COMPARATIVE STUDY ON SEISMIC ANALYSIS & DESIGN OF G+15 MULTISTOREY BUILDING STIFFENED WITH BRACING IN STADD PRO

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ABSTRACT :

In this research project work,we mainly focuses on comparison of seismic analysis of G+15 building stiffened with bracings. The performance of the building is analyzed in Zone II, Zone III, Zone IV, Zone V. The study includes understanding the main consideration factor that leads the structure to perform poorly during earthquake in order to achieve their appropriate behavior under future earthquakes. The analyzed structure is symmetrical, G+15,Ordinary RC moment-resting frame (OMRF). Modelling of the structure is done as per staad pro. V8i software. Time period of the structure in both the direction is retrieve from the software and as per IS 1893(part 1):2002 seismic analysis has undergone. The Lateral seismic forces of RC frame is carried out using linear static method as per IS 1893(part 1) : 2002 for different earthquake zones. The scope of present work is to understand that the structures need to have suitable Earthquake resisting features to safely resist large lateral forces that are imposed on them during Earthquake. Shear walls are efficient, both in terms of construction cost and effectiveness in minimizing Earthquake damage in structure. Also the braced frames can absorb great degree of energy exerted by earthquake.. The results of the performance and the analysis of the models are then graphically represented and also in tabular form and is compared for determining the best performance of building against lateral stiffness by arrangement of three different types of bracings with three different orientation of bracings. A comparative analysis is done in terms of Base shear, Displacement, Axial load, Moments in Y and Z direction in columns and shear forces, maximum bending moments, max Torsion in beams.

Keywords:RC Building Frame,Staad Pro,Soil Zone etc.

INTRODUCTION :

Nowadays, the Earthquake disaster has become a great concern. Many damages have been caused due to earthquake in both Asia & other continent. It is very tremendous as it is unforeseeable in nature. So it is very necessary to keep in mind the hazards due to seismic effects and should adopt the necessary assumptions before design. Because structures are susceptible to severe damages due to earthquake. Different countries have a variety of provisions of providing such system with a view to dissipating the energy of earthquake. Shear wall and steel bracing systems are most effective means to adopt to add more stiffness in frames. At present, in many high rise building constructions, shear wall has been provided as lift core in case of core type shear wall or constructed as load bearing walls. Besides, the steel bracing systems are allocated in that portion of a structure where more rigidity is required. For different cases, distinct kinds of bracing systems are assumed. Though, bracings have less stiffness comparing with shear wall, there is a significant concern that is the self-weight of bracings are to a small extent comparing with concrete shear wall.

The present study is an effort towards analysis of the structure during the earthquake.G+15stories residential building is considered. To analyze a multistoreyed RC framed building considering different earthquake intensities II, III, IV and V by response spectra method and find the base shear value for different structures. Seismic analysis of RC frame with bare and different position of shear wall and braced frame is carried out using Linear static analysis method as per IS 1893 (Part I): 2002[22] by using STAAD-PRO software .For this analysis different types of models are considered and comparison of seismic performance is carried out.

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

(a) To performed the Seismic Analysis of multistorey building framed structure by using Staad Pro software.
(b) To comparative Study of Seismic Analysis of Building Frame Structure considered with different zone.
(c) To Comparative Analysis of Building frame stiffened with bracing.

LITERATURE REVIEW :

- Zandi (2013) discussed on comparison between thin steel plate shear walls with dual system of steel moment frame and cross bracing or chevron with a design method based on performance levels. The study focused an discuss on the dual system comprising with thin steel plate shear wall and bracings. In addition, it is based on steel moment resisting frames and approach on performance based design has been arrogated in this research.

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

- Kumar.n et al (2014) has presented a review of shear wall systems. The main focused of this research has been found that the behaviour and resistance of miscellaneous type shear wall against cyclic loads. The output of this analysis shows the suitability of inner shear walls comparing with outer shear walls.
- Gowardhan et al (2015) reviewed on comparative seismic analysis of steel frame with and without bracing by using software. This research has depended upon the affectivity of steel bracings in steel structures. A comparison has been deliberated between structure with and without steel bracings resistant to seismic effects. It has been found that seismic bracings increase the stiffness against lateral loadings and it might be a good practice to use bracings as retrofitting scheme.

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:

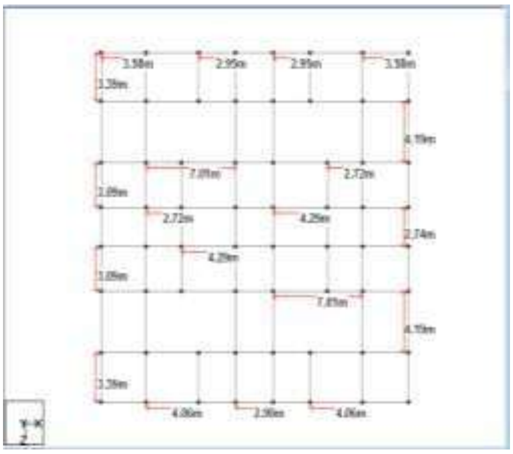
Where Z = zone factor given in table 2 in IS 1893:2002

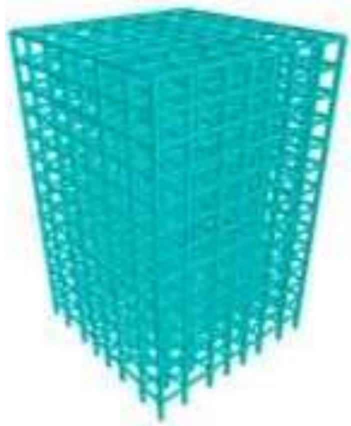
Table 1.1 : Seismic Zone and Intensity

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

1. RESEARCH 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:





Plan of building

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

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.

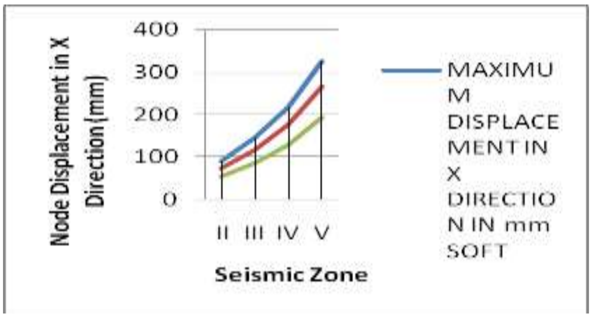
S. No.	Parameter	Value	As per code
1	Zone (II,III,IV and V)	0.1, 0.16, 0.24 and 0.36 respectively	Table: 2
5	Damp ratio.	0.05	Table: 3
2	Importance. factor(I)	1.5	Table: 6
3	Response reduction (R.F)	5	Table: 7
4	soil site factor (S.S)	Soft,Medium and Hard	

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

1. RESULTS AND ANALYSIS :

1.1 Maximum Node Displacement (mm)

ZONE	MAXIMUM DISPLACEMENT IN XDIRECTION 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

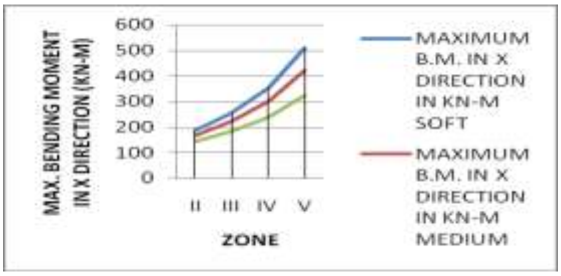


1.2 Maximum Shear Forces (KN)

ZONE	MAXIMUM SHEAR FORCE IN XDIRECTION 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

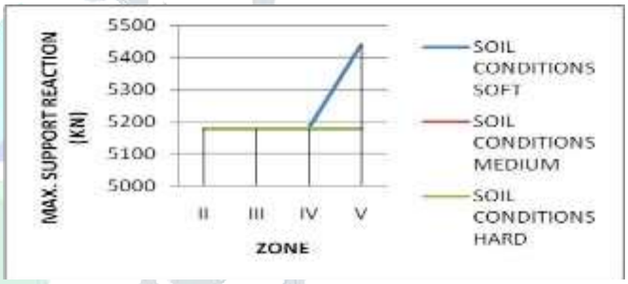
1.3 Maximum bending moment (KN)

ZONE	MAXIMUM BENDING MOMENT IN XDIRECTION IN mm		
	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



1.4 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 :

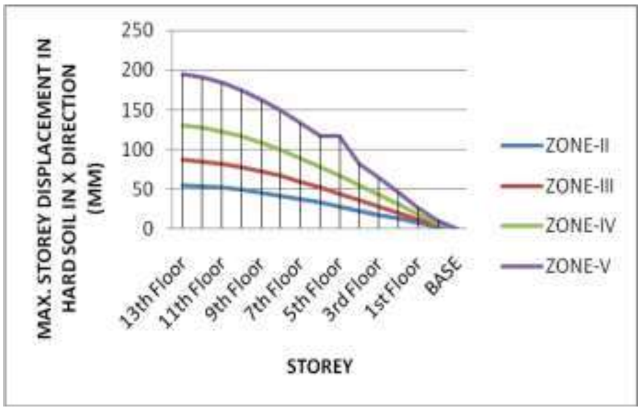
STOREY	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
15th Floor	80.156	126.125	183.246	282.466
14th Floor	75.268	122.402	180.248	279.291
13th Floor	73.844	118.008	176.892	265.218
12th Floor	72.074	115.305	172.947	259.411
11th Floor	64.251	111.181	166.768	250.149
10th Floor	65.886	105.415	158.121	237.179
9th Floor	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 Medium Soil

STOREY	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
15th Floor	95.325	155.292	238.112	340.834
14thFloor	92.757	149.200	232.155	336.244
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 Hard Soil

STOREY	ZONE-II	ZONE-III	ZONE-IV	ZONE-V
15th Floor	60.684	90.288	134.504	202.426
14th Floor	56.266	88.862	132.487	198.298
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



2. 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, 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.

3. REFERANCES

[1] Himalee Rahangadle, S. R. Satone, "Design and Analysis of Multistoried Building with Effect of Shear wall", International journal of Engineering Reserch and Applications, Vol 3, Issue 3, pp-223- 232, ISSN:2248-9622.

[2] Arlekar J. N., Jain S. K. and Murty C. V.R., "Seismic Response of RC Frame Building with Soft First Storey", proceeding of CBRI Golden Jubliee Conference on Natural Hazards in Urban Habitat, 1997, New Delhi, pp.13-24.

[3] Anand. N., Mightraj. C., Prince Arulraj G., "Seismic Behaviour of RCC shear wall Under Different Soil Conditions", Indian Geotechnical Conference-2012, GEO trendz , IGS Mumbai chapter ant IIT Bombay.

[4] FEMA 356, Presented and Commentry for the Seismic Rehabilitation of Buildings, Federal Emergency Management Agency , Washington, 2000.