

QUARTERLY PROGRESS REPORT

July, 1 2009 to September, 30 2009

In September we received additional 15K from WI for the project. The total funding received for the TPF-5(164) study so far is \$195,000.

In this reporting period we continued working on capturing boundary layer velocities using the THFRC Hydraulics Laboratories 3-dimensional (stereo) Particle Image Velocimetry (PIV) system. A new helical corrugated culvert pipe was installed in the flume (pipe diameter 18" with 2.66"x0.5" corrugations) (Figure 1). The velocity flow field recordings are currently being performed at 2 culvert sections. Figure 2 and 3 show the current 3-dimensional (stereo) Particle Image Velocimetry (PIV) experimental set-up in the culvert flume. Two 36" long sections of the pipe were cut out and replaced by plexiglass corrugated windows. This was necessary to bring in the laser light sheet from the side to perform the PIV recordings. Figure 4 and 5 show a velocity flow field area at the side of the culvert. We will use also an Acoustic Doppler Velocity (ADV) probe to augment the PIV recordings. All velocity recording data will be sent to the Transportation Research Analysis and Computing Center (TRACC) at the Argonne National Laboratory. TRACC currently performs High Performance Computational Fluid Dynamics (CFD) modeling for the fish passage study. The CFD codes used for the fish passage modeling are FLUENT, STAR-CD and STAR-CCM+. The velocity information from the PIV and ADV recordings are used by TRACC to calibrate the culvert flow simulation models.

As mentioned in the previous progress report a tilting mechanism is currently being designed for the culvert flume for researching friction factors for low flows (Figure 6). Further progress was made in the design and several new parts needed for construction were ordered. Work is also performed in developing sophisticated control logic for automation of the culvert tilting flume.

In the period from 07-01-09 to 09-30-09 we received \$15,000 and no TPF funds were spent.

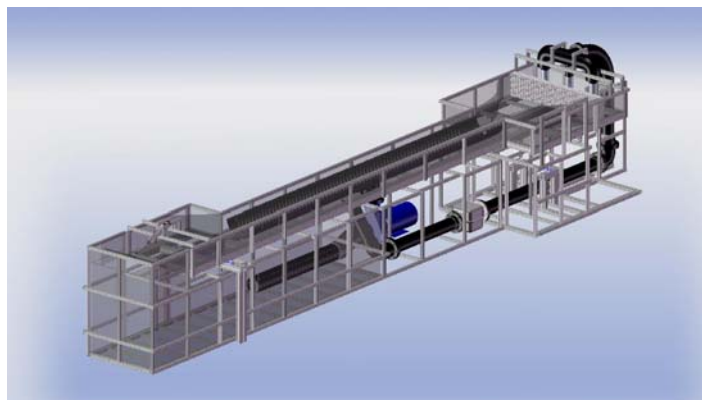


Figure 1: New corrugated pipe (diameter 18" with 2.66"x0.5" corrugations) installed in the culvert flume.

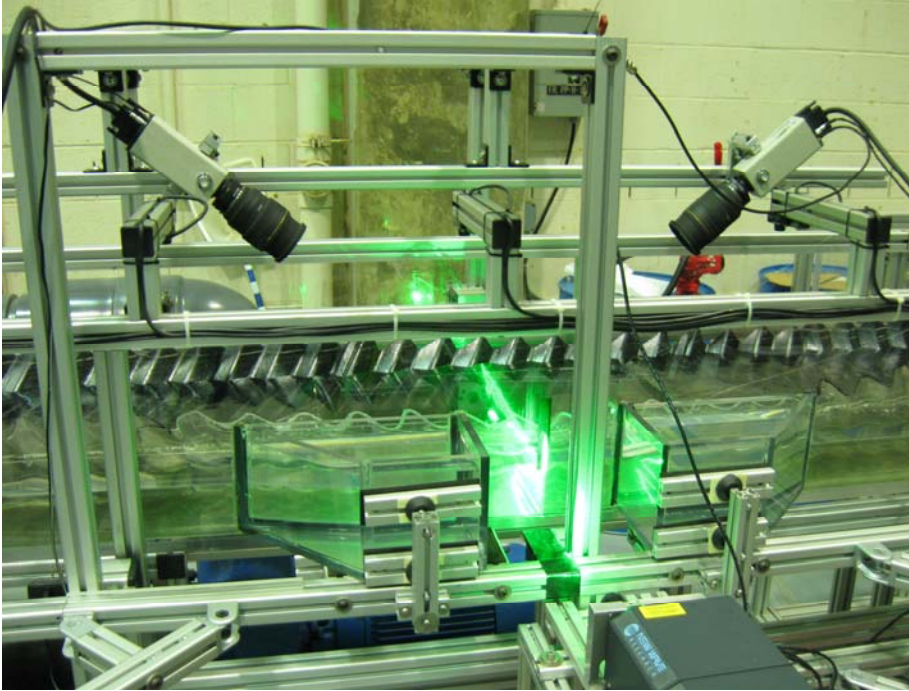


Figure 2: Stereo camera arrangement for the 3D-PIV recordings

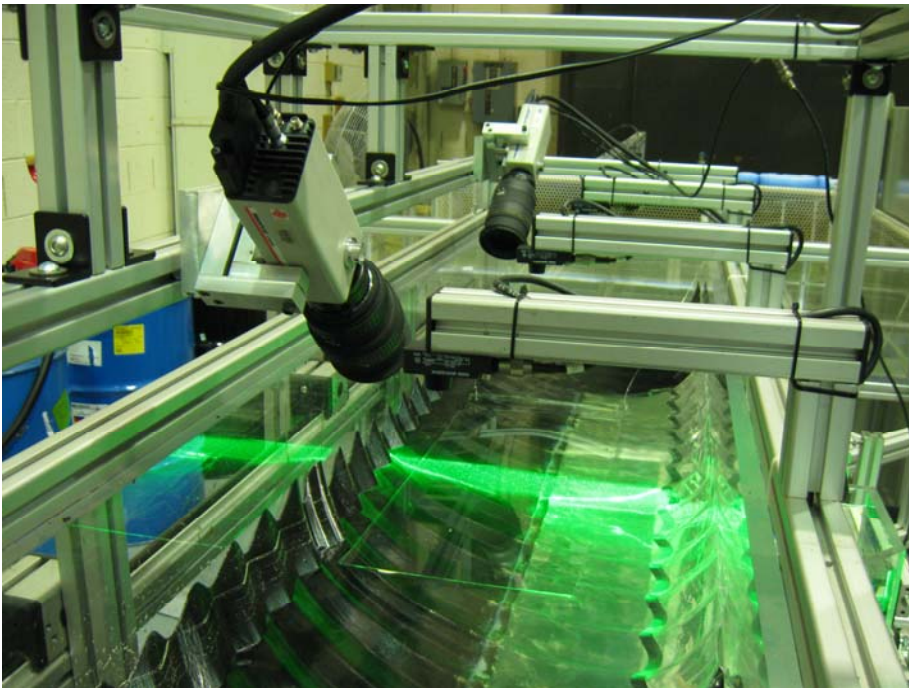


Figure 3: Thin laser light sheet illuminating flow particles in the culvert flume.

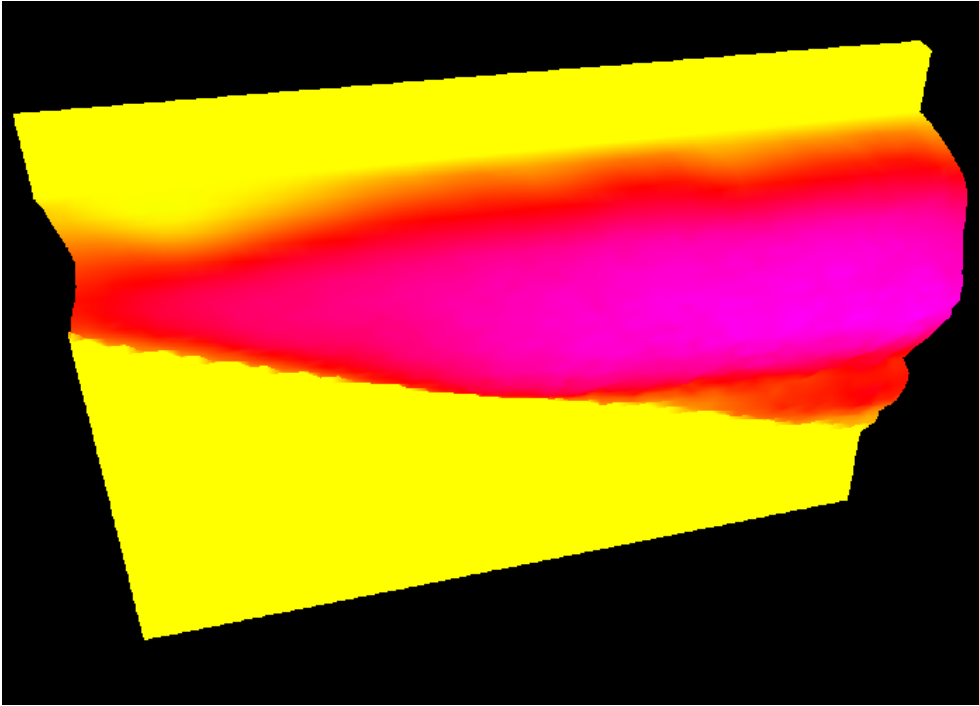


Figure 4: Surface plot showing a flow field recording at the side of the culvert flume.

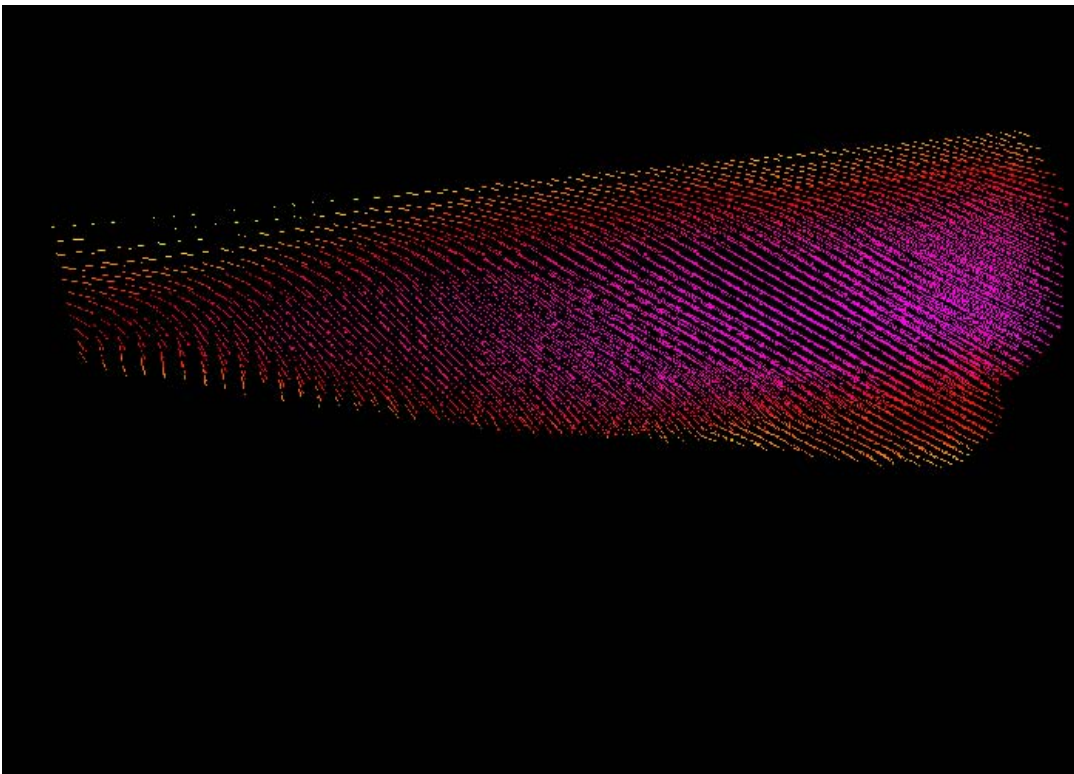


Figure 5: Vector plot showing a flow field recording at the side of the culvert flume.

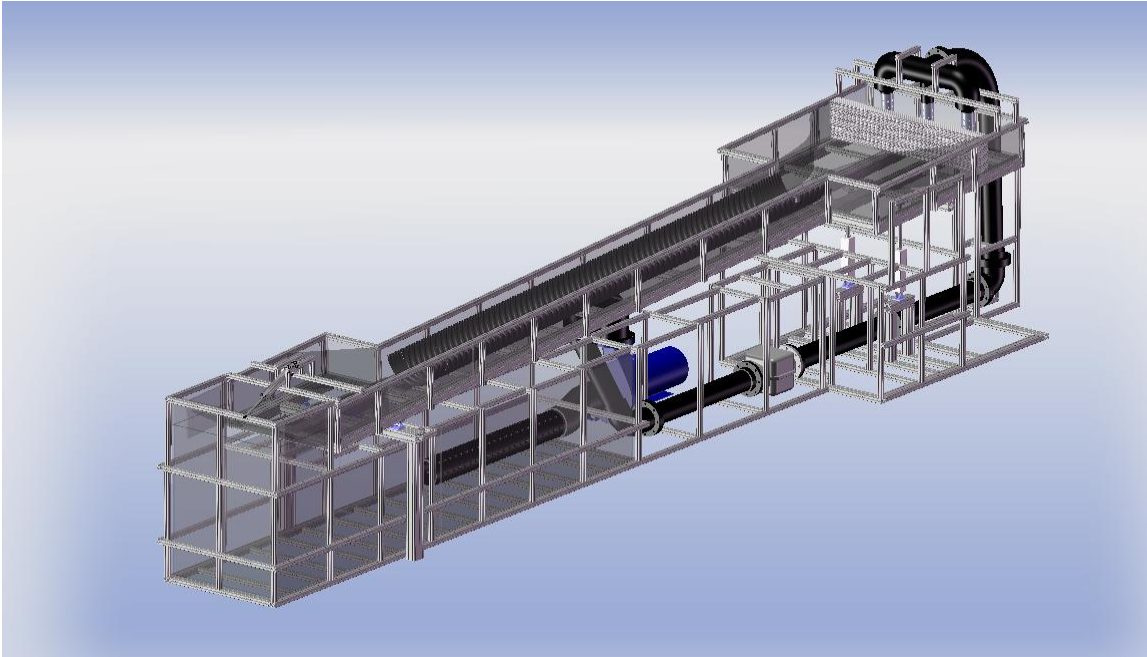


Figure 6: Design of the culvert tilting flume