

**A DYNAMIC, CLAY DOUBLE WALL SYSTEM FOR
INDOOR COOLING**

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(188044B)

Degree of Doctor of Philosophy

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfilment of the requirements for the degree
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DECLARATION

I declare that this is my own work, and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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Name of the Supervisor: Prof. R.U.Halwatura

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ABSTRACT

Truly, sustainable development promises environmental, social, economic, yet personal meaningfulness, beyond increasing financial wealth. The usage of clay in construction is proven sustainable in all three aspects since its usage from the very beginning of human civilization. However, the chauvinism toward clay as a nonmodern material is detrimental, and therefore novel innovations of clay, are required to fasten with modern architecture for a whole new perspective. The usage of clay for primary, heavy walling is common in hot arid climates, yet fewer studies incorporate clay for interiors and double walling in the tropics.

This gap was addressed by developing a Dynamic, Clay Double Walling (DCDW) solution for heat reduction with easy maintenance and favorable aesthetics. The cooling effect of these structures can be attributed to the resistance of heat flux to the building due to the porosity of the structure, heat absorption, and thus decline of thermal conductivity.

The research thus investigates improvements in internal porosity and air permeability of clay, for improved mechanical and chemical properties, and thermal stability upon firing. Patterns and characteristics for best indoor air temperature reduction were identified on the material mix, mix composition, firing configurations, thermal conductivity, shrinkage, panel thickness, etc.

The practicality and application potentials of the invention were tested on-site, potential improvements were tested virtually (with building simulations) for their effectiveness, and in completion, the long-term sustainability, and profitability of the DCDW system were investigated by identifying the LCC.

The innovation suggests an energy-efficient, low-cost, low maintenance and lightweight, sustainable, double walling solution for high-end to low-end, yet new construction to retrofitting for tropical interiors.

Keywords: Cooling, Dynamic, Clay, Double wall, Tropical indoors

DEDICATION

This dissertation is dedicated to my loving parents, husband, and baby 'Graahie'.

For their endless love, support, and encouragement

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LIST OF ABBREVIATIONS

DCDW	Dynamic Clay Double Wall
DSF	Double Skin Facades
RH	Relative Humidity
OE	Operational Energy
EE	Embodied Energy
CFP	Carbon Footprint
GHG	Green House Gas
HVAC	Heating, Ventilation and Air Conditioning
LCC	Life Cycle costing
WLC	Whole Life Costing
WLA	Whole Life Appraisal
A/C	Air Conditioning
NPV	Net Present Value
IC	Initial cost
OC	Operational Cost
RC	Replacement Cost
MC	Maintenance Cost
DC	Direct Current
IRR	Internal Rate of Return
MCW	Mud Concrete Wall
ASTM	American Standards of Test Methods

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