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):	**Phone Number:**	**E-Mail**
Kornel Kerenyi	*(202) 493-3142*	*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:

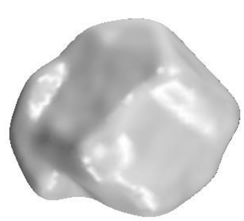
- Provide research and analysis for a variety of highway hydraulics projects managed or coordinated by State DOTs
- Provide and maintain a high performance Computational Fluid Dynamics (CFD) computing environment for application to highway hydraulics infrastructure and related projects
- Support and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

The work includes:

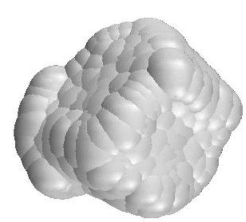
- Computational Mechanics Research on a Variety of Projects: The TRACC scientific staff in the computational mechanics focus area will perform research, analysis, and parametric computations as required for projects managed or coordinated by State DOTs.
- Computational Mechanics Research Support: The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

- Simulation of movable rocks by implementing Discrete Element Method (DEM)
    - The sphere-filled method in commercial software was explored to achieve the construction of arbitrary shape by assembling DEM particles.

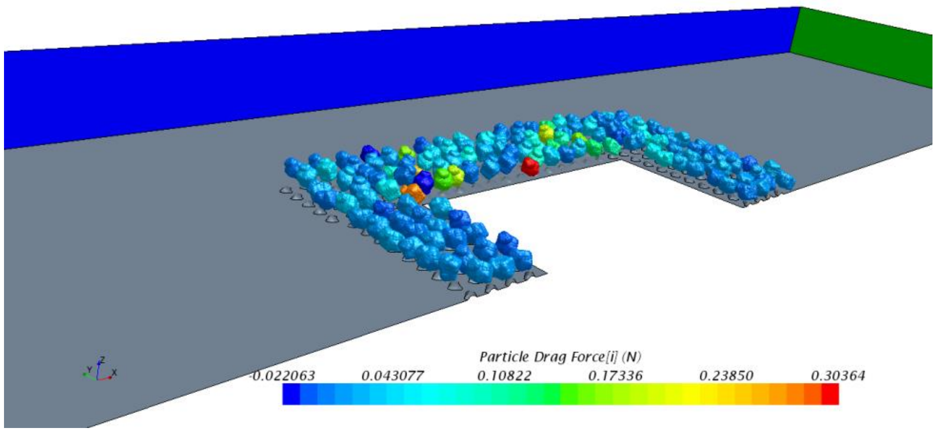


Original shape

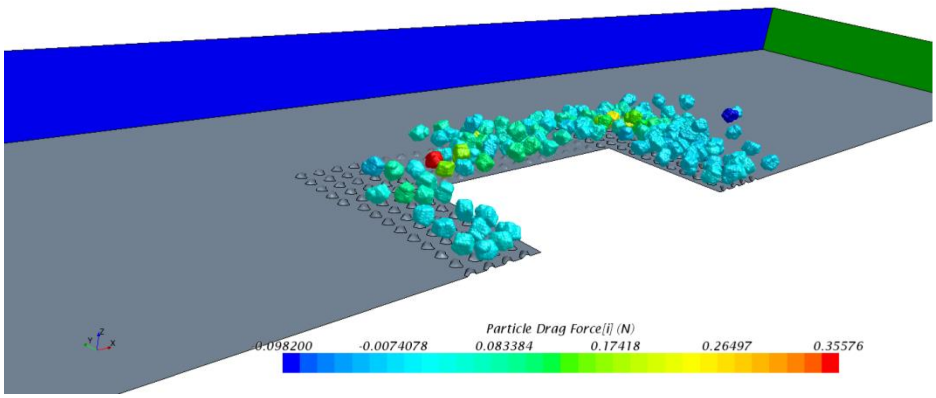


Sphere-filled Shape

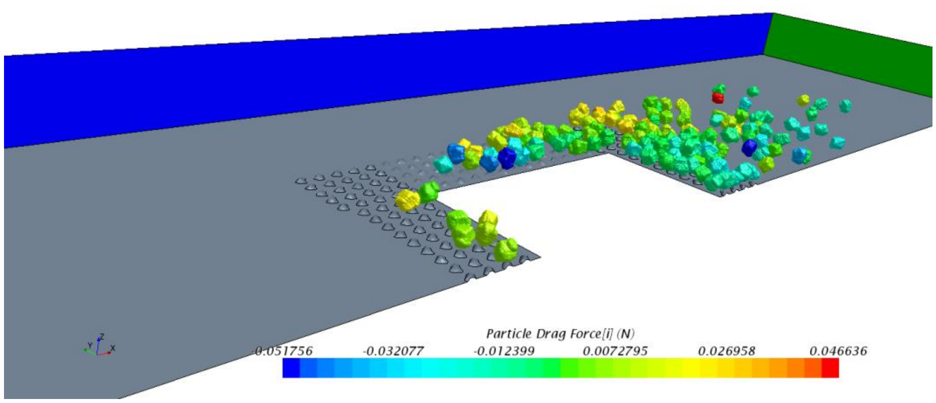
    - CFD simulations are conducted on the riprap around the abutment of a contracted channel to explore the potential for simulating the movable rocks in the stream.



Time step 1

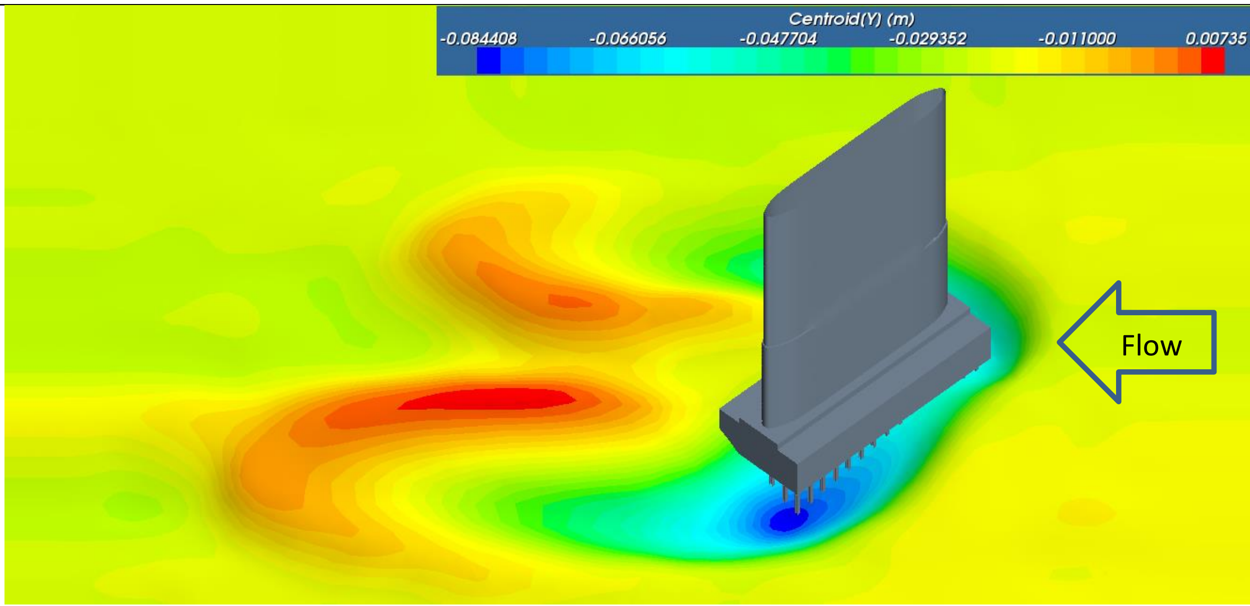


Time step 2

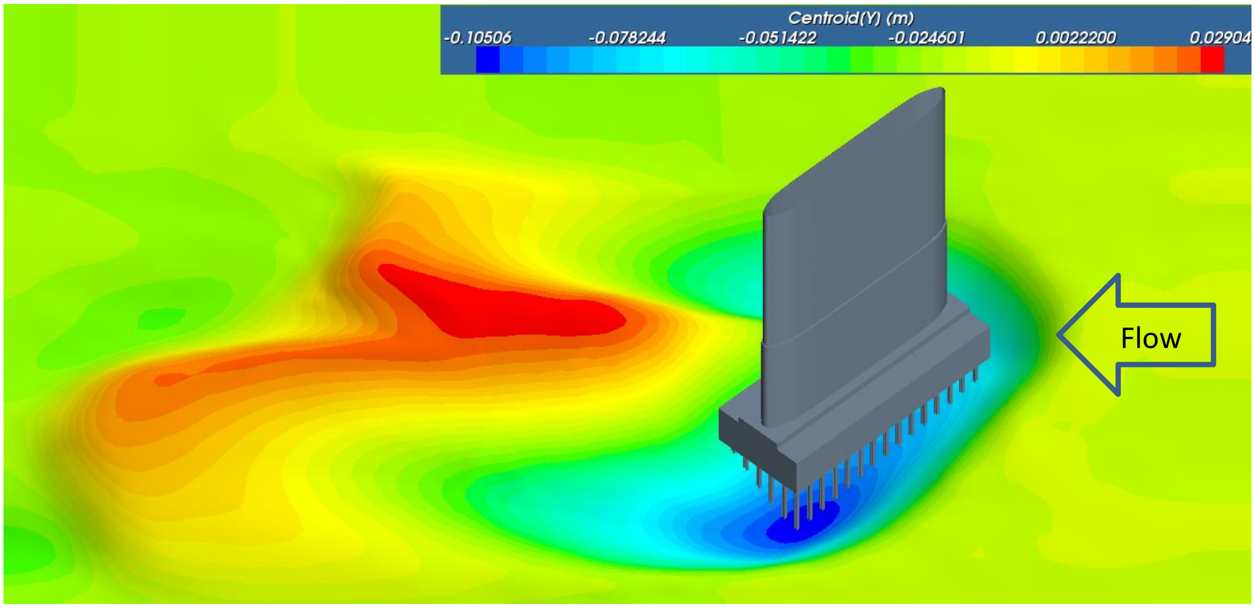


Time step 3

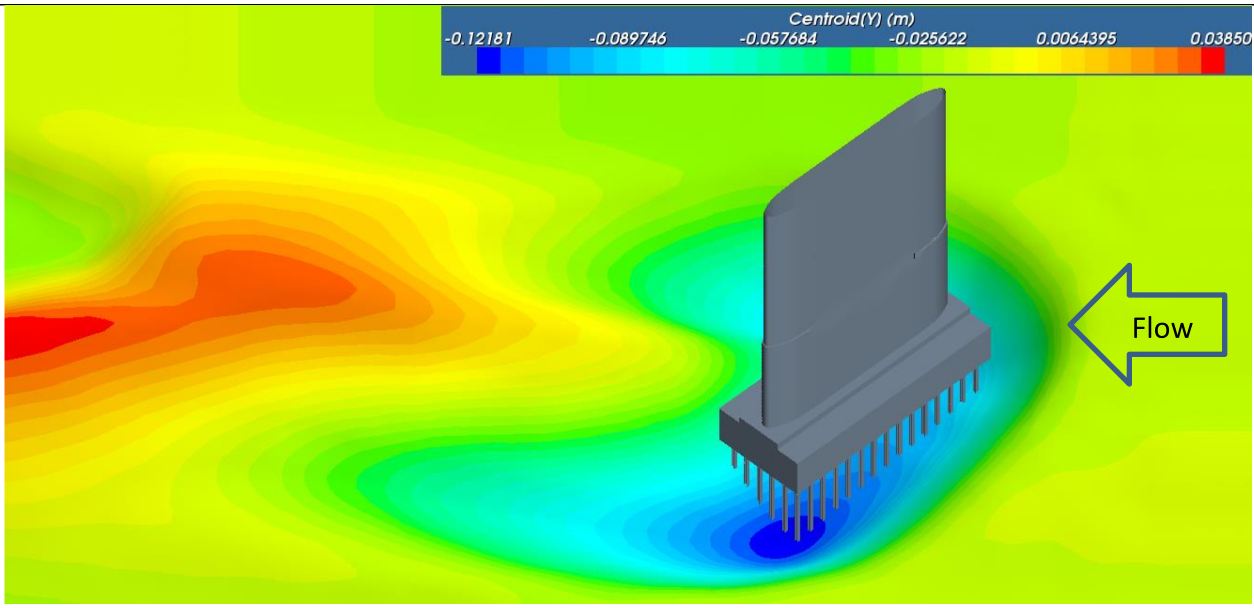
- CFD Modeling for Flow Conditions around the Pier of Feather River Bridge
  - Under the same upstream flow condition, four cases with different bathymetry and scour depths were simulated to develop the relation between maximum scour depths and maximum bed shear stress. The results will provide a basis for validating the preliminary decay function for pier scour.



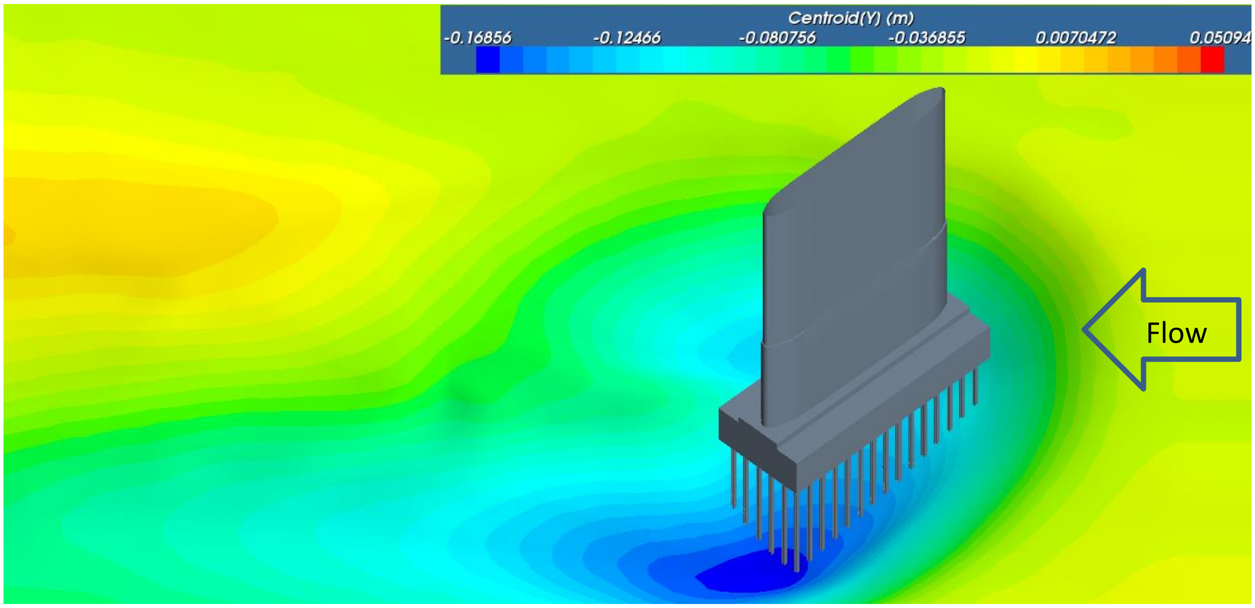
Case 1 Bathymetry



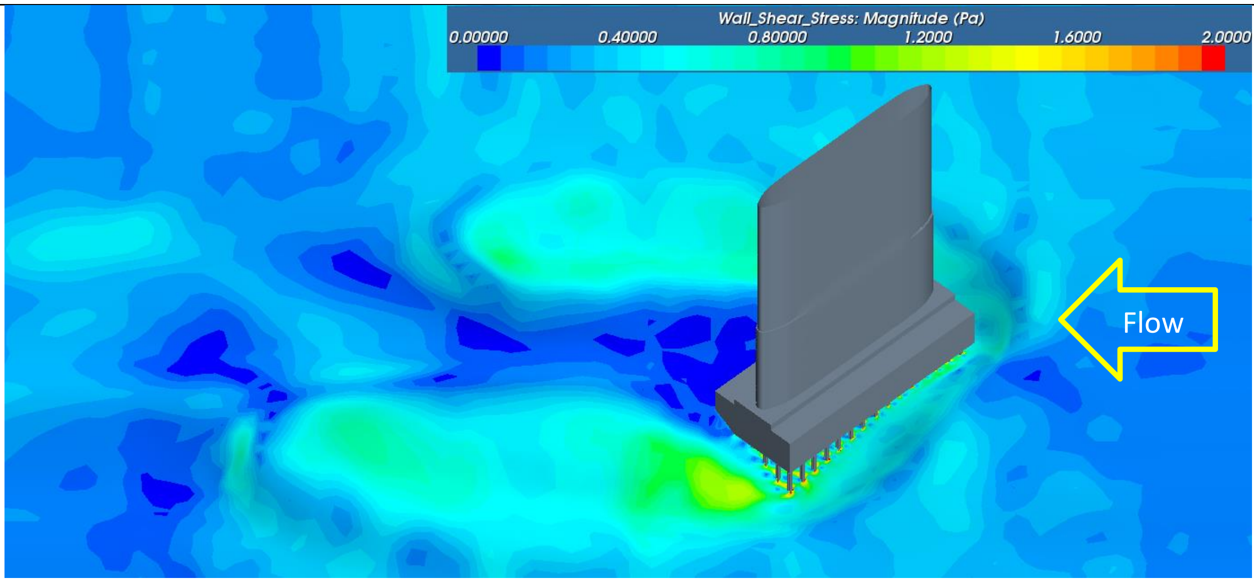
Case 2 Bathymetry



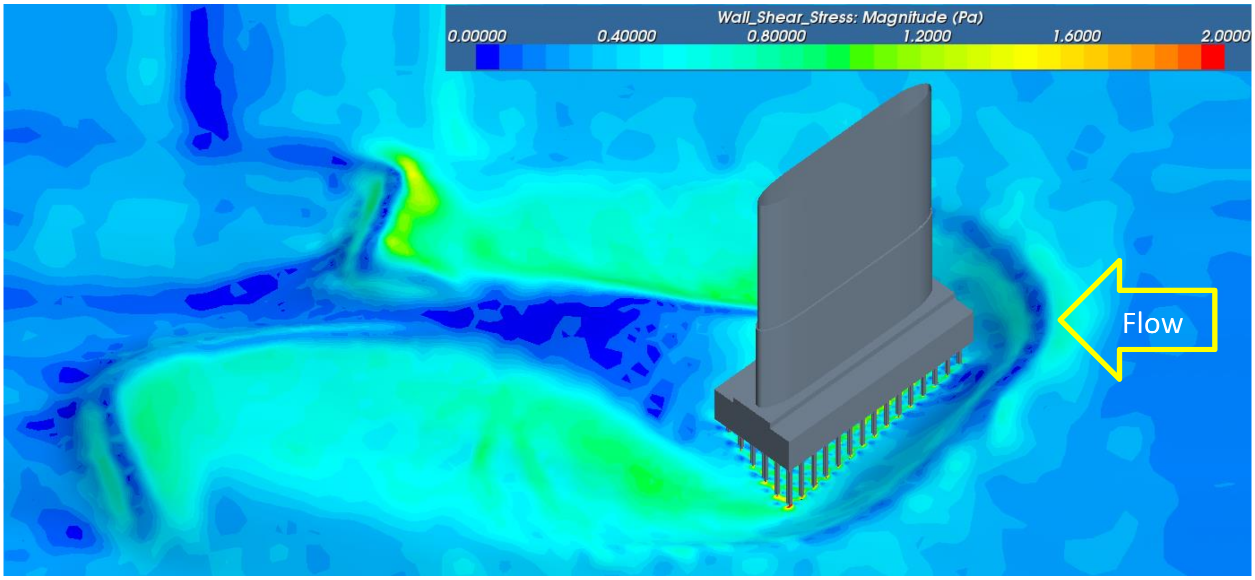
Case 3 Bathymetry



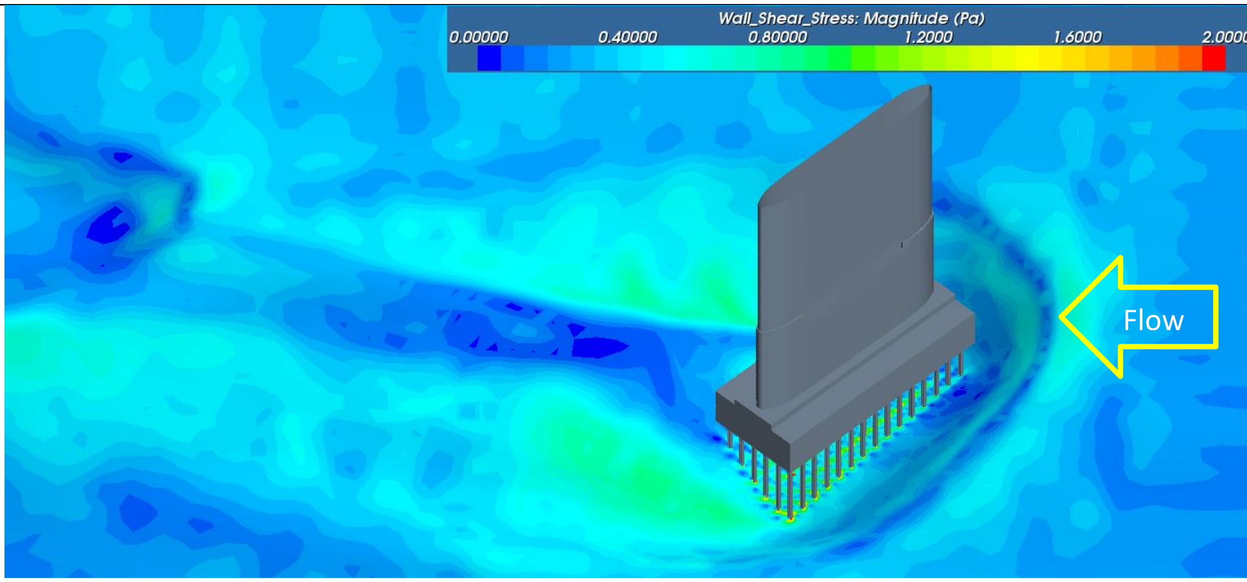
Case 4 Bathymetry



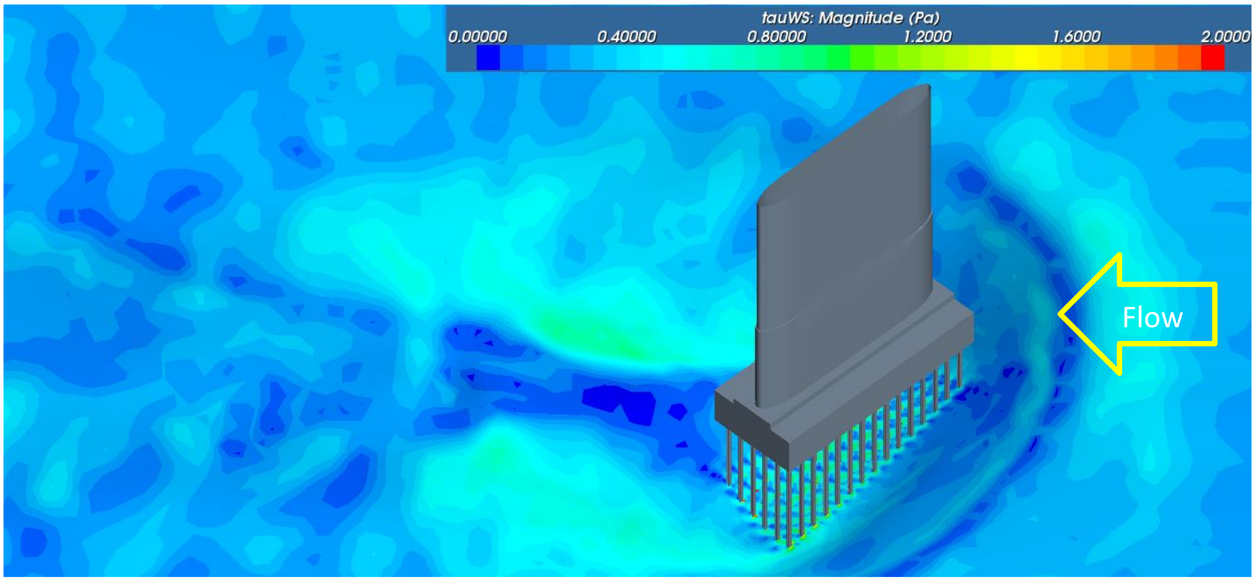
Case 1 Bed shear stress



Case 2 Bed shear stress



Case 3 Bed shear stress



Case 4 Bed shear stress

Anticipated work next quarter:

- Data points from the feather river pier simulation will be compared with the preliminary scour decay function to validate its applicability.

Significant Results:

The first series of data is obtained for Feather river bridge. More results will be given in the final report.

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: