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) 2015 ☐Quarter 2 (April 1 – June 30) 2015 ☐Quarter 3 (July 1 – September 30) 2015 ☐Quarter 4 (October 1 – December 31) 2015

Project Title:
High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics

Name of Project Manager(s):	**Phone Number:**	**E-Mail**
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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:

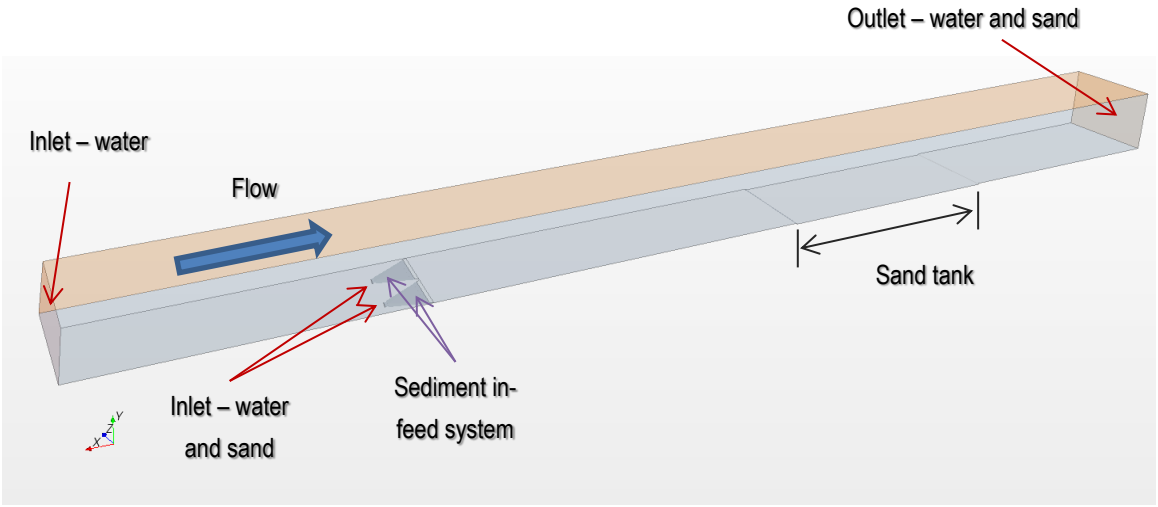
- Provide research and analysis for a variety of highway hydraulics projects managed or coordinated by State DOTs
- Provide and maintain a high performance Computational Fluid Dynamics (CFD) computing environment for application to highway hydraulics infrastructure and related projects
- Support and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

The work includes:

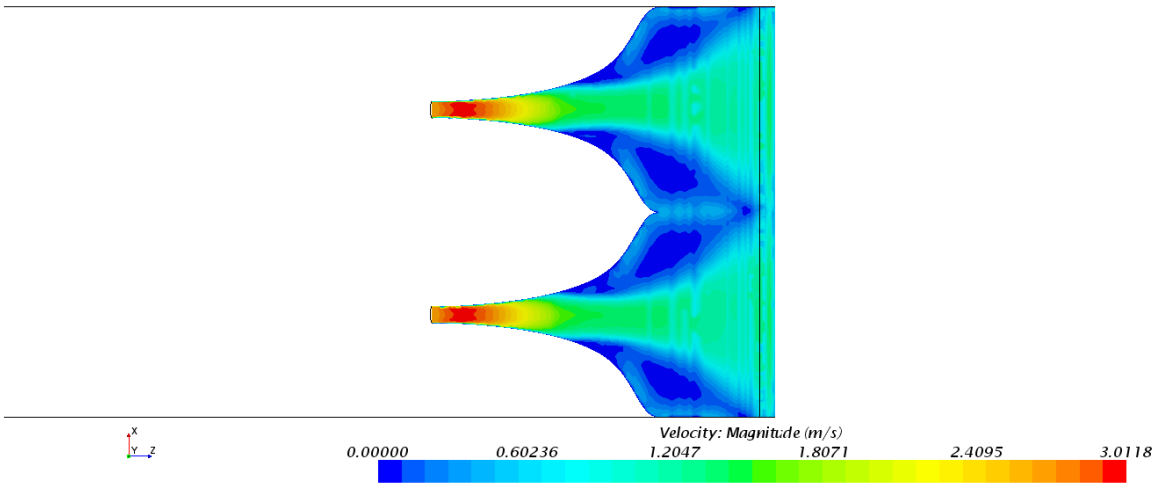
- Computational Mechanics Research on a Variety of Projects: The TRACC scientific staff in the computational mechanics focus area will perform research, analysis, and parametric computations as required for projects managed or coordinated by State DOTs.
- Computational Mechanics Research Support: The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

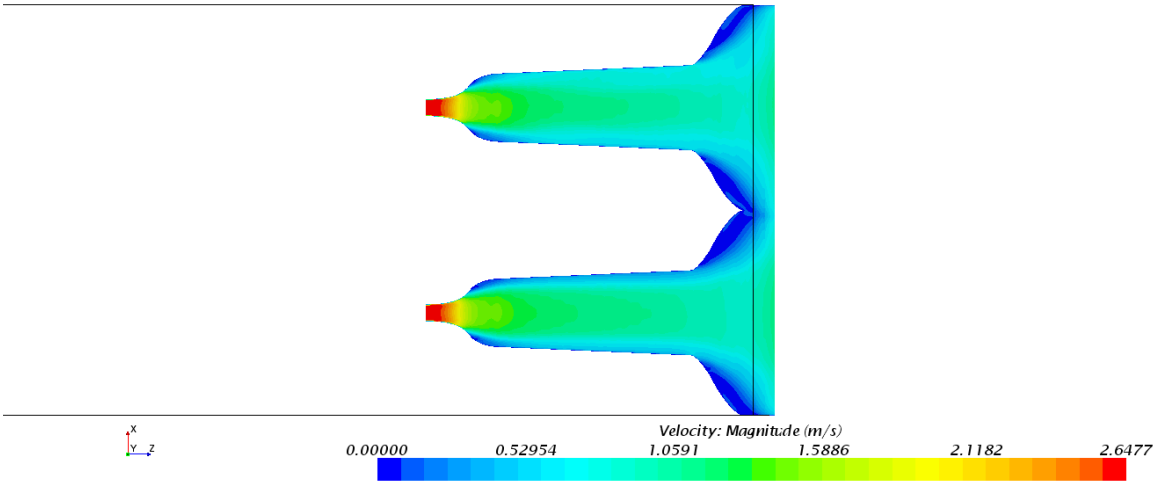
- Optimization of Sediment In-Feed System Design
    - The new multifunctional flume system (MFS) in FHWA Hydraulics Laboratory is designed to be capable of running live-bed scour tests. Compared to other live-bed flume testing systems, MFS is feeding the sediment from the bottom of the flume for a better 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 four different optimized nozzle shapes and compared to the original one that was designed by the manufacturer of MFS.
    - The CFD results show that all four optimized nozzles outperform the original design in terms of the velocity distribution in the nozzle and bed shear stress distribution in the MFS channel. Comparing the performance between four nozzles, option 2 apparently provides a more evenly velocity distribution with the least ineffective regions as well as a more uniform bed shear distribution in the flume. It is anticipated the nozzle of option 2 will be the best solution to generate a uniform sediment distribution during a live-bed scour test.



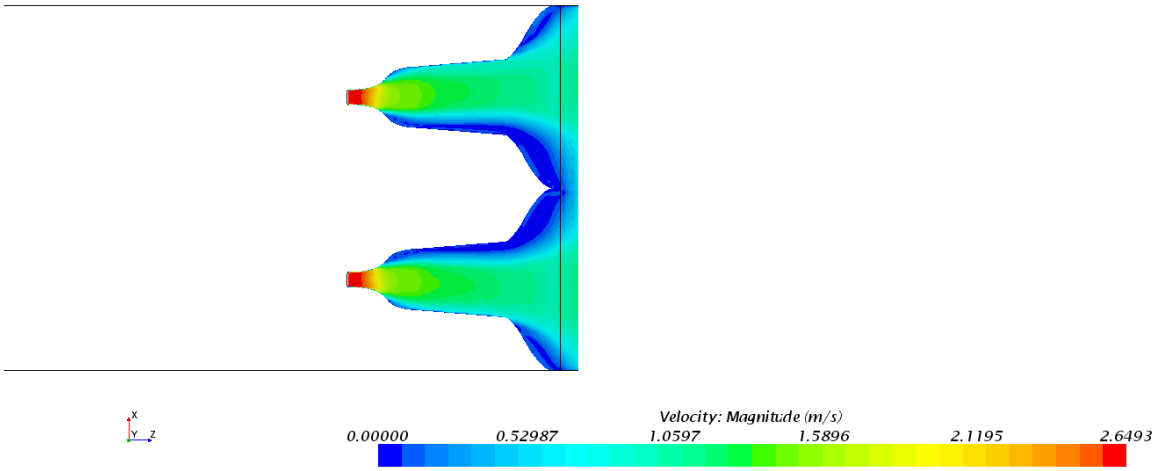
Overview of the MFS



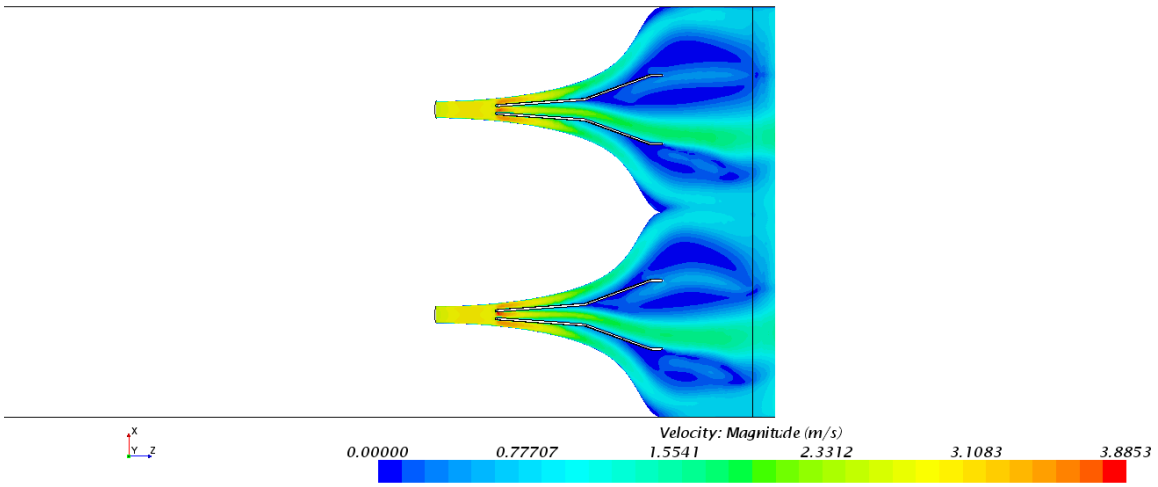
Velocity distribution of optimized design option 1



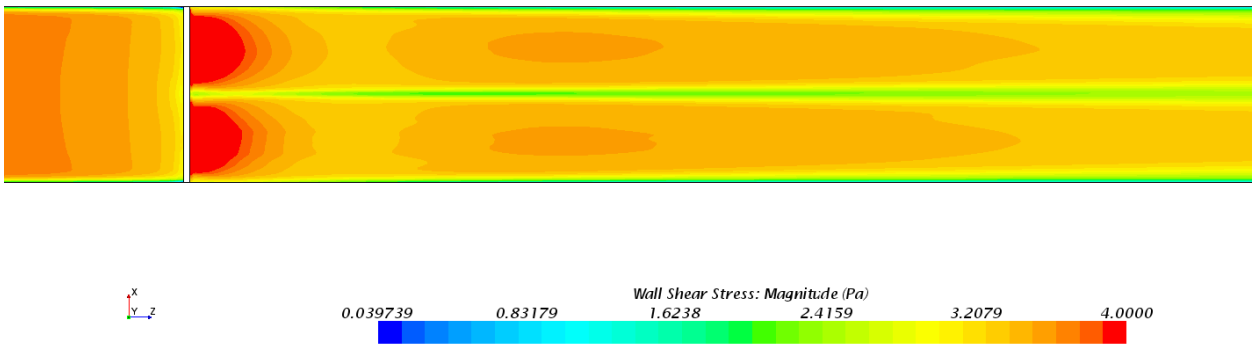
Velocity distribution of optimized design option 2



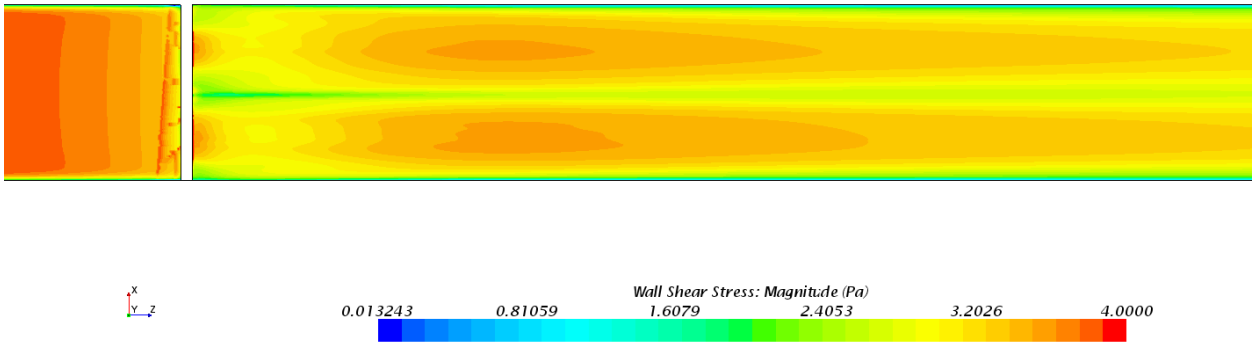
Velocity distribution of optimized design option 3



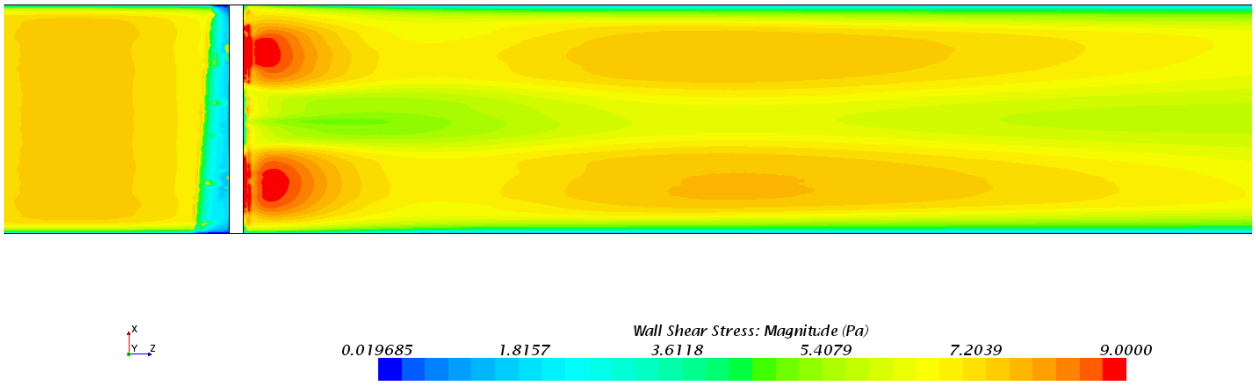
Velocity distribution of optimized design option 4



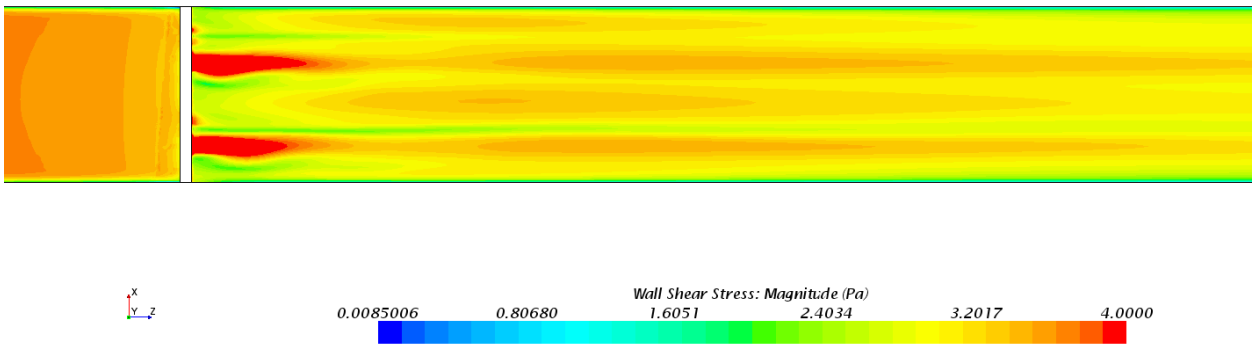
Bed shear stress distribution of optimized design option 1



Bed shear stress distribution of optimized design option 2



Bed shear stress distribution of optimized design option 3



Bed shear stress distribution of optimized design option 4

Anticipated work next quarter:

- Potentially a further optimization on the nozzle shape may be needed depending on the results of a physical trial test on the selected nozzle.

Significant Results:

- An optimized nozzle shape was selected from four options based on the results of CFD simulations and the comparison with original design.

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: