



OREGON DEPARTMENT OF TRANSPORTATION

Research Section
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SPR Quarterly Progress Report
October 1, 2015 through December 31, 2015

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Date February 10, 2015

TO: Technical Advisory Committee Members:

Ray Bottenberg, ODOT Bridge Engineering Section
Albert Nako, ODOT Bridge Engineering Section
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1. Project

High Strength Steel Reinforcement for Bridges
SPR 762

2. Project Investigator

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3. Project Coordinator

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4. Key Dates

Project start date: 9/25/2013
Project completion date: 12/31/2015

5. **Project Status** (Completed by project investigator)

Task 1: Literature Review

Percent completed reported in last quarterly report: 95%

Percent completed after this quarter: 98%

Key Progress-To-Date

Literature has started to be collected and reviewed for the two main topics related to this research, that is, material characterization for low-cycle fatigue and for shear-friction related to Grade 60 and Grade 80 reinforcing steel. Literature on existing experimental research to shear friction have been gathered and reviewed.

- For low-cyclic testing:
 - Questions raised by the TAC have been under review, namely the use of as-received rebar versus machined specimen in the low-cyclic testing. Even though there are arguments supporting both, the PIs, have identified that testing as-received specimen is the preferred way of testing in the literature; however, no publication was found comparing results from the as-received versus milled specimen and the research team will continue to investigate this question;
 - Distance between gripped bar ends is a key parameter and most experimental setups described in the literature required the development of a specialized grip or attachment to existing grips of the Universal Testing Machine (UTM).
- In terms of the shear friction push-tests, key issues from the literature are:
 - Associated with ensuring that moment is not transferred across the shear friction surface under testing;
 - Treatment of friction surface is a parameter that influences the results, however, details are often not provided.
- Literature review chapter developed by the graduate student has been reviewed by the PIs.

Specific Progress This Quarter

- As we wrap up the report, latest literature is being included in the Literature Review.

Problems

- None

Work Planned for Next Quarter

- Wrap-up and check for publications coming out on the topic over the coming quarter as we finalize the report

Task 2: Develop Experimental Program

Percent completed reported in last quarterly report: 100%

Percent completed after this quarter: 100%

Key Progress-To-Date

- Low-cycle fatigue:
 - OSU's 110 kip MTS UTM grip systems have been designed, built, and tested.
 - Gripping system was tested and is appropriate.
 - Alignment was verified following ASTM E8 standards.
 - Alignment is an important issue. A jig for improving alignment and repeatability of specimens when installed in the UTM.
 - Gripping system was tested.
 - Jig used to setup experiment was checked and tested and provided successful results in terms of maintaining alignment.
 - Test repeatability was verified.
- Shear friction:
 - Experimental design with vertical load application is complete.

Specific Progress This Quarter

- None

Work Planned for Next Quarter

- None

Task 3: Fabricate Specimens and Perform Experimental Testing

Percent completed reported in last quarterly report: 95%

Percent completed after this quarter: 100%

Key Progress-To-Date

- Low-cycle fatigue:
 - 100% of specimens have been tested
- Shear friction:
 - Testing is complete.

Specific Progress This Quarter

- Low-cycle fatigue:
 - Testing is complete. Data processing is nearly complete (98% complete). Drafting of the chapter has been started. 50% complete.
- Shear friction:
 - Data processing and analysis is complete. Drafting of the section for the report is complete and revised. Ready for submission to ODOT for review.

Problems

- None

Work Planned for Next Quarter

- Finalize data processing for inclusion of the data in the draft report for submission to ODOT.

Task 4: Produce Final Report and Disseminate Findings

Percent completed reported in last quarterly report: 60%

Percent completed after this quarter: 80%

Key Progress-To-Date

- Special session on the 16WCEE (World Conference in Earthquake Engineering) is being organized by Barbosa and colleague from NC State on High Strength Materials for Seismic Design (including High Strength Reinforcing Steel). The special session was proposed and accepted by the organization committee of the conference. In this session, national and international experts will share their latest findings on high strength steel reinforcement, and the PIs will disseminate the findings of testing funded through this project as well as results obtained in a previously funded project by ODOT on use of high strength steel reinforcement on columns.
- Poster with the work developed to date was presented at the Region X UTC Transportation Center (PacTrans) Annual Meeting in October 17, 2014.
- Poster with the work developed to date was presented at the Oregon Convention Center in Portland, Oregon. This corresponded to a Graduate Student Expo that had participation of members from the university as well as from industry partners. The graduate student assistant in the project, along with the PIs, presented a poster with a description of the project and a summary of the on-going works.
- Poster with the work developed to date was presented at the Oregon Convention Center in Portland, Oregon. This corresponded to a Graduate Student Expo that had participation of members from the university as well as from industry partners. The graduate student assistant in the project, along with the PIs, presented a poster with a description of the project and a summary of the on-going works.
- Drafting of the section on low cycle-fatigue is at the 80% draft stage. Section of the report on shear friction testing has been ready for submission to ODOT.
- Presentation prepared and submitted to ODOT with preliminary results on shear friction testing for dissemination by ODOT engineers in AASHTO committees.
- Working with ODOT engineers, ODOT submitted requests other DOTs towards developing a working agenda item for possible submission to AASHTO T-10 committee. This WAI summarizes work done in Phase 1 and proposes need for additional research related to use of HSS.

Specific Progress This Quarter

- 85% of the report is now drafted

Problems

- The drafting of the report is currently under way and we are scheduling to submit the final draft of the report by March 2016.
- A no cost extension has been requested and is currently under appreciation by ODOT until June 2016. The requested no cost extension would allow time for ODOT to revise the document and propose changes, so that we may reflect the feedback of ODOT engineers on the report.

Work Planned for Next Quarter

- Finalize the draft report and submit to ODOT for comments.
- Submit revisions to a first journal paper that has been tentatively accepted for publication at the ASCE Journal of Bridge Engineering.
- Prepare a third journal publication on low-cycle fatigue performance of HSS.
- Continue work on organization of the special session to be held at 16WCEE.

6. **Project Coordinator's Comments** (Completed by ODOT)

This project should have had a no-cost extension in place by the end of the quarter, but I overlooked that need in the process of shuffling research coordinators. I will get to work on this immediately.

7. **Finances** (Completed by ODOT)

SPR Project Summary

VENDOR	FY14	FY'15	FY'16	FY'17	TOTALS
ORIGINAL BUDGET	\$ -				\$ -
WORKPLAN BUDGET	\$45,000	\$80,000	\$10,000		\$135,000
REVISED BUDGET	268	\$45,000	\$89,732		\$ 135,000
EXPENDITURES - VENDOR	\$ 268	\$ 99,037	\$ 24,882	\$ -	\$ 124,187
BALANCE	\$ -	\$ (54,037)	\$ 64,850	\$ -	\$ 10,813
ODOT	FY14	FY'15	FY'16	FY'17	TOTALS
ORIGINAL BUDGET	\$61,750	\$121,500	\$61,750		\$ 245,000
REVISED BUDGET	\$8,268	\$5,000	\$5,000		\$18,268
EXPENDITURES - ODOT	\$ 8,268	\$ 4,729	\$ 1,345	\$ -	\$ 14,342
BALANCE	\$ -	\$ 271	\$ 3,655	\$ -	\$ 3,926
PROJECT	FY14	FY'15	FY'16	FY'17	TOTALS
ORIGINAL BUDGET	\$ 61,750	\$ 121,500	\$ 61,750	\$ -	\$ 245,000
REVISED BUDGET	\$8,536	\$50,000	\$94,732	\$0	\$153,268
EXPENDITURES - PROJECT	\$ 8,536	\$ 103,766	\$ 26,227	\$ -	\$ 138,529
BALANCE	\$ -	\$ (53,766)	\$ 68,505	\$ -	\$ 14,739