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) 2014 ☐Quarter 2 (April 1 – June 30) 2014 ☐Quarter 3 (July 1 – September 30) 2014 ☑Quarter 4 (October 1 – December 31) 2014

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:

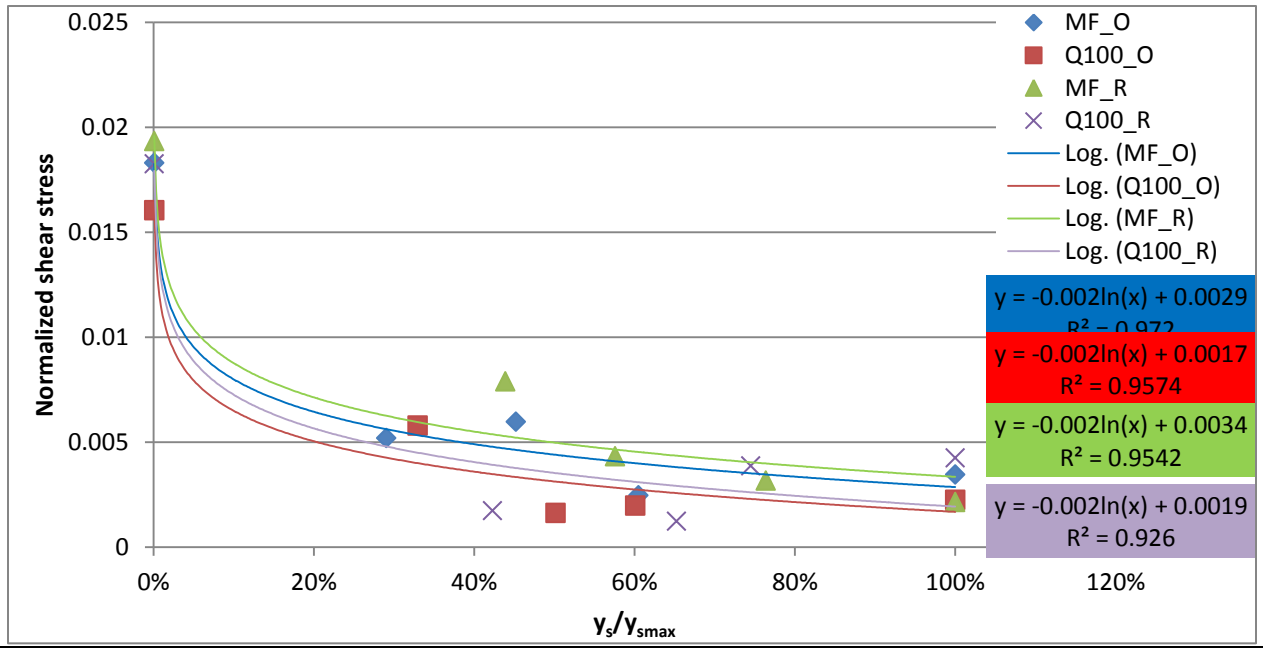
- Provide research and analysis for a variety of highway hydraulics projects managed or coordinated by State DOTs
- Provide and maintain a high performance Computational Fluid Dynamics (CFD) computing environment for application to highway hydraulics infrastructure and related projects
- Support and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

The work includes:

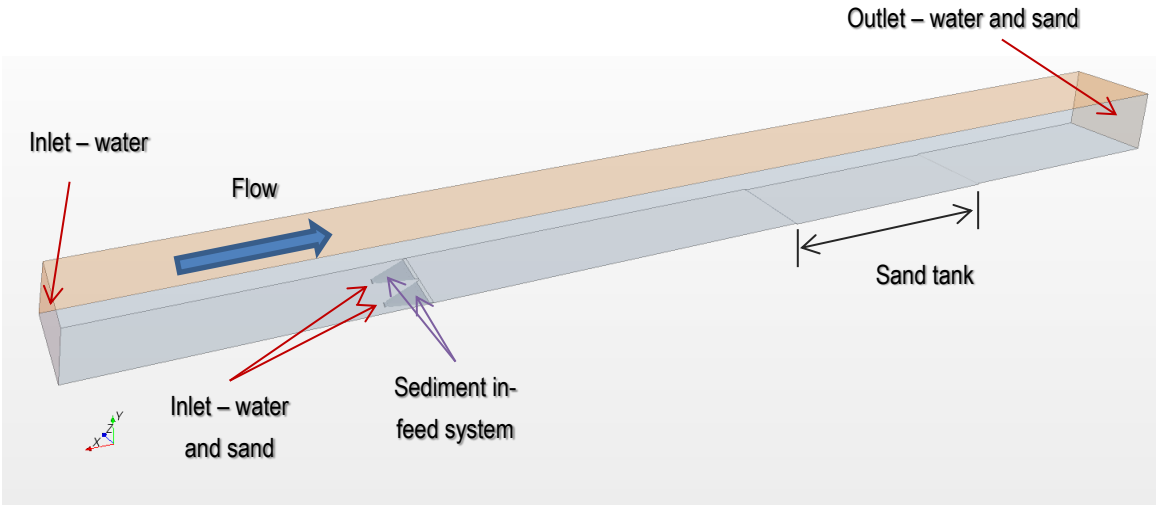
- Computational Mechanics Research on a Variety of Projects: The TRACC scientific staff in the computational mechanics focus area will perform research, analysis, and parametric computations as required for projects managed or coordinated by State DOTs.
- Computational Mechanics Research Support: The 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.):

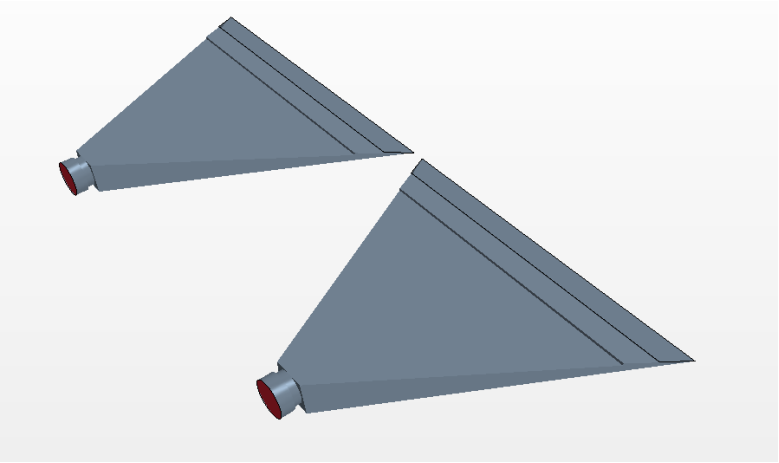
- CFD Modeling for Flow Conditions around the Pier of Feather River Bridge
  The results of four series of CFD simulations with different upstream flow conditions (March flow and Q100) and pier shape (original pier and retrofitted pier) were plotted against four preliminary decay functions for pier scour. See the figure below.



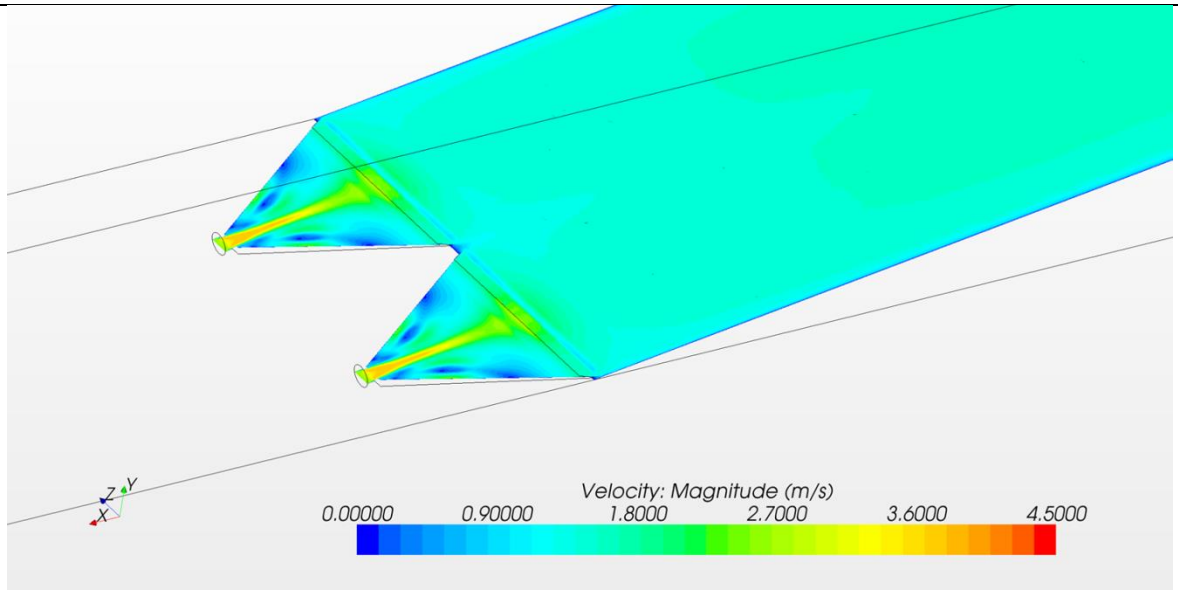
- Optimization of Sediment In-Feed System Design
  - The new multifunctional flume system (MFS) in FHWA Hydraulics Laboratory is designed to be capable of running live-bed scour tests. Compared to other live-bed flume testing systems, MFS is feeding the sediment from the bottom of the flume for a better realization of the live-bed condition. In this case, the shape of the in-feed system (nozzle) will significantly impact the sediment distribution in the flume. CFD simulation was conducted on the original nozzle shape designed by the manufacturer of MFS.
  - The CFD results show that the high velocity is concentrated along the centerline of each nozzle. A pair of symmetric flow circulation occurs in the ineffective zones, which may cause a severe sediment deposition in the nozzle and significant loss in the in-feed capacity. Furthermore, there is an obvious low shear region around the centerline of MFS that causes sediment deposition.



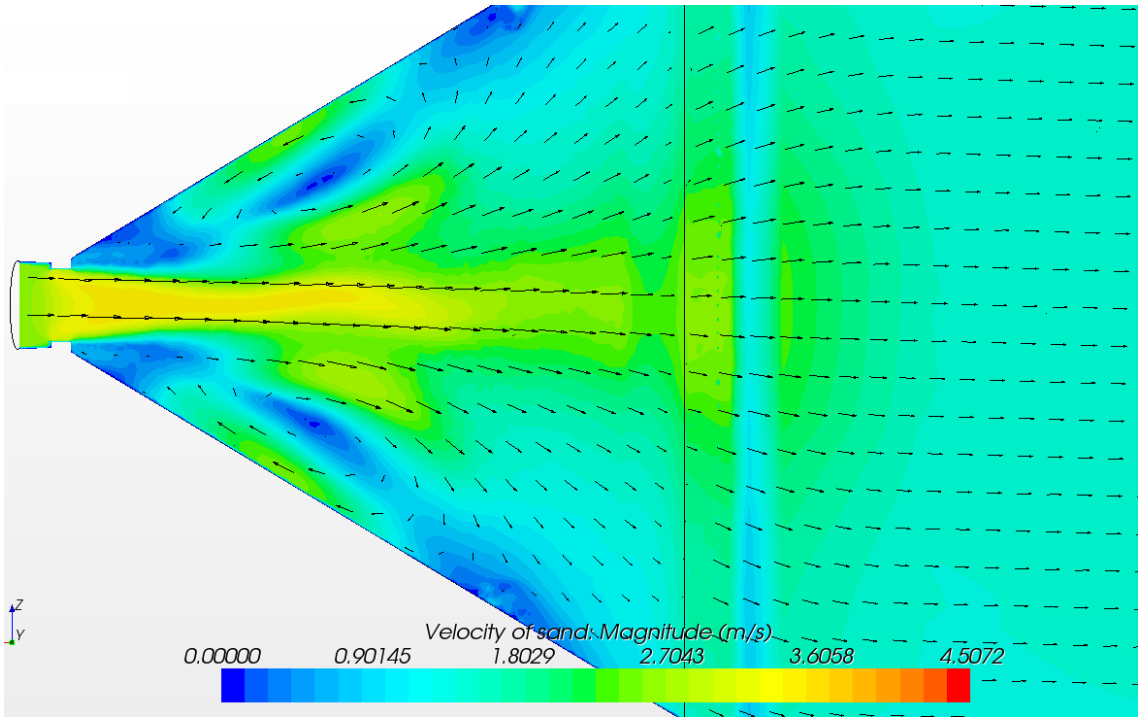
Overview of the MFS



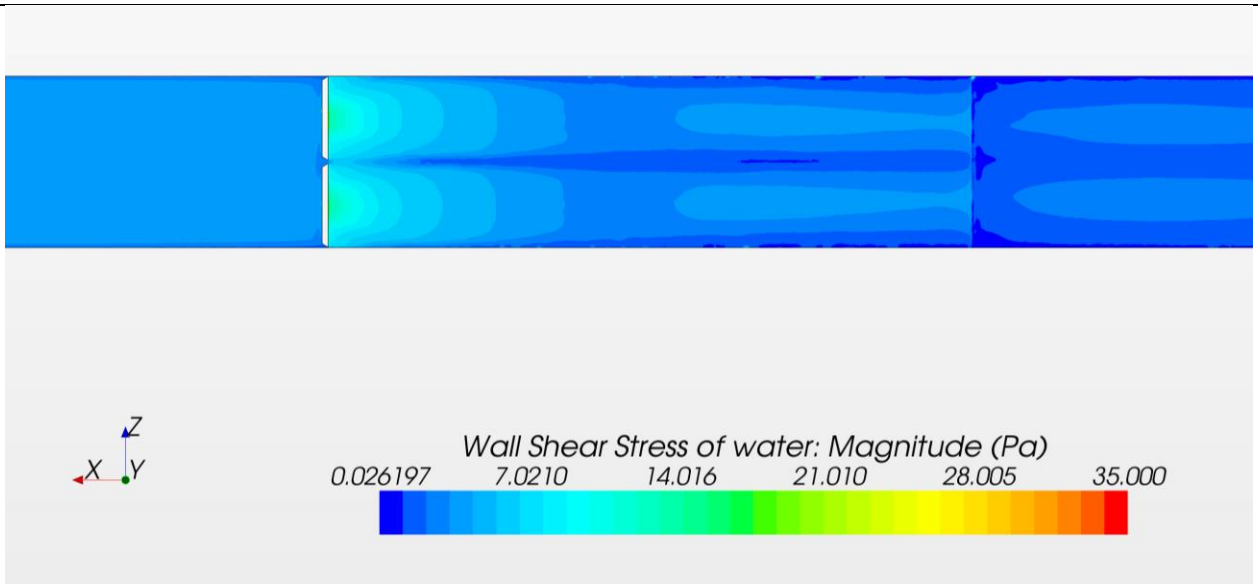
Geometry of the orginal design for the sediment in-feed system



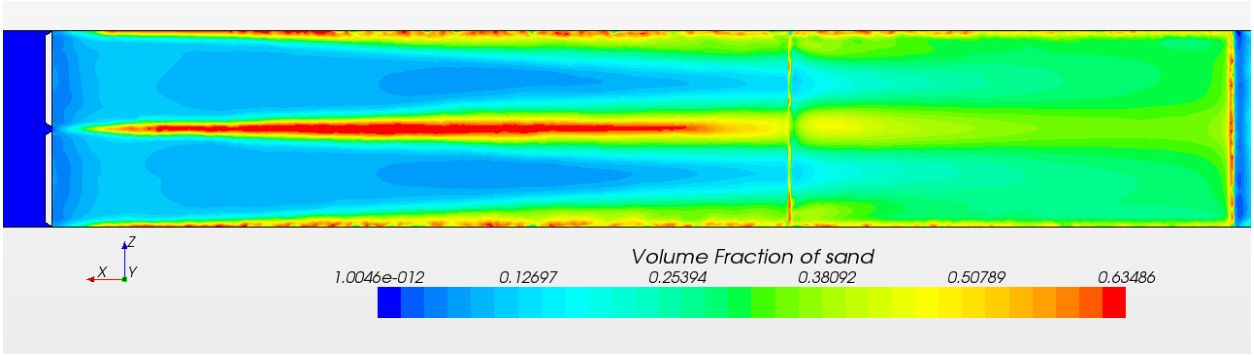
Velocity distribution of original design



Velocity vector of original design



Bed shear distribution of MFS with original designed nozzle



Volume Fraction of sand in the MFS with original designed nozzle

Anticipated work next quarter:

- An optimization of nozzle shape will be conducted based on the results of CFD simulations and compared with those from original design.

Significant Results:

The results from CFD simulation of the nozzle show the flaws of original design. Optimized design will provide a better solution to the issues.

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: