Non-destructive Structural Assessment Method using Imaging technology and Infrared Thermography

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Summary

Traditionally, highway bridge conditions have been monitored by visual inspection with structural deficiencies being manually identified and classified by qualified engineers and inspectors. However, the quality of inspection results obtained through the traditional inspection approach depends on the individual inspector's subjective judgment based on his/her knowledge and experience, as well as varying field conditions. In addition, these traditional inspection procedures require significant investments in both time and labor cost. Under these circumstances, innovative non-destructive bridge condition assessment technologies using infrared thermography and digital concrete surface imaging have been developed and applied to the highway bridge structures in Japan. This paper describes the results of integrated high-end infrared thermography (IR) and line cameras to obtain bridge deck cracks, defects and delamination with on-site applications for sample bridges in the state of Florida.

Keywords: bridge inspection; non-destructive evaluation; bridge deck scanning; infrared thermography, crack map; delamination; network level inspection

1. Introduction

Condition ratings of bridge components in the US Federal Highway Administration (FHWA)'s Structure Inventory and Appraisal (SI&A) database are determined by bridge inspectors in the field for bridge deck, superstructure and substructure. This information has been used by bridge owners as a basis for decisions on bridge maintenance, rehabilitation, and replacement. The condition ratings also influence a bridge's Sufficiency Rating (SR), as well as whether the bridge may be classified as "structurally deficient (SD)". However, the bridge condition rating in the United States defined in the Bridge Inspector's Reference Manual [1] is generally subjective depending on individual inspectors' knowledge and experience, as well as varying field conditions. For the evaluation and documentation of concrete deterioration (cracks, spalls, delamination, etc.) and changes over time, the current practice can be lacking in accuracy and completeness, as well as time consuming and costly if road closures are required for the inspection (Fig. 1a,b). In addition to the overall bridge condition state, bridge owners are also collecting condition data in bridge element level based on the AASHTO Guide Manual for Bridge Element Inspection [2]. After execution of the surface transportation act 'Moving Ahead for the Progress in the 21st Century Act (MAP-21)' in July 2012, it is mandatory that the element level condition states for bridges carrying National Highway Systems be reported annually to the federal government. Applying a more efficient method to collect the filed data to determine the element condition state of the bridge decks can contribute to the significant time and cost reduction for bridge owners across the country.

Recent advancements in imaging technologies have made their applications practical and possible in more detailed bridge inspections. The technologies can overcome some shortcomings of human subjectivity and are intended to improve and complement, but not to replace, human inspections. The innovative technologies presented herein will be able to make bridge inspections more

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