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. #75	**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: Length of Need for Free-Standing, F-Shape, Portable 12.5' Concrete Protection Barrier		
Name of Project Manager(s): Ron Faller, Bob Bielenberg, John Reid	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611211107001	**Other Project ID (i.e., contract #):** RHE-08	**Project Start Date:** 7/1/2014
Original Project End Date: 12/31/15	**Current Project End Date:** 12/31/16	**Number of Extensions:** 1

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
$189,820.00	$93,050.00	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
	$31,381.00	

Project Description:

The objective of this research effort is to investigate and evaluate the safety performance of the previously developed F-shape PCB system in order to determine minimum system length and the number of barriers required for the beginning and end of the length of need. It is proposed that the system be evaluated according to the TL-3 criteria set forth in MASH. Two full-scale crash tests would be conducted to evaluate the performance of PCB system in order to evaluate its safety performance and investigate its dynamic deflection. The research effort will be split into two phases. Phase I, will be conducted to investigate the F-shape PCB system through computer simulation modeling in order to determine minimum system length and the number of barriers required for the beginning and end of the length of need. Phase II, would consist of the full-scale crash testing required to validate the system length and beginning and end of length of need recommendations from Phase I.

Phase I

The research effort for Phase I will begin with LS-DYNA computer simulation of the F-shape PCB system. Previous research efforts at MwRSF involving the F-shape PCB have developed reasonably accurate computer simulation models of the free-standing F-shape PCB system. These models will be used to analyze PCB system length and beginning and end of the length of need requirements. Four cases are proposed for analysis.

1. Simulation of the minimum number of PCB segments required on the upstream end of the barrier installation for a long overall system length.
2. Simulation of the minimum number of PCB segments required on the downstream end of the barrier system for a long overall system length.
3. Simulation of the minimum number of PCB segments required on the upstream end of the barrier system for a minimum overall system length.

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

Previously, MwRSF completed simulation of impacts on the upstream and downstream ends of the 200 ft long barrier system to determine the length of need. It was determined that three barriers would be recommended for both the beginning and the end of length-of-need for the TCB system, until the results could be further discussed with the TAC.

The next step of the simulation analysis was to conduct impacts at the selected beginning and end of length-of-need lengths for a reduced system length in order to verify that the length-of-need definitions work for shorter lengths and to examine the minimum potential length of the TCB system. Simulation models were evaluated using a seven barrier long TCB system. The results of these models found that the 2270P vehicle was successfully redirected for the seven barrier installation at both the beginning and end of the LON. In both cases, the reduced barrier system increased barrier deflections by approximately 16" over the full-length, 16 barrier system. Additionally, the impact at the end of the LON indicated a potential for the last barrier in the system to rotate rapidly towards the vehicle as it was redirected and impact the vehicle door. Thus, while the vehicle was redirected and the increases in deflections were manageable, the impact of the barrier with the driver side door was a concern.

These findings were discussed in detail at the July 21st TAC meeting in order to determine what the TAC concerns were and what was desired to be investigated through full-scale testing. The TAC indicated that the rotation and impact of the end barrier with the vehicle was a concern and wished to analyze the system with eight barriers, 3 for the beginning of LON, one in the middle, and 4 on the end of the LON. These models were simulated. Again both models successfully redirected the impacting vehicle. The addition of the fourth barrier on the end of LON mitigated the impact of the barriers on the vehicle door. Barrier deflections for impact at the beginning and end of LON for the 8 barrier installation were found to be 94.8 in. and 90 in., respectively. These results were given to the TAC in a meeting on 10-15-15. They concurred that testing should proceed on the 8 barrier installation.

Anticipated work next quarter:

The remaining work for the project will consist of additional simulation analysis and reporting. The simulations investigating MASH TL-3 and the 85% impact severity on both the standard length and reduced length systems will be analyzed and compiled for providing barrier deflection guidance.

The summary report of the research including the analysis, full-scale crash testing, and conclusions and recommendations is currently underway and will continue in the upcoming quarter. In addition, a paper will be prepared for the 2017 International Roadside Safety Conference in San Francisco.

Significant Results:

Simulations of reduced system lengths were completed and a minimum system length of eight barrier segments was recommended for testing.

CAD details were developed and system hardware is ready and waiting in test queue.

Two full-scale crash tests were conducted on the beginning and end of length-of-need on a reduced length PCB system.

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).

Currently, remaining tasks in the project include two full-scale crash tests, additional simulation of reduced length system deflections, and completion of the summary report. Funding for the project tasks remains, but a time extension was requested and received this quarter that extends the project completion date to 12/31/16.

Potential Implementation:

Evaluation of the F-shape PCB minimum system length and the number of barriers required for the beginning and end of the length of need will provide NDOR with improved and validated guidance for their PCB system configurations. These guidelines will improve the safety of PCB installations and may potentially shorten the number of barriers used in these types of installations. This will improve the flexibility of the PCB systems and reduce the number of impacts. The research would also define the increase in barrier deflection for shorter system lengths and better define necessary clear areas behind the PCB segments in work zones.

MwRSF will work closely with NDOR engineers and the TAC committee throughout the evaluation of the LON for PCB systems in order to ensure that the research effort meets the project goals and supplies adequate information to NDOR. This should ensure that the results of the study are viable for NDOR as well as state DOT's across the country.

The dissemination of the research results will be made through the use of a final report describing the computer simulation and investigation of PCB system lengths and the full-scale testing used to evaluate the proposed guidelines. In addition, the results of the research effort will be published as a paper in a refereed journal, if warranted. Following the completion of the study, the results of the study will be disseminated by MwRSF personnel in future NDOR transportation presentations given to State DOTs and to participants of technical engineering conferences, industry meetings, trade shows, and conventions so that dissemination and distribution of the final research results will provide the most significant impact in terms of safety benefit for the motoring public.