Project Summary

Texas Department of Transportation

0-5505: Simplified Method for Estimating Scour

Background

There are approximately 600 scour-critical bridges in Texas (see Figure 1). This designation comes in part from the use of methods that predict excessive scour depths in erosion-resistant materials. To minimize this over-conservatism, researchers at Texas A&M University developed the SRICOS-EFA method in the mid-1990s. This method gives time-dependent scour depths based on site-specific erosion tests. The method developed in this project uses the concepts of the SRICOS-EFA method but bypasses the need for site-specific erosion testing, making use of observed scour depths along with flood events actually experienced by the bridge.

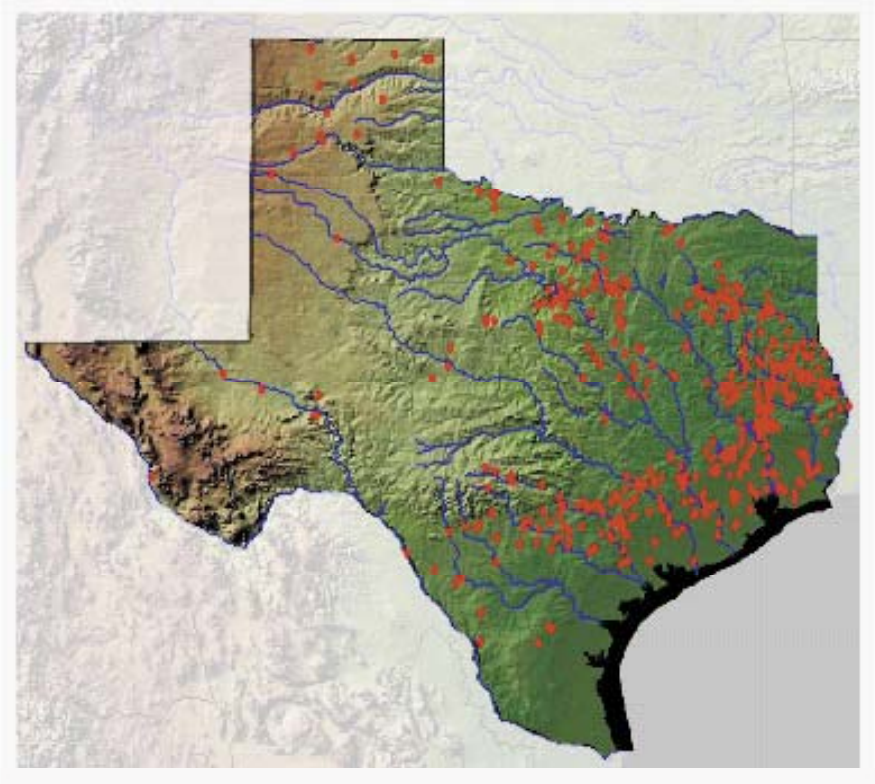

Figure 1. Locations of Scour-Critical Bridges in Texas.

What the Researchers Did

The approach selected to solve the problem was based on review of existing knowledge, soil erosion tests, study of case histories, computer simulations, fundamental principles in method development, verification of the method against available data, and application to a few scour-critical and non-scour-critical bridges. The review of existing knowledge helped establish a solid foundation. The erosion tests provided a database of erodibility properties according to soil type, which led to the ability to present erosion categories in a standardized erosion chart. Case histories gave an idea of the data currently available. The computer simulations were used for hydrologic and hydraulic analyses aimed at obtaining relevant flow parameters. A parametric analysis was carried out to generate scour depth extrapolation charts.

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The validation of the method was based on comparisons between case histories that were subjected to the proposed assessment procedure and actual field measurements. The method was then applied to 10 scour-critical bridges and 3 non-scour-critical bridges in Texas to check the impact of the method on the current scour designation of these bridges.

What They Found

The researchers developed a three-level Bridge Scour Assessment (BSA) procedure that is simple, economical, and does not require site-specific erosion testing. The first level, BSA1, consists of obtaining the maximum observed scour depth Z_{mo} during the bridge life and the maximum flood velocity V_{mo} during the bridge life. Z_{mo} is gathered from bridge records while V_{mo} is obtained from a simple computer program that generates maps of maximum floods in Texas for a given period. These maps are based on interpolation between records collected at USGS flow gages during the last century. The values of V_{mo} and Z_{mo} are used together with a specified future flood velocity V_{fut} to predict the corresponding future scour depth Z_{fut}. Z_{fut} is then compared to the scour depth tolerable for the foundation Z_{thresh}. Z_{thresh} is often taken as one-half of the pile length in Texas. If Z_{fut} is less than Z_{thresh}, the bridge is not scour-critical. Otherwise, one needs to proceed to BSA2, which involves more calculations including maximum scour depth Z_{max}. If BSA2 also fails to conclude that the bridge is not scour-critical, one needs to proceed to BSA3, which involves more calculations including the time-dependent scour depth Z_{fin} based on the standard erosion charts. The BSA1 method was evaluated against 11 case histories by comparing the predicted and measured Z_{fut} values. The comparison was very good. BSA1 was then applied to 10 scour-critical and 3 non-scour-critical bridges. In this process, 6 of the 10 scour-critical bridges were found to be stable and could be removed from the scour-critical list and the 3 non-scour-critical bridges were confirmed as non-scour-critical.

What This Means

The proposed bridge scour assessment procedure enables economical and simple evaluation of scour-critical bridges. It also overcomes the over-conservatism embedded in current scour depth prediction methods. This new assessment procedure will lead to a more realistic bridge scour evaluation and stands to remove many bridges from the scour-critical list at a great saving to the State of Texas.

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