

Comparative Performance based Evaluation of Irregular RC Building as per IS 1893-2016 & IS 1893-2002

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Abstract - In this study the impact of IS 1893-2016 & IS13920-2016 on the performance of building under the action of seismic loads is studied. using pushover analysis with ETABS 2015.2.2 software. For this low, high rise buildings are studied. Firstly irregular building design by IS 18933-2002 & IS13920-1993. The parameters such as lateral displacement, drift ratio, pushover curve, progressive development of hinges and moment curvature relation of hinges are evaluated and compared with the same model building design by IS 1893-2016 & IS13920-2016. It is found that in comparative studied of two model design by IS1893-2002 & IS1893-2016. Lateral stability & strength of building is not fulfill the required criteria of codal provision of IS1893-2016, the building designed by IS1893-2002.

Key Words: (Pushover analysis, ETABS, Irregular building, IS 1893, IS 13920 performance point)

1. INTRODUCTION

To analyze these structures is very complex and time taking task. In contrast to initial methods many new methods are now been followed to study the structure with greater insight. One of these techniques involves studying the non-linear behavior of structures. Nonlinearity can be of two types, geometric nonlinearity and material nonlinearity which will be talked about later. Quest to understand the behavior of structure more lively or in a more realistic way leads us to dynamic study of structures.

1.1 Different methods for seismic analysis

Thus at present we have various types of methods in hand to analyse a structure for its seismic performance. These methods are shown in table.

Analysis Type	Linear	Nonlinear
Static	Strength based	Pushover Analysis
Dynamic	Response Spectrum	Time History

1.2 Advantage of the study

The advantage of this study we compare the both code IS 1893-2002 & IS1893-2016 and know the effect of IS 1893-2016 on performance of building design by IS 1893-2002.

In this study we compare the lateral stability analysis result of building design by IS 1893-2016 & IS 1893-2002.

2. MODELING OF G+8 BUILDING AS PER IS 1893-2002 & IS 1893-2016

The grade concrete used is M25 for beams and slab. M 30 grade of concrete is used for columns.

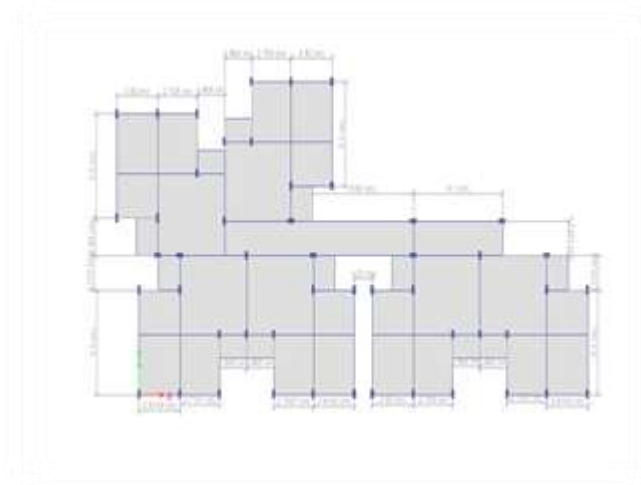
2.1 Geometric detail and use of building

Table -1: uses of floor

FLOOR NO.	USE OF FLOOR
Ground Floor	Use for parking
First floor	Residential use
Second floor	Residential use
Third floor	Commercial use
Fourth floor	Commercial use
Fifth floor	Commercial use
Sixth floor	Residential use
Seventh floor	Residential use
Eighth floor	Commercial use

The dimensions of beam is 230mm x 450mm for residential use of floor and 300mm x 600mm for commercial use of floor. The dimensions of columns is varies 300mm x 450mm to 300mm x 900 mm.

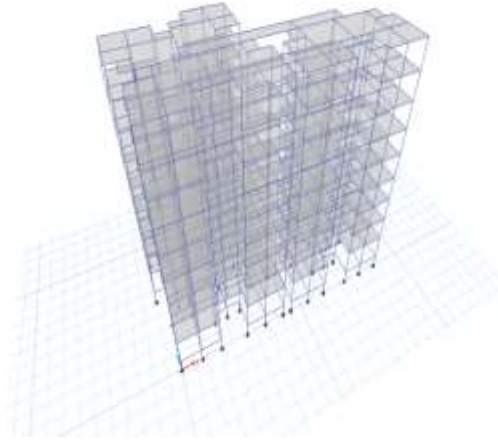
Fig. 1 plan of building



Following load cases are taken:

1. Dead load: - the dead load of frame members i.e. beams and columns is calculated automatically by the software and it need not be provide explicitly. The dead load of slab of 150mm is 3.75 kN/m².
2. Live load: - live load on slabs is 2 kN/m², 3 kN/m², 5 kN/m² as per IS 875 (part 2)
3. Floor finish load: -1.5 kN/m².
4. PX- this load case is used for pushover analysis in X-direction.
5. PY- this load case is used for pushover analysis in Y-direction.
6. As per IS 1893-2002 importance factor considered I = 1
7. As per IS 1893-2016 importance factor considered I= 1.2
8. The value of response reduction factor (R) is considered "5" for seismic zone -4 as per IS 1893-2002 & IS 1893-2016.

Etabs model of G+8 Building



3. RESULT AND CONCLUSIONS

3.1 The results of the study include results obtained from the analysis of the building models by ETABS. These are presented for the following categories:

1. Liner static analysis
 - 1.1 Diaphragm drifts
 - 1.2 Max. story displacements
 - 1.3 Max. story drifts
 - 1.4 Story stiffness
 - 1.5 Story shear
2. Pushover analysis

Table -2 Maximum story displacements for G+8 building in X direction

Maximum story displacement in x direction			
Story No.	model 1893-2002	model 1893-2016	% increase
	Maximum (mm)	Maximum (mm)	
9	42.59	48.25	13.290
8	40.69	46.08	13.246
7	37.49	42.50	13.364
6	33.02	37.44	13.386
5	28.49	32.28	13.303
4	24.19	27.41	13.311
3	19.68	22.29	13.262
2	14.22	16.11	13.291
1	7.83	8.87	13.282
0	1.23	1.39	13.008

Fig 2:-Story shear for G+8 building in X direction (as per IS 1893-2016)

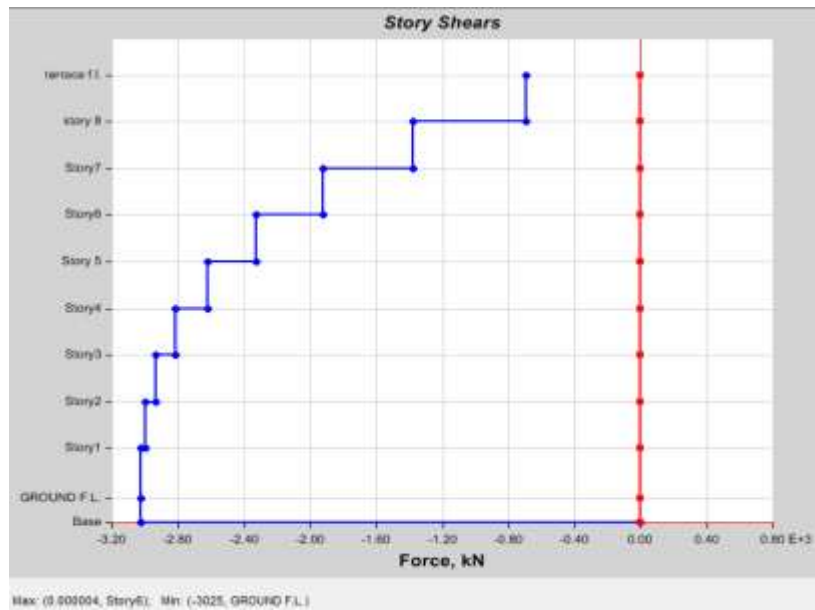


Fig 3:-Story shear for G+8 building in X direction (as per IS 1893-2002)

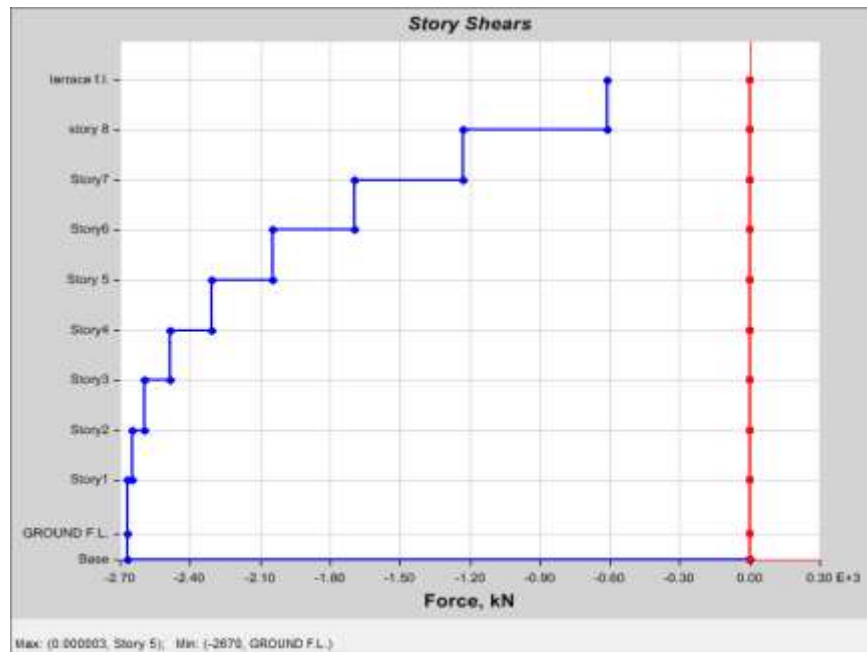


Fig.4 -PX, Progressive development of non-linear hinges in X direction of building (as per IS 1893-2002).

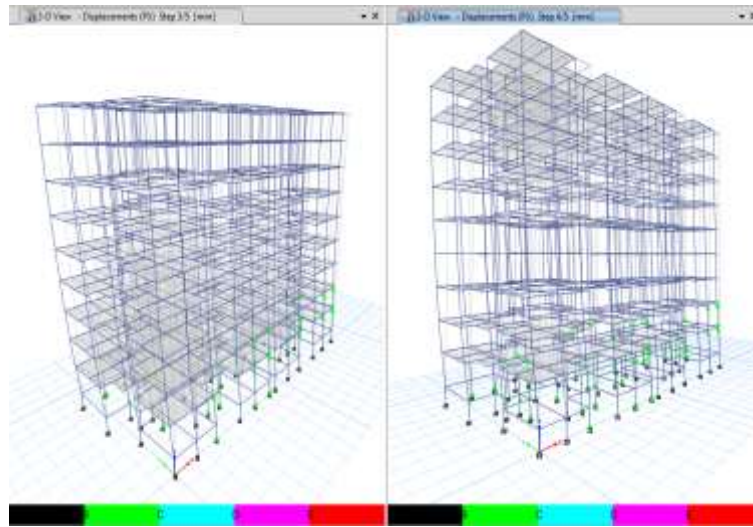
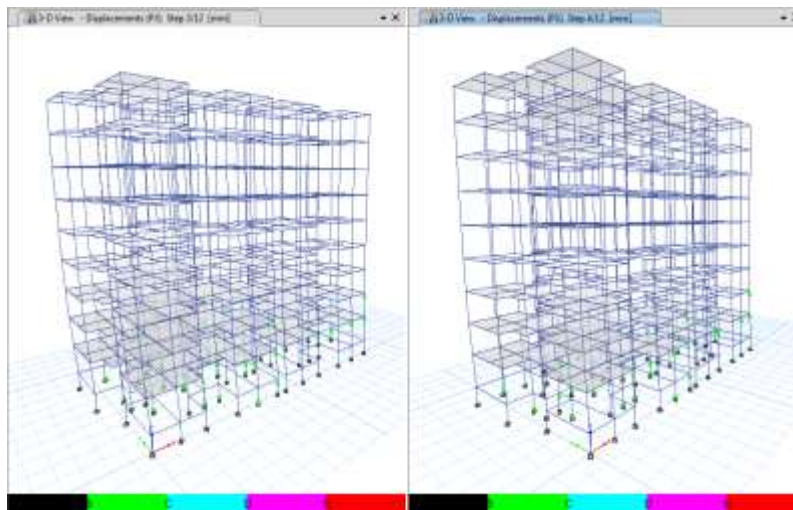


Fig.5 -PX, Progressive development of non-linear hinges in X direction of building (as per IS 1893-2016).



3.2:- CONCLUSIONS

In the present study, G+8 building are analyzed using linear static analysis & pushover analysis for two different types of models. Out of the two models one design by IS 1893-2002 and other one is design by IS 1893-2016. On the basis of present analysis the following conclusions can be drawn:

1. In the linear static analysis the diaphragm drifts increases by 13-14 % in the G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002.
2. The maximum story displacements increases by 13-14 % in the G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002.
3. The maximum story drifts increases by 13-14 % in the G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002.
4. The story stiffness decreases in the G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002. The soft story is generate in G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002.
5. The story shear increases in the G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002.

6. By observing the progressive development pattern of non-linear hinges, it is concluded that number of locations where non-linear zones are formed is more in G+8 building design by IS 1893-2016 as compare building design by IS 1893-2002.
7. The non-linear hinges requires more bending moment to cross different performance levels for the G+8 building model design by IS 1893-2016 as compare building design by IS 1893-2002.

The final conclusion is that if we use importance factor I -1.2 (IS 1893-2016) as compare to importance factor I- 1 (IS 1893-2016) building reinforcement is increase with 20-25% so building cost will increase. The performance of building is diereses in design of IS -1893 2016, the building previously design in Is 1893-2002.

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