

STEEL PORTAL FRAME DESIGN FOR
DECONSTRUCTION AND REUSE

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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

“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 our 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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Dr. (Mrs) MTP Hettiarachchi

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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 it 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 |

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