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"ANALYSIS AND COMPARISONS OF RCC BUILDING WITH INDIAN AND BRITISH CODE USING STAAD-PRO SOFTWARE"

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Abstract— The present's study is seismic behavior of various structures using different codal provision as given Indian code and British code for earthquake analysis. This study is carried out on residential building of G+10 story Special RC structure. Modeling of the structure is done as per ETABS software.

Reinforced concrete frames are the most commonly adopted buildings construction practices in cities. With growing economy, urbanization and unavailability of horizontal space increasing cost of land and need for agricultural land, high-rise sprawling structures have become highly preferable in cities. With high-rise structures, not only the building has to take up gravity loads, but as well as lateral forces. Many important cities fall under high-risk seismic zones; hence strengthening of buildings for lateral forces is a prerEarthquakeuisite.

Hence the aim of present study is to compare seismic performance of G+10 story structures situated in earthquake zones III. All frames are designed under same gravity loading. Response spectrum method of analysis used for seismic analysis. ETABS software is used and the results are compared. A comparative analysis is performed in terms of base shear, deflection and story drift at linearly static using response spectrum method.

Key words: *STAAD pro, Earthquake loading, high-rise, response spectrum method.*

I. INTRODUCTION

General Introduction

In all over country's most of the structures are low rise buildings. Now a day due to greater migration towards cities, results in increase in the population in most of the major cities. In order to fulfill the requirement of this increased population in limited land the height of building becomes medium to have high rise buildings Structural planning and design is an art and science of designing with economy and elegance, serviceable and durable structure. The entire process of structural planning and designing requires not only imagination and conceptual thinking but also sound knowledge of science of structural engineering besides knowledge of practical aspects, such as relevant design codes and byelaws backed up by example experience.

The process of design commences with planning of structural primarily to meet the defined as he is not aware of various implications involved in the process of planning and design. The functional requirements and aspects of aesthetics are locked into normally be the architect while the aspect of the safety, serviceability, durability and economy of the structure are attended by structural designer. ETABS 2015 features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, ETABS 2015 is the professional's choice for steel, concrete, timber, aluminum and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more. ETABS 2016 consists of the following: The ETABS 2015 Graphical User Interface: It is used to generate the model, which can then be analyzed using the ETABS 2016 engine. After analysis and design is completed, the GUI can also be used to view the results graphically. The ETABS 2016 analysis and design engine.

To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, displacements. This information is then compared to criteria that indicate the conditions of failure.

RESEARCH OBJECTIVE

The objectives of the dissertation are stated below

1. To compare the results and behavior of structures using different country code.
2. To understand the basic principles of structures by different country Codes.
3. To perform analysis of the building using statics analysis method.
4. Design of G+10 story building Indian and British code Criteria for earthquake resistant design of structures, by using software.
5. To gain design knowledge on various structural elements like beam, column, slab, foundation, etc.
6. Comparing the results of Indian and British code.

''aPROJECT STATEMENT

The study will give more knowledge of British and Indian code and result into benefits for future implementation with the help of RCC building design.

i) Response Spectrum Method

A response spectrum is simply a plot or steady-state response (displacement, velocity or acceleration) of a series of oscillators of varying natural frequency that are forced into motion by same base vibration. The resulting plot can then be used to pick off the response of any linear system, given its natural frequency of oscillation. One such use is in assessing the peak response of building to earthquake. The science of strong ground motion may use some values from the ground response spectrum for correlation with seismic damage.

In technical terms it can be said that it is the representation of the maximum response of idealized single degree of freedom having certain period and damping during earthquake ground motion. The maximum response is plotted against the undammed natural period and for various damping values can be expressed in terms of maximum relative velocity or maximum relative displacement. The characteristics of seismic ground vibrations expected at any location depends upon the magnitude of earthquake, its depth of focus, distance from the epicenter, characteristics of the path through which the seismic waves travel, and soil strata on which the structure stands. The random earthquake ground motions, which cause the structure to vibrate, can be resolved in any three mutually perpendicular directions.

Seismic Base Shear

According to IS 1893 (Part-I): 2002, Clause 7.5.3 the total design lateral force or design seismic base shear (VB) along any principal direction is determined by

$$V_b = A_h * W$$

Where,

Ah is the design horizontal acceleration spectrum

W is the seismic weight of building.

Design Horizontal Seismic Coefficient

For the purpose of determining the design seismic forces, the country (India) is classified into four seismic zones (II, III, IV, and V). Previously, there were five zones, of which Zone I and II are merged into Zone II in fifth revision of code. According to IS 1893: 2002 (Part 1), Clause6.4.2 Design Horizontal Seismic Forces Coefficient Ah for a structure shall be determined by following expression,

$$A_h = (Z/2) * (I/R) * (Sa/2g)$$

Where,

Z = Zone factor seismic intensity.

II. PROBLEM FORMULATION

In this title of parametric investigation, a detailed study of analysis of RCC structure using IS codes and British code has been presented. Study has been done on Reinforced concrete structure. Analysis of all the above-mentioned structures has been carried out by using Indian and British Standard with response spectrum Method. Cost effectiveness of structures has also been studied only from material point of view.

Methodology of Comparison

1. Select a plan of Regular shape residential building with analyzed at Indian code and British code building models.
2. Select suitable earthquake and wind parameters along with site conditions & environment for various zones.
3. Model structures in ETABS software, analyses it by response spectrum Analysis methods for zone III for Indian code and British code for special moment-resisting frame.
4. Observation of result & discussion.

Comparing the result with past researches & conclusion.

Table1.1 Detail Features of Buildings

Sr. No	Parameters	Values
1	Material Used	Concrete-M25 &M30 Reinforcement Fe-415Mpa
2	Plan Dimension	
3	Height Of Each Story	3.0m
4	Height Of Ground Story	1.2m
5	Density Of Concrete	25KN/M^3
6	Poisson Ratio	0.2-Concrete And 0.15-Steel
7	Density Of Masonry	20KN/M^3
9	Code Of Practice Adopted	IS456:2000, IS1893:2002 & BS 8110-1997 [40}
10	Seismic Zone for IS1893:2016	III
12	Importance Factor	1
13	Response Reduction Factor	5
14	Foundation Soil	Medium
15	Slab Thickness	150mm
17	Floor Finish	1KN/M^2
18	Live Load	2KN/M^2
19	Earthquake Load	As Per IS 1893-2016& BS 8110-1997 40
20	Size Of Beam	380X230 & 450X230mm
21	Column Size	450X230 & 520X230mm
23	Model To Be Design	G+10
24	Ductility Class	IS1893:2016 SMRF

Types of Loads

Unless otherwise specified, all loads listed, shall be considered in design for the Indian Code following load combinations shall be considered.

Load case

1) DL: Dead load
2) LL: Live load
3) EQ: Earthquake load
4) WL: Wind Load

Load Combination

1. 1.5DL+1.5LL
2. 1.2DL+1.2LL + 1.2EX
3. 1.2DL+1.2LL- 1.2EX
4. 1.2DL+1.2LL+ 1.2EY
5. 1.2DL+1.2LL - 1.2EY
6. 1.2DL+1.2LL+1.2WLX
7. 1.2DL+1.2LL-1.2WLX

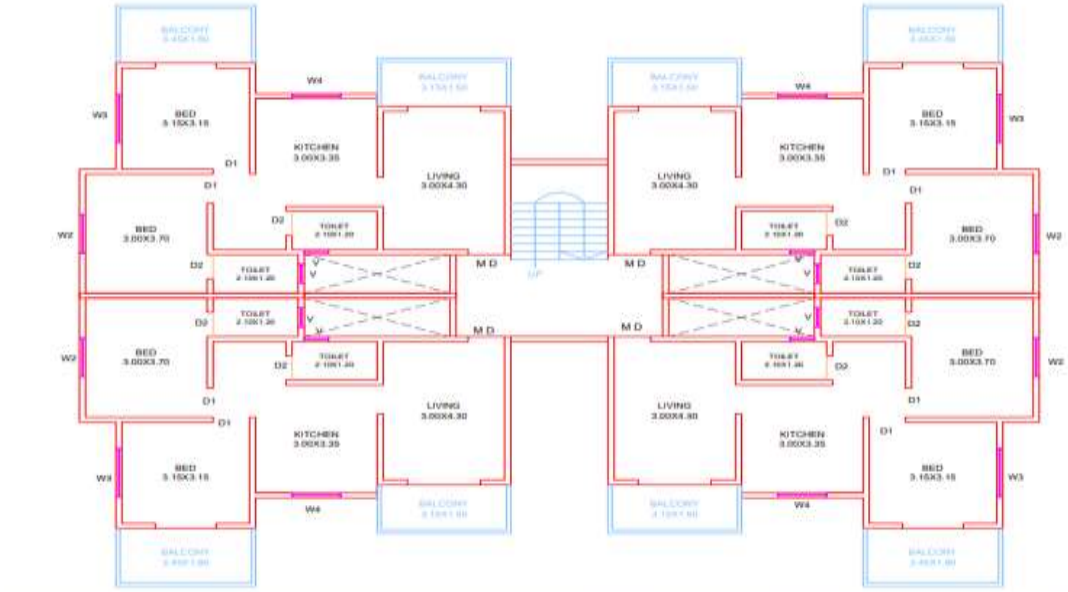
8. 1.2DL+1.2LL+1.2WLY
9. 1.2DL+1.2LL-1.2WLY
10. (0.9DL±1.5EQ)

Loads Considered

Table 1.2 Dead and Live Load Considered

Dead Load	Self-Weight of Slab, Beam, Column, Wall, Parapet Wall
Live Load	For Intermediate Floor = 2.5 KN/M2 For Terrace Floor = 1.25 KN/M2
Floor Finish	For Intermediate Floor = 1 KN/M2 For Terrace Floor = 1KN/M2

Proposed Building Plan for Analysis:



A. **STAAD Pro Software Plan (1st To 10th Floor Plan Typical) :**

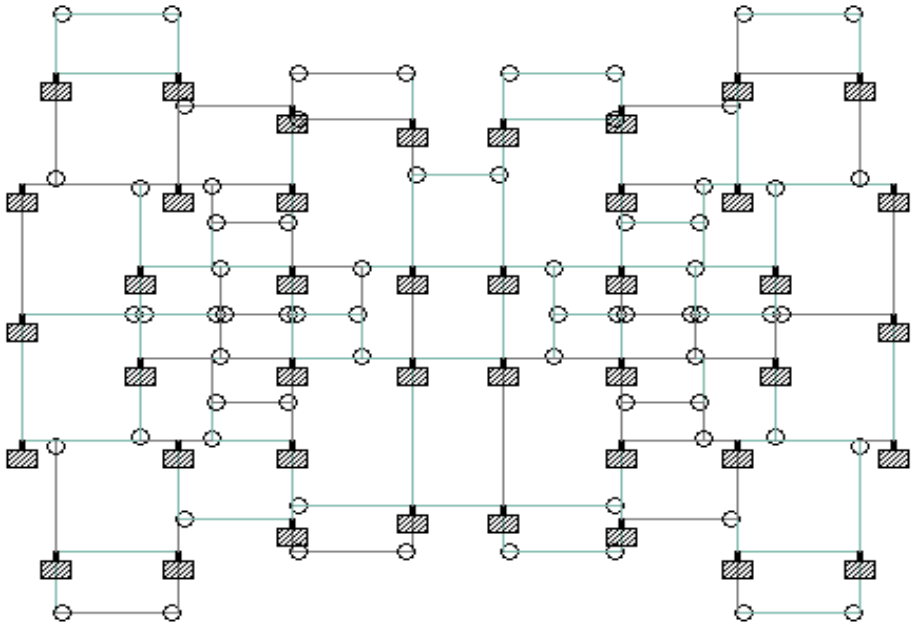


Fig. Software Typical Floor Plan (1st Floor to 10th Floor)

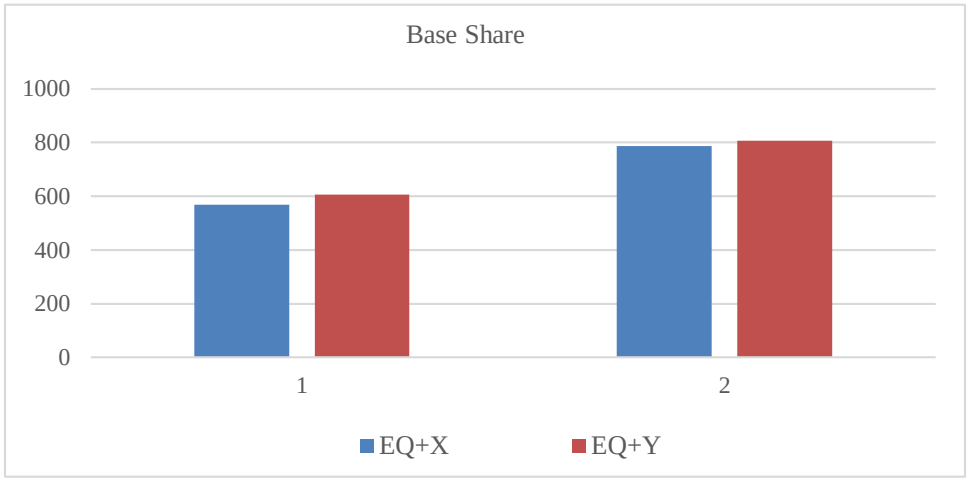
III. RESULTS

A. Base Shear Results

Table 1.3 Base Shear for Indian and British Code Response Spectrum Analysis Method

TABLE: Auto Seismic - IS 1893:2002				
Load Pattern	Soil Type	I	Indian Code	British Code
			Base Shear(kN)	Base Shear(kN)
EQ + X	II	1	567.9431	786.2996
EQ - X	II	1	567.9431	786.2996
EQ + Y	II	1	606.5139	806.1185
EQ - Y	II	1	606.5139	806.1185

Graph 1.1 Base Shear vs. Indian and British code for Zone III of Building



B. Earthquake Displacement Results

Table 1.4 Earthquake Displacement at Zone III for Indian code and 0.2 factor for British code

TABLE: Diaphragm Centre Of Mass Displacements			
Story	**Load Case/Combo**		
		UX (mm)	**UX** (mm)
10th Slab		17.059	22.043
9th Slab	EQ+X	16.456	21.133
8th Slab	EQ+X	15.415	19.779
7th Slab	EQ+X	13.969	18.011
6th Slab	EQ+X	12.368	16.075
5th Slab	EQ+X	10.566	13.873
4th Slab	EQ+X	8.618	11.446
3rd Slab	EQ+X	6.582	8.844
2nd Slab	EQ+X	4.509	6.124
1st Slab	EQ+X	2.452	3.36

Graph: 1.2 Earthquake Displacement vs. Indian and British code for Response Spectrum Analysis

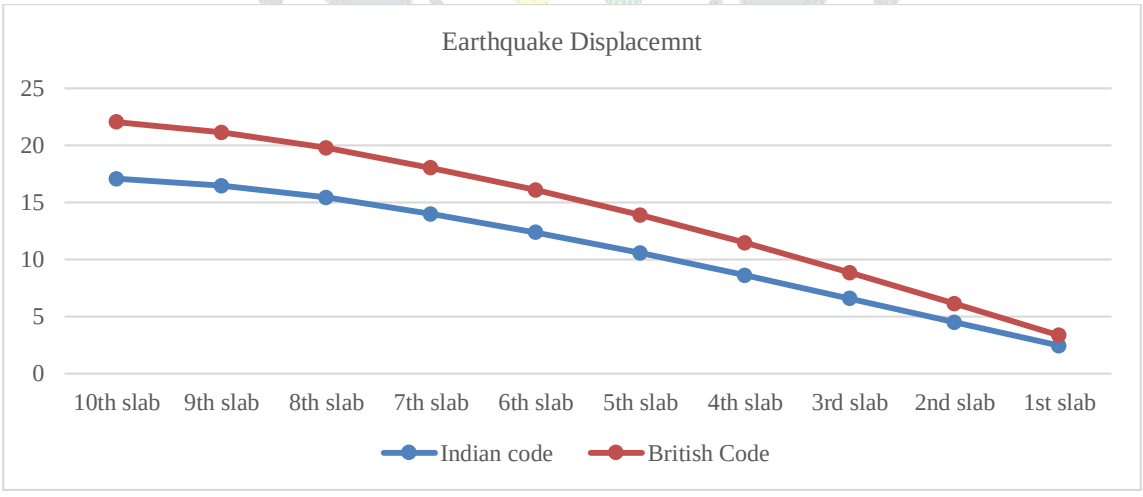


Table 1.5 Wind Displacement at Indian and British Code for 39 M/Sec Basic Wind Speed

TABLE: Diaphragm Centre of Mass Displacements			
Story	**Load Case/Combo**	**UX**	**UX**
		mm	mm
10th slab	W L+X	13.766	12.504
9th slab	W L+X	13.356	12.156
8th slab	W L+X	12.699	11.599
7th slab	W L+X	11.776	10.812
6th slab	W L+X	10.705	9.887
5th slab	W L+X	9.425	8.767
4th slab	W L+X	7.947	7.45
3rd slab	W L+X	6.287	5.941
2nd slab	W L+X	4.463	4.249
1st slab	W L+X	2.507	2.4

Graph 1.3 Wind Displacement vs. Indian and British Code for Wind Analysis 39 M/Sec Basic Wind Speed

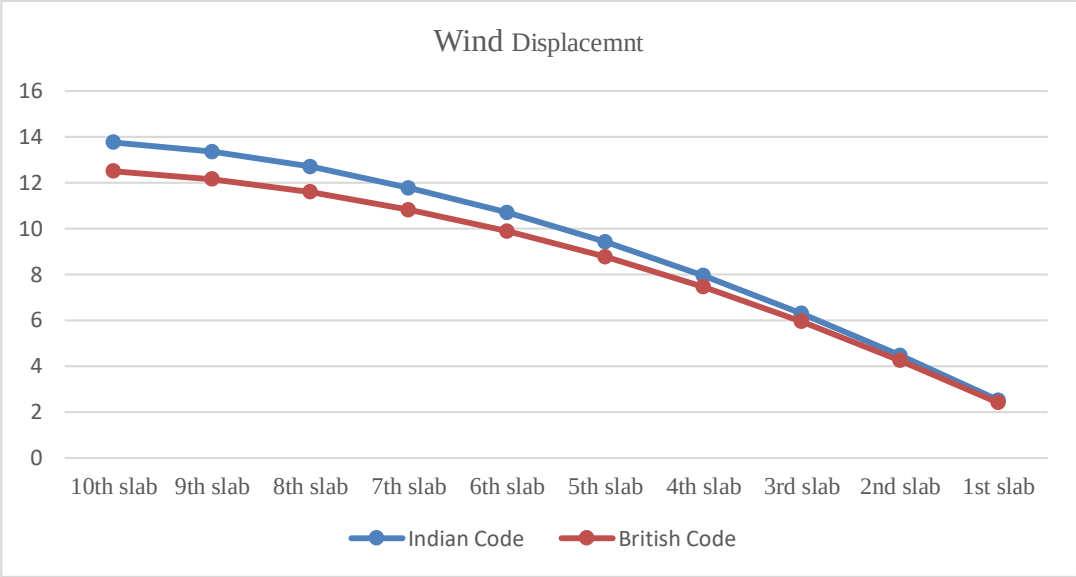


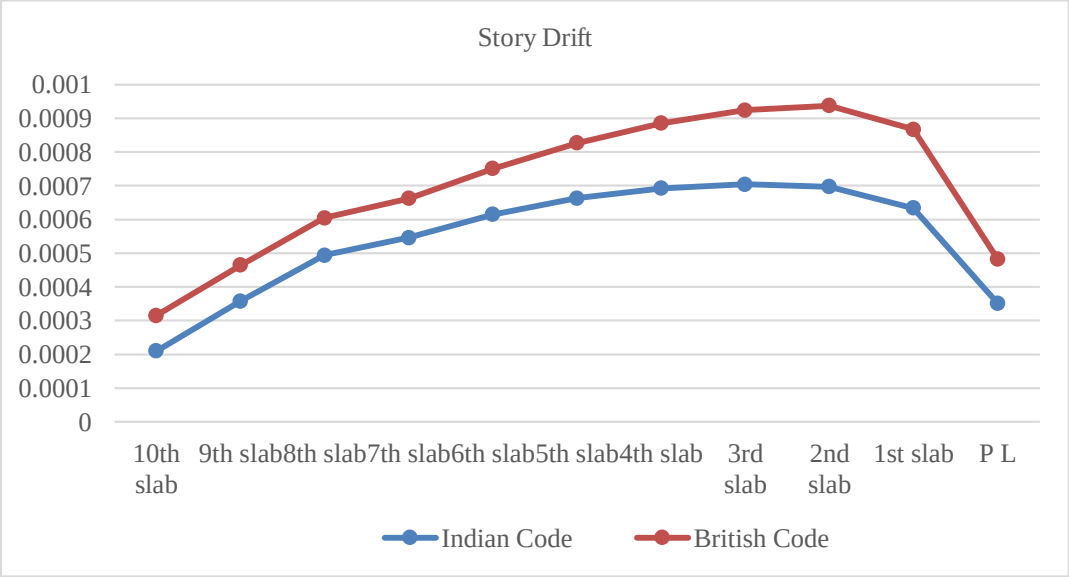
Table 1.6 story force for Indian and British code for 1.5(DL+LL) case

Story	**Load Case/Combo**	**P**	**P**
		kN	kN
10th slab	1.5(DL +LL)	4090.6765	4090.6765
9th slab	1.5(DL +LL)	11336.1386	11336.1386
8th slab	1.5(DL +LL)	18581.6007	18581.6007
7th slab	1.5(DL +LL)	25887.782	25887.782
6th slab	1.5(DL +LL)	33193.9632	33193.9632
5th slab	1.5(DL +LL)	40500.1444	40500.1444
4th slab	1.5(DL +LL)	47806.3256	47806.3256
3rd slab	1.5(DL +LL)	55112.5069	55112.5069
2nd slab	1.5(DL +LL)	62418.6881	62418.6881
1st slab	1.5(DL +LL)	69724.8693	69724.8693
P L	1.5(DL +LL)	73568.5754	73568.5754

Table 1.7 Story Drift Results for Indian and British Code

TABLE: Story Drifts			
Story	**Load Case/Combo**	**Drift**	**Drift**
10th slab	EQ+X	0.00021	0.000315
9th slab	EQ+X	0.000358	0.000465
8th slab	EQ+X	0.000494	0.000605
7th slab	EQ+X	0.000546	0.000662
6th slab	EQ+X	0.000615	0.000751
5th slab	EQ+X	0.000663	0.000827
4th slab	EQ+X	0.000692	0.000885
3rd slab	EQ+X	0.000704	0.000924
2nd slab	EQ+X	0.000697	0.000937
1st slab	EQ+X	0.000634	0.000867
P L	EQ+X	0.000352	0.000483

Graph 1.4 Story Drift vs. Indian and British Code Comparisons for Earthquake Loading.



IV. CONCLUSION

Conclusions In the present study, Relative Analysis of RCC structure with Different code comparisons i.e. Indian code and British code use for building Analysis. The structures are analyses for earthquake zone III & British code 0.2 factor with medium soil and Results Compare. It has been made on different structural parameters viz. base shear, Earthquake displacement, wind displacement, Story Drift and story force etc. Grounded on the analysis results following conclusions are drawn.

1. Analysis of RCC building with different Code i.e. Indian code and British code with medium soil condition at zone III. The base shear in X- direction, in British code building, the base shear is increased 38.4% as compare to Indian code building in base share results.
2. The Indian code building with British code building at zone III and Factor 02. But results indicate that variation of base shear is increase in British code building, hence Indian building is economical as compare to British code building.
3. Comparing earthquake displacement in Indian and British code building, British code displacement is 1.2921 increased as Comair to Indian code, hence in wind displacement, Indian code displacement is increased 1.1009 times as compare to British code

4. In G+10 story building, story drift in British code building as compare Indian code building, British code building story drift is increased almost 50 % as compare to Indian code building, also in story force results, all force are same for all story level in both code building.
5. Indian code Building and British code building, Indian code building is economical as compare to British code building, but relatively both building shows good performance in all Results.

REFERENCES

1. Imam Usman Shekh, Udaysinh Redeker, Kartar Rathod, Sagar Sabale, Sachin Ghatule, Pranay Khare, N.L.Shelke "Analysis, Design and Estimation of G +7 Storey Building Structure by using IS Code Methods and by Software's". Volume-7, Issue-2, March-April 2017 International Journal of Engineering and Management Research Page Number: 522-528.
2. C.V.Siva Rama Prasad, N. SaiPavan, A.Varun Kumar, G.Sandeep Kumar, S.Sampath "ANALYSIS AND DESIGN OF G +20 RESIDENTIAL RCC BUILDING BY USING ETABS IN ZONE II". 2019 JETIR March 2019, Volume 6, Issue 3 www.jetir.org (ISSN-2349-5162).
3. Mahesh Suresh Kumawat and L G Kalurkar "ANALYSIS AND DESIGN OF MULTISTORY BUILDING USING COMPOSITE STRUCTURE". Int. J. Struct. & Civil Engg. Res. 2014 ISSN 2319 – 6009 www.ijscer.com Vol. 3, No. 2, May 2014 © 2014 IJSCER. All Rights Reserved
4. P.P.Tapkire, Saeed J.Birajdar "Comparative Study of High Rise Building using INDIAN Standards and EURO Standards under Seismic Forces". International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438".
5. Dr. S.V. Itti, Prof. Abhishek Pathade and Ramesh B. Karadi "A Comparative Study on Seismic Provisions Made in Indian and International Building Codes for RC Buildings". Dept. of Civil Engg., KLESCET, Belgaum – 590008 (Karnataka).
6. Labani Nandi "Design Comparison of Different Structural Elements By using Different International Codes". International Journal of Engineering Research & Technology (IJERT) IJERT ISSN: 2278-0181 Vol. 3 Issue 3, March – 2014.
7. Tabish Izhar "Comparison of Reinforced Concrete Member Design Methods of Various Countries". International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 4, April 2018, pp. 637–646, Article ID: IJCIET_09_04_072 Available online at http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=4 ISSN Print: 0976-6308 and ISSN Online: 0976-6316.
8. Imam Usman Shekh, Udaysinh Redekar, Kartar Rathod, Sagar Sabale, Sachin Ghatule, Pranay Khare, N.L.Shelke. "Analysis, Design and Estimation of G +7 Storey Building Structure by using IS Code Methods and by Software's". Volume-7, Issue-2, March-April 2017 International Journal of Engineering and Management Research Page Number: 522-528".
9. Tabish Izhar, Neha Mumtaz, "Comparative Study on Analysis and Design of Reinforced Concrete Building under Seismic Forces for Different Codal Guidelines". International Journal of Trend in Scientific Research and Development (IJTSRD), Volume: 3, Issue 4, May-Jun 2019.
10. Anupoju Rajeev, Naveen Kumar, Meena Kumar Pallav, "Comparative Study of Seismic Design and Performance of OMRF Building Using Indian, British, and European Codes."(MDPI), Volume: 4, Issue 71, Nov-2019.
11. Samreen Bano, "Comparative Study on Analysis and Design of Reinforcement concrete Building under Seismic Forces for Different Codal Guidelines". Integral University Lucknow (IUL), Apr-2019.
12. Tabish Izhar, Samreen Bano, Neha Mumtaz, "Design of RC member using different building code". Integral University Lucknow (IUL), Apr-2019.
13. Anupoju Rajeev, Naveen Kuma, Kumar Pallav, "Comparative Study of Seismic Design and Performance of OMRF Building Using Indian, British, and European Codes". (MDPI), Sep-2019.

14. Abhay Guleria, "Structural Analysis of a Multi-Story Building using ETABS for different Plan Configurations". International Journal of Engineering Research and Technology (IJERT), May -2014.
15. Gaurav Charavande, Savita Maru, "Earthquake Analysis, of RC Structure using Different Codes and Different Countries". International Journal of Engineering and Advanced Technology (IJEAT), Dec 2019.
16. IS 875(part 1-5)-code of practice for structural safety of Building loading standards.
17. IS 875, "Code of practice for design loads (other than earthquake) for building and structures - Part 2: Imposed loads", Bureau of Indian Standards, New Delhi, 1987.
18. IS 456, "Indian Standard Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi, 2000.
19. IS 1893 (Part I), "Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards, New Delhi, 2002.