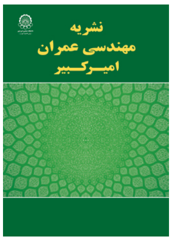

Amirkabir Journal of Civil Engineering

Amirkabir J. Civil Eng., 49(1) (2017) 7-9
DOI: 10.22060/ceej.2017.10468.4896

Evaluation of Ductility of Bearing Concrete Wall Systems with Regard to their Boundary Element

A. R. Rahai*, S. H. Rashedi

Department of Civil and Environmental Engineering, Amirkabir University of Technology, Tehran, Iran

ABSTRACT: Bearing Concrete Wall (BCW) is one of the most applicable structural systems. In this paper, with the aim of evaluating bearing wall performance, nonlinear static analysis based on several assumptions drawing upon experimental research is used. To validate the nonlinear analysis method, the analytical and experimental results are compared. To evaluate the reduction factor and ductility level of BCW systems, a vast study on several models with different stories and several nonlinear analysis are performed. The results indicated that, the components of the boundary element have a limit effect on the models' ductility factor. Also, the reduction factors show acceptable values for building height up to 50 meters and the decreasing rate of this coefficient is increased in the higher elevations.

Review History:

Received: 25 April 2015
Revised: 8 November 2016
Accepted: 8 November 2016
Available Online: 20 February 2017

Keywords:

Concrete Bearing Wall System
Boundary Element
Non-linear Static Analysis
Fiber Element
Response Reduction Factor

1- Introduction

Bearing reinforced concrete wall system is suitable for mid-rise buildings. According to number of walls in plan and reduce the share of lateral force, is suitable system and it can be performed quickly and with high quality [1-4].
Today major part of the seismic design of buildings based on the equivalent static method and calculation of seismic forces by applying the reduction coefficients called response reduction factor is done. In this study to evaluate the ductility of this structural system, several models with different stories selected and the ductility and reduction factor of these structures is investigated [6,7].

2- Modeling the load-bearing wall

For validation of modeling method and analysis in PERFORM-3D [5] software, a model of a wall made and according to the Fig. 1, analysis results of nonlinear static and nonlinear dynamic analysis with an acceptable error of about 5 to 10 percent, show the actual behavior of the wall [8].

3- Structural models

The typical plan is used for modeling structural system in different stories as shown in Fig. 2. The Non-linear static analysis is performed on models and capacity curves were obtained by PERFORM-3D software. [9-11].

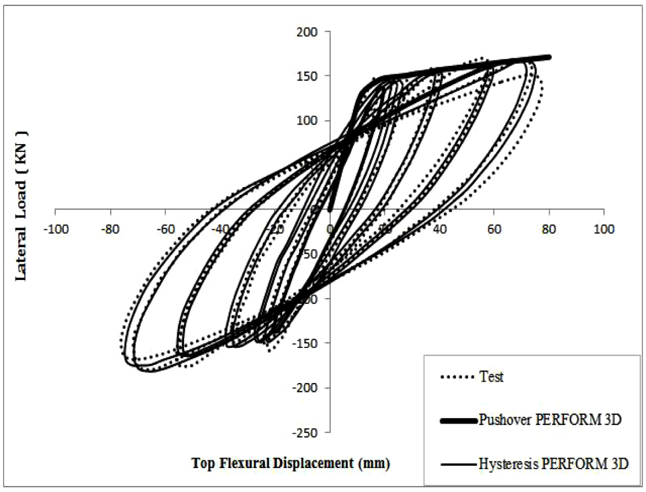

Fig. 1. The results of the analysis

Table 1. Material properties

Properties	Amount (MPa)
E_s	2.1×10^5
F_y	400
E_c	2.5×10^4
f'_c	28

*Corresponding author, E-mail: rahai@aut.ac.ir

4- Capacity curves

The nonlinear static analysis results are obtained for the models with or without boundary element in the form of capacity curves, as illustrated in Figs. 3 and 4.

5- Conclusions

According to the capacity curves, by increasing the number of floors, initial stiffness reduced and lateral load capacity is increased. The application of the boundary elements cause to increase in base shear and displacement of the control point by 5 to 10 percent and 10 to 40 percent respectively. Therefore, the boundary element increases the load capacity of models.

Also, the reduction factors show acceptable values for building height up to 50 meters. The decreasing rate of the coefficient is increased in the higher elevations [12-15].

According to the results obtained in this study can be said that, due to the declining trend of ductility these structures at

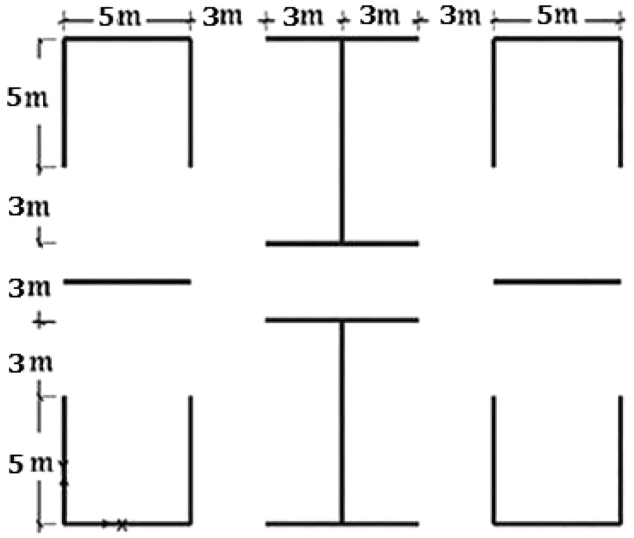

Fig. 2. Typical floor plan

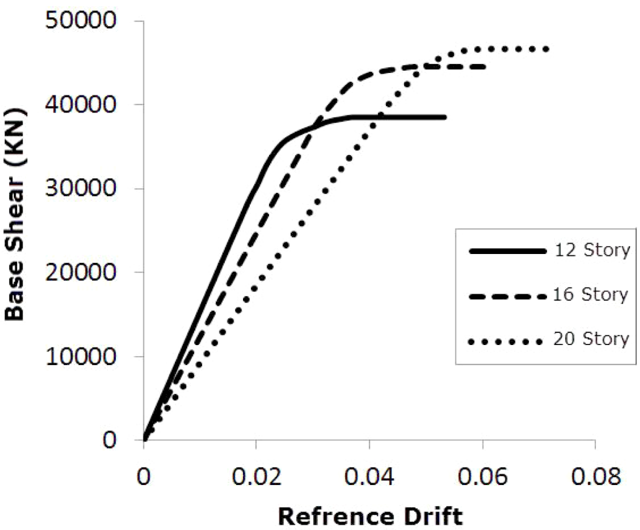

Fig. 3. Capacity curve of models without boundary element in X direction

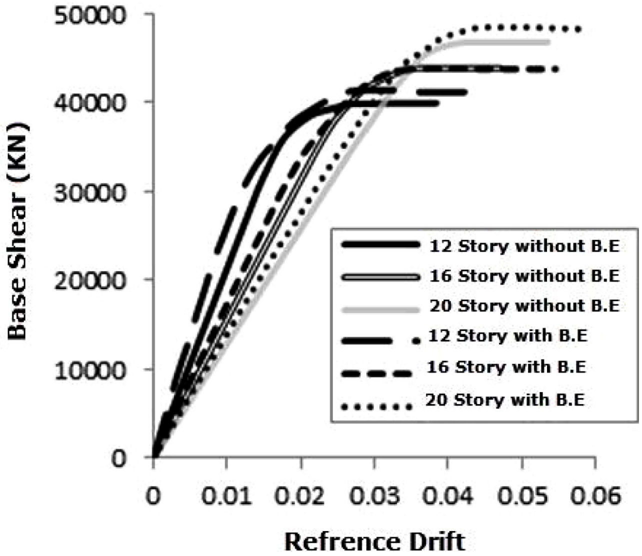

Fig. 4. The capacity curve of models in Y direction

higher elevations, optimal height for this structural system is about 50 meters.

References

[1] P., Unnikrishna, C. V., Parthasarathy; Ultimate Strength and Design of Concrete Walls, Building and Environment, pp. 25-29, *Pergamon Press*, Britain, 1977.

[2] S. W., Han, Y. H., Oh, L. H., Lee, Seismic Behaviour of Structural Walls with Specific Details, *Magazine of Concrete Research*, Vol. 54, No. 5, pp. 333-345, 2002.

[3] Y. H., Chaia, J. D., Anderson; Seismic Response of Perforated Lightweight Aggregate Concrete Wall Panels or Low-Rise Modular Classrooms, *Engineering Structures*, Vol. 27, No. 4, pp. 593-604, 2005.

[4] C. H., Hyun, S., Choi, K. R., Choi, H. M., Shin, J. H., Park; Seismic Response Evaluation of an RC Bearing Wall by Displacement-Based Approach, *13th World Conference on Earthquake Engineering*, pp. 2649, Canada, 2004.

[5] Perform 3D V5.0.0, Nonlinear Analysis and Performance Assessment for 3D Structure, *Computer and Structures Inc.*, Berkeley CA, 2011.

[6] ATC-19, Applied Technology Council, Structural Response Modification Factors, *California Seismic Safety Commission*, Redwood City, California, 1995.

[7] E., Miranda, M., Eeri, V., Bertero, Evaluation of Strength Reduction Factors for Earthquake-Resistant Design, *Earthquake Spectra*, Vol. 10, No. 2, pp. 357-379, 1994.

[8] J. H., Thomsen, J. W., Wallace, Displacement Based Design of Slender Reinforced Concrete Structural Walls-Experimental Verification, *ASCE Journal of Structural Engineering*, Vol. 130, No. 4, pp. 618-630, 2004.

[9] ACI, American Concrete Institute, Building Code Requirement for Structural Concrete, *Advancing Concrete Knowledge, Farmington Hills*, 2011.

[10] J. B., Mander, M. J. N., Priestley, R., Park, Theoretical Stress-Strain Model for Confined Concrete, *ASCE Journal of Structural Engineering*, Vol. 114, No. 8, pp.

1804-1826, 1998.

[11] J. B., Mander, M. J. N., Priestley, R., Park; Observed Stress-Strain Model of Confined Concrete, *ASCE Journal of Structural Engineering*, Vol. 114, No. 8, pp. 1827-1849, 1988.

[12] UBC, Uniform Building Code, *Structural Engineering Design Provisions, UBC-97*, Vol. 2, USA, 1997.

[13] NEHRP, National Earthquake Hazards education Program, Recommended Provisions for the Development of Seismic Regulations for New Buildings and Other Structures, *Building Seismic Safety Council*, Washington DC, 2003.

[14] ASCE, American Society of Civil Engineers, Minimum Design Loads for Building and other Structures, *Structural Engineering Institute, ASCE/SEI 7-10*, USA, 2010.

[15] Standard 2800, Iranian Code of Practice for Seismic Resistant Design of Buildings, *Institute of Standard and Industrial Research of Iran*, 3rd Edition, 2005.

Please cite this article using:

A. R., Rahai, S. H., Rashedi, "Evaluation of Ductility of Bearing Concrete Wall Systems with Regard to their Boundary Element". *Amirkabir J. Civil Eng.*, 49(1) (2017) 13-21.

DOI: 10.22060/ceej.2017.10468.4896