Estimation of Long-Term Scour at Maryland Bridges Using EFA/SRICOS

Problem

Current methods used by most bridge owners to estimate scour at piers and abutments assume cohesionless bed materials (sand, gravel, cobbles), incorporating variables such as the bed condition and particle size. The current methods can be applied to cohesive soils (clay) with the understanding that they will probably over-predict the extent of the scour. This is because, in general, cohesive soils are likely to be more scour resistant than sand or other cohesionless materials. The maximum depth of scour in cohesive soils is the same as for non-cohesive soils. Time is the difference. Because cohesive soils generally scour much more slowly than non-cohesive soils, it is reasonable to consider the rate of scour in the calculations. If the rate of scour in a cohesive soil is such that it would take hundreds of years to equal the maximum scour in sand for the same conditions, then it would be reasonable to take this rate of scour into consideration in the design of the bridge foundations. Under some conditions, this approach may result in a cost savings without incurring any significant additional risk to the stability of the bridge.

Objectives

This study evaluates a set of hardware and software tools developed to estimate bridge pier scour in cohesive soils. Researchers at the University of Texas, in partnership with the Texas Department of Transportation, developed a device to measure scour rates in cohesive soils (Erosion Function Apparatus, or EFA), along with equations and software to incorporate this information in determining scour depths at bridges in cohesive soils (Scour in Cohesive Soils, or SRICOS). Maryland is one of five states that have agreed to work cooperatively to test the EFA and SRICOS methodologies by using them to predict scour at the foundations of selected bridges. This report chronicles the results of the Maryland investigations and studies.

Description

Five bridge sites in Maryland were identified for study. Shelby tube samples were taken of the cohesive soils at the bridge sites and tested in the EFA. This research study also developed an innovative approach for synthesizing a long term sequence of daily flow discharges using information obtained from data-based regression equations for ungaged watersheds. The flows were transformed into a long-term series of daily velocities using hydraulic software. The soil parameters and the daily discharge measurements provide the information required by the SRICOS program to estimate long-term scour at the selected bridge sites for periods of 100 years or more.

Results

This study has shown that the SRICOS method for estimating scour in cohesive materials can be applied to Maryland bridge sites. The SHA personnel running the EFA tests have become familiar with the use of the equipment to obtain the erosion rate vs. shear stress for selected flow velocities, and with using the Windows-based SRICOS software, which integrates hydraulic and soils data to estimate long-term scour. A new concept was developed for synthesizing long term daily flow rates from the regression equations for ungaged watersheds in Maryland. For the sites studied, the 160-year scour predicted by EFA/SRICOS was less than that estimated by the current method, which assumes non-cohesive soil; however, the two methods start from different assumptions and have different design goals. This study has shown that the SRICOS method, as used in Maryland, provides a method that can help estimate long term scour in cohesive soils.

Report Information

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