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Pushover Analysis of Multistoried Building

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PUSHOVER ANALYSIS OF MULTISTORIED BUILDING

Strictly as per the compliance and regulations of :

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I. Introduction

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 evaluation purposes 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, in literature, 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. However, the improved procedures are mostly computationally demanding and conceptually complex that uses of such procedures are impractical in engineering profession and codes.

As traditional pushover analysis is widely used for design and seismic performance evaluation purposes, its limitations, weaknesses and the accuracy of its predictions in routine application should be identified by studying the factors affecting the pushover predictions. In other words, the applicability of pushover analysis in predicting seismic demands should be investigated for low, mid and high-rise structures by identifying certain issues such as modeling nonlinear member behavior, computational scheme of the procedure, variations in the predictions of various lateral load patterns utilized in traditional pushover analysis, efficiency of invariant lateral load patterns in representing higher mode effects and accurate estimation of target displacement at which seismic demand prediction of pushover procedure is performed.

a) Analysis and Design

The recent advent of performance based design has brought the nonlinear static pushover analysis procedure to the forefront. Pushover analysis is a static, nonlinear procedure in which the magnitude of the structural loading is incrementally increased in accordance with a certain predefined pattern. With the increase in the magnitude of the loading, weak links and failure modes of the structure are found. The loading is monotonic with the effects of the cyclic behavior and load reversals being estimated by using a modified monotonic force-deformation criteria and with damping approximations. Static pushover analysis is an attempt by the structural engineering profession to evaluate the real strength of the structure and it promises to be a useful and effective tool for performance based design. The ATC-40 and FEMA-273documents have developed modeling procedures, acceptance criteria and analysis procedures for pushover analysis. These documents define force-deformation criteria for hinges used in pushover analysis. As shown in Figure 5.1, five points labeled A, B, C, D, and E are used to define the force deflection behavior of the hinge and three points labeled IO, LS and CP are used to define the acceptance criteria for the hinge. (IO, LS and CP stand for Immediate Occupancy, Life Safety and Collapse Prevention respectively.) The values assigned to each of these points vary depending on the type of member as well as many other parameters defined in the ATC-40 and FEMA-273 documents. This article presents the steps used in performing a pushover analysis of simple three-dimensional building.SAP2000, a state-of-the-art, general-purpose, three-dimensional structural analysis program, is used as a tool for performing the pushover. The SAP2000 static pushover analysis capabilities, which are fully integrated into the program, allow quick and easy implementation of the pushover procedures prescribed in the ATC-40 and FEMA-273 documents for both two and three-dimensional buildings. Pushover analysis is performing for old as well as new building. In our case we consider the new

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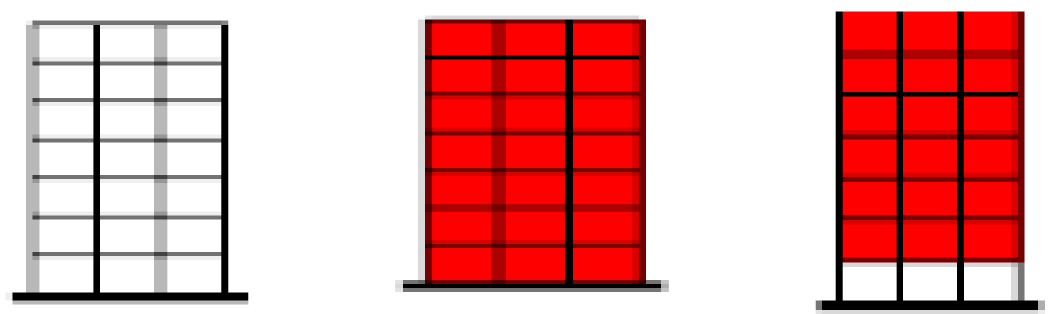
building so, first Analysis G+6 Residential building and Design by SAP2000 V11.0 software. Design sections of Beam, Column are take input for Nonlinear Static analysis. Architectural layouts and structural framing plans of masonry infill R/C framed building constructed in practice, the following reprehensive and practically relevant structural configuration of a planer masonry infill panels over the frame elevation were identified for the nonlinear static analysis

(a) Bars frame considering the dead weight of the masonry infill panels while disregarding their effect structural contribution in the nonlinear static analysis, a hypothetical case consistent with the prevalent design practice.

(b) Completely infill frame

(c) Masonry in filled frames without infill panels in the ground storey (i.e. 'open' or 'soft' storey at the ground level corresponding to building supported on stilt columns) with the open ground storey designed for horizontal seismic base shear computed using the response spectrum method degrading the 'soft' storey



(a) (b) (c)

b) Properties

Material properties and design parameter for masonry infill wall

Masonry prism strength (Mpa) f'm	Masonry prism strength	Compression strength of in fill	Allowable shear strength	Coefficient of friction of frame in fill surface	Thickness of masonary in fill (mm)	Density(KN/ CUBIC M)	Initial elastic modulus (Mpa)
10	0.002	0.6 f'm	0.05f'm	0.3	230	20	5500

c) Properties of Grade of Concrete and Steel

Grade of concrete = M20

Grade of steel = Fe415

Density of concrete = 25kN/m^3

BEAM	
B1	230 x 700

d) Seismic Coefficient for Response Spectrum method

1. Seismic Zone v, Zone Factor 0.36
2. Medium soil, Soil type II
3. Residential building, Importance factor 1
4. Response reduction factor (SMRF) 5
5. Loads on Frame:

i). Dead Load of External Wall = 13.80 KN/M^2

ii). Dead Load of External Wall =6.90 KN/M^2

iii). Floor Finish= 0.75 KN/M^2

iv). Live Load on Floor = 3.0 KN/M^2

v). Live Load on Roof = 1.5 KN/M^2

e) Plan of Building

Size of Beam and Column:

All Dimension in mm

Slab thickness = 125mm

COLUMN	
C1	230 x 700
C2	300 x 1000

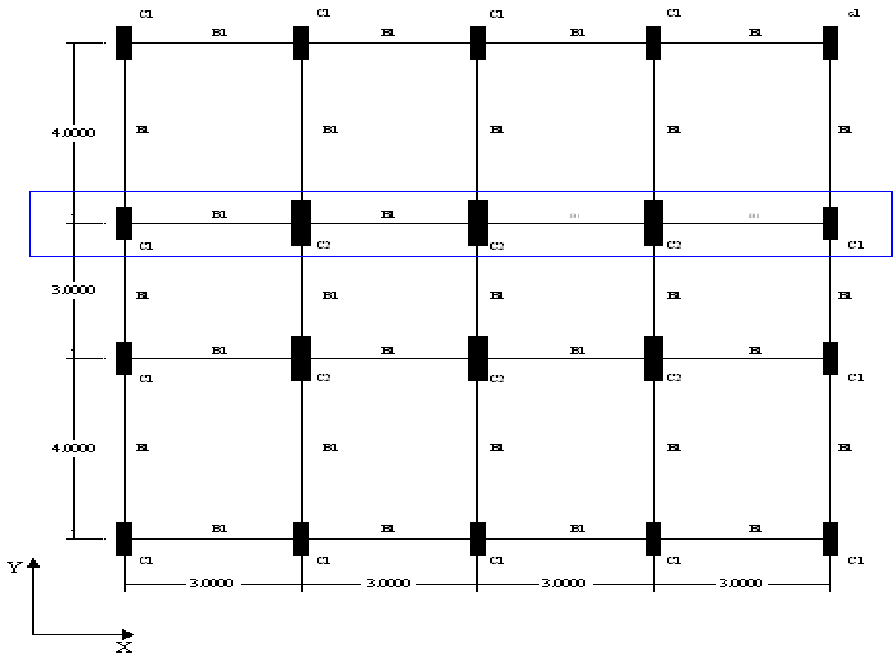


Figure 1 : Sectional Elevation along Y-Direction

II. Results & Discussion

Table 1: Comparison between Bare Frame, Infill Wall frame and Weak storey frame

	BARE FRAME			INFILL WALL			WEAK STORY		
Step	Displace-ment	Base Force	Story Shear	Displace-ment	Base Force	Story Shear	Displace-ment	Base Force	Story Shear
	M	KN	KN	m	KN	KN	M	KN	KN
0	2.97E-06	0	11992.32	2.97E-06	0	35808.585	2.97E-06	0	26326.93
1	0.00958	998.235	11992.32	0.005923	1453.227	35808.585	0.01256	1453	26326.93
2	0.013547	1258.552	10994.08	0.011458	3254.491	34355.358	0.01355	2213	24873.71
3	0.05683	1910.125	9735.532	0.05683	6258.258	31100.867	0.08625	4258	22660.46
4	0.138688	2005.568	7825.407	0.115645	7207.032	24842.609	0.13523	5896	18402.34
5	0.168203	2562.258	5819.839	0.12389	8721.291	17635.577	0.15498	6135	12506.65
6	0.269185	3257.581	3257.581	0.127093	8914.286	8914.286	0.1682	6372	6371.674

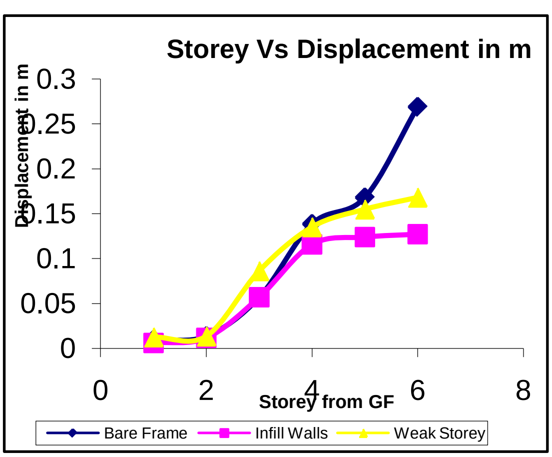


Figure 2: Story Level Vs Displacement Curve

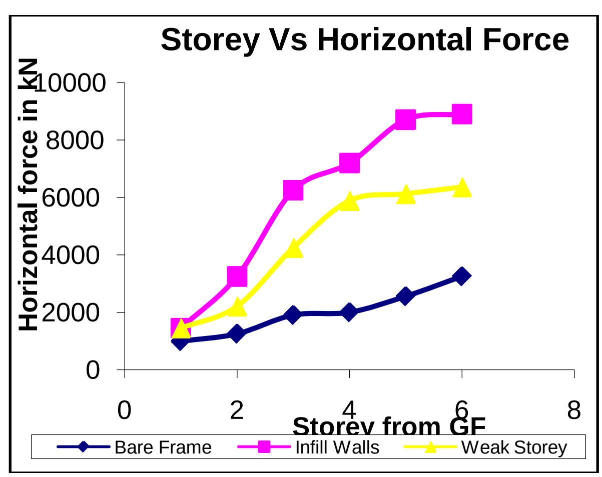


Figure 3 : Story level Vs Horizontal Force Curve

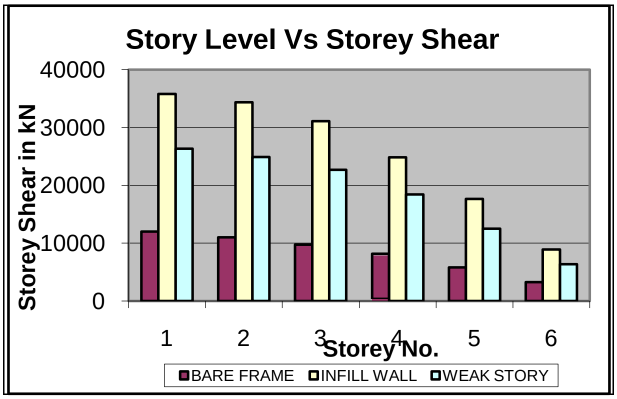


Figure 4 : Story No Vs Story Shear Curve

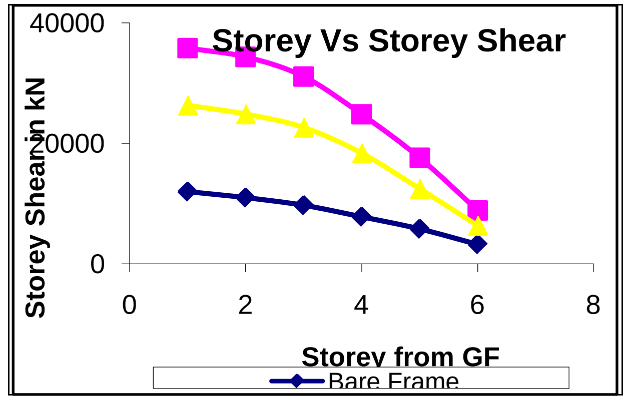


Figure 5 : Story Level from Ground Floor Vs Story Shear

III. Conclusion

The result of the nonlinear static pushover analysis quantitatively establish that the seismic performance of a masonry infill R/C adversely and significantly affected if the infill panels were discontinued in the ground story resulting in the structural configuration with an open story, commonly termed as 'weak' story , at the ground levels. Hinges formation in the beam is more than column and demonstrates rational nonlinear displacement-based analysis methods for a more objective performance-based seismic evaluation of the masonry infilled R/C frames with seismically undesirable (and preferred) distribution of masonry infill panels over the frame elevation.

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