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Comparative Study of RCC Multi Storey Building for Various Grades of Steel in Various Seismic Zones

Swati Patil, Shrikrishna A. Gosavi, Amol Kalubarme

***Abstract*— The method of analysis and design of Rcc multistorey building for various grades of steel in various seismic zone i.e., III, IV, V. The scope behind this project is to learn relevant Indian standard codes used for design of various building element such as beam, column, foundation by using a software STAAD-PRO under seismic load acting on a structure. The calculation of base shear and also dead load, live load, seismic load acting on a structure. The structure was analyzed with various combination as per IS 1893:2002 part-1. The analysis and design of structure in various zones and base shear, storey drift, deformation by using STAAD-PRO. We used STAAD-PRO for analysis and design of structure.**

***Index Terms*—Analysis & design, STAAD-PRO, base shear, storey drift, deformation.**

I. INTRODUCTION

Seismic analysis is related to calculation of the response of a building or other structures under earthquakes. It is a part of the process of structural design which includes earthquake engineering or structural assessment and retrofit in regions where earthquakes are prevalent.

During earthquake many of the buildings collapse due to lack of understanding of the inelastic behavior of structure. Elastic analysis gives only elastic capacity of the structure and indicates where the first yielding occurs. It cannot give any information about redistribution of forces and moments and failure mechanism.

For study of inelastic behavior of structure nonlinear analysis is necessary. The development of rational methodology that is applicable to the seismic design of new structures using available ground motion information and engineering knowledge, and yet is flexible enough to permit the incorporation of new technology as it becomes available has been supported for sometimes now. This is the focus of several major research and development efforts throughout the world. In majority of cases nonlinear analysis is used.

Ms. Swati Patil, Civil Engineering, Sveri's college of Engineering Pandharpur, India
Prof. Shrikrishna Gosavi, Civil Engineering, Sveri's college of Engineering, Pandharpur, India
Prof. Amol Kalubarme, Civil Engineering, Sveri's college of Engineering (Poly), Pandharpur, India

II. METHODOLOGY

Following Steps are followed for analysis & Design of G+10 RCC structure for various grades of steel in various seismic zones.

Step 1: Initial setup of Standard Codes and Country codes

Step 2: Creation of Grid points & Generation of structure After getting opened with STAAD-PRO.we select a new model and a window appears where we had entered the grid dimensions and story dimensions of our building.

Step 3: Defining of property Here we had first defined the material property by selecting define menu material properties. We add new material for our structural components (beams, columns, slabs) by giving the specified details in defining. After that we define section size by selecting frame sections as shown below & added the required section for beams, columns etc.

Step 4: Assigning of Property After defining the property we draw the structural components using command menu. Draw line for beam for beams and create columns in region for columns by which property assigning is completed for beams and columns.

Step 5: Assigning of Supports By keeping the selection at the base of the structure and selecting all the columns we assigned supports by going to assign menu joint\frame Restraints (supports) fixed.

Step - 6: Defining of loads in STAAD-PRO all the load considerations are first defined and then assigned. The loads in STAAD-PRO are defined as using stat

Step - 7: Assigning of Dead loads After defining all the loads dead load are assigned for all external walls, internal walls in STAAD-PRO

Step - 8: Assigning of Live loads Live loads are assigned for the entire structure including floor finishing. Step - 9: Assigning of Seismic loads Seismic loads are defined and assigned as per IS 1893: 2002 by giving response reduction factor in X and Y directions having total height less than 12 meters there is no need of assigning Seismic loads.

Step - 10: Assigning of load combinations Using load combinations command in define menu be taken as mentioned in above.

Step - 11: Analysis After the completion of all the above steps we have performed the analysis and checked for errors.

Step - 12: Design After the completion of analysis we had performed concrete design on the structure as per IS 456:2000.

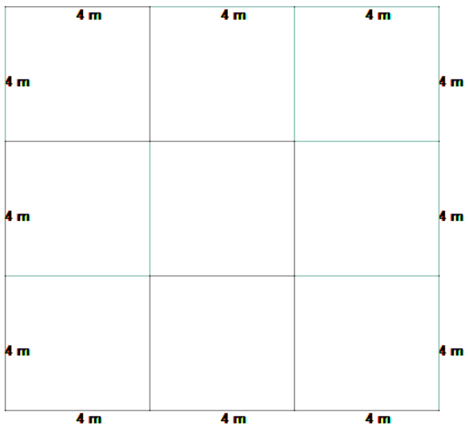

Fig 1: Plan of a structure

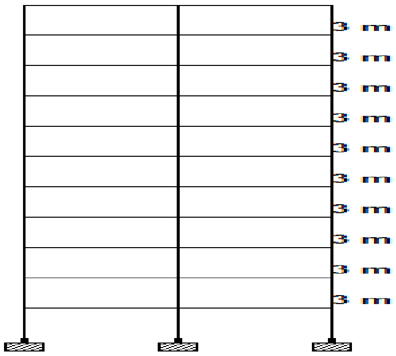

Fig 2: Elevation of a Structure

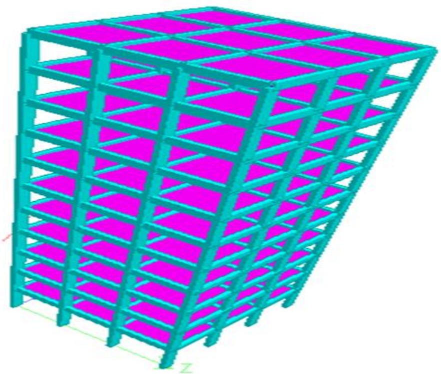

Fig 3: 3D view of a Structure

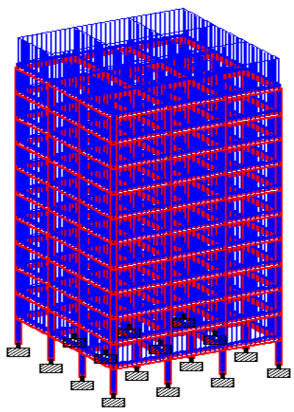

Fig 4: Structure subjected to vertical loading

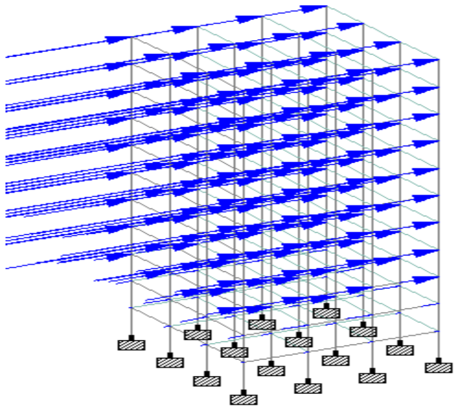

Fig 5: Structure subjected to earthquake loading in +X direction

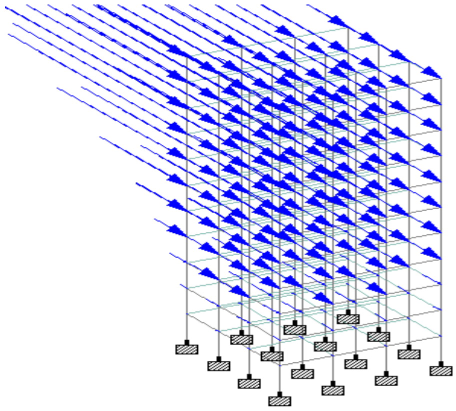

Fig 6: Structure subjected to earthquake loading in +Z direction

A) Preliminary data for problem taken

Type of the structure	RCC Framed structure
Number of stories	G+10
floor to floor height	3 m
Grade of concrete	M30
Grade of steel	415 N/mm²& 500 N/mm²
Earthquake load	As per IS1893 (Part 1): 2002
Size of the columns	0.3mx0.6m
Size of the beams	0.6mx0.3m
Slab thickness	0.150 m
Type of soil	Medium soil
Live load	3.5 KN/ m²
Seismic zones considered	IIII, IV, V

Table-1 Data used for analysis of RCC structure

III. RESULT

In order to understand the behavior of structure Bending moments, shear force, deflection, weight of steel, base shear results are compared with different grades of steel in various seismic zones.

Beam Result			
Grade of steel	Bending Moment (KN/m2)		
	III	IV	V
Fe 415	73.55	81.72	183.88
Fe 500	81.72	110.33	122.59

Table. 2 Comparison of Bending Moment of beam in different seismic zones

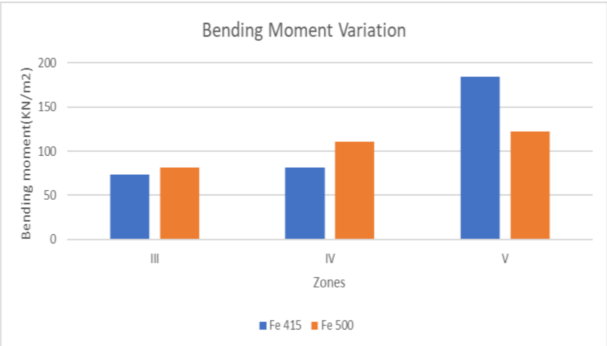

Fig 7: Variation of Bending Moment in Beam in different seismic zones

Beam Result			
	Shear Force (KN)		
Grade of steel	III	IV	V
Fe 415	25.34	28.16	63.36
Fe 500	28.16	38.01	42.24

Table.3 Comparison of Shear Force in beam in different seismic zones

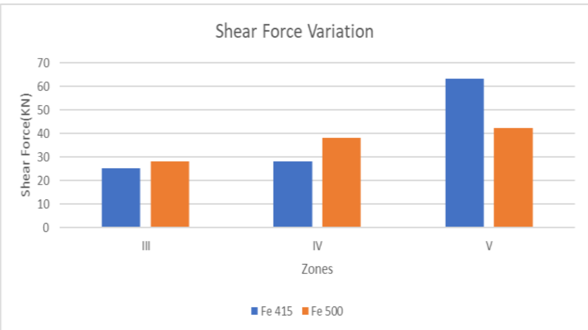

Fig 8: Variation of Shear Force in beam in different seismic zones

Beam Result			
Grade of steel	Deflection (MM)		
	III	IV	V
Fe 415	3.644	4.049	9.109
Fe 500	4.049	5.466	6.073

Table.4 Comparison of Deflection in beam in different seismic zones

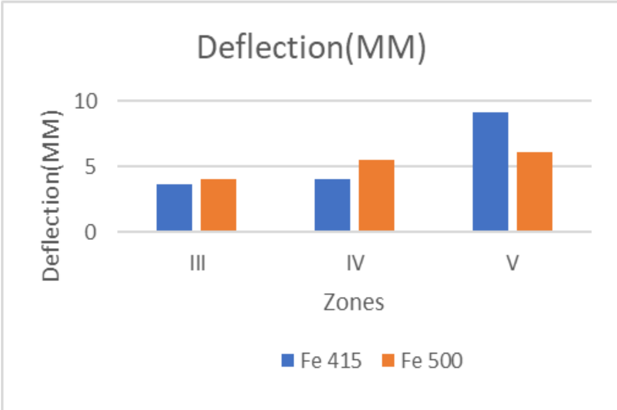

Fig 9: Variation of Deflection in beams in different seismic zones

Column Result			
Grade of steel	Bending Moment (KN/m2)		
	III	IV	V
Fe 415	55.76	61.96	139.41
Fe 500	61.96	83.64	92.94

Table. 5 Comparison of Bending Moment in Column in different seismic zones

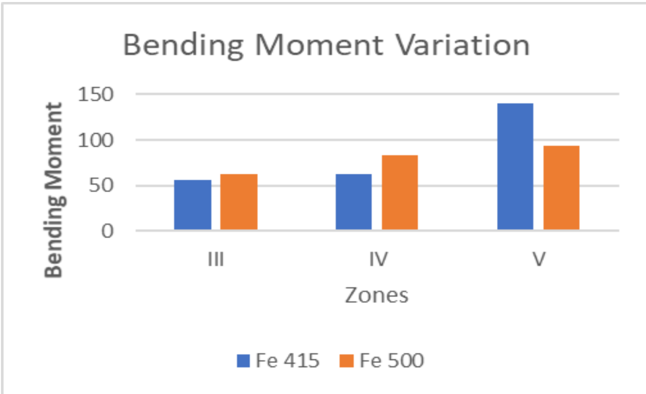

Fig 10: Variation of Bending Moment in Column in different seismic zones

Column Result			
	Shear Force (KN)		
Grade of steel	III	IV	V
Fe 415	32.47	36.08	81.18
Fe 500	36.08	48.7	54.12

Table.6 Comparison of Shear Force in Column in different seismic zones

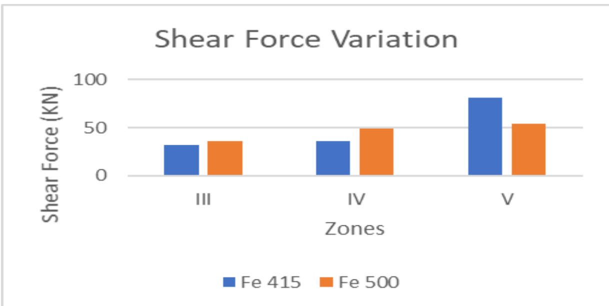

Fig 11: Variation of Shear Force of Column in different seismic zones

Column Result			
Grade of steel	Deflection (MM)		
	III	IV	V
Fe 415	3.644	4.049	9.109
Fe 500	4.049	5.466	6.073

Table.7 Comparison of Deflection in Column in different seismic zones

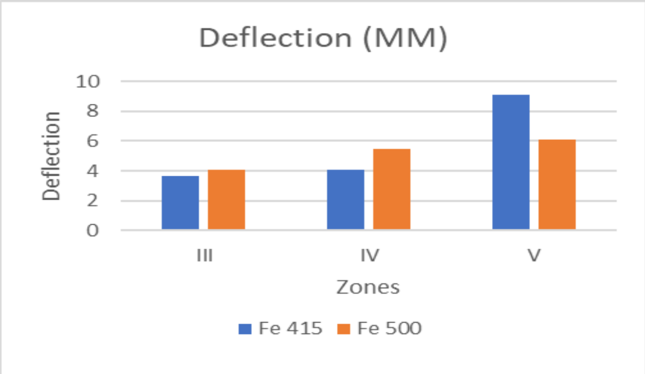

Fig 12: Variation of Deflection in Column in different seismic zones

RCC structure			
Weight of steel(ton)			
Grade of steel	III	IV	V
Fe 415	141.381	141.391	193.162
Fe 500	122.655	130.017	133.509

Table 8 : Comparison of weight of steel of a structure in different seismic zones

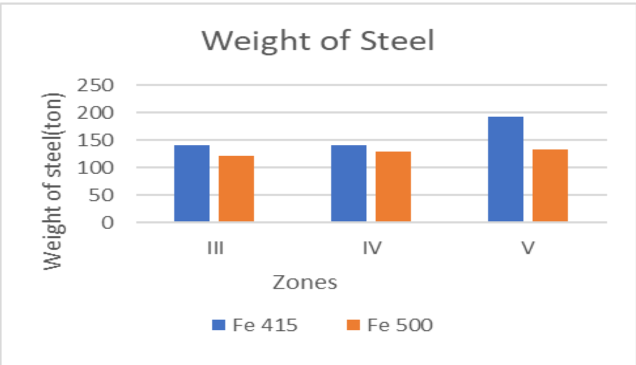

Fig 13: Variation of weight of steel of a structure in different seismic zones

Base Shear (KN)			
Grade of steel	III	IV	V
Fe 415	428.01	475.56	642.01
Fe 500	475.56	713.34	1070.01

Table. 9 Comparison of Base shears of structure in different seismic zones

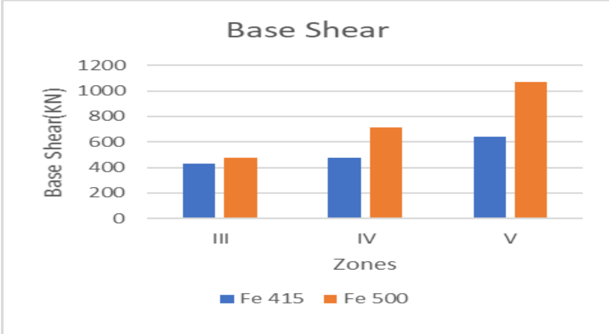

Fig 14: Variation of Base shear of structure in different seismic zones

IV. Conclusion

In this study the behavior RCC Multistorey building, The Building models were investigated by using Linear analysis in STAAD-PRO. these Building were analyzed & designed with different seismic loading combinations. The Research focused on analysis of RCC Multistorey building for different grades of steel in various seismic zones from this study following conclusions were drawn.

G+10 RCC building is modelled in Staad-Pro with Different grades of steel i.e., Fe415, Fe500 in various seismic zone III, Zone IV, Zone V and Analysis & Design is done in Staad-Pro.

In Beam, bending moment, Shear Force, Deflection in zone-V is seen maximum as compared with Zone-III & Zone-IV.

In Column Maximum Bending Moment, Maximum Shear Force, Maximum Deflection are Calculated and it is observed that it increases from Zones IIII to V.

The effect of increasing levels of seismic force the steel requirement is increases, and cost of building is also increases.

The structure is analyzed in different seismic zones from that we find out results in base shear of a building is more in Zone-V as compared with Zone-III & Zone-IV.

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