PROJECT TITLE: Performance Base Testing for Erosion Prevention and Sediment Control (EPSC) Devices
RES #: 2016-20
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Purpose of the project:

The central objective of this project is to conduct systematic performance evaluations of select Erosion Prevention and Sediment Control (EPSC) devices in use in Tennessee following the National Transportation Product Evaluation Program (NTPEP; http://www.ntpep.org/Pages/default.aspx). Currently, methods for preventing erosion and controlling sediment at highway and other construction sites in Tennessee are based on limited site-specific criteria and information with minimal testing if any. This project is providing systematic performance evaluations from which the Tennessee Department of Transportation (TDOT), and other construction project managers, will be able to design more successful and cost effective erosion plans that are based on sound engineering and detailed testing. This project is also directly benefit the TDOT Design Division and the Environmental, Materials and Test, and Construction Division by providing valuable design input for common EPSC devices so designers can develop erosion products with targeted sediment discharge goals.

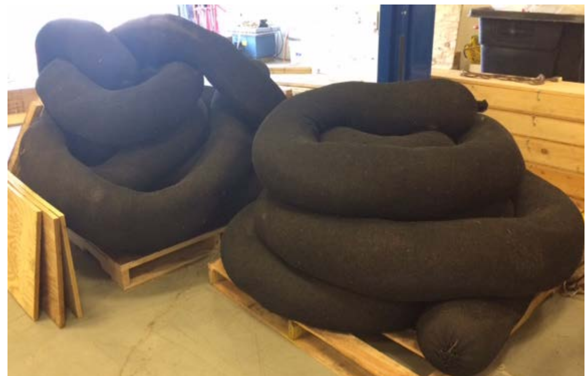

Figure 1. The straw-filled and mulch-filled sediment tubes to be tested in this study.

We are measuring the efficiency of different EPSC devices at trapping sediment. The devices include the Silt fence, Straw-filled sediment tubes, Mulch-filled sediment tubes, and the Rock check dam (Figure 1). Based on the ASTM procedures, we are simulating three different rainfall intensities during these tests based on design storms from across the state. Using rainfall simulators, we are delivering the rainfall over a soil box with the EPSC at end of the box. Below the EPSC, we are collecting the runoff and sediment from the soil box to quantify the trapping efficiency.

Scope and significance of the project:

Rates of soil erosion from highway and other construction sites can be on the order of 10 to 100 times higher than soil loss rates from agricultural lands. Aside from the obvious deleterious environmental outcomes, these exceedingly large losses can escalate construction costs by requiring the need to replace the lost soil and clean up the exported sediment.

To abate this soil loss, the EPA established a daily average turbidity threshold for the discharge from a construction site. Construction project managers were mandated to implement erosion control plans for their project sites to control runoff and sediment exports. However, due to methodological difficulties with establishing a suitable limit, the EPA withdrew the restriction. Regardless of the EPA revoking the limit, the need still exists for project managers to identify best practices for controlling soil loss from their sites.

Project managers have a multitude of Erosion Prevention and Sediment Control (EPSC) devices at their disposal when designing an erosion control plan. There are numerous literature and web-based sources that describe the different methods (e.g., from the Chief Engineer of the Tennessee Department of Transportation, TDOT). However, a need still exists in Tennessee, as in other Southeastern states, to quantify the effectiveness of different practices under local conditions using *systematic performance evaluation methods*. Regardless of the project size and type, the process of selecting the optimum erosion control measures for the specific set of site conditions must be simplified and made more cost effective to ensure the proper implementation. Project managers need a simple means for determining the EPSC practices that best fit their site in terms of mitigation and cost effectiveness.

Expecting outcomes:

The effectiveness of each EPSC practice will be determined by comparing the runoff volume and sediment yield from each practice with those values under the control (i.e., bare soil) conditions for the ASTM D 6459-11 tests. Graphs of the runoff/ sediment yield reduction will be developed for the different practices with respect to different rainfall intensities.

We will develop nomographs of the P-factors from the Universal Soil Loss Equation for different combinations of R, K, and LS-factors. The P-factors are determined as a “soil-loss ratio” or the soil loss with the structure present to the soil loss without the structure. The resulting R-, K-, LS-, and P-factors are then plotted to develop nomographs that TDOT and other construction project managers can use to develop erosion control plans for the respective sites.

Time periods and status of the project:

We have built a soil box (Figure 2). The box is 1.83 m (6 ft) long x 2 m (6.5 ft) wide by 0.30 m (1 ft) to accommodate both the size of the EPSC devices and the width of the rainfall simulators. The box has a 3:1 (Horizontal:Vertical) slope. We are currently filling the box with the sediment mentioned above for the first round of tests.

The soil for the tests was also identified as the dominant top soils in the state is a red-brown cherty clay (AASHTO A-6). We obtained soil from the UTK Facility Services Department, from one of the several construction sites on campus. These are clayey soil with a liquid limit ~40 and a plasticity. index >11The soil texture was determined using a hydrometer. It has a d_{50} between 2 and 6 microns. The Atterberg limits (Figure 2) were determined using standard practices and the Liquid Limit was 42 and the Plasticity Index was 19. We are preparing to begin the soil box experiments.

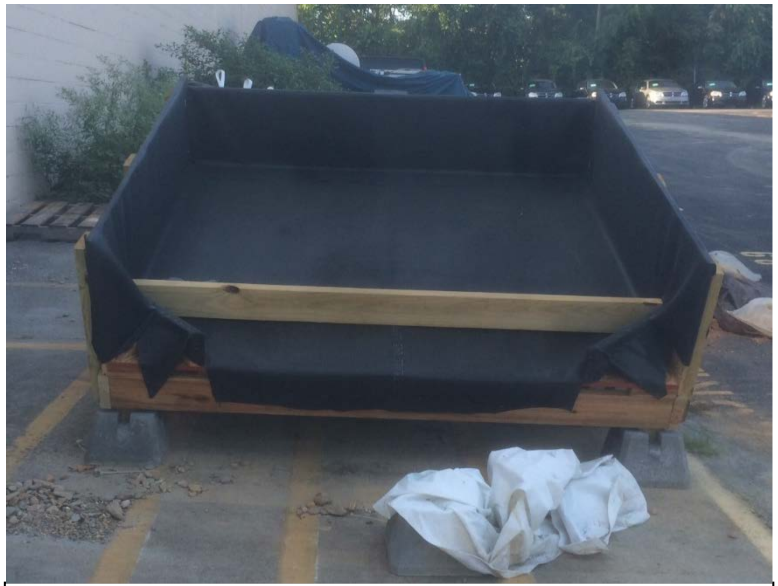

Figure 2. The soil box for the ASTM D 6459-11 tests.