STEEL PORTAL FRAME DESIGN FOR DECONSTRUCTION AND REUSE

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July-2022

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This Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree Master of Science (Structural Engineering)

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DECLARATION

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Dr. (Mrs) MTP Hettiarachchi

ACKNOWLEDGEMENT

This report and the research behind it would not have been possible without the exceptional support of my supervisor, Dr.(Mrs.) MTP Hettiarchchi. Her enthusiasm, knowledge and exacting attention to detail have been an inspiration and kept my work on track from my first discussion with her to the final draft of this thesis.

I would also like to thank the staff of the civil engineering department of University of Moratuwa, especially all the lecturers who taught me over the past few years.

My gratitude should goes to all the teachers who taught me from primary education to professional career.

I thank all the authors of reference documents and books used during this study.

I am grateful to information department of Sri Lanka Custom for providing me useful data.

I am also grateful to all of those with whom I have had the pleasure to work during this research and during my entire career.

Nobody has been more important to me in the pursuit of this project than the members of my family. I would like to thank my parents, my wife and two wonderful children, whose love and guidance are with me in whatever I pursue.

ABSTRACT

Steel Portal Frame Design for Deconstruction and Reuse

Today, the world over, much emphasis is focused on the use of sustainable materials in infrastructure. One of the main attributes that has led to the widespread use of steel in infrastructure is that is considered sustainable. Steel meets the 3R concept of Sustainability, Reduce, Reuse and Recycle. While steel components are 100% recyclable, the manufacture of stronger and better quality steel products has enabled the design and construction of structures using reduced quantities of steel. Due to scarcity of raw material, conservation of energy coupled with escalation of steel prices, it is prudent to design steel structures that can be re-used, thus extending the life cycle of steel. This is an aspect that has hitherto not received sufficient consideration by structural engineers.

The focus of this thesis is on extending the life cycle of steel components, with particular emphasis on the design of single span steel portal framed structures by considering the aspects of deconstruction and re-use. The scope of the study was limited to a span range of 20m to 40m and eaves heights of 4m and 6m and typical vertical action of 10kN/m.

The adoption of haunches hinders the re-use of the rafter. An innovation recently adopted facilitating the re-use of rafters is that of replacing the haunch at the eaves with a steel knee brace pinned at either end to the column and rafter. This concept was investigated and found to be viable within this range of span and eaves heights. Optimum locations for knee brace connections were found to be 10% of span length at the rafter end and 3% of the span length from the rafter axis at the column end.

These initial studies indicate that greater attention should be paid on the aspect of deconstruction and re-use of steel at the preliminary stages of design in order to extend the life cycle of steel components and thereby enhance the sustainability of steel structures.

Key words:

3R concept, deconstruction, re use, sustainability, knee brace

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LIST OF ABBREVIATION

Abbreviation	Description
BM	Bending Moment
CHS	Circular Hollow Section
EHF	Equivalent Horizontal Force
GA	General Arrangement
KB	Knee Brace
NHF	Notional Horizontal Force
PEB	Pre Engineered Buildings
SLS	Serviceability Limit State

LIST OF APPENDICES