iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** XI **Month of publication:** November 2019

DOI: http://doi.org/10.22214/ijraset.2019.11113

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue XI, Nov 2019- Available at www.ijraset.com

Nonlinear Pushover Analysis of Irregular R.C. Frame Building: A Review

Rahul Singh Dhakar[1], Dr. Savita Maru[2]
[1]PG Student, [2]Professor, Department of Civil Engineering, Ujjain Engineering College Ujjain, (M.P.)

Abstract: In India, construction and study of tall structure couldn't be done because of lack of knowledge and practical studies in engineer and researchers. So in this research paper study the behaviour of specific type of tall structure. Studies, tubular structure with constant plan area with different plan irregularity in horizontal direction by changing the position of shear wall in modelling. The behaviour of tubular structure under the action of wind load and seismic effect, could suffer a considerable degree of shear lag in the normal-to-panels. The performance based (pushover analysis) study of tube-in-tube structure shows the more accurate result against the lateral loading based on ATC-40 and FEMA-356 depends the ductility and non-linear performance of material to show plastic rotation of components of the structure.
Keywords: Non-linear Static Analysis, Performance based design, Capacity, Demand, Performance point, Pushover analysis, RCC Framed structure.

I. INTRODUCTION

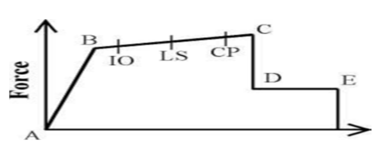
In construction field tall structure and light in weight construction for covering large area in vertical direction is studied the main purpose of designing this structure to cover less geological earth area. The basic design philosophy in all of those forms has been to place as much as possible of the load-carrying material around the external periphery of the building to maximize the flexural rigidity of the cross section. The original development was the framed tube, which under the action of wind loading could suffer a considerable degree of shear leg in the normal-to-wind panels. The later more efficient bundled-tube systems were designed to produce a more uniform axial stress distribution in the columns of the "normal" panels. Some recent irregular "postmodern" buildings have evolved a hybrid form of structure. In which only part of periphery is of framed tube construction while the remainder consists of a space-frame system. The general analysis of three-dimensional tubular structures is considered in brief initially, and then the techniques that have been developed to reduce the amount of computation for symmetrical system are described.

II. PUSHOVER ANALYSIS

The performance based design process primarily requires that the expected performance objectives be clearly defined. These objectives correspond to a seismic hazards level and the expected performance levels of the structure .In other words, the level of 'acceptable risk' needs to be well defined. The 'risk' may be expressed in terms of seismic hazard and a susceptibility of structure to damage. The performance objectives are quantified can be called as 'performance criteria' which means a quantified acceptance criteria necessary to meet the performance objective. In recent times the performance objectives other than life safety which was the major focus to reduce the threats to the life safety are also being considered. Such performance objectives may vary from collapse prevention for the rare events of a large earthquake to an operational level for frequent earthquake of moderate size. The various performance level along with their force displacement characteristics are given below in figure 1.

Structural performance levels and Ranges are assigned a title and, for case of reference, a number. The number is called structural performance number and is abbreviated SP-n (where n is the designated number).Structural performance levels-

A. Immediate occupancy
B. Life safety
C. Structural stability (damage control)



Deformation
Figure1 - Performance levels in pushover analysis

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue XI, Nov 2019- Available at www.ijraset.com

III. LITERATURE REVIEW

A brief review of previous studies on the application of the pushover analysis on multistory building is presented. This literature review also includes previous studies on different size of column. This literature review on recent contribution related to nonlinear static pushover analysis of multistory building.

(Habibullah and Pyle, 1998). Yielding and post-yielding behavior can be modeled using discrete user-defined hinges. Currently SAP2000 allows hinges can only be introduced into frame elements; the PHP properties can be assigned to a frame element at any location along it. The authors have been developed a dual parameters method to define the PHP properties of RC frame structure for the pushover analysis,

A. K. Chopra (2001) extracted an improved Direct Displacement-Based Design Procedure for Performance-Based seismic design of structures. Direct displacement-based design requires a simplified procedure to estimate the seismic deformation of an inelastic SDF system, representing the first (elastic) mode of vibration of the structure. This step is usually accomplished by analysis of an “equivalent” linear system using elastic design spectra. In their work, an equally simple procedure is developed that is based on the well-known concepts of inelastic design spectra.

X.-K. Zou et al., (2005) presented an effective computer- based technique that incorporates Pushover Analysis together with numerical optimization procedures to automate the Pushover drift performance design of reinforced concrete buildings. Performance-based design using nonlinear pushover analysis, which generally involves tedious and intensive computational effort, is a highly iterative process needed to meet designer-specified and code requirements. This paper presents an effective computer-based technique that incorporates pushover analysis together with numerical optimization procedures to automate the pushover drift performance design of reinforced concrete (RC) buildings.

Mehmet et al., (2006) explained that due to its simplicity, the structural engineering profession has been using the nonlinear static procedure (NSP) or pushover analysis. Modeling for such analysis requires the determination of the nonlinear properties of each component in the 4 structure, quantified by strength and deformation capacities, which depend on the modeling assumptions. Pushover analysis is carried out for either user-defined nonlinear hinge properties or default-hinge properties, available in some programs based on the FEMA-356 and ATC-40 guidelines.

Chung-Yue Wang et al., (2007) 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. Nonlinear relationship between the lateral shear force and lateral deformation of RC wall is calculated first by the Response-2000 and Membrane-2000 code. The PHP (plastic hinge properties) value of each parameter for the pushover analysis function of SAP2000 or ETABS is defined as the product of two parameters α and β. Values of α at states of cracking, ultimate strength and failure of the concrete wall under shear loading can be determined respectively from the calculations by Response-2000. While the corresponding β value of each PHP parameter is obtained from the regression equations calibrated from the experimental results of pushover tests of RC frame-wall specimens. The accuracy of this newly proposed method is verified by other experimental results. It shows that the presented method can effectively assist engineers to conduct the performance design of structure containing RC shear wall using the SAP2000.

Whittaker , Y. N. Huang et al (2007) summarize the next (second) generation tools and procedures for performance-based earthquake engineering in the United States. The methodology, which is described in detail in the draft Guidelines for the Seismic Performance Assessment of Buildings.

Mehdi Poursha et al. (2009) presented a new pushover procedure which can take into account higher-mode effects. The procedure, which had been named the consecutive modal pushover procedure, utilizes multi-stage and single-stage pushover analyses. The final structural responses were determined by enveloping the results of multi-stage and single-stage pushover analyses. The procedure was applied to four special steel moment-resisting frames with different heights.

Mehanny and El Howary (2010) evaluated the seismic assessment of ductile versions of low to mid-rise moment frames located in moderate seismic zones was carried out through 5 comparative trial designs of two (4 and 8-story) buildings adopting both space and perimeter framed approaches.

Shahrin Hossain (2011) followed the procedures of ATC 40 in evaluating the seismic performance of residential buildings in Dhaka. The present study investigated as well as compared the performances of bare frame, full in filled and soft ground story buildings. For different loading conditions resembling the practical situations of Dhaka city, the performances of these structures were analyzed with the help of capacity curve, capacity spectrum, deflection, drift and seismic performance level.

Dinesh J. Sabu and Pajgade (2012) concentrated on seismic evaluation of existing reinforced concrete building. Seismic analysis was carried out for existing reinforced concrete building.

IV. CONCLUSION

A brief review of several literatures presented shows that non-linear static analysis (pushover analysis) proves to be efficient tool for studying the behavior of the structure in non-linear zone. Structure‟s failure modes due to seismic actions become more apparent by performing pushover analysis. There is future scope for further study in this area.

REFERENCES

[1] Agarwal A. (2012): Seismic Evaluation of Institute Building, Bachelor of Technology Thesis, National Institute of Technology Rourkela.
[2] Applied Technology Council (ATC), Seismic Evaluation and Retrofit of Concrete Buildings. ATC-40, Redwood City, CA, 1996.
[3] ASCE 41-06 (2007), Seismic Rehabilitation of Existing Buildings, American Society of Civil Engineers.
[4] Computers and Structures Inc; CSI. ETABS 2013 V. "CSI analysis reference manual". Berkeley, California, USA, 2008.
[5] EC8, Design of structures for earthquake resistance, Part 1: General rules, seismic actions and rules for buildings. European committee for standardization, Brussels, 2002. .
[6] FEMA 356, Pre-standard and Commentary for the Seismic Rehabilitation of the Buildings, Federal Emergency Management Agency & American Society of Civil Engineers, November 2000.
[7] Goel R. K. (2008): Evaluation of Current Nonlinear Static Procedures for Reinforced Concrete Buildings, The 14th World Conference on Earthquake Engineering October 12- 20, 2008, and Beijing, China.
[8] Griffith M. C., Pinto A. V. (2000):"Seismic Retrofit of RC Buildings - A Review and Case Study", University of Adelaide, Adelaide, Australia and European Commission, Joint Research Centre, Ispra Italy.
[9] IS 456, Plain and Reinforced Concrete Code of Practice (fourth revision), New Delhi110002: Bureau of Indian Standards, 2000 14
[10] IS 875 (part1), Dead loads, unit weights of building material and stored and stored material (second revision), New Delhi 110002: Bureau of Indian Standards, 1987.
[11] IS 875 (Part2) Imposed loads (second revision), New Delhi 110002: Bureau of Indian Standards, 1987.
[12] IS1893-2002, Indian Standard CRITERIA FOR EARTHQUAKE RESISTANTDESIGN OF STRUCTURE, Bureau of Indian Standards, Fifth revision
[13] Kadid A., Boumrkik A. (2008): Pushover Analysis of Reinforced Concrete Frame Structures, Asian Journal of Civil Engineering (Building and Housing) Vol. 9, No. 1(2008) Pages 75-83
[14] Krawinkler H., Seneviratna G.D.P.K. (1998): Pros and Cons of a Pushover Analysis of Seismic Performance Evaluation, Engineering Structures, Vol.20, 452-464.
[15] Lawson R.S., Reinhorn A.M., Lobo R.F. (1994): Nonlinear Static Pushover Analysis - Why, When and How? Proceedings of the 5th US National Conference on Earthquake Engineering, Chicago, Vol. 1, 283-292.
[16] Mwafy A.M. and Elnashai A.S (2001), "Static pushover versus Dynamic Collpse analysis of RC buildings", Journal of Engineering Structures, Vol. 23, pp.407-424.
[17] SERMİN OĞUZ (April 2005) Master of Science Thesis, the Graduate School of Natural and Applied Sciences of Middle East Technical University.