



# Project Summary

Texas Department of Transportation

## 0-6060: Realtime Monitoring of Scour Events Using Remote Monitoring Technology

### *Background*

Bridge scour is a major reason for bridge failures. Countermeasures such as the placement of riprap around bridge foundations can be expensive, but in some cases, such as waiting for bridge replacement, monitoring the bridge for scour could be less expensive. Fixed scour monitors can be placed at bridges for round-the-clock monitoring. Fixed scour monitors include instruments that monitor the depth of the scour hole on a continuous basis, such as sonar, or on a discrete basis, such as float-outs, as well as instruments that monitor the global behavior of the bridge, such as tiltmeters.

In this project, these instruments were evaluated and new instruments were developed. Recommendations were made to optimize scour monitoring of bridges.

### *What the Researchers Did*

In this project, researchers undertook the following tasks:

- a thorough literature review,
- two large-scale laboratory experiments on a simulated bridge,
- instrumentation of two full-scale bridges in Texas including remote transmission of data via cell phone modem and internet,
- a series of numerical simulations including 4D finite element modeling of the bridge and the soil,
- establishment of thresholds for tiltmeters, and
- development of guidelines and protocols for scour monitoring.

### *What They Found*

As a result of project activities, researchers found the following items:

- For accelerometers, the frequency domain analysis and the acceleration ratio approach require considerable data to be collected and stored. The two approaches worked well for the model bridge because the structure and its vibration were simple, but did not work well for the full-scale bridges where the vibration was much more complex.
- Tiltmeters are reliable, simple, and relatively low-cost to purchase and install. They are recommended as integrating behavior sensors that work when failure is getting close. They can also be used for detecting other problems as well as bridge scour.

### *Research Performed by:*

Texas Transportation Institute (TTI),  
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- Tethered buried switches are helpful and inexpensive to purchase but costly to install. They cover only one location chosen by the engineer. They are recommended for early warning but recommended for use in combination with tiltmeters.
- Float-outs are likely helpful, but have limited battery life. They are recommended for short-term warning systems.
- Cameras are a very good idea and should be pursued. They are recommended in most cases.
- Water-stage sensors showed problems. Cameras can cover the same purpose more effectively.

## What This Means

Based on the findings from this project, researchers recommend the use of tiltmeters and tethered buried switches for scour monitoring of bridges. Place them as follows:

- Tiltmeter on the deck of each span measuring tilt angle around the flow direction axis.
- Tiltmeter on the top of each pier measuring tilt angle around both the traffic and flow direction axes.
- Place tethered buried switches or float-outs as redundant systems.

Place cameras if at all possible: they will indicate water level, presence of debris, large movements. At night, infrared still photos can be used.



*Researchers Conducted Large-Scale Laboratory Experiments on a Simulated Bridge*



*Researchers Installed Scour Monitoring Systems on two Bridges as Part of Their Study*

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