COMPARATIVE ANALYSIS OF PERCENTAGE OF STEEL AND AXIAL FORCES IN RC BUILDING FOR DIFFERENT SEISMIC ZONES

Mr. Randhir Bute[1], Ms. Vaishnavi Umathe[2], Mr. Akshay Bisen[3], Mr. Amit Borkar[4], Ms. Shubhangi Kurve[5], Mr. Shubham Balekaramkar[6], Ms. Prachi Bondre[7]

[1]*Assistant Professor, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*
[2]*Under Graduate, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*
[3]*Under Graduate, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*
[4]*Under Graduate, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*
[5]*Under Graduate, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*
[6]*Under Graduate, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*
[7]*Under Graduate, Depatment of Civil Engineering, Priyadarshini J.L. College Of Engineering, Nagpur, Maharashtra, India*

ABSTRACT

The main aim of the project is to compare the earthquake resistance structure in different seismic zones by adopting parameters like Percentage of steel and axial forces in beam by using STAAD-PRO. The objective of the project is obtaining the correlation between various parameters like axial force and percentage of steel. The behavior of the structure according to different seismic zone was analyzed. The earthquake load can be applied by using equivalent static method . Zone factor,importance factor,response reduction factor is taken from IS 1893(part 1):2016 according to different zones in india . Analysis of G+3 building by referring IS codes i.e IS: 456 : 2000, IS : 1893 (part I) : 2016, IS : 875 (part II) : 1987 and comparision between the normal load cases i.e DL, LL, EQX, EQZ. Live load will be taken from IS codes.

Keyword – *Percentage of steel, Axial forces, Staad pro, Seismic zones, G+3 Residential building.*

1. INTRODUCTION

Comparison of G+3 RC frame building on different seismic zones by adopting earthquake loads and comparing that structure in terms of different parameters such as percentage of Steel and Axial load by using software STAAD PRO. Due to different zones, zone factor, Importance factor and Response reduction factor are changes. The structure is analysis for maximum load from different load cases. Selecting columns from the whole RC frame building and that selected column are compare in different parameters.

The results which we are getting of different parameters in different zones, which are plotted in the form of graph and obtaining the co-relationship between them.

Following are the parameters which are taken for the analysis and to obtain results:

- Axial force
- Percentage of Steel

2. LITERATURE REVIEW

2.1 Papa Rao and Kiran Kumar (2013): The author's researches on the changes in the percentage of steel and volume of concrete for the RCC framed structure for various seismic zones of India. They have designed the structure for gravity load and seismic forces, which might be effect on building. According to their research, they conclude that the variation in support reactions for exterior columns increased from 11.59% to 41.71% and in case of edge columns, it is 17.72% to 63.7% from Zone II to Zone V and as in the case of interior columns, it is very less. In case of concrete quantities, volume of concrete has been increased for exterior and edge columns from Zone III to Zone V because of increase in support reactions with the effect of lateral forces and variation is very small in interior columns. Percentage variations of steel in external beams are 0.54% to 1.23% and in internal beams, it is noted 0.78% to 1.4%.

2.2 Inchara K P, Ashwini G (2016): The main objectives of this study were to study the performance and variation in steel percentage and quantities concrete in R.C framed irregular building in gravity load and different seismic zones. And to know the comparison of steel reinforcement percentage and quantities of concrete when the building is designed as per IS 456:2000 for gravity loads and when the building is designed as per IS 1893(Part 1):2002for earthquake forces in different seismic zones. In this study five (G+4) models were considered. All the four models were modelled and analysed for gravity loads and earthquake forces in different seismic zones.

2.3 Md Zubair Ahmed, Arshad, & Abdul Khadeer, (2015) the study was conducted to compare percentage of steel quantities for buildings subjected to gravity loads, seismic forces along with wind load. After analysis and design they got to the conclusion that percentage of reinforcement in column with maximum load is 1.985% to 45.438%, in case of beams it was 35.112% to 95.867% for basement floors. As the concrete grade increased reinforcement area decreased. Steel percentage is more in exterior and edge columns while it is less in interior columns and in case of beam external beams require less percentage of reinforcement compare to internal beams.

3. METHODOLOGY

- Seismic analysis of RC frame G+3 building in different zones.
- Review of literature.
- Study of IS code provisions.
- Comparison of results and correlating them in graphs.
- Result discussion and interpretation.

TABLE : Preliminary data of the structure considered for analysis and design

1	**No. of storey**	**G+3**
2	Floor to floor height	3 m
3	Type of support	Fixed support
4	Size of column	450 * 230 mm
5	Size of beam	a. 450 * 300 mm b. For staircase : 600 * 230 mm c. For cantilever : 450 * 150 mm
6	Earthquake load	As per IS: 1893: 2016
7	Slab thickness	150 mm
8	Wall thickness	a. External wall : 230 mm b. Internal wall : 150 mm

9	Dead load including floor finish	4.75 KN/m^2
10	Floor finish	As per IS: 875 (part II): 1987
11	Sesmic zone	All four seismic zones
12	Type of soil taken	Hardy rocky
13	SBC of soil taken	250 KN/m^2

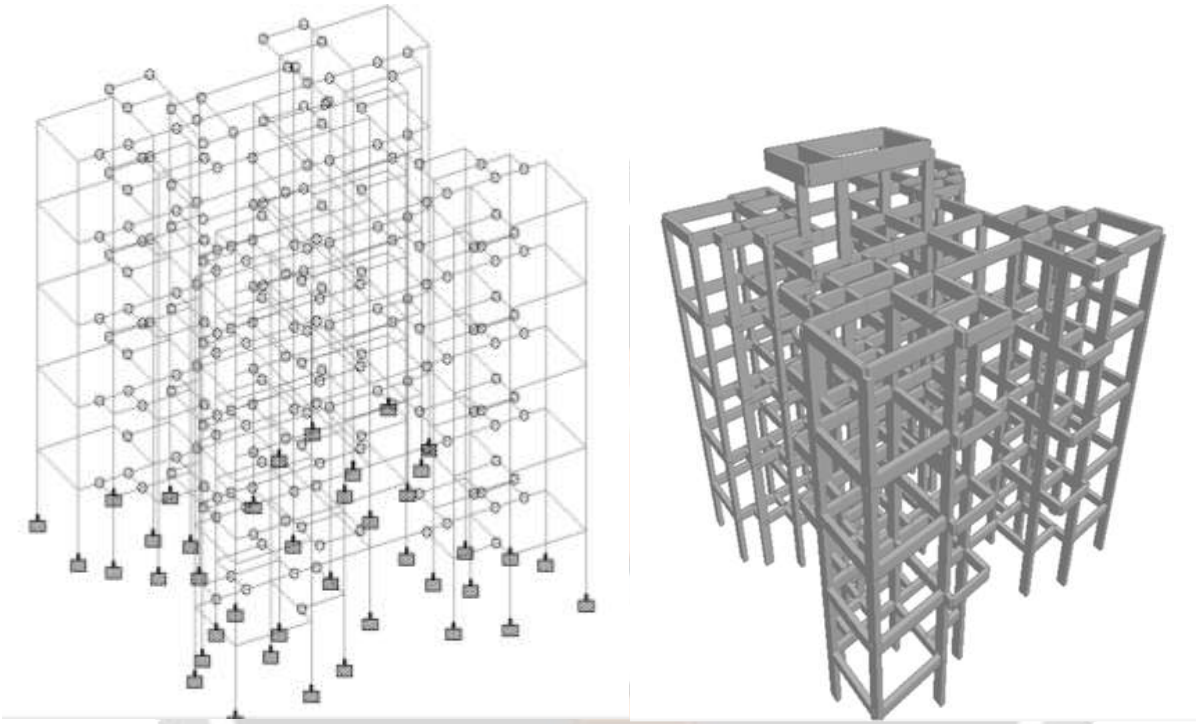

Fig 3.1: Typical 3d view and rendering view of building

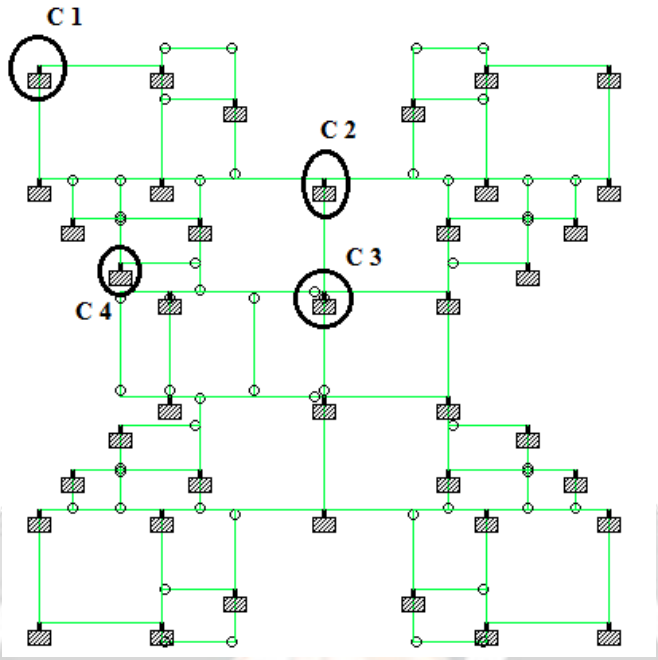

Fig 3.2 : Selected column for analysis

The selected columns for analysis are:-
C1 & C4-Corner column
C2-Middle column
C3-Interior column

4. RESULT AND DISCUSSION:

4.1 Results of axial forces in column :

	I F	II F	III F	IV F	V F
zone II	642.122	526.627	372.291	222.347	84.284
zone III	732.73	598.322	417.517	244.852	91.275
zone IV	844.081	686.942	473.868	273.107	100.104
zone V	1012.518	820.297	557.947	314.89	113.088

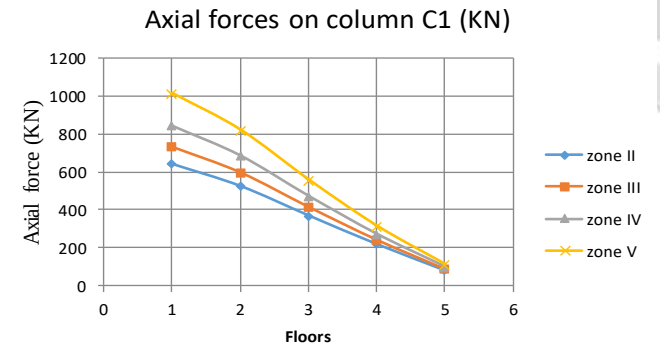

Fig 4.1: Maximum axial forces on column C1

	I F	II F	III F	IV F	V F
zone II	849.052	713.027	516.628	317.966	116.594
zone III	890.326	727.331	518.139	317.966	116.594
zone IV	957.853	777.85	545.293	323.43	116.558
zone V	1264.334	1032.646	722.615	429.204	162.291

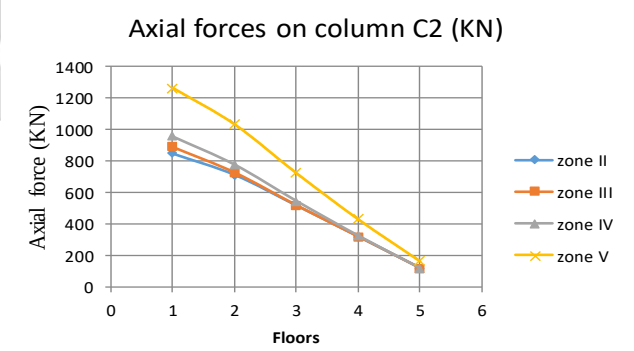

Fig 4.2 : Maximum axial forces on column C2

	I F	II F	III F	IV F	V F
zone II	1284.704	1122.067	855.472	600.91	352.256
zone III	1284.704	1122.067	855.472	600.91	352.256
zone IV	1621.065	1432.361	1109.716	782.483	448.349
zone V	1591.688	1405.768	1089.155	769.197	443.043

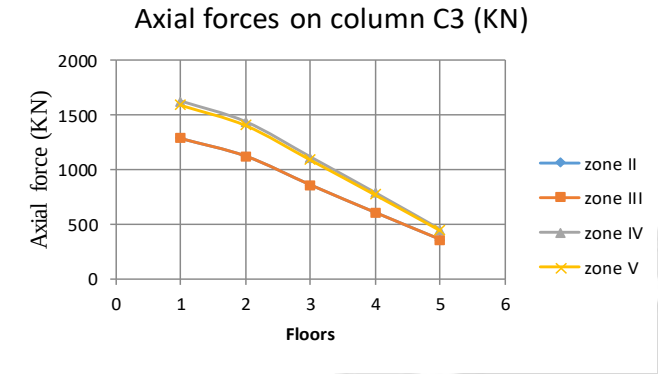

Fig 4.3: Maximum axial forces on column C3

	I F	II F	III F	IV F	V F
zone II	544.527	442.576	312.313	185.494	68.681
zone III	637.18	514.565	356.769	206.932	74.857
zone IV	745.868	598.733	408.073	230.616	81.039
zone V	920.984	735	492.304	271.093	92.668

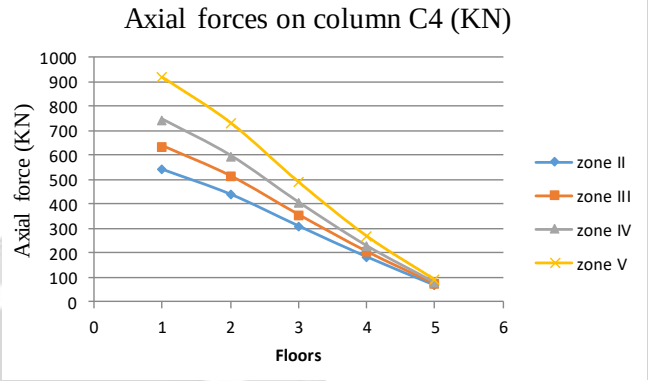

Fig 4.4: Maximum axial forces on column C4

- The axial forces which likely to occur due to seismic force is calculated and tabulated.
- The axial forces which is minimum at each floor level corresponding to ground is shown in fig 4.1, 4.2, 4.3 and 4.4 for equivalent static method.
- The axial forces values are taken and compare in different seismic zone

4.2 Results of percentage of steel:

	C1	C2	C3	C4
zone 2	0.67	1.31	2.12	0.87
zone 3	1.01	2.33	2.33	1.55
zone 4	1.79	3.79	3.45	2.33
zone 5	3.93	3.93	3.79	3.79

Table 2: Percentage of steel

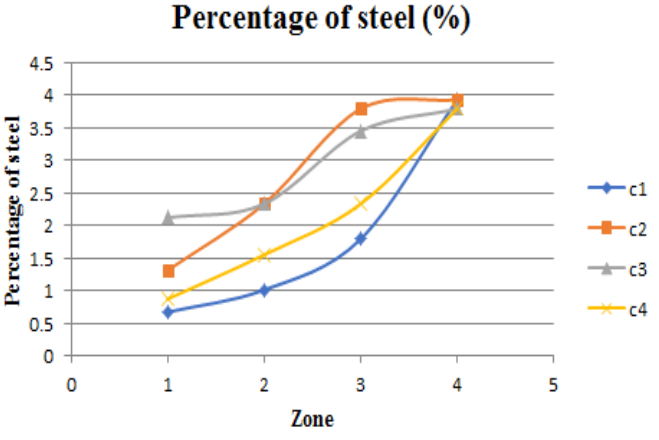

Fig 4.5 : Graphical representation of percentage of steel

- The Percentage of steel which likely to occur due to seismic force is calculated and tabulated.
- The Percentage of steel which is increases at each zone corresponding to zone II is shown in fig 4.5 for equivalent static method.
- The Percentage of steel values are taken and compare in different seismic zone.

5. CONCLUSION

1. An axial force varies floor to floor and decreases with increase of floors.
2. Axial forces in interior column (C3) are more than exterior column (C1).
3. Percentage of steel increases from zone II to zone V.
4. In exterior column i.e. C1, C2 and C4, the percentage is less as compare to interior column i.e. C3.
5. The interior column C3 is also a staircase column. Therefore, the requirement of percentage of steel is more in that column as compare to others.
6. Percentage of steel is approximately same in zone V for selected columns.

6. REFERENCES

1. Comparative study of percentage variation of steel in different seismic zones in india. Salahuddin Shakeeb, prof Brij Bhushan, Prof. Maneeth, Prof. Shaik Abdulla (2015).

2. Variation of steel percentage in different seismic zones including wind effect VS gravity load. Abdul Khadeer Quraishi, Arshad Syed Masood Ahmed, Md. Zubair Ahmed (2015).

3. Comparison of percentage steel and concrete quantites of a R. C building in different seismic zone. Kiran Kumar and G. papa Rao (2013).

4. Reinforced concrete multi-storied structures are very complex to model as structural systems for analysis. C.M. Ravi Kumar1, K.S. Babu Narayan2, M.H. Prashanth3(2012).

5. IS : 456 : 2000 (Plain and reinforced concrete – code of practice).

6. IS : 1893 (PART I) : 2016 General provision and building (Criteria for earthquake resistance design of structures).
7. IS : 875 (Part 2) : 1987 Imposed load (Code of practice for design loads)