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Comparative Study of IS 1893:2002 & 2016 for G+12 Staff Quarter Residential Building

Rohit Kokane
r.p.kokane@gmail.com
Dr. V.V.P. College of Engineering

Prof. P. B. Autade
pankajautade@gmail.com
Dr. V.V.P. College of Engineering

ABSTRACT

IS1893 gives guidelines for designing seismic resistant structures. Significant enhancements in seismic resistant design has been seen in recent years. Hence, after a gap of 14 years, Indian seismic code IS: 1893 has been revised in year of 2016. The purpose behind presenting this project is to gain relevant Indian standard codes knowledge that has been used for design of various buildings component such as beam, column, slab, and foundation and stair case using the software Etabs under the earthquake load and wind load acting on the structure.

Keywords: *Seismic Analysis, Etabs 2019, Comparison between IS 1893:2002 & 2016, Dynamic Analysis.*

1. INTRODUCTION

An RCC framed structure is fundamentally an association of slabs, beams, columns and foundation inter -connected to each other as a monolithic unit. The load transfer path, in such a structure takes place from the floor slabs to the beams, from the beams to the columns and then to the lower columns and finally to the foundation which in turn transfers it to the ground soil. The floor area of a R.C.C framed structure building is 10 to 12 percent more than that of a load bearing walled building structure. Monolithic construction is possible with R.C.C framed structures and it can resist seismic shocks, vibrations more efficiently than load bearing walled buildings structure. Time Span for construction for RCC framed structures is fast.
Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are resisted by the presence of reinforcement having higher tensile strength and ductility. The reinforcement is usually added passively in the concrete before the concrete sets. The reinforcement needs to have the following properties at least for the strong and durable construction:

- High toleration of tensile strain
- High relative strength
- Good bonding to the concrete, regardless of pH, moisture, and similar factor.
- Thermal compatibility, not causing unacceptable stresses in response to changing temperatures.

A building shall be considered as irregular as per is IS code, if it lacks symmetry and has discontinuity in geometry, mass or load resisting elements. These irregularities may cause problem in continuity of force flow and stress concentrations. A building should possess four main attributes, mainly having simple and regular configuration, adequate lateral strength, stiffness and ductility. Structural analysis is mainly deal with evaluating the structural behavior subjected to some external action. The dynamic loads includes the wind load, shock waves, traffic, earthquakes load, and blasts load.

To perform well during an earthquake, a structure should possess main four attributes namely regular and simple configuration and adequate stiffness, lateral Strength and ductility. Current seismic codes define structural configuration as either irregular or regular in terms of shape and size of the structure, arrangement of the building and non-structural elements within the building, mass distribution in the building etc. A structure should be considered as irregular for the purposes of this standard, if at least one of the conditions is applicable as per IS 1893:2002 or IS 1893:2016

2. PRIMARY DATA CONSIDERED FOR ANALYSIS

MODEL

- LENGTH X DIRECTION= 18.7 M
- LENGTH Y DIRECTION= 7.55M
- TYPICAL FLOOR TO FLOOR HEIGHT= 3.0 M
- NUMBER OF STORIES= 12

LOAD CALCULATION

DEAD LOAD

- Self-weight of the member
- Super imposed dead load- 2kn/m2 LIVE LOAD- 2kN/m2

SEISMIC LOADING

- Z=0.36 (for zone V IS1893:2016)
- I=1.0 (importance factor)
- Soil Type II
- R=5(Response Reduction Factor)

Codes used for analysis of the structure:-

- R.C.C. design : IS 456: 2000
- Earthquake design: IS1893: 2016
- Code for Dead load: IS875: Part 1
- Code for Live load: IS875: Part 2
- Code for wind load: IS875: Part 2

The basic parameters considered for the analysis and design:-

- Slab depth: 150 mm thick :Assumed
- Live load in floor area: 2 kN/sq m
- Live load in Balcony area:2 kN/sq m
- Live load in passage area : 2 kN/sq m
- Live load in urinals : 2 kN/sq m
- Floor finish load : 0.5 kN/ sq m
- ShearWall thickness : 200 mm thick wall
- Stair case loading : 3 kN/sq m

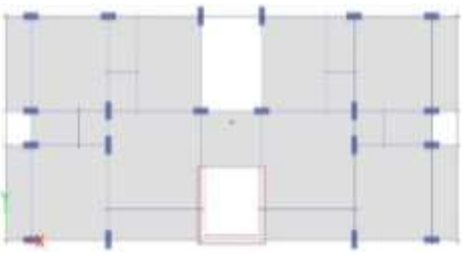


Fig. 01- Building Plan View

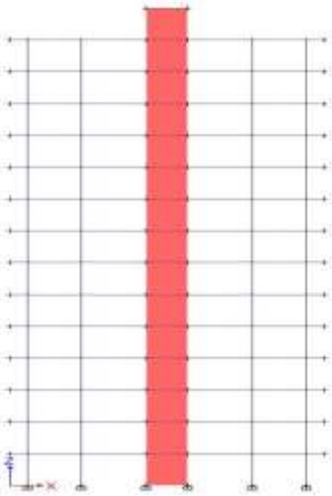


Fig. 02- Elevation View from Shear wall side

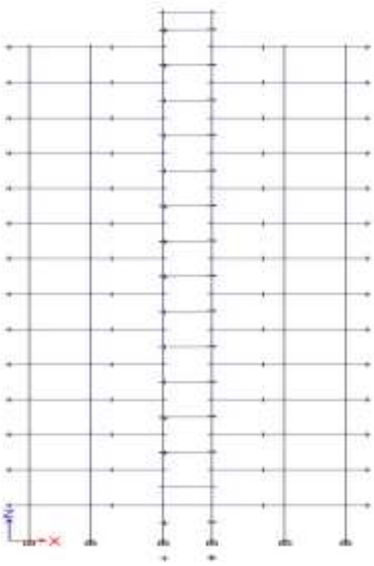


Fig. 02- Elevation View from Staircase side

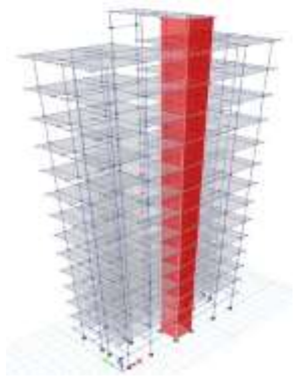


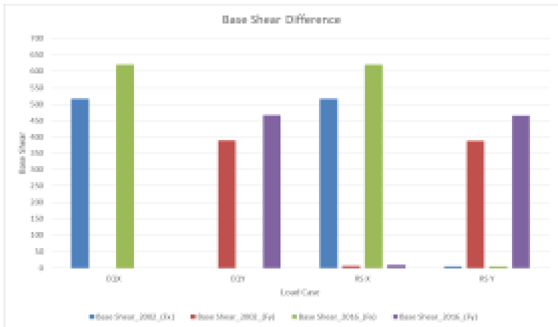
Fig. 034- 3D View

3. RESULTS & DISCUSSION

a) Base Shear Results-

Table.01- Base Shear Comparison

	2002		**2016**	
Output Case	**FX** KN	**FY** KN	**FX** KN	**FY** KN
EQX	516.5261	0	619.8313	0
EQY	0	388.5017	0	466.2021
RS X	516.4125	7.523	618.9393	9.0166
RS Y	4.9817	388.3797	5.9654	465.0686



The above table shows the comparative values of base shear with equivalent static earthquake loading and dynamic earthquake loading i.e. response spectrum analysis. EQX and EQY are the equivalent static seismic load cases and RSX and RSY are the response spectrum loads cases. The table shows difference between the base shear obtained from IS 1893:2002 and IS 1893:2016. The base shear values are higher from the latest revised code i.e. IS1893:2016

b) Story Displacement Results-

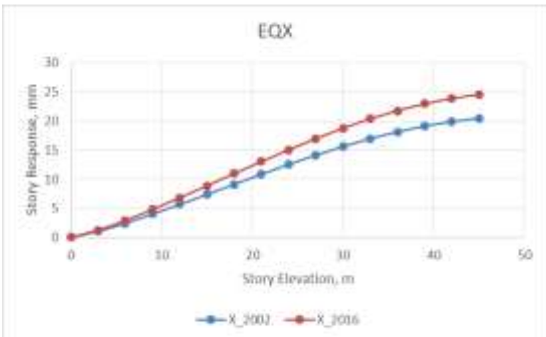


Fig. 04- Displacement Comparison Graph for EQX

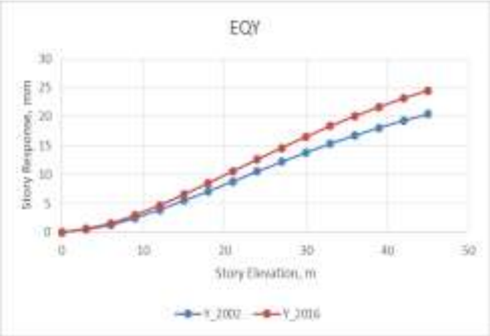


Fig. 05- Displacement Comparison Graph for EQY

Table 02- Story displacement for EQX & EQY

	RS X		**RS Y**	
	2002	**2016**	**2002**	**2016**
Elevation m	**X-Dir** kN	**X-Dir** kN	**Y-Dir** kN	**Y-Dir** kN
45	15.946	19.112	15.385	18.423
42	15.608	18.707	14.586	17.466
39	15.129	18.132	13.678	16.379
36	14.508	17.388	12.713	15.223
33	13.742	16.47	11.681	13.987
30	12.846	15.396	10.583	12.673
27	11.836	14.186	9.43	11.292
24	10.726	12.856	8.231	9.857
21	9.529	11.42	6.999	8.381
18	8.251	9.889	5.748	6.882
15	6.902	8.272	4.497	5.385
12	5.488	6.578	3.277	3.924
9	4.023	4.822	2.13	2.55
6	2.529	3.031	1.123	1.345
3	1.125	1.348	0.486	0.582
0	0	0	0	0

The above graph shows the displacement variation for load case EQX & EQY. The displacement occur from IS1893:2016 is higher than IS 1893:2002 for both load cases.

c) Lateral Loads to Stories

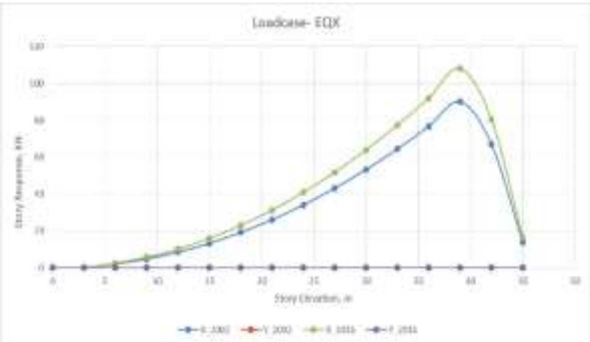


Fig. 06- Lateral Loads to floor by EQX Load

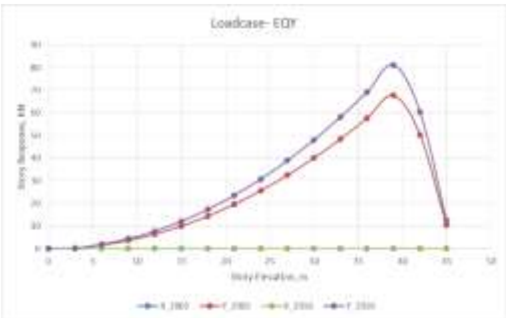


Fig. 07- Lateral Loads to floor by EQY Load

Table-03 Lateral Loads to Story

	EQX				**EQY**			
	2002		**2016**		**2002**		**2016**	
Height m	**X-Dir** kN	**Y-Dir** kN	**X-Dir** kN	**Y-Dir** kN	**X-Dir** kN	**Y-Dir** kN	**X-Dir** kN	**Y-Dir** kN
45	13.745	0	16.494	0	0	10.33	0	12.40
42	66.957	0	80.349	0	0	50.36	0	60.43
39	90.005	0	108.00	0	0	67.69	0	81.23
36	76.691	0	92.02	0	0	57.68	0	69.21
33	64.441	0	77.33	0	0	48.46	0	58.16
30	53.257	0	63.90	0	0	40.05	0	48.06
27	43.138	0	51.76	0	0	32.44	0	38.9
24	34.085	0	40.90	0	0	25.63	0	30.76
21	26.096	0	31.31	0	0	19.62	0	23.55
18	19.172	0	23.00	0	0	14.42	0	17.30
15	13.314	0	15.97	0	0	10.01	0	12.01
12	8.521	0	10.2	0	0	6.40	0	7.69
9	4.793	0	5.75	0	0	3.60	0	4.32
6	2.130	0	2.55	0	0	1.60	0	1.92
3	0.173	0	0.20	0	0	0.13	0	0.156
0	0	0	0	0	0	0	0	0

From lateral loads results, it clearly seen that, loads are higher side in IS 1893:2016 than IS 1893:2002.

d) Story Drift-

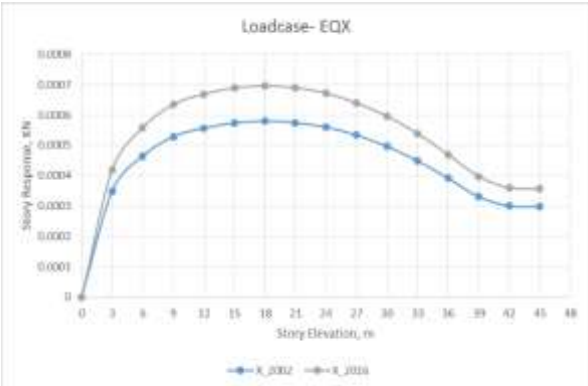


Fig. 08- Story Drift for EQX

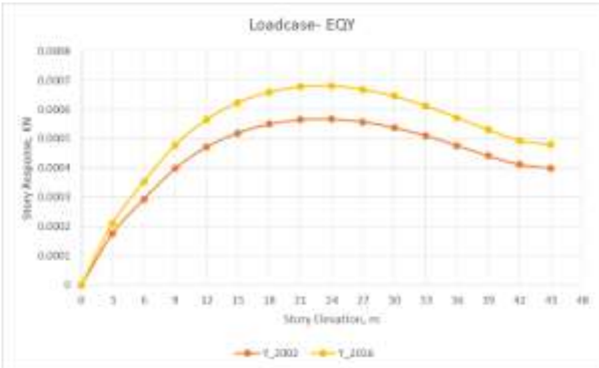


Fig. 09- Story Drift for EQY

Table 04- Story Drift for EQX & EQY

	EQX		**EQY**	
	2002	**2016**	**2002**	**2016**
Elevation m	**X-Dir** kN	**X-Dir** kN	**Y-Dir** kN	**Y-Dir** kN

45	0.000298	0.000357	0.0004	0.00048
42	0.000301	0.000361	0.000412	0.000494
39	0.000331	0.000398	0.000442	0.000531
36	0.000392	0.00047	0.000477	0.000573
33	0.000449	0.000539	0.000511	0.000613
30	0.000497	0.000596	0.000538	0.000646
27	0.000534	0.00064	0.000558	0.000669
24	0.00056	0.000672	0.000567	0.000681
21	0.000575	0.00069	0.000565	0.000678
18	0.00058	0.000696	0.00055	0.00066
15	0.000574	0.000689	0.00052	0.000624
12	0.000557	0.000669	0.000472	0.000566
9	0.000529	0.000635	0.000399	0.000479
6	0.000465	0.000558	0.000294	0.000353
3	0.00035	0.00042	0.000176	0.000211
0	0	0	0	0

From above story drift result, in IS 1893:2002, the drift is occur less than the IS 1893:2016

4. CONCLUSION

Base shear values occurred from IS 1893:2016 is higher than IS 1893:2002, this is because of importance factor. Importance factor is 1 in IS 1893:2002 for residential building. But in IS 1893:2016, for multistorey building, importance factor will be 1.2. As a result the base shear will occurred higher in latest earthquake resistant design code. As a result of this, structural member size will increases and affects the cost of construction.

In IS 1893:2002 code, spectral acceleration coefficient i.e. (Sa/g) is calculated from one curve diagram for both static and dynamic analysis for different soil types such as hard, medium & soft. But in IS 1893:2016, for calculating the (Sa/g) for static and dynamic analysis, there are two different curves provided. And hence as (Sa/g) values for static and dynamic analysis are different.

The design approach seismic resistant structure. The IS 1893: 2016 code clearly evaluates the design seismic force is much higher than what can be expected during strong earthquake shaking.

Shear force obtained with IS 1893-2002 code for the considered building is 388.3797 KN whereas IS 1893-2016 is obtained is 465.0686 KN.

Bending moment occurred with IS 1893-2002 for considered building is 12496.7 KN-m whereas for new code IS 1893-2016 is obtained is 14996.04KN-m.

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