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OUTLINE OF DOCTORAL DISSERTATION

Student Name: Cao Vu Dung

Department: Civil Engineering

Title of thesis:
A Study on Load Sensing and Local Stress Approach for Fatigue Assessment of Steel Bridge Deck Structures

Abstract:

This study attempts to enhance the fatigue assessment of steel bridge deck structures. A sensing system using piezo film sensors is proposed for live load evaluation. Piezo film sensors have demonstrated sensing ability in the low frequency region and linearity between applied load and sensor response. The sensor response can be evaluated from the applied load using numerical simulation. The applicability of piezo film sensors for vehicle weight identification has been demonstrated through a trial live load evaluation in an actual bridge. For fatigue assessment of orthotropic steel decks, a rib-to-deck joint with 100% weld penetration and a local stress approach using the effective notch stress method to evaluate the local stress range are proposed.

Chapter 1. Introduction

The background of research is discussed and the purpose and objectives are set.

Chapter 2. Literature Review

A review of previous studies related to fatigue assessment of RC decks and orthotropic steel decks is presented, which includes state-of-the-art live load evaluation methods, fundamental characteristics and existing applications of polyvinylidene fluoride (PVDF) sensors, and fatigue strength enhancement of rib-to-deck joints.

Chapter 3. Fundamental Study on Live Load Sensing System

A new live load sensing system using power-generating (PVDF) sensors is proposed. The fundamental characteristics of the proposed sensing system including the low-frequency sensing performance, the effect of strain distribution, and the linearity between applied load and sensor response are investigated through laboratories experiments.

Chapter 4. Trial Live Load Evaluation in Actual RC Deck

The proposed sensing system using PVDF sensors is employed for load evaluation in an actual RC-deck steel bridge. Accuracy of the sensing system is verified through identification of the fundamental input parameters for load evaluation algorithms and identification of vehicle weights. Vehicle weight identification algorithms are proposed for live load evaluation in RC-deck steel bridges based on the measurement data obtained by PVDF sensors.

Chapter 5. Local Stress Approach for Orthotropic Steel Decks

Local stress approach using effective notch stress method is employed to evaluate the local stress range at rib-to-deck joints in orthotropic steel decks. Investigation on effects of governing parameters on local stress range is conducted through parametric studies. Investigation on the effect of weld-root existence on fatigue strength and fatigue assessment of rib-to-deck joints is conducted using the local stress approach and the newly proposed rib-to-deck joint with no-root weld (100% weld penetration).

Chapter 6. Conclusions and Recommendations

The results of the previous chapters are summarized. Based on the findings obtained in this study, recommendations on the applicability of PVDF sensors for live load sensing system in steel bridge decks and on the new rib-to-deck joint detail for enhanced fatigue assessment are presented.