Comparative Study on Irregular Structures in Different Seismic Zones

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***Abstract*: Base shear is the expected lateral force that will act at the base of particular building when seismic ground motion takes place. we can find out the base shear using the many techniques like manual method, software method. Many software's are available (ETABS, STAAD Pro, etc..) to find out base shear value of the building STAAD Pro software was chosen for this purpose. This paper directs the study about how much percentage of base shear difference of multistoried building would be there between software method (STAAD Pro) and method.**

Index Term--Manual method, Multistoried building, Lateral force, STAAD Pro, Base shear

I INTRODUCTION

The word earthquake is used to express any seismic occurrence whether natural or caused human that can produced seismic influence around any particular area. Earthquake are caused generally by rupture of geological faults inside the earth, but also by other events such as volcanic movement, landslides, mine blasts, and atomic tests."

"An earthquake may be defined as a wave-like motion generated by forces in constant turmoil under the surface layer of the earth (the lithosphere), travelling through the earth's crust. It may also be defined as the vibration, sometimes violent, of the earth's surface as a result of a release of energy in the earth's crust. This release of energy can be caused by sudden dislocations of segments of the crust, volcanic eruptions, or even explosions created by humans. Dislocations of crust segments, however, lead to the most destructive earthquakes. In the process of dislocation, vibrations called seismic waves are generated. These waves travel outwards from the source of the earthquake at varying speeds, causing the earth to quiver or ring like a bell or tuning fork."

II LITERATURE REVIEW

[1] Arun et.al (2019): In this paper seismic analysis of regular and irregular(C-shape) building model were conducted using manual and software calculation method (STAAD. PRO) and result were compared to each other. For the study they took G+6 multistoried building model with different seismic zones (II, III, IV, V) from the observation that they concluded that results from both methods were not similar to each other and also results were in regular models then irregular models because regular models have more dimension in between their bays.

[2] Akash Panchal, Ravi Dwivedi "ANALYSIS AND DESIGN OF G+6 BUILDING IN DIFFERENT SEISMIC ZONES OF INDIA" In this paper a G+6 existing RCC frame 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. They are to co9mpare the variation of steel percentage, maximum shear force maximum bending moment and maximum deflection in different seismic zone. Variation are drastically higher from zone II to V.

[3] Kumar.n et al (2014) has presented a review of shear wall system. 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.

III. OBJECTIVES

1. To study the IS code recommendations of earthquake (IS: 1893:2002).
2. To calculate and find out the base shear of Multistoried building through static method by

means of manual method as well as using Staad pro software.

3. To study the behavior of regular & irregular building in different zones.
4. To study the earthquake analysis in Staad pro Software.
5. To understand the concept of earthquake and its effects on the structure.
6. To study and analyse the shear forces for various seismic zones.

IV. MODEL DESCRIPTIONS

- 26-storey SMRF Building
- Storey height is 3.2m²
- Slab finish 3.75kN/m²
- Floor finish 1kN/m²
- Intensity of live load on each floor 3kN/m²
- Intensity of live load on each roof 1.5kN/m²
- The soil below foundation is hard
- Building is located in Delhi
- Column =0.5X0.23
- Beam= 0.35X0.23m²

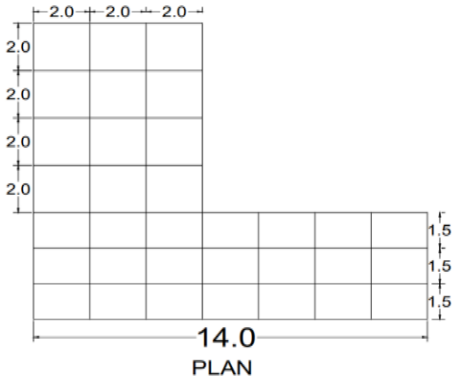

Figure.1 Plan

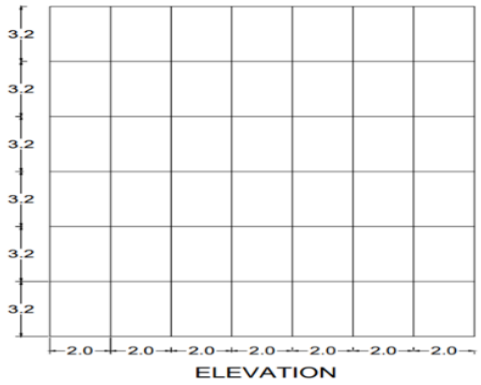

Figure.2: Elevation

V. MANUAL CALCULATION

SL NO	DESIGN PARAMETER		UNITS	REMARKS
1	Zone III	Z=0.24		Clause 6.4 (IS 1893:2002)
2	Importance Factor	I=1.0		Clause 7.2 (IS 1893:2002)
3	Responce Reduction Factor	R=5.0		Clause 6.4 (IS 1893:2002)
4	Floor Area	111	m²	
5	Dead load	3.75	kN/m²	
6	Percentage of live load	50%		
	FLOOR			
7	Effective weight at each floor	6.5	kN/m²	
8	Weight of beam at each floor and roof	293.82	kN	
9	Weight of columns at each floor	441.60	KN	
	ROOF			
10	Effective weight at each roof	3.75	KN/m²	
11	Weight of columns at each roof	220.80	kN	
12	Equivalent load at roof level	930.87	kN	
13	Equivalent load at each floor	1456.92	kN	
14	Seismic weight of the building	8215.47	kN	

Base shear:
Fundamental natural period of vibration of a moment resisting frame without infill
T_a=0.075$h^{(0.75)}$
T_a=0.687sec Clause 7.6.1 from IS 1893(Part1):2002

Average response acceleration co-efficient Sa/g for 5% damping type 1 soil is 1.455
V_B=185.63kN

Content	Data		Remarks
For Delhi (IV), Zone factor	Z	0.16	Clause 6.4 (IS 1893:2002)
Importance factor	I	1.0	Clause 6.4 (IS 1893:2002)
Response reduction factor	R	5.0	Clause 6.4 (IS 1893:2002)
Seismic weight:			
Floor area	[(3X1.5) x (2X7)] + [(2X3) x (2X4)]	111m²	
Dead load	3.75 kN/m²		Clause 6.4 (IS 1893:2002)
Live load	3.5 kN/m²		
Percentage of live load to be considered=50%			
Total seismic weight on the floors W= $\sum W_i$			
Where $\sum W_i$ is the sum of loads from all the floors, which includes dead loads and appropriate percentage of live loads			
LOADS ON FLOOR			
Effective weight at each floor except the roof	3.75+ (3.5X0.5) +1	6.5kN/m²	
Weight of beam at each floor and roof			
Weight of columns at each floor	0.5X0.23 X 3.2 X 48 X25	441.6kN	

LOADS ON ROOF		
Weight of column at the roof	0.25 X 0.5 X (3.2/2) X 24 X 48	220.8KN
Equivalent load at roof level	3.75X111 +220.8 +293.82	930.87kN
Equivalent load at each floor	6.5X111+293.82+441.6	1456.92kN
Seismic weight of the building	930.87+(1456.92*5)	8215.47 kN

VI. MANUAL RESULTS

Table 1: Base shear values for Zone III

SL.NO	STOREY HEIGHT	BASE SHEAR
1	3.2	2.26
2	6.4	11.89
3	9.6	33.61
4	12	72.34
5	16	132.80
6	19.2	188.35

Table 2 : Base shear values for Zone IV

SL.NO	STOREY HEIGHT	BASE SHEAR
1	3.2	3.35
2	6.4	17.59
3	9.6	49.71
4	12	106.97
5	16	196.35
6	19.2	278.47

Table 3: Base shear values for Zone V

SL.NO	STOREY HEIGHT	BASE SHEAR
1	3.2	5.12
2	6.4	26.90
3	9.6	76.02
4	12	163.59
5	16	300.29
6	19.2	425.88

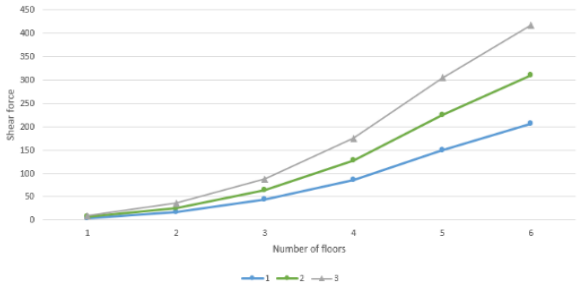

Figure.3: Manual result graph.

ANALYSIS PART

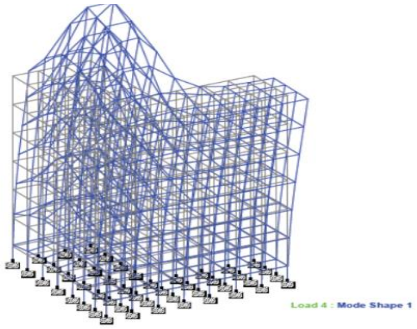

Figure.4: Mode Shape 1

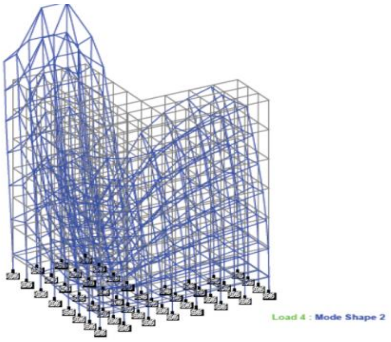

Figure.5: Mode Shape 2

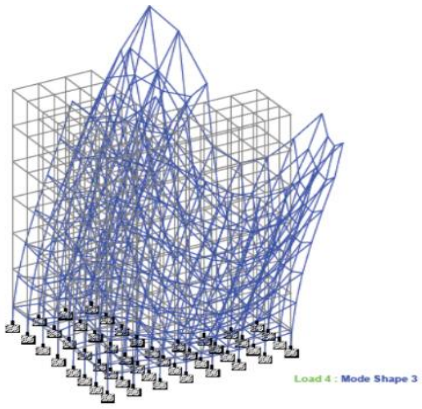

Figure.6 :Mode Shape 3

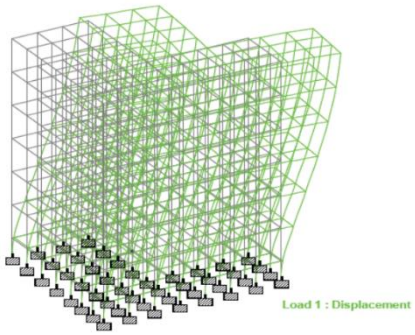

Figure.7: Displacement

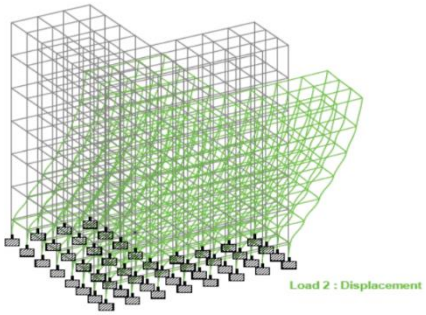

Figure8 : Displacement

VII. SOFTWARE RESULTS

Table 4 **:** Base shear values for Zone III

No of Floors	Storey Height	Lateral Forces (Fx)	Lateral Forces (Fz)
1	3.2	4.61	4.61
2	6.4	13.05	13.05
3	9.6	25.76	25.76
4	12.9	42.75	42.75
5	16	64.03	64.03
6	19.2	55.41	55.41

Table 5 : Base shear values for Zone IV

No of floor	Storey Height	Lateral Forces (Fx)	Lateral Forces (Fz)
1	3.2	6.89	6.89
2	6.4	19.46	19.46
3	9.6	38.43	38.43
4	12.9	63.78	63.78
5	16	95.52	95.52
6	19.2	82.28	82.28

Table 6 :Base shear values for Zone V

No of floor	Storey Height	Lateral Forces(Fx)	Lateral Forces(Fz)
1	3.2	9.37	9.37
2	6.4	26.47	26.47
3	9.6	52.27	52.27
4	12.9	86.75	86.75
5	16	129.93	129.93
6	19.2	112.47	112.47

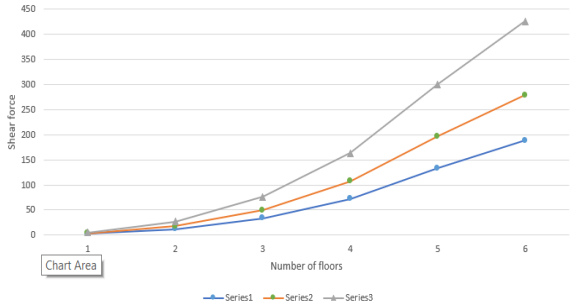

Figure.4

VIII. VALIDATION OF RESULTS

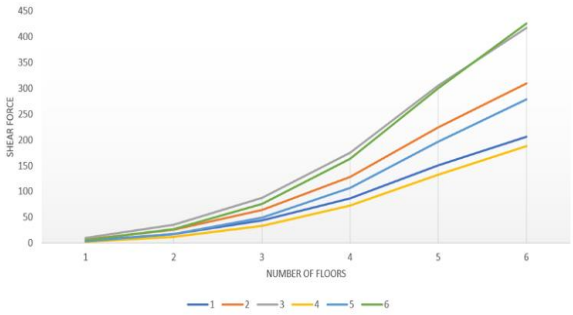

Figure.4

Discussion

From the above graph we can observe that

Software Results

X- axis represents the number of floors and Y-axis represents the shear force. Blue line shows the shear forces for zone III at each floor, red line shows shear forces for zone IV at each floor and grey line shows the shear forces for zone V at each floor.

Manual Results

From the above graph we can observe that X-axis represents the number of floors and Y-axis represents

the shear force. Orange line shows the shear forces for zone III at each floor, sky blue line shows shear forces for zone IV at each floor and green line shows the shear forces for zone V at each floor.

IX CONCLUSION

1) From the graph base shear of the regular building increased by 9% for zone III and zone IV is increased by 11%, zone V is reduced by 2% when we compared manual results with software results.
2) The Base shear value goes on increasing From Zone III to Zone V
3) Manual calculation method shows less base shear value
4) Staad Pro software method shows maximum Base Shear value for zone III, IV and V respectively

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