Florida Department of Transportation
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BRIDGE SCOUR IN BED MATERIALS OTHER THAN COHESIONLESS SEDIMENTS PART II

PROBLEM STATEMENT

The soil at many bridge sites in the state of Florida is composed of materials other than cohesionless sediments (i.e., other than sand, loose shell, etc.). This includes cohesive materials (such as muds and clays), combinations of cohesive and cohesionless sediments, and harder materials such as limestone and coquina. The erosion characteristics of these materials are quite different from those of cohesionless sediments, but because of our lack of understanding of their erosion characteristics, they are treated as cohesionless sediments in current design scour prediction equations in HEC-18 (1993). Since the "erodibility" of these sediments can vary widely, the present approach for determining scour depths may be excessive in some cases and too conservative in others. There is a clear need to improve our ability to predict design local and contraction scour depths in these types of materials.

OBJECTIVES

The overall objective of this study was to provide a means of predicting aggradation and degradation, contraction, and local (structure-induced) sediment scour at bridge sites for the range of bed materials encountered in Florida. With the measurements of the bed material properties at the site (or a laboratory analysis of bed material samples from the site), researchers could predict the rates at which the material would erode as a function of flow conditions. Knowledge of the predicted design flow conditions (water velocities, depths, etc.) at the site would then allow the researchers to estimate the design scour depths. The bed material to be investigated included cohesive sediments (and mixtures of cohesive and cohesionless sediments) and different types of limestone and coquina. The specific objectives were to:

1. Construct the laboratory apparatus designed in an earlier study. The wide range of materials being considered in this investigation required the design and construction of two test facilities. The design of these facilities was completed in Part I. The instrumentation, needed both to control the apparatus and to measure the rates of erosion, will be constructed, assembled, and installed in this study.

2. Calibrate and test the apparatus. The facility will be tested and calibrated using materials with "known" erosion rates and modifications made to the apparatus and/or instrumentation as needed.

3. Using samples of standard cohesive sediments, measure rheological properties and erosion rates to verify correlations reported in the literature.

4. Obtain field samples of coquina and limestone. Measure rheological properties and correlate them to erosion rate characteristics for these materials. Measure the erosion rates of these samples using either the apparatus used for cohesive sediments or one designed specifically

for these harder (composite) materials.

FINDINGS AND CONCLUSIONS

Researchers constructed a rotating cylinder test apparatus and then proposed the following approach for classifying rock materials and erosion rates in Florida. The testing apparatus can determine the rates of erosion of different types of rock materials, which may in turn be used to estimate the depth of contraction scour for a given flow scenario. The purpose of classifying the rock materials and their respective rates of erosion is to provide hydraulic engineers with an efficient means (database-oriented) for estimating the erodibility of rock. No uniform system currently exists for identifying and labeling rock materials in boring logs across the state.

Researchers thus proposed that a set of maps, *Physiographic Divisions* and *The Geology of Florida*, developed by Dr. H. K. Brooks at theUniversity of Florida in 1981, be adapted for the creation of a database to be used as the basis for the general identification of the different rock materials within the state. The database would provide, on a general basis, a description of the types of rocks that may be found in particular locations within the state.

Researchers then proposed that a range of geotechnical properties for these rock materials be used. Since the types of rocks and their properties may vary within a region, the geotechnical testing data may provide a more detailed description as to the rocks characteristics. The exact ranges and categories have not yet been determined.

Once the rates of erosion for the various rocks are determined utilizing the test apparatus, the ranges of erosion rates could be compiled and assigned to the corresponding rock based on its district and geotechnical engineering properties.

The Department has begun using the testing apparatuses to predict scour around state maintained bridges that are founded in rock. The State Drainage Section may be contacted to coordinate the use of these devices, as applicable, in projects in which rock is encountered.

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