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Analysis of Nodal Displacement and Beam End Forces for Multistoried Framed Structure

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Abstract: **In present study, Multistory Rigid Jointed Steel Framed Regular Building Modal has been analyzed by static, dynamic and pushover procedures. The post processing results obtained are compared to get some important concluding remarks. The various results obtained are compared to find out differences in Nodal Displacements and Beam End Forces. This study will emphasize on the requirement of non-linear analysis procedures with the existing linear analysis procedures provided by various codal provisions. Present study will help in evaluating the difference in various parameters during elastic (conventional) and inelastic (pushover) analysis.**

Keywords: **Seismic, Maximum moment, Linear, Non-linear (pushover).**

1. INTRODUCTION

In general, linear procedures are applicable when the structure is expected to remain nearly elastic for the level of ground motion or when the design results in nearly uniform distribution of nonlinear response throughout the structure. As the performance objective of the structure implies greater inelastic demands, the uncertainty with linear procedures increases to a point that requires a high level of conservatism in demand assumptions and acceptability criteria to avoid unintended performance. Therefore, procedures incorporating inelastic analysis can reduce the uncertainty and conservatism. This approach is also known as "pushover" analysis.

Nonlinear static analysis, or pushover analysis, has been developed over the past twenty years and has become the preferred analysis procedure for design and seismic performance an evaluation purpose as the procedure is relatively simple and considers post- elastic behavior. However, the procedure involves certain approximations and simplifications that some amount of variation is always expected to exist in seismic demand prediction of pushover analysis. Although, pushover analysis has been shown to capture essential structural response characteristics under seismic action, the accuracy and the reliability of pushover analysis in predicting global and local seismic demands for all structures have been a subject of discussion and improved pushover procedures have been proposed to overcome the certain limitations of traditional pushover procedures.

2. LITERATURE REVIEW

[1] Shuraim et al., summarized the nonlinear static analytical procedure (Pushover) as introduced by ATC-40 has been utilized for the evaluation of existing design of a new reinforced concrete frame, in order to examine its applicability.[2] Chung-Yue Wang et al., in this paper he presented a method for the determination of the parameters of plastic hinge properties (PHP) for structure containing RC wall in the pushover analysis is proposed. [3] Konuralp Girgin et al., explained that structural frames are often filled with in filled walls serving as partitions. In this study, a parametric study of certain infilled frames, using the strut model to capture the global effects of the infill was carried out. [4] S. Chandrasekaran et al., The major focus of study is to bring out the superiority of pushover analysis method over the conventional dynamic analysis method [5] Faramarz Khoshnoudian et. al The aim of this paper is to modify the (CMP) analysis procedure to estimate the seismic demands of one-way asymmetric-plan tall buildings with dual systems. An

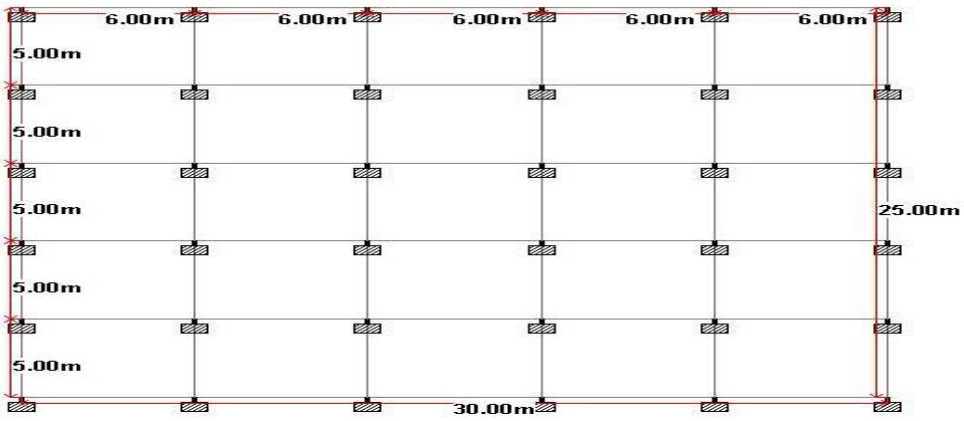
analysis of 10, 15 and 20-story asymmetric-plan buildings is carried out, and the results from the modified consecutive modal pushover (MCMP) procedure are compared with those obtained from the modal pushover analysis (MPA) procedure and the nonlinear time history analysis (NLTHA).recommended by the code. The results obtained from the numerical studies show that the response spectrum method underestimates the response of the model in comparison with modal pushover analysis.

3. DESIGN PARAMETERS

In this study analysis is performed for G+15 multistory building by computer software using STAAD.pro considering following preliminary data-

1.	Type of Structure-	Multistory Rigid Jointed Plane Frame
2.	Number of Storey-	Fifteen
3.	Seismic Zones-	V
4.	Floor Height-	3.0 m
5.	Depth of Foundation-	2.0 m
6.	Building Height-	42.0 m
7.	Plan Size-	30.0 m x 25.0 m
8.	Total Area-	750.0 sq m
9.	Column Section-	ISWB600A
10.	Beam Section-	ISWB600
11.	Wall Thickness-	0.20 m
12	Thickness of slab-	125 mm
13.	Imposed load-	2.00 kN/ m^2
14.	Floor finish-	1.00 kN/ m^2
15.	Specific Weight of RCC-	25.00 kN/ m^3
16.	Earthquake Load-	As per IS 1893 (Part 1):2002
17.	Type of Soil-	Type -II, Medium soil as per IS 1893 (Part 1):2002
18.	Static Analysis-	Equivalent Static Method
19.	Dynamic analysis-	Response Spectrum Method
20.	Pushover Analysis-	Displacement Coefficient Method

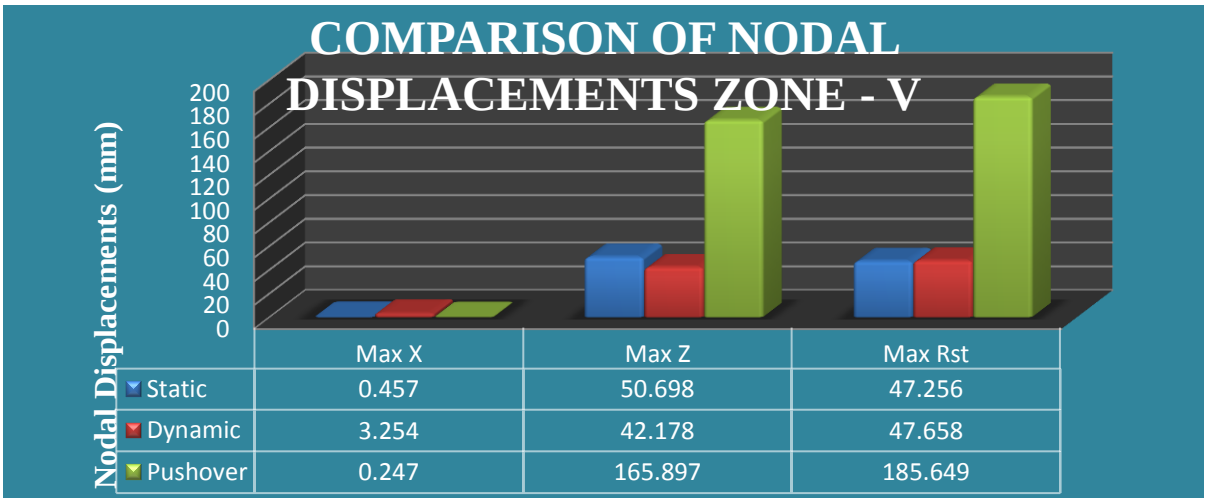
4. WORKING PLAN



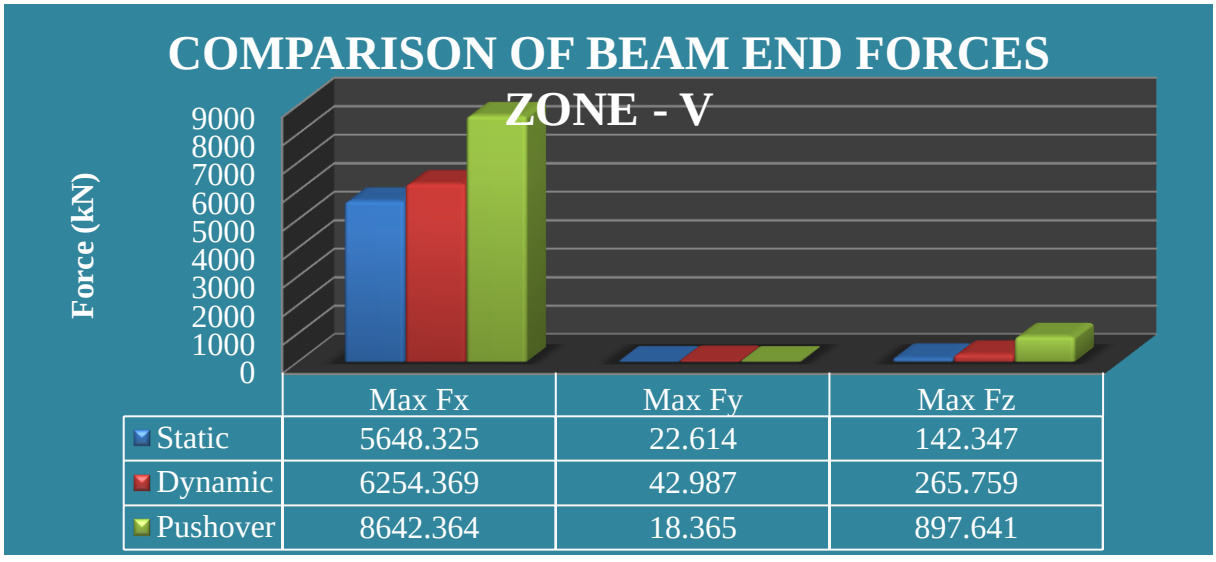
5. RESULTS

Three different columns i.e. **Concentric, Uniaxially Eccentric** and **Biaxaially Eccentric**, are selected and various post-processing results are obtained, observed and compared for them.

COMPARISON OF NODAL DISPLACEMENTS ZONE – V				
	Node	**Static**	**Dynamic**	**Pushover**
Max X	547	0.457	3.254	0.247
Max Z	553	50.698	42.178	165.897
Max Rst	541	47.256	47.658	185.649



COMPARISON OF BEAM END FORCES ZONE – V				
Force (kN)	**Beam**	**Static**	**Dynamic**	**Pushover**
Max Fx	75	5648.325	6254.369	8642.364
Max Fy	286	22.614	42.987	18.365
Max Fz	786	142.347	265.759	897.641



6. SUMMARY OF RESULTS

Nodal Displacements:

Maximum Displacement in X direction and Maximum Resultant Displacement vary in the same pattern. The numerical values are in between 3 to 4 times for Pushover analysis as compared to Static and Dynamic Analysis.

Beam End Forces:

Axial Force in X direction is least for Static analysis and maximum for Pushover analysis. The numerical value for Pushover analysis is 1.3 times as compared to Static analysis and 1.1 times when compared to Dynamic analysis.

7. CONCLUSIONS

The conclusions are basically drawn on the basis of structural behavior under Linear and Non-Linear conditions. After performing Static, Dynamic & Pushover analysis; the results are tabulated and summarized. Following are the major concluding remarks obtained.

1) Nodal Displacement in Pushover analysis is 3 to 5 times more as compared to Static and Dynamic analysis. This observation shows that displacement in Non-Linear zone is very large as compared to linear zone.

2) Axial force in X direction in Pushover analysis is 1.5 to 2 times more as compared to Static and Dynamic analysis.

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