TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

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 # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #93 MwRSF Project No. RPFP-16-MGS-4	☑ Quarter 1 (January 1 – March 31) ☐ Quarter 2 (April 1 – June 30) ☐ Quarter 3 (July 1 – September 30) ☐ Quarter 4 (October 4 – December 31)

Project Title:		
Top Mounted Socket for Weak Post Bridge Rail		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Faller, Bielenberg, Lechtenberg, Rosenb	402-472-9324	srosenbaugh2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211123001	RPFP-16-MGS-4	10/1/2015
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
9/30/2018	9/30/2018	0

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
$130,538	$61,050	70%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$29,126	

Project Description:

Numerous box culverts across the country utilize low-fill soil above the top slab, typically in the range of 1 to 3 ft. Because these fill heights do not permit full guardrail post embedment (i.e., 40 inches), alternative post attachment/anchorage options are required to protect the culvert drop-off. Top-mounted post systems have been developed to bolt to the top culvert slab. Unfortunately, when the guardrail system is impacted and posts need to be repaired and/or replaced, maintenance personnel are required to dig up the roadway and/or fill soil to access the attachment bolts and base of posts. This effort adds significant time and costs to system repairs.

Recently, a side-mounted socket system for weak-post MGS was developed for attachment to the outside face of culvert headwall. The system posts are inserted into steel sockets that remain undamaged during impacts. Thus, damaged posts can be replaced without any soil removal or the need for a post driver. However, there are many installations where the culvert or roadway geometry is not compatible with this side-mounted system. For example, the culvert headwall may be farther from the roadway than the adjacent guardrail system. Additionally, there may be a fill slope between the edge of the roadway and the culvert headwall, and the side-mounted guardrail system was only recommended for level terrain applications. The ideal guardrail system for use on low-fill culverts would combine the benefits of a top-mounted system with that of a socketed system. Utilizing sockets would allow for quick and easy repairs to damaged posts, while mounting the sockets to the top of the culvert slab would allow the system to be installed on virtually all culverts.

The objective of this project is to develop a top-mounted socket to attach the weak-post W-beam guardrail system to the top slab of low-fill (1-3 ft) box culverts.

Objectives / Tasks:

1. Literature Review
2. Conceptual Design and Analysis

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Previously, the project sponsors elected to move forward with the evaluation of 3 socket configurations: 1) a steel socket, 2) a cylindrical concrete foundation, and 3) sockets encased in a concrete slab. The steel socket was successfully tested through both the strong and weak axis configurations. The cylindrical concrete foundation was successfully tested through the strong axis at the minimum fill depth of 12.5".

This quarter, a cylindrical concrete foundation was installed at the maximum fill depth of 36" and subjected to a weak-axis impact at a height of 12" above ground line. Post bent over and the bogie eventually overrode the top of the post. the foundation sustained no damage and had only 1/16" of permanent displacement.

Additionally, the concrete slab concept was fabricated and tested. A 9-ft long x 3 ft wide x 4" thick concrete slab was poured with its back edge at the slope break point of a 2:1 slope. Two sockets spaced 37.5" apart were placed within the concrete slab 24" from the back edge of the slab. The test was conducted such the the bogie vehicle impacted 2 posts simultaneously through the strong axis at 25" above ground line. Upon impact, the concrete slab fractured apart almost immediately and allowed the sockets to rotate. Due to the socket rotation, the posts did not bend as intended. Thus, the concrete slab concept was not recommended for future use.

After the conclusion of the component testing program, the test installations and the simulated culvert were removed from the test site.

Anticipated work next quarter:

Drawings will be developed to illustrate the recommended system installations for top-mounted sockets for weak-post MGS on culverts. Also, work will begin on the summary report.

Significant Results:

A literature review was completed covering all previous crash-testing of related weak-post systems and top-mounted culvert guardrail systems. Following some initial conceptual designs, discussions with the project sponsors led to the selection of 3 socket design options for evaluation: 1) a steel socket, 2) a cylindrical concrete foundation, and 3) sockets encased in a concrete slab.

The reinforced steel socket option was evaluated through both the strong and weak axis of the post at impact heights of 25" and 12", respectively. The sockets were placed on the slope break point of a 2:1 slope, and the culvert soil fill depth was at its maximum of 36 inches. This configuration was considered critical to maximize the potential for socket damage and displacement. Both tests resulted in virtually no damage to the socket, and permanent deflections of the socket was less than 0.5" (as measured at the top of the socket.

A dynamic component test was also conducted on the cylindrical concrete foundation. Since this concept has already proven to resist movement in soil with a 30" embedment depth, the shallowest embedment depth (12') was selected as the critical soil depth to evaluate the anchorage of the foundation to the top of the culvert. The test was conducted through the strong axis of the post with a 25" impact height. The test resulted in virtually no damage or displacement of the concrete foundation. A second cylindrical concrete foundation was installed at the maximum fill depth of 36" and subjected to a weak-axis impact at a height of 12" above ground line. The post bent over and the bogie eventually overrode the top of the post. the foundation sustained no damage and had only 1/16" of permanent displacement.

A 9-ft long x 3 ft wide x 4" thick concrete slab was poured with its back edge at the slope break point of a 2:1 slope. Two sockets spaced 37.5" apart were placed within the concrete slab 24" from the back edge of the slab. The test was

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

Potential Implementation:

With the successful completion of this project, state DOTs will have a crashworthy, top-mounted, socketed guardrail system for use on low-fill culverts. The use of sockets to support the guardrail posts will minimize maintenance and repair costs, while having a top mounted system will allow the guardrail system to be placed anywhere on the culvert.