

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 # TPF-5(279)	Transportation Pooled Fund Program - Report Period: <input type="checkbox"/> Quarter 1 (January 1 – March 31) 2015 <input type="checkbox"/> Quarter 2 (April 1 – June 30) 2015 <input checked="" type="checkbox"/> Quarter 3 (July 1 – September 30) 2015 <input type="checkbox"/> Quarter 4 (October 1 – December 31) 2015	
Project Title: <i>High Performance Computational Fluid Dynamics (CFD) Modeling Services for Highway Hydraulics</i>		
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:

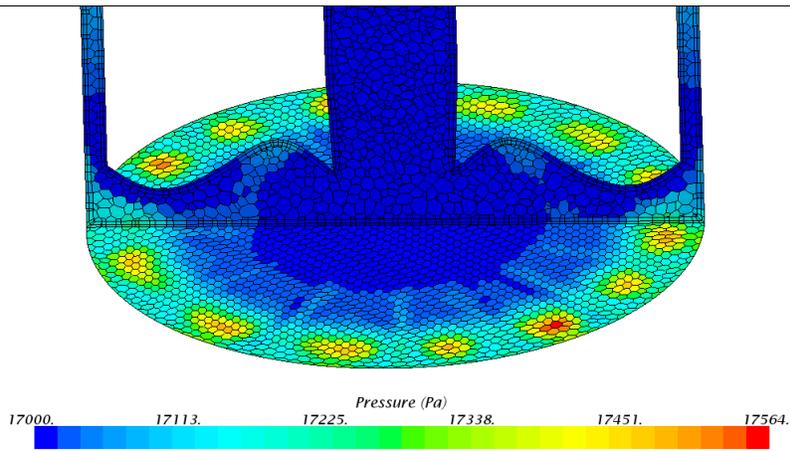
- Provide research and analysis for a variety of highway hydraulics projects managed or coordinated by State DOTs
- Provide and maintain a high performance Computational Fluid Dynamics (CFD) computing environment for application to highway hydraulics infrastructure and related projects
- Support and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

The work includes:

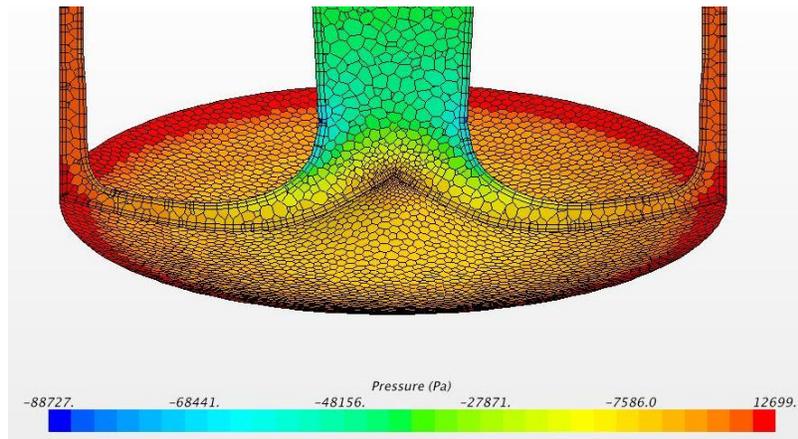
- Computational Mechanics Research on a Variety of Projects: The TRACC scientific staff in the computational mechanics focus area will perform research, analysis, and parametric computations as required for projects managed or coordinated by State DOTs.
- Computational Mechanics Research Support: The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

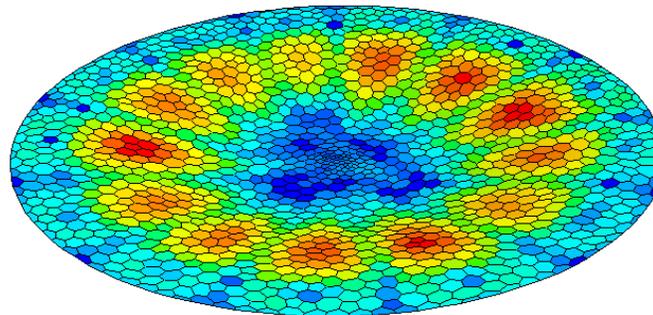
- Optimized Design of In-situ Scour Testing Device (ISTD) Erosion Head
 - An in-situ scour testing device was developed by the Hydraulics Laboratory in Turner-Fairbank Highway Research Center (TFHRC) for use as a foundation design aid by the highway and bridge engineering community. One of the challenges is to achieve a flat surface at the bed which is critical for the accuracy of shear stress measurement. Based on the results of study during last quarter, it is found that there are some ineffective regions between the erosion head and the flat bed, which will significantly impact the suction performance of the ISTD. Therefore the erosion head needs to be further optimized.
 - To increase the suction capacity of the ISTD while maintaining a uniform distribution of bed shear stress, a mesh-morphing technology was used to estimate the deformation of soil bathymetry. From the CFD results, the pressure is more evenly distributed for the optimized erosion head. The drawbacks are the shear stress is near zero on the outer edge and that may not be improved further, the shear stress may not be improved near the center either.



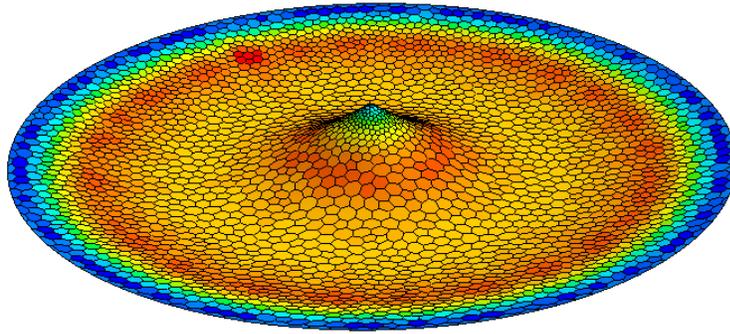
Pressure distribution of the initial design



Pressure distribution of the optimized design



Bed shear stress distribution of initial design, uniformity = 0.695



Bed shear stress distribution of optimized design, uniformity = 0.841

Anticipated work next quarter:

- Velocity distribution of the flow in the erosion head will be compared to those in a straight channel to explore the similarity of scour process in ISTD and real flow.

Significant Results:

- The shape of the erosion head was further optimized based on the results of CFD simulations to consider both the uniformity of the shear stress and the suction performance of ISTD.

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: