IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Earthquake analysis: the comparison of nominal loads, load combination, load factor, design parameters from various building codes.

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Abstract – This paper presents a seismic behavior of various structures using different codal provision as given Indian code, American code, & New Zealand code for earthquake analysis. This study is carried out on residential building of G+5, G+11, G+21 of Special RC structure. Modelling of the structure is done as per ETAB software. Time period of the structure in both the direction is taken from the software as per the three standard (9 model are made 3 model for each code). A comparative analysis is performed in terms of base shear, deflection limit, stores drift at linearly static and response spectrum.

Key Words: Base Shear, Displacement, Seismic Analysis, Storey Drift.

INTRODUCTION

Structural design is a workmanship and study of understanding the conduct of basic part of oppressed powers and loads and structuring them with economy and style to give a protected, useful and tough. Structural design of structures of any nation depends on specific codes of practice which give the fundamental information and norms in breaking down and planning the structure from quality perspective and affordable perspective. These codes are completed by profoundly experienced basic architects, academicians and other prominent colleagues of separate regions.

This paper concerned the comparison of nominal loads, load combination, load factor, design parameters like beam, column and beam and their suitability from various building codes. The utilization of various plan strategies and codes give various outcomes in basic investigation and structure that prompts changeability in conduct, expenses and strength of structures. Such examination gives heaps of data identified with basic structure that at what degree one nation's code vary from another nation's code as far as level of exactness, security, multifaceted nature and subtleties are considered. Thus, it is the obligation of basic designer to give precise measures that lead to ideal execution and economy by with respect to the most proper structure technique. Such inventive capacity and creative mind is completely founded on understanding of auxiliary architects. The auxiliary plan procedure

includes basic arranging, activity of powers and loads, part investigation, part structure, correlation among various structures codes and their itemizing.

It is checked on that those nations where more than one code is received for basic plan so it is useful in establishing what code has higher factor of security and level of precision than another.

Objective of the project:

The main objective of this project is to bring out the most causative factors that cause poor performance throughout the earthquake and build recommendations that ought to be taken under consideration in coming up with the multi- storied concrete buildings therefore on bring home the bacon their adequate safe behaviour. Indian common place Code IS:1893 was appropriately update in 2016 therefore on address the assorted style problems brought call at the earthquake behaviour of the RC Buildings. The chosen standards are Indian Standard Code (IS:1893), American code (ASCE-7-2002), & New Zealand code(1170.2004) . A comparative analysis was performed in terms of Base shear, Displacement, for different codes.

Methodology:

The methodology worked out to achieve the mentioned objectives is as follows:

- Modelling of the selected building in Etab Software.
- Three models as per the codes i.e. Indian code, American code, New Zealand code specification were made.
- Applied manually calculated Lateral seismic forces and load combinations as per IS 1893-2016, American code (ASCE-7-2002), & New Zealand code(1170.2004)
- Analyzed the models and graphical and tabular representation of the data is presented.

Modelling

A multi-storey building of G+5, G+11, and G+21, Special RC moment-resting frame (SMRF) is taken for study. The typical storey height is 3.2 m for all storey.

The three codal provisions as mentioned above. A Linear Static analysis is done using Etab Software. The model is studied for all three code for severe parameter with medium soil condition.

Plan and Specification of the Building

:- MODEL: Plan of the building

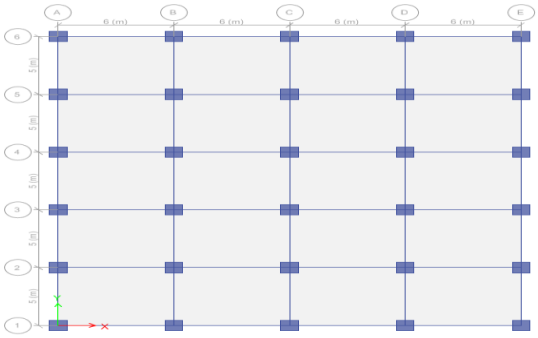


Fig (1). Plan of Building

Table -2.2 : Specification of the Building

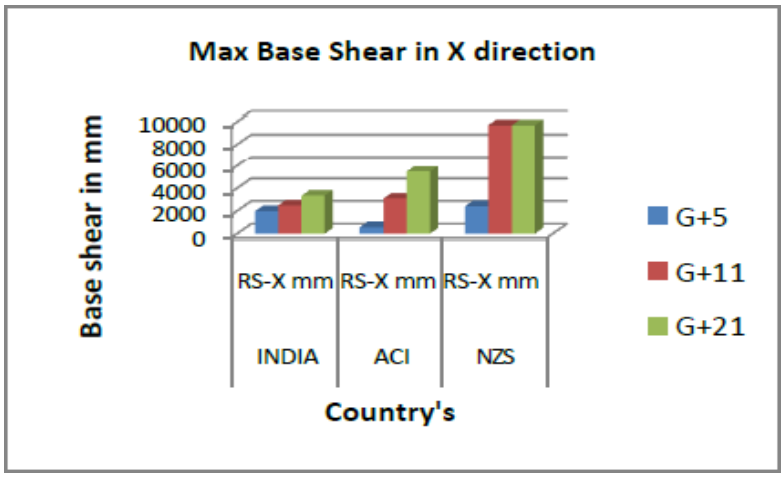
SR NO.	Parameters	Dimension/Type
1	Plan Dimension	25m x 24m
2	No. Of Stories	G+5, G+11, G+21
3	Height of EachStorey	3.2 m
4	Grade of Concrete	M30
5	Frame Type	SMRF
6	Soil Type	Medium Soil
7	Column Size	450mm, 600mm, 900mm
8	Beam Size	250mm, 450mm, 500mm
9	Slab Thickness	125 mm
10	Unit Weight ofConcrete	25 Kn/Cum

Analysis and Results

Result obtained for Base Shear

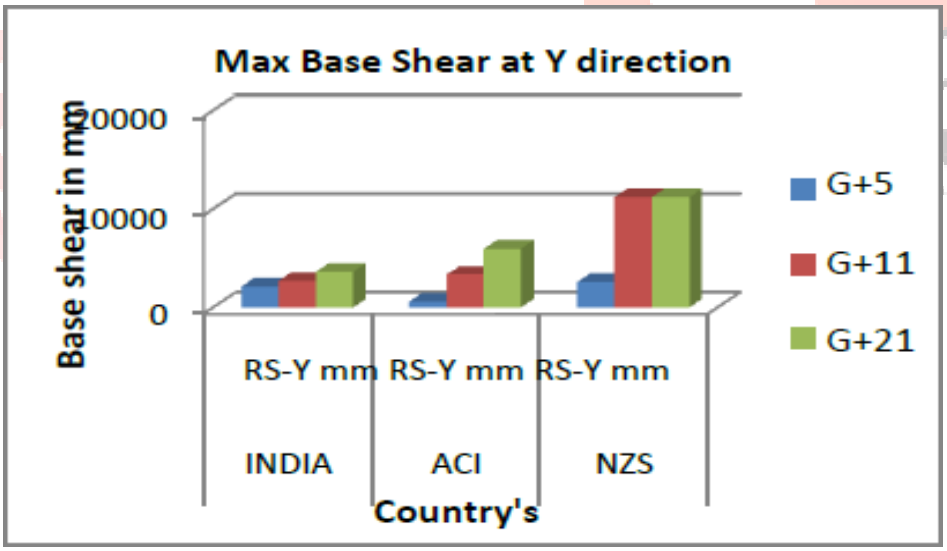
Case (i). Result for Base Shear in X-Direction Max base shear

STORY	INDIA X-Dir mm	ACI X-Dir mm	NZS X-Dir mm
5	1956.936	556.532	2419.568
G+11	2449.362	3078.322	9697.909
G+21	3339.521	5470.615	9697.909



Case (ii). Result for Base Shear in Y- Direction Max base shear

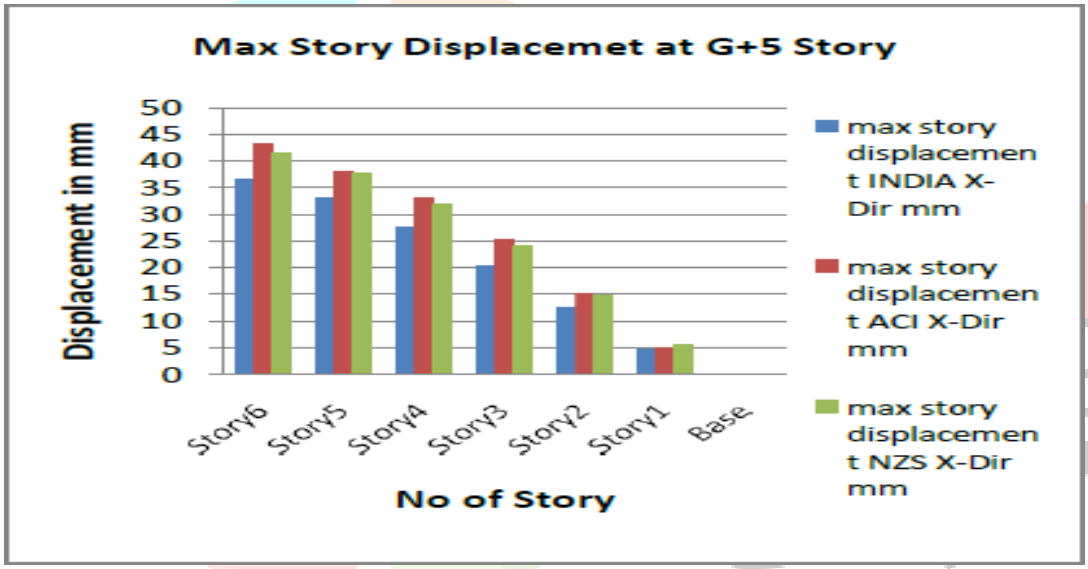
STORY	INDIA Y-Dir mm	ACI Y-Dir mm	NZS Y-Dir mm
G+5	1956.936	556.532	2536.676
G+11	2449.362	3078.322	9697.909
G+21	3339.521	5470.615	9697.909



Result obtained for Displacement. Result for G+5

Max story displacement

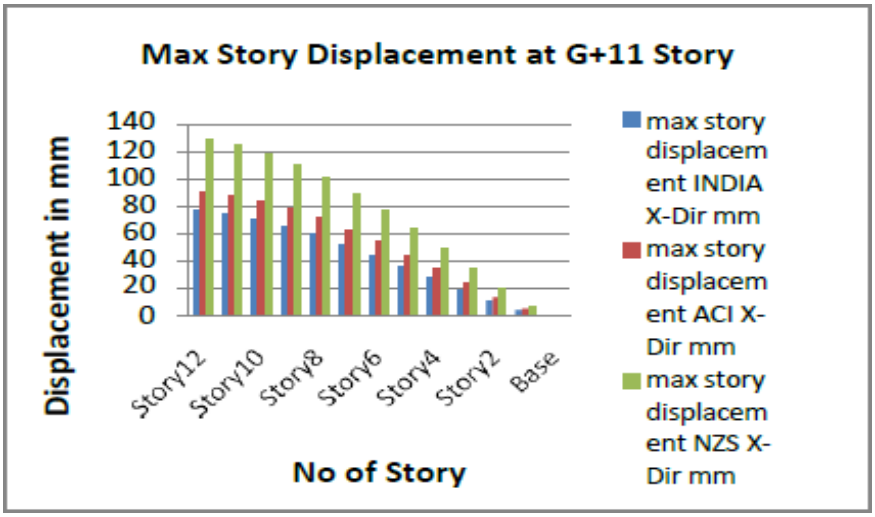
STORY	INDIA mm	ACI mm	NZS mm
Story6	36.7	43.18	41.4
Story5	33.2	38.1	37.7
Story4	27.6	33.02	31.8
Story3	20.4	25.4	24.0
Story2	12.5	15.24	14.9
Story1	4.7	5.08	5.7
Base	0	0	0



Result for G+11

Max story displacement

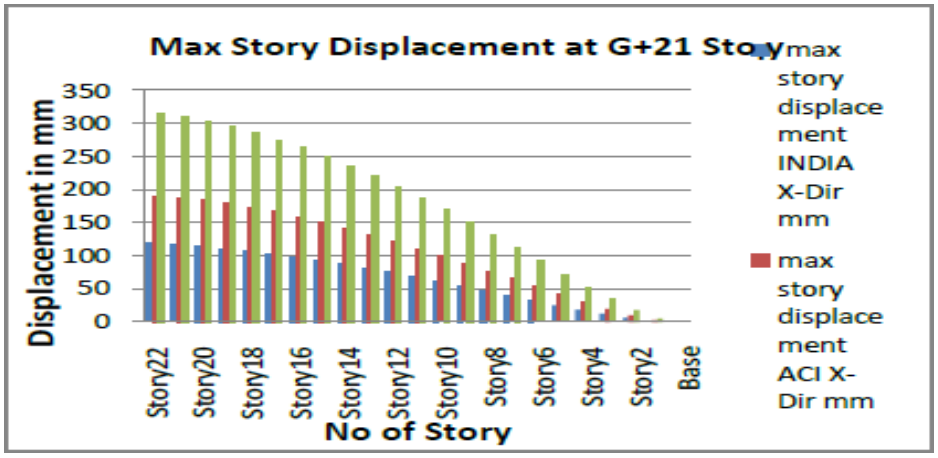
STORY	INDIA mm	ACI mm	NZS mm
Story12	76.8	90.4	129.3
Story11	74.2	87.6	124.9
Story10	70.3	83.5	118.7
Story9	65.3	77.9	110.7
Story8	59.1	71	101
Story7	52	62.9	89.7
Story6	44.2	53.9	77
Story5	35.9	44.1	63.3
Story4	27.4	33.8	48.7
Story3	18.7	23.3	33.7
Story2	10.5	13	19
Story1	3.5	4.3	6.3
Base	0	0	0



Result for G+21

Max story displacement

STORY	INDIA mm	ACI mm	NZS mm
Story22	118.8	190.6	315.3
Story21	116.8	187.4	309.6
Story20	114.3	183.6	303.0
Story19	111.3	178.8	295.1
Story18	107.6	173.2	285.9
Story17	103.4	166.6	275.4
Story16	98.7	159.1	263.6
Story15	93.4	150.8	250.6
Story14	87.7	141.8	236.4
Story13	81.7	132.2	221.2
Story12	75.2	121.9	204.9
Story11	68.6	111.2	187.8
Story10	61.6	100.1	169.8
Story9	54.5	88.7	151.1
Story8	47.3	77.0	131.9
Story7	40.0	65.2	112.2
Story6	32.7	53.4	r92.2
Story5	25.5	41.6	72.2
Story4	18.5	30.2	52.6
Story3	12.0	19.5	34.1
Story2	6.2	10.1	17.7
Story1	1.8	3.0	5.3
Base	0	0	0



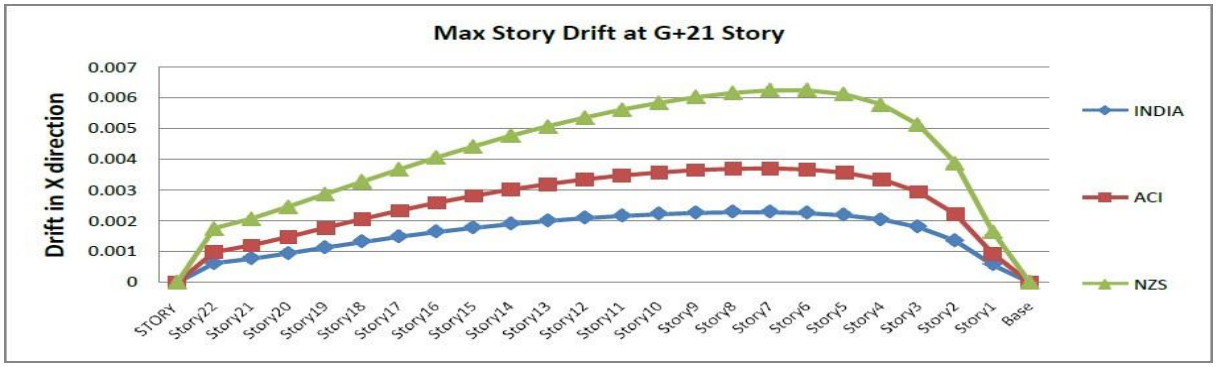
Result obtained for Storey Drift Result for G+5

Max story drift

STORY	INDIA	ACI	NZS
Story6	0.001097	0.001143	0.001167
Story5	0.001753	0.001913	0.001854
Story4	0.002231	0.00257	0.002429
Story3	0.002483	0.003011	0.002824
Story2	0.002433	0.003074	0.002884
Story1	0.00147	0.001904	0.001791
Base	0	0	0

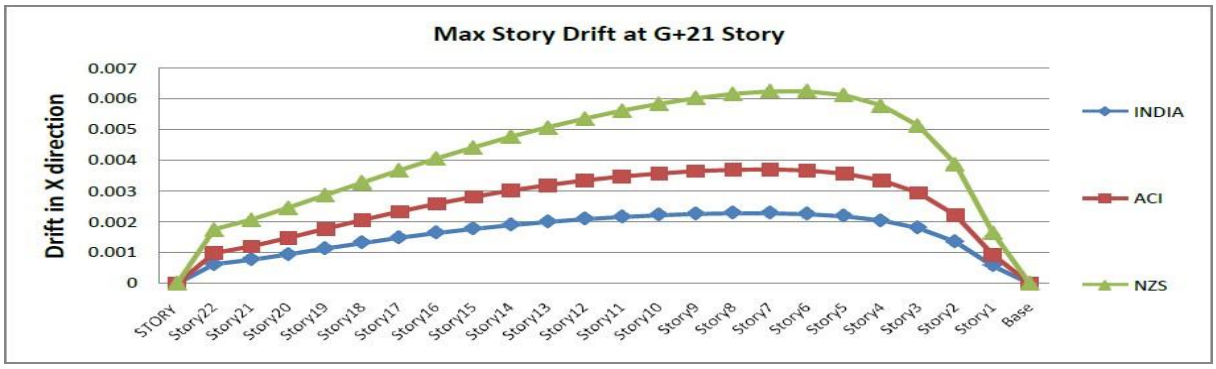
Result for G+11 Max story drift

TORY	INDIA	ACI	NZS
Story12	0.000824	0.00088	0.001381
Story11	0.001201	0.001295	0.00193
	0.00159	0.001744	0.002501
Story9	0.001933	0.00216	0.003039
Story8	0.002214	0.002522	0.003525
Story7	0.00243	0.002823	0.003947
Story6	0.002585	0.003058	0.004298
Story5	0.002678	0.003222	0.004562
Story4	0.002695	0.00329	0.004698
Story3	0.002586	0.003192	0.004597
Story2	0.002195	0.002731	0.003961
Story1	0.00108	0.00135	0.001968
Base	0	0	0



Result for G+21

STORY	INDIA	ACI	NZS
Story22	0.000635	0.000986	0.001762
Story21	0.000775	0.001205	0.00208
Story20	0.00095	0.00148	0.002463
Story19	0.001135	0.001773	0.002871
Story18	0.001316	0.002061	0.003281
Story17	0.001486	0.002335	0.003682
Story16	0.00164	0.002586	0.004065
Story15	0.001778	0.002814	0.004427
Story14	0.001899	0.003016	0.004765
Story13	0.002003	0.003193	0.005076
Story12	0.002091	0.003344	0.00536
Story11	0.002162	0.00347	0.005615
Story10	0.002218	0.003572	0.005836
Story9	0.002258	0.003647	0.006021
Story8	0.00228	0.003693	0.006161
Story7	0.002282	0.003704	0.006243
Story6	0.002254	0.003667	0.006242
Story5	0.002185	0.003561	0.006115
Story4	0.002049	0.003344	0.005786
Story3	0.0018	0.002942	0.005122
Story2	0.001358	0.00222	0.003886
Story1	0.000576	0.000943	0.001656
Base	0	0	0



Conclusion

Conclusions for Base Shear

- **For G+5**
- When base shear was Calculated in X-Y direction, American code showed better results than Indian code, Newzealand code.
- When Newzealand and Indian code were compared , Indian code gave low base shear.
- **For G+11**
- When base shear was Calculated in X-Y direction, Indian code showed better results than American code, Newzealand code.
- When Newzealand and American code were compared, American code gave low base shear.
- **For G+21:** When base shear was Calculated in X-Y direction, Indian code showed better results than American code, Newzealand code.
- When Newzealand and American code were compared , American code gave low base shear.

Conclusions for Story Drift For G+5

- When Story Drift was Calculated , Indian code showed better results than American code, Newzealand code. American code gave Max storey drift which is unaccettable
- **For G+11:** When Story Drift was Calculated , Indian code showed better results than American code, Newzealand code. Newzealand code gave Max storey drift which is unaccettable.
- **For G+21:** When Story Drift was Calculated , Indian code showed better results than American code, Newzealand code.. Newzealand code gave Max storey drift which is unaccettable.

Conclusions for Displacement

- **For G+5:** When Story Displacement was Calculated , Indian code showed better results than American code, Newzealand code. Newzealand code gave Max storey drift which is unaccettable at story 6
- **For G+11:** When Story Displacement was Calculated , Indian code showed better results than American code, Newzealand code. Newzealand code gave Max storey drift which is unaccettable at storey 12.
- **For G+21:** When Story Displacement was Calculated , Indian code showed better results than American code, Newzealand code. Newzealand code gave Max storey drift which is unaccettable at storey 22.

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