Florida Department of Transportation Research

Enhancement of FDOT's SERF Device and Study of Erosion Rates of Rock, Sand, and Clay Mixtures using FDOT's RETA and SERF Equipment
BDK75-977-09

Scour, erosion of the river bottom around a bridge's foundations, is the primary cause of bridge failure in the U.S. As many as 200,000 bridges are susceptible. Given the scale of the problem and the potential expense of remediating it, it is important to have dependable predictive methods to aid the design and repair processes.

Though most bridge sites are over sand bed channels, many bridge channels contain clay or rock that is, to differing levels, resistant to scour. Treating such scour-resistant channels as sand results in significant over-conservatism and wasted resources. Thus, predictive methods for rock and clay soils are needed for proper stewardship of public resources.

The best predictive methods for cohesive materials require a parameter, the sediment transport function, which relates flow conditions to bed material erosion rate in the absence of the structure. Equations exist for predicting this parameter, but they are difficult to compute and often do not correlate to the variable erosion-resistant conditions found in soils. Current standards recommend measuring sediment transport functions in a laboratory, but there has been some question as to how to do this accurately. In this project, University of Florida researchers developed critical refinements to these measurements that improve the methodology and produce more consistent and reliable results.

Previous research by FDOT had developed the Sediment Erosion Rate Flume (SERF), an advanced device for determining water-erosion resistance of soils. This follow-up project enhanced the SERF by adding a laser-leveling device, improved temperature control, a new shear-stress sensor, a sediment injection system, and others.

In the improved SERF, relationships were developed for bed shear-stress as a function of particle size and compared with flat-walled results

The SERF device is a unique device for testing shear-stress relationships of erodable materials.

from the Darcy-Weisbach equation and results obtained using the Colebrook equation.

Efforts were made to directly compare results from SERF with those from the Rotating Erosion Test Apparatus (RETA). A standard material was developed to facilitate the comparison. Despite promising results, researchers found that developing datasets needed for direct comparison required more time than the current project allowed.

Researchers worked to verify shear-stress results from the RETA using a semi-analytical approach. RETA data were well-fitted by a shear-stress-deficit erosion rate formula, but limited cohesive data settled to low correlation values.

Studies of sand-clay erosion were instructive, but not conclusive. Behavior of sand-clay mixtures was very sensitive to how they were created. Factors affecting mixture behavior were identified, but how mixture behavior would correlate to natural materials remained an open question.

Project Manager: Rick Renna, Roadway Design Office
Principal Investigator: David Bloomquist, University of Florida
For more information, visit http://www.dot.state.fl.us/research-center