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Analysis of Multi-Storey Building by Response Spectrum Method using E-Tabs Software

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Abstract: **Response spectrum had been used for quite a long time by researchers, and engineering professionals, their use for building design professionals has been confined. Nowadays, as response spectrum analysis are being incorporated for the newer building designs. So, there is a need for structural engineering professionals to clearly understand the meaning and advantages of using the response spectrum method.**

The objective of this research paper is to discuss the idea of the response spectrum to analyze the multi-storey building at different seismic zones, and directing the need for taking these impact in choosing earthquake resistance criteria.

The codal provisions as per IS:1893 (Part 1)-2002 code for response spectrum analysis of multi-story building is also summarized.

I. INTRODUCTION

In order to perform the seismic analysis and design of a structure to be built at a particular location, the actual time history record is required. However, it is not possible to have such records at each and every location. Further, the seismic analysis of structures cannot be carried out simply based on the peak value of the ground acceleration as the response of the structure depend upon the frequency content of ground motion and its own dynamic properties.

To overcome the above problems, the response spectrum is the most prominent tool in the seismic examination of structures. There are a computational point of interest in utilizing the response spectrum of seismic analysis for the expectation of member forces and displacements in structure. The technique includes the evaluation of the peak values of the member forces and displacement in every kind of vibration utilizing smooth spectra that are the average of few earthquake movements.

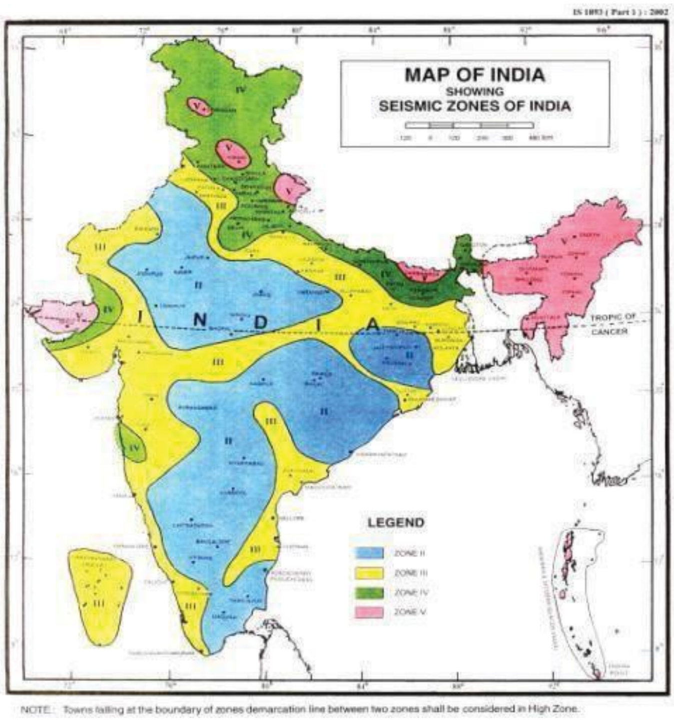
II. CONCEPT OF RESPONSE SPECTRUM

Response spectra are curves plotted between the peak reaction of the SDOF framework subjected to determined earthquake ground movement and its time-span (or frequency). The response spectrum can be translated as the locus of the peak response of an SDOF framework for a given damping proportion. Response spectra along these lines help in getting the peak structural reactions under linear range, which can be utilized for getting lateral forces created in structure because of earthquake thus facilitates the earthquake safe design of structures.

Usually, the response of an SDOF framework is controlled by time area or recurrence (or frequency) domain examination, and for a given time-span of the framework, the peak reaction is picked. This process has proceeded for all range of conceivable time-span of the SDOF framework. The last plot with the framework time-span on the x-axis and reaction amount on the y-axis is the necessary response spectra relating to indicated damping proportion and input ground movement. A similar procedure is completed with various seismic zones to get response spectra curve.

III. SEISMIC ZONES OF INDIA

Based on the levels of forces continued during past earthquakes, the seismic zone guide is re-examined with just four zones, rather than five. Recent Zone-I have been converged to Zone II. hence, Zone I don't show up in the new zoning; just Zones II, III, IV, and V.



Modified Seismic zones of INDIA (IS 1893-PART 1 2002).

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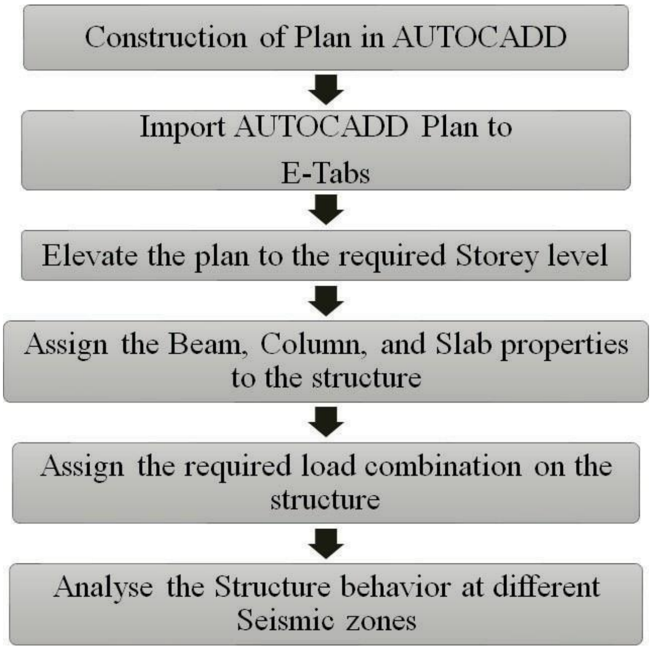
IV. OBJECTIVES OF THE STUDY

The present work goes for the investigation of following destinations:

1. To carry out seismic evaluation of structure.
2. To investigate the responses of a structure under the activity of seismic loads.
3. To compare different investigated results of structure under zone-II, zone-III, zone-IV &, zone-V utilizing E-TABS Software.
4. The structure model in the investigation has twelve storey's with consistent storey tallness of 10ft.
5. Different values of zone factor are taken and their corresponding effects are interpreted in the results.

V. METHODLOGY



VII. MODELING AND ANALYSIS

COMPUTER PROGRAM:

In this study a computer program ie., E-Tabs has been created to analyze the structures under earthquake loading considering the new changes in the IS 1893 PART-1 2002.The program calculates the base shear that resist the design lateral loads. Moments, lateral shear forces and the additional shear forces due to torsion on each vertical element resisting lateral load at each floor are also calculated. All the results are illustrated graphically by the program to clearly showing the results.

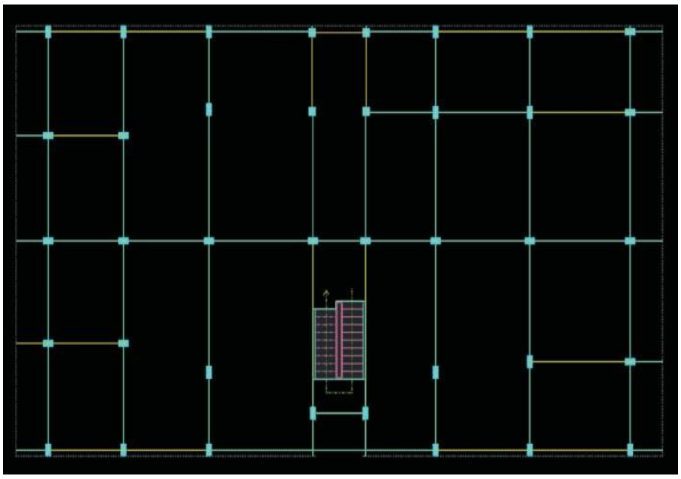
BUILDING CONFIGRATION:

The building model in the investigation has tweleve storeys with consistent storey tallness of 10ft. Different values of ZONE FACTOR are taken and their corresponding effects are interpreted in the results. Other details are given below:

PARAMETERS	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
Response Reduction Factor	5	5	5	5
Importance Factor	1	1	1	1
Soil Condition	Medium	Medium	Medium	Medium
Slab Thickness	0.2m	0.2m	0.2m	0.2m
Beam Size	0.23*0.4m	0.23*0.4m	0.23*0.4m	0.23*0.4m
Column Size	0.23*0.46m	0.23*0.46m	0.23*0.46m	0.23*0.46m
Live Load	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN/m^2
Grade of Concrete	M30	M30	M30	M30
Grade of Steel	Fe 415	Fe 415	Fe 415	Fe 415
Shear Wall Thickness	0.2m	0.2m	0.2m	0.2m

PLAN AND 3D MODEL OF BUILDING:

PLAN:



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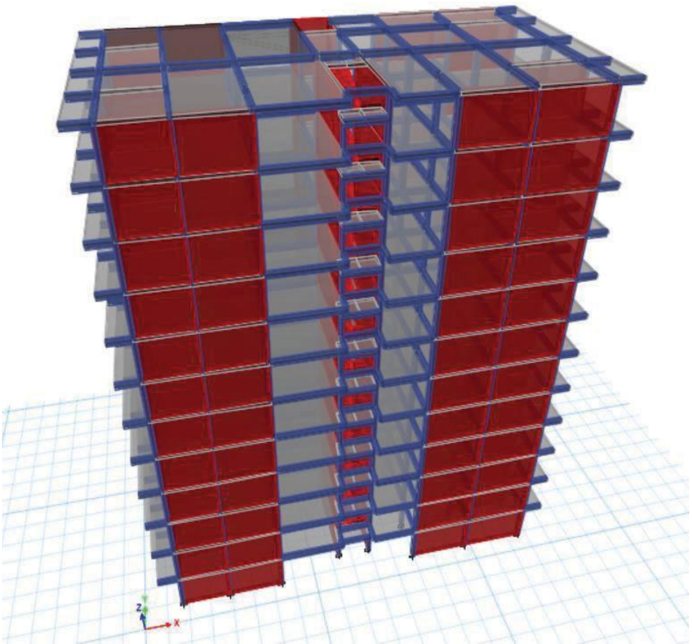
3D MODEL:

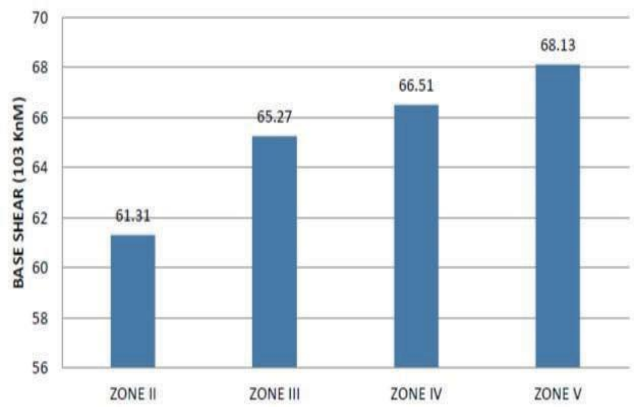


VIII. RESULTS AND DISCUSSIONS OBTAINED BY RESPONSE SPECTRUM METHOD

BASE SHEAR:

ZONES	BASE SHEAR (10^3 KN-M)
ZONE II	61.31
ZONE III	65.27
ZONE IV	66.51
ZONE V	68.13

GRAPH:

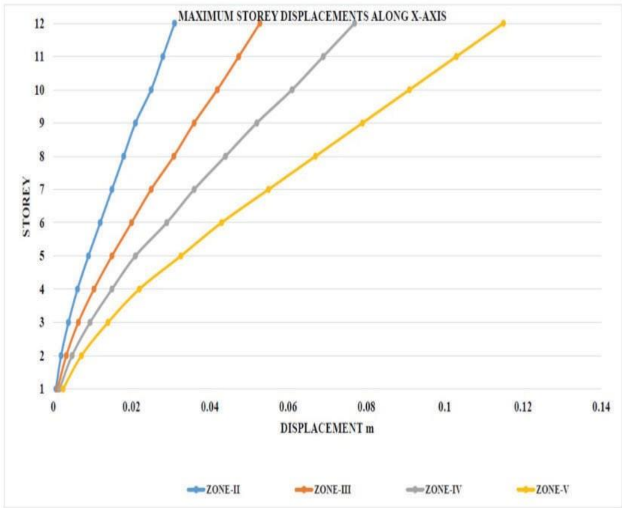


MAXIMUM STOREY DISPLACEMENT:

Along Global X-axis

STOREY	MAX STOREY DISPLACEMENT m			
G-X	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
1	0.00069	0.0011	0.0016	0.0025
2	0.002	0.00333	0.0048	0.0072
3	0.0039	0.0064	0.0094	0.014
4	0.0062	0.0104	0.015	0.022
5	0.009	0.015	0.021	0.0326
6	0.012	0.02	0.029	0.043
7	0.015	0.025	0.036	0.055
8	0.018	0.0308	0.044	0.067
9	0.021	0.036	0.052	0.079
10	0.025	0.0419	0.061	0.091
11	0.028	0.0474	0.069	0.103
12	0.031	0.0528	0.077	0.115

GRAPH



Along Global Y-axis:

STOREY	MAX STOREY DISPLACEMENT m			
G-Y	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
1	0.001	0.0017	0.0045	0.0068
2	0.0032	0.0054	0.014	0.021
3	0.0064	0.0106	0.026	0.0404
4	0.01	0.0169	0.042	0.063
5	0.014	0.0241	0.058	0.0875
6	0.019	0.0319	0.075	0.1125
7	0.024	0.04	0.091	0.1374
8	0.029	0.048	0.107	0.1616
9	0.034	0.056	0.123	0.1846
10	0.039	0.0646	0.137	0.206
11	0.044	0.0725	0.151	0.2268
12	0.048	0.0797	0.163	0.245

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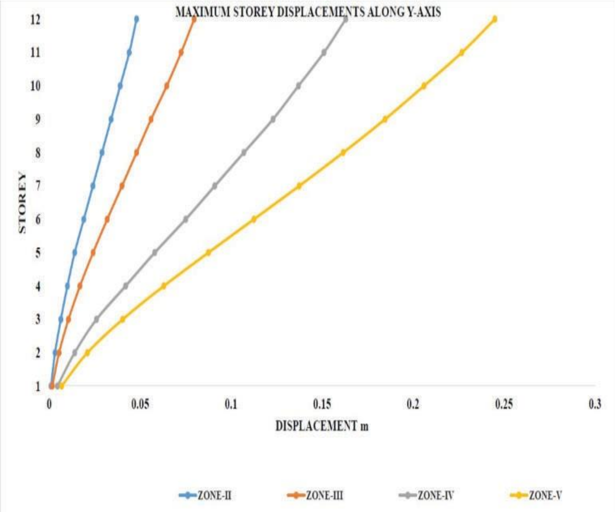
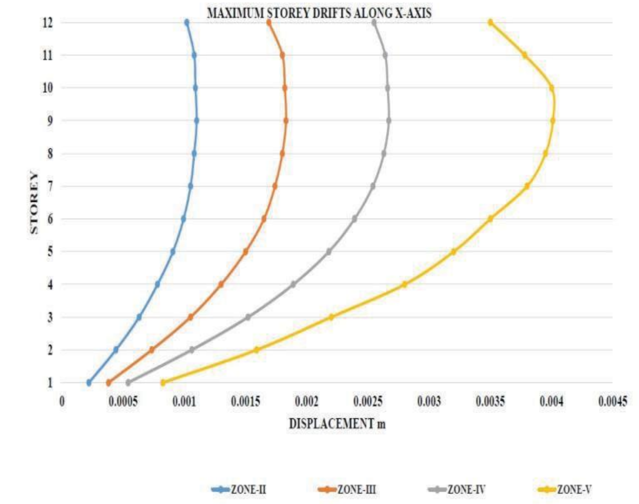
GRAPH:



MAXIMUM STOREY DRIFT:
Along Global X-axis:

STOREY	MAX STOREY DRIFT IN m			
G-X	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
1	0.00022	0.00038	0.00054	0.000824
2	0.00044	0.000733	0.00106	0.00159
3	0.00063	0.00105	0.00152	0.0022
4	0.00078	0.0013	0.00189	0.0028
5	0.000906	0.0015	0.00218	0.0032
6	0.000993	0.00165	0.00239	0.0035
7	0.00105	0.00174	0.00254	0.0038
8	0.00108	0.0018	0.00263	0.00395
9	0.0011	0.00183	0.00267	0.00401
10	0.00109	0.00182	0.00266	0.004
11	0.00108	0.0018	0.00264	0.00378
12	0.00102	0.00169	0.00255	0.0035

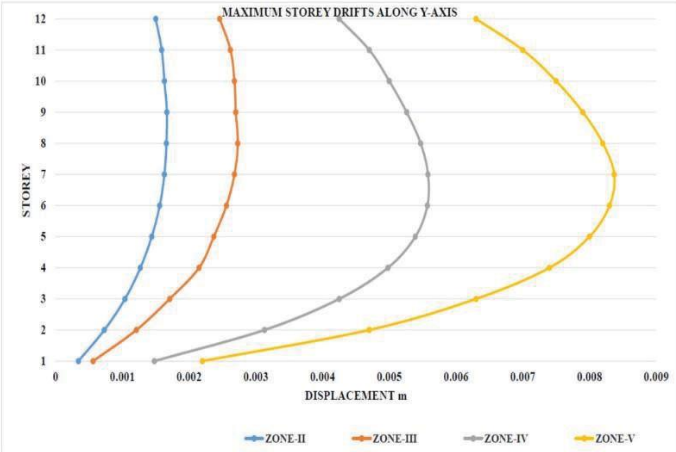
GRAPH:



Along Global Y-axis:

STOREY	MAX STOREY DRIFT IN m			
G-Y	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
1	0.00034	0.00056	0.00148	0.0022
2	0.00073	0.00121	0.00313	0.0047
3	0.00104	0.00171	0.00425	0.0063
4	0.00127	0.00215	0.00498	0.0074
5	0.00144	0.00237	0.00539	0.008
6	0.00156	0.00256	0.00557	0.0083
7	0.00163	0.00268	0.00558	0.00837
8	0.00166	0.00273	0.00547	0.0082
9	0.00167	0.0027	0.00526	0.0079
10	0.00163	0.00268	0.005	0.0075
11	0.00159	0.00262	0.0047	0.007
12	0.0015	0.00246	0.00425	0.0063

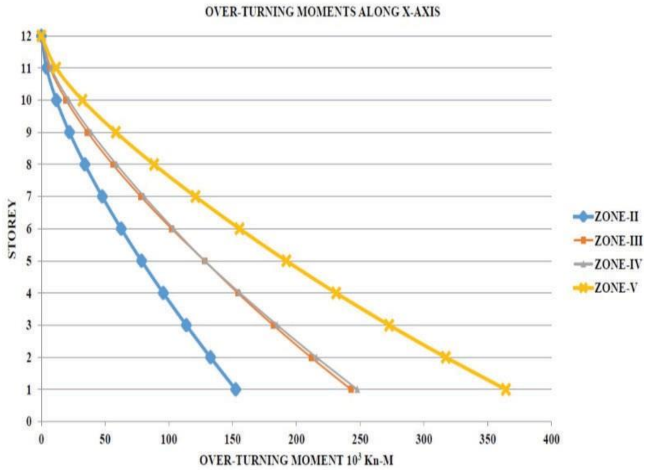
GRAPH:



OVER-TURNING MOMENTS:
Along Global X-axis:

STOREY	OVERTURNING MOMENT (10^3 KN-m)			
G-X	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
1	152.33	242.76	247.7	364.15
2	132.61	215.65	211.43	317.15
3	113.66	184.89	181.84	272.76
4	95.61	155.64	154.08	231.13
5	78.57	128.04	128.08	192.12
6	62.59	102.16	103.62	155.44
7	47.75	78.1	80.55	120.83
8	34.16	56.01	58.9	88.35
9	22.03	36.25	38.97	58.46
10	11.78	19.45	21.49	32.23
11	4.08	6.78	7.74	11.61
12	0	0	0	0

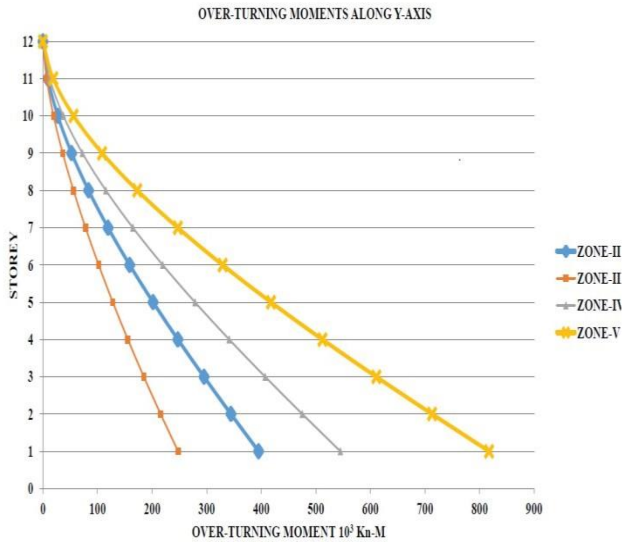
GRAPH:



Along Global Y-axis:

STOREY	OVERTURNING MOMENT (10^3 kN-m)			
G-Y	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
1	242.79	395.14	545.06	817.6
2	211.69	344.53	475.36	713.04
3	181.29	295.11	407.24	610.86
4	151.91	247.38	341.44	512.15
5	123.87	201.83	278.65	417.97
6	97.49	158.97	219.53	329.3
7	73.11	119.35	164.8	247.2
8	51.14	83.61	115.34	173.02
9	32.08	52.56	72.37	108.55
10	16.61	27.29	37.47	56.2
11	5.56	9.19	12.6	18.9
12	0	0	0	0

GRAPH:



IX. CONCLUSIONS

In the view of the analysis of multi-storey structure, the following conclusion are made:

- Base Shear legitimately depends upon the seismic acceleration. Along these lines, if a structure isn't required to be exposed to high seismic forces, its design base shear would be low, Which is good.
- If a structure is stiff (high K) then it will also displace less (low U) but if a structure is flexible (low K), it will displace much more (high U) resulting in greater or lower than the same amount of base shear = K*U.
- Story displacement is the total estimation of relocation of the story under the activity of the lateral forces.
- The significance of story drift is in design of divider walls. They must be so designed as to accommodate the storey drift, else they will crack. For the brick walls on external elements, this may cause major damage.
- The overturning of the structure is caused because of the lateral forces. At the point when structures are exposed to lateral forces, for example, seismic powers, they experience deflection in the horizontal direction and horizontal sway is likewise seen one direction of the structure. This makes structure experience overturning.
- Tall structures experience enormous lateral forces because of their tallness. In this way, they are designed so that the structure can check the impact of overturning. At the point when the design examination includes the thought of the overturning impact, the stability of the structure increments up to a more prominent degree. On the off chance that the overturning of the structure isn't controlled, at that point, it can, in the end, lead to auxiliary disappointment, which causes the structure failure.

REFERENCE

[1] IS: 1893 (Part 1), (2007), Indian Standard Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
[2] P.P.Chandurkar, Dr. P. S. Pajgade 2013 " Seismic Analysis of RCC Building with and Without Shear Wall"
[3] Jag Mohan Humar et al (2013) "Dynamic analysis of buildings for earthquake-resistant design"
[4] Jag Kim and Elnashai (2009) "VERTICAL GROUND MOTIONS AND ITS EFFECT ON ENGINEERING STRUCTURES"