NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATIONS IN ENGINEERING RESEARCH AND TECHNOLOGY [IJIERT]
ISSN: 2394-3696
VOLUME 5, ISSUE 6, June -2018

A COMPARATIVE STUDY ON SEISMIC ANALYSIS OF INDIAN CODES WITH OTHER COUNTRIES CODE

BHANU
Department of Civil Engineering, ALFALAH University, Faridabad, India
bhanuaggarwal501@gmail.com

MIRZA AAMIR BAIG
Department of Civil Engineering (Assistant Professor), ALFALAH University, Faridabad, India
aamirmirzagarri@gmail.com

ABSTRACT

Earthquakes are unpredictable and devastating. And the most unfortunate thing about earthquakes is that, they are not regular phenomena like the change of seasons in India. And perhaps that is why, we are mostly not prepared for them in advance. Earthquakes are low-probability events, but with high levels of risk to the society, it is important that the design of structures must be done in the best possible way to take into account these effects and thereby aiming for an adequate structural response. Parameters of different countries seismic codes differ significantly due to which performance of the building also varies. Hence, it is necessary to do a comparative study so as to conclude which building will perform better. In this paper, we present the analysis and design of a G+12 building for seismic forces using four different countries seismic codes:- IS:1893-2002 - Criteria for earthquake resistant design of structures Part 1, IS: 1893-2016 - Criteria for earthquake resistant design of structures, Euro code 8 - Design of structures for Earthquake resistance and ASCE7-10 - Minimum Design loads for buildings and other structures. Building was analysed using Etabs 2016 then designed as per the specified codes.

INTRODUCTION

In this project, a G+12 building is planned and analysed. The design is carried out using four different countries seismic codes:- IS:1893-2002 - Criteria for earthquake resistant design of structures Part 1, IS: 1893-2016 - Criteria for earthquake resistant design of structures, Euro code 8 - Design of structures for Earthquake resistance and ASCE7-10 - Minimum Design loads for buildings and other structures. The performance of the building will be checked using pushover analysis.

METHODOLOGY

Fundamental time period of any structure is one of the most important aspect as it determines the amount of base shear and all other design forces that are to be considered in the analysis and design of the structure. If a structure has a higher value of time period making it fairly flexible, it will attract lesser forces compared to its stiffer counterpart with smaller time period. The empirical formulae suggested by IS 1893 (2002) are based on observed natural period values on real buildings during the 1971 San Fernando earthquake in California which are very general in nature and does not incorporate the inherent variety of asymmetry, irregularities existing in different buildings. The time period obtained using these formulae often gives large variations when compared with the fundamental mode time periods of dynamic analysis. As a result of this variation the base shear calculated using dynamic analysis is often lower than the static analysis. Due to this the code recommends to scale the dynamic analysis base shear, so that it matches with the static one. This approach however conservative may be, but is not accurate. In the present study we are trying to find a rational approach by studying different models and investigate the variation in time period and forces between dynamic analysis results and code recommended empirical formulae results. An effort has been made to incorporate different kind of buildings along with some asymmetry and irregularities; and investigate their vibrational behaviour. Regression analysis has also been carried out to generate empirical expressions from the dynamic analysis results and their variation with the Code recommended formulae have been investigated. After studying these variations it was realized that the basic issue with our code still remains in its empirical formula approach. However large be the sample size, there would always be buildings that are not part of that sample size. In fact, every other buildings may behave differently under

ISSN: 2394-3696
VOLUME 5, ISSUE 6, June -2018

dynamic loads. Thus a more rational approach would be to drop the empirical formula and analyse every building rigorously. A more rigorous dynamic analysis, pushover analysis or performance based analysis would be more suited for the purpose.

AIM OF PROJECT

The objectives of the paper are stated below:

- To plan a G+12 building.
- To analyse the building
- To design the G+12 building using four different countries seismic codes:- IS:1893-2002 - Criteria for earthquake resistant design of structures Part 1, IS: 1893-2016 - Criteria for earthquake resistant design of structures, Euro code 8 - Design of structures for Earthquake resistance and ASCE7-10 - Minimum Design loads for buildings and other structures.
- To check the performance of the designed building by carrying out pushover analysis using SAP2000.

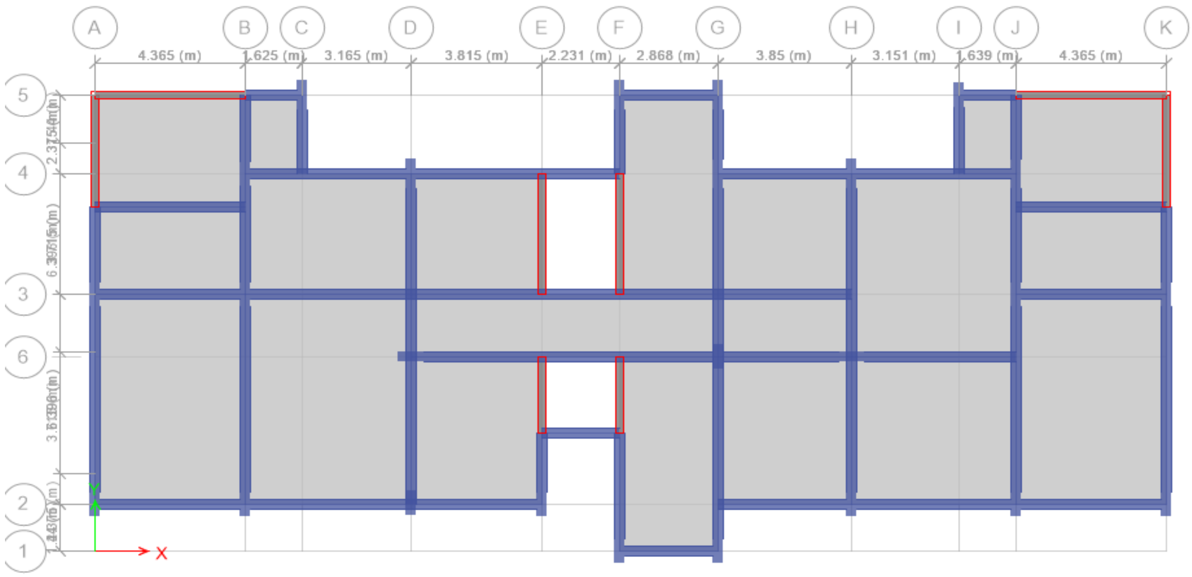


FIGURE 1 TYPICAL BAY WIDTHS IN X AND Y DIRECTION (IN PLAN)

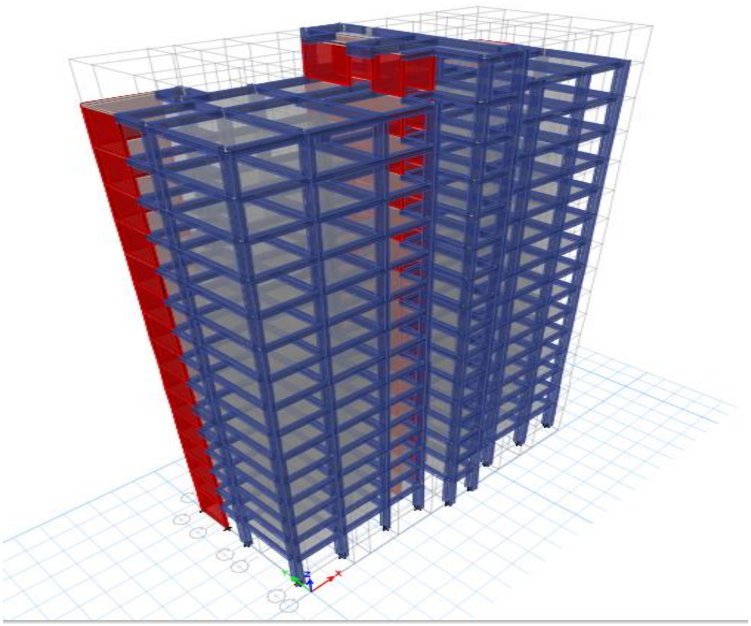


FIGURE 2 3D VIEW OF FRAMED BUILDING WITHOUT STEEL BRACING

Now it is the time to articulate the research work with ideas gathered in above steps by adopting any of below suitable approaches:

RESULT AND ANALYSIS

The present study is based on analysis of R.C.C frames with different seismic codes as IS-1893 2002, IS-1893-2016, EURO CODE and ASCE for comparision of displacement, stiffness, modal period, base shear and different clauses of various codal provision as per guidelines.

Design Parameters- Here the Analysis is being done for G+12, (rigid joint regular frame) building by computer software using ETABS.

Table 1. BASE SHEAR

Base Shear (kN)				
Load	IS 1893 2002	IS 1893 2016	EURO	ASCE
SPEC X	6970.6959	4481.4584	13062.0503	6970.6959
SPEC Y	4480.8413	4481.4297	17271.4015	4480.8413
EQX	-5482.562	5145.4347	-13183.5624	-6401.5327
EQY	-3636.9471	10080.8519	-16705.6679	-6401.5327

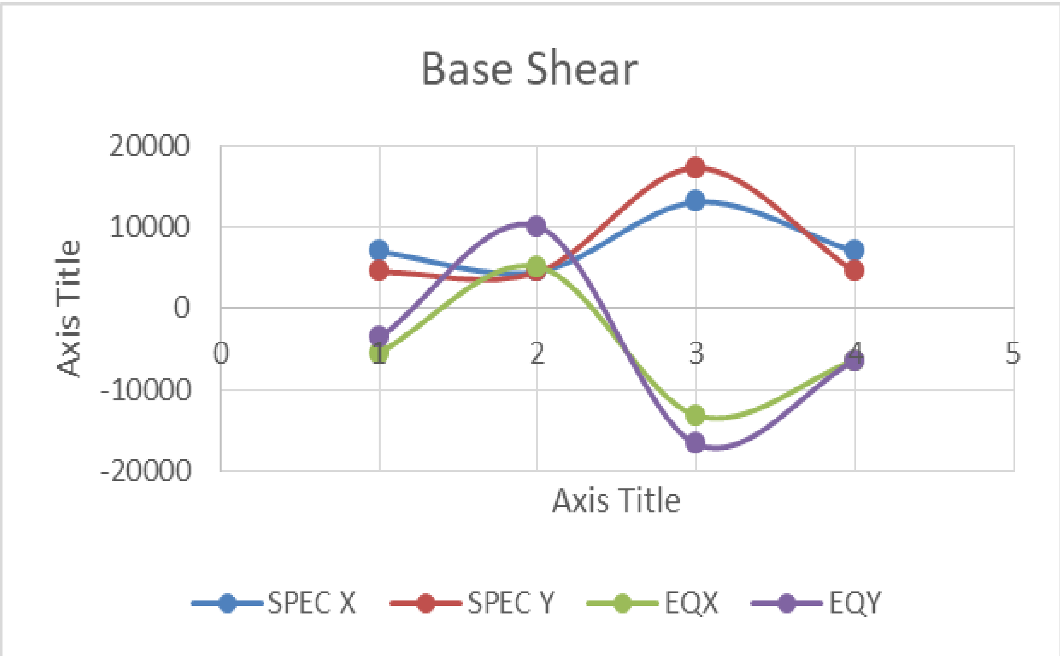


Table 2. Storey Displacement of model in X - direction

Storey Displacement (EQX)					
STOREY	HEIGHT	IS 1893 2002	IS 1893 2016	EURO	ASCE
MUMPTY	49	102.372	122.846	261.768	140.399
TERRACE	46	99.757	119.709	253.034	135.367
13	43	94.646	113.576	240.657	128.366
12	40	89.009	106.811	227.132	120.717
11	37	82.738	99.285	212.153	112.278
10	34	75.822	90.987	195.603	103.016
9	31	68.339	82.007	177.564	93.01
8	28	60.418	72.502	158.25	82.406
7	25	52.217	62.661	137.968	71.397
6	22	43.928	52.714	117.136	60.224
5	19	35.809	42.971	96.376	49.227
4	16	27.977	33.573	75.993	38.563
3	13	20.549	24.659	56.315	28.397
2	10	13.7	16.439	37.864	18.977
1	7	7.777	9.332	21.669	10.796
GF	4	3.109	3.731	8.73	4.324
Base	0	0	0	0	0

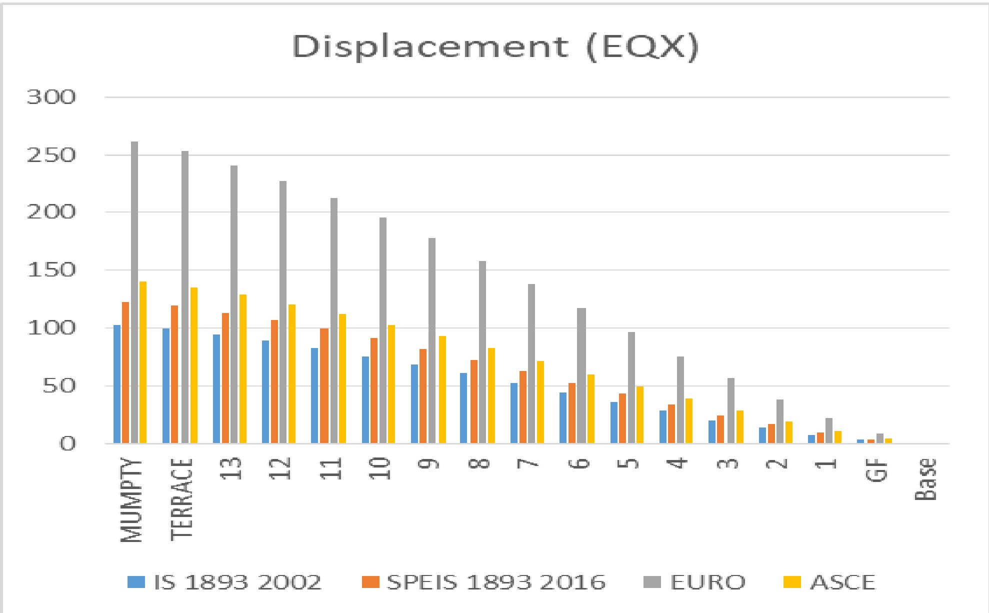
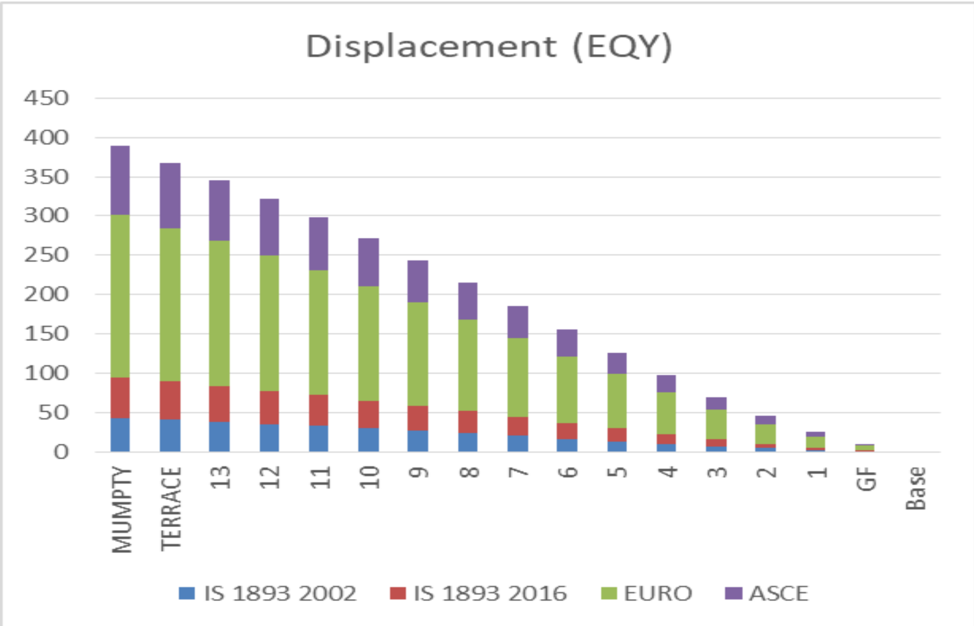


Table 3. Storey Displacement of model in Y - direction

Storey Displacement (EQY)					
STOREY	HEIGHT	IS 1893 2002	IS 1893 2016	EURO	ASCE
MUMPTY	49	42.799	51.359	207.272	87.355
TERRACE	46	40.54	48.648	195.65	82.372
13	43	38.024	45.629	184.443	77.324
12	40	35.402	42.483	172.511	72.116
11	37	32.636	39.163	159.648	66.514
10	34	29.68	35.615	145.896	60.552
9	31	26.569	31.883	131.361	54.288
8	28	23.356	28.028	116.223	47.812
7	25	20.081	24.097	100.626	41.195
6	22	16.783	20.14	84.726	34.51
5	19	13.507	16.208	68.719	27.843
4	16	10.318	12.382	52.924	21.327
3	13	7.37	8.844	38.119	15.275
2	10	4.774	5.728	24.897	9.92
1	7	2.615	3.138	13.755	5.448
GF	4	1.003	1.203	5.319	2.095
Base	0	0	0	0	0



CONCLUSION

The analysis and design of G+12 building was done using software. A comparative study was carried out for the analysis of building to check which was the most economical. It was concluded that the Euro standards served to be the most economical design and the Indian Standards (IS: 1893 2002) were the least economical.

As per the displacement values it can be concluded that the Indian Standards (IS: 1893 2002) undergo minimum displacement. As compared to the Indian Standards (IS: 1893 2002) Euro Standards has a percentage increase of 28%, American Standards an increase of 26% and Indian Standards (IS: 1893 2016) an increase of 19%. It can thus be inferred that building designed according to the Indian standards are more rigid and thus it attracts more seismic forces.

REFERENCES

I. Applied Technology Council, ATC-40. Seismic evaluation and retrofit of concrete Buildings, California, 1996; Vols. 1 and 2.
II. American Institute of Steel Construction Inc.– Steel Construction Manual (13th Edition)
III. AS 4100; 1998 – Australian Code for Design of Steel Structures
IV. Chopra AK, Goel RK (2001), "A modal pushover analysis procedure to estimate seismic Demands for buildings: Theory and preliminary evaluation", Pacific Earthquake Engineering Research Centre, University of California, Berkeley.
V. CP 110: PART 1:1972- British code of practice.
VI. CSI, SAP2000 Integrated finite element analysis and design of structures basic analysis reference manual, Berkeley: Computers and Structures
VII. Duggal. S.K. ,Limit State Design of Steel Structures, Tata McGraw Hill Education
VIII. Euro Code 8 – 2004
IX. Federal Emergency Management Agency (FEMA), (1997). NEHRP provisions for the seismic rehabilitation of buildings. Rep FEMA 273 and 274. Washington, DC: FEMA.
X. IS: 1893 Part 1 (2002),"Indian Standard Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards, New Delhi
XI. IS: 800 (1984), General Construction in Steel – Code of Practice, Bureau of Indian Standards, New Delhi, 2007.
XII. IS: 800 (2007), General Construction in Steel – Code of Practice, Bureau of Indian Standards, New Delhi, 2007.
XIII. IS: 875 (Part 1 To 2)-1987 - Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structure
XIV. IS: 875 (Part 3)-2015 - Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures – Wind Loads
XV. IS: 1893-2002 - Criteria for Earthquake Resistant Design of Structures
XVI. IS: 456-2000 - Plain and Reinforced Concrete - Code of Practice
XVII. IS: 13920:2016 - Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice
XVIII. IS: 800-2007 - Code of Practice for General Construction, In Steel
XIX. Code IS: 1786 -2008 - Specification for high strength deformed steel bars and wires for concrete reinforcement
XX. IS: 1904 - Indian Standard Code of Practice for Design and Construction of Foundation in Soils: General requirements.
XXI. J. N. Bandyopadhyay, Department of Civil Engineering, IIT, Kharagpur, "Earthquake resistant design and detailing of RCC structures as per codal provisions".
XXII. Jack P. Moehle, John D. Hooper, Chris D. Lubke, National Institute of Standard Technology, "Seismic Design of Reinforced Concrete Special Moment Frames".
XXIII. SP-16 – Design aids for IS-456
XXIV. SP-34 – Handbook on Concrete reinforcement and Detailing