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Experimental Study for Higher Seismic Performance of Masonry Walls
Part 1: Objective and Outline of Preliminary Tests

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1. INTRODUCTION

Confined masonry walls, which are defined as brick or concrete masonry walls confined by reinforced concrete (R/C) columns and beams, are widely accepted as seismic structural walls in low- and medium-rise residential building structures in Latin American countries as well as in the People's Republic of China. Confined masonry walls are composed of brick or hollow concrete-block masonry units, which are confined by cast-in-place R/C small columns and beams (and/or floor slabs) along the perimeter of each masonry wall. These structural wall systems are very popular and have been frequently designed and constructed in those earthquake countries. It is noted, however, that any wall-reinforcing bars (Re-bars) are usually not provided in the masonry wall panels in this wall system.

Quindio Earthquake in Colombia on January 25th 1999 [Ref.1], which caused thousands of death toll and totally collapsed buildings, indicated the necessity to develop additional experimental studies of seismic masonry building structures. In order to develop more seismic confined concrete masonry walls, authors have conducted various experimental studies including several parameters [Ref.2]. Main objective of the first phase of this study is to develop much more seismic confined brick masonry walls. Herein, the test specimens and loading method used in this investigation of experimental study for higher seismic performance of masonry walls are presented. Four confined brick masonry wall specimens with different parameters are tested under the condition of constant vertical compression and alternately repeated lateral forces.

2. SPECIMENS

Four different confined and unconfined masonry wall specimens listed in Table 1 and Figure 1 were designed and constructed. Thickness of all the masonry walls is 105mm, and except for 2D-L0-H0V0-LC Specimen, all other three masonry walls are confined by R/C confining columns with 105mm x 105mm cross-sections in the extreme edges of each wall. Each of the specimens is designated by six symbol code, such as 2D-L1-H42V0-LC, with exception of 2D-L1-H0V0-LC-CB Specimen which has seven symbol code. The first symbol "2D" represents two-dimensional specimens. The second letter "L" represent the location of the applied lateral forces (or height of the inflection point of the wall) is "low". The third numeral "1" after the letter L represents that only one longitudinal Re-bar with bar-size of D19 (#6) is provided in each of the confining R/C column-section, which is transversely reinforced by circular spiral hoops of D6 (#2) as shown in Figure 1. The fourth symbol "H42" indicates that the horizontal Re-bars are provided in the spacing of 42cm and "H0" means that there is no horizontal Re-bars provided, and also the fifth symbol "V0" indicates that vertical Re-bars are not used. The sixth letters "LC" represents that the constant low axial compression load is applied to the specimens. The seventh symbol "CB" indicates that U-shaped connecting steel Re-bars with bar-size of D6 (#2) are placed

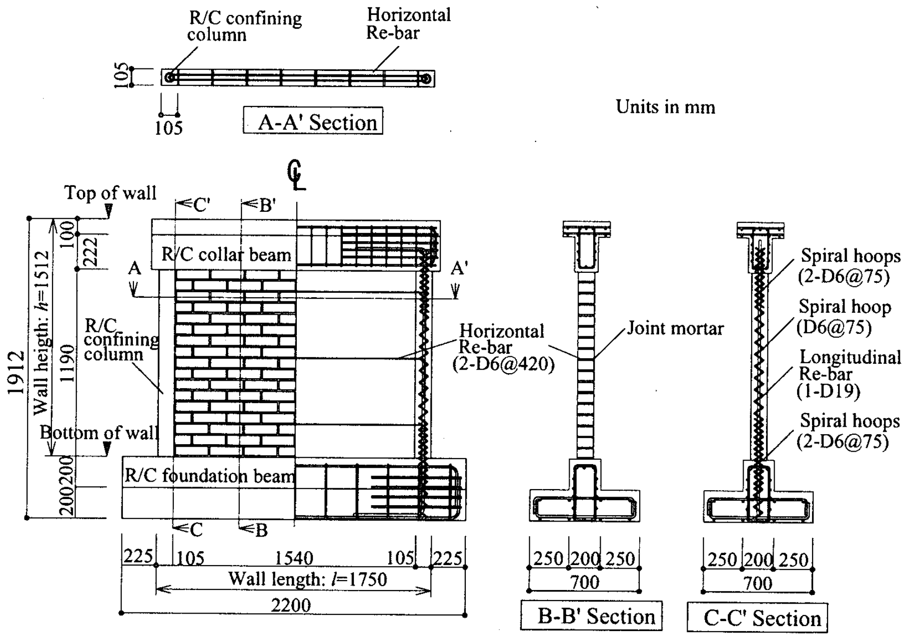

Figure 1. Typical test specimen

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every 21cm between masonry wall-edges and attached R/C column sections. In case when the specimen's name does not have this symbol, there is no connecting bars provided in the masonry wall panel. Mechanical properties of materials used for specimens are shown in Tables 2 and 3.

Table 1. List of test specimens

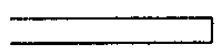
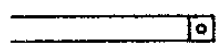
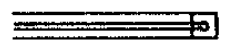
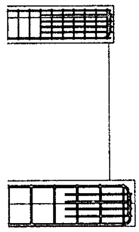
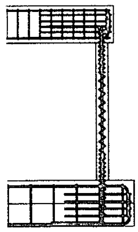
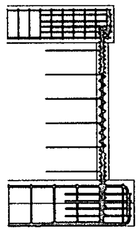
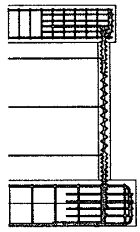
Specimen	2D-L0-H0V0-LC	2D-L1-H0V0-LC	2D-L1-H0V0-LC-CB	2D-L1-H42V0-LC
Heigth of applied lateral force	0.67x*h* (*h*:Wall height)			
Axial stress σ_0 (MPa)	0.84			
Horizontal Wall Re-bars	None	None	None	2-D6(#2)@420
Vertical Wall Re-bars	None	None	None	None
Connection Re-bars	None	None	D6(#2)@210	None
Longitudinal Column Re-bars	None	1-D19(#6)	1-D19(#6)	1-D19(#6)
Column Hoop	None	D6(#2)@75	D6(#2)@75	D6(#2)@75
Horizontal Cross-section				
Details of Reinforcement				

Table 2. Mechanical properties of reinforcing bars

Bar size	Yield strength (MPa)	Tensile strength (MPa)	Elongation (%)
D6(#2)	448	565	10
D19(#6)	335	480	20

Table 3. Compressive strength of concrete, prism and mortar

Specimen	Concrete (MPa)		Prism (MPa)	Joint Mortar (MPa)
	Column	Beam		
2D-L1-H0V0-LC	30.5	28.6	18.9	25.7
2D-L0-H0V0-LC	none	29.8	20.8	22.7
2D-L1-H0V0-LC-CB	28.8	28.6	19.4	24.6
2D-L1-H42V0-LC	27.4	29.4	18.5	21.5

3. TEST SETUP

The test setup adopted in the present study is shown in Figure 2, where height of the longitudinal axis of the lateral forces applied to the specimens (or height of the inflection point induced in the wall) is approximately 0.67 times of the wall height. Constant vertical axial load of 0.84 MPa per unit horizontal wall section was applied by a hydraulic jack with a capacity of 490kN (50tf), and alternately repeated lateral forces were applied by another double-acting hydraulic jack with 980kN (100tf) capacity. An auxiliary jack installed between loading- and reaction-frame is for counterbalancing, and important displacements and strains in reinforcing bars and wall surfaces were measured, and all the measured information were processed simulta-neosly by a personal computer.

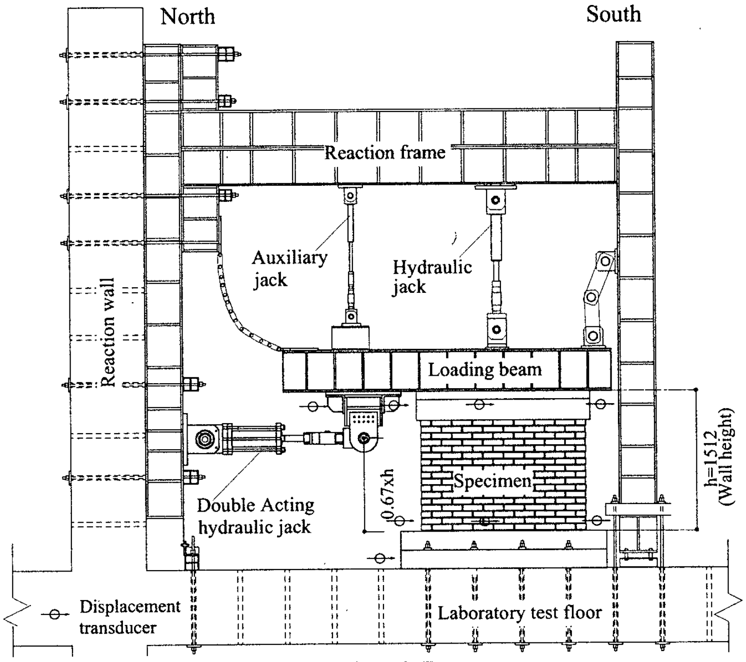


Figure 2. Test setup

4. CONCLUSION

Test specimens and loading method used in the investigation of experimental study for higher seismic performance of masonry walls are presented in the present paper. References are presented in the Part 2 of this study.

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