WYOMING DEPARTMENT OF TRANSPORTATION

QUARTERLY PROGRESS REPORT

Project title: Pooled Fund for the Development of Approach Guardrail Transitions for Box Beam and MGS

Project Number: TPF-5(393)

Progress period: 11/1/2022 – 01/31/2023

Principal Investigator and all others who have worked on the project (provide name and ORCID number): Roger Bligh (#0000-0001-5699-070X), Nauman Sheikh (#0000-0003-1718-4881), Nathan Schulz (#0000-0002-7527-9419), James Kovar (#0000-0002-1542-7010)

1. Please state whether the project is ahead of schedule, on time, or behind schedule:

The design of the box beam transition to concrete parapet took longer than expected to complete due to design challenges associated with the stability of the pickup truck. Additionally, the approval of Amendment #3 to the contract was delayed due to delays in WYDOT receiving federal funds. The testing performed on the concrete parapet shape transition resulting in more extensive damage than initially planned. This resulted in a need for additional design and reconstruction under a proposed Amendment #4.

2. Percentage of overall work completed.

88% (Note that this percentage reflects completion of work for the adjusted scope of work under Amendment #3).

3. Activities and Accomplishments:

a. What are the major goals and objectives of the project?

The research objective is to develop non-proprietary approach guardrail transition systems from box beam and MGS guardrail to the Texas Department of Transportation (TxDOT) Type C2P bridge rail system that are MASH Test Level 3 (TL-3) compliant. An additional objective added to the scope of the project is to develop a box beam guardrail transition to a vertical concrete parapet. Shape transitions will be designed to transition the vertical concrete parapet to both a single slope barrier and a New Jersey profile barrier. The work plan for the project is divided into ten tasks. These include:

Task 1: Engineering Design and Drawing Development
Task 2: Finite Element Modeling & Simulation
Task 3: Test Installation Construction
Task 4: Crash Testing of the Box Beam Transition

Task 5: Crash Testing of the MGS Transition
Task 6: Concrete Transition Parapet Design and Analysis
Task 7: Development of Box Beam Transition to Concrete Parapet
Task 8: Full-Scale Crash Testing – Box Beam Transition to Concrete Parapet
Task 9: Final Report
Task 10: FHWA Eligibility Letter

b. Describe what was accomplished under these goals.

Task 1: Engineering Design and Drawing Development (previously completed)

Task 2: Finite Element Modeling & Simulation (previously completed)

Task 3: Test Installation Construction (previously completed)

Task 4: Crash Testing of the Box Beam Transition (previously completed)

Task 5: Crash Testing of the MGS Transition (previously completed)

Task 6: Concrete Transition Parapet Design and Analysis (previously completed)

Task 7: Development of Box Beam Transition to Concrete Parapet (previously completed)

Task 8: Full-Scale Crash Testing – Box Beam Transition to Concrete Parapet

As previously reported, testing of the concrete shape transition resulted in substantial damage to the short concrete parapet section. It was concluded that the concrete parapet should be repaired before attaching and testing the box beam transition. The WYDOT technical representative concurred that reconstruction of the concrete parapet should be completed prior to any further testing of the box beam transition to concrete parapet. A modification request for the redesign and reconstruction of the concrete parapet was prepared and submitted to WYDOT for consideration.

A strength analysis was performed on the parapet anchorage reinforcement, and a recommendation for a reduced anchor spacing to mitigate need for repairs in the field was discussed and approved by the WYDOT technical representative. The concrete parapet has been reconstructed with the new anchorage design.

Task 9: Final Report

The researchers have not received notification of the publication of the interim report and assume it is still in the publication process. The research team and the WYDOT technical representative recommended publishing the report as a standalone Phase I report rather than an interim report that will be added to the final report. The report is very sizeable, and the material stands on its own. The development and testing of the box beam transition to concrete parapet can be prepared as a Phase II or final report.

Task 10: FHWA Eligibility Letter

Additional comments were received from FHWA regarding the funding eligibility package for the C2P bridge rail that was submitted to FHWA by the Texas Department of Transportation (TxDOT). The questions were addressed, and the test summary pages and drawings were converted to be 508 compliant for posting on the FHWA web site. The publication of the eligibility letter is still pending.

Draft eligibility request forms for the box beam and MGS transitions to C2P bridge rail were previously developed and submitted to WYDOT for review and approval. Submittal of the funding eligibility packages for both systems can be completed once approval to submit the interim (Phase I) report is received.

c. What opportunities for training and professional development has the project provided? If the research is not intended to provide training and professional development, state "Nothing to Report". Otherwise, describe opportunities for training and professional development, training activities, and professional development.

Nothing to report.

d. How have the results been disseminated to communities of interest? Describe what results have been disseminated and in what manner, including publications, conference papers, and presentation. Please list ALL derivative reports/publications which were generated from this project, and provide an electronic copy of the report/publication.

Nothing to report.

e. What do you plan to do during the next reporting period to accomplish the goals and objectives? Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.

Task 8: Full-Scale Crash Testing – Box Beam Transition to Concrete Parapet

The box beam transition system, approach rail, and terminal will be installed and attached to the reconstructed concrete parapet. MASH Test 3-20 has been tentatively scheduled for March 23, 2023. This test involves a 2,420-lb passenger car impacting the transition at its critical impact point (as determined through finite element simulation) at a speed of 62 mph and an angle of 25 degrees. The results will be reported to the WYDOT technical representative after the test. The test installation will then be repaired in preparation for MASH Test 3-21.

Test 3-21 will be scheduled and performed after approval of Amendment #4, which is currently pending. Amendment #4 provides additional funding that was needed to cover parapet

reconstruction. Existing funds from the planned testing program were used for the reconstruction in the interim.

Task 10: FHWA Eligibility Letter

The FHWA funding eligibility packages for the box beam and MGS transitions to C2P bridge rail will be submitted upon WYDOT approval of the interim report documenting the full-scale crash testing of these systems. In addition to the interim report, the FHWA eligibility request package for the transition systems will include FHWA Office of Safety Form to Request Federal Aid Reimbursement Eligibility of Safety Hardware Devices (version 10.0), drawings of the test installations, high-speed and real-time video of the crash tests performed, and photographs of the test installation and test vehicle before and after each test.

An eligibility request form will be initiated for the concrete shape transition, which successfully completed the MASH crash testing matrix. However, it cannot be submitted until the final report is completed and approved.

Because the upstream end of the box beam transition required modification from the previously tested version, an eligibility request cannot be submitted for the box beam transition. However, a professional opinion for the system based on the finite element simulations will be prepared upon successful completion of the MASH crash testing on the downstream end.

f. List any products resulting from the project during the reporting period. Include in this list:

1. Publications, conference papers, and presentations.
2. Website(s) or other internet sites (List the URL).
3. Technologies or techniques.
4. Inventions, patent applications, and/or licenses.
5. Other products, such as data or databases, physical collections, audio or video products, software or NetWare, models, educational aids or curricula, instruments or equipment.

Nothing to report.

g. Impact:

1. How will this project impact WYDOT?
2. How will this project impact other agencies?

WYDOT's Mission Statement is to "provide a safe, high quality and efficient transportation system." One of the goals within the mission statement is to "improve safety on the state transportation system." Successful implementation of the transitions developed under this project into WYDOT's standard plans will provide an improved level of safety. The transitions will provide continuity of motorist safety from MASH guardrail systems to MASH bridge rail systems. Full implementation of MASH compliant roadside safety devices, including transition systems, will provide an enhanced level of safety that will help reduce the severity of lane departure crashes that represent over 75% of highway fatalities in Wyoming. Additionally, the AASHTO/FHWA MASH Implementation Agreement requires state DOTs to provide MASH

compliant roadside safety features to obtain federal funding reimbursement on projects. The results of this research will be useful to other agencies. This project is being funded as a pooled fund effort between WYDOT and Montana DOT. It will provide transition details that will be immediately implementable by both of these agencies as well as other agencies that use similar guardrail and bridge rail systems.

h. Changes to Scope of Work. Provide the following changes, if applicable:

1. Scope of work or objectives of the project.
2. Changes in key persons.
3. Disengagement from the project for more than three (3) months, or a twenty five (25) percent reduction in time devoted to the project.
4. The inclusion of costs that require prior approval.
5. The transfer of funds between line items in the budget.
6. The subawarding, transferring or contracting of work.
7. Changes in the approved cost-sharing or match.

As noted in this report, the damaged concrete parapet required reconstruction prior to further testing of the box beam transition. The reconstruction of the concrete parapet was not anticipated and was not budgeted in the current project scope. A modification request was prepared to cover the reconstruction of the concrete parapet and associated design work.