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Comparison of Analysis and Design of Regular and Irregular Configuration of Multi Story Building in Various Seismic Zones and Various Type of Soils

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ABSTRACT: *Today world facing some of the major problems causing by the nature. One of the major natural disaster is the Earthquake. Multistory RC Structure subjected to most dangerous earthquakes. It was found that main reason for failure of RC building is irregular distributions of mass, stiffness and strength and due to irregular geometrical configurations and different type of soil. In reality, many existing buildings contain plan irregularity due to functional and aesthetic requirements. Due to plan irregularity building the settlement is also vary as compare to regular shape building.*

However, past earthquake records show the poor seismic performance of this structure. This is due to ignorance of the irregularity aspect in formulating the seismic design methodologies by the seismic codes (IS 1893:2002). These analysis are carried out by considering G+11 multi story building with different seismic zones 3 and 4 and for each zone the behaviour is assessed by taking two different types of soils namely Hard and Medium .Different response like story drift, displacements base shear are plotted for different zones and different types of soils in accordance with the seismic provisions suggested in IS: 1893-2002 using equivalent static method and STAAD Pro V8i software.

KEYWORDS: *Regular and irregular configuration, static analysis.*

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I. INTRODUCTION

A large portion of India is susceptible to damaging levels of seismic hazards. Hence, it is necessary to take in to account the seismic load for the design of structures. in buildings the lateral loads due to earthquake are a matter of concern. these lateral forces can produce critical stresses in the structure, induce undesirable stresses in the structure, induce undesirable vibrations or cause excessive lateral sway of the structure. sway or drift is the magnitude of the lateral displacement at the top of the building relative to its base. traditionally, seismic design approaches are stated, as the structure should be able to ensure the minor and frequent shaking intensity witout sustaining any damage, thus leaving the structure serviceable after the event. the structure should withstand moderate level of earthquake ground motion without structural damage, but possibly with some structural as well as non- structural damage. this limit state may correspond to earthquake intensity equal to the strongest either experienced or forecast at the site. In present study the results are studied for equivalent static method. Now a day population of India increases day by day therefore requirement of buildings, houses, row-houses, apartments is also increases. Due to more population high rise building are constructed. While construction of high rise building some factor are affected on building like soil strata or soil type, earthquake zone, wind lode etc. The nominal design of building or without earthquake desigen is provided for building in zone -2 because the zone factor for zone-2 is 0.1 and intensity is also minimum but for zone-3,4,5 the earthquake design is mandatory. In zone-3,4,5 the intensity of lateral forces is much more and these forces acting on building in horizontal direction. The lateral forces force the building to move or shake that's why the earthquake analysis is much more important in high rise building. Earthquake forces random in nature and unpredictable, the static and dynamic analysis of structure have become become a primary concern of structural engineers. The main parameters of the seismic analysis of structures are load carrying capacity, ductility, stiffness, damping and mass.The earthquake analysis is done with many software but in this project the Staad pro software is used. In multy story building the maximum displacement is occur at top story and minimum displacement is at bottom story or ground floor. And the base shear is maximum at bottom. The main component part of the muilty-story building is column, beam, footing. In our project the analysis of G+11 building in different earthquake zone and different type of soil (medium, hard) with different plan irregulaty

like C-shape, L-shape and rectangele shape building is done. The SBC of medium tye of soil is 245 KN/M^2 to 300 KN/M^2 and for hard soil is 300 KN/M^2 to 440 KN/M^2.

II. LITERATURE REVIEW

1) Seismic analysis of multistoried rcc building regular and irregular in plan

This paper focuses on the study of seismic response of buildings having regular and irregular plan configurations. RC buildings (Regular and Irregular) of height G+6, G+9 & G+14 having re-entrant corners are selected for this study. FEM modelling and analysis was carried out using ETABS software. Response spectrum Analysis is carried out for seismic zones (II to V) specified in IS 1893 (Part I): 2002 with soil types II(medium stiff). Linear Static Dynamic Analysis has been performed to understand the performance characteristics of the irregular structures in comparison with regular RC structures. Further, the response obtained for each structure in different zones and heights are compared. It is observed from the results that the irregular building has maximum displacement compared to regular building maximum story shear is observed in regular building.

2) Seismic analysis of a multistorey rc frame building in different seismic zone

The analysis of a structural system to determine the deformations and forces induced by applied loads or ground excitation is an essential step in the design of a structure to resist earthquake. There is a range of methods from a linear analysis to a sophisticated nonlinear analysis depending on the purpose of the analysis in the design process. In this paper seismic response of a residential G+10 RC frame building is analysed by the linear analysis approaches of Equivalent Static Lateral Force and Response Spectrum methods using ETABS Ultimate 2015 software as per the IS1893-2002-Part-1. These analysis are carried out by considering different seismic zones, medium soil type for all zones and for zone II & III using OMRF frame type and for those of the rest zones using OMRF & SMRF frame types. Different response like lateral force, overturning moment, story drift, displacements, base shear are plotted in order to compare the results of the static and dynamic analysis.

3) Analysis and design of G+6 building in different seismic zone of india

This paper Designing a structure in such a way that reducing damage during an earthquake makes the structure quite uneconomical, as the earthquake might or might not occur in its life time and is a rare phenomenon. In this paper a G+6 existing RCC framed structure has been analysed and designed using STAAD.Pro V8i. The building is designed as per IS 1893(Part 1):2002 for earthquake forces in different seismic zones. The main objectives of the paper are to compare the variation of steel percentage, maximum shear force, maximum bending moment, and maximum deflection in different seismic zone. Variations are drastically higher from zone II to zone V. The steel percentage, maximum shear force, maximum bending moment, maximum deflection is increases from zone II to zone V.

III.MODELLING OF R.C.C. FRAMES

An R.C.C. framed structure is basically an assembly of slabs, beams, columns and foundation inter-connected to each other as a unit. The load transfer mechanism in this structure is from slabs to beams, from beams to columns, and then ultimately from columns to the foundation, which in turn passes the load to the soil. In this structural analysis, study, we have adopted four cases by assuming different shapes for the same structure, as explained below.

1. Rectangular plan
2. C- shape plan
3. L- shape plan

Detail of buildings considered in this work are as follows

Type of structure- Residential building

Shape of building – Rectangular, C-Shape, L-Shape, H-Shape Buildings,

Number of stories 11

Height of typical floor: 3m

Column size: 300mm X750mm

Beam size: 300 mm X 450mm

Slab thickness: 125 mm

Masonry wall thickness: 230 mm, 150mm, 100mm

Live load : 2 Kn/m^2

Floor finish : 1 Kn/m^2

Characteristic compressive strength of concrete, f_{ck}: 25N/mm^2

Grade of steel : 500 N/mm^2, 415 N/mm^2

Density of concrete : 25N/mm^2

Modules elasticity of concrete : 2500N/ mm^2

poison‟s ratio of concrete: 0.3

Density of brick masonry : 20 KN/m3
Modulus elasticity of brick masonry: 14000N/mm2
Poison"s ratio of brick masonry : 0.2

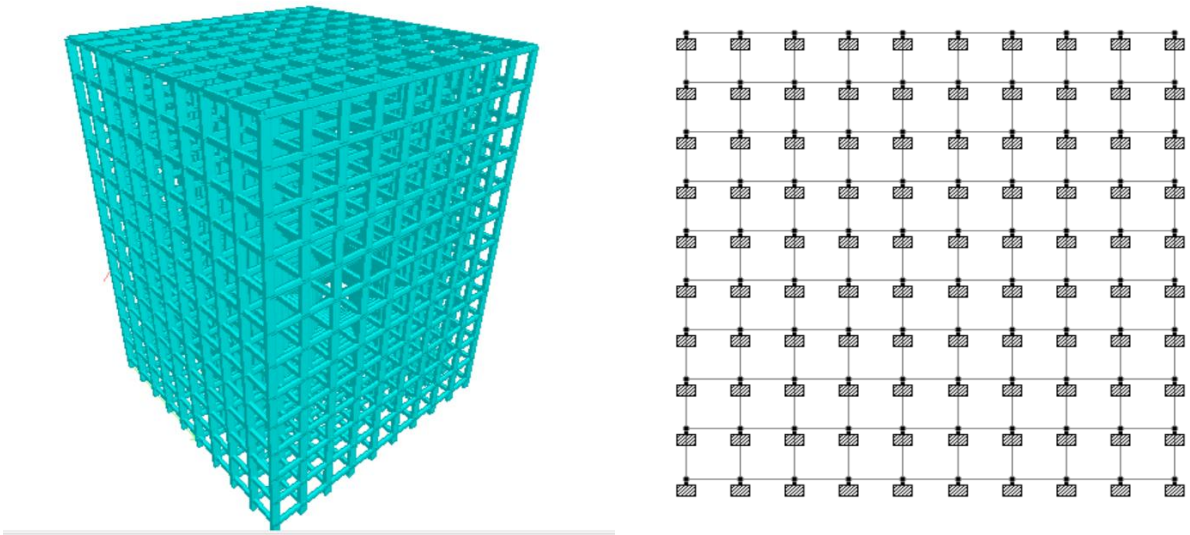

Fig.No.1 3D Elevation and plan of of Rectangular Building

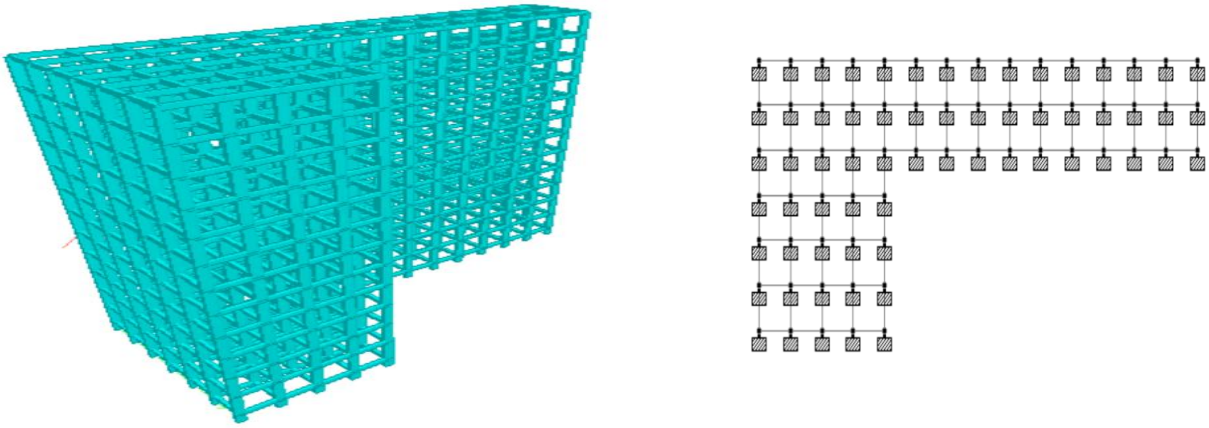

Fig.No.2 3D Elevation and plan of L- Shape Building

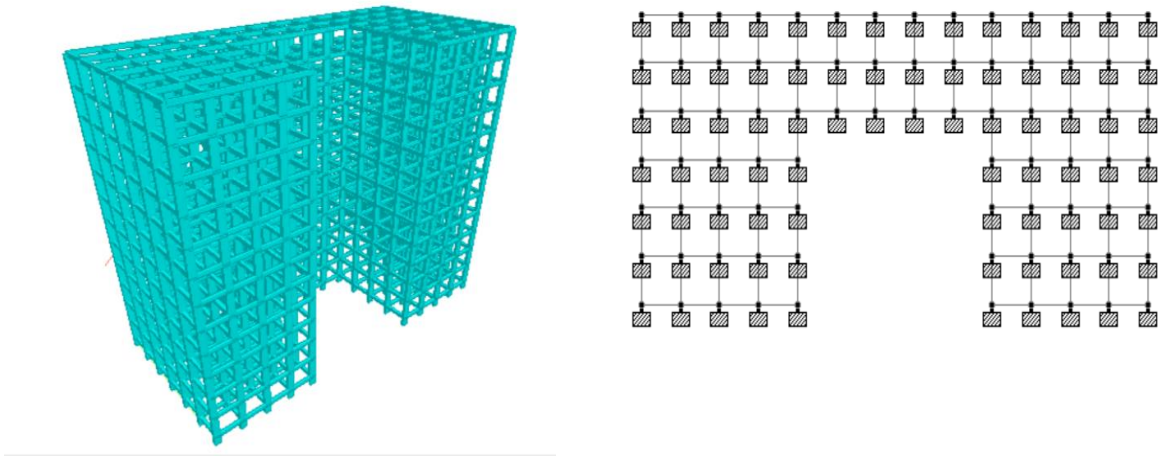

Fig No.3 3D Elevation and plan of C-shape building

IV. RESULT AND DISCUSSION FOR ALL SHAPES OF BUILDINGS

Lateral Displacement: The lateral displacement of building in various seismic zone and various shape of building in different type of soil is given below.

Table 1. Comparison of lateral displacement(mm) in X and Z-direction for Hard soil

Shape/Direction /Zone	Hard soil					
	Rect. shape		C-shape		L-shape	
	X-dir.	Z-dir.	X-dir.	Z-dir.	X-dir.	Z-dir.
Zone-3	24.23	43.78	25.93	47.05	25.17	55.90
Zone-4	36.29	65.63	38.82	70.43	37.70	83.81

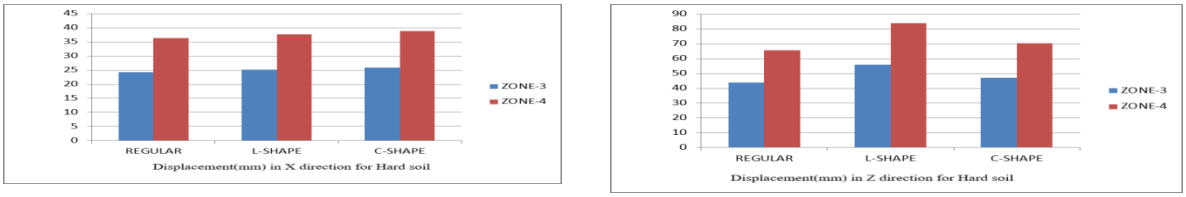

Chart 1. Comparison of lateral displacement(mm) in X and Z-direction for Hard soil

Table 2. Comparison of lateral displacement(mm) in X and Z-direction for Medium soil

Shape/Direction /Zone	Medium soil					
	Rect. shape		C-shape		L-shape	
	X-dir.	Z-dir.	X-dir.	Z-dir.	X-dir.	Z-dir.
Zone-3	32.91	59.52	35.21	63.88	34.19	76.00
Zone-4	49.32	89.24	52.74	95.69	51.24	113.9

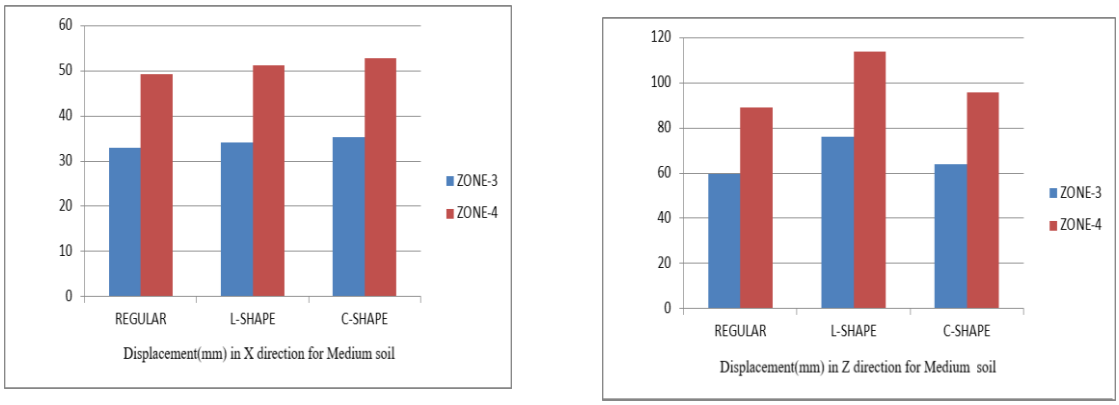

Chart 2.Comparison of lateral displacement(mm) in X and Z-direction for Medium soil

Base shear: Following table shows the value of base shear in hard , medium soil and zone 3 , zone 4. The value of base shear in X and Z direction is same as per software output.

Table 3. Comparison of base shear(KN) in X and Z direction for Hard soil

Zone/Soil /Shape	Hard soil		
	Rec. Shape	C-Shape	L-Shape
Zone 3	2480.09	1918.34	1491.69
Zone 4	3720.13	2877.50	2237.53

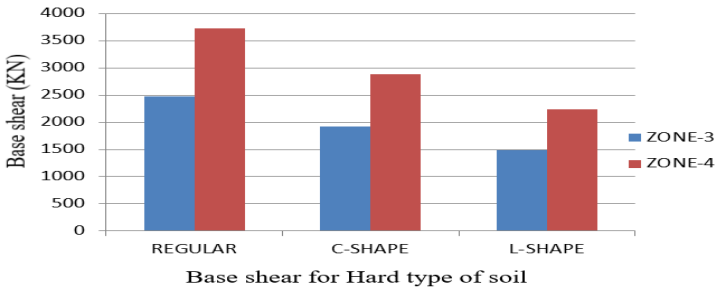

Chart 3. Comparison of base shear in X and Z direction for Hard soil

Table 4. Comparison of base shear(KN) in X and Z direction for Medium soil

Zone/Soil /Shape	Medium soil		
	Rec. Shape	C-Shape	L-Shape
Zone 3	3372.92	2608.94	2028.69
Zone 4	5059.38	3913.41	3043.04

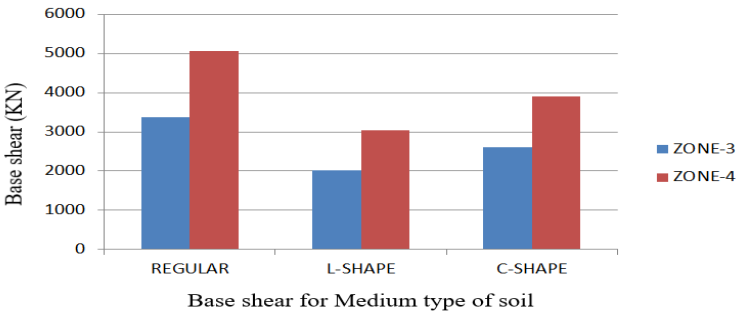

Chart 4. Comparison of base shear in X and Z direction for Medium soil

Steel percentage: Requirement of steel for all building is given in below table.

Table 5. Comparison of steel percentage(%) for Hard soil

Zone/Soil /Shape	Hard soil		
	Rec. Shape	C-Shape	L-Shape
Zone 3	14.19	7.42	14.08
Zone 4	14.21	14.12	14.11

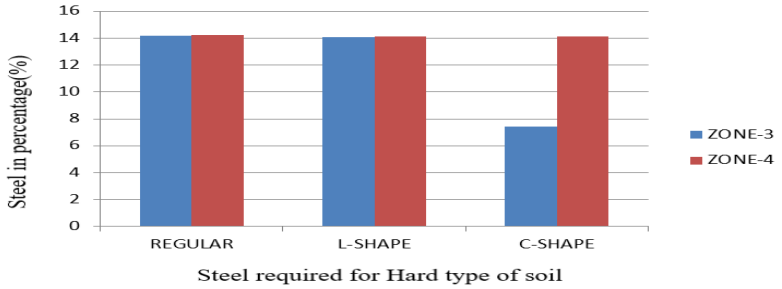

Chart 5. Comparison of steel percentage(%) for Hard soil

Table 6. Comparison of steel percentage(%) for Medium soil

Zone/Soil /Shape	Medium soil		
	Rec. Shape	C-Shape	L-Shape
Zone 3	14.21	14.12	14.09
Zone 4	14.81	14.73	14.63

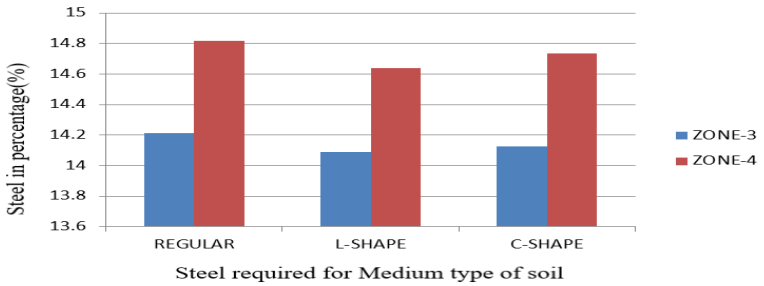

Chart 6. Comparison of steel percentage(%) for Medium soil

Storey Drift: It is defined as the difference in lateral deflection between two adjacent stories and it is shown in bleow.

Table 7. Comparison of storey drift(mm) in X and Z direction for Hard soil , Zone 3

Storey/Soil/ Zone/Shape/Direction	Hard soil and Zone-3					
	Rec. Shape		C-Shape		L-Shape	
	X	Z	X	Z	X	Z
0	0	0	0	0	0	0
1	0.238	0.443	0.231	0.444	0.222	0.461
2	1.883	4.216	1.838	4.184	1.760	4.306
3	2.444	4.653	2.411	4.698	2.293	4.916
4	2.571	4.675	2.556	4.767	2.420	5.038
5	2.576	4.626	2.577	4.756	2.432	5.069
6	2.524	4.513	2.538	4.675	2.389	5.021
7	2.424	4.323	2.449	4.511	2.299	4.882
8	2.270	4.041	2.307	4.251	2.160	4.638
9	2.058	3.655	2.104	3.881	1.964	4.277
10	1.780	3.150	1.836	3.390	1.706	3.786
11	1.433	2.513	1.500	2.765	1.383	3.152
12	1.027	1.735	1.106	1.997	1.005	2.370
13	0.627	0.879	0.720	1.157	0.633	1.514

Table 8. Comparison of storey drift(mm) in X and Z direction for Medium soil , Zone 3

Storey/Soil/ Zone/Shape/Direction	Medium soil and Zone-3					
	Rec. Shape		C-Shape		L-Shape	
	X	Z	X	Z	X	Z
0	0	0	0	0	0	0
1	0.324	0.602	0.315	0.604	0.302	0.627
2	2.561	5.734	2.500	5.687	2.393	5.854
3	3.324	6.328	3.279	6.384	3.116	6.682
4	3.496	6.358	3.476	6.475	3.288	6.847
5	3.503	6.292	3.505	6.459	3.303	6.888
6	3.433	6.138	3.452	6.346	3.244	6.821
7	3.296	5.879	3.331	6.122	3.122	6.631
8	3.088	5.496	3.137	5.767	2.932	6.299
9	2.799	4.971	2.862	5.263	2.665	5.807
10	2.421	4.284	2.498	4.595	2.314	5.138
11	1.949	3.418	2.040	3.743	1.875	4.276
12	1.396	2.360	1.504	2.699	1.360	3.212
13	0.853	1.196	0.979	1.557	0.854	2.048

V. CONCLUSIONS

1. The Structure analyzed in zone 3 and zone 4 of India , than we find out the results in Base shear value is more in the zone 4 and that in the medium soil in irregular configuration.
2. Base shear value is more in the zone 4 and that in the medium soil in regular configuration.
3. Baseshear of seismic zone 4 is higher than 73.53% as compared to zone 3.

4. 4 When compared the both the regular and irregular configuration and the base shear value is more in the regular configuration. Because of the structure have more symmetrical dimensions.
5. Coming to Floor Displacements zone 4 as higher displacements than zone 3.
6. Minimum Displacement is occurring on Rectangular shape of building.
7. Maximum storey drift is occurring on intermediate storey of Rectangular shape building while the minimum storey drift occur on L-shape of building.
8. When compared the both the regular and irregular configuration and the story drift value is more in the regular configuration. Because of the structure has more dimensions.
9. Steel quantity of seismic zone 4 is higher than zone 3.
10. When compared the both the regular and irregular configuration and the steel quantity is more in the regular configuration.
11. From the above results zone 4 is critical for the G+11 structure.
12. comes to seismic zones zone 4 has higher zone factor than zone 3. so zone 4 values are more than zone 3.
13. Base shear, Displacements, and steel quantity are Depends on zone factor, so these values are more in zone 4.

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