Structural System Comparison using IS 1893:2002 and IS 1893 Draft code

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Abstract- *Tall building development have been rapidly increasing worldwide because rapid growth of the population, high cost of land and need importance of agriculture production. This article is discuss importance of structural system for lateral load design. and various standard provide for lateral load resisting system IS 1893(Part-1):2002 are generally use for static and dynamic effect of seismic load. This standard is revised by some research present by IITK IS 1893(Part-1): Draft code. There is various changes like time period for shear wall structure.*

Keywords- Rigid frame structure, Shear wall structure, Braced structure, Etab, Displacement, Storey drift, Storey force, Storey shear

I. INTRODUCTION

The earthquake resistant design of structure taking into account seismic data from studies of these Indian earthquakes has become very essential, particularly in view of the intense construction activity all over the country. It is to serve this purpose that Is 1893:1962 'Recommendation for earthquake resistant design of structures' was published and revised first time in 1966.

Revise the standard again incorporating many changes, such as revision of maps showing seismic zones and epicenters, and adding a more rational approach for design of building and sub-structures of bridges. These were covered in the second revision of IS 1893 brought out in 1970.

Third revision of the standard was brought out in 1975. Which make changes in seismic zone factors, Importance factors, Clauses for design of multi storey building, Shear force formula etc.

The forth revision, brought out in 1984, was prepared to modify some of the provisions of the standard as a result of experience gained with the use of the standard. In this revision, a number of important basic modifications with-respect to load factors, field values of N, base shear and modal analysis was introduced. A new concept of performance factor depending on the structural framing system and on the structural framing system and on the ductility of the construction was incorporated. Acceleration spectra was also modified and a curve for zero percent damping incorporated.

In the fifth revision of IS:1893 (Part 1) contains following major and importance modification are considered.

- The seismic zones map is revised with only four zones, instead of five.
- The value of seismic zone factor have been changed.
- Design Acceleration spectra are now specified for three types of founding strata, namely rocks and hard soil, stiff soil and soft soil.
- Empirical expression for estimating the fundamental natural period Ta of multi storey building with regular moment resisting frames has been revised.
- Introducing the 'response reduction factor' in place of the earlier performance factor.
- A lower bound is specified for the design base shear of building, based on empirical estimate of the fundamental natural period Ta.
- Torsional eccentricity values have been revised upward in view of serious damage observed.

In the sixth revision of draft code of IS:1893 (Part 1), a number of improvement have been made in the code.

- Specific treatment for different types of irregularity has been specified.
- Explicit treatment on RC frame buildings with masonry infill walls has been included.
- Torsional provisions have been simplified.

II. OBJECTIVE

- Study of two Indian standard IS 1893 (Part:1) : 2002 and IS 1893 (Part:1): Draft code
- Analysis of three main structural system for different height based on IS 1893 (Part:1) : 2002 and IS 1893 (Part:1): Draft code
- Parameters comparison for different structural system analyzed based on IS 1893 (Part:1) : 2002 and IS 1893 (Part:1): Draft code

III. BUILDING DESCRIPTION

Plan dimension	20 m x 18 m
Height of typical storey	3.5 m
Height of base storey	3 m
Slab thickness	125 mm
Column size	600 x 600 mm
Main beam size	300 x 500 mm
Brick wall thickness	230 mm thick at periphery
Shear wall thickness	230 mm thick L- shape
Bracings	230x300 mm X- Bracings
Live load	5 KN/m^2
Floor finish	1.2 KN/m^2
Location	Ahmadabad
Earthquake data	IS 1893 (Part 1)-2002
Type of soil	Medium Soil
Importance factor	1
Response reduction factor	5
Grade of concrete	25 KN/m^3
Grade of steel	Fe 415
Density of concrete	25 KN/m^3
Damping ratio	5%
Density of brick masonry	20 KN/m^3

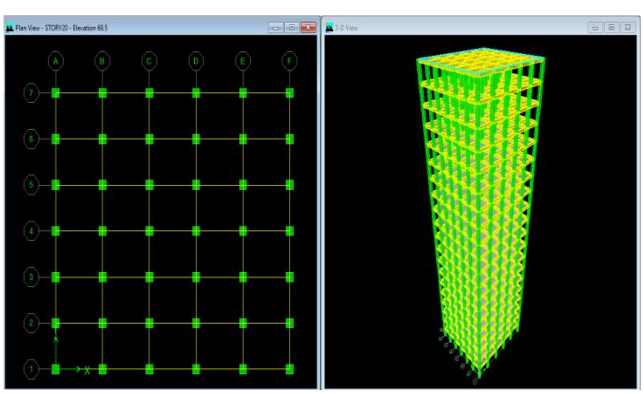

Fig 1. Time period as per IS 1893 2002 and Draft code

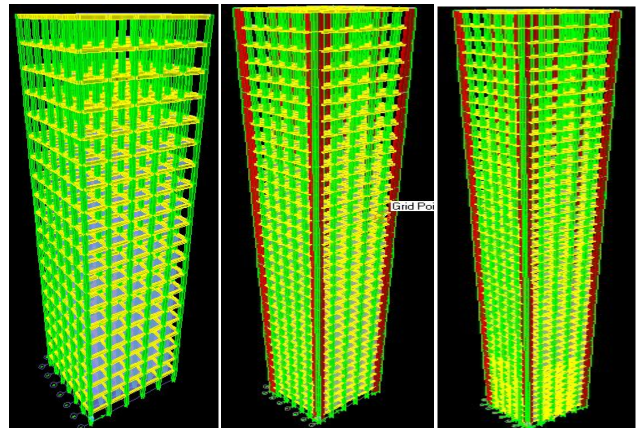

Fig 2. Time period as per IS 1893 2002 and Draft code

IV. PROCEDURE OF MAJOR WORK AND ANALYSIS

There is three main structural system 20 storey frame structure, 35 storey shear wall structure, 47 shear wall + braced structural system compare all the three system with IS 1893:2002 and IS 1893 Draft code.

IS 1893(Part-1)-2002	IS1893 (Part-1)-Draft code
Fundamental Period of Vibration $\boldsymbol{T_a} = \frac{\mathbf{0.09\ h}}{\sqrt{\mathbf{d}}}$ h = Height of building in meter d = Base dimension of the building at the plinth level in m along the considered direction of the lateral force. For 35 Storey Shear wall structure h = 122 m d = EQX-20 m EQY-18 m $\boldsymbol{T_a} = \frac{\mathbf{0.09\ x\ 122}}{\sqrt{\mathbf{20}}}$ = 2.45 s (EQX) $\boldsymbol{T_a} = \frac{\mathbf{0.09\ x\ 122}}{\sqrt{\mathbf{18}}}$ = 2.58 s (EQY)	Fundamental Period of Vibration $T_a = \frac{0.075}{\sqrt{A_w}} h^{0.75}$ A_w = Total effective area of the walls in the first storey of the building in m^2 $A_w = \sum\left[A_{wi}\left(0.2 + \left(\frac{L_{wi}}{h}\right)\right)^2\right]$ A_{wi} = Effective Cross sectional area of the wall *i* in the first storey of the building, in m^2 L_{wi} = Length of the shear wall *i* in the first storey in the considered direction of the lateral force in m For 35 Storey Shear wall structure h = 3 m L_{wi} = 1.5 m A_{wi} = 0.230 x 1.5 = 0.345 m^2

	$A_w = \sum\left[0.345\left(0.2 + \left(\frac{1.5}{3}\right)\right)^2\right]$ In X direction 14 shear wall A_w = 14 x 0.169 = 2.36 $T_a = \frac{0.075}{\sqrt{2.36}} 122^{0.75}$ = 1.79 s (EQX) In Y direction 12 Shear wall A_w = 12 x 0.169 = 2.028 $T_a = \frac{0.075}{\sqrt{2.028}} 122^{0.75}$ = 1.93 s (EQY)

There is shown in table calculation on objective of various recommendation of IS 1893 is to ensure that as far as possible structure are able to respond earthquake, without structural damage to shocks of moderate intensities and without total collapse to large shocks. General design criteria are presented in IS 1893 which is applicable to regular structure or more or less uniform configuration. In this research there is seismic coefficient method is generally use which time period calculation is shown as per IS 1893 and draft code for that changes various parameters changes on that bases.

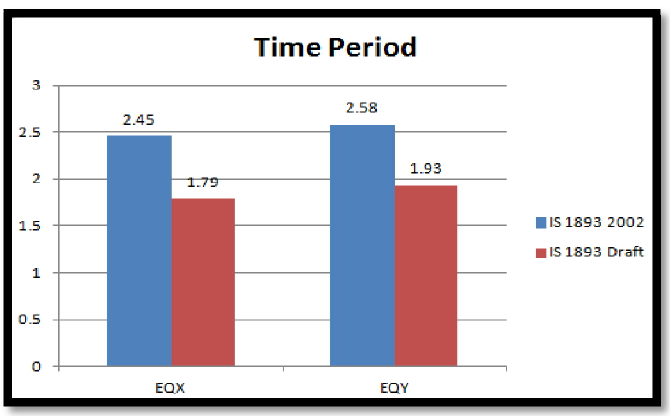

Fig 3. Time period as per IS 1893 2002 and Draft code

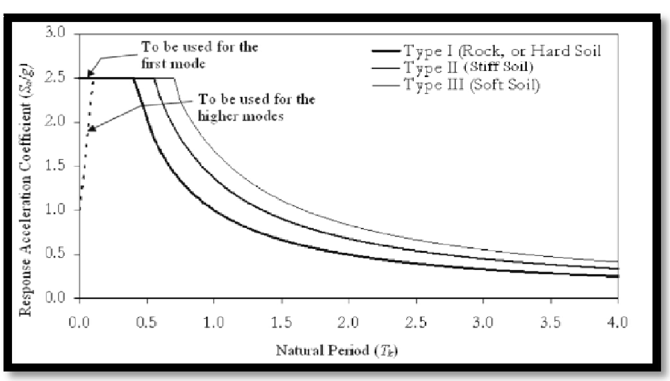

Fig 4. Response acceleration coefficient

V. RESULTS AND DISCUSSION

1) Displacement(mm):

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	62.8	62.8
35 Storey Shear wall	86.1	117.8
47 Shear wall + braced	136.4	201.8

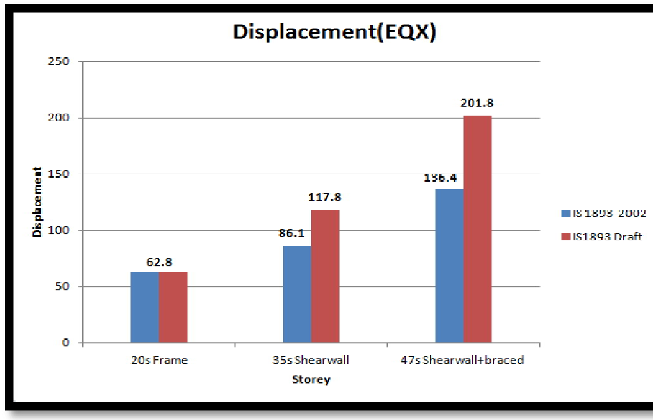

Fig 5. Displacement as per IS 1893 2002 and Draft code

2) Storey Drift(mm)

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	4.01	4.01
35 Storey Shear wall	3.02	4.13
47 Shear wall + braced	3.8	5.63

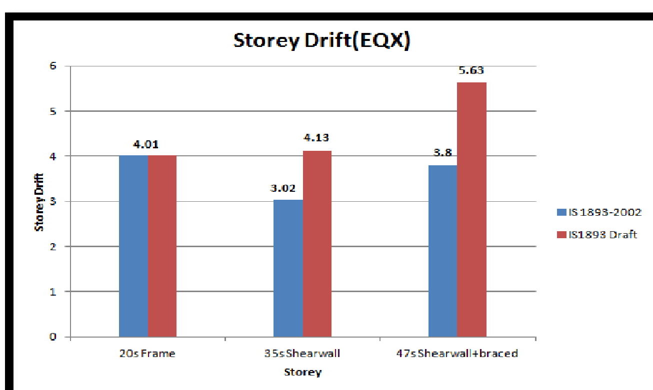

Fig 6. Storey drift as per IS 1893 2002 and Draft code

3) Storey force(KN)

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	252.05	252.05
35 Storey Shear wall	164.32	224.91
47 Shear wall + braced	125.48	185.69

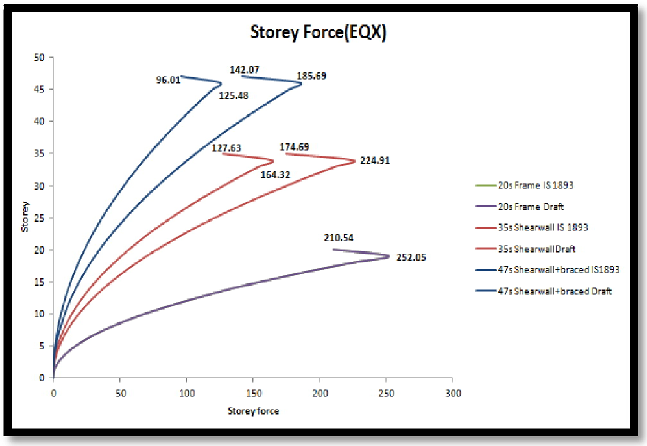

Fig 7. Storey drift as per IS 1893 2002 and Draft code

4) Storey shear(KN)

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	1923.13	1923.13
35 Storey Shear wall	2826.46	2077.99
47 Shear wall + braced	2826.46	3075.05

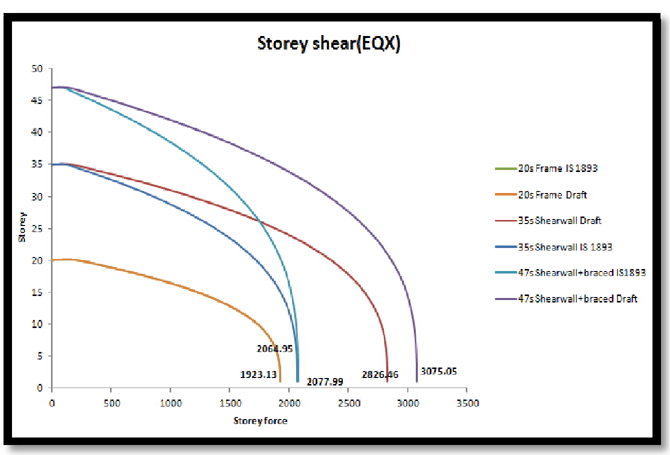

Fig 8. Storey drift as per IS 1893 2002 and Draft code

5) Axial force(KN)

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	605.85	605.85
35 Storey Shear wall	773.95	1061.19
47 Shear wall + braced	864.46	1279.25

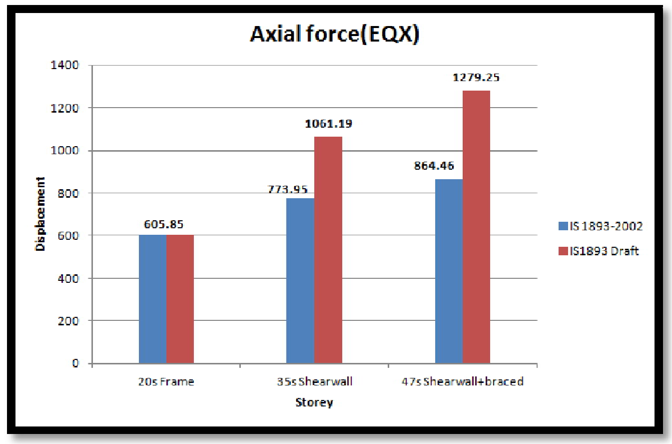

Fig 9. Storey drift as per IS 1893 2002 and Draft code

6) Bending moment(KN.m)

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	128.62	128.62
35 Storey Shear wall	46.37	63.46
47 Shear wall + braced	30.21	44.7

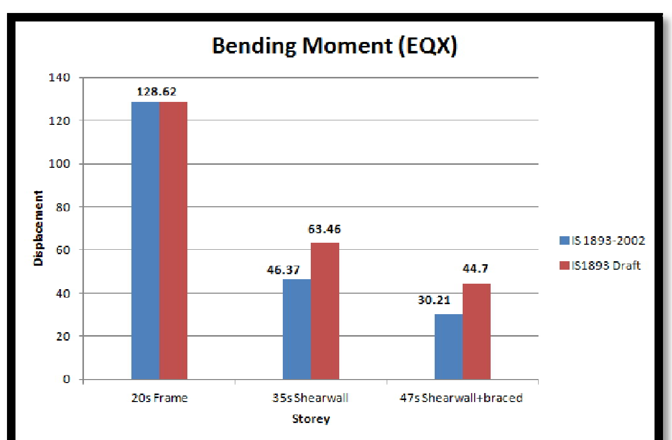

Fig 10. Bending momet as per IS 1893 2002 and Draft code

7) Overturning moment(KN.m)

Structure	IS 1893:2002	IS 1893 draft code
20 storey frame	101319.97	101319.97
35 Storey Shear wall	189749.2	259006.86
47 Shear wall + braced	256138.25	378008.66

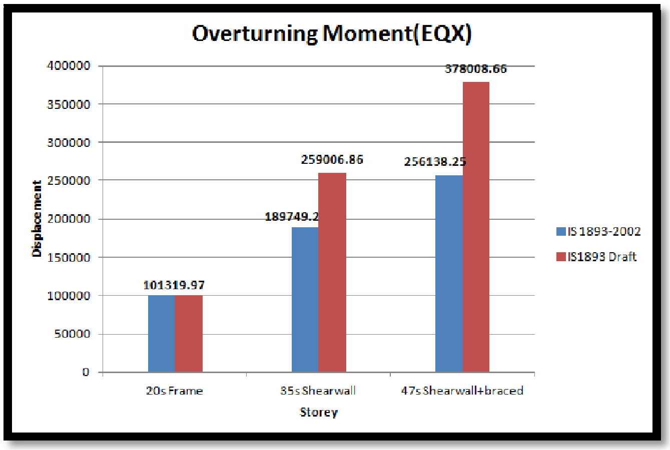

Fig 11. Overturning moment as per IS 1893 2002 and Draft code

VI. CONCLUSION

- Time Period increase as the height of the building increase but as compared to IS 1893 Draft code time period decrease for particular height.
- IS 1893 draft code increase the design seismic force which make more flexible structure as compared to IS 1893:2002.
- IS 1893 draft code clearly reflects that design seismic force increase as compared to IS 1893:2002 so there is Parameters of the seismic analysis like Displacement, storey drift, storey shear, storey force, overturning moment, axial force, bending moment also increase.

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