QUARTERLY PROGRESS REPORT

April, 1 2012 to June, 30 2012

In this reporting period the task order to conduct a study on Bridge Pier Scour Research (see below) was submitted to the FHWA contracting office (HAAM). HAAM will negotiate the task order between TFHRC Hydraulics Laboratory Support Services contractor and FHWA. The task order was not awarded in this reporting period.

Contract No. DTFH61-11-D-00010 "Hydraulics Laboratory Support Services Contract".
Task Order No. 13
Title: Bridge Pier Scour Research

The FHWA has a requirement for a new task order under DTFH61-11-D-00010 Contract in support of the statement of work provided below. The proposal submittals by the contractor shall be to the Contracting Officer (CO) and the Contracting Officer's Technical Representative (COTR) at:

Samantha.Reizes@dot.gov, CO
Kornel.Kerenyi@dot.gov, COTR

All questions should be forwarded to the CO and the COTR.

RESEARCH OBJECTIVES

The contractor shall work with federal personnel from the Hazard Mitigation team at the Turner Fairbank Highway Research Center (TFHRC) to research identified bridge pier scour issues to predict scour and to improve scour prediction equations. The research will be based on a combination of data obtained from the historical scour research literature, laboratory experiments and numerical (CFD) modeling.

BACKGROUND

NCHRP report 175 "Evaluation of Bridge Pier Scour Research: Scour Processes and Predictions was finalized in March 2011. The report examined the present state of knowledge regarding bridge-pier scour, evaluated the reliability of leading current methods to provide accurate estimates of design scour depth, and recommends a structured approach to scour-depth estimation for design use. The large variation in factors potentially influencing scour at bridge sites requires an approach sufficiently comprehensive to account for the more important individual parameter

influences to be considered, yet that also treats pier scour from a systems-analysis perspective when the number of parameters is too numerous, or the parameters are insufficiently independent, to be described practically in terms of a series of individual parameter influences.
The present evaluation showed that, while the individual scour influences of the many bridge waterway variables are now well understood for simple or standard pier designs, and that recently developed scour estimation methods attempt to encompass these influences, there are several sources of substantial complexity that complicate the development of reliable comprehensive design relationship for estimating scour depth at piers:

- Complexity of flow field
- The fundamental problem of simultaneously scaling three scales (flow depth, bed material size and, structure size)
- Variations in channel boundary materials
- Differences in pier structure
- The complicating interaction of pier scour and other boundary erosion processes , such as accumulation of woody debris, ice bridge over-topping, abutment proximity, channel morphology, bedforms
- The large number of parameters involved.

This project is funded through the Transportation Pooled Fund Program TPF-5(211) (http://www.pooledfund.org/Details/Study/439). The contributing states are CA, CO, FL, MS, and NY.

STATEMENT OF WORK (SOW)

This task order will address the following research issues whose resolution should enhance the reliability of scour depth estimation.

- Fundamental processes inadequately understood. The issues primarily concern flow field capacity to erode the channel boundary, and the boundary's capacity to resist erosion.
- Complicating processes inadequately understood. The issues concern flow field capacity to erode the channel boundary, and the boundary's resistance to erosion.

A research study to understand the flow field capacity to erode the channel boundary for a simple pier geometry (rectangular pier) conducted at TFHRC Hydraulics Laboratory used a hybrid approach concept. Compared to the convenience offered by modern computational facility, physical modeling has become a much more expensive, time-consuming, and inflexible option for investigating a large variety of bridge hydraulics subjects. However, there are specific aspects in CFD that requires the assistance from physical modeling. Examples of such needs include turbulence models, scaling effect, roughness simulation, and sediment transport. It is, in many occasions, most efficient to have a relatively small number of high-precision physical experiments

that spans through the range of important parameters and their critical values, and use the result to set up or calibrate corresponding CFD models. Subsequently, these CFD models can be used to conduct more detailed parametric study at a modest cost.
This study will use the hybrid approach to understand the flow field capacity to erode the channel boundary for complex pier geometries. Several scaled complex pier geometries (e.g. Feather River Bridge, CA) will be tested. Physical experiments will be conducted at the TFHRC Hydraulics Laboratory and CFD modeling will be carried out at the TRACC/Argonne National Laboratory. The CFD modeling for this study will conducted through a different task order.

RESEARCH TASKS

Considering the above, the work shall be performed in accordance to the following tasks:

Task 1: Technical Advisory Committee

- Assemble a technical advisory committee (TAC) comprised of members of State DOTs who are contributing to the project that will provide oversight and guidance on all aspects of the project. Organize meetings of this committee during the project.

Task 2: Design and fabricate scaled models of complex pier footings

- Determine the appropriate scaling factor using Froude similitude.
- Generate SoidWorks CAD drawings of scaled models for the Feather River Bridge before and after the retrofit.
- Generate SoidWorks CAD drawings of scaled complex pier geometry models determined by TAC.
- Use 3D rapid prototyping to fabricate scaled models of the Feather River Bridge before and after the retrofit.
- Use 3D rapid prototyping to fabricate scaled complex pier geometry models determined by TAC.

Task 3: Physical Experiments in the TFHRC Hydraulics Laboratories Tilting Flume.

- Developed a comprehensive test matrix including various flow velocities, depths, angle of attacks, sediment sizes, etc.
- Run tests identified in the test matrix and map the 25%, 50%, 75% and 100% scour bathymetry using a resolution that is sufficient to be incorporated into a CDF model.
- If possible, use a laser based Surface Examining Imager (SExI) to map the scour bed bathymetry.
- Reduce measured data into a format that is compatible with CFD input data files

Task 4: Quarterly Reports for Transportation Pooled Fund Website.

- Prepare quarterly reports documenting all the work conducted so far.
- Post quarterly reports on the TPF website for project TPF-5(211) "Bridge Pier Scour Research".

Task 5: Final Report.

- Upon completion of Task 3, the contractor shall submit a detailed final report documenting all the work conducted in Tasks 2 and 3.

DELIVERABLES

Table I - Project Time frame and expected deliverables

Main Research Tasks	Time period (beginning month to ending month) (All times are based from the effective date of the task order)							
	1	2	3	4	5	6	7	8
TASK 1	Technical Advisory Committee							
TASK 2	Design and fabricate scaled models of complex pier footings							
TASK 3		Physical Experiments in the TFHRC Hydraulics Laboratories Tilting Flume.						
TASK 4	Quarterly Reports for Transportation Pooled Fund Website.							
TASK 5							Final Report	