Joint Transportation Research Program

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Implementation Study: Continuous, Wireless Data Collection and Monitoring of the Sagamore Parkway Bridge

Introduction

The new seven-span concrete Sagamore Parkway Bridge over the Wabash River in Lafayette, IN, was constructed in November 2018. The new bridge consists of two end-bents (bent 1 and bent 8) and six interior piers (piers 2 to 7) that are founded on closed-ended and open-ended driven pipe piles, respectively. As part of SPR-4165 (*Verification of Bridge Foundation Design Assumptions and Calculations*), one of the bridge piers (pier 7) and its foundation elements were instrumented with strain gauges to monitor the bridge response to dead and live loads. Considering the valuable data obtained from the instrumentation of the pier and the fact that all the strain gauges installed were fully functional and producing valuable data, there was mutual agreement between the Study Advisory Committee (SAC) members to start an implementation project for the long-term monitoring of the Sagamore Parkway Bridge through wireless data collection. The *Implementation Study: Continuous, Wireless Data Collection and Monitoring of the Sagamore Parkway Bridge* (SPR-4546) aimed at implementing a continuous monitoring protocol for the bridge. A wireless data acquisition system was used to collect the data from the strain gauges and the temperature sensors to initiate the study of the effects of water table fluctuations and temperature variations on the bridge performance.

The report presents in detail the implementation of a wireless DAQ system powered by a solar powered system that consists of solar panels and batteries. The data collected includes the total load and settlement of bridge pier 7 under service, the load carried by the pile cap, the load carried by the individual piles supporting pier 7, the daily ambient temperature, and the water level of the Wabash River.

Findings

The data analysis showed that there is no significant change in the load-settlement response of pier 7 after the construction of the bridge. The pile cap is carrying about 20% of the total load carried by the bridge pier. The trend of the hourly ambient temperature variations matches the trend in the incremental bending moment measured on the bridge pier and the piles. The load transferred to the piles within the pile group was also affected by the daily temperature cycles, as expected. The fluctuations of the Wabash River water level had an impact on the total load carried by the pier. It was observed that a rise in water level above the level of the strain gauges installed in the bridge pier generated uplift forces causing a slight drop in the total load carried by the bridge pier.

Implementation

Several implementation items have been identified from this research project.

1. Long-term continuous wireless monitoring of the foundations of the Sagamore Parkway Bridge for completeness of the data set and for future use in design by INDOT is needed.
2. Instrumentation of all the bridge piers or at least more than one pier of another bridge to understand the load redistribution between bridge piers

and their foundations in service and to study the deflection response of the bridge in-service is needed.

3. Employment of a similar instrumentation scheme at other bridge sites to augment the dataset acquired in this project with the goal of improving the design and performance of bridge and foundations in the State of Indiana is needed.
4. Consideration of pile cap capacity in other bridge projects in which an instrumentation scheme similar to the Sagamore Parkway Bridge should be implemented.
5. The contribution of the pile cap, as assessed from the monitoring of the Sagamore Parkway Bridge pier for a period of about 4 years, was measured to be at least 18% of the load transferred by the bridge. In foundation design, the contribution of the pile cap in support of the total load may be considered to achieve an economical design. It must be noted that the contribution of the pile cap reported in this study is only applicable to similar foundation layouts, soil type/profile, and loading conditions. Further research is needed to study the effects of different factors affecting the pile cap capacity, such as soil type and profile below the pile cap, pile cap–soil contact, scouring conditions, layout of the pile group, and size of the pile cap.

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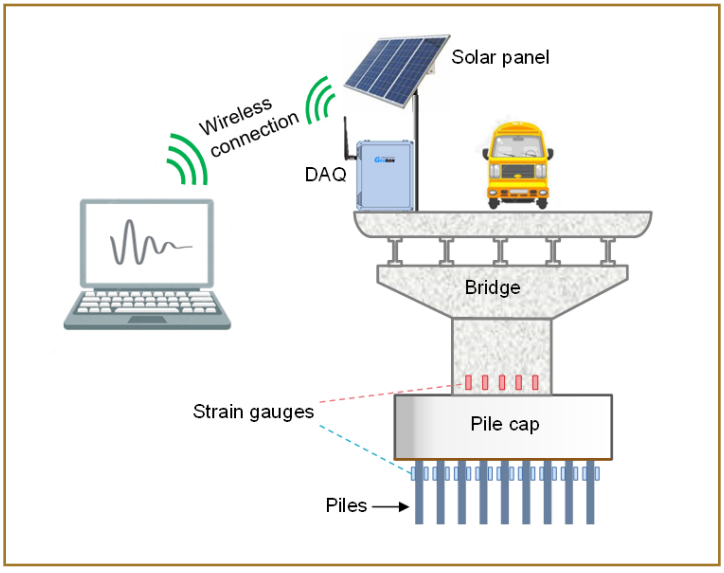
Secured cabinet at bridge deck containing DAQ.



Wireless scheme for remote data collection.