Bridge Evaluation using Structural Health Monitoring and Field Testing

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Abstract

Structural health monitoring provides an efficient way to monitor and evaluate the performance of infrastructure. With the introduction of new materials and construction methods, various types of bridges are being instrumented with monitoring devices to determine their performance as well as their response to various loading conditions. Among many other objectives, this includes monitoring concrete deck cracking behavior, measuring time-dependent deformations such as camber and deflection, evaluate and load rate existing bridges, and validation of new design or construction provisions. In this study, various types of instrumentation techniques were used to monitor and test bridges. The monitoring and testing results incorporated with Finite Element Modeling (FEM) hereafter can be used to evaluate the performance and cracking potential of new concrete deck for highway bridges, which would improve the construction techniques and extend the service life of the structure. Moreover, since most of the railway bridges in New Jersey are approaching 100 years of age and these bridges experiences different degree of deterioration due to repeated live loads and environmental effects during their service years. This paper developed a refined method to load rate and evaluate the performance of the bridge using structural health monitoring and field testing.

Keywords*:* Monitoring; Bridges; Testing; Design; Sensors; Strain; Load Rating; Health Monitoring.

1. Introduction

Structural Health Monitoring (SHM) has recently become more attractive to owners and consulting engineers, not only because Structural Health Monitoring (SHM) allow for the understanding of the structural interaction and failure mechanism of different components of a structure, but also due to its economic advantage and noninterference of normal use. In the past, engineers could only rely on analytical and computer models that are based on various assumptions. These assumptions introduced many uncertainties that could lead to erroneous calculation and ultimately structural failure or unnecessary structural replacement. Moreover, the long-term performance of new construction materials and new design methodologies also need to be evaluated by long-term monitoring and field-testing. Thus SHM and field-testing provide very important and economical tools to assess and protect the condition of structures and owner investment.

This paper presents results from various research projects employed to monitor structural components and evaluate the performance of the bridge. Various types of sensors are installed on the structure for field-testing and long-term monitoring. These sensors consist of strain transducers, accelerometers, Vibrating Wire Strain Gages (VWSG), Laser Doppler Vibrometer (LDV), and weigh in motion (WIM) system.

https://doi.org/10.2749/222137816819258825