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)* TPF-5(193) Suppl. #87	**Transportation Pooled Fund Program - Report Period:** ☐ 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: Guidelines for Placement of Breakaway Light Poles Behind MGS		
Name of Project Manager(s): Faller, Bielenberg, Reid, Pajouh	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611130094001	**Other Project ID (i.e., contract #):**	**Project Start Date:** 7/10/2015
Original Project End Date: 6/30/17	**Current Project End Date:** 6/30/17	**Number of Extensions:** 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
$262,603	$112,173	40%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$76,421	

Project Description:

Light poles are a commonly found along most highways due to the need to provide proper illumination to critical areas of the road. It is not uncommon for light poles to be placed in areas where guardrail is present as well. In these situations, light poles must be placed sufficiently close to the roadway while not interfering with the performance of the guardrail system. However, several concerns exist when placing light poles in close proximity to guardrail that may affect its ability to safely contain and redirect vehicles. First, interaction between a deflected guardrail system and a pole may create unwanted stiffening or hinging of the barrier system about the pole, which may cause pocketing and increased loading to the guardrail. The pole may also present a snag hazard to impacting vehicles, which may cause increased vehicle decelerations and instabilities. Third, interaction between the guardrail posts and light pole may affect barrier performance. While the use of breakaway light poles may mitigate these concerns to some degree, the interaction between a guardrail system and a closely-positioned light pole requires further investigation.

The Illinois Tollway currently has many instances where light pole placement is desired directly behind W-beam guardrail in order to provide adequate road illumination. Illinois Tollway and Illinois Department of Transportation have recently adopted the Midwest Guardrail System (MGS) as their standard W-beam guardrail design. The current Illinois Tollway standard for light poles is to place the pole no closer than the minimum barrier clearance distance of 28 in. (standard 6 ft -3 in. post spacing), 23 in. (½-post spacing), and 14 in. (¼-post spacing). In order to accommodate poles positioned closer than the minimum barrier clearance distance, an investigation should be conducted to determine if the minimum standard distance for breakaway light poles can be reduced, and if so, determine the optimal position of the light pole with respect to the guardrail system. It is anticipated that computer simulation/modeling with non-linear finite element analysis will be conducted to reduce the number of required crash tests. Crash tests should be conducted according to the AASHTO MASH Test Level 3(TL-3) impact safety criteria.

The objective of this research effort is to develop guidance for safe placement of the Illinois Tollway standard light pole

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

In this quarter of the research project, further computer simulations of the vehicle impacting the MGS offset a light pole were conducted to identify the critical impact point and the critical location of the light pole. Based on results of simulations and the sponsor input, 20 in. lateral offset of pole from the back of MGS was recommended as the minimum pole offset that could have a reasonable chance of passing MASH safety criteria.

In addition to the computer simulations results, previous crash testing of the MGS system was analyzed to select the longitudinal pole offset along the MGS. The longitudinal pole offset was selected to ensure that the post would have the maximum engagement with the pole upon the vehicle wheel impact. Accordingly, 24-in offset of pole from the post with the maximum deflection (post no. 13) was recommended for full-scale crash testing, test designation 3-11 using 2270P.

The numerical analysis primarily focused on the 2270P vehicle due to its larger dynamic deflections and potential for snagging, but 1100C vehicle impacts were also evaluated. Similar to case of the 2270P pickup, the 1100C wheel may extend under rail and interact with posts and pole. Several cases were simulated when the pole was placed at 20 in. offset from the back of post (selected from the pickup truck analysis) and longitudinal offset varying from 4 in. to 16 in. along the barrier from the post no. 13. Based on the previous crash testing and simulation results, a 16-in. longitudinal offset of the pole from post no. 13 was recommended for full-scale crash testing, test designation 3-10.

The recommended critical pole offsets and critical impact points for both tests (test designation 3-11 and 3-10) were discussed with the sponsor and finalized for full-scale crash testing. The as-tested CAD drawings for both tests were prepared.

Anticipated work next quarter:

During the upcoming quarter, two full-scale crash tests will be conducted:

• Test Designation 3-10 with a 2,425-lb small car (1100C) impacting at speed of 62 mph and angle of 25 degrees

• Test Designation 3-11 with a 5,000-lb pickup truck (2270P) impacting at a speed of 62 mph and angle of 25 degrees

In both tests, a 175-ft long standard MGS with 31 in. rail height with the recommended critical offset from the Illinois Tollway specified breakaway pole will be impacted at the critical point that was determined in the numerical investigation phase. The crash tests results will be utilized to prepare the guidelines for safe placement of pole behind MGS.

Work will also continue on the summary report for the research project.

Significant Results:

The lateral offset of pole was recommended 20 in. from the back of MGS as the minimum pole offset that can have a reasonable chance of passing MASH safety criteria.

For the test designation 3-11 (2270P pickup truck): Critical impact point was found just downstream of a post (post no. 11). A longitudinal offset to the pole pole of 20 in. downstream of post no. 13 was observed to produce the most critical behavior.

For the test designation 3-10 (1100C passenger car): The critical impact point was found to be at the midspan between posts. A longitudinal offset to the pole of 16 in. downstream of post no. 13 was observed to produce the most critical behavior.

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:

The successful development and evaluation of a minimal offset for light poles placed adjacent to the MGS would allow the Illinois Tollway and the Illinois DOT to reduce light pole relocations in upcoming construction projects and avoid relocation in projects that are currently underway. Avoiding or reducing light pole relocations when minimum clearance distance is not met would reduce construction costs. In addition, the research could potentially reduce the need for supplemental lighting, planning, and analysis of lighting impacts due to necessary light pole relocation.