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"Comparative Seismic Analysis of RC G+13 MultiStorey Building Frame"

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Abstract – *In this research project work, we analyzed the Seismic analysis of RC (G+13) Multi-storey building frame structure in different seismic zone by using Linear Static Methods in a Staad Pro V8i. We considered different soil condition and different parameter like size of column 450x450mm, size of beam 230x450mm, thickness of slab 150mm, height of each floors 3m. The comparative analysis of the building frame in the term of Node displacement, Maximum Shear Force, Maximum Bending Moment, Maximum Axial forces. The comparative analysis results observed that As per the results shows that maximum node displacement, shear force and bending moment in zone V in soft soil while minimum at zone II and hard soil. It means that, of we increased the zones the node displacement is also increased. The results in the term of support reaction shows that zone II, III & IV are same with all type of soils but increased with change the zone from IV to zone V with soft soil. The maximum storey-wise displacement founded in zone V with soft soil and minimum at zone II with hard soil and also shows that if we increased the number of storey, node displacement is also increased.*

Key Words: RC Building Frame, Staad Pro., Soil, Zone etc.

1. INTRODUCTION

In India, we know that the Earthquakes are most unpredictable and devastating of all-natural disasters and have the potential for causing the greatest injured among all the natural hazards. Since Seismic forces or earthquake forces are random in nature and unpredictable. They not only cause great harm in human casualties, but also have a huge economic impact on the affected area. The concern about earthquake hazards has led to an increasing awareness and demand for any structure designed to withstand earthquake forces. When a structure is subjected to ground motions during earthquake, it responds by vibrating and those ground motion causes the structure to shake or vibrate in all the directions which the predominant direction of shaking is horizontal. During an earthquake, the effect in a structure generally initiates at location of the structural weakness present in the building systems which also depends upon the location of seismic zone. High-Rise Reinforced Concrete structures are a special class of structures with their own peculiar characteristics and requirements for analysis and design.

B. Gireesh Babu (2017) , studied that the Conventional Concrete Design and seismic analysis and design of G+7 storey Residential building in seismic zone II by using Staad pro Software. He analyzed the 2-D frame and the different parameters used like RF =3 for OMRF and importance factor =1. He observed that the quantity of steel increased in the conventional concrete design resulting in the ground floor to higher floors as compared to Staad Pro.

Vikash Mehta, KanchanRana April-Sept. 2017 , studied that the seismic analysis of Multi-storey Regular Building (G+25) in Seismic Zone V by using Time History method and Response Spectrum Method in a Staad Pro Software as per IS 1893 (Part-I) 2002. He found that the storey drift slightly decreased while increased storey displacement with increased the storey heights.

Dr. Syed Aqueel Ahmad, Rajiv Banarjee et.al. (2018) , studied that Seismic Analysis & Designing of G+10 Storied Building by Strut & Staad pro Software with different loading conditions and compared the results. He observed that shear wall should be placed at a point by coinciding the center of gravity and centroid of the building.

A Primary Objective of this research works per IS 1893 (Part-I) 2002

(a) To performed the Seismic Analysis of RC building framed structure by using Staad Prof. software.
(b) To comparative Study of Seismic Analysis of Building Frame Structure considered with different zone.
(c) To Comparative Analysis of Building frame with different soil conditions**.**

2. SEISMIC EFFECTS

It has been seen in past earthquake effects that the building structures zone V and Soft soils are more damage. This force cause damages to building structures, for instance, loss of wealth and life in the building structures and if the force of effects is high it prompts breakdown of the structure. As we know that, In the past years population has been extended and a result of which urban zones and towns have started to make different storey of building. In light of this reason, different structures are being locally seismic zones. Now a days, India has an extensive shoreline forefront which is secured with mountains and slopes, like Various resorts are being produced in uneven zones to give courses of action to guests. The structures in these zones are created on sloping

grounds. In India, a huge part of the rough ranges go under the seismic zone (II, III and IV) which determines its intensity as zone II is low where chances of occurrence of earthquake is low whereas zone V is very severe which means chances of earthquake is very high in this areas. In such case building frail against seismic tremor.

Different Seismic Zone in India: As per IS 1893 Part I.

As per Indian Slandered Code IS 1893:2002, the Vibration and Intensity due to seismic waves are calculated, where the design horizontal seismic coefficient A_h can be calculated by the expression:

$$A_h = \frac{Z I S_a}{2 R g}$$

Where Z = zone factor given in table 2 in IS 1893:2002

Table 1.1 : Seismic Zone and Intensity

Seismic Zone	II	III	IV	V
Intensity	Low	Moderate	Severe	Very Severe
Z	0.1	0.16	0.24	0.36

3. METHODOLOGY

In the recent time, Civil & Structural software's analysis is more effectively used in analysis and design of different civil engineering structures. In this work, we using Staad pro software and analyzed the structure as per IS 1893:2002. The following steps are adopted:

Step-1 Modeling of building frame in Node & Transitional repeat with different type of soils, symmetrical (24.02mX24.02m)G+13 story of 3D frame. Fig. 2.1

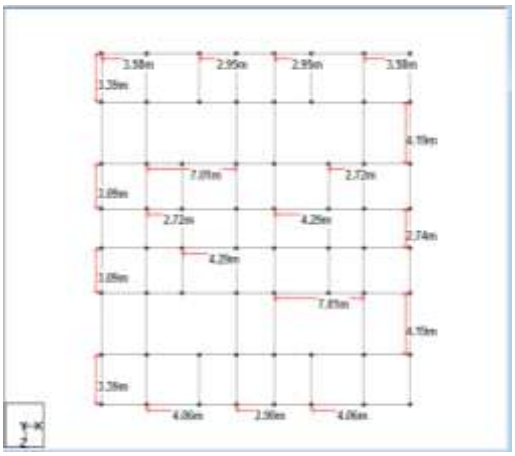


Fig. 2.1 Plan of Building

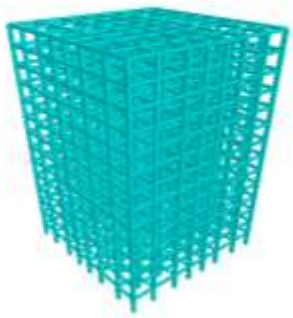
Step-2 Selection of Building Geometry: Plan of Building 24.02mX24.02m , Size of Columns 450mmX450mm, Size of Beam 230mm X 450mm, Thickness of Slab 150mm; Height of each floor 3.0m, Unit weight of RCC 25KN/m^3, Unit weight of bricks 20KN/m^3 and Fixed supports.

Step-3 selection of Seismic Zone and soil conditions As per IS Code.

Step-4 Load combinations.

Load case no.	Load cases
1	DL
2	LL
3	EQ,X+
4	EQ,X-
5	E.Q,Z+
6	E.Q,Z-
7	1.5(DL+LL)
8	1.5(DL+E.Q.,X)
9	1.5(DL-E.Q.,X)
10	1.5(DL+E.Q.,Z)
11	1.5 (DL-E.Q.,Z)
12	1.2(DL+LL+E.Q.,X)
13	1.2 (D.L+L.L-E.Q.,X)
14	1.2 (DL+LL+E.Q.,Z)
15	1.2 (DL+LL-E.Q.,Z)

Step-5 Designing of building frames using STAAD.Pro v8i software in 3D rendered view.



Step-6 Analysis considering different types of soil condition providing different seismic zones.

S. No.	Parameter	Value	As per code
1	Zone (II,III,IV and V)	0.1, 0.16, 0.24 and 0.36 respectively	Table: 2
5	Damp ratio.	0.05	Table: 3
2	Importance. factor(I)	1.5	Table: 6
3	Response reduction.(R.F)	5	Table: 7
4	soil site factor (S.S)	Soft,Medium and Hard	

Step-7 Comparative the results in the term of storey-wise displacement, shear force, bending moment, node displacement etc.

FLOW CHART DIAGRAM:

For this Project Work, Flow chart of proposed method of this analysis.

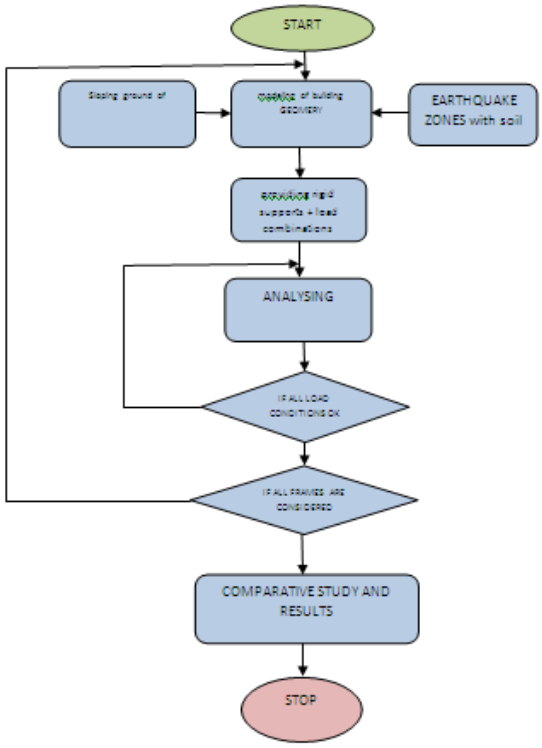
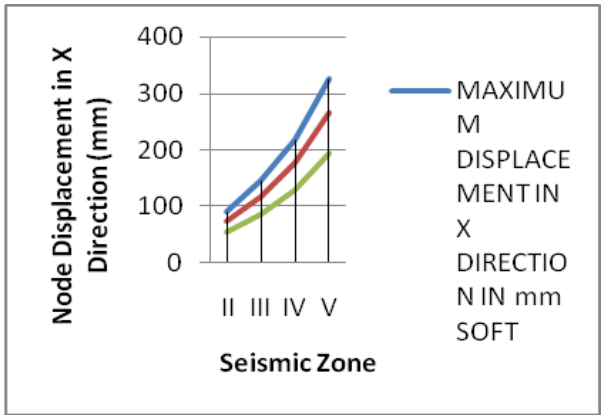


Fig. Flow Chart Diagram

4. RESULTS AND ANALYSIS

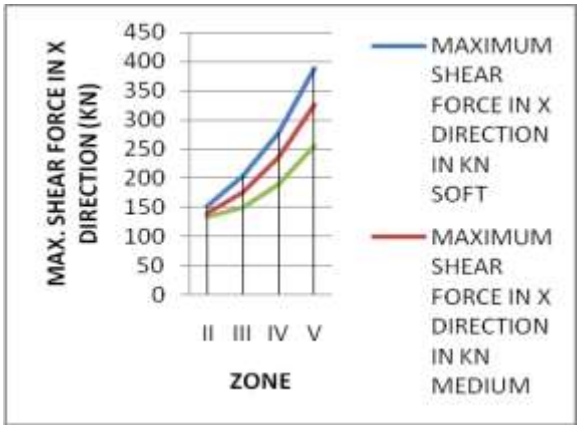
Maximum Node Displacement (mm).

ZONE	MAXIMUM DISPLACEMENT IN X DIRECTION IN mm		
	SOFT	MEDIUM	HARD
II	90.622	73.844	54.361
III	144.852	118.008	86.834
IV	217.158	176.892	130.131
V	325.618	265.218	195.077



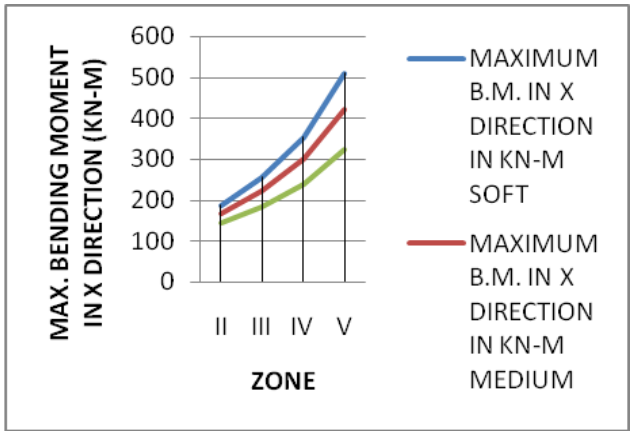
Maximum Shear Forces (KN)

ZONE	MAXIMUM SHEAR FORCE IN X DIRECTION IN KN		
	SOFT	MEDIUM	HARD
II	151.269	140.138	133.275
III	204.076	176.714	148.738
IV	277.777	236.734	189.071
V	388.329	326.764	255.27



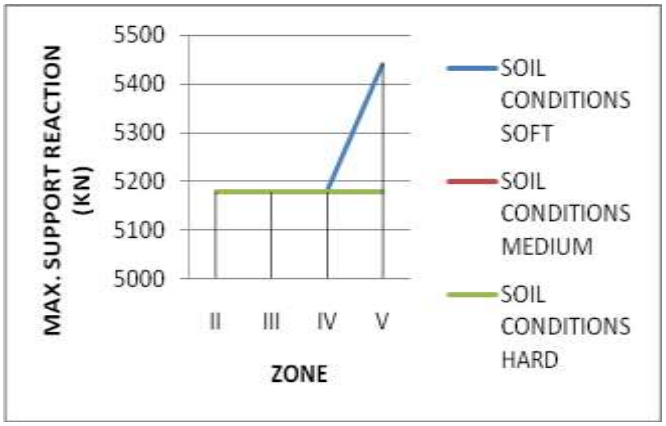
Maximum Bending Moment (KN-m)

ZONE	MAXIMUM B.M. IN X DIRECTION IN KN-M		
	SOFT	MEDIUM	HARD
II	188.369	167.615	144.634
III	257.581	222.921	183.667
IV	353.26	299.701	238.574
V	509.944	420.81	323.889



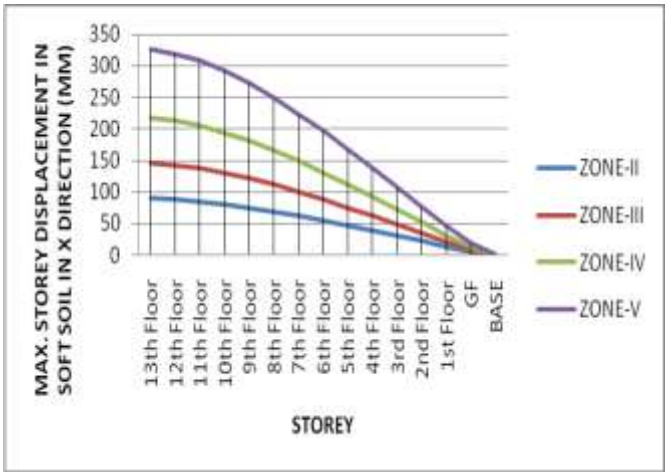
Maximum Support Reaction (KN)

ZONE	SOIL CONDITIONS		
	SOFT	MEDIUM	HARD
II	5177.04	5177.04	5177.04
III	5177.04	5177.04	5177.04
IV	5177.04	5177.04	5177.04
V	5439.906	5177.04	5177.04



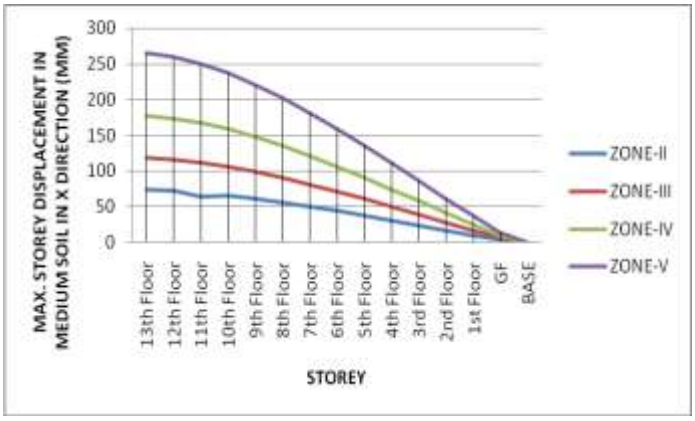
Maximum Storey Displacement (mm) in Soft Soil

STOREY	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
13th Floor	90.622	144.852	217.158	325.618
12th Floor	88.498	141.583	212.364	318.538
11th Floor	85.328	136.522	204.78	307.167
10th Floor	80.903	129.442	194.162	291.241
9th Floor	75.407	120.649	180.971	271.454
8th Floor	69.033	110.45	165.672	248.504
7th Floor	61.971	99.149	148.719	223.075
6th Floor	54.366	86.98	130.465	195.693
5th Floor	46.363	74.175	111.257	166.881
4th Floor	38.092	60.94	91.404	137.1
3rd Floor	29.664	47.454	71.174	106.754
2nd Floor	21.181	33.88	50.812	76.211
1st Floor	12.777	20.434	30.646	45.965
GF	4.907	7.85	11.774	17.659
BASE	0	0	0	0



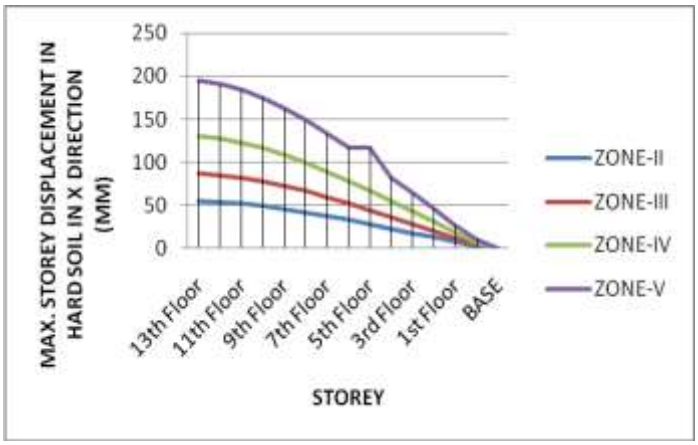
Maximum Storey Displacement (mm) in Medium Soil

STOREY	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
13th Floor	73.844	118.008	176.892	265.218
12th Floor	72.074	115.305	172.947	259.411
11th Floor	64.251	111.181	166.768	250.149
10th Floor	65.886	105.415	158.121	237.179
9th Floor	61.411	98.254	147.378	221.065
8th Floor	56.22	89.948	134.919	202.376
7th Floor	50.469	80.745	121.114	181.667
6th Floor	44.276	70.835	106.248	159.368
5th Floor	37.759	60.408	90.607	135.905
4th Floor	31.024	49.63	74.439	111.653
3rd Floor	24.16	38.648	57.965	86.94
2nd Floor	17.252	27.594	41.382	62.067
1st Floor	10.408	16.644	24.958	37.434
GF	3.999	6.393	9.589	14.382
BASE	0	0	0	0



Maximum Storey Displacement (mm) in Hard Soil in

STOREY	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
13th Floor	54.361	86.834	130.131	195.077
12th Floor	53.001	84.789	127.173	190.748
11th Floor	51.097	81.752	122.625	183.935
10th Floor	48.446	77.512	116.266	174.397
9th Floor	45.156	72.247	108.368	162.549
8th Floor	41.34	66.14	99.207	148.807
7th Floor	37.111	59.374	89.056	133.581
6th Floor	32.558	52.087	78.126	117.185
5th Floor	27.767	44.421	66.625	117.185
4th Floor	22.815	36.496	54.738	82.101
3rd Floor	17.769	28.421	42.625	63.93
2nd Floor	12.689	20.294	30.432	45.641
1st Floor	7.658	12.242	18.356	27.527
GF	2.948	4.702	7.046	10.575
BASE	0	0	0	0



5. CONCLUSION

As per the results shows that maximum node displacement, shear force and bending moment in zone V in soft soil while minimum at zone II and hard soil. It means that, of we increased the zones the node displacement is also increased. The results in the term of support reaction shows that zone II, III & IV are same with all type of soils but increased with change the zone from IV to zone V with soft soil. The maximum storey-wise displacement founded in zone V with soft soil and minimum at zone II with hard soil and also shows that if we increased the number of storey, node displacement is also increased.

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