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Seismic Effect on R.C.C.Building for Floor Wise Minimization of Column Cross Section

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ABSTRACT- These project deals with the comparative study of performance of multistory R.C.C. building for floor wise reduction of column cross section and constant column cross section. For this study a G+6 storey R.C.C. building in Zone IV is selected. Horizontal seismic forces are calculated based on Equivalent static method. The R.C.C component like beam and column are designed by preparing Microsoft Excel sheet based on analysis result. The columns are designed as constant column cross section and reducing column cross section. The push over analysis is carried out on the building frame model with constant column cross section and floor wise reducing column cross section separately using SAP 2000 Software package. A comparative study is carried out for the formation of plastic hinges on column and beam, base force and displacement of the building model for constant column cross section and reducing column cross section. A comparative study of Bending moment and Shear force for the building model is also carried out constant column cross section and reducing column cross section. The quantity estimation for the beam and column is also carried out for constant column cross section and reducing column cross section building model and comparative study is carried out.

Keywords- G+6 storey R.C.C. SAP 2000 Software package, constant column & reduction of column.

I. INTRODUCTION

A column is an important component of R.C.C Structures. A column in general may be defined as a member carrying direct axial load and bending moment. The design of RCC column is very important in structural design of building. Reinforced concrete columns are used to transfer the load of the structure to its foundations. These are reinforced by means of main longitudinal bars to resist compression and bending; and transverse steel (ties) to resist bursting force. Generally ground floor column carries maximum axial load and it reduces with the number of floor. The cross section of the column is kept constant throughout its height from ground floor to top floor for simplicity in construction work. In the present study an attempt will be made to study the effect of reduction of column cross section, floor wise on the performance of the building using pushover analysis. The reduction in the column cross section may result in reduction of cost also. Here, the seismic analysis and design of RCC components will be carried out using STAAD pro and pushover analysis will be carried out using SAP2000.The building is first modeled in STAAD. Pro and subjected to Dead Load, Live Load & Earthquake Load under various Load

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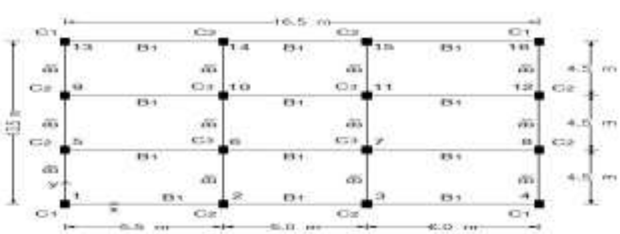
Combinations. Base Shear is calculated using the provisions given in IS 1893:2002 and the obtained pattern is plotted for reference. The reinforcements derived from STAAD output file are grouped and saved in the form of reinforcement results. With the obtained results the file is imported to SAP2000, where they obtained reinforcement is provided and the building is subjected to loads and Pushover Analysis is carried out. During Modeling in SAP 2000 for pushover analysis precautions were taken in defining the hinge properties and their locations.

II. METHODOLOGY

The project deals with the brief introduction of project work and scope of the project. Also Explores brief about the literatures in the area of nonlinear analysis, seismic analysis and design. And Introduction of seismic analysis and detail procedure, different terms involved and also seismic analysis of G+6 storied R.C.C. building carried out by STAAD-PRO and checked by manual calculations. Then discuss RCC design of Beam and column of G+6storey building for constant column cross section and reducing column cross section. After that pushover analysis carried out for G+6 storey building for constant column cross section and reducing column cross section.

Seismic Analysis of (G+6) Storied Building

The seismic analysis of G+6 storey building following data is carried out using equivalent static method as per IS1893:2002. Seismic Zone IV, Floor height 3.6 m, Building height 25.2 m, Plan size 16.5m x 13.5m, Super imposed load 3kN/m^2 , Floor load 1.5kN/m^2 , Size of columns 300 mm x 600 m , Size of beams 300x450 mm, Walls (a) External 230mm (b) Internal 115mm, Thickness of slab 150mm, Hard strata below ground level 2m.



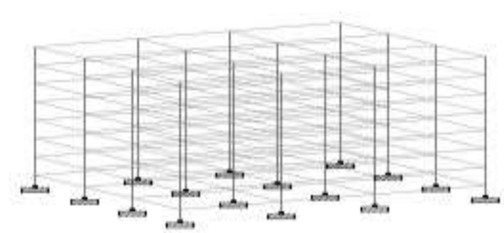


Fig 1. Typical Floor plan for (G+6) Storied building Fig 2.Model of G+6 building by using STAAD- PRO

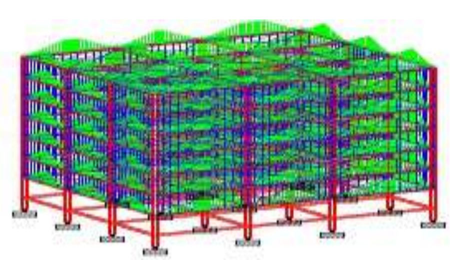


Fig 3. Rendering view for G+6 buildingFig 4. Dead load assignment in G+6 building model.

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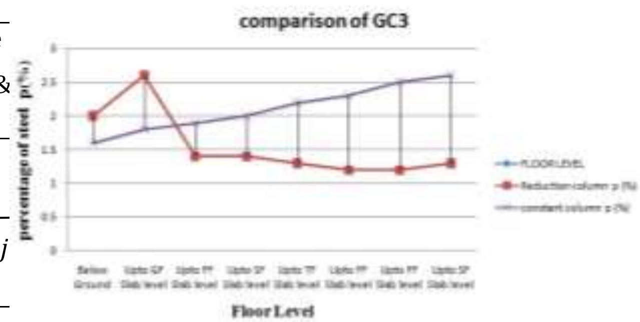
Comparison of results between manually & software (STAAD-PRO)

Floor	wj (kN)	hj (m)	$wjhj^2$	Lateral force direction X & X direction Vbx= $\frac{wjHj^2}{\sum wjHj}$			
7	1730.66	25.2	1.099X10^6	202.93	[illegible]	[illegible]	[illegible]
6	3193.43	21.6	1.49X10^6	275.128	243.135	233.70	211.398
5	3193.43	18	1.034X10^6	190.928	168.073	167.85	151.822
4	3193.43	14.4	662.19X10^3	122.273	108.055	112.86	100.085
3	3193.43	10.8	372.48X10^3	68.778	60.780	68.75	62.188
2	3193.43	7.20	165.55X10^3	30.569	27.014	35.52	32.126
1	3193.43	3.60	41.38X10^3	7.640	6.752	9.38	11.90
∑			4.865X10^6	898.246	793.669	827.382	749.815



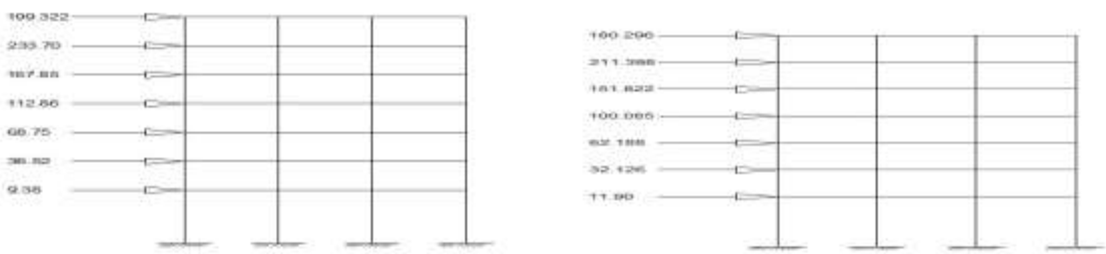


Fig 5. Lateral Forces at each floor in X & Y Direction by software Calculation.

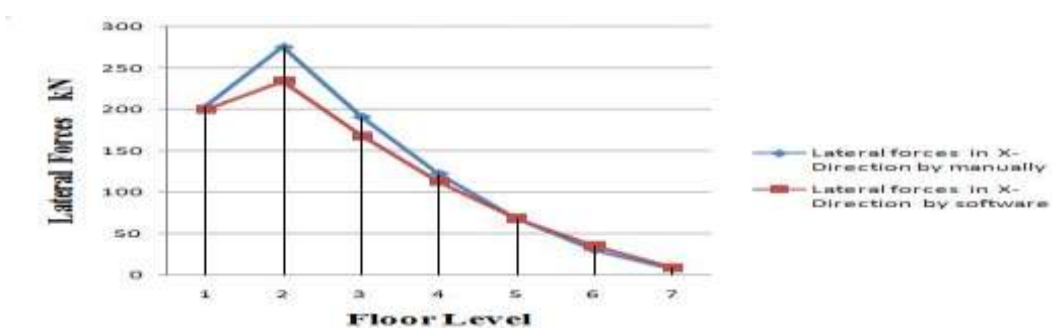


Fig 6.Graphical Representation of comparison of Lateral Forces by manually & Software in X-direction.

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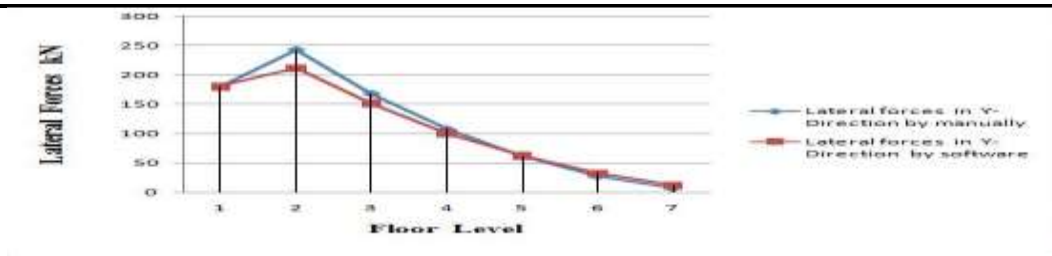


Fig 7. Graphical Representation of comparison of Lateral Forces by manually & Software in Y-direction.

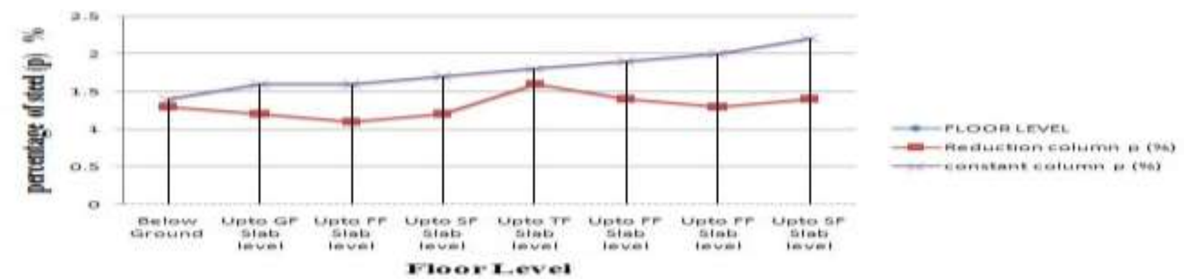


Fig 8. Graphical Representation of comparison of percentage of steel (pt) for GC1 related to Constant and Reduction of column cross section.

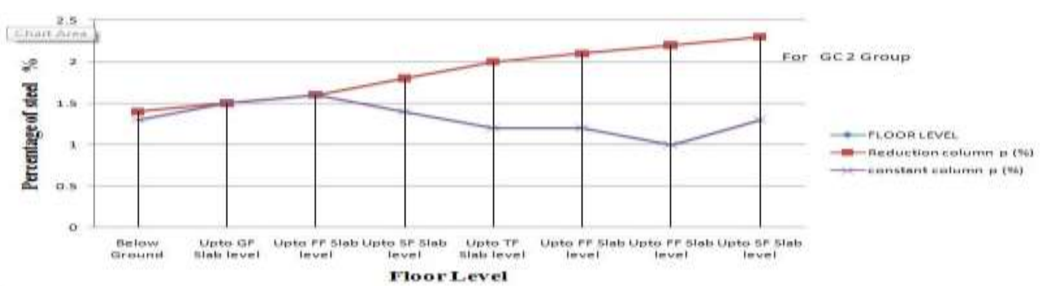
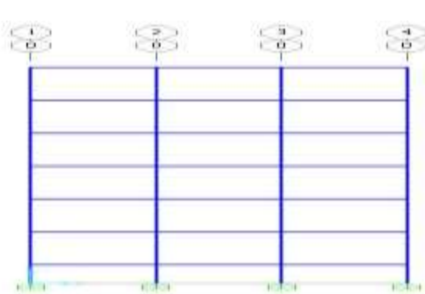


Fig 9.Graphical Representation of comparison of percentage of steel (pt) for GC2 related to Constant and Reduction of column cross section



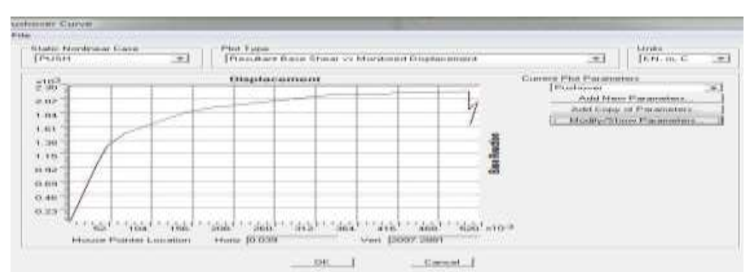


Fig 10.Side View of Constant Column Cross Section by Sap2000 **Fig 11.Push over curve for Base shear Vs Displacement**

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Step	Displacement	Base Force	A to B	B to IO	IO to LS	LS to CP	CP to C	C to D	D to E	Beyond E	Total
	meter	kN									
0	0.000042	0	560	0	0	0	0	0	0	0	560
1	0.033411	958.632	558	2	0	0	0	0	0	0	560
2	0.047099	1277.411	512	48	0	0	0	0	0	0	560
3	0.069835	1499.98	462	98	0	0	0	0	0	0	560
4	0.14661	1848.065	406	154	0	0	0	0	0	0	560
5	0.182344	1933.886	392	148	20	0	0	0	0	0	560
6	0.329268	2140.577	378	68	112	2	0	0	0	0	560
7	0.331072	2142.103	376	70	112	2	0	0	0	0	560
8	0.505982	2208.493	376	0	90	92	0	2	0	0	560
9	0.506082	1895.013	376	0	90	82	0	0	12	0	560
10	0.512461	1981.082	376	0	88	84	0	0	12	0	560
11	0.517482	2020.317	376	0	88	78	0	6	12	0	560
12	0.508211	1635.669	376	0	88	76	0	0	20	0	560

Table: - For pushover curve Base Force Vs Displacement(For Constant Column Cross Section)

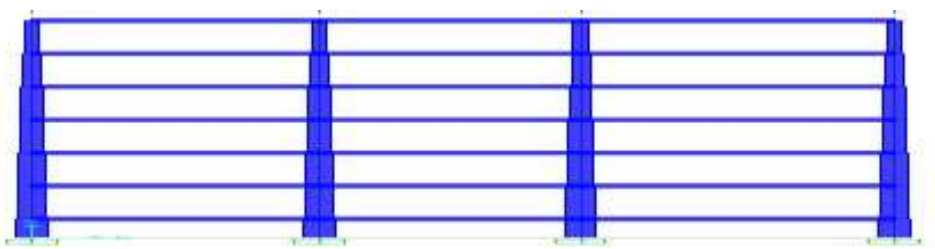

Fig 12. Side View of Reduction Column Cross Section by Sap2000

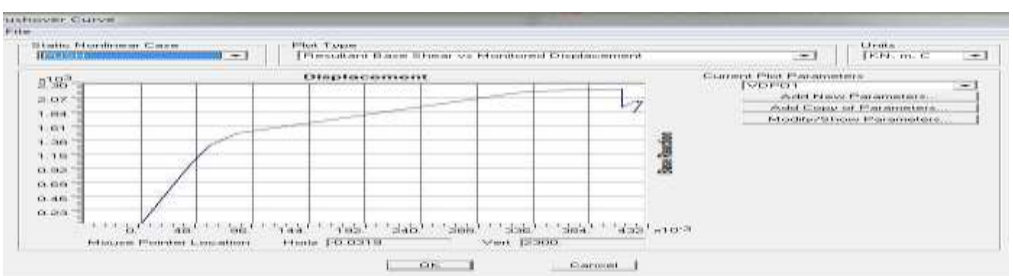

Fig 13. Push over curve for Base shear Vs Displacement

Table: - for pushover curve Base Force Vs Displacement For Reduction of Column cross section)

Step	Displacement	Base Force	A to B	B to IO	IO to LS	LS to CP	CP to C	C to D	D to E	Beyond E	Total
	meter	kN	560	0	0	0	0	0	0	0	560
0	-0.000105	971.912	510	4	0	0	0	0	0	0	560
1	0.041966	1278.422	472	50	0	0	0	0	0	0	560
2	0.058152	1481.256	472	88	0	0	0	0	0	0	560
3	0.082363	2149.418	414	52	0	0	0	0	0	0	560
4	0.323954	2176.734	400	66	70	24	0	0	0	0	560
5	0.340696	2217.801	396	56	68	26	0	0	0	0	560
6	0.412384	1906.804	396	56	50	54	0	4	0	0	560

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7	0.412484	1960.804	396	56	50	46	0	0	12	0	560
8	0.417119	1960.794	396	56	48	48	0	0	12	0	560
9	0.426585	2015.919	396	56	44	50	0	2	12	0	560
10	0.425785	1987.929	396	56	44	50	0	0	14	0	560
11	0.429551	2015.402	396	56	44	48	0	2	14	0	560
12	0.422303	1815.260	396	56	44	48	0	0	18	0	560

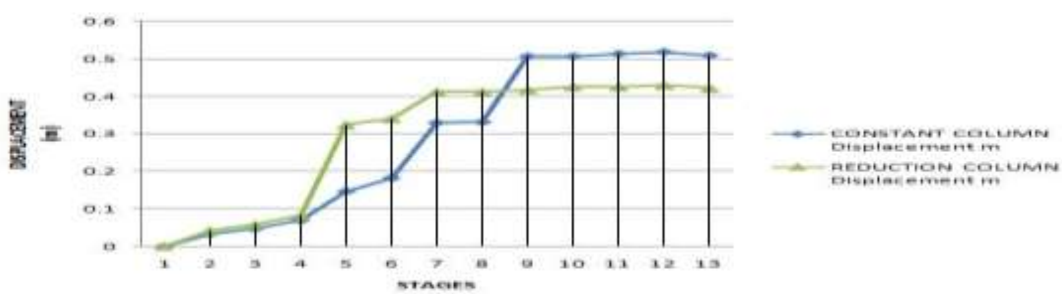

Fig 14. Graphical Representation of comparison of Displacement (m) for Constant and Reduction of column cross section

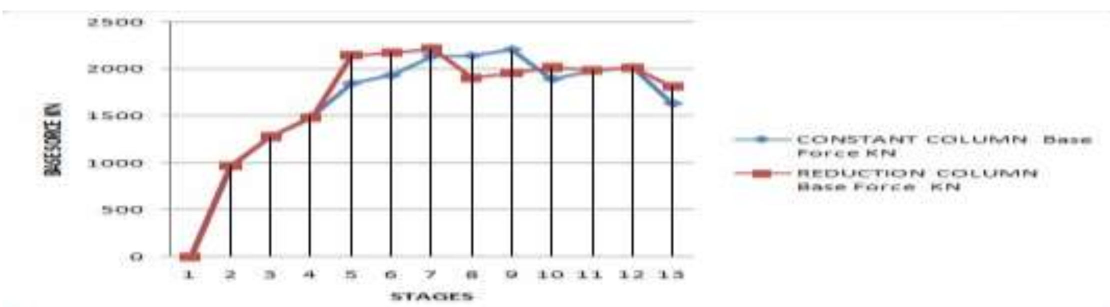

Fig 15.Graphical Representation of comparison of Base force (kN) for Constant and Reduction of column cross section.

III. CONCLUSION

The effect of horizontal Force or Gravity load on reduction of column cross section is less as compare to constant column cross section. For reducing column cross section building model as a cross section is reducing the percentage of steel requirement for column is lesser than the constant column cross section. From pushover analysis on building model with constant column cross section and reducing column cross section, it is observed that the plastic hinges are quickly form in reducing column cross section as compare to constant column cross section. The comparison of maximum displacement in constant column cross section and reducing column cross section shows that the, displacement in reducing column cross section is less than constant column cross section. The comparison of maximum Base force in constant column cross section and reducing column cross section shows that the, Base force in reducing column cross section is more than constant column cross section. The bending moment in constant column cross section is more than reducing column cross section. The shear force in constant column cross section is more than reducing column cross section. The quantity of concrete in constant column cross section is more than reducing column cross section.

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