THE EFFECTIVENESS OF ALTERNATIVE STABILIZER FOR MUD CONCRETE TECHNOLOGY

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November 2018

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A thesis submitted in fulfillment of the requirements for the degree of Doctor of Philosophy

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DECLARATION

I here by declare that the thesis entitled "The effectiveness of alternative stabilizer for Mud Concrete Technology" submitted by me, for the award of the degree of *Doctor of Philosophy* to University of Moratuwa is a record of bonafide work carried out by me under the supervision of Prof.Rangika Halwatura.

This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Place: University of Moratuwa

Date: 30/11/2018 **.....**

(Chameera Dussantha Udawattha)

CERTIFICATE

This is to certify that the thesis entitled "The effectiveness of alternative stabilizer for Mud Concrete Technology" submitted by Chameera Udawattha, University of Moratuwa for the award of the degree of *Doctor of Philosophy*, is a record of bonafide work carried out by him under my supervision, as per the University of Moratuwa code of academic and research ethics.

The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university. The thesis fulfills the requirements and regulations of the University and in my opinion meets the necessary standards for submission.

Place: University of Moratuwa

Date: 30/11/2018

(Prof.Rangika Halwatura)

ABSTRACT

The building wall is our third skin. Edifice the third skin out of earth has been practiced since prehistoric era, because of the availability of soil as a raw material. Merely soil have many weakness including its geo technical properties of shrink swell, low density and high permeability. In order to convert geotechnical properties into engineering material, there should be a stabilizer. This study was conducted to study alternative stabilizer for earth based construction particular to mud concrete earth construction.

An inventory of potential alternative stabilizers were arose based on an immense literature survey, inspired from nature and from ancestral folk knowledge. Several mix designs were subjected to a strength development study. Overall engineering properties and total life cycle study was conducted according to engineering standards. The durability, cost, thermal performances, embodied energy and life-cycle cost were studied and compared with most available wall construction units. Finally, the impertinent technology was enhanced to use as residential scale technology for poor people in the country. The application and the manufacturing process was advocated among low income villagers to building their houses.

The study has found that natural polymers such as natural rubber latex, pines resin, dawul kurudu, and sugarcane bagasse can enhance the mechanical properties of a mud concrete block. Industrial waste such as fly ash, bottom ash, and rice husk ash can work as an alternative stabilizer. A more advanced technology of geopolymerizing mud concrete block was invented by this study. In the practical construction world, this novel wall material should be testified in front exiting wall material palette. Found that mud concrete block is a suitable solution to replace existing expensive wall construction technology. Finally, the manufacturing process was optimized into the plenteous production process to manufacture mud concrete block in mass scale. More than all, this thesis has given birth to an affordable wall construction technology for poor people in the country.

Keywords: *Earth building*, *soil stabilization*,*engineering properties*, *walling material*, *environmental fitness*, *life cycle analysis*.

ACKNOWLEDGEMENT

Once upon a time I was crossing the land of dust and fear

Looking for a land to seed without fear

*Then **Dr.Narein Perera** showed me a river,*

A river running through the land of dust and fear,

And he showed me a place and taught me how to seed a tree in the fastest gear,

Thank you for allowing me to plant a tree on your soils and let it breathe in your air,

And for bearing my dream topiary that provides you nothing but endeavor,

You provide rivers and streams for me and to nourish my saple,

You ruffle it with your whirly winds for that and much more,

Thank you for the pelts of sand and pours of fine, and thank you for erasing my dull

Leaves with your magical words,

*Thank you my dear sir **Prof.Rangika Halwatura** for selflessly giving*

All that you do have, although at ; times I dont deserve it,

There upon many others helped me with fertilizers and continuous supplies,

Praneeth Dilshan and Darshana Jayasinghe helped when I planted it.

And then Rasangi Lakmini, Himhansi Galkanda, Isuri Shanika Ariyarathne and Devinda

eranga water the plant.

Rizna Arooz, Kasun Nandapala, and Shakila Pathirana showed the

Way to grow it.

*My big brother **Nadheera Udawattha** removed all the moss on the trunk*

*My younger brother **Sanjaya Udawattha** helped me to root down to the bed rock*

I have a long way to go with this tree, and it becomes taller than Eifel tower because

*Of my wife **Shanika and Baby Shaven.***

*It has many branches because **my father** never ever commanded to trim it.*

*Thank you, **my first Mother**, for opening my eyes with your elusive warnings,*

*you are unlucky to see I was growing this tree but another **mother** helped me to grown.*

But I promise you all; I will grow more and more.

I will help others to grow their corn.

"Because some trees grow in to heaven"

Chameera Dussantha Udawattha

CONTENTS

List of Figures

List of Tables

List of Terms and Abbreviations

AWR	Agard wood resin
BOQ	Bills of quantities
BR	Bael Resin
CAB	Hard soil block
CC	Cleaning Cost
CP	Cement slurry plaster
CSEB	Cement stabalized
DK	Dawul Kurudu
DCS	Dry Mean Compressive
DMCS	Dry Mean Compressive Strength
EC	Energy Cost
EE	Embedded energy
FC	Fixed Cost
FSEB	Fly Ash stabilized earth blocks
GHG	Green House Gas
HCB	Hollow cement Block
IC	Initial Cost
JR	Jack Resin
LCC	Life Cycle Cost
LS	Linear Shrinkage
MC	Maintenance Cost
MCB	Mud concrete Block
NP	Natural Polymer
NRL	Natural Rubber Latex
NPV	Net present values
OC	Overheads
PR	Pines Resin
RE	Refurbishment
RES	Residential Buildings
RV	Resale value
SB	Sugarcane Bagasse
SI	Suitability Index
TSS	Tensile splitting strenght
UC	Utilization Cost
UCS	Compressive Strength
WAR	Wood apple resin