Seismic Vulnerability Study on RC Bare Frames Using Non Linear Ststic Analysis

Supreeth H K[1], Ramya. K[2]
[1, 2] Department of Computer Aided Design of Structures
[1, 2] V.T.U Sahyadri college of Engineering and management, Mangaluru, India

Abstract- *Many buildings in the present have irregular configurations both in plan and elevation. An analysis has been performed to study the lateral forces and base shear of a Multi-storeyed (15-story) building for 4 different models. To perform analysis by equivalent static force method ETABS V.15 is used however, when the buildings are subjected to Non-Linear static analysis method, Comparison of Zone III and IV.*

Keywords- Nonlinear static Analysis, ETABS 2015, Hinge properties, bare Frames, Regular and Irregular buildings

I. INTRODUCTION

Earthquake is rapid release of stress waves during a brittle rupture of rocks earthquake damages depends upon many parameters including intensity, duration and frequency content of ground motion geologic and soil condition quality of construction etc.

Pushover analysis is a static non-linear in which the magnitude of the structural loading is incrementally increased in accordance with a certain predefined pattern. It consists of series of elastic analyses it is based on force displacement curve to total building of the structure. Load deformation of lateral force resisting element is created and push x and push y is applied in three dimensional model consists of bilinear or tri-linear load deformation is formed. Distribution of predefined lateral load is distributed by height of the building. Increase in lateral forces up to structure of the members yield.

II. ANALYSIS AND RESULTS OF NONLINEAR STATIC ANALYSIS

In the present work a 15-storied RC Frame with different plans of configurations with brick Infill panels are considered, situated in zone III, and Zone IV of India is taken for Analysis. Comparison of zones III and IV are carried.

Plan Configurations models

Fig.4.1 shows the Regular plan, fig.1 T-shape plan, fig 2 and all plan data are given of (30x25) m and 15 storeys each storey consists of 3 m column size (750x750) mm and beam size (230x550) mm slab thickness consists of 150 mm Live load of 4kN/m² and wall load of 11.5kN/m Regular model is compared with zone III and zone IV with both equilateral static analysis and Nonlinear static analysis in both X and Y directions

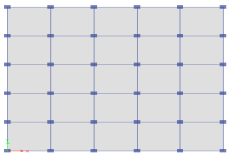


Fig .1

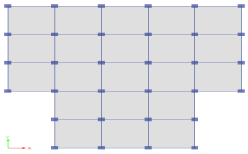


Fig. 2

Analysis of 3D frames models

Design of horizontal seismic coefficient

$$Ah = \frac{ZxI}{2xR} X\ sa/g$$

Design of Base shear
Vb = Ah x W

Fundamental natural time period

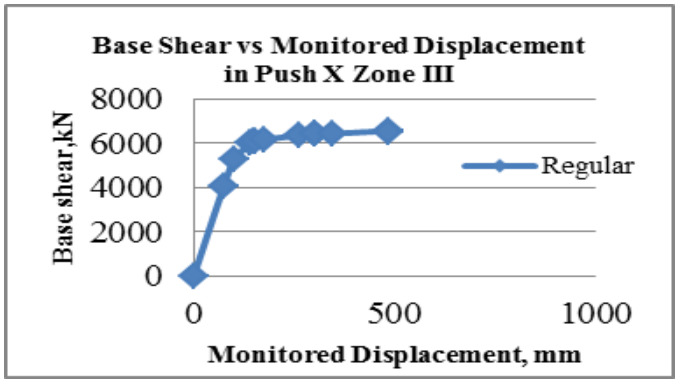
$$Ta = \frac{0.09\ h}{\sqrt{d}}$$

Results and discussions for

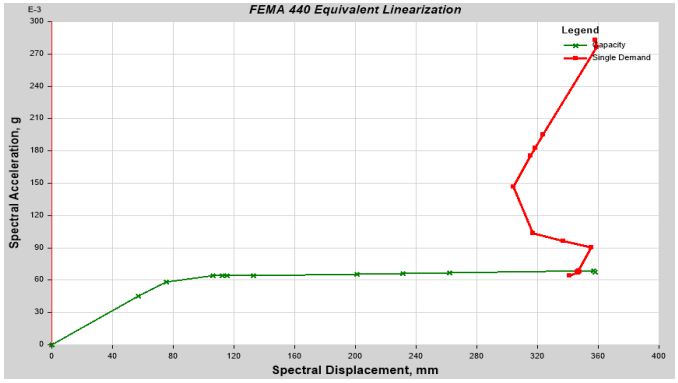
Nonlinear Static analysis

Table 1: Push X for Regular plan with Zone III

Step	Monitored Displacement	Base Force	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN					
1	75.8	4079.6878	2880	0	0	0	2880
2	101.3	5270.8179	2876	0	0	4	2880
3	485.7	6549.173	1990	860	24	6	2880
4	487.1	6481.6711	1990	860	24	6	2880



Graph: 1.Base shear vs displacement

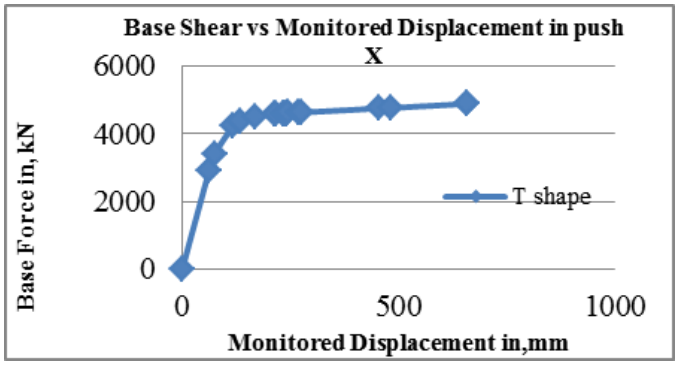


Graph: 2. Performance point

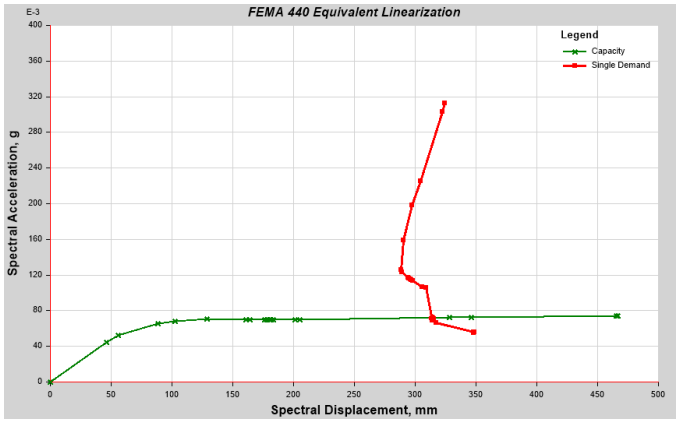
From above table 1 results are shown from that table we get the graph of base shear vs monitored displacement as shown in the graph 1the graph increasing from base to top of the roof structures .and graph 2 shows the performance point this shows the capacity and single demand of the structure.

Table 2: Push X for T shape with Zone III

Step	Monitored Displacement	Base Force	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN					
1	61.958	2903.0805	2520	0	0	0	2520
2	455.772	4753.3336	1712	803	0	5	2520
3	481.761	4766.4001	1710	805	0	5	2520
4	657.988	4888.3635	1710	780	25	5	2520
5	659.343	4887.0769	1710	780	25	5	2520



Graph: 3.Base shear vs displacement

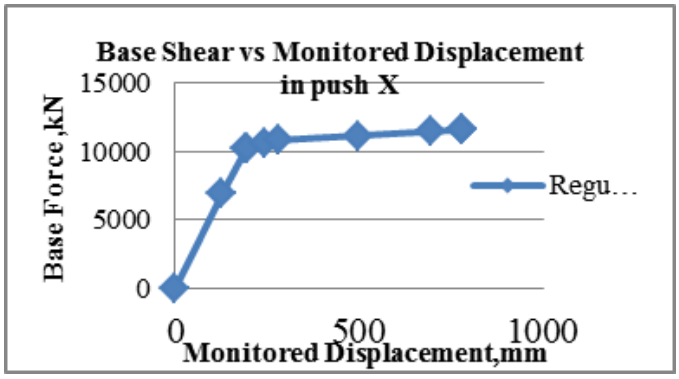


Graph: 4. Performance point

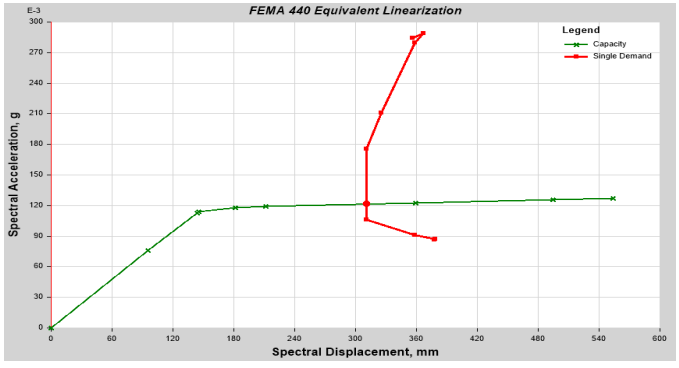
From above table 2 and graphs 3 and 4 the displacement and base shear is low compared to regular plan of zone III and performance point also reaches the capacity demand so it is stratified.

Table 3: Push X for Regular shape with Zone IV

Step	Monitored Displacement	Base Force	A-IO	IO-LS	LS-CP	>CP	Total
	mm	kN					
1	127.439	6898	2880	0	0	0	2880
2	193.155	10202	2880	0	0	0	2880
3	781.805	11616	1944	900	36	0	2880
4	781.899	11603	1944	900	34	2	2880



Graph: 5.Base shear vs displacement

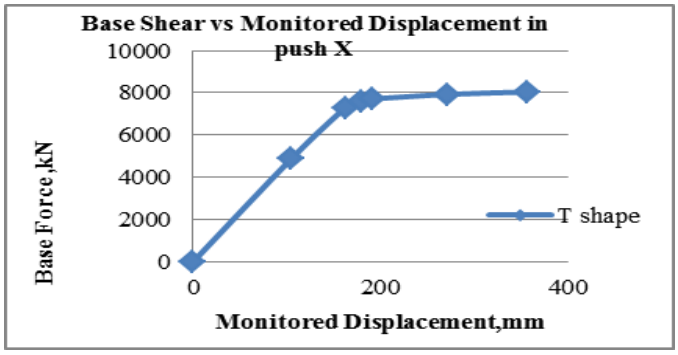


Graph: 10.Performancepoint

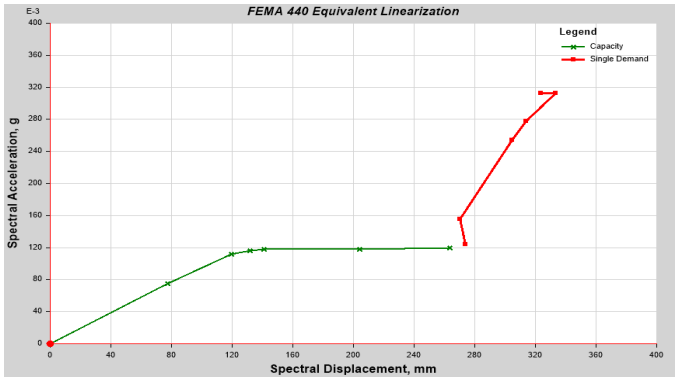
Table 3 shows the zone IV in another zone displacement and base shear is more compared to zone III we can see that more and performance point also meets. Deflection is not match by zone IV because of more displacement and base shear.

Push X for T shape with Zone IV

Step	Monitored Displacement	Base Force	IO-LS	LS-CP	>CP	Total
	mm	kN				
1	104.227	4857.08	0	0	0	2520
2	162.228	7288.59	0	0	3	2520
3	271.584	7934.79	13	0	11	2520
4	356.777	8046.95	402	0	11	2520



Graph: 13.Base shear vs displacement



Graph: 14.Performancepoint

In zone IV the demand is not meet the point so retrofitting is must need we can see the capacity and single demand is not meet each other

III. CONCLUSION

- In zone III deflection is between H/500 ratios .In zone IV deflection is above the H/500 ratios.
- Capacity of the buildings is same for all building but the seismic demand curve changes while configuration is changes.
- Models of Regular, and T-shape, give seismic performance in zone III. And in zone IV no seismic performance.
- The hinges of all type building is between life safety and Collapse prevention and there is no Hinges formed in T shape of push Y.
- No need of Retrofitting in zone III and in zone IV Retrofitting is needed.

IV. SCOPE OF FUTURE WORK

- In Zone III we can take another 2 -5 storeys to be extended.
- In both Zone III and Zone IV regular building is best for future work compare to other building plan.
- In zone III specified material property is enough for construct but in zone IV material property is not enough for future work.

REFERENCES

[1] Ms. Nivedita N. Raut & Ms. Swati D. Ambadkar (2013) "Pushover Analysis of Multistoried Building" Volume 13 Issue 4 Version 1.0 Year 2013.

[2] Santosh. D (2014) " Pushover analysis of Rc frame structure using ETABS 9.7.1" volume 11, Issue 1 Ver. V (Feb. 2014), PP 08-16 .

[3] S.Devi , Dr.G.Nandini Devi (2015) " Seismic Demand study on RC Structural systems using Pushover Analysis" Vol. 4, Issue 10, October 2015.

[4] D.N. Shinde, Nair Veena V, Pudale Yojana M (2014) "Pushover Analysis of Multy story Building" Volume: 03 Special Issue: 03 | May-2014 | NCRIET-2014.

[5] Arvindreddy, R.J.Fernandes (2015) "Seismic Analysis of RC Regular and Irregular frame structures" Volume: 02 Issue: 05 | Aug-2015.

[6] M.Mouzzoun, O. Moustachi, A.Taleb2, S.Jalal (2013) " Seismic performance assessment of reinforced concrete buildins using pushover analysis" Volume 5, Issue 1 (Jan. - Feb. 2013), PP 44-49.

[7] Yousuf Dinar, Md. Imam Hossain2, Rajib Kumar Biswas, Md. Masud Rana (2014)

[8] "Desperctive Study of Pushover analysis in RCC structures of Rigid joint" Volume 11, Issue 1 Ver. II (Jan. 2014), PP 60-68.

[9] ATC-40 – "Seismic Evaluation and Retrofit of Concrete Buildings", Applied Technology Council, November 1996.

[10] Rahul Leslie (2012), "Pushover Analysis in its Simplicity", Structural Magazine, winter edition.

[11] FEMA 440 (2005), "Improvement of Nonlinear Static Seismic Analysis Procedires", Applied Technology Council.

[12] IS: 1893 (Part 1): 2002, Indian Standard Criteria for Earthquake Resistance Design of Structures, Part 1 General provisions and buildings (Fifth Revision), Bureau of Indian Standards, New Delhi.

[13] IS 456:2000, "Plain and Reinforced concrete – Code of practice", Bureau of Indian Standards, New Delhi.