TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): __FHWA____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project #		**Transportation Pooled Fund Program - Report Period:**
TPF-5(279)		☑Quarter 1 (January 1 – March 31) 2016 ☐Quarter 2 (April 1 – June 30) 2016 ☐Quarter 3 (July 1 – September 30) 2016 ☐Quarter 4 (October 1 – December 31) 2016
Project Title: *High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics*		
Name of Project Manager(s): *Kornel Kerenyi*	**Phone Number:** *(202) 493-3142*	**E-Mail** *kornel.kerenyi@fhwa.dot.gov*
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**

Project schedule status:

☑ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

Project Description:

The Federal Highway Administration established an Inter-Agency Agreement (IAA) with the Department of Energy's (DOE) Argonne National Laboratory (ANL) Transportation Analysis Research Computing Center (TRACC) to get access and support for High Performance Computational Fluid Dynamics (CFD) modeling for highway hydraulics research conducted at the Turner-Fairbank Highway Research Center (TFHRC) Hydraulics Laboratory. TRACC was established in October 2006 to serve as a high-performance computing center for use by U.S. Department of Transportation (USDOT) research teams, including those from Argonne and their university partners. The objective of this cooperative project is to:

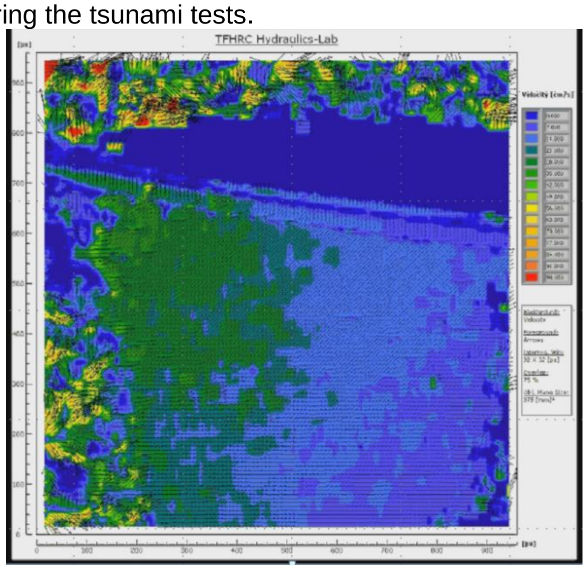
- Provide research and analysis for a variety of highway hydraulics projects managed or coordinated by State DOTs
- Provide and maintain a high performance Computational Fluid Dynamics (CFD) computing environment for application to highway hydraulics infrastructure and related projects
- Support and seek to broaden the use of CFD among State Department of Transportation employees.

The work includes:

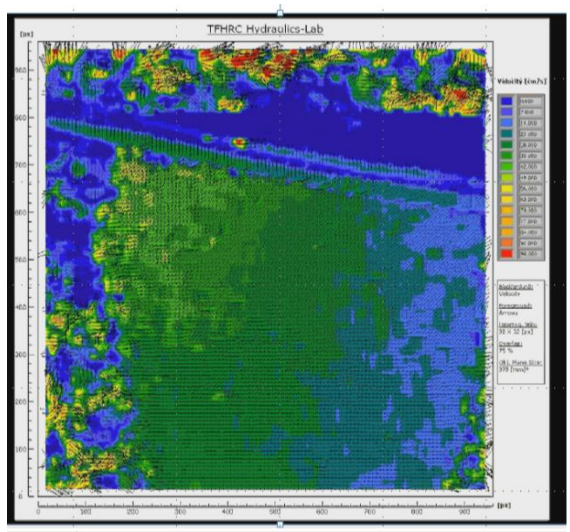
- Computational Mechanics Research on a Variety of Projects: The TRACC scientific staff in the computational mechanics focus area will perform research, analysis, and parametric computations as required for projects managed or coordinated by State DOTs.
- Computational Mechanics Research Support: The TRACC support team consisting of highly qualified engineers in the CFD focus areas will provide guidance to users of CFD software on an as needed or periodic basis determined by the State DOTs.
- Computing Support: The TRACC team will use the TRACC clusters for work done on projects; The TRACC system administrator will maintain the clusters and work closely with the Argonne system administrator's community; The TRACC system administrator will also install the latest versions of the STAR-CCM+ CFD software and other software that may be required for accomplishing projects.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

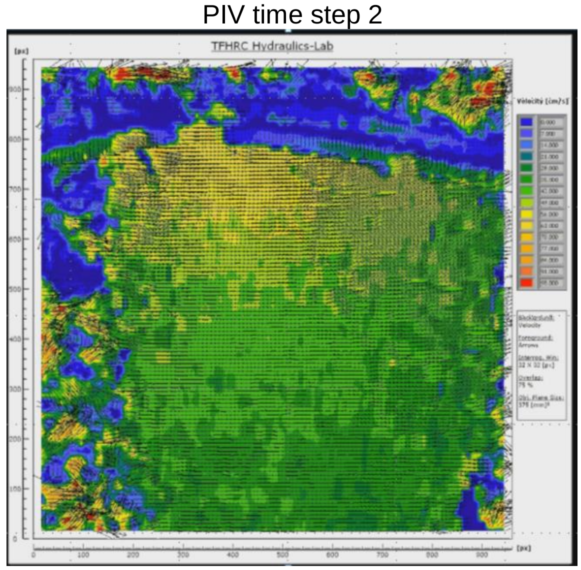
- CFD Simulations on Tsunami Tests
    - To study the force applied on a bridge deck caused by tsunami, a series of physical tests were conducted at the Hydraulics Laboratory in Turner-Fairbank Highway Research Center (TFHRC). CFD simulations of the same test setup were conducted to investigate more details such as the structural response of the bridge. The CFD modeling is further calibrated by comparing the results to the Particle Image Velocimetry data during the tsunami tests.



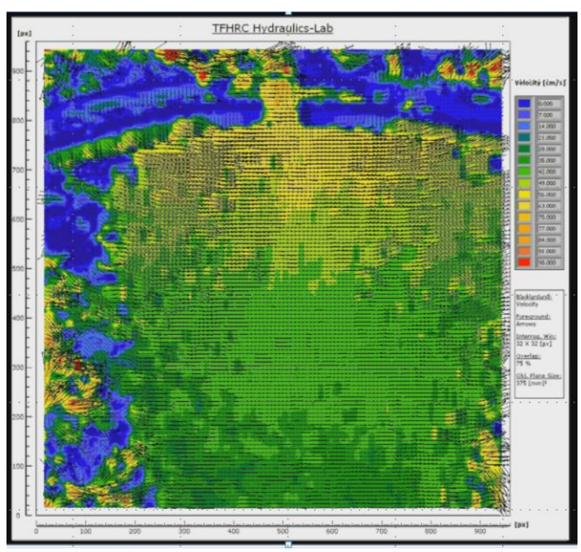
PIV time step 1



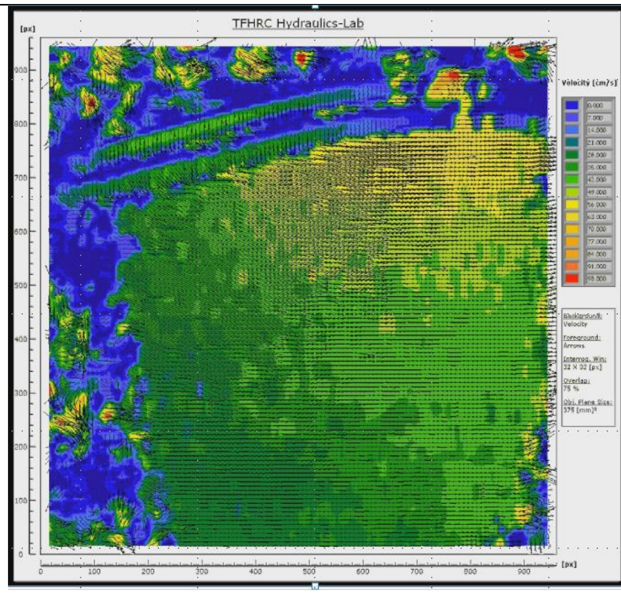
PIV time step 2



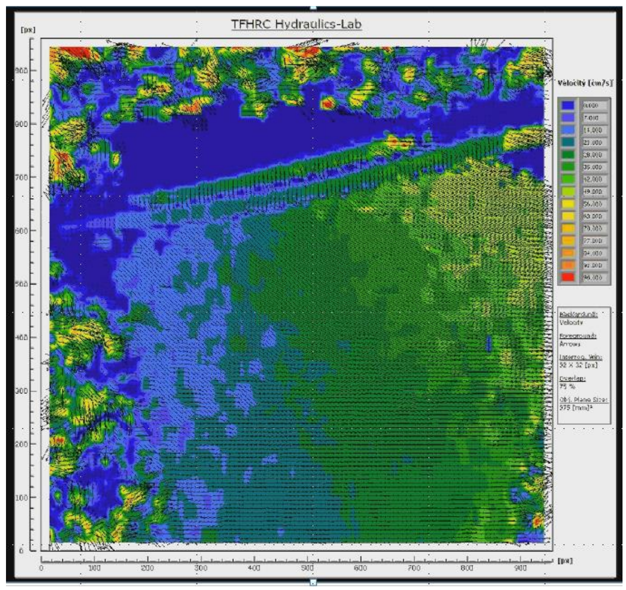
PIV time step 3



PIV time step 4

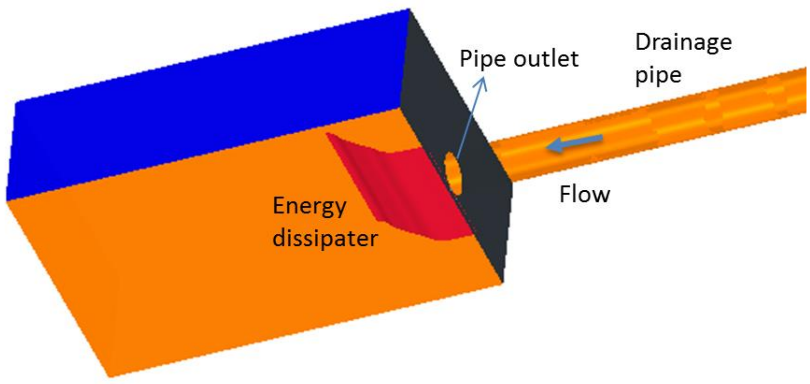


PIV time step 5

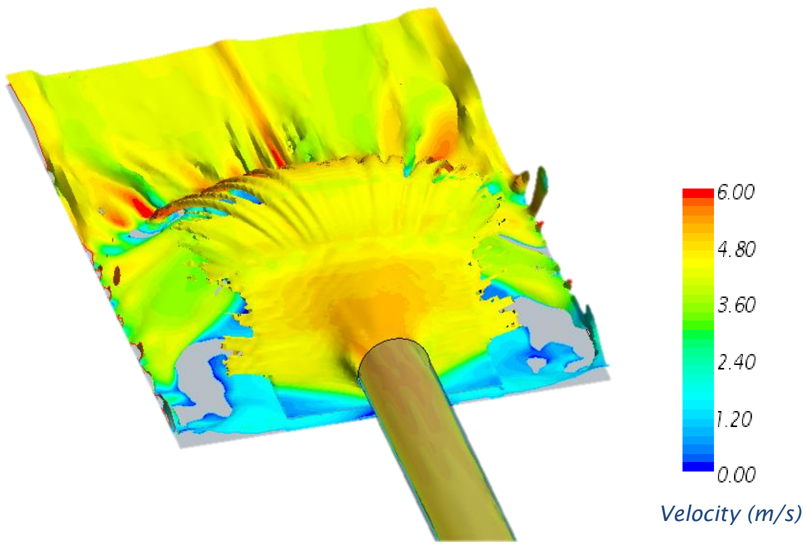


PIV time step 6

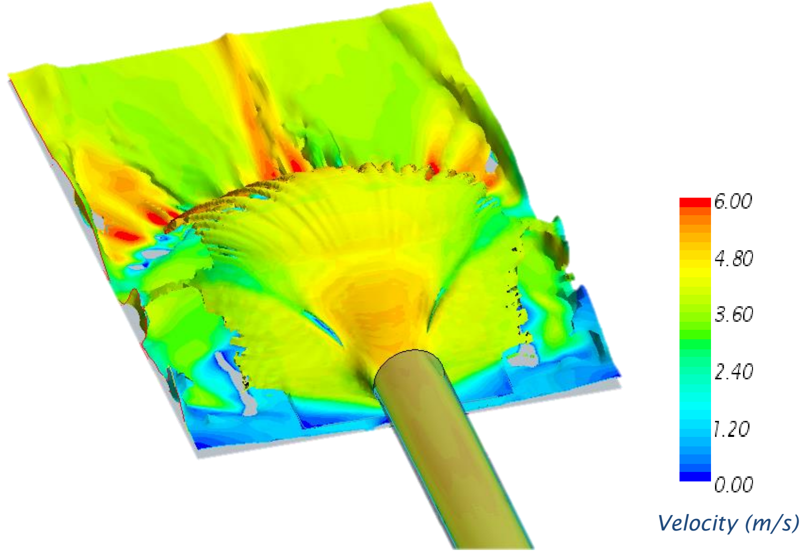
- Optimization on the Energy Dissipater at Pipe Outlets
    - The drainage pipes in many national parks have a very steep slope due to their mountainous topography. The induced high-velocity flows can lead to a tremendous erosion force on the soil at the pipe outlet. Energy dissipaters are commonly installed at the pipe outlet to reduce the velocity and the erosion force as well as eliminate potential scour issues. CFD modeling is used to optimize the shape of those energy dissipaters to generate a uniformly distributed velocity and dissipate the kinetic energy.



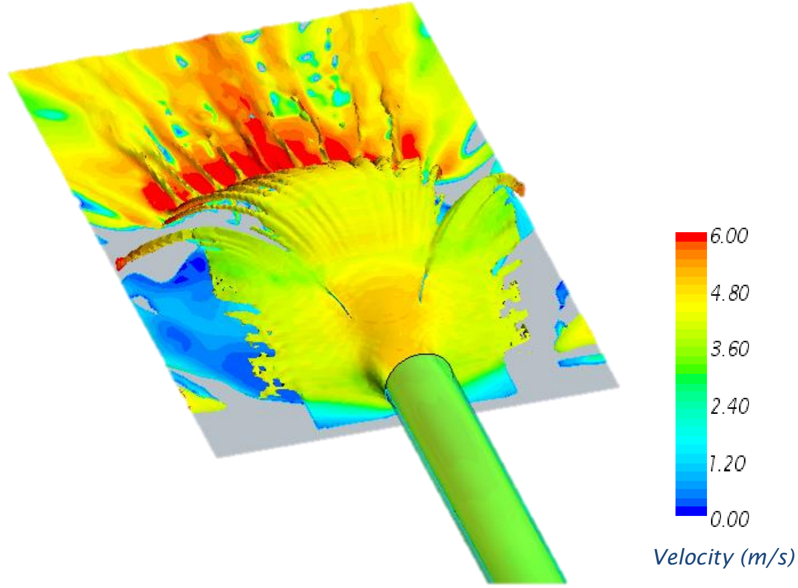
Geometry of the pipe flow and energy dissipater



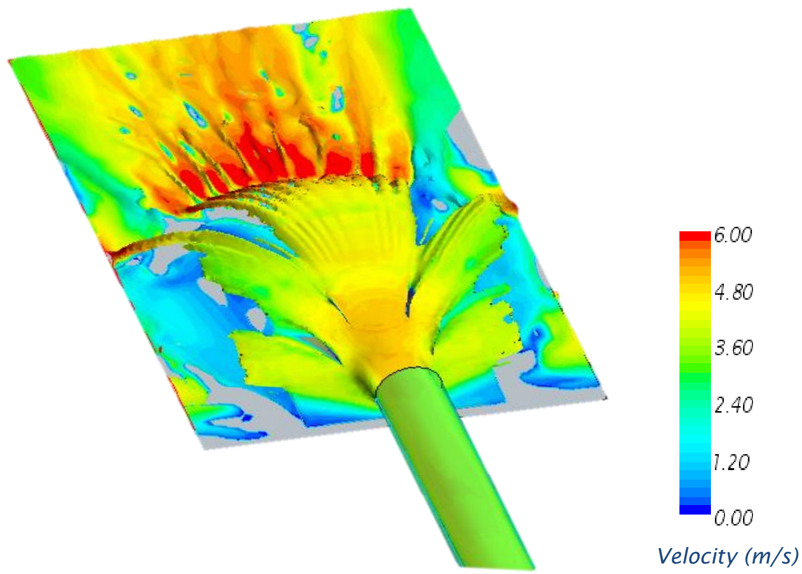
Velocity distribution of option 1: Deflector Ski Jump



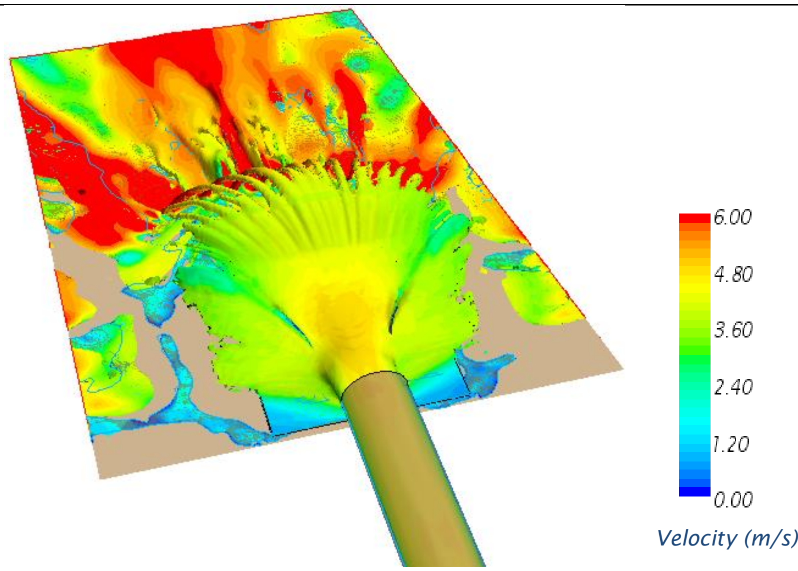
Velocity distribution of option 2: Deflector Ski Jump with guides



Velocity distribution of option 3: Deflector Ski Jump with guides (moved up on ski ramp)



Velocity distribution of option 4: Deflector Ski Jump with 2 guides



Velocity distribution of option 5: Deflector Ski Jump with guides and slots

Anticipated work next quarter:

- Further optimization of energy dissipater will be performed.

Significant Results:

- The CFD modeling of tsunami was further calibrated by comparing the CFD results and the PIV data.
- An optimization on the shape of energy dissipaters for pipe flow outlet is conducted based on CFD simulations.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

None to report.

Potential Implementation: