

First Quarter 2006 Progress Report
Midwest Roadside Safety Facility
Mid-States Regional Pooled Fund
April 25, 2006

Projects with Pending Full-Scale Crash Tests

Development of a Guardrail Treatment at Intersecting Roadways-Year 3

After discussion at the April Pooled Fund meeting, a design change was developed to eliminate the trigger mechanism in front of the rail system. Bogie testing of the new anchor system was completed and information regarding the change was distributed to the States and found acceptable to the majority. A full-scale 820C test (SR-6) was performed on 10/7/05. While the vehicle was captured in the system, there was substantial damage. The test was determined to be a marginal pass. We are going to rebuild the system and perform a test with an update 2270P vehicle to evaluate the changes made in the system. That test is anticipated in the 2nd Quarter of 2006. There are two more funded tests on this project. We are going to utilize update vehicles for the next two tests so money from contingency funds will be utilized for the additional vehicle cost.

Three-Cable Guardrail

Based on responses from the States, we are going to proceed with this test utilizing an offset distance of 48" from a 1.5:1 slope and 4' post spacing. This test will follow culvert testing.

Development of a Four-Strand, High-Performance Cable Barrier

This research plan will focus on three primary issues facing application of the system. The first will involve evaluation of the system at the base of a V-ditch and at other potential locations along the slope to determine critical locations. LS-DYNA modeling will be utilized to evaluate the influence of moderate roadside slopes on system performance. Results of crash tests on flat ground will be used to refine the barrier model and improve its accuracy. The modeling will be utilized to determine the maximum ditch slope and depth at which the barrier can be expected to perform adequately. The second objective is the design of an anchorage system to provide long term maintenance of cable tension. This design effort will by necessity consider a variety of potential soil conditions and provide guidance for design of anchorage based on in situ conditions that may be encountered at various sites. Finally, the attachment of the cable to the post that provides a positive connection for backside hits is critical to the performance of the cable in the median. A connection that provides lateral capacity when the cable is mounted on the off-impact side of the post allows the system to be constructed without weaving the cables.

Over the past quarter a number of attachment concepts have been evaluated both statically and dynamically. Due to the significant number of patented concepts in this area, the subset of available options is somewhat limited. Attached is the attachment method that is most promising. It has the lateral capacity to move the post in the soil while releasing if the vehicle impacts the post. Currently we are getting parts fabricated for the final testing of this attachment scheme.

Two full-scale crash tests of the new system (1 @ 820C and 1 @ 2000P) are budgeted herein to verify performance in a V-ditch. Additional funding will be required at the completion of this effort to evaluate system compliance at TL-4.

Evaluation of Transverse Culvert Safety Gate

Full-scale testing is anticipated in the 2nd Quarter of 2006 depending on the weather. We have completed a test pit and have poured two of the four sides of 20' X 20' culvert grate system which will be tested on a 3:1 slope. The vehicle will leave the flat at about the lower right hand corner of the excavation shown and will land on the culvert grate which is located near the bottom of the slope approximately in the middle of the excavation. The upper left excavation is to provide run out room. This same pit will be utilized for the cable on slope project after the culvert tests are completed.



Flare Rates for MGS W-Beam Guardrail

As previously discussed, three successful crash tests have shown the MGS system to perform well at a 7:1 flare rate. With the one additional test budgeted in the project we have constructed a system with a 5:1 flare. This system will be tested during the annual pooled fund meeting, weather willing. If this system performs adequately, an additional test with the 820C vehicle will be needed to assure compliance.

Approach Slopes for W-Beam Guardrails Systems

Based on the result of our simulation study and feedback from States we will initially test an MGS system located 5' from travelway on an 8:1 slope. This offset distance was deemed critical during the simulation study, so success at this offset would indicate that locating an MGS system at any distance from the travelway on an 8:1 or flatter slope would be acceptable. If this test is successful, a steeper slope will be investigated.

Concept Development of a Bridge Pier Protection System for Longitudinal Barrier

Plans for the proposed system were distributed to the States in the 3rd Quarter of 2005. We are anticipating beginning construction of the system in the 2nd Quarter after completion of the MGS long span testing.

New TL-5 Median Barrier and Anchor

The literature review for this project is nearing completion. Several shapes are being investigated based on head ejection. Currently feedback from slipformers is being sought with regard to these cross sections. Design and subsequent requests for review from Pooled Fund States are anticipated in the 2nd Quarter.

Long Span Design for the MGS Guardrail System

The system in the attached drawing has been constructed. Testing is currently planned for the week before the pooled fund meeting, but may be delayed due to weather. This system is similar to the existing long span, but utilizes the MGS system and does not have any nested rail.

Midwest Guardrail System on Breakpoint of a 2:1 Slope

Simulation of this system continued in the 1st Quarter. A bogie matrix evaluating different length posts will be performed in the 2nd Quarter. Our objective is to either utilize standard length posts (6') with reduced post spacing or longer posts (6.5' or 7') with standard post spacing.

Cost Effective Measures for Roadside Design on Low Volume Roads

Study of rural highways with <500 ADT and ≥55 mph speed limit. This study will initially consider one State. Currently working on acquiring data.

Termination of Temporary Concrete Barrier

A simulation study as been undertaken based on previous work with both previous work with free-standing barriers and different restraint systems previously developed.

Submission of Pooled Fund Guardrail Developments to AASHTO TF-13 Hardware Guide

We are currently producing the MGS and other recent developments for submission, we will work on the backlog of past developments over the next year.

Redesign of Anchors for Temporary Concrete Barriers

No progress to date.

Develop Temporary Concrete Barrier Transition for Highest Priority Problem

Based on the results of the survey discussed below, design median transition between a permanent wall and temporary barriers will be initiated.

Evaluation of the Safety Performance of Vertical and Safety Shaped Concrete Barriers

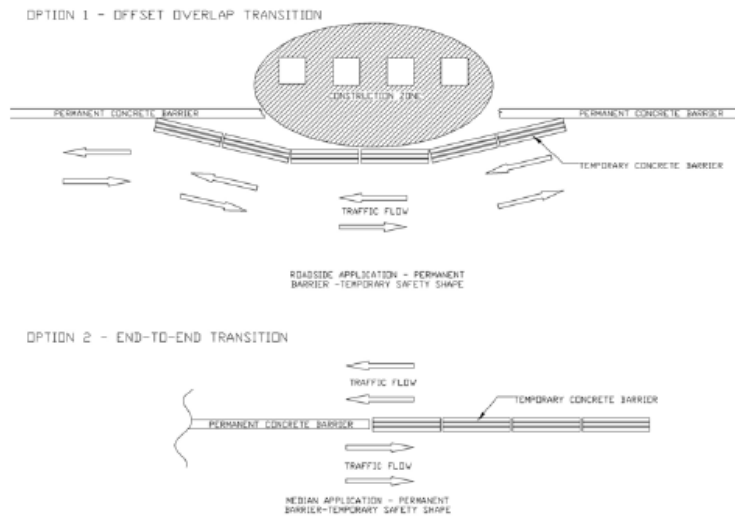
Over the past Quarter, the pooled fund states were surveyed to determine which types of temporary concrete barrier transitions are needed, which types are currently used, and which types are the most important.

The preliminary survey was sent to each of the pooled fund states. States were given eight types of commonly used temporary concrete barrier transitions and invited to add their own as desired. For each transition, the states were asked to identify the usefulness of the transition, identify the approximate percentage of all temporary barrier transitions that each type composes, and rank the transition types in order of importance.

Nine of the thirteen states responded. According to this response, the most useful transitions were those connecting temporary barriers to permanent concrete safety shape barriers and permanent concrete vertical barriers. The highest percentage of all the transitions currently in use were those from temporary barriers to permanent concrete safety shape barriers and tubular steel bridge railing. In rank of importance, transitions to permanent concrete safety shape barriers were again at the top, followed by transitions to W-beam guardrail.

As the most popular in all three categories, the transition between temporary barriers and permanent concrete safety shape barriers was chosen as the design with which to proceed. Realizing that such a transition may be applicable to more than one type of permanent concrete barrier, researchers expanded the scope of the design to include both vertical concrete parapets and safety shapes, intending to test only the most critical. Because a 350 compliant design for the transition between temporary concrete barriers and permanent safety shaped barriers was recently developed with funding from Florida, a median application was selected for this study.

After making this initial selection, a second request was sent to the states to select between two specific configurations, an end-to-end barrier transition or an offset-overlap barrier transition, both of which are shown below. Eight states replied to the additional survey. Five of those states selected the end-to-end barrier transition, and three selected the offset-overlap transition. Therefore, the project will proceed with the design of a median, end-to-end transition between a permanent concrete barrier and a series of temporary concrete safety shape barriers as shown in Option 2 below.



Paper Studies not Involving FS Crash Tests

Evaluation of Temporary Transition Needs

A survey of Pooled Fund States is currently being prepared to determine which temporary barrier transitions designs are needed, where the transitions are used, and the importance of each.

Awaiting Reporting

MGS W-Beam to Thrie-Beam Transition Contingency 2000P Test and Additional 820C Test

Utilizing the fabricated 10 gage welded asymmetrical thrie-beam section, two full-scale crash tests of this system were performed this quarter; a 2000P test on 11/10 and an 820C test on 11/22. Both tests performed well, meeting all salient criteria.

Open Railing Mounted on New Jersey Concrete Barrier (2'8")

After two unsuccessful tests of this system, we are planning on preparing a final report on the project.

Evaluation of Rigid Hazards in Zone of Intrusion

The third and final full-scale test in this project, a luminaire pole mounted on the concrete deck behind the barrier was performed on 3/3/05. The interaction of the single axle truck and the luminaire pole were incidental, but maximum intrusion over the barrier occurred before the vehicle reached the pole. All salient criteria were satisfied. In review both TL-3 and TL-4 tests of a luminaire pole mounted on the top of a 32" single slope barrier and behind that same barrier successfully passed full-scale testing with the qualification that the impact condition for the pole mounted behind the rail was not "worst case". A report for this study will be initiated.

Retest of the Cable End Terminal

Based on successful testing of this system a final report of the project will be initiated.

MnDOT Work Zone Sign Testing

Results of additional testing under this project.