A Comparative Study of IS Code 1893-2002 And IS Code 1893-2016 For the Design of Earthquake Resistant Structure

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Abstract- There is a progressive improvement in earthquake resistant design has been observed in recent past. Due to such results Indian seismic code IS: 1893 hasalso been revised in year 2016, after a gap of 14 years. This project presents the seismic load estimation for multistorey buildings as per IS: 1893-2002 and IS: 1893- 2016 recommendations. The method of analysis and design of multi-storey (G+3) and (G+6) residential building located in zone IV. The scope behind presentingthis project is to learn relevant Indian standard codes areused for design of various building element such as beam,column, slab, foundation and stair case using a software ETAB under the seismic load and wind load acting the structure. As the there is continuous analysis and effortsput by researchers to study the function and performanceof structure during past earthquake give more power and work on development and advancement in designing earthquake resistant structure. Therefore, it is required torevise the seismic code time to time. IS: 1893-2016 revisedafter 14 years in year 2016.In this study an attempt is made to compare the multistoried building analyzed by using both IS 1893-2002 and IS 1893-2016. For this, Same building models with different number of storeys i.e. G+3 and G+6 are considered. The 3D analysis of building is carried out for earthquake zone IV. We had compared the parameters in project are Story Drift and base shear.

Indexed Terms- Base Shear, Earthquake Design, Storey Drift

I. INTRODUCTION

General- Earthquake is known to be one ofthe most destructive phenomena experienced on earth. It is caused due to a sudden release of energy in the earth's crust which results in seismic waves. When the seismic waves reach the foundation level of the structure, it experiences horizontal and vertical motion at ground surface level [1]. Due to this, earthquake is responsible for the damage to various man-made structures likebuildings, bridges, roads, dams, etc. It also causes landslides, liquefaction, slope- instability and overall loss of life and property. 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 nowadaysneed and demand of the latest generation andgrowing population has made the architects or engineers inevitable towards planning of irregular configurations. Hence earthquake engineering has developed the key issues in understanding the role of building configurations. structures contribute a large portion of urban infrastructure. Vertical irregularities are one of the major reasons of failures of structures during earthquakes. Forexample, structures with soft storey were themost notable structures which collapsed. So, the effect of vertically irregularities in the seismic performance of structures becomes really important. Height-wise changes in stiffness and mass render the dynamic characteristics of these buildings different from the regular building [5]. IS 1893 definition of Vertically Irregular structures: The irregularity in the building structures may be due to irregular distributions in theirmass, strength and stiffness along the height of building. When such buildings are constructed in high seismic zones, the analysis and design become more complicated Codes and standards are the conventional source of information to the designers of civil engineering structures. Theseismic codes are primarily based on comprehensive data on ground motion that are erratic in direction, magnitude, duration and sequence and the results of the research were carried out to understand the con- sequence of these ground motion on the structures. In the last several decades, the seismic codes are becoming sophisticated with rapid development in earthquake engineering practice.[2] Recommendations provided by seismic codes help the designer to improve the behavior of structures so thatthey may withstand the earthquake effects without significant loss. Seismic codes are unique to a particular region or country. They take into account the local seismology,accepted level of seismic risk, properties of available materials, methods used in construction and building typologies. Further, they are indicative of the level of progress a country has made in the field of earthquake engineering and property. Most of the recommendations of IS codes are based on observation during past earthquakes as well as experimental and analytical studies made by scientists, engineers and seismologists. On the basis ofanalysis of performance of structures duringpast seismic events and efforts put by researchers, considerable advancement has been made over the years in earthquake resistant design of structures, and seismic design requirements in building codes have steadily improved. Therefore, the seismic code needs revision from time to time. The building designed as per the earlier version of the code may be checked for recommendations made by the revised code. Such comparison is to be carried out to establish whether existing buildings designed by earlier version are safe for revised recommendation also.

In the project work, entitled “A comparative study of IS code 1893-2000 and IS code 1893-2016 for the design of earthquake resistant structure”, analytical study is carriedout on a G+3 and G+6 storey building. The 3D analysis of building is carried out for earthquake zone IV. The main objective of the study was to compare these multi storey building with old IS code 1893-2000 and then analyzed them by new code IS 1893-2016[3]. The comparisons parameter considered are, storey drift, and base shear. All the multistorey buildings are generated using the finite element software ETABS 18.

Aim and objective of work –

The aim of the project is to study and analyzevarious provision, rules of earthquake Indianstandard code.

Objective:

1. The objective of the project is tounderstand the similarities anddissimilarities of both the code.
2. The main motive of the project is to compare the IS-code 1893-2002 & IS- code 1893-2016 for the design of earthquake resistant building.
3. To compare both the IS codes to addressdifferences in their philosophies and applicability of the IS-code 1893-2002 & IS-code 1893-2016.

II. MATERIAL AND METHODOLOGY

Type of Building: RCC (G+3 & G+6)Seismic Zone: IV
Floor to Floor Height:3m
Load acting- Dead, Live, Earthquake

Material PropertiesHYSD 500
M30

Member Dimensions Column-350*400mm Beam-230*350mm Slab-150mm

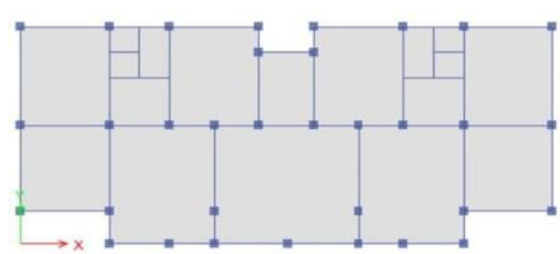


Fig 1-Plan of building

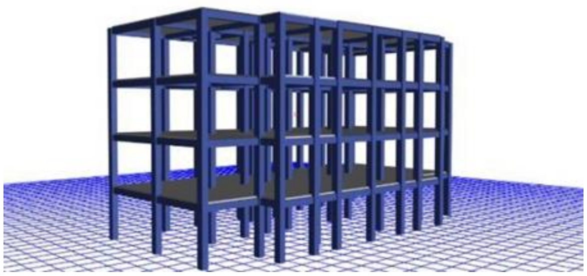


Fig 1- G+3 structure

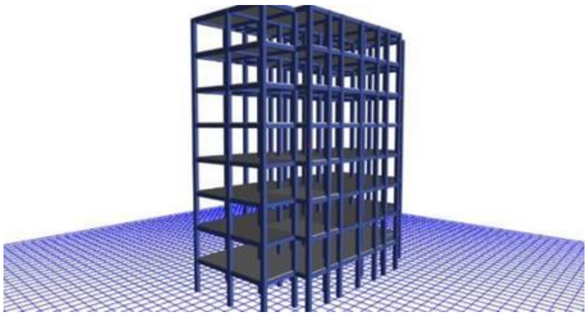


Fig 3- G+6 structure

Table 1: Storey Data

Name	Height(mm)	Elevation(mm)
Storey 8	3000	52950
Storey 7	3000	49950
Storey 6	3000	46950
Storey 5	3000	43950
Storey 4	3000	40950
Storey 3	3000	37950
Storey 2	3000	34950
Storey 1	3000	31950
Base	0	0

Table 2: load case

Name	Type
Dead	Linear Static
Live	Linear Static
EQ	Linear static

Table 3: Load Pattern

Load Pattern	Multiplier
Dead	1
Live	0.25
EQ	1

(G+3) and (G+6) Building were analyzed usingETAB for different parameters such as Story Drift and Base shear.

Storey Drift: It is defined as ratio of displacementof two consecutive floors to height of that floor. Itis very important term used for research purpose in earthquake engineering.

Table 4. Storey Drift (G+3)

Storey	Storey Drift (IS 1893-2002)	Storey Drift (IS 1893-2016)
Story3	0.000781	0.001917
Story2	0.000897	0.002208
Story1	0.000647	0.001594

Fig 4. Storey Drift vs Storey(G+6)

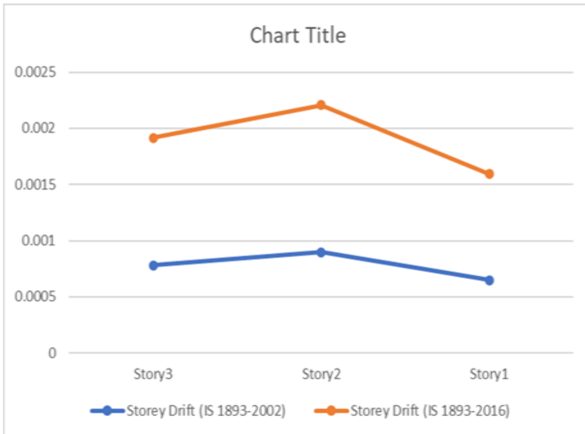
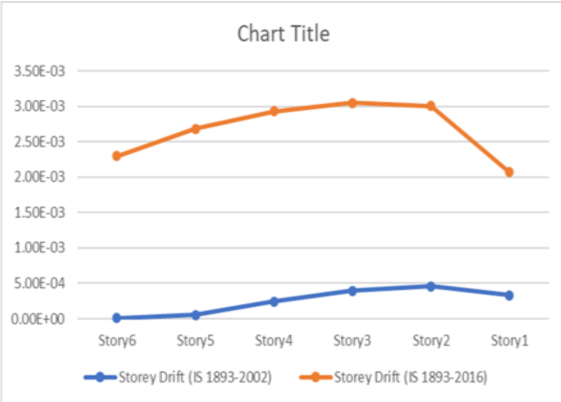


Table 5. Storey Drift (G+6)

Storey	Storey Drift (IS 1893-2002)	Storey Drift (IS 1893-2016)
Story6	9.00E-06	0.002296
Story5	5.10E-05	0.002686
Story4	0.000246	0.002931
Story3	0.000397	0.003051
Story2	0.000457	0.003008
Story1	0.00033	0.002074

Fig 5. Storey Drift vs Storey(G+6)



Base Shear- Base shear is the maximum expected lateral force on the base of the structure due to seismic activity. It is calculated using the seismic zone, soil material, and building code lateral force equations.

Table 6. Base Shear (G+3)

	IS 1893-2002			IS 1893-2016		
Direction	Period used (Sec)	W(KN)	Vb (KN)	Period used(Sec)	W(KN)	Vb (KN)
X	0.611	8256.84	440.7492	0.987	21865.87	1084.297
Y	0.594	8256.84	453.5785	0.956	21865.87	1119.498

Table 7. Base Shear (G+6)

	IS 1893-2002			IS 1893-2016		
Direction	Period Used (Sec)	W(KN)	Vb (KN)	Period Used (Sec)	W(KN)	Vb (KN)
X	1.199	8256.84	224.7159	1.695	32144.908 6	1393.0638
Y	1.202	8256.84	224.2482	1.693	32144.908 6	1394.5656

III. RESULT

1. For (G+3) storey building there is increment in storey drift by nearly 59% by using IS code 1893-2016 as compare to IS code 1893-2002.
2. For (G+6) storey building there is increment in storey drift by 92% using IS code 1893- 2016 as compare to IS code 1893-2002
3. For (G+3) storey building there is incrementin base shear by nearly 59% by using IS code1893-2016 as compare to IS code 1893-2002.
4. For (G+6) storey building there is incrementin base shear by 83% using IS code 1893- 2016 as compare to IS code 1893-2002.

CONCLUSION

1. The increment in base shear percentage occurs due to the change of importance factor in latestversion
2. Importance factor for multi storey residential buildings has been changed from 1.0 to 1.2. As I increases, A will h increase and therefore Base shear V will B increase. This may lead to increase in size of lateral load resisting members and reinforcement. Ultimately structure cost may increase
3. In IS 1893-2002 full section, i.e., full M.I. of columns and beams is considered. In new code IS 1893-2016, cracked section with 70% MI of columns and 35 % MI of beams is considered. As cracks may develop in structure after some period, MI of sections may reduce.
4. The increment in story drift percentage occursdue to reduction in moment of inertia of structural members

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