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## **PRECISION MONITORING OF BRIDGE DECK CURVATURE CHANGE DURING REPLACEMENT**

### **Problem**

Accurate monitoring of bridge deck curvature and vertical displacement is important to ensure safe operation of the structure after deck replacement. Excessive change in curvature after deck replacement will result in undesirable consequences, such as ponding and accelerated wearing of surface.

### **Objective**

The goal of this project was to introduce a novel method for long term monitoring of vertical displacement and change in curvature in highway bridge decks. The method used an array of high precision wireless inclination (tilt) sensors to constantly monitor changes in the inclination of the bridge deck at various points of a span. A geometric model translated tilt data into numeric values of vertical displacement and curvature at various points of a bridge span.

### **Description**

This project introduced the use of wireless high precision inclination sensors for long term monitoring of a bridge deck. A specific goal of the project was to use wireless inclinometer sensors to monitor change in vertical displacement and curvature during the deck replacement process. To achieve this goal, a special wireless inclinometer sensor was developed. The sensor used electrolytic tilt measurement technology and it was capable of reporting inclination with a resolution of about 0.00014 degrees. It was also capable of reporting temperature at its surroundings. Since the sensor was wireless it had the advantage of easy attachment to the bridge girders before the deck removal process began. Additionally in the hostile environment created from falling debris during deck removal, the wireless device was robust. A system of eight wireless inclination sensors was attached to the girders of a bridge located near Pocomoke City, Maryland, which underwent the deck replacement process from January until August 2015. The 8-month temperature and inclination data was fed into a mathematical model which calculated the change in vertical displacement and curvature of the bridge deck throughout the deck replacement process.

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## Results

The collected temperature and inclination data revealed that temperature change could lead to small changes in the inclination of bridge girders. The changes in the inclination of girders would correspond to the temperature induced vertical displacement of the bridge deck. As a result, comparing the change in displacement of the bridge deck before and after deck replacement is not meaningful, unless the temperature effects are characterized. Additionally, this study revealed a previously unrecognized shortcoming in the survey methods used to find the change in the curvature of a bridge. Unless two surveys, for a bridge deck, are taking place at the same time, their results cannot be directly compared with each other. The method used in this project characterized the effect of temperature and therefore, it separated the contribution of temperature from the change in the displacement caused by deck replacement.

## Report Information

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## Link to Final Report

[http://www.roads.maryland.gov/OPR\\_Research/MD-16-SHA-UM-3-18\\_Monitoring-Bridge-Deck-Curvature-During-Deck-Replacement\\_Final%20Report.pdf](http://www.roads.maryland.gov/OPR_Research/MD-16-SHA-UM-3-18_Monitoring-Bridge-Deck-Curvature-During-Deck-Replacement_Final%20Report.pdf)