COST IMPLICATIONS OF ADOPTING EUROCODES

FOR

STEEL CONCRETE COMPOSITE BRIDGES

IN SRI LANKA

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168901H

Master of Science in Structural Engineering Design

Department of Civil Engineering

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Thesis submitted in partial fulfilment of the requirements for the
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Abstract

Keywords – Traffic loads, bridge deck types, composite bridges, deck cost, cost comparison

Construction of concrete bridges gained popularity after the introduction of pre-stressed concrete in 1950s, due to low cost of maintenance and locally available construction material. The concrete bridge industry was developed, so that reinforced and pre-stressed concrete bridges were designed and constructed in Sri Lanka.

Steel being imported material that require maintenance, steel bridge industry was not developed. Although with present high-grade steel, durable protective systems, steel composite bridges offer competitive designs for longer spans, locations with poor ground conditions, accessibility problems due to congested traffic and remote locations.

BS5400-2 (1978) and R.D.A Bridge design Manual remained as the main bridge design standards during past few decades up-to-date. Pre-tensioned beams used in the road network are still produced, and bridges are designed for these standards. BS design standard need to be replaced with Eurocode standard since BS standards will not be updated in future. This study selected UK National Annex for traffic loads (NA to BSEN 1991-2:2003) to compare with current BS 5400-2 loading adopted in Sri Lanka.

Standard simply supported bridge decks with two traffic lanes (carriageway 7.4m) and two footways on either side considered in this study. Standard pre-tensioned concrete beam deck spans 9.04m – 24.54m and composite designs made for this study for spans 31.5m – 50m considered in the comparison of traffic loads of BS5400-2 (1978 & 2006) and Eurocode UK National Annex. Culverts and existing bridge span up to 9.0m were not considered to maintain the simplicity of this study.

In order to compare deck costs, existing concrete decks were estimated based on Highway Schedule of Rates (HSR) and past construction data. Designs and estimates were prepared for recommended UKNA loading for steel composite bridges for spans 11.5m – 50m. The cost information provided from a steel fabricator and published data together with past construction data were considered in the estimation of composite decks.

This study recommends suitable UKNA loading, to replace current BS loading and identifies economical span range for steel composite bridges designed, when compared with existing concrete bridge types for prices prevailed in 2020. Identical costing process could be repeated with latest prices and HSR rates to for comparison of cost between concrete and steel concrete composite decks in future years.

I dedicate this thesis to my loving parents and family.

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List of Abbreviations

BS – British Standard

BCSA – British constructional steel work association

BOQ – Bill of Quantities

EC – Euro Code

ELS - Engineering & Laboratory Services (Pvt) Ltd, Sri Lanka

HSR – Highway schedule of Rates. Document published by Road Development Authority for each province that gives rates for construction of roads, bridges and highway structures

ICTAD – Institute for Construction Training and Development, Sri Lanka

KEL – Knife edge load BS 5400 part 2

RDA – Road Development Authoriry, Sri Lanka

SD&CC – State development and Construction Corporation, Sri Lanka

SEC – State Engineering Corporation, Sri Lanka

SLS – Serviceability Limit State

SOV – Special Order Vehicles

SV – Special Vehicles

TS – Tandem System

UDL, udl – Uniformely distributed load

UK – United Kingdom

UKNA – National Annex for United Kingdom

ULS – Ultimate Limit State

US $ - United States Doller

UB – Universal steel beam section

SLSEN – Eurocode National Annex for Sri Lanka

SCI – Steel Construction Institution, UK

Sqm – square meters

Rs – Sri Lankan rupees

" +" together with