

Draft Report

HYDRAULIC TESTING AND ANALYSIS REPORT 2009 FOR EROSION TECH, INC.

SCOURSTOP TRANSITION MAT™ WITH KENTUCKY BLUEGRASS

Prepared for

Erosion Tech, Inc.



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1 INTRODUCTION

During the fall of 2009, hydraulic performance testing was conducted by Colorado State University (CSU) on one ScourStop Transition Mat™ (ScourStop TM) erosion control system with Kentucky Bluegrass, manufactured by Erosion Tech, Inc. A total of seven tests were conducted under the test program. Figure 1-1 provides a photograph of the vegetated ScourStop Transition Mat™ system prior to installation and testing. Testing was performed at the Hydraulics Laboratory at the Engineering Research Center. Information presented with this report documents the testing processes, as well as provides data from hydraulic testing of a full-scale turf reinforcement mat (TRM) system under controlled laboratory conditions for purposes of identifying stability threshold conditions. Descriptions of the test program, test matrix, database, and hydraulic analysis are presented in this report.



Figure 1-1: Photograph of ScourStop TM with Kentucky Bluegrass

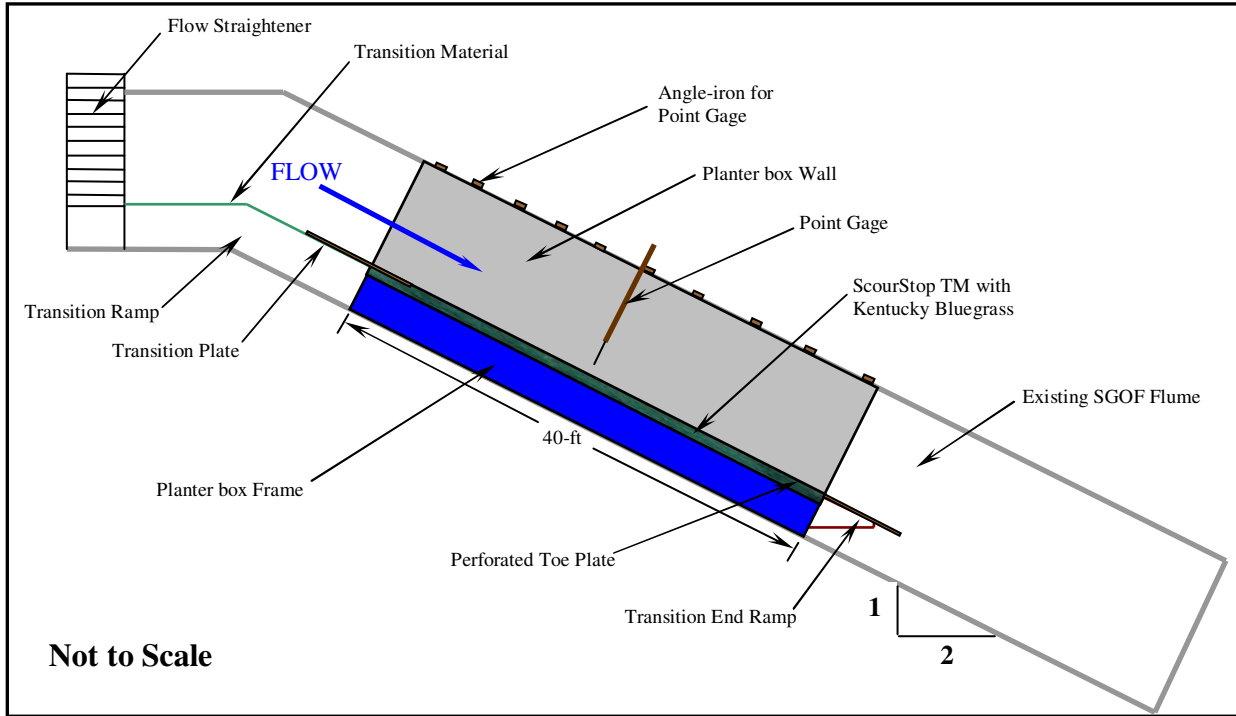


Figure 2-3: Profile View of the Test Facility and Planter box

2.2 TEST PROCEDURE

Prior to all testing scenarios, a seasoning flow was used to acclimate the system and provide a degree of saturation in the soil. This low flow rate was applied for approximately ten minutes before each test was conducted. A test consisted of a continuous 30 minute flow over the revetment system at a uniform discharge, with the exception of Test 7. Test 7 was conducted for the standard duration of one hour. The performance threshold for the vegetated ScourStop™ system examined within this test program was defined as the point at which soil loss exceeding one-half inch occurred, with soil loss being quantified by the Clopper Soil Loss Index (CSLI). Other instability not resulting in exceedence of the soil loss standard, (e.g. localized, unquantified scour or loss of contact between root mass and soil) was also evaluated. Provided that the erosion control system successfully endured the 30 minute flow without exceeding the defined performance threshold, the procedure was repeated at the next higher target discharge. Typically, target discharges corresponded to predicted shear stress tolerances, although performance during individual tests dictated the progression.

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3.7 TEST 7: 110.7 CFS

Upon conclusion of Test 6, there was no observed exceedence of the performance threshold. Test 7 initiated on October 9th, 2009. The system was once again seasoned at a low flow and subsequently, flow was increased to the target discharge of 110.7 cfs. Figure 3-15 presents a photograph of Test 7 in progress. Upon stabilization of the total discharge, data were collected at each established station over the test section. Table 3-14 presents the hydraulic data collected during Test 7. Data beyond 24 ft could not be acquired due to mechanical difficulties with the data acquisition equipment. Aerated water was not observed within the test section. At the conclusion of the hour-long test, the discharge was terminated and post-test bed elevation readings along with vegetal riser counts were recorded. Figure 3-16 presents a photograph of the test section following the test. Table 3-15 presents the soil loss data collected from the test section.



Figure 3-15: Test 7 in Progress

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Table 3-15: Soil-loss Data, Test 7

Station (ft)	Inches of Soil Loss at Position		
	Left (in)	Center (in)	Right (in)
8.00	0.12	0.00	0.00
10.00	0.00	0.00	0.12
12.00	0.00	0.00	0.00
14.00	0.00	0.00	0.00
16.00	0.00	0.00	0.00
18.00	0.00	0.00	0.00
20.00	0.00	0.00	0.00
22.00	0.00	0.00	0.00
24.00	0.00	0.00	0.00
26.00	0.00	0.00	0.00
28.00	0.00	0.00	0.00
30.00	0.00	0.00	0.00
32.00	0.00	0.00	0.00
34.00	0.00	0.00	0.00
36.00	0.00	0.00	0.00
38.00	0.00	0.00	0.00
40.00	0.00	0.00	0.00
42.00	0.00	0.00	0.00
44.00	0.00	0.00	0.00

4 ANALYSIS

4.1 SYSTEM PERFORMANCE

Following the completion of testing, the dataset was analyzed to determine the overall performance of the product. Shear stress values were determined from a standard step hydraulic model and are presented in Table 4-1. Table 4-1 also presents the average vegetal counts and soil loss values obtained from testing. The soil loss was determined using the Clopper Soil Loss Index, which is detailed in Appendix B. The system was not compromised nor was soil loss greater than one-half inch experienced during any test. The soil loss during the tests was minor enough that expected measurement error prevents a reliable correlation to shear stress or velocity.

Table 4-1: Summary Data, ScourStop™ with Kentucky Bluegrass

Test Number	Discharge (cfs)	Max Shear Stress (psf)	Avg. Shear Stress (psf)	Max Velocity (ft/s)	Avg. Velocity (ft/s)	Manning Roughness (-)	Avg. Post Blade Count (blade/ft ²)	Soil Loss CSLI (in)	Condition
1	28.0	10.5	8.6	15.3	14.0	0.037	6272	0.03	Stable
2	40.1	14.7	10.3	18.9	16.1	0.036	5323	0.03	Stable
3	50.0	12.7	9.7	21.6	19.0	0.030	4613	0.04	Stable
4	65.0	16.1	11.6	23.8	20.5	0.031	4155	0.05	Stable
5	80.0	13.5	9.2	28.0	23.4	0.025	3893	0.05	Stable
6	95.0	15.3	10.5	29.6	24.7	0.025	4880	0.07	Stable
7	110.7	12.7	8.3	31.6	25.7	0.022	3733	0.00	Stable

*All data represents the non-aerated portion of the test section.

Vegetal blade densities counted during the test procedures are presented in Table 4-2. Each count was conducted using a 3-inch by 3-inch box. Table 4-2 presents both the counts per 9 square inch box and the extrapolated values to one square foot. During testing, a steady reduction in blade densities was observed; however the classification of the vegetative stand remained excellent according to guidelines presented by Temple *et al.* (1987). The relationship

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between the shear stress, occurring at the vegetal count location, and the blade count reduction can be seen in Figure 4-2. Figure 4-4 shows the relationship between the blade count reduction and average cross-sectional velocity.

	Location	Station (ft)	Blades per 9 in ²	Blades per ft ²	Blade Loss (%)	Local Shear Stress (psf)	Local Velocity (ft/s)
Initial	Upstream	8.50	435	6960	0.0	-	-
	Central	17.25	368	5888	15.4	-	-
	Downstream	26.00	402	6432	7.6	-	-
	Avg	-	402	6427	7.7	-	-
Post-test 1	Upstream	8.50	409	6544	6.0	8.8	14.3
	Central	17.25	379	6064	12.9	11.5	16.0
	Downstream	26.00	396	6336	9.0	11.9	16.2
	Avg	-	395	6315	9.3	10.7	15.5
Post-test 2	Upstream	8.50	358	5728	17.7	8.5	15.0
	Central	17.25	319	5104	26.7	12.9	18.0
	Downstream	26.00	321	5136	26.2	14.2	18.7
	Avg	-	333	5323	23.5	11.9	17.3
Post-test 3	Upstream	8.50	314	5024	27.8	5.0	14.6
	Central	17.25	296	4736	32.0	10.3	19.8
	Downstream	26.00	255	4080	41.4	13.0	21.8
	Avg	-	288	4613	33.7	9.4	18.7
Post-test 4	Upstream	8.50	305	4880	29.9	7.1	16.9
	Central	17.25	248	3968	43.0	12.3	21.4
	Downstream	26.00	226	3616	48.0	15.2	23.4
	Avg	-	260	4155	40.3	11.5	20.6
Post-test 5	Upstream	8.50	293	4688	32.6	4.3	17.2
	Central	17.25	222	3552	49.0	8.4	22.9
	Downstream	26.00	210	3360	51.7	11.5	26.2
	Avg	-	242	3867	44.4	8.1	22.1
Post-test 6	Upstream	8.50	305	4880	29.9	4.6	17.8
	Central	17.25	273	4368	37.2	9.0	23.5
	Downstream	26.00	337	5392	22.5	12.3	27.0
	Avg	-	305	4880	29.9	8.6	22.7
Post-test 7	Upstream	8.50	250	4000	42.5	3.4	18.0
	Central	17.25	236	3776	45.7	6.8	24.2
	Downstream	26.00	214	3424	50.8	9.7	28.1
	Avg	-	233	3733	46.4	6.6	23.4

Table 4-2: Vegetal Counts, ScourStop™ with Kentucky Bluegrass

5 SUMMARY

During the fall of 2009, hydraulic performance testing of the ScourStop™ erosion control system with Kentucky Bluegrass patented by Erosion Tech, Inc. was conducted at Colorado State University. Testing was performed at the Hydraulics Laboratory located at the Engineering Research Center. This report provides data from the hydraulic testing of a vegetated turf reinforcement mat under controlled laboratory conditions for purposes of identifying stability threshold conditions. A description of the test facility, test program, test matrix, and resulting database is presented in this report. For the testing program, the ScourStop™ erosion control system with Kentucky Bluegrass was determined to be stable for maximum shear stresses and velocities of 16.3 psf and 32.1 ft/s, respectively.