LOAD DISTRIBUTION IN EDGE-STIFFENING BEAM OF A SIMPLY SUPPORTED BRIDGE DECK

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ABSTRACT

This study involves two distinct methods for analysis of a simply supported bridge deck with or without edge-stiffening beam and the effect of edge-stiffening on the longitudinal and transverse moments along the deck. An analysis of a slab bridge with or without edge-stiffening beams is made and the result obtained from LUSAS programs (Finite Element Method) are compared with those derived theoretically (Load Distribution Method). The analysis considered HB loading acting on deck bridge. The analysis is confined to the case where the effective depth of the bridge is constant between the edge-stiffening. The degree of accuracy to be expected from the theoretical analysis and the difference in the longitudinal and transverse bending moment due to the effect of edge-stiffening beams are estimated. Part of the analysis for the above problems involves the determination of longitudinal moment in the corner or edge-stiffening beam.

ABSTRAK

Studi ini melibatkan dua metoda yang beda untuk analisa suatu jembatan yang disokong secara mudah, dengan atau tanpa pengukuhan tepi (ketebalan di samping jembtan) dan efek dari pengukuhan tepi pada gaya momen yang membujur dan melintang sepanjang geladak itu. Suatu analisa dari papan jembatan dengan atau tanpa pengukuhan tepi dibuat dan hasilnya diperoleh dari program LUSAS (Metode Unsur Tak Terhingga) dibandingkan dengan hasil yang diperoleh secara teoritis (Metoda Distribusi Beban). Analisa mempertimbangkan beban HB yang berada di atas jembatan. Analisa terbatas pada kasus di mana ketebalan efektif dari jembatan adalah tetap diantar pengukuhan tepi. Derajat ketepatan yang diharapkan dari analisa secara teoritis dan perbedaan pada gaya momen yang membujur dan melintang akibat dari adanya pengukuhan tepi dapat diperkirakan. Bagian dari analisa untuk permasalahan di atas melibatkan penentuan dari gaya momen membujur di sudut atau balok untuk pengukuhan tepi.

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2a	-	Span Bridge
2b	-	Width Bridge
d	-	the slab depth
E	-	Young's modulus of the material of deck
G	-	modulus of rigidity or torsional modulus of the material of the deck
i	-	longitudinal second moment of area of the equivalent deck per unit width
I	-	second moment of area of each longitudinal girder
i_o	-	longitudinal torsional stiffness per-unit length
j	-	transverse second moment of area of the equivalent deck per unit length
J	-	the second moment of area of each transverse diaphragm or cross beam
j_o	-	transverse torsional stiffness per unit length
K_a	-	the distribution coefficient for the actual value of a.
K_o	-	distribution coefficient for a equal to 0.
K_1	-	distribution coefficient for a equal to 1.
l_o	-	torsional stiffness constant of a longitudinal girder
p	-	spacing of longitudinal girders
q	-	spacing of stiffners i.e. diaphragms or cross beams

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CHAPTER I

INTRODUCTION

1.1 General

A bridge is a permanent raised structure which allows people or vehicles to cross an obstacle such as a river without blocking the way of traffic passing underneath (Heinz Kurth 1976). And the construction of bridge comprises one section of the work of the civil engineering which was has an immediate impact upon the public. The reasons of the impact are not hard to find since most major bridge combine a strong visual impression together with obvious benefit in the way of improved communication.

Many bridges are designed to incorporate some forms of edge stiffening for the need to accommodate services of various types, or deal with narrow or negligible footpaths, (which permit excessive eccentricities of abnormal loads) or, in the case of a railway over bridge, to provide a parapet specifically to prevent accidents. Whatever the reason for its presence, the edge stiffening will considerably affect the behaviour of the bridge structure under load and, of more importance; it can improve the distribution characteristics of the bridge with regard to longitudinal moments.

However, the beneficial effects of edge stiffening can only be obtained by ensuring a positive structural connection between any edge stiffening and the main bridge structure and by analyzing in detail the entire structure. On the other hand cases exist where the effective transverse stiffness of the main bridge structure is maintained to the parapet beams. Then the effect of the stiffness beams at the edges should be ignored. No theoretical analysis at present available to cover this particular aspect of bridge design, though Massonnet [4] has extended his distribution analysis to allow for the effect of edge beams in which no torsional stiffness is present.

Load distribution analysis includes the effect of torsion and covers the range from a no torsion grillage to a full torsion slab. From this analysis it is possible to assess the effect of torsion in the edge beams at the design stage and hence it will be for the designer to use his judgement in deciding whether or not to include the torsional effect. If the torsion is neglected, the analysis will yield results which would be identical to those obtained by Massonet.

1.2 The Importance of the Study

The study will address some of the important aspect as follows:

- The development of load distribution in edge-stiffening beam of a simply supported bridge deck.
- The analysis of bending moment in a bridge deck using load distribution coefficients method and finite element method for comparison.
- The example of design of a selected structure is illustrated.
- To comparison of bending moments in bridge deck with edge-stiffening and without edge stiffening.

1.3 Objectives

The objectives of this study are as follows:

- To study various forms of edge-stiffening in concrete bridge deck

- To analyse the bending moment in a bridge deck with and without edge stiffening using load distribution coefficient (manual method) and finite element method
- To compare maximum moments in a bridge deck with and without edge stiffening

1.4 Scope of the Study

In the beginning, complete sets of information on concrete deck bridge being used and applied in Malaysia is collected. The public Work department ministry of work and Malaysia provide all data about standard design of concrete deck bridge. And the standard design is the studied. Several parameters which need to be studies are finalized. Finally, the structures are modeled, in the putted with the different sets of parameter and analysis using finite element software. LUSAS finite element software has been used in the study. The scope of this study is:

- A single span simply supported bridge
- Effect of 45 unit HB live load only (BS 5400).

1.5 Methodology of the Study

In this project, the steps taken in studying load distribution in Edge-stiffening beam of a simply supported bridge deck can be summarized into several steps as below:

Problem Identification and Definition

- Identify the problem through reading, discussion and observation of the area studied.
- Understand the background of the problem through literature studies.
- Study the feasibility and the needs to carry out the research topic and the scope.
- Identify the title, scope, aim and objectives of the project.
- Plan the methodology for the project.

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Literature Survey

- Search information from book, journals, articles, thesis, seminar notes or conference paper, and internet.
- Review of the various type of the bridge deck.
- Understand the principles of load distribution.
- Understand the basic principles of maximal bending moment in longitudinal and transverse.
- Understand the basic principles of the application of LUSAS programs.

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Edge-Stiffening in Concrete Bridge Deck Analysis

- Review the form of edge-stiffening.
- Understand the basic steps analytical solution of edge-stiffening
- Understand the principles effected of edge stiffening.

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Design of deck

- Deck without edge-stiffening beam.
- Deck with edge-stiffening beam use form edge-stiffening 1.
- Deck with edge-stiffening beam use form edge-stiffening 2.

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Case Studies

- Carry out the edge-stiffening on three selected case studies.
- Calculate using load distribution method.
- Calculate using Finite Element Method
- Interpret the result of the analysis

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Discussion

- Discuss of comparison of the case studies.

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Conclusions and Recommendations

- Write an overall conclusion for this project.
- Give some recommendations for future research or project.

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