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Experimental Study for Higher Seismic Performance of Masonry Walls
Part 2: Results and Discussions of Preliminary Tests

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1. INTRODUCTION

In order to investigate the effect of confining columns, horizontal wall reinforcing bars (Re-bars) and connecting bars between masonry wall-edges and attached reinforced concrete (R/C) column sections on seismic behavior of confined masonry walls, a total of four different specimens were tested under a constant gravity load and alternately repeated lateral forces. All the test results obtained from the four specimens are compared each other in the present paper.

2. RESULTS AND DISCUSSIONS

Complete hysteresis loops between applied lateral force (Q) versus story drift (R) relations obtains from the present test are shown in Figures 1(a) through 1(d), where story drift (R) is defined as an interstory displacement divided by the story-height of the specimen. In all the Q-R curves shown in Figure 1, crack and strain information are also presented by using five different symbols shown in Table 2. Dashed lines in the figures represent the theoretical values determined by the ultimate flexural moment capacity at the bottom of each wall, while dotted lines are the ultimate lateral strengths determined in shear fail-

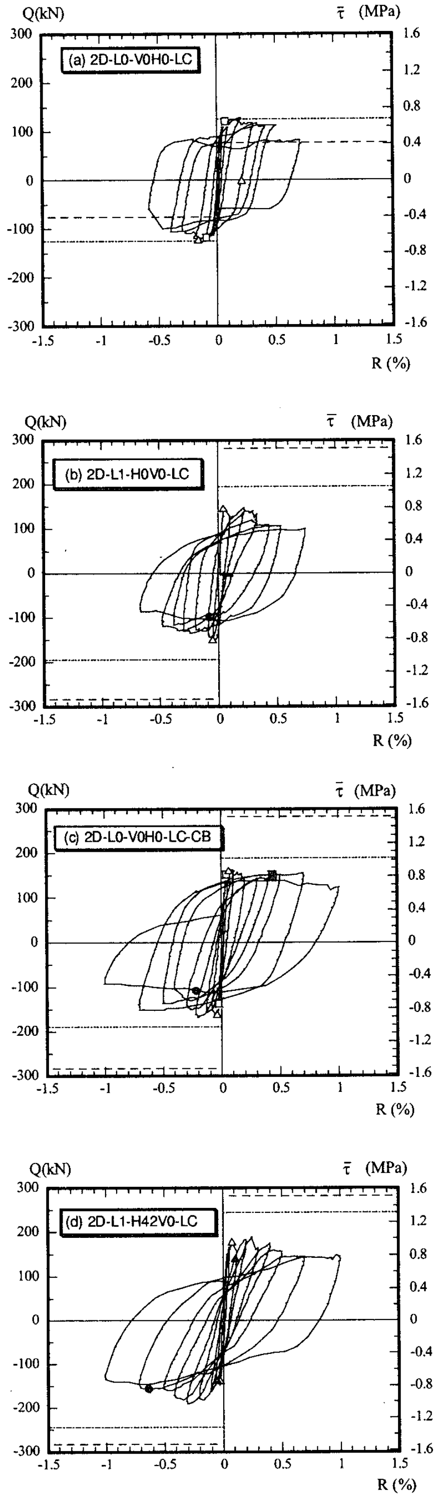
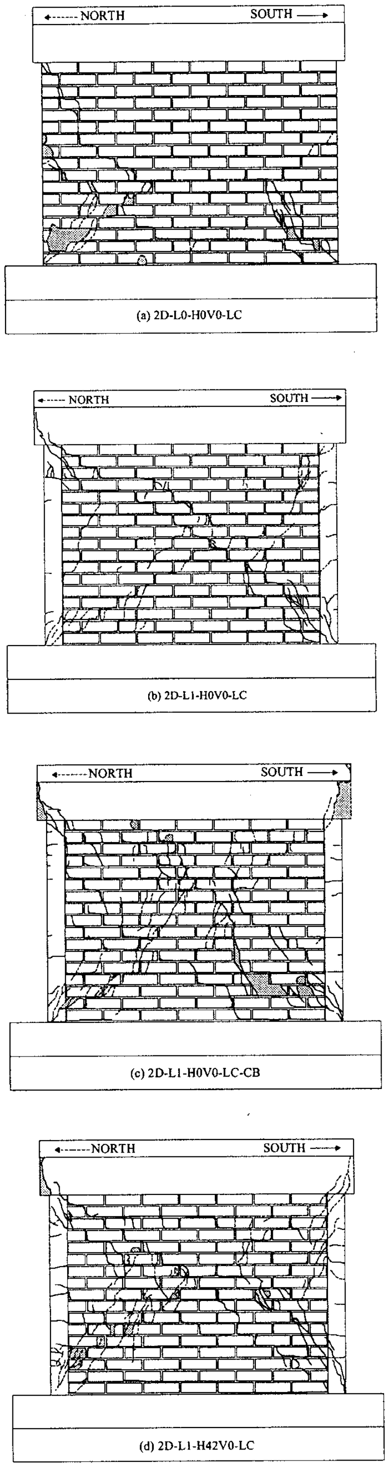


Figure 1. Q-R Hysteresis loops



(a) 2D-L0-H0V0-LC
(b) 2D-L1-H0V0-LC
(c) 2D-L1-H0V0-LC-CB
(d) 2D-L1-H42V0-LC

Figure 2. Final crack patterns

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Table 1. Predicted and observed ultimate lateral strengths and failure modes

Specimen	References used for theoretical prediction	Theoretical prediction			Test Results	
		Ultimate lateral strength		Predicted failure mode*	Ultimate lateral strength Q(kN)	Observed failure modes*
		Flexural mode Q_u(kN)	Shear mode Q_u(kN)			
2D-L0-H0V0-LC	[3]-[4]	76	125	F	125	F, S
2D-L1-H0V0-LC	[5]	282	195	S	149	S
2D-L1-H0V0-LC-CB	[5]	282	189	S	167	S
2D-L1-H42V0-LC	[5]	282	244	S	190	S

*F=Flexural Failure Mode, S=Shear Failure Mode

Table 2. Symbol used in Figure 1

□ :	Initial flexural crack in masonry wall
△ :	Initial shear crack in masonry wall
● :	Initial yield* in longitudinal Re-bar in south
▣ :	Initial yield* in longitudinal Re-bar in north
▲ :	Initial yield* in horizontal Re-bar in masonry

* Yield in tension

ure mode of the masonry wall with flexural reinforcement in its wall-edges (or R/C confining columns). In addition, final crack patterns observed on the West surface of all the specimens are shown in Figures 2(a) through 2(d).

For 2D-L0-H0V0-LC specimen, theoretical ultimate lateral strengths to predict the ultimate flexural strength is given by the Equation (4.4.1) in Reference [3] and shear strength has been calculated using the Equation (5.2.4) in Reference [4]. For the other three specimens confined by R/C columns, theoretical ultimate lateral strengths to predict the ultimate shear and flexural strength of the masonry walls have been calculated using the Equations (2.2) and (2.4) in Reference [5], respectively. The obtained results are shown in Table 1, together with the expected failure modes and observed test results.

By summarizing the test results obtained:

In Specimen (2D-L0-H0V0-LC), initial flexural crack in the brick masonry wall occurred at R=+0.069%, after this the ultimate flexural strength is presented at R=+0.199%, then the specimen starts to failure by shear and the ultimate strength occurred at R=-0.166%.

In Specimen (2D-L1-H0V0-LC), initial shear crack in the brick masonry wall occurred at R=+0.039%. Additional, diagonal crack occurred in the bottom and top of both columns. The ultimate strength occurred at R=-0.051 and R=+0.196. Additional, the longitudinal Re-bar in the south columns yielded at R=-0.086%.

In Specimen (2D-L1-H0V0-LC - CB), initial flexural crack occurred at R=-0.025% and R=+0.041% between the bottom of the masonry wall and the top surface of the foundation-beam. Then initial shear cracks are observed at R=-0.039% and R=+0.063%. Diagonal cracks occurred in the brick masonry wall propagated into top and bottom of both columns and passed completely into the top of each columns and beam-column connections. The ultimate strength occurred at R=+0.08% and R=-0.199%. The longitudinal Re-bar in the south and north columns yielded at R=-0.221% and R=+0.266%, respectively.

In Specimen (2D-L1-H42V0-LC), initial shear crack occurred at R=-0.025% and R=+0.079% and the ultimate strength occurred from R=+0.245% to R=-0.303. Both columns were damaged by the propagation of the wall-diagonal cracks into the bottom and top of each columns and transversal cracks in the center of both columns. Finally, the south column in the bottom part yielded at R=-0.637.

3. CONCLUSION

To develop much more seismic masonry walls, the horizontal reinforcements in masonry wall play an important role for expecting higher ultimate lateral strength and better ductility.

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