



AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Structural Engineering

Behavior of Masonry Walls Constructed Using Locally Available Dry-Stack Interlocking Masonry Units

A Thesis submitted in partial fulfillment of the requirements of the
degree of

Doctor of Philosophy in Civil Engineering
(Structural Engineering)

by

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Master of Science in Civil Engineering
(Structural Engineering)

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Cairo - (2015)



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Statement

This thesis is submitted as a partial fulfillment of Doctor of Philosophy in Civil Engineering (Structural Engineering), Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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THESIS SUMMARY

This thesis contains analysis details of an experimental and analytical study conducted to evaluate the in-plane behavior of dry-stacked masonry shear walls under cyclic loading and to study the effect of the reinforcement configurations, grouting and post-tension on the failure mode and lateral load capacity of the dry-stacked masonry shear walls. The test program consists of ten masonry shear walls constructed with three different types of locally available concrete masonry blocks (conventional, Azar and Spar-lock), the walls were tested under reversed cyclic lateral load with a displacement controlled loading protocol up to failure.

Key experimental results showed that the similarity behavior of Azar system shear walls to the conventional masonry system, and the brittle failure of Spar-lock system walls even after rearrangement because the system doesn't allow horizontal reinforcement. Post-tensioning is an effective method to construct un-grouted dry-stacked shear walls with minimum or no reinforcement, which resists 62.00% of the ultimate load capacity of fully-grouted reinforced shear walls. The usage of sliding control can improve the ductility of post-tensioned dry-stacked shear walls.

An analytical study using FEM to extend the experimental results of post-tensioned dry-stacked shear walls by studying other parameters as initial post-tensioning level and position of post-tensioning bars. Key analytical results showed that the ultimate load capacity for both grouted and un-grouted dry-stacked shear wall is directly proportional to the initial post-tensioning level with almost no effect of the position of bars. The grouting of wall's first course can increase the ultimate load by 11%, and the grouting of two courses increases the ultimate load by 28% for

the same post-tensioning level. The usage of sliding control decreases the ultimate load by 15% but with a significant improvement of ductility. The ultimate load capacity of partially-grouted walls with sliding control directly proportional with the initial post-tension stress, and the usage of central bars can improve the ultimate load by 40%.

Keywords: Dry-stacked Masonry, Post-Tensioning, Seismic Behavior, Interlocking Masonry, In-plane cyclic loading

ACKNOWLEDGEMENT

I would like to express my deepest thanks and appreciation to my supervisor, Dr. Hany El-Shafie for his guidance and advice throughout this work. I am grateful to him all for having the opportunity to work under his supervision.

Special thanks for my supervisors, Dr. Ahmed Rashad and Dr. Hussein Okail for their valuable assistance, guidance, patience and endless support throughout this research, and reviewing of the manuscript are greatly acknowledged.

The experimental work was carried out at the Properties and Testing of Materials Laboratory of the Structural Engineering Department of Ain-Shams University. The help of the laboratory staff in developing work is greatly appreciated. For thier distinguished assistance during the experimental work.

Finally, I would like to thank my family for their continuous encouragement, overwhelming support, fruitful care and patience, especially during the hard times.

TABLE OF CONTENTS

Thesis Summary	i
Acknowledgement	iii
Table of Contents.....	v
List of Figures.....	xiii
List of Tables	xxv
CHAPTER (1)	1
Introduction.....	1
1.1. Background.....	1
1.2. Dry-Stacked Masonry.....	2
1.3. Definition of the Problem.....	2
1.4. Research Objectives	3
1.5. Thesis Organization.....	4
CHAPTER (2)	7
Literature Review	7
2.1. Introduction	7
2.2. Dry-Stacked Masonry.....	8
2.2.1. Dry-Stacked Masonry Systems	11
2.2.2. Properties of Dry-Stacked Masonry	16
2.2.2.1.Compressive Strength.....	16
2.2.2.2.Initial Settlement	20
2.2.2.3.In-Plane behavior of Dry-Stacked Masonry Walls	22
2.3. Grouting Effect.....	31
2.4. Post-Tensioned Masonry	32
2.5. The Codification of Pre-Stressed Masonry	37
2.6. Behavior of Reinforced Masonry Shear Walls	45
2.7. Behavior of Post-Tensioned Masonry Shear Walls	57
2.8. Needed Research	59
CHAPTER (3)	61
Research Plan and Design of Test Walls.....	61
3.1. Introduction	61

3.2.	Research Plan	61
3.2.1.	Objectives	61
3.2.2.	Scope	62
3.3.	Test Program	63
3.4.	Pre-Test Analysis	71
3.4.1.	Design of Walls W1 (C:RVH:FG) and W2 (A:RVH:FG)	71
3.4.2.	Design of Wall W3 (S:RV:FG)	74
3.4.3.	Design of Wall W4 (A:RH:FG:PT)	76
3.4.4.	Design of Wall W5 (A:RH:UG:PT) and W6 (C:RH:UG:PT)	78
3.4.5.	Design of Wall W7 (S:RH:UG:PT)	81
3.4.6.	Design of Wall W8 (A:RH:UG:PT:Sl)	83
3.4.7.	Design of Wall W9 (A:RH:PG:PT:Sl)	84
CHAPTER (4)		87
Material Characterization		87
4.1.	Introduction	87
4.2.	Material Testing.....	87
4.2.1.	Concrete Block Units	87
4.2.2.	Masonry Mortar.....	90
4.2.3.	Grout	92
4.2.4.	Masonry Prisms	93
4.2.5.	Diagonal Tension (Shear) Test.....	98
4.2.6.	Shear Friction (Triplet Test).....	100
4.2.7.	Reinforcing Steel	103
4.2.8.	Post-Tensioning Bars	103
CHAPTER (5)		105
Construction and Testing of Masonry Shear Walls.....		105
5.1.	Introduction	105
5.2.	Specimen Construction and Preparation	105
5.2.1.	General Description.....	105
5.2.2.	Reinforced Concrete Footings.....	108
5.2.3.	Masonry Panels	109
5.2.3.1.	Masonry Blocks.....	109

5.2.3.2.Reinforcement	110
5.2.3.3.Post-Tensioning Bars	111
5.2.3.4.Grout	111
5.2.3.5.Sliding control	111
5.2.4. Reinforced Concrete Top Beam.....	112
5.3. Test Setup	112
5.3.1. Reaction System.....	114
5.3.2. Lateral Load System.....	117
5.3.3. Out-of-Plane Bracing System.....	118
5.4. Instrumentation.....	119
5.5. Data Acquisition System	122
5.6. Test Procedure	123
CHAPTER (6)	125
Test Results and Analysis of Wall Response	125
6.1. Introduction	125
6.2. Test Results for Wall W1 (C:RVH:FG).....	129
6.2.1. General	129
6.2.2. Crack Patterns.....	129
6.2.3. Lateral Load – Overall Drift Angle Curve	129
6.2.4. Flexural Strain – Overall Drift Angle Curves	130
6.2.5. Panel Drift Angle – Displacement Curves	130
6.2.6. Sliding	130
6.2.7. Failure Mechanism	131
6.2.8. Summary of Major Events	131
6.3. Test Results for Wall W2 (A:RVH:FG).....	136
6.3.1. General	136
6.3.2. Crack Patterns.....	136
6.3.3. Lateral Load – Overall Drift Angle Curve	136
6.3.4. Flexural Strain – Displacement Curves.....	136
6.3.5. Panel Drift Angle – Displacement Curves	137
6.3.6. Sliding	137
6.3.7. Failure Mechanism	137
6.3.8. Summary of Major Events	138