QUARTERLY PROGRESS REPORT

July 1, 2011 to Sep 30, 2011

No additional funding was received for the project in this reporting period. The total funding received for the TPF-5(164) study so far is $270,000.

In the previous stage, the physical modeling of fish passage culverts primarily considered the flow condition measurement for Corrugated Metal Pipes (CMP) with no sediment in the pipe (Section 1 in Figure 1). The physical modeling of the past quarter (Jul. 1, 2011 to Sep. 30, 2011) was focusing on the preparation for the measurement of flow conditions in Section 2, which had sediment with a thickness of 15% of the pipe diameter (i.e. 5.4"). This work included the preparation of the pipe section as well as the characterization of bed material.

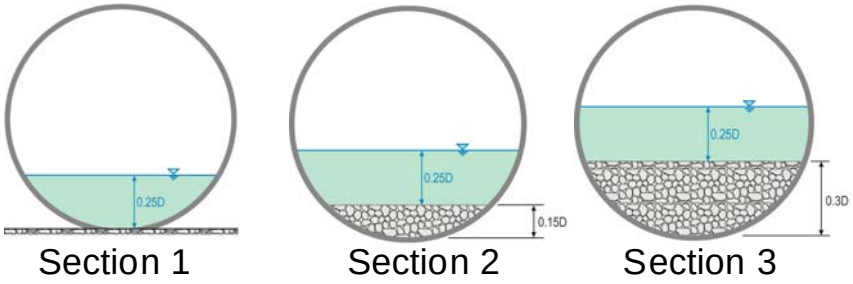

Figure 1 Planned test sections of corrugated metal pipes

Section 2 was physically simulated in the Fish Passage Culvert Testing Flume (FPCTF) at the Hydraulics Lab of TFHRC in a quarter-pipe configuration (see Figure 2). The maximum depth of flow was 0.25D (9"). The bottom surface of the flume was used as the surface of bed material. A proper roughness needed to be provided on the bed to represent the roughness from the material of the sediment.

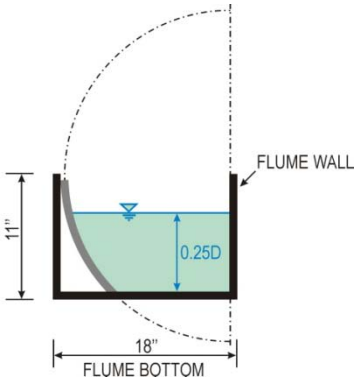

Figure 2 Quarter-pipe configuration for fish passage culvert with a bed elevation (sediment thickness) of 0.15D

The following tasks were performed in accordance with the proposed statement of work/time schedule.

Task #1 Sieve Analysis for the bed material

The Section 2 testing included a bed roughness. According to the test plan, a Manning's n value of 0.023 was targeted, which could be obtained from a layer of gravel with a D_{50} of 12 mm. Sieve analyses for the gravel was conducted and results were shown in Figure 3 to Figure 5.

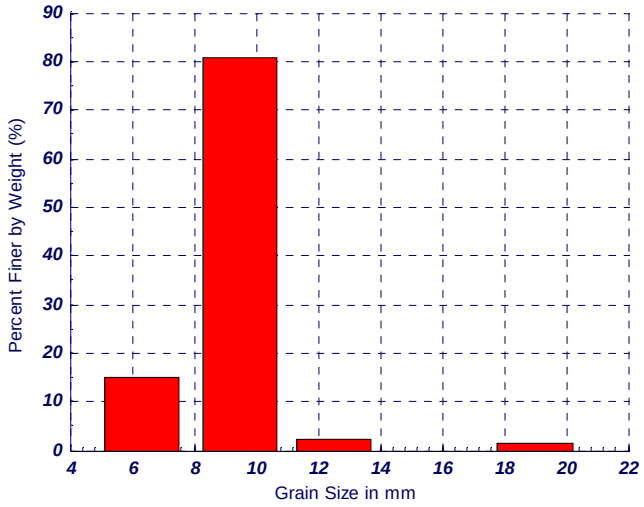

Figure 3. Histogram from sieve analysis

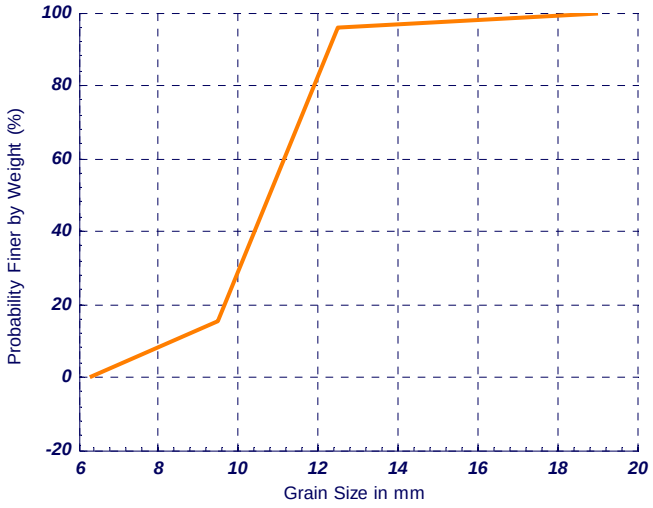

Figure 4. Percentage-pass Curve

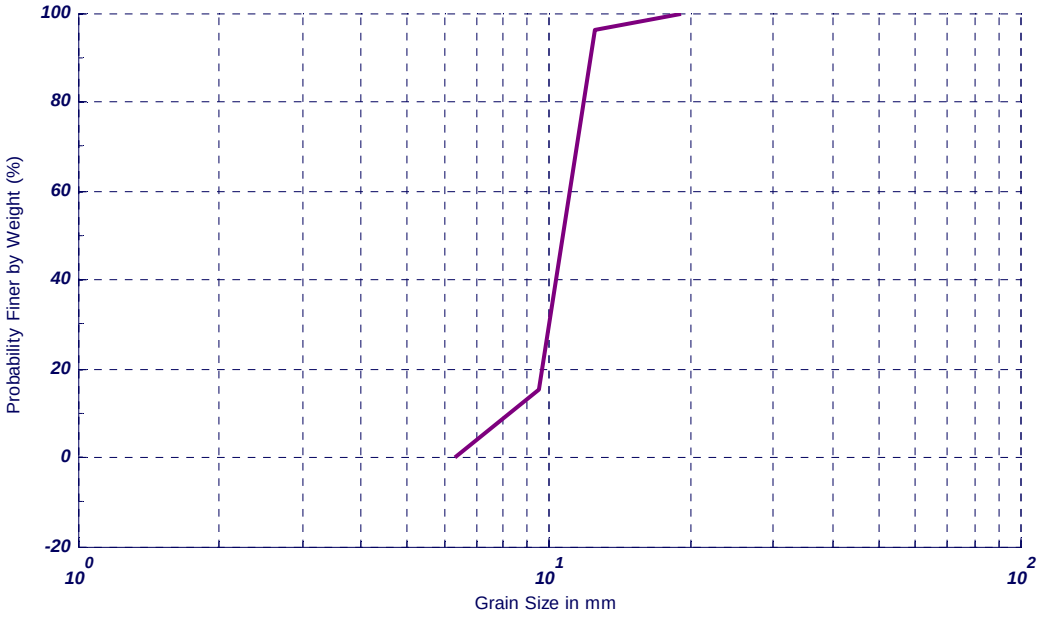

Figure 5. Percentage-pass Curve (logarithmic)

Detailed data from sieve analysis were listed in the Table 1 and Table 2.

Table 1. Grain size for the proposed soil

D5 [mm]	D10 [mm]	D16 [mm]	D30 [mm]	D50 [mm]	D60 [mm]	D75 [mm]	D84 [mm]	D95 [mm]
7.5639	8.7422	9.559	10.2808	10.6667	10.7829	11.1272	11.5475	12.4

Table 2. Physical Characteristics of the proposed soil

Standard Deviation	Skewness	Kurtosis	Coefficient of uniformity [C_u]	Coefficient of curvature [C_c]
7.5639	8.7422	9.559	10.2808	10.6667
Very well sorted	Coarse skewed	Very leptokurtic		

Task #2 Providing roughness model to CFD simulation

In order to accurately simulate the bed roughness in CDF modeling, a detailed survey was conducted to map the geometry of the gravel layer used for the physical modeling. A high-resolution laser topographic scanning system mounted on a robotic carriage was used to perform this work. This system was designed to obtain bathymetry data around scour holes in the large tilting flume. In this task, the gravel used to simulate the sediment in the culvert was spread onto a rectangular piece of acrylic panel and laid on the smoothed sand bed in the flume. This gravel sheet was approximately 2.5m long and 0.3m wide. The laser topography system produces a grid of measurements at a 2mm interval in both longitudinal and lateral directions. A part of the data was visualized in Figure 8.

Figure 6. Simulating gravel for CFD model

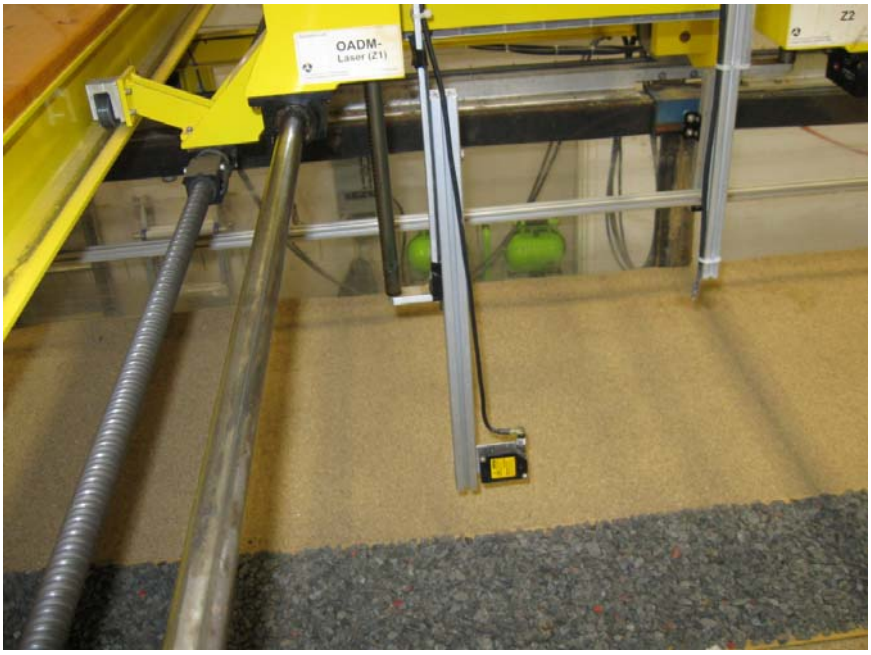

Figure 7. OADM Laser used for scanning bed

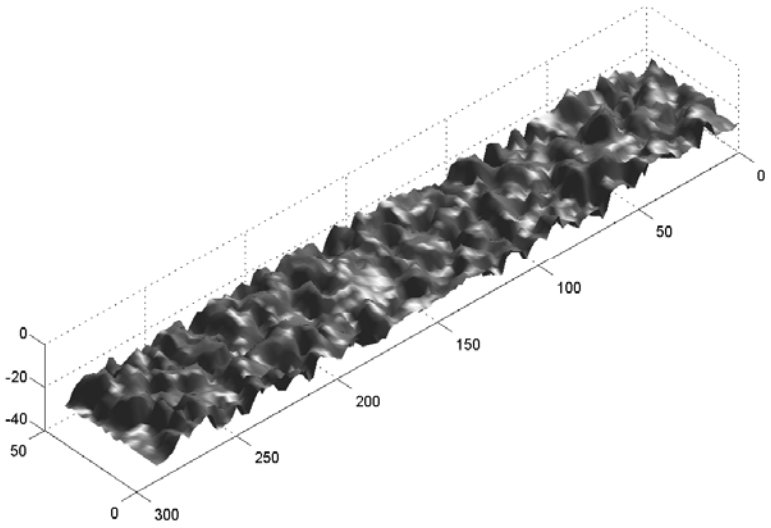

Figure 8 Visualization of topographic scanning data

Task #3 Preparation of culvert pipe

Shown in Figure 2 as an arc in gray, the part of the pipe needed for the quarter-pipe configuration was only approximately 1/8 of the entire pipe wall. A long strip of 1/8 circumference of the pipe was cut off from a corrugate metal pipe 36-inch in diameter. In order to prevent corrosion as well as reducing reflection to the high power laser from the particle image velocimetry (PIV) system that would be used to measure the flow, the pipe was coated with epoxy tar. Figure 9 shows the original pipe from which the segment for testing was cut off. Figure 10 shows the pipe segment before installation in the flume.

Figure 9. Original CMP pipe

Figure 10. 2nd CMP pipe after applying tar

The Transportation Research Analysis and Computing Center (TRACC) at the Argonne National Laboratory continued performing computer modeling for the study. The current status of the high performance Computational Fluid Dynamics (CFD) modeling for the fish passage study is presented in the TRACC-CFD quarterly progress report.

In the period from 07-01-2011 to 09-30-2011 no TPF funds were spent.