

# QUARTERLY PROGRESS REPORT

April, 1 2009 to June, 30 2009

No additional funding was received for the project in this reporting period. So the total funding received for the TPF-5(164) study is \$180,000. In this reporting period we continued working on capturing boundary layer velocities using the 3-dimensional (stereo) Particle Image Velocimetry (PIV) system. The velocity flow field recordings were performed in the culvert section with helical corrugations (pipe diameter 36" with 2.66"x0.5" corrugations). A 2-dimensional robot to mount an Acoustic Doppler Velocity (ADV) probe was added to the culvert flume (Figure 1). The robot can scan velocity cross sections through the culvert. The ADV measurements will augment the 3-dimensional (stereo) Particle Image Velocimetry (PIV) recordings.

To measure average velocity friction factors for various flow depths above the corrugations a tilting mechanism will be added to the culvert flume. The parameters flow rate, flow depth and culvert slope are going to be varied until the water surface and the slope of the culvert are parallel. Automated control logic between will be used to match the water surface and culvert slope. The momentum equation for steady open channel flow will be used to determine shear stress and average friction factors. The design for the tilting mechanism was completed and the material needed for construction was ordered in this reporting period (Figure 2 and Figure 3). In the period from 04-01-09 to 06-30-09 no funds were received and \$24,189.57 was spent.



Figure 1: 2-dimensional robot that supports an Acoustic Doppler Velocity (ADV) probe

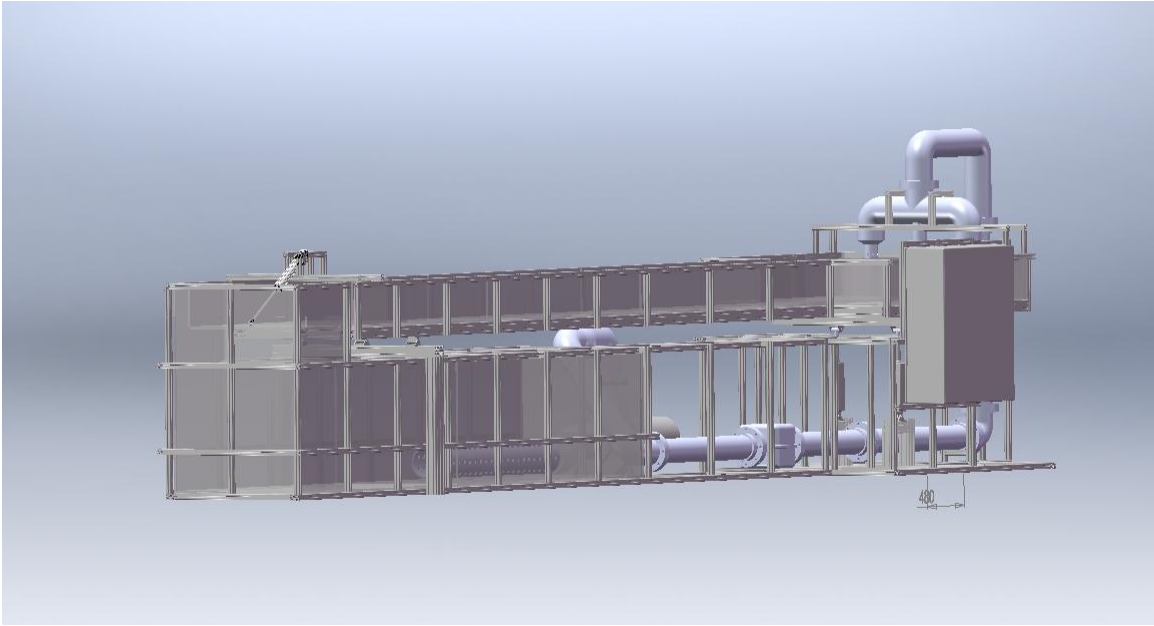


Figure 2: Design drawing of the culvert flume before tilting.

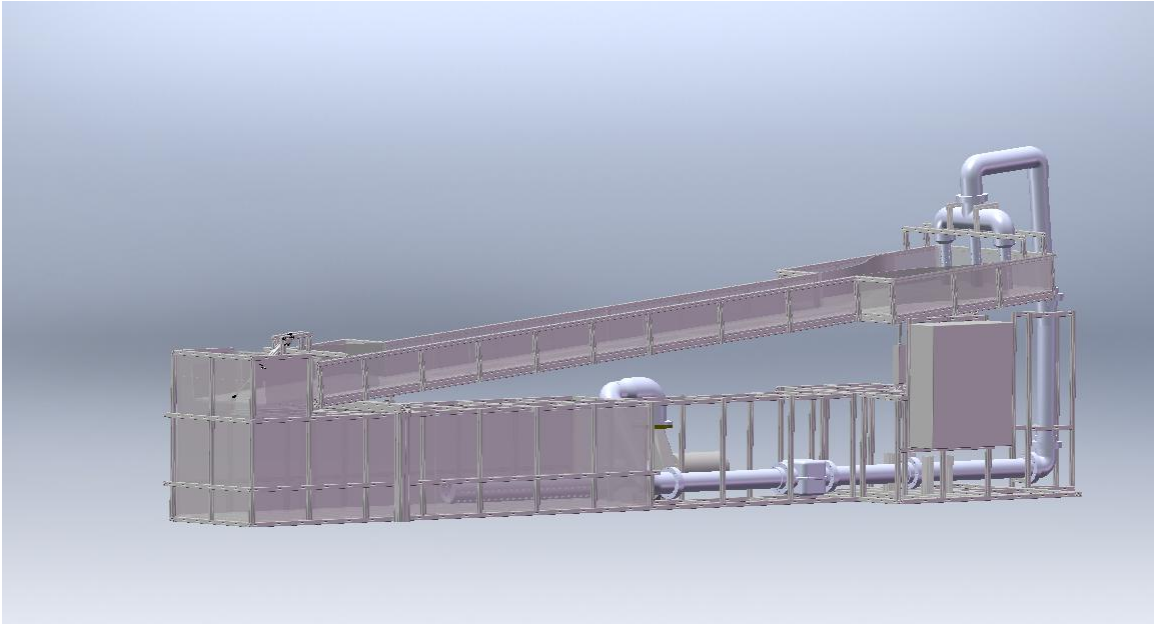


Figure 3: Design drawing of the culvert flume after tilting