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Seismic Analysis and Comparison of IS 1893 (Part-1) 2002 and 2016 of (G+10) Regular Building

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ABSTRACT: Generally, for high rise building structures, earthquake resistant method is used using IS1893-2002 and IS1893-2016. In this project, the G+10 RCC structure has been analysed. The various section of this national building code (NBC) have undergone changes as per latest technologies and user requirements. It is necessary to identify the performance of the structure to stand against disaster. The paper discusses the performance evaluation of RCC buildings with plan. This paper presents the seismic load estimation for multi storey buildings as per IS: 1893-2002 and IS: 1893-2016 recommendations.

KEYWORDS: STAAD-PRO IS 1893:2002 & 2016.

I. INTRODUCTION

During an earthquake, failure of structure starts at points of weakness. This weakness arises due to discontinuity in mass, stiffness and geometry of structure. The structures having this discontinuity are termed as irregular structures. But now a day, the need and demand of the latest generation and growing population has made the architects or engineers and inevitable towards the planning of irregular configurations. Hence, earthquake engineering has developed the key issues in understanding the role of building configurations. For the design of any structure, we have to consider the earthquake load for structural safety during major earthquakes. In recent earthquakes, so many reinforced concrete structures have been damaged. It indicates the assessment of the seismic behaviour of structures is how important. So everyone must have to design a satisfactory level of safety is a concern.

The main objective of this study is the seismic performance of the RC frame building structure. Also, conducting static analysis and dynamic analysis has been conducted. A structural frame modelled as (G+10) storied residential building frame. The storey plan changes for regular and irregular buildings on floors. The models are to be analysed in both static and dynamic methods based on IS codes: The storey displacements, base shear, frequency, and the time period in the response spectrum analysis are compared. The study on a 6 storied RC frame building model and was analysed using the software STAAD-PRO. The static analysis is performed on the modelled RC frame building using the software STAAD-PRO.

Five mock-ups are generated with this plan of the building by presenting different variations and displacements. Story drift, base shear and story shear are the various considerations. The study, which involved earthquake analysis of the RC frame (10 stories) building with different models, included a bare frame, an incomplete frame and an open first storey frame. The parameters such as base shear, time period, natural frequency, storey drift and bending moments are studied; the building model was analysed using STAAD-PRO.

II. OBJECTIVES

- 1. To study IS 1893 2002 and IS 1893 2016 for the differences introduced in the new code.
- 2. To design and analyse the G+10 building structure by using IS 1893-2002 and IS 1893-2016.
- 3. To compare the analysis results from 1893-2002 and IS 1893-2016.



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Comparison of codes i.e.IS 1893(part 1)2002 and IS 1893(part 1)2016

Sr. no.	IS 1893 (part 1)2002	IS 1893 (part 1)2016
1	Importance Factor(I)(C.I 6.4.2)	Importance Factor(I):(C.I 7.2.3) For residential or
	Importance factor 1.5 was for	commercial buildings, with more occupancy
	Important structure and 1.0for all	Than 200 person importance factor 1.2 has been
2	Another building, Table 6.	Assigned to the new code, Table 8. Moment of Inautic for
2	Clause regarding moment of inertia	structural analysis shall be taken as given below:
	is not mentioned in the old code. Thus,	For RC and Masonry Structure:
	analysis is made considering full at the	I require =70% for column.
	moment, i.e., the uncracked section is	Ireq=30% for beam.
	considered	
3	Torsion irregularity:(C.I.7.1)	Torsion irregularity:(C.I.7.1)
	Table-4 tensional integularity As per the old code is $\frac{1}{2} \frac{1}{2} \frac{1}{2$	Table-5 tensional integularity. As per the new code it is $\Delta max > 1.5 \Delta min$
	$\Delta \mathcal{L} \geq 1.2 (\Delta 1 + \Delta \mathcal{L})/2$	When
		Δ max> (1.5-2.0) Δ min. The Configuration shall be revised.
4	Soft story(C.I.4.20)	Soft story(C.I.4.20)
	A soft story is defined as the story in	A soft story is defined as the storey in which the
	which the lateral stiffness is less than	lateral stiffness is less than that in the storey
	70% of that in the story above or less	Above.
	Stiffness of the three storeys above	
5	Weak story(CI425)	Weak story($CI4202$) As per new IS1893(part-1)2016 a
5	As per old IS1893(part-1)2002,a	weak story is Defined as the storey in which the lateral
	weak storey is defined as the storey	strength Is less than that in the storey above.
	in which the lateral strength is -less	
	than 80% of that in the storey	
	Above.	
6	Dynamic Analysis Require(C.I./.8.1) For regular building	Dynamic Analysis Require(C.1././.1) Equivalent static analysis shall be
	zone-IV.V-height>40m	applicable for regular building with height $\leq 15m$ in seismic
	zone-II,III-height>90m	zone II[C.I.7.6 and
	For irregular building :	C.I.7.7.1]
	zone-IV,V-height>12m	Equivalent static method should be used
	zone-11,111-neignt>40m	for regular building structure with
		0.4sec.[C.I.6.4.3]
7	Increase in allowable soil pressure	Increase in net pressure on soil in design Of foundation
	cI.6.3.5.2 when earthquake forces are	C.I.6.3.5.2. New code
	considered, increase in allowable pressure	IS1893(part 1)2016, gives percentage
	in soil for different types of soil (Type-	increase in net bearing pressure and skin pressure for soil times $A_{\rm e}$ B and C as 50% 25% and 0% respectively in
	etc. was given in table-1 from 25%-50%	types A, B, and C as 50%, 25% and 0% respectively in table1
		For soft soil no increase in bearing
		pressure shall be applied because,
		settlement cannot be restricted
8	The damping value of building may be taken as 2 and	The damping value of building may be taken as minimum 5
	5 percent or critical for the purpose of dynamic	percent or critical for purpose or steel and reinforced concrete
	respectively	and masonry.
9	In 2002 these are restriction for base.	In 2016 there are some criteria are given:
		1. Pile foundation, it is considered to be at the top of pile.
		 Kall, it is considered to be at the top of the raft. Exactings, it is considered to be at the top of footings.
		5. Footings, it is considered to be at the top of footings.

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INVESTIGATION DATA

Building type	G+10 Residential Building
Plan area	812.00M ²
Beam size	500(mm)*300 (mm)
	400(mm)*230(mm)
Column size	800(mm)*500 (mm)
Group Centroid	60mm
Column clear cover	40mm
Confinement Bars	40 mm
Slab thickness	150mm
Typical storey height	3m
Bottom storey height	3m
Live load, LL	3kN/m ²
External Wall load	20kN/m
Partition and floor finishing load, FL	2kN/m2
Earthquake Direction	X and Z
Seismic Zone	III
Soil type	Type II (Medium Soil)
Materials	M20 and Fe415
Importance Factor	1.5 (IS 1893·2002)
importance i actor	1.2(IS 1893:2016)
Response Reduction	5

III. RESULTS AND DISCUSSIONS

Design and analysis of (G+10) residential structure. The structure is situated in zone III. The soil condition is medium, and the R.C frames are in filled with brick masonry. The plans for Residential Building are as follows:



Fig.1 Floor plan for residential building

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Fig.4 Bending Moment Diagram in Zone III (IS 1893:2002)

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The above figure shows the bending moment diagram in a regular building in zone III.



Fig.6 Shear Force Diagram Zone in III (IS 1893:2002)





The above figure shows the shear force diagram in a regular building in zone III.

Floor level	IS 1893:2002	
	Fx	Fz
10	392.148	247.51
9	364.15	211.45
8	354.58	111.23
7	333.87	92.47
6	320.74	90.74
5	293.67	81.18
4	231.45	64.78
3	174.58	42.35
2	157.25	44.37
1	137.54	30.29
0	115.21	26.17

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BASE SHEAR FOR IS 1893:2016 (PART 1)

Floor level	IS 1893:2016	
	Fx	Fz
10	402.118	256.039
9	375.625	227.285
8	368.143	122.371
7	333.87	98.429
6	324.64	92.498
5	302.39	90.291
4	249.652	75.238
3	198.438	53.257
2	163.544	47.451
1	148.908	41.357
0	123.451	30.345



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MANUAL CALCULATIONS OF BASE SHEAR



IV. CONCLUSION

- 1. A study concludes that seismic analysis as per the guidelines of IS 1893:2016 shows a higher value of base shear than as per IS 1893:2002.
- 2. From the analysis and design of the slab and beams it was found that checking for deflection and shear is safe.
- 3. While calculating base shear manually and in STAAD PRO software there is huge difference between them.

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