Hernando Desoto I-40 Bridge Seismic Instrumentation Upgrade

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PURPOSE OF THE PROJECT

The current instrumentation on the Hernando Desoto Bridge was installed in 2001 and currently 26 of the 81 channels are malfunctioning. The sensors used have internal bearings that wear over time especially in the high vibrational environment of the I40 Bridge. Additionally, upgrade of the data acquisition systems in 2012 would allow real-time continuous data transfer to a data concentrator node at the AutoZone Headquarters building in downtown Memphis except that bandwidth is limited by the telemetry. The objective of this research is to replace the existing sensors with a higher quality and industry standard accelerometers. The addition of high quality static-based sensors will be purchased and used.

SCOPE AND SIGNIFICANCE OF THE PROJECT

The scope of the proposed work include:

1) Upgrading and replacing current accelerometers (UM)
2) Replacing the Microsoft Windows PCs with rack mount Linux servers (USGS)
3) Upgrading the power infrastructure and surge suppression to be compatible with the new instrumentation (UM)
4) Working with United States Geological Survey (USGS) in data collection and dissemination of data to general public (UM)
5) Install a static based monitoring system (Tenn Tech)

The objectives of the proposed research are to:

1) Replace the existing sensors with a higher quality and industry standard accelerometers.
2) The new instrumentation will enable the measurement of bridge movements during ground shaking for mild event which occur frequently and this data may be used to calibrate models for expected large magnitude earthquakes to better understand and define the effects of the deep soil deposits of the Mississippi embayment upon bedrock ground motions.
3) Supplement the dynamic data with static displacement, strain, and tilt angle measurements

EXPECTED OUTCOME

1) The new instrumentation will enable the measurement of bridge movements during ground shaking for mild event which occur frequently and this data may be used to calibrate models for expected large magnitude earthquakes to better understand and define the effects of the deep soil deposits of the Mississippi embayment upon bedrock ground motions.
2) The current instrumentation, which was installed in 2001, has malfunctioning sensors that will be replaced. Upgrading the current system will significantly

streamline routine monitoring of the system state of health. The data from the bridge, free field, and downhole array will be streamed and will be available to TDOT engineers as well as the engineering community for research and testing.

3) Rapid availability of data after earthquake or strong wind events can be used for ascertaining the structural integrity of the bridge and will open the door for the University of Memphis researchers for a wide use of data such as development of early warning system and health monitoring.

TIME PERIODS AND STATUS OF THE PROJECT

The project started on October 1, 2015. The project is progressing ahead of schedule. It is expected to have this project by September 2017 – ahead of schedule.

1) Upgrading and replacing current accelerometers

We purchased new sensor from Kinemetrics along with one shallow borehole Episensor package. The sensor decks have been installed in the weatherproof enclosures and the electronics interface card has been installed in each package (Figure 1 and 2). All of the sensors have gone through a series of tests, mechanical centering and then an electronic calibration using static tilt acceleration tests (Figure 3).

Figure 1. Episensor packages which designed and packaged to be deployed on the bridge.

Figure 2. Inside of the Episensor package enclosure.

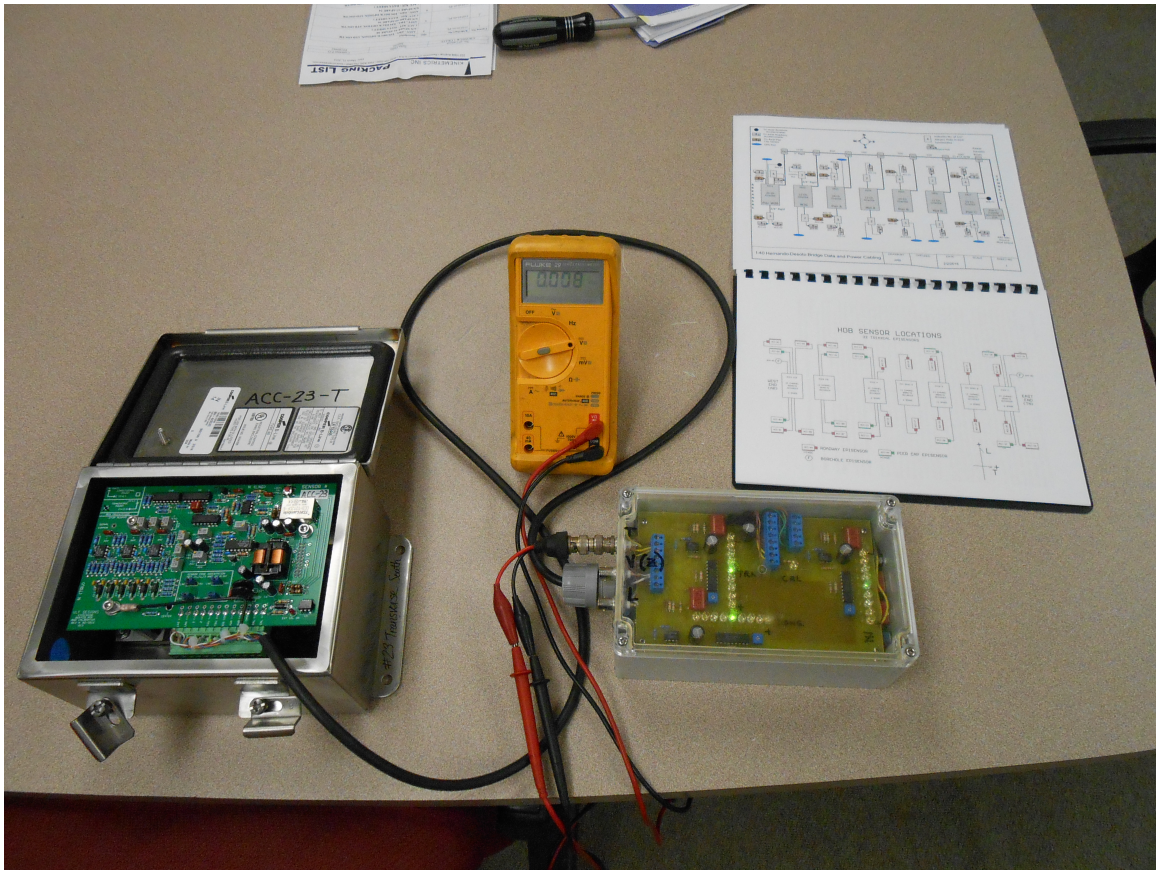

Figure 3. Inside of the Episensor package enclosure checked through a mechanical centering and then an electronic calibration using static tilt acceleration tests.

The borehole sensor and its interface/ transient suppression card were tested and calibrated as a unit. Centering spiders and an orientation yoke were added to the borehole sensor (Figure 4).

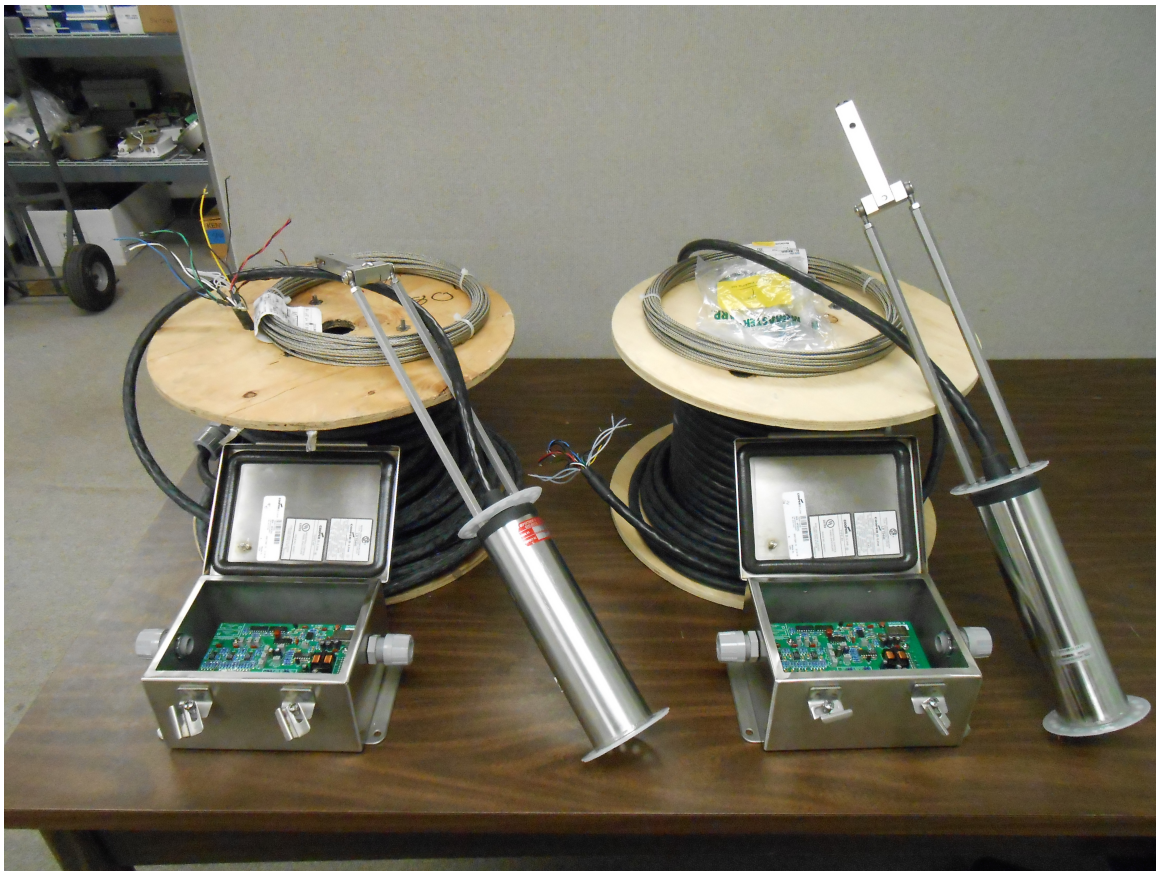

Figure 4. Two borehole sensors packages ready to be installed.

2) <u>Install a static based monitoring system</u>

This phase of the project will be done by Dr. Matthew Yarnold of Tennessee Tech University.