EVALUATION OF A PROPOSED RETROFIT TECHNIQUE FOR UNREINFORCED MASONRY WALLS USING FEM NONLINEAR ANALYSIS

Habibollah KAKOLVAND
M.Sc. Graduate Student, Islamic Azad University, South Tehran Branch, Iran
kakolvand1476@yahoo.com

Mehrtash MOTAMEDI
Assistant Professor, Islamic Azad University, South Tehran Branch, Iran
m_motamedi@azad.ac.ir

Keywords: Unreinforced Masonry Walls, Opening, Seismic Retrofit, Failure Mode

This paper deals with the modeling of existing unreinforced concrete block walls with finite elements and evaluation of a proposed retrofit solutions used in practice. The objectives of developing the analytical model were prediction of inelastic response of the walls with the openings and the study of the effect of the retrofit solution for seismic upgrading of the existing walls.

Concrete core technique was employed for wall retrofit of the different models. To study of in-plane behavior of the walls FEM models were verified with the test results obtained from the similar walls studied in previous works and calibrated to present the identical inelastic load-deformation response of the tested specimens. Nonlinear push over analysis was performed on the models to study the capacity of the walls up to 4% drifts. As results, the inelastic response was compared in different studied walls. Lateral resistance capacity, initial stiffness and the mode of failure of the walls were presented and the effect of the retrofit solution on the behavior of the existing masonry walls with large openings was evaluated.

Typical masonry wall studied in this paper and the proposed retrofit elements layout are shown in Figure 1. Failure mode, deformation and crack pattern of the unreinforced masonry wall and retrofitted masonry wall are shown in Figures 2 and 3, respectively. The unreinforced wall showed rocking motion when subjected to lateral load. Load-deformation response of the unreinforced wall is presented in Figure 4-a. The finite element model was compared with a test result to validate the model. Shear failure was observed in the retrofitted wall under lateral loading. Load-deformation response of the retrofitted wall is presented in Figure 4-b. The model was calibrated with the experimental results obtained from similar walls. The results show an improvement in strength and ductility of the walls by using retrofit technique. The measured response parameters of the masonry wall models obtained from push over analysis is presented in Table 1.

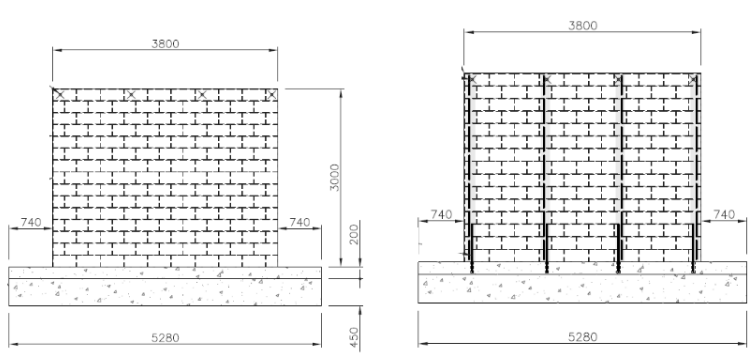


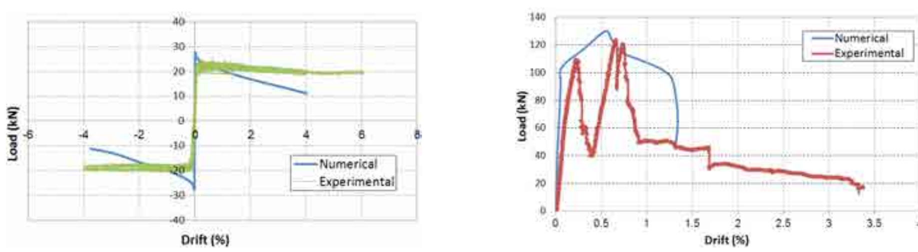
Figure 1. Concrete masonry wall layout and the retrofit solution

(a) (b)

Figure 2. Deformation and crack pattern of the unreinforced masonry walls subjected to lateral load:
a) Numerical; b) Experimental

(a) (b)

Figure 3. Deformation and crack pattern of the retrofitted masonry walls subjected to lateral load:
a) Numerical; b) Experimental



(a) (b)

Figure 4. Verification of the FE models with the experimental results:
a) Unreinforced masonry wall; b) Retrofitted wall

Table 1. Measured response parameters of the masonry wall models obtained from push over analysis

		No opening	One opening	Two opening (D&W)	Two opening (2W)
Elastic Stiffness (kN/m)	URM Wall	712.82	544.22	317.46	408.16
	Retrofit Wall-2M15	631.42	684.06	388.34	456.29
	Retrofit Wall-4M15	947.42	669.86	580.64	448.81
Shear Capacity (kN)	URM Wall	27.80	24.00	20.00	24.00
	Retrofit Wall-2M15	130.00	67.20	70.00	46.00
	Retrofit Wall	130.00	84.00	108.00	54.80
Failure Drift (%)	URM Wall	4.04	4.11	3.31	2.77
	Retrofit Wall-2M15	2.10	2.56	1.63	3.65
	Retrofit Wall	1.31	3.10	0.91	2.02

REFERENCES

Benedetti D, Carydis P and Pezzoli P (1998) Shaking table tests on 24 simple masonry buildings, *Journal of Earthquake Engineering and Structural Dynamics,* 27(1): 67-90

Galano L and Gusella V (1998) Reinforcement of masonry wall subjected to seismic loading using steel x-bracing, *Journal of Structural Engineering,* 124(8): 886-895

Paulay T and Priestley MJN (1992) Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, New York

Ventura CE, Motamedi M and Centeno J (2011) Technical report on laboratory test program, Structural Engineering Guidelines for the Performance-Based Seismic Retrofit of British Columbia School Buildings, *APEGBC*, Vancouver, BC., Canada