ISSN No:-2456-2165

Review Study on Seismic Analysis of High-rise Building by Using Software

Nasim khan[1*], Assistant Professor, Civil Engineering Department, Mewat Engineering College Wakf, palla, Nuh, Haryana – 122107 India.
Sultana[2] , Assistant Professor, Mechanical Engineering Department, Mewat Engineering College Wakf, palla, Nuh, Haryana – 122107 India.

Abstract:- This paper tends to the Case study on seismic investigation of elevated structure framework (Ground+ 3Basements+50) story RCC by STAAD pro v8i with use of Indian standard provision. One of the most alarming and ruinous marvels of a nature is a serious tremor and it awful delayed consequence. It is profoundly difficult to forestall an earth shake from happening, however the harm to the structures can be controlled through appropriate plan and enumerating. Henceforth it is required to do the seismic investigation and plan to structures against breakdown. Planning a structure so that harm during seismic effects makes the structure very uneconomical, as the earth shake may or probably won't happen in its life time and is an uncommon wonder. This investigation essentially on to understanding the outcomes from STAAD Pro v8i software under gravity loads arrangement made in IS 456:2000, Results will fulfill the general rules from being a disappointment after examination Results to improve the accuracy according to IS code 1893 : 2002.

Keywords:- *High Rise Building, STAAD, Seismic analysis, Dynamic etc.*

I. INTRODUCTION

High-rise buildings are constructed everywhere in the world. The height and Size of high-rise buildings gets larger and larger. The auxiliary structure of elevated structures relies upon dynamic investigation for winds and earthquakes. Since today execution of Performance of Computer progress remarkably, practically auxiliary originators utilize the product of PC for the basic structure of elevated structures. Subsequently, after that the basic plane and blueprint of elevated structures are resolved, the auxiliary plan of tall structures which checks basic well being for the individual basic individuals isn't important remarkable basic capacity by the utilization of basic programming available. In any case, it isn't distortion to state that the exhibition of tall structures is nearly decided in the primary plan stages which take a shot at multifaceted assessments of the auxiliary structure and layout.

Traditionally, seismic plan approaches are expressed, as the structure ought to have the option to guarantee the minor and continuous shaking force without supporting any harm, in this way leaving the structure functional after the occasion. The structure ought to withstand moderate degree of tremor ground movement without auxiliary harm, yet perhaps with some basic just as non-basic harm. This breaking point state may relate to seismic tremor power equivalent to the most grounded either experienced or gauge at the site. In present investigation the impact of exposed casing, support casing and shear divider outline is concentrated under the quake stacking. The outcomes are read for reaction range technique. The primary parameters considered in this investigation to think about the seismic exhibition of various models are story float, base shear, story avoidance and time period.

II. OBJECTIVES OF THE WORK

- The main objective of high rise structure to analyze the building as per IS Code 1893-2002 part- I criteria for earthquake resistant structure.
- Dynamic analysis of building by using response spectrum method.
- Building with different lateral stiffness systems.
- To get economical and efficient lateral stiffness system.
- To control the future population.
- To deal with energy and environmental challenges.
- Development of a city.

III. SCOPE OF THE WORK

Recently there has been a considerable increase in the number of tall buildings, both residential and commercial, and the modern trend is towards taller structures. Thus the effects of lateral loads like winds loads, earthquake forces are attaining increasing importance and almost every designer is faced with the problem of providing adequate strength and stability against lateral loads. This reason to estimate wind load and earthquake loading on high-rise building design.

- Considering the regularly expanding populace just as restricted space, flat extension is not any more a practical arrangement particularly in metropolitan urban communities. There is sufficient innovation to construct super-tall structures today, however in India we are yet to find the innovation which is now settled in different pieces of the world.

- Many times, wind designing is being misconstrued as wind vitality in India. Then again, wind designing is extraordinary piece of building where the effect of wind on structures and its condition being considered. All the more explicitly identified with structures, wind stacks on claddings are required for the choice of the cladding frameworks and wind stacks on the auxiliary edges are

ISSN No:-2456-2165

required for the plan of bars, segments, horizontal supporting and establishments. Wind as a rule administers the structure

IV. METHODOLOGY

A. Framing of plan:-

Plan that will require in order to analyze the respective structure as for understanding the result properly as height goes above further practices create complications for that proper bifer-fication is necessary with proper practices.

B. Input loading :-

Dead load and live loads (AS Per IS 875 PART II , IS 1893:2002)

Load description value/units

Superimposed load on each floor

- Live load 2 KN /M^2
- 230mm thickness external wall 13.12KN/M
- 115 mm thickness internal wall 6.6 KN/M

Additional service load over roof top

- Water proofing l 3 KN /M^2
- Live load 2 KN /M^2
- Service load 5 KN /M^2

Material properties

Concrete	M40 N/MM^2
Steel	500 N/MM^2
Concrete density	25, KN/ M^3
Brick work	22 KN/ M^3

Load combination will be as per IS 1893:2002 PART 1

For general RCC purpose will be as per IS 456:2000

(G + 3B + 50)
Fig 1:- Key Plan

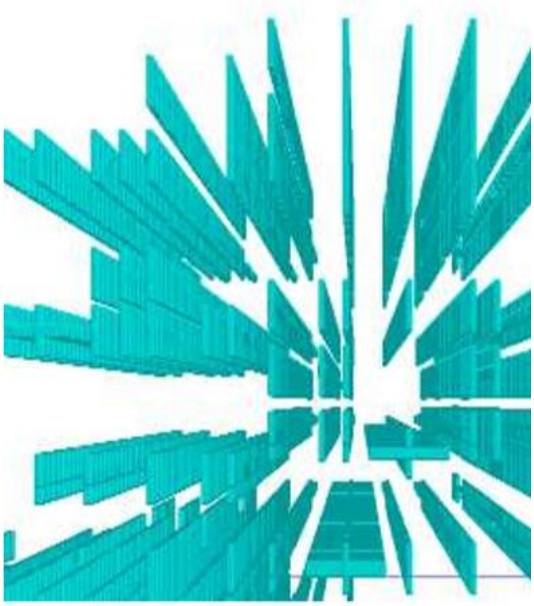

Fig 2:- Long Walls

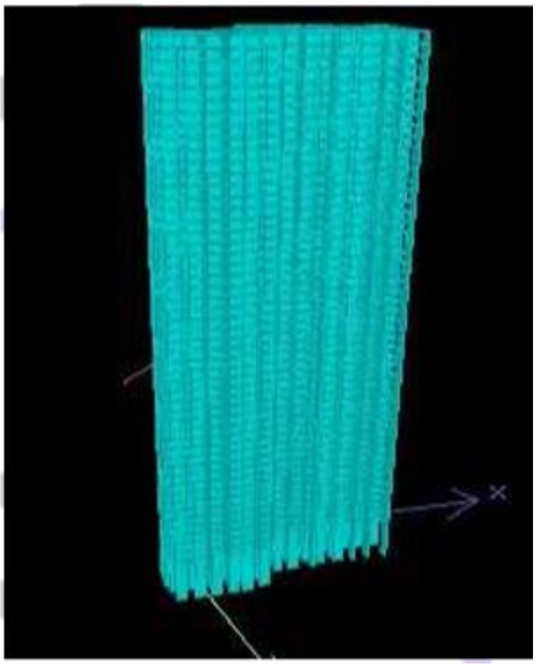

Fig 3:- Model

ISSN No:-2456-2165

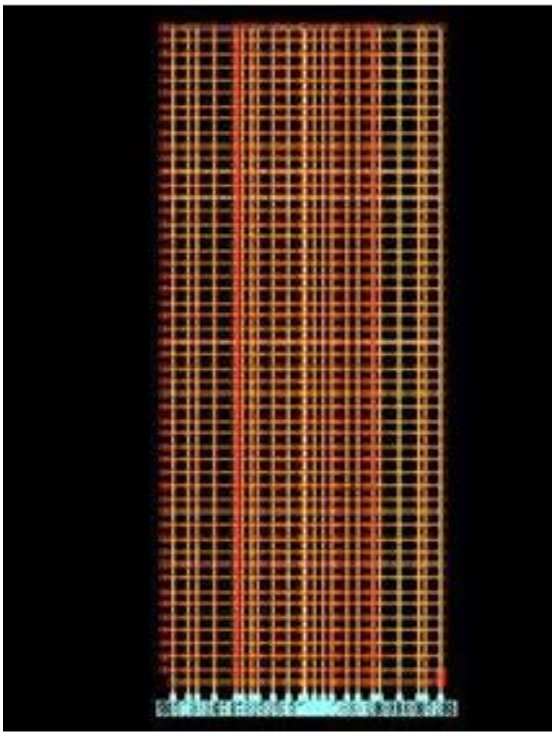

Fig 4:- Skeletal Structure

SITE DETAILS :
Seismic zone: - 4 (as per IS 1893:2002 fifth revision)
City: - Mumbai, Maharashtra region
Floor height = 3m

Load combinations that been considered as per

IS 1893 :2002 PART 1

- 1.5 (DL + LL)
- 1.2 (DL + LL + EQ X)
- 1.2 (DL + LL - EQ X)
- 1.2 (DL + LL + EQ Z)
- 1.2 (DL + LL - EQ Z)
- 1.5(DL - EX)
- 1.5 (DL + EQ X)
- 1.5 (DL + EQ Z)
- 1.5 (DL - EQ Z)
- 0.9 DL + 1.5 EQ X
- 0.9 DL - 1.5 EQ X
- 0.9 DL +1.5 EQ Z
- 0.9 DL -1.5 EQ Z

Reaction will be consider for worse load combination in analysis while designing vertical structural member (column / shear wall).

- Calculations:- As per clause 7.8.1 Dynamic analysis shall be performed to obtain the design seismic force, and its distribution to different levels along the height of the building and to the various lateral load resisting elements, for the following buildings:

- In this examination, G+3B+50 celebrated RC Building has been broke down utilizing the reaction spectra strategy in STAAD-Pro. The arrangement and height of the structure taken for investigation is appeared in above pictures. In the tremor investigation alongside seismic tremor loads, vertical burdens are likewise applied. For the tremor investigation, IS 1893-2002 code was utilized .The complete structure seismic base shear (V_b) along any important course will be dictated by duplicating the plan level speeding up the thought about way of vibration (A_h) and the seismic load of the structure.

The Design base shear

(V_b) = $\mathbf{A_h}$ x **W** [IS 1893(Part I):2002, clause

7.5.3]

A_h = design horizontal acceleration in the considered direction of vibration

= **(Z/2)** x **(I/R)** x **(S_a /g)**

[IS 1893(Part I):2002, clause **6.4.2**]

W = total seismic load of the building The design base shear (V_b) computed shall be distributed along the height of the building as per the following expression
(BIS1893: 2000).

$$Q_i = V_B \frac{W_i h_i^2}{\sum_{j=1}^{n} W_j h_j^2}$$

[IS 1893(Part I):2002, clause **7.1.1**]
Where, Qi is the design lateral forces at floor i,
Wi is the seismic weights of the floor i, and
Hi is the height of the floor i, measured from base
Design seismic load

The approximate fundamental natural period of vibration (Ta), in seconds, of all other buildings, Including moment-resisting frame buildings with brick infill panels, may be estimated by empirical expression:

Ta = **0.09 h /√d**
[IS 1893(Part I):2002, clause **7.6.2**]

Calculating value.
In X direction for, Ta (d= 53.09 meter)
Ta = 0.09 x 150 / √53.09 = 1.852 seconds
In Z direction for, Ta (d= 20.65 meter)
Ta = 0.09 x 150 / √20.65 = 2.970 seconds

Now,
Zone factor, Z = **0.24** for seismic zone IV
[IS 1893(Part):2002, table 2]
Importance factor, I = **1.0** table 6
Response reduction factor, R = **5.0** (SMRF – special moment resisting frame)
Soil type = medium soil
Damping % ratio = **5** % (assume)

For Sa/g value,
1.36 / Ta(X direction)= 1.36 /1.852 = **0.734** seconds
1.36 / Ta(X direction)= 1.36 /2.970 = **0.457** seconds
Value of Ah from above expression could
we get
A_h = 0.0176 (In x direction)
A_h = 0.0109 (In z direction)
Therefore,
W = 100 % DL + 25 % LL
Seismic load on building
W = 680245.43 **KN**

Then,
V_b = Ah x Ws
base shear

V_b = (Z/2) x (I/R) x (Sa /g) x W
= 0.0176 x 680245.43

= 11972.31 KN (x direction)
and
V_b = (Z/2) x (I/R) x (Sa /g) x W

= 0.0109 x 680245.4 = 7414.67 KN
(z direction)

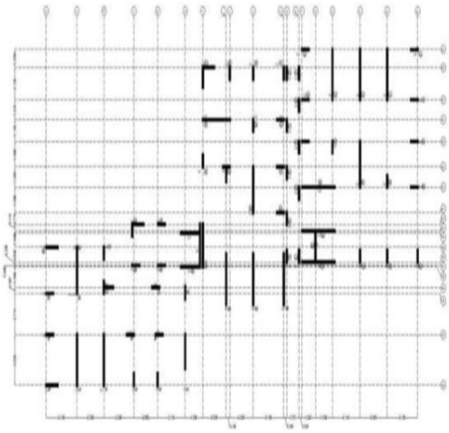

Fig 5:- Centre Line Plan

V. RESULT

Storey	level In meter	peak storey
	X	Z (KN)
50	135.00	2641.02
49	132.00	3022.15
48	129.00	3384.17
47	126.00	3726.52
46	126.00	4048.79
45	120.00	4350.69
44	117.00	4632.07
43	114.00	4892.92
42	111.00	5133.41
41	108.00	5353.86
40	105.00	555.78
39	102.00	5728.22
38	99.00	5877.05
37	96.00	6008.20
36	93.00	6127.74
35	90.00	6241.24
34	87.00	6342.33
33	84.00	6432.74
32	81.00	6514.33
31	78.00	6589.09
30	75.00	6659.11
29	72.00	6726.52
28	69.00	6793.46
27	66.00	6862.03
26	63.00	6934.25
25	60.00	7011.99
24	57.00	7096.92

23	54.00	7190.49
22	51.00	7293.82
21	48.00	7407.75
20	45.00	7532.77
19	42.00	7669.01
18	39.00	7816.30
17	36.00	7971.29
16	33.00	8124.29
15	30.00	82889.90
14	27.00	8459.73
13	24.00	8631.56
12	21.00	8805.92
11	18.00	8988.71
10	15.00	9204.20
9	12.00	9445.12
8	9.00	9660.52
7	6.00	9848.16
6	3.00	10004.57
5	0.00	10176.66
4	-2.80	10242.28
3	-5.20	10288.33
2	-8.40	10316.23
1	--11.20	10326.39
Base	-14.20	10326.45

Table 1:- (per story shear)

Calculated frequency for first 6 modes that software just calculated as below

MODE	FREQUENCY (CYCLES/SEC)	PERIOD (SEC)	ACCURACY
1	0.137	7.31097	1.052E-15
2	0.176	5.67043	4.919E-14
3	0.192	5.20709	7.145E-13
4	0.252	3.96507	9.393E-12
5	0.475	2.10445	9.292E-08
6	0.536	1.86628	3.691E-07

Table 2

Modal mass participation in % (after the iteration of 300) Mass participation factors in percent, base shear in **KN.**

MODE	X	Y	Z	SUMM-X	SUMM-Y	SUMM-Z	X	Y	Z
1	19.51	0.00	47.34	20.511	0.001	47.343	2598.31	0.00	2160.26
2	48.24	0.00	23.18	70.747	0.002	70.521	8282.11	0.00	6890.74
3	8.49	0.00	0.14	79.237	0.005	70.656	1587.57	0.00	1319.7
4	0.04	0.00	0.12	79.275	0.005	70.777	9.330	0.00	0.00
5	0.05	0.00	0.16	86.324	0.006	70.940	22.70	0.00	0.00
6	10.28	0.00	2.27	90.606	0.007	73.215	5363.64	0.00	4882.47

Table 3

As per clause **7.8.2** [IS 1893:2002] the base shear (V_b) from response spectrum is less than the base shear (v_b) calculated by using empirical formula for fundamental time period multiplying factor are :-

(v_b/V_b) = 11973 / 5363.64 = 2.23 (X direction)
(v_b/V_b) = 7414 / 4882.47 = 1.51 (Z direction)

ISSN No:-2456-2165

Seismic weight of general model in dynamic equilibrium is as follows

Modal Weight (Modal Mass Times G) In **KN**

MODE	X	Y	Z	WEIGHT
1	2.7935557E+04	1.246851E+04	6.955578E+04	3.547164E+04
2	6.906343E+04	1.477191E+00	3.405194E+04	5.662841E+04
3	1.215680E+04	4.435340E+00	1.985320E+02	1.762951E+04
4	5.438716E+01	2.710154E-02	1.776414E+02	7.870725E+03
5	7.024110E+01	1.092947E+00	2.394500E+02	9.778552E+03
6	1.472071E+04	1.458399E+00	3.342232E+03	3.559350E+04

Table 4

Reactions (for the worse condition):-

Node no.	Horizontal	Vertical	Horizontal		Moments	
	Fx (KN)	Fy (KN)	Fz (KN)	Mx (KNm)	My (KNm)	Mz (KNm)
2281	7.961	12304.34	-3.174	-4.583	-2.508	-109.305
2283	18.714	11577.60	-3.242	-4.649	-1.588	-98.865
2284	21.285	6311.45	7.722	9.179	-2.764	-28.69
2286	-18.622	24123.53	24.408	1627.67	-15.563	29.615
2288	17.532	5060.89	-53.261	-85.78	-1.852	-24.785
2289	-2.354	3538.27	3.953	6.163	2.429	-2.980
2290	-51.462	22469.22	133.69	1915.41	3.366	70.053
2292	-13.191	5296.45	-32.64	-48.644	-5.586	19.151
2293	-52.165	25333.32	156.109	2501.09	-0.206	72.573
2294	0.521	4261.33	5.543	8.340	-1.842	-5.756
2295	-140.58	6585.29	-15.231	-21.05	-6.280	148.623
2296	-67.65	6182.57	-16.105	-22.00	-2.109	60.226
2297	5.349	25926.83	1.203	573.703	-6.520	-19.232
2298	3.860	4250.38	0.227	0.573	-0.402	-10.310
2299	31.793	11349.34	-3.686	-5.101	-2.428	-96.835
2300	-52.947	9602.35	-4.357	-5.791	-3.005	84.220
2301	46.21	5741.500	-8.880	-7.262	5.227	-54.238
2302	25.276	26577.57	90.745	4164.70	12.417	-44.681
2303	-9.666	5417.820	-64.271	-95.598	-0.656	15.188
2304	-1.271	11082	-185.99	-219.350	1.027	-7.317
2305	4.686	5040.667	-0.450	2.526	-2.392	-12.208
2303	-9.666	5417.820	-64.271	-95.598	-0.656	15.188
2304	-1.271	11082.055	-185.992	-219.350	1.027	-7.317
2305	4.686	5040.66	-0.450	2.526	-2.392	-12.208
2306	8.773	24881.416	366.932	6866.805	-20.869	-29.261
2307	-12.859	5441.938	-47.312	-71.086	-7.198	15.667
2308	-17.823	6480.8	-41.063	-56.618	-12.406	9.386
2309	6.187	5261.869	-32.329	-48.198	-5.687	-13.777
2312	-7.919	7457.670	-1.2228	1.046	0.365	8.232
2313	218.138	31122.83	2.910	23.048	3.767	-2363.18
2314	-4.723	7731.80	2.892	5.637	0.596	5.470
2315	16.485	5121.85	3.599	5.817	-0.739	-2363.18
2316	13.255	7076.87	1.871	3.686	0.465	-23.658
2317	5.199	6708.70	0.475	2.277	0.505	-15.893
2318	7.588	5860.554	0.882	2.694	0.196	-21.385
2319	26.433	29246.20	58.826	2028.95	-2.131	-57.028
2322	11.811	7217.38	2.112	4.403	0.771	-20.280
2323	-7.993	7956.861	0.682	2.504	0.608	9.422
2324	-7.110	8202.004	0.223	2.017	2.841	10.32
2325	20.186	5543.79	2.537	4.462	0.240	-33.661

2327	15.851	4913.68	0.538	2.367	-0.095	-29.641
2299	31.793	11349.34	-3.686	-5.101	-2.428	-96.835
2300	-52.947	9602.35	-4.357	-5.791	-3.005	84.220
2301	46.21	5741.500	-8.880	-7.262	5.227	-54.238
2302	25.276	26577.57	90.745	4164.70	12.417	-44.681
2303	-9.666	5417.820	-64.271	-95.598	-0.656	15.188
2304	-1.271	11082	-185.99	-219.350	1.027	-7.317
2305	4.686	5040.667	-0.450	2.526	-2.392	-12.208
2303	-9.666	5417.820	-64.271	-95.598	-0.656	15.188
2304	-1.271	11082.055	-185.992	-219.350	1.027	-7.317
2305	4.686	5040.66	-0.450	2.526	-2.392	-12.208
2306	8.773	24881.416	366.932	6866.805	-20.869	-29.261
2307	-12.859	5441.938	-47.312	-71.086	-7.198	15.667
2308	-17.823	6480.8	-41.063	-56.618	-12.406	9.386
2309	6.187	5261.869	-32.329	-48.198	-5.687	-13.777
2312	-7.919	7457.670	-1.2228	1.046	0.365	8.232

Node no.	**Horizontal**	**Vertical**	**Horizontal**		**Moments**	
	Fx (KN)	**Fy (KN)**	**Fz (KN)**	**Mx (KNm)**	**My (KNm)**	**Mz (KNm)**
2313	218.138	31122.83	2.910	23.048	3.767	-2363.18
2314	-4.723	7731.80	2.892	5.637	0.596	5.470
2315	16.485	5121.85	3.599	5.817	-0.739	-2363.18
2316	13.255	7076.87	1.871	3.686	0.465	-23.658
2317	5.199	6708.70	0.475	2.277	0.505	-15.893
2318	7.588	5860.554	0.882	2.694	0.196	-21.385
2319	26.433	29246.20	58.826	2028.95	-2.131	-57.028
2322	11.811	7217.38	2.112	4.403	0.771	-20.280
2323	-7.993	7956.861	0.682	2.504	0.608	9.422
2324	-7.110	8202.004	0.223	2.017	2.841	10.32
2325	20.186	5543.79	2.537	4.462	0.240	-33.661
2327	15.851	4913.68	0.538	2.367	-0.095	-29.641
2328	4.736	5334.75	1.682	3.600	-0.160	-17.755
2329	4.639	16874.02	42.218	1022.060	-0.733	-17.955
2330	12.425	16366.23	41.274	1578.47	-4.365	-28.332
2331	19.720	4057.91	1.600	3.518	-0.222	-32.776
2334	-2.849	4099.270	-15.525	-22.001	0.854	-1.538
2335	39.225	20338.994	-495.475	-791.29	-5.276	-2619.76
2336	9.629	5303.35	-15.513	-22.163	4.357	-28.854
2337	4.631	1856.959	-41.292	-63.902	-7.125	-8.509
2336	9.629	5303.35	-15.513	-22.163	4.357	-28.854
2337	4.631	1856.95	-41.292	-63.902	-7.125	-5.509
2339	0.000	92.774	0.000	0.000	0.000	0.000
2340	0.000	92.774	0.000	0.000	0.000	0.000
2341	88.542	6179.854	-124.893	-154.720	3.577	-105.563
2342	189.270	11110.483	-139.06	-163.40	7.797	-188.363
2343	64.331	7536.136	-27.630	-34.262	4.469	-45.606
2344	182.418	10841.271	-14.497	-21.245	20.689	-139.380
2347	9.543	17419.24	40.076	1587.234	3.830	-25.619
2350	-3.796	7190.52	53.098	254.632	3.378	8.239
2352	-564.47	47209.07	1201.091	8586.13	-88.975	695.097
2353	-53.966	4582.868	-32.169	-27.931	2.662	58.236
2356	-60.364	10509.024	41.164	246.077	4.185	94.784
2369	-11.887	2911.958	-17.027	-23.290	2.407	16.277
2370	-13.088	21980.48	-55.613	-82.650	3.727	17.487
2371	119.810	15306.870	-113.327	-178.619	17.730	-1551.12
2372	2.495	1818.812	-52.309	-79.131	6.333	-5.529

Table 5

VI. CONCLUSION

In our Case study we found that in table no.3 due to unsymmetrical of building geometry modes are not resisting 90 % as its satisfying in X direction successfully after carried out 300 iteration of analysis in such case cut off mode must be add in it & need to check either stiffness of building shall be increase or not. In table no. 4 after carried results of 6 modes the building seismic weight was found to be as **3.559350 x 10^4 KN.** As we can see from table no. 1 the maximum story shear was found to be at the base as **10326.45 KN.**

Another important term clause like 7.8.2 from IS 1893:2002 (PART 1) The multiplying factor of static and dynamic equilibrium in X & Z direction was found to be **v_b/V_b) =** 11973 / 5363.64 = **2.23** (X direction) where as in z direction are , **(v_b/V_b)** = 7414 / 4882.47 = **1.51** (Z direction). Meaning of adopting tall building for Response spectra analysis is to study the results by using staad pro software with provision of IS 1893:2002 (PART 1) successfully and it is studied. Seismic analysis with Response Spectrum Method with CQC method are used for analysis of a 3Basement + Ground + 50 story RCC high rise building as per IS 1893(Part1):2002.

ACKNOWLEDGMENT

I take this opportunity to express our profound gratitude and deep regards to my guide and my friend Ms. Sultana for his exemplary guidance, monitoring and constant encouragement throughout the course of this work. The blessing, help and guidance given by him time to time me a long way in the journey of life. I am obliged to Mr. Kaushar hussain , HOD of our Department, for providing opportunity to do project base research work.

REFERENCES

[1]. **IS code 1893** (part 1):2002 for understanding the general parameters that seismic analysis purposes.
[2]. Handbook on seismic analysis & design of a structures [**Farzad Neaim**].
[3]. Analysis & design of tall buildings subjected to wind & earthquake loads [**K.Ramaraju**].
[4]. Earthquake Resistant Design of Structures [**Pankaj**].
[5]. Wikipedia
[6]. **Staad.pro** user manual
[7]. Staad.pro tutorials
[8]. **Anil K. Chopra [2003]** “Dynamics of Structures,
[9]. Theory and Applications to Earthquake Engineering” (**Prentice Hall of India Private Limited**).
[10]. **Chandurkar P. P, Dr. Pajgade P. S. (2013).** “Seismic Analysis of RCC Building with and Without Shear Wall.” , International Journal of Modern Engineering Research (IJMER) (2249-6645).
[11]. **Chavan Krishnaraj R. ,Jadhav H.S. (2014).** “Seismic Response of RC Building With Different Arrangement of Steel Bracing System.”, International Journal of engineering Research and Applications (2248-9622).
[12]. **Esmaili O. et al. (2008).** “Study of Structural RC Shear Wall System in a 56- Storey RC Tall Building.”, The 14th World Conference on Earthquake Engineering October 12-17, 2008 , Beijing, China.
[13]. **Akbari R.et al. (2014).** “Seismic Fragility Assessment of Steel X-Braced and Chevron-Braced RC Frames.”, Asian Journal of Civil Engineering (BHRC), VOL-16 No.1 .
[14]. **Kappos Andreas J., Manafpour Alireza** (2000). “Seismic Design of R/C Buildings with the aid advanced analytical techniques.” Engineering Structures (2001)319-332.
[15]. **Yamada M. et al.** “Multistorey Bracing Systems of Reinforced Concrete and Steel - Rigid Frames Subjected To Horizontal Loads- Proposition of Total Evaluation on the A seismic Capacity for Design.”
[16]. **Viswanath K.G. et al.(2010).** “Seismic Analysis of Steel Braced Reinforced Concrete Frames. International Journal of Civil & Structural Engineering (0976-4399).
[17]. **Anurag upadhyay et al (2011)**. “Behavior of cantilever retaining walls under seismic Conditions”. 5th international conference on earthquake geotechnical engineering January 2011, 10-13 Santiago, chile.
[18]. **C. Chougule (2017).** “Effective Use of Shelves in Cantilever Retaining Walls” International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 07 | July -2017.
[19]. **B.S. Tasildar et al (2015).** “Stability of retaining wall under seismic load: a review”. International journal of engineering sciences & research technology issn: 2277-9655 (i2or), publication impact factor: 3.785 (isra), impact factor: 2.114 4(5): may, 2015.
[20]. ***Dr. Ram Chandra*** **“**Reinforced concrete structure” (Limit State Design) Chapter 16 Page No. 918.
[21]. **Dr. S.S. Patil et al (2015).** “ Analysis and design of stepped cantilever retaining wall”. International journal of engineering research & technology (ijert) issn:2278-0181 www.ijert.org**ijertv4is020033** (this work is licensed under a creative commons attribution 4.0 international license.) Vol. 4 issue 02, february-2015.
[22]. **I.S. 456-2000.** Criteria for design of cantilever retaining wall, the given detail of how cantilever retaining wall design.
[23]. **I.S. 1893-1984/2002/2005**. Criteria of Earthquake resistance structures Part (1,4) given the estimation of horizontal and vertical coefficient or earthquake loads.
[24]. **Leuzzi Francesco et al (2010).** “Dynamic response of cantilever retaining walls considering soil non-linearity”. Fifth international conference on recent advances in geotechnical earthquake engineering and soil dynamics. Mahmoud yazdani et al (2013).
[25]. **“Extended‘‘Mononobe-okabe’’** method for seismic design of retaining walls”. Hindawi publishing corporation journal of applied mathematics volume 2013, article id 136132,10 pages. shttp://dx.doi.org/10.1155/2013/13613.