STRENGTH EVALUATION OF

DRY-STACK MASONRY

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DECLARATION

I declare that this dissertation is my own work. It is being submitted for the degree of Masters of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

Signature: ___________________________________

Date: May 7th, 2007

ABSTRACT

Accelerated dry-stack masonry construction is seen all over the world in the last two decades. Intense investigation on structural behaviour of dry-stack masonry is also seen worldwide. This research work, presents an investigation of the structural behaviour of Hydraform dry-stack masonry developed in South Africa. Unit compressive strength, masonry wall compressive strength and flexural resistance of dry-stack masonry/reinforced concrete beams were investigated.

Due to the interlocking mechanism nature of Hydraform dry-stack blocks, three different unit compressive testing methods were investigated. The methods are described as:

- Shoulder test;
- Centre test;
- Cube test.

Tests were carried out under different humidity conditions:

- Dry;
- Wet;
- Normal.

Influence of different cement contents within the block units and moisture contents were investigated. The study made proposal of Hydraform block unit grads to be used for design.

Compressive strength of dry-stack masonry walls was experimentally investigated. Dry-stack masonry wall specimens made by different block grades were subjected to in-plane vertical uniformly distributed load. Test results were used to establish dry-stack masonry characteristic compressive strength for several block grades.

Flexural strength of dry-stack masonry/reinforced concrete composite beams was investigated. Series of beams were tested for flexural resistance. Applicability of conventional reinforced masonry flexural analysis philosophy was established.

STATEMENT OF ACHIEVEMENT

The following technical papers were derived from this investigation:

1. Uzoegbo, H. C. and Pave, R. F. “Compressive Strength Evaluation of Compressed-Soil Cement Interlocking Blocks”, 4º Congresso Luso-Moçambicano de Engenharia, Maputo - 2005 (Published);

2. Pave, R. F. and Uzoegbo, H. C. “Strength Evaluation of Compressed Soil-Cement interlocking Masonry Unit and Walling System”, 3rd Young Concrete Engineer’s, Practitioners’ & Technologists’ Conference, Midrand - 2006 (Published);

3. Uzoegbo, H. C.; Senthivel, R. and Pave, R. F. “Seismic Behaviour of Single-Storey URM Buildings with Lightweight Steel Roof”, 7th International Masonry Conference of the British Masonry Society; London - 2006 (Published);

4. Pave, R. F. and Uzoegbo, H. C. “Flexural Strength Evaluation of Reinforced Interlocking Block Beams”, The Third International Masonry Conference on Structural Engineering, Mechanics and Computation, Cape Town, South Africa, 10 - 12 September 2007 (Published).

DEDICATION

To all my family, special to

Celeste and Nicol Pave,

“The essence of knowledge is, having it to apply it”

Confucius 551 - 497 BC

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CONTENTS

CHAPTER 3

BLOCK UNITS COMPRESSIVE STRENGTH

CHAPTER 4

COMPRESSIVE STRENGTH OF DRY-STACK MASONRY PANEL

CHAPTER 5

FLEXURAL RESISTANCE OF DRY-STACK MASONRY/REINFORCED CONCRETE COMPOSITE BEAMS

CHAPTER 6

CHAPTER 7

APPENDIX A

APPENDIX B

APPENDIX C

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

A	Cross section area
A_s	Area of tensile reinforcement
A_{si}	Cross section area of reinforcement of layer i
A_{sv}	Cross section area of resisting legs of a link
b	Cross section width
-	Percentage of cement content by volume in dry mixture
	Effective depth of a section
	Reinforcement modulus of elasticity
	Cube/block unit mean compressive strength
	Panel mean compressive test load
	Masonry characteristic compressive strength

f_m	The mean compressive strength of dry-stack wall panel
f_y	Reinforcement steel characteristic yield strength
f_{yv}	Characteristic strength of reinforcement links
h	Panel height
k	Loading method factor
L	Panel length
p_o	Specified compressive strength
p_1	Acceptance limit for compressive strength
p_u	Unit mean compressive strength obtained on laboratory
s_{sv}	Spacing of the links
t	Humidity conditions factor
t	Panel thickness
V	Acting shear force due to applied loads
v^{acting}	Acting shear stress at a given cross section
$v^{reis\tan ce}$	Shear resistance stress at a given cross section
v_c	Shear resistance attributed to plain concrete
v_{sv}	Shear resistance attributed to shear reinforcement links
	Empirical material factor
	Reduction factor for strength of mortar
	Unit reduction factor
	Coefficient which accounts for the deviations in the masonry strength
	Coefficient adopted to correct x from the really parabolic stress-strain diagram to the approximate rectangular diagram

x	Depth of the compression zone of the section
$\varepsilon = \varepsilon_{si}(x)$	Reinforcement strain on layer i and is a function of the neutral axis position x
ε_y	Yield strain for reinforcement
γ_{ms}	Safety coefficient for reinforcement
γ_m	Partial safety factor for material