STRUCTURAL BEHAVIOR OF DOUBLY CURVED SHELL STRUCTURE CONSTRUCTED WITH MUD-CONCRETE

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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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Abstract

Embodied carbon emissions have been overlooked in the past few decades. As such, today, the building sector is responsible for 38% of all carbon emissions in the world greenhouse gas emissions. To overcome the climate crisis, sustainable construction practices, reducing reliance on carbon insensitive raw materials usage and net-zero carbon standards are being implemented across the globe. Building with earthen materials becomes a focal point in sustainable building design practices since its an environmentally friendly construction practice. Although there are several earth-based modern construction techniques for walling available in Sri Lanka (such as rammed earth, mud-concrete), no reliable technique is developed or adopted as a slab system. Most of the recent earthen constructions are either single-storied or use concrete as their slab system. Thus, the earthen slab system would be a huge step towards a structure entirely made of earthen materials.

Here, it is attempted to identify the structural behavior of the doubly curved shell structure using Finite Element Analysis (FEA) and the possibility of constructing an earthen slab system using Mud-concrete. It was identified that nearly 50% of cost reduction can be expected when compared with the reinforced concrete slab systems. A 1m x1m prototype Mud-concrete slab was constructed to check the potential for modular construction practice with a square footprint. The masonry mould method was used as the formwork system by considering the ease of the construction. Shell thickness of 50mm is the primary structural component, while the non-structural filling of 50mm from apex was used with the Mud-concrete mixture used as a flat floor surface.

Key words: Doubly curved shells, Mud-concrete, Sustainable, Vault structures

DEDICATION

This dissertation is dedicated to my loving parents.

For their endless love, support and encouragement

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LIST OF ABBREVIATIONS

Abbreviations	Description
AD	Anno Domini
BC	Before Christ
FEA	Finite Element Analysis
FEM	Finite Element Method
LC	Load Case
MC	Mud Concrete
TNA	Thrust Network Analysis
TRC	Textile Reinforced Concrete
SDG	Sustainable Development Goals

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