RESEARCH PROPOSAL

RATE OF EROSION PROPERTIES OF ROCK AND CLAY

SUBMITTED TO:

FLORIDA DEPARTMENT OF TRANSPORTATION
RESEARCH OFFICE
TALLAHASSEE, FLORIDA

SUBMITTED BY:

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INTRODUCTION:

Erodable rock is found at a number of bridge sites throughout the State of Florida. The composition of these softer rock materials is one or more of the following: lime rock, consolidated sandstone, coquina or coral. Often the geotechnical properties of the rock materials are not sufficient for it to be considered as "unscourable" by the Federal Highway Administration (FHWA) as described in their Hydraulic Engineering Circular No. 18 (HEC-18) and thus are considered as cohesionless sediments for the purpose of estimating design bridge scour depths. In many cases this yields overly conservative scour depth estimates that translate into excessive costs in the construction of new bridges and/or the retrofitting of existing bridges. The Florida Department of Transportation (FDOT) State Drainage Engineer's Office has recommended that when the FDOT Districts encounter these materials, a special investigation, that includes the State Drainage Office, be made to determine the appropriate design scour depths for that site. It is recognized that there is significant variability from one site to the next and that if improved scour estimates are to be made each case must be considered individually. As part of this investigation the State Drainage Engineer's Office has recommended that cores from the site be tested for "Rate of Erosion" characteristics using apparatus developed at the University of Florida under contract with the FDOT Research Office in Tallahassee. These tests provide information on the rate at which these materials will erode as a function of the intensity of the water flow over them.

The University of Florida has developed two different apparatus for this purpose. The first apparatus which has been has been operational for approximately two years, is limited to testing sediments that can support their weight. That is, more rigid sediments that will not deform under their own weight. This apparatus [referred to here as the Rotating Erosion Test Apparatus (RETA)] is shown in Figures 1 and 2. A technical paper on the prototype version of this apparatus was presented at the International Symposium on Scour at Foundations in Melbourne, Australia on November 19, 2000 [Henderson, et al. (2000)]. A copy of this paper is attached to this proposal in Appendix A. The main advantages of the rotating apparatus (RETA) are that the applied shear stress can be measured directly and the attainable shear stresses are higher that those for the second apparatus. Four additional RETAs are under construction and should be operational by the end of January 2002. Having five RETAs will allow much faster turnaround when analyzing core samples for a particular site.

The second apparatus is a recirculating flume. This apparatus is approximately 80% complete and should be operational before the end of the spring semester 2002 (i.e. before May 2002). This devise has the advantage of being able to test a wider range of sediment types from silt to rock.

Once both apparatus are functional it will be necessary to test the same sediment sample in both apparatus in order to establish the relationship between the results from the two devises. This must be done for a range of sediment types including some of the more

rigid clays to the harder limestone formations. The flume devise tests the rate of erosion on horizontal planes and thus is much closer to what actually happens in nature. The RETA measures the rate of erosion on vertical planes. There is reason to believe that these rates are larger than those for horizontal planes (and thus give more conservative estimates of scour depths) but this needs to be tested.

Problem

There is a need to:

1. Test a number of sediment samples in both the flume apparatus and in RETA in order to establish the relationship between rate of erosion results produced by the two approaches and
2. Start a database on rate of erosion for softer clays and silts in the higher (design bed) shear stress range.

APPROACH:

The proposed work is summarized in the tasks below:

Task 1. Run approximately twenty sediment samples in the flume "rate of erosion" apparatus.
Task 2. Make any required modifications to the flume and/or procedures in order to achieve accurate and repeatable results.
Task 3. Run the same (or similar) sediment samples in the RETA.
Task 4. Analyze the results obtained in 1) and 2) and establish (where possible) the relationship between the rates obtained by the two methods.
Task 5. Run a minimum of 20 additional tests on silts and less rigid clays. Rates of erosion data exist for these types of sediments for low shear stresses. Some tests will be performed in the low shear stress range and the results compared with published data. Higher shear stresses will then be applied to the same samples to determine how they respond to design flow conditions.
Task 6. Write a preliminary report with all of the test results.
Task 7. Write a final report that includes FDOT reviewer comments.

SCHEDULE:

MONTHS AFTER NTP[1] → / **TASKS**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	xxxx	xxxx	xxxx	xxxx	xxx							
2	xx	xxxx										
3		xxxx	xxxx	xxxx	xxx							
4	xx	xxxx	xxxx	xxxx	xxxx	xxx						
5					xxxx	xxxx	xxxx	xxxx	xxxx			
6						xxxx	xxxx	xxxx	xxxx	xxxx		
7												xxxx

[1] Notice to proceed