twist and for RCC twisted building will be analyzed. The different rate of twist 1.5, 3.5 degree per floor for twisted building are considered. The modelling and analysis will be done using ETab Results obtained will be plotted for parameters such as storey displacement, storey drift and base shear. The aim of this project is to achieve the optimum angle of twist of twisted building for 1.5, 3.5 degree per floor angle of twist for different storey.

***Keywords* – Twisted Building, ETab, Seismic Analysis, RCC**

I. INTRODUCTION

An earthquake is a natural tragedy that has claimed millions of lives throughout known and unwritten historey. 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.



Twisted Structure

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.
- 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 of RCC twisted buildings under seismic loads."

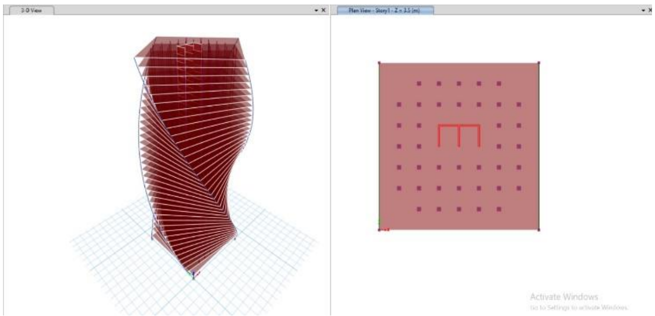
Objectives

- Comparatively Study Design and analysis of RCC twisted building for G+40, by using ETAB.
- To Design RCC twisted building for 1.5, 3.5 degree per floor angle of twist for G+40 Storey.
- To Evaluate RCC twisted building for different parameters on alternate floor
- To find the parameters such as storey displacement, storey drift and base shear etc.

II. RESEARCH METHODOLOGY

a) Static Analysis :
   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.
b) 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+40 buildings and each building has given angle of twist.
   For modeling and analysis of buildings ETab will be used.

The parameters storey displacement, storey drift and base shear will be checked and their graphical



representation will be made.

Centre Line Diagram

III. METHODS OF ANALYSIS

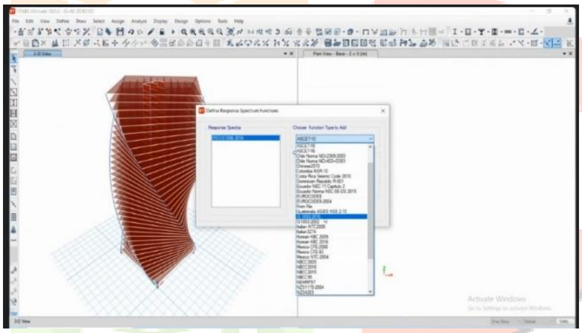
Two types of analysis

1) LINEAR STATIC (not applicable for high rise)
2) LINEAR DYNAMIC (applicable for high rise structure)

- INPUT DATA IN SOFTWARE
- FOCUSES ON 3 PARAMETERS

i. IS CODE 1893-2016

ii. SEISMIC ZONE – III

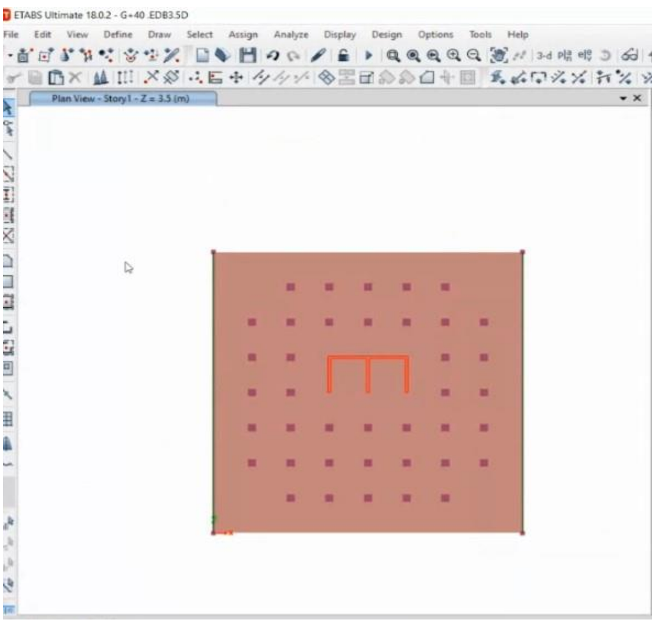


iii. SOIL TYPE – II

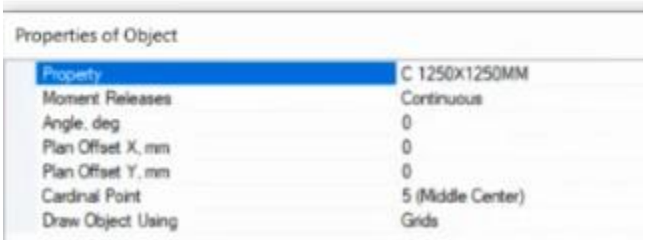
Response Spectrum Function

IV. MODEL DESIGNING

- DESIGN BASE
- ASSIGN LOAD ON SLAB

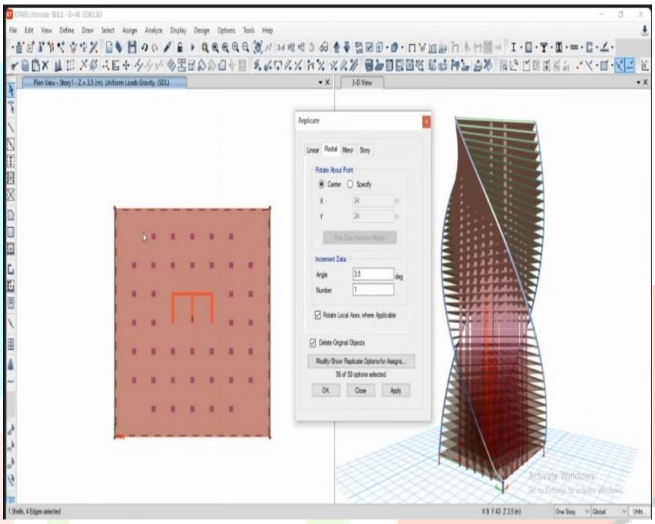


Design of Base



Design Column

Design Beam



ROTATION OF FLOOR

ANALYSIS FOR G+40 STOREY BUILDING

TABLE 1 MAXIMUM STOREY DISPLACEMENT (MM)

STOREY	1.5D	3.5D
Storey40	162.125	150.672
Storey39	155.443	148.138
Storey38	154.632	145.529
Storey37	153.532	142.762
Storey36	151.737	139.84
Storey35	146.65	136.758
Storey35	143.408	133.502
Storey34	142.454	130.073
Storey33	137.486	126.484
Storey32	133.301	122.753
Storey31	130.186	118.888
Storey30	129.735	115.34
Storey29	124.323	111.951
Storey28	121.759	108.433
Storey27	117.928	104.783
Storey26	113.998	101.004
Storey25	109.918	97.099
Storey24	105.68	93.069

Storey23	101.288	88.919
Storey22	96.744	84.648
Storey21	92.046	80.266
Storey20	87.211	76.137
Storey19	82.236	71.991
Storey18	77.132	67.788
Storey17	71.908	63.514
Storey16	66.566	59.171
Storey15	61.132	54.751
Storey14	57.65	52.748
Storey13	55.633	50.239
Storey12	49.097	45.644
Storey11	43.548	40.961
Storey10	36.991	36.219
Storey9	32.521	31.443
Storey8	28.143	26.684
Storey7	22.94	21.975
Storey6	17.999	17.389
Storey5	12.44	13.369
Storey4	9.277	9.087
Storey3	5.562	5.421
Storey2	2.655	2.793
Storey1	1.518	2.127
Base	0	0

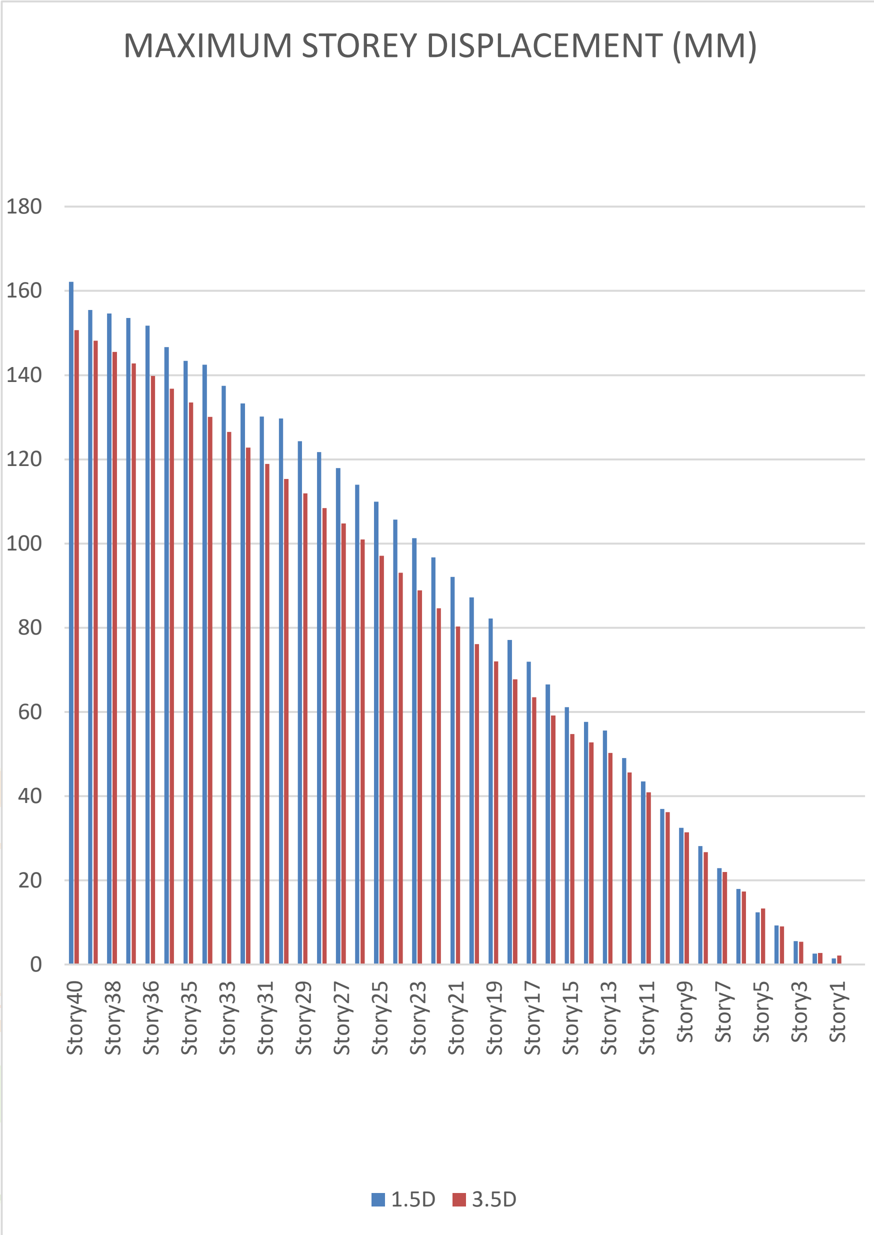
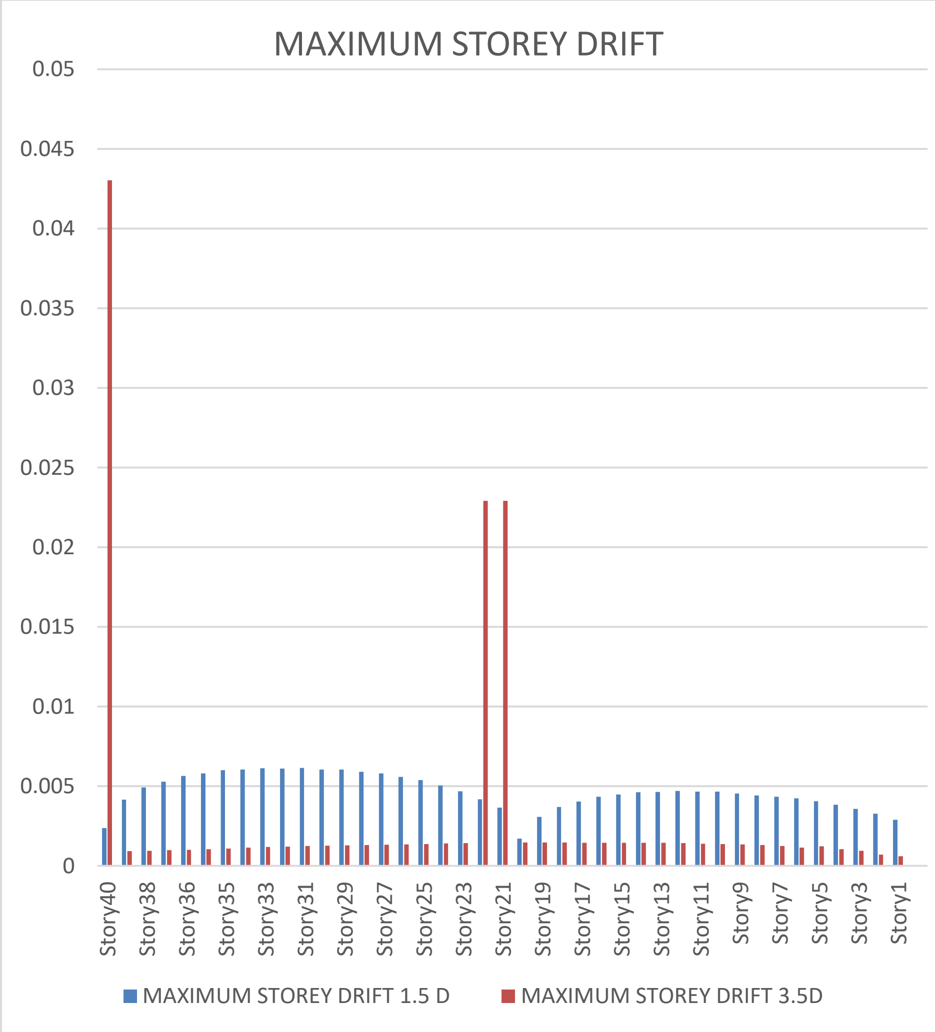


TABLE 2 MAXIMUM STOREY DRIFT

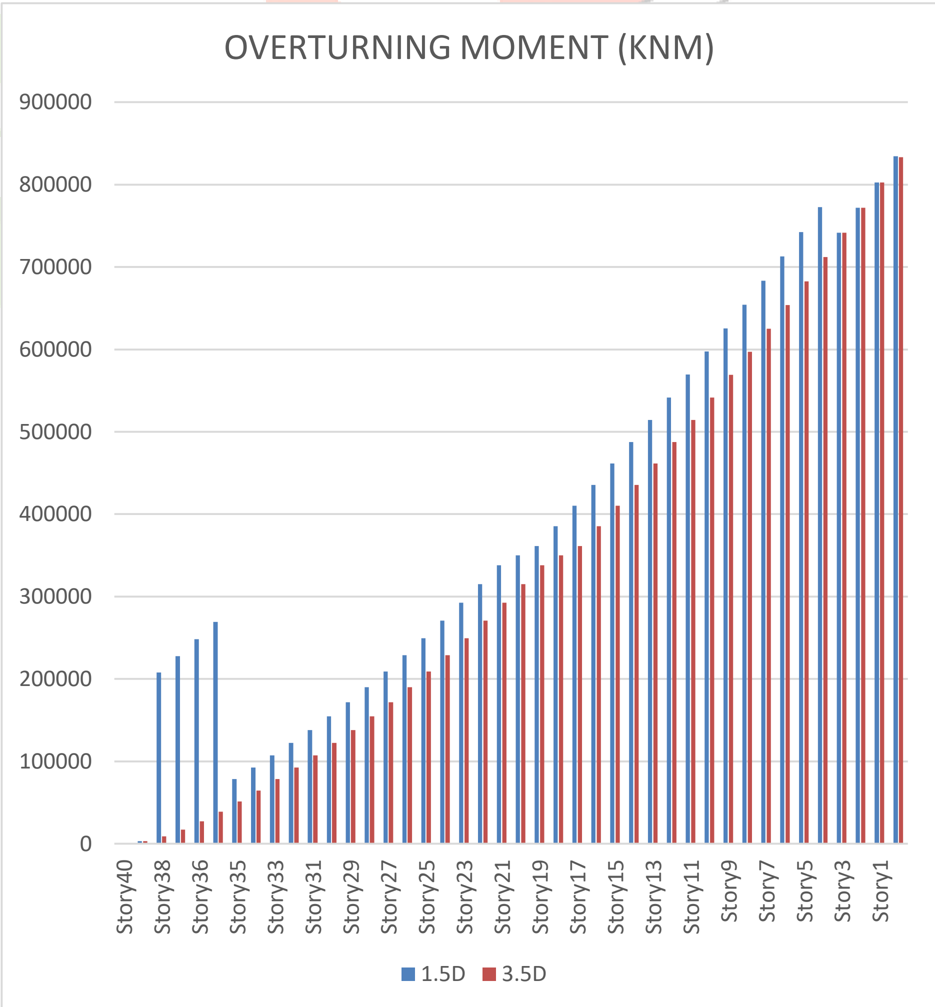


STOREY	1.5 D	3.5D
Storey40	0.002378	0.043048
Storey39	0.004171	0.000923
Storey38	0.004922	0.000959
Storey37	0.005282	0.000989
Storey36	0.005646	0.001018
Storey35	0.005807	0.001046
Storey35	0.006017	0.001099
Storey34	0.006044	0.001146
Storey33	0.006141	0.001187
Storey32	0.006111	0.001223
Storey31	0.006144	0.001254
Storey30	0.006059	0.001283
Storey29	0.006046	0.0013
Storey28	0.005913	0.001317
Storey27	0.005809	0.001329
Storey26	0.005599	0.00135
Storey25	0.005385	0.00138
Storey24	0.005051	0.001404
Storey23	0.004679	0.001425
Storey22	0.004179	0.022923
Storey21	0.003654	0.022923
Storey20	0.001712	0.001467
Storey19	0.003082	0.001472

Storey18	0.003694	0.001471
Storey17	0.004054	0.001458
Storey16	0.004351	0.001454
Storey15	0.004494	0.001463
Storey14	0.00463	0.001463
Storey13	0.004653	0.001452
Storey12	0.004704	0.00143
Storey11	0.00467	0.001393
Storey10	0.004659	0.001367
Storey9	0.00454	0.00135
Storey8	0.004425	0.001313
Storey7	0.004345	0.001245
Storey6	0.004255	0.001149
Storey5	0.004057	0.001225
Storey4	0.003847	0.001048
Storey3	0.003575	0.000946
Storey2	0.003274	0.000715
Storey1	0.002909	0.000608
Base	0	0

TABLE 3 OVERTURNING MOMENT (KNM)

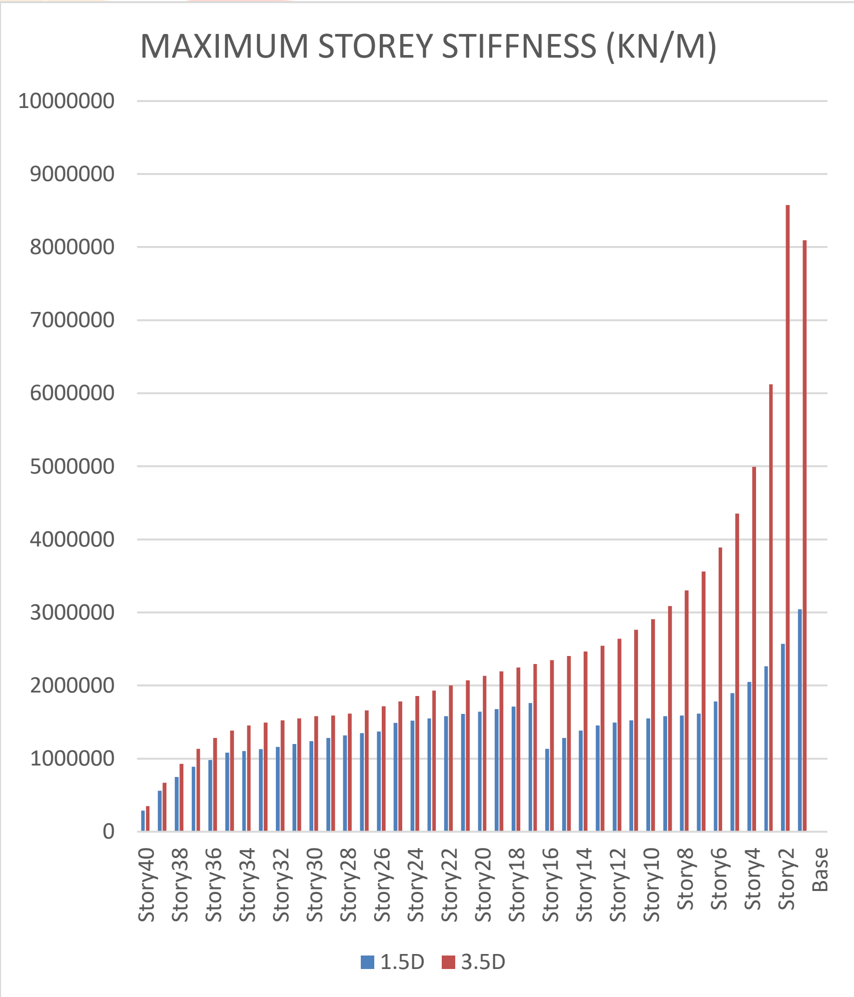
STOREY	1.5D	3.5D
Storey40	0	0
Storey39	2960.486	2980.6788
Storey38	207733.6	8877.8783
Storey37	227549	17157.2645
Storey36	248115.3	27303.6964
Storey35	269364	38847.8813
Storey35	78379.15	51392.4364
Storey34	92542.66	64634.3561
Storey33	107138.1	78379.1479
Storey32	122249.1	92542.6579
Storey31	137994	107138.099
Storey30	154488.1	122249.148
Storey29	171814.2	137993.996
Storey28	190006.2	154488.1
Storey27	209048	171814.23
Storey26	228886.3	190006.151
Storey25	249449.9	209047.96
Storey24	270669.3	228886.322
Storey23	292492.3	249449.883
Storey22	314890.9	270669.28
Storey21	337859.7	292492.287
Storey20	349872.2	314890.902
Storey19	361407.3	337859.724
Storey18	385544.2	349872.2
Storey17	410270.9	361407.347



Storey16	435570.4	385544.202
Storey15	461406.9	410270.862
Storey14	487730.2	435570.398
Storey13	514444.1	461406.877
Storey12	541730.1	487730.175
Storey11	569357.7	514485.404
Storey10	597312.8	541624.031
Storey9	625601.7	569113.375
Storey8	654245.7	596941.8
Storey7	683270.5	625118.16
Storey6	712695.7	653665.616
Storey5	742525.4	682611.577
Storey4	772744	711976.455
Storey3	741764.7	741764.677
Storey2	771959.9	771959.94
Storey1	802527.1	802527.083
Base	834486.6	833428.858

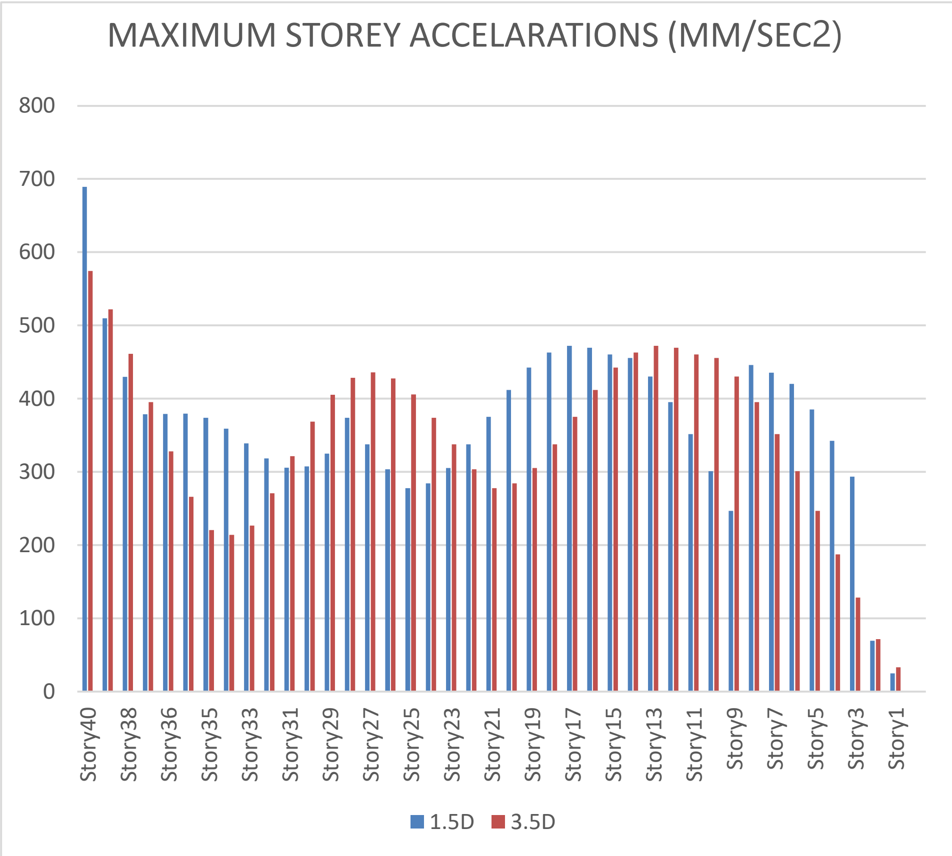
TABLE 4 MAXIMUM STOREY STIFFNESS (KN/M)

STOREY	1.5D	3.5D
Storey40	287158.08	348691.845
Storey39	560721.497	671650.784
Storey38	747921.316	929913.983
Storey37	888356.067	1131652.505
Storey36	979123.862	1280992.007
Storey35	1079111.621	1385371.433
Storey34	1104453.558	1452667.107
Storey33	1130033.346	1494472.066
Storey32	1161037.127	1524389.027
Storey31	1198247.724	1551034.301
Storey30	1239115.005	1578846.675
Storey29	1281393.026	1589231.242
Storey28	1319428.848	1614544.45
Storey27	1349169.257	1657695.595
Storey26	1371685.252	1716674.364
Storey25	1490041.254	1783329.638
Storey24	1519519.535	1855514.744
Storey23	1550386.024	1929824.119
Storey22	1580923.599	2001801.857
Storey21	1611729.281	2070544.725
Storey20	1642748.988	2134306.071
Storey19	1674811.262	2191713.209
Storey18	1712326.598	2244583.484
Storey17	1759957.185	2295294.048
Storey16	1131652.505	2346203.322
Storey15	1280992.007	2402162.127
Storey14	1385371.433	2465653.332
Storey13	1452667.107	2544076.723
Storey12	1494472.066	2641581.695



Storey11	1524389.027	2760971.254
Storey10	1551034.301	2906892.473
Storey9	1578846.675	3086398.385
Storey8	1589231.242	3300603.981
Storey7	1614544.45	3559725.82
Storey6	1783102.248	3889068.083
Storey5	1896184.231	4351884.545
Storey4	2051195.722	4993396.758
Storey3	2265177.447	6122139.692
Storey2	2568951.444	8574127.417
Storey1	3044506.349	8091486.113
Base	0	0

TABLE 5 MAXIMUM STOREY ACCELRATIONS(MM/SEC2)



STOREY	1.5D	3.5D
Storey40	689.41	574.39
Storey39	509.78	521.9
Storey38	429.78	461.33
Storey37	378.67	395.27
Storey36	379.07	327.91
Storey35	379.37	265.93
Storey35	373.84	220.27
Storey34	359.08	214.1
Storey33	338.73	226.54
Storey32	318.53	270.57
Storey31	305.87	321.44
Storey30	307.3	368.6

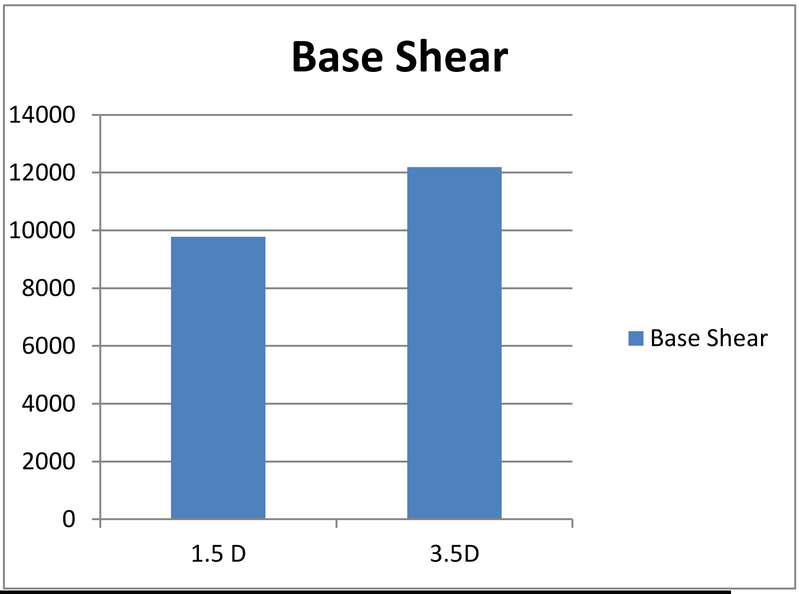
Storey29	324.75	405.41
Storey28	373.75	428.4
Storey27	337.49	435.73
Storey26	303.27	427.48
Storey25	277.76	405.55
Storey24	284.31	373.75
Storey23	305.31	337.49
Storey22	337.7	303.27
Storey21	375.34	277.76
Storey20	411.97	284.31
Storey19	442.34	305.31
Storey18	463.05	337.7
Storey17	472.34	375.34
Storey16	469.72	411.97
Storey15	460.25	442.34
Storey14	455.41	463.05
Storey13	430.26	472.34
Storey12	395.12	469.72
Storey11	351.66	460.25
Storey10	301.08	455.41
Storey9	246.87	430.26
Storey8	445.87	395.12
Storey7	435.25	351.66
Storey6	420.08	301.08
Storey5	385.26	246.87
Storey4	342.54	187.14
Storey3	293.4	128.18
Storey2	69.21	71.61
Storey1	24.69	33.1
Base	0	0

TABLE 6 BASE SHEAR

MODEL 1.5 D		
EQX		
	TIME PERIOD (SEC)	BASE SHEAR (KN)
	3.285	9776
EQY		
	TIME PERIOD (SEC)	BASE SHEAR (KN)
	4.279	9776

Twist	Base Shear
1.5 D	9776
3.5D	12189.33

MODEL 3.5D		
EQX		
	TIME PERIOD (SEC)	BASE SHEAR (KN)
	5.058	12189.3381
EQY		
	TIME PERIOD (SEC)	BASE SHEAR (KN)
	5.907	12189.3381



V. 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 decrease 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.

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