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Performance Based Evaluation of Shear Walled RCC Building by Pushover Analysis

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***ABSTRACT**: As the world move towards the implementation of Performance Based Engineering philosophies in seismic design of Civil Engineering structures, new seismic design provisions require Structural Engineers to perform both linear and nonlinear analysis for the design of structures. In the present work three storey and six storey building models with plus shape Shear wall have been considered. Equivalent static and response spectrum methods are carried out as per IS:1893 (Part 1) -2002 using finite element analysis software ETABS v9.1.1. Seismic performance is assessed by pushover analysis as per ATC-40 guidelines for earthquake zone V in India. The paper also deals with the effect of the variation of the building height on the structural response of the shear wall. This paper highlights the accuracy of Push over analysis in comparison with the most commonly adopted Response Spectrum Analysis and Equivalent Static Analysis.*

***Keywords**: Equivalent Static method, Pushover Analysis, Response Spectrum Analysis, Shear Wall, Storey height.*

I. INTRODUCTION

Recently there has been a considerable increase in the tall buildings both residential and commercial and the modern trend is towards more tall and slender structures. Thus the effects of lateral loads like wind loads, earthquake loads and blast forces are attaining increasing importance and almost every designer is faced with the problems of providing adequate strength and stability against lateral loads. This is the new development as the earlier building designers designed the buildings for vertical loads and as an afterthought checked the final design for lateral loads as well. Now the situation is quiet different and a clear understanding of effect of the lateral loads on the building and the behavior of various components under these loads is essential.

Structural design of buildings for seismic loading is primarily concerned with structural safety during major earthquakes, but serviceability and the potential for economic loss are also of concern. Seismic loading requires an understanding of the structural behavior under large inelastic deformations. Behavior under this loading is fundamentally different from wind or gravity loading, requiring much more detailed analysis to assure acceptable seismic performance beyond the elastic range. Some structural damage can be expected when the building experiences design ground motions because almost all building codes allow inelastic energy dissipation in structural systems.

II. OBJECTIVES

The main objectives of present study include:

1. The effect of Plus shaped shear wall on structural response under seismic loading.
2. Analysis of framed structures using Static Non linear Pushover analysis, Response Spectrum Method and Equivalent Static Method.

III. STRUCTURAL MODELLING

The finite element analysis software ETABS v 9.1.1 is utilized to create 3D model and run all analyses. The software is able to predict the geometric nonlinear behavior of space frames under static or dynamic loadings, taking into account both geometric nonlinearity and material inelasticity. The software accepts static loads (either forces or displacements) as well as dynamic (accelerations) actions and has the ability to perform eigen values, nonlinear static pushover and nonlinear dynamic analyses.

Table 1. Structural Details

Young's modulus of M20 concrete, E	2.48×10^7 kN/m^2
Grade of concrete	M20
Grade of steel	Fe 415
Density of Reinforced Concrete	25 kN/m^3
Modulus of elasticity of brick masonry	2100×10^3 kN/m^2
Density of brick masonry	20 kN/m^3
No of storey	G+2, G+5
Beam size	0.25m x 0.45 m
Column size	0.5 m x 0.5m
Shear wall thickness	0.4 m
Slab thickness	0.125 m
Height of all storeys	3 m

3.1 Nonlinear Hinge Assignment for Pushover Analysis

Shear walls: Typically, PMM hinges with axial force-moment interaction were assigned at the wall ends near floor levels and shear hinges were assigned at the mid-height level of walls.

Columns:

PMM hinges were assigned at the columns ends and at a few equally-spaced intermediate points.

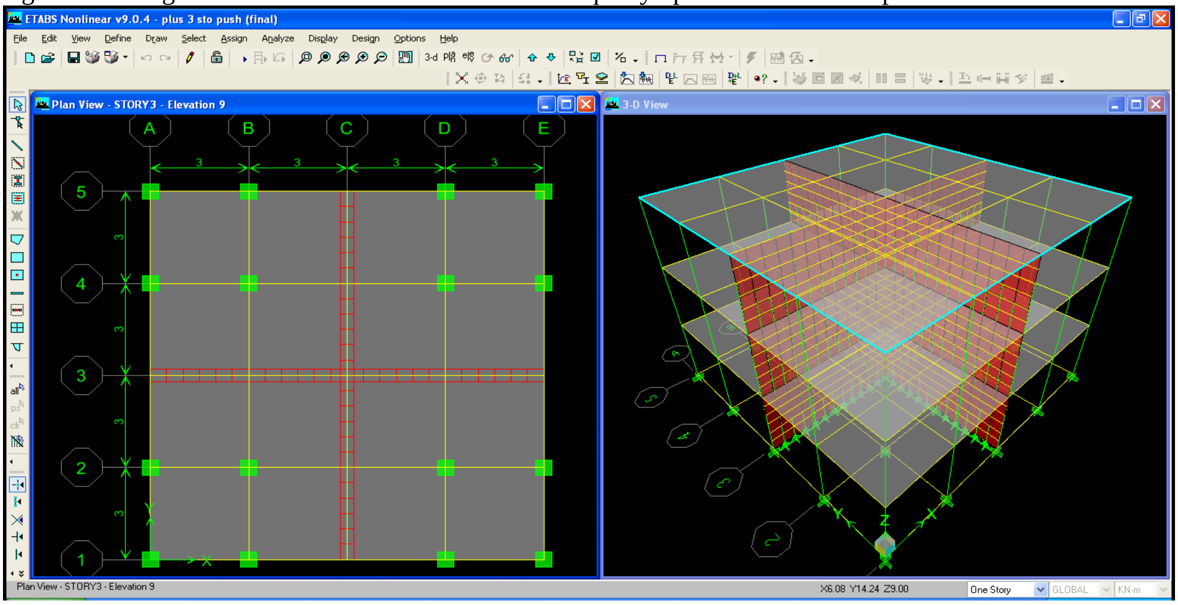

Figure 1. Plan and elevation of the three storey building

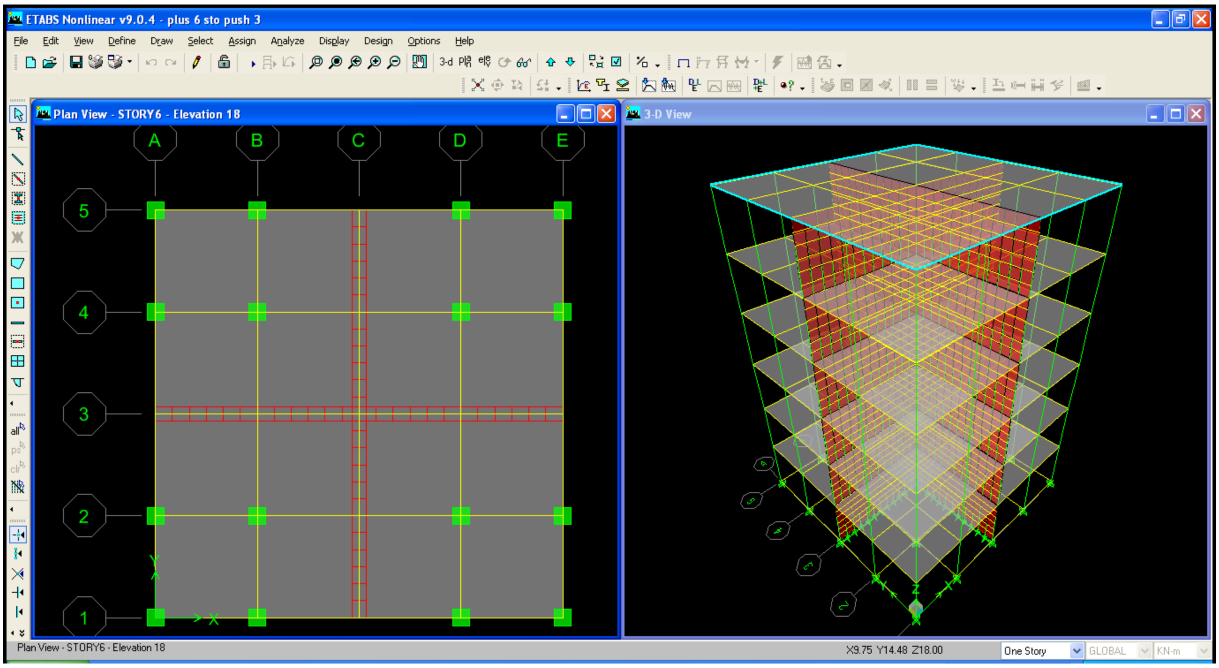

Figure 2. Plan and elevation of the six storey building

IV. RESULTS AND DISCUSSIONS

Table 2. Base Shear calculations

No of Storeys	Longitudinal Direction		Transverse Direction	
	$\overline{V}_B$ (kN)	V_B (kN)	$\overline{V}_B$ (kN)	V_B(kN)
6	1201.09	1462.3	1201.09	1462.3
3	692.8	635.34	692.8	637.34

4.1 Comparison between Equivalent Static Method and Response Spectrum Method

Equivalent static method is a linear static method for the seismic analysis whereas response spectrum method is a linear dynamic method. Figure.3 illustrates the comparison of storey drift using equivalent static method and response spectrum method for three storey building with plus shaped shear wall. The percentage variation between the two methods of analysis for the above case is 3.4%.

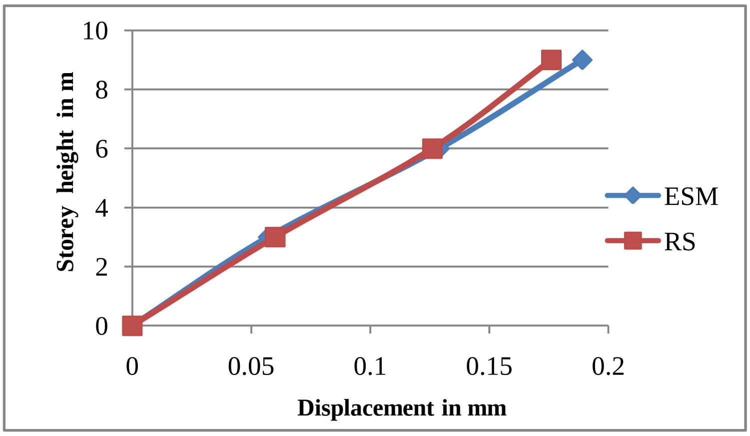

Figure 3. The comparison of storey drift using equivalent static method and response spectrum method for three storey building with plus shaped shear frame.

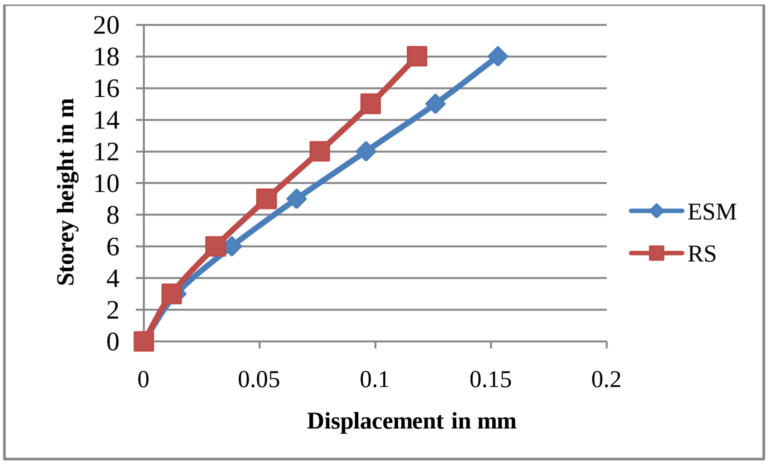

Figure 4 . The comparison of storey drift using equivalent static method and response spectrum method for six storey building with plus shaped shear frame.

Figure 4 illustrates the comparison of storey drift using equivalent static method and response spectrum method for six storey building with plus shaped shear frame. The percentage variation between the two methods of analysis for the above case is 7.1%.

4.2 Comparison between Response Spectrum Method and Pushover analysis method

A comparison between response spectrum method and push over analysis is carried out for storey drift for three storey and six storey building with infill walls for Plus shape shear wall. Figure. 5 illustrates the comparison of storey drift using response spectrum method and push over analysis method for three storey building with plus shaped shear frame .The percentage variation between the two methods of analysis for the above case is 10.39%.

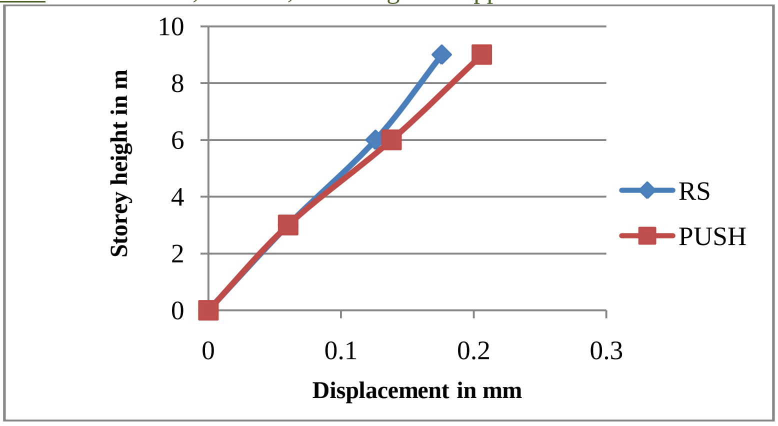

Figure 5 . The comparison of storey drift using response spectrum method and pushover analysis method for three storey building with plus shaped shear frame.

Figure. 6 illustrates the comparison of storey drift using response spectrum method and push over analysis method for three storey building with plus shaped shear frame .The percentage variation between the two methods of analysis for the above case is 43.76%.

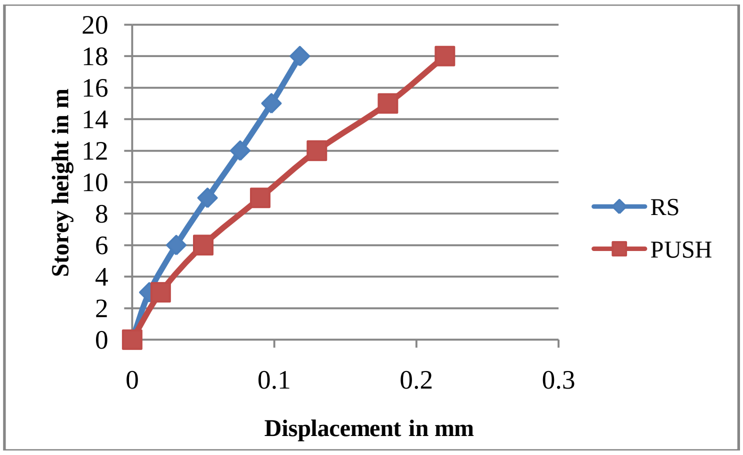

Figure 6. The comparison of storey drift using response spectrum method and pushover analysis method for six storey building with plus shaped shear frame

V. CONCLUSIONS

From the above studies it can be concluded that

1. Equivalent Static Method can be used effectively for symmetric buildings up to 20 m height. For higher and unsymmetrical buildings Response Spectrum Method should be used.
2. For important structures Push over Analysis should be performed as it predicts the structural response more accurately in comparison with other two methods since it incorporates p - Δ effects and material non linearity which is true in real structures.
3. From the above studies it is evident that Plus shaped shear wall can effectively resist the lateral forces coming on the structure.

REFERENCES

Journal papers:

[1] Romy Mohan and C Prabha , Dynamic Analysis of RCC Buildings with Shear Wall , *International Journal of Earth Sciences and Engineering ISSN 0974-5904, Volume 04, No 06 SPL, October 2011, pp 659-662.*

[2] Rahul Rana , Limin Jin and Atila Zekioglu, Pushover analysis of a 19 story concrete shear wall Building, *13th World Conference on Earthquake Engineering Vancouver, B.C., Canada August 1-6, 2004 Paper No. 133.*

Books:

[3] Chopra A. K, *Dynamics of structures theory and applications to earthquake engineering* (Prentice Hall, Englewood Cliffs, N.J. 1995).

Codes:

[4] ATC-40. “Seismic evaluation and retrofit of concrete buildings.” Volume 1 and 2. Applied Technology Council, California, 1996.

[5] FEMA-273. “NEHRP guidelines for the seismic rehabilitation of buildings.” Federal Emergency Management Agency, Washington DC, 1997.

[6] FEMA-356. “Prestandard and commentary for the seismic rehabilitation of buildings.” Federal Emergency Management Agency, Washington DC, 2000.

[7] IS: 1893 (Part 1) 2002- Indian standard- “*Criteria for earthquake resistant design of structures”*, Bureau of Indian Standards, New Delhi.