STRUCTURAL PERFORMANCE ASSESSMENT OF LIGHT-WEIGHT FLOOR SYSTEMS USING LOCALLY AVAILABLE CFB AND CFS SECTIONS

J.M.G. Indunil

219743M

Master of Science in Structural Engineering

Department of Civil Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

June 2025

STRUCTURAL PERFORMANCE ASSESSMENT OF LIGHT-WEIGHT FLOOR SYSTEMS USING LOCALLY AVAILABLE CFB AND CFS SECTIONS

J.M.G. Indunil

219743M

Thesis submitted in partial fulfilment of the requirements for the degree
Master of Science in Structural Engineering

Department of Civil Engineering
Faculty of Engineering

University of Moratuwa
Sri Lanka

June 2025

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. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature: Date:

The above candidate has carried out research for the master's thesis under my supervision. I confirm that the declaration made above by the student is true and correct.

Dr. K. Baskaran

ACKNOWLEDGEMENT

I would like to express my special gratitude to my supervisor, Dr. K. Baskaran, Senior Lecturer, Department of Civil Engineering, University of Moratuwa, for his invaluable guidance, support, and encouragement throughout the selection of the research, carrying out the necessary testing program and the preparation of this report. His insightful feedback and expertise have been instrumental in shaping this work.

I extend my heartfelt gratitude to Dr. H. G. H. Damruwan, Course Coordinator, for his invaluable guidance and support throughout my MSc program. I am also deeply thankful to all the lecturers for their dedication, insightful knowledge sharing, and continuous encouragement, which have greatly enriched my learning experience and professional growth.

Further, I would also like to thank the Structural Testing Laboratory and Workshop non-academic staff in the Department of Civil Engineering, University of Moratuwa, for their invaluable support in setting up the experiments and assisting with the testing arrangements. Their technical expertise and dedication greatly contributed to the successful execution of the testing process.

I also extend my appreciation to El Toro Roofing Products Ltd for generously providing the test specimens, which were essential for conducting the experimental investigations. Their contribution significantly enhanced the depth of this study.

Furthermore, I am grateful to Sterling Steels (Pvt) Ltd for supplying the section properties, which played a crucial role in the analysis and validation of the findings presented in this report.

Finally, I would like to acknowledge everyone who has contributed directly or indirectly to the successful completion of this work.

Abstract

Studies, on the use of alternative materials to conventional reinforced concrete flooring have become increasingly important in modern construction. One encouraging option is a lightweight composite slab system using natural cellulose fibre cement boards supported by cold-formed steel purlins. In Sri Lanka, such fibre cement boards are locally manufactured and becoming popular in low-rise residential and commercial buildings. However, the lack of reliable mechanical property data for these boards presents a challenge to structural engineers during detailed design. To address this gap, a comprehensive experimental program was conducted at the University of Moratuwa to determine the mechanical properties of locally available fibre cement boards with thicknesses of 15 mm, 18 mm, and 20 mm. Tests were performed in accordance with BS EN 12467, BS EN 789, and BS EN 1383 to evaluate bending strength (along and perpendicular to the fibre direction), tensile strength, compressive strength (in-plane and perpendicular), and pull-through resistance. All tests were conducted under dry conditions using a Universal Testing Machine (UTM) in displacement-controlled mode. Characteristic strengths were calculated following the procedures in EN 14358. Based on the experimentally derived characteristic strengths, this research proposes a set of span tables for fibre cement boards supported by cold-formed "C" purlins as per the Eurocodes. These span tables offer a practical and cost-effective design tool for engineers and promote the use of sustainable, lightweight flooring systems in the local construction industry.

Keywords: fibre cement boards; cold formed "C" purlin; span table; mechanical property; characteristic strengths

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AISI	American Iron and Steel Institute
CEN	European Committee for Standardization
CFRP	Carbon Fibre Reinforced Polymer
CFS	Cold Formed Steel
DB	Dry Board
ETF	End-Two-Flange
FCB	Fibre Cement Board
GGBFS	Ground Granulated Blast-Furnace Slag
ITF	Interior-Two-Flange
LCB	Lipped Channel Beams
LSB	LiteSteel Beams
LT	Lateral-Torsional
LTB	Lateral-Torsional Buckling
MOR	Moment of Resistance
NAS	North American Specification
OPC	Ordinary Portland Cement
PSS	Profiled Steel Sheet
SCM	Supplementary Cementitious Material
THFB	Triangular Hollow Flange Beam
ULS	Ultimate Limit State
UTM	Universal Testing Machine

LIST OF APPENDICES