Strain-based FEM-aided Bridge Health Monitoring

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ABSTRACT

This article presents a physics-based nondestructive testing / structural health monitoring (SHM) approach applied to a lenticular truss bridge to predict the deformations associated with the presence of transient loads. A detailed finite element model was generated using a commercial software to create an accurate model of the bridge. The presence of concentrated loads on the deck at different locations was simulated, and a static analysis was performed to quantify the deformations induced by the loads. Such deformations were then compared to the strains recorded by an array of wireless strain gages during a controlled truckload test performed by an independent third-party. The test consisted of low-speed crossings at controlled distances from the bridge parapets using a truck with a certified load. The array was part of a SHM system that consisted of 18 wireless strain gages. The results of the comparative analysis show that the proposed physics-based monitoring is capable of identifying sensor-related faults and of determining the load distributions across the box beams. In addition, the data relative to four-years monitoring are presented and show the reliability of the SHM system as well as the challenges associated with environmental effects on the strain reading.

Keywords: Structural Health Monitoring; Finite Element Modeling; Bridge Monitoring; Strain Sensors.