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

Mohamed Kohail M. Fayez

Master of Science in Civil Engineering

(Structural Engineering)

Faculty of Engineering, Ain Shams University, 2009

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Date: 06 May 2015

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

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