Comparative Study of IS1893(2002) Part-1 & IS 1893(2016) Part-1 For Seismic Design of Structure

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Abstract- *The sixth revision of IS 1893 (Part 1): 2016, "Criteria for Earthquake Resistant Design Of Structures" have been published by Bureau of Indian Standards recently in December 2016. In this new code many changes have been included considering standards and practices prevailing in different countries and in India. This work aims at studying revisions in various clauses of new IS 1893 (Part 1): 2016 with respect to old IS 1893 (Part 1): 2002 and their effect especially, Separate response spectra for Equivalent static method and Response spectrum method. Old IS-1893- 2002 has given one response spectra for Equivalent Static Method and Response Spectrum method for 4.0 s periods. Expressions are given for calculating design acceleration coefficient (Sa/g), for Rocky/hard soils, medium soils and soft soils. New IS 1893- 2016 has given response spectra for Equivalent Static Method and Response Spectrum method separately for 6.0 s periods. Expressions are given for calculating design acceleration coefficient (Sa/g), for Equivalent Static Method and Response Spectrum method separately for Rocky/hard soils, medium soils and soft soils. It will change the Sa/g values. Definition of soft storey and weak storey, change in definition of mass, torsion and vertical irregularities has been modified. Importance factor of 1.2 has been specified in new code for residential buildings, in old code residential buildings were assigned importance factor of 1.0. Naturally, it will increase the design horizontal seismic coefficient Ah.*

I. INTRODUCTION

Importance of seismic codes - ground vibrations during earthquake cause forces and deformations in structures. Structure need to be designed to withstand such forces and deformation. Seismic codes help to improve the behaviour of structures so that they with stand the earthquake effects without significance loss of life and property.

Code Revised in 2016 (Sixth revision):

- The basic design philosophy remains the same i.e. intended to provide life safety.
- The structures designed as per this Standard is expected to sustain damage under strong earthquake.
- The Standard is not applicable to Buildings with base isolation and Energy Dissipative devices.

II. LITERATURE REVIEW

Paper – 1

Title of Paper: "Impact of new is 1893 & related codes on design of tall buildings, including trend setting structures“

Journal: Conference
Name of Author: S. C. MEHROTRA
Publication Year: Sep 1, 2017.
Conclusion: Author also compared the codes which are related to tall building structures. He also analysed the new clauses which would be use for design of tall building. In this paper only theoretical comparison is done.

Paper – 2

Title of Paper: Limitations of Indian Seismic Design Codes for RC Buildings

Journal: Research Gate
Name of Author: VIJAY NAMDEV KHOSE, YOGENDRA SINGH AND DOMINIK LANG
Conclusion: Author gave limitations of the Indian seismic design and ductile detailing codes, is 1893 and is 13920 with comparison of ASCE 7

- The Indian site classification is based on single parameter, i.e. SPT value. However, a more direct characterization can be made using shear wave velocity.
- The Indian code specifies design spectrum up to 4 sec period only, but design period of medium rise and high rise building may be longer than 4 sec.
- Code limits the inter storey drift to 0.4%
- Strong column and weak beam and joint shear design are ignored

The code does not provide any guidelines about effective stiffness of RC members.

Paper – 3

Title of Paper: REVISIONS IN IS 1893- Part 1 ON ERD OF TALL BUILDING
Author: Dr. D.K. Paul
Conclusion: Author also analysed the code 1893:2016 and gave following revisions which are incorporated in code

- Design spectra defined up to natural period 6.00 s
- Same design spectra corresponding to 5% damping are specified for all buildings, irrespective of material
- Introduced intermediate importance category of buildings to consider the density of occupancy
- Buildings designed for at least a minimum lateral force
- Additional clarity about different types of irregularity of structural system
- Effect of masonry infill walls included.
- Natural period of buildings with basement, step back buildings and Buildings on hill slopes included.
- Simplified procedure for evaluating liquefaction potential is added.

Paper - 4

Title of Paper: SEISMIC ANALYSIS OF HIGH RISE BUILDING WITH IS CODE 1893 - 2002 and IS CODE 1893 - 2016
Author: Narayan Malviya, Sumit Pahwa
Conclusion:

- Maximum deflection found with old code IS 1893 - 2002 for considered building is 1.0865 Meter and for new code IS 1893 - 2016 is 0.161888.
- Shear force obtained with old code IS 1893 - 2002 for considered building is 334.178 KN whereas for new code IS 1893 - 2016 is obtained is 188.483 KN
- Bending moment obtained with old code IS 1893 - 2002 for considered building is 1023.9694 KN – m whereas for new code IS 1893 - 2016 is obtained is 361.9106 KN – m.

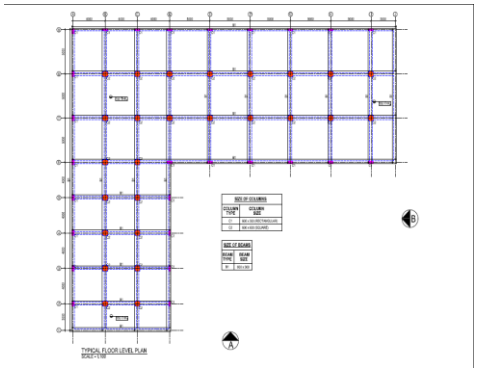
- Response spectrum results show that acceleration against time is higher in case of revised code.

STUDY AREA.

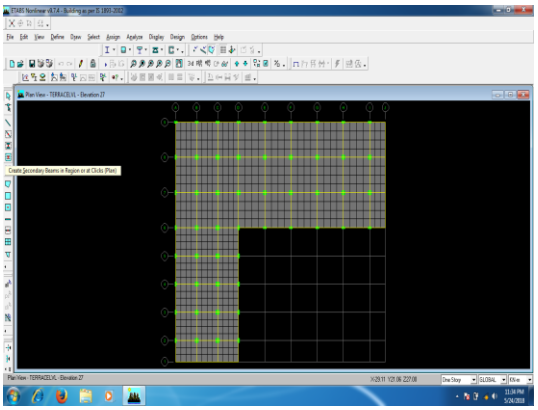
L – SHAPE IRREGULAR OFFICE BUILDING G+7

PARAMETERS	
Slab element	shell
Shear wall element	N/A
diaphragm	N/A
Diaphragm type	N/A
Type of analysis	Static analysis
Zone factor Z	0.24
Response reduction factor	5
Importance factor	1
Soil type	Medium
Mass source for earthquake load	DL+0.50LL
Earthquake start from level	Foundation level

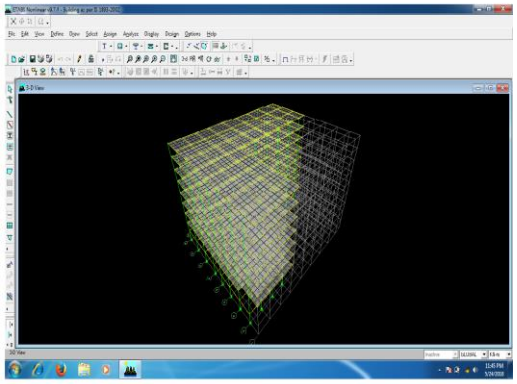
Ground level plan in AUTOCAD



Plan view in ETABS software



Plan view in ETABS software



Earthquake Calculation by Empirical Formula as per IS 1893:2002

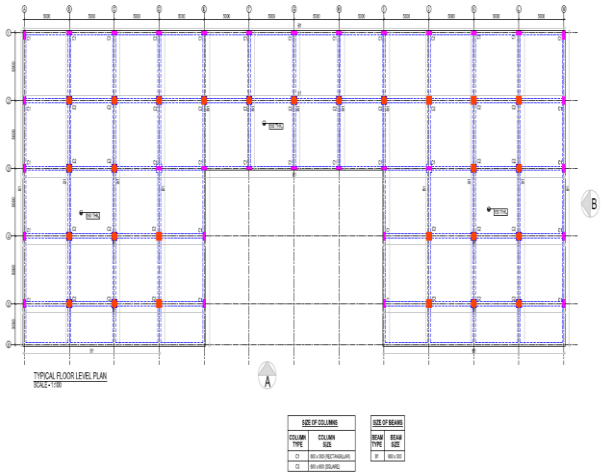
Z =	0.24				
I =	1				
R =	5				
h =	27.000	m			
Soil Type =	2				
dx =	37.450	m		(Sa/g)x =	(Sa/g)y =
dy =	31.450	m	1= Rock o	FALSE	FALSE
Tx =	0.397	sec	2= Mediun	2.500	2.500
Ty =	0.433	sec	3= Soft So	FALSE	FALSE
(Sa/g)x =	2.500				
(Sa/g)y =	2.500				
(Ah)x =	6.00%				
(Ah)y =	6.00%				

Earthquake Calculation by Empirical Formula as per IS 1893:2016

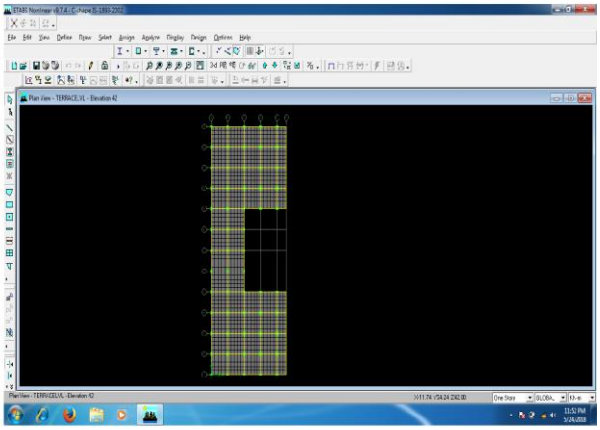
Z =	0.24				
I =	1.2				
R =	5				
h =	27.000	m			
Soil Type =	2				
dx =	37.450	m		(Sa/g)x =	(Sa/g)y =
dy =	31.450	m	1= Rock o	FALSE	FALSE
Tx =	0.397	sec	2= Mediun	2.500	2.500
Ty =	0.433	sec	3= Soft So	FALSE	FALSE
(Sa/g)x =	2.500				
(Sa/g)y =	2.500				
(Ah)x =	7.20%				
(Ah)y =	7.20%				

C – SHAPE IRREGULAR OFFICE BUILDING G+12

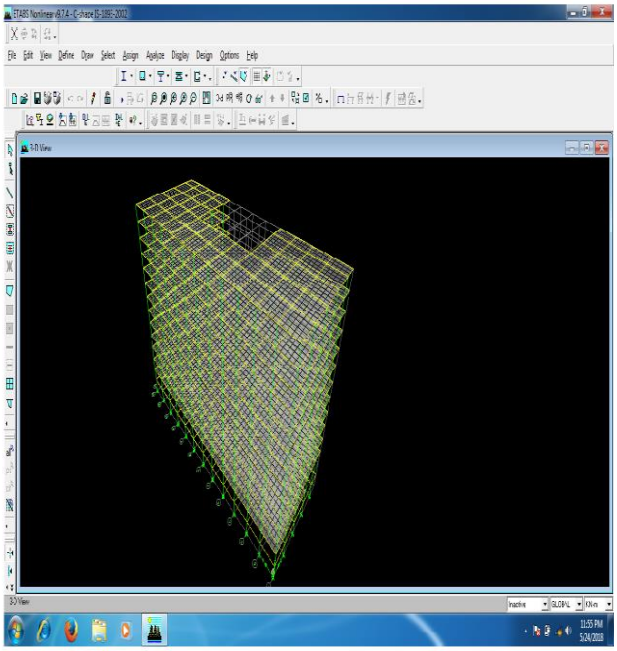
INPUT PARAMETERS AS PER 1893:2002	
PARAMETERS	
Slab element	shell
Shear wall element	N/A
diaphragm	N/A
Diaphragm type	N/A
Type of analysis	Static analysis
Zone factor Z	0.24
Response reduction factor	5
Importance factor	1
Soil type	Medium
Mass source for earthquake load	DL+0.50LL
Earthquake start from level	Foundation level



Plan view in ETABS software



3D- view in ETABS software



Earthquake Calculation by Empirical Formula as per IS 1893:2002					
Z =	0.24				
I =	1				
R =	5				
h =	27.000	m			
Soil Type =	2				
dx =	37.450	m		(Sa/g)x =	(Sa/g)y =
dy =	31.450	m	1= Rock o	FALSE	FALSE
Tx =	0.397	sec	2= Mediun	2.500	2.500
Ty =	0.433	sec	3= Soft So	FALSE	FALSE
(Sa/g)x =	2.500				
(Sa/g)y =	2.500				
(Ah)x =	6.00%				
(Ah)y =	6.00%				

Storey Shear Graph

Earthquake Calculation by Empirical Formula as per IS 1893:2016					
Z =	0.24				
I =	1.2				
R =	5				
h =	42.000	m			
Soil Type =	2				
dx =	23.000	m		(Sa/g)x =	(Sa/g)y =
dy =	60.000	m	1= Rock o	FALSE	FALSE
Tx =	0.788	sec	2= Mediun	1.725	2.500
Ty =	0.488	sec	3= Soft So	FALSE	FALSE
(Sa/g)x =	1.725				
(Sa/g)y =	2.500				
(Ah)x =	4.97%				
(Ah)y =	7.20%				

III. CONCLUSION

Followings are the major conclusion of the study

The following conclusion are made from the literature review as mentioned above: Importance factor for multi storey residential buildings has been changed from 1.0 to 1.2. As I increases, Ah will increase and therefore Base shear VB will increase. This may lead to increase in size of lateral load resisting members and reinforcement. Ultimately structure cost may increase. Response spectra for Equivalent Static Method and Response Spectrum method are given separately, in both cases Sa/g values will change. It will change the values of Ah and VB. As per Old code IS 1893-2002 if Stiffness of masonry infill is not considered in analysis, it will increase the sizes of lateral load resisting elements like-columns/shear walls. As per IS 1893-2016 New code, Modelling with URM infill consider the stiffness of the infill in analysis thus, sizes of columns/shear wall may decrease or increase as per the stiffness distribution.. In old 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. ranging from 20 mtrs to 100 mtrs with help of Staad-Pro.

REFERENCES

[1] IS: 1893(Part 1): 2002, " Criteria for Earthquake Resistant Design of Structures." Part-1, Bureau of Indian Standards, New Delhi, 2002.
[2] IS: 1893(Part 1): 2016, " Criteria for Earthquake Resistant Design of Structures." Part-1, Bureau of Indian Standards, New Delhi, 2016.