

**Fourth Quarter 2006 and First Quarter 2007 Progress Report**  
Midwest Roadside Safety Facility  
Mid-States Regional Pooled Fund  
April 27, 2007

**Projects with Full-Scale Crash Tests This Quarter**

**Midwest Guardrail System on Breakpoint of a 2:1 Slope**

A 31" high, MGS system utilizing 9' long, W6X9 posts spaced at 75" was tested utilizing a 2270P update vehicle on 12/15/06. As shown in the accompanying photos, the vehicle was safely redirected. A prior 2270P test was unsuccessful at the 27 ¾" mounting height.



**Three-Cable Guardrail**

The cable barrier system, utilizing low-tensioned cable, an offset distance of 48" from the breakpoint of the slope, a steel post anchor on each end, and 4' post spacing was tested on 11/1/06. As is shown below, the vehicle was safely redirected.



**Projects with Pending Full-Scale Crash Tests**

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

With the completion of the three-cable system, excavation work on the 4:1 V-ditch has been accomplished during the 1<sup>st</sup> Quarter. System construction is currently underway. Three full-scale crash tests of the new system utilizing update vehicles (1 @ 1100C, 1 @ 2270P and 1 @ 10,000S) are planned to verify performance in a V-ditch.

**Concept Development of a Bridge Pier Protection System for Longitudinal Barrier**

Construction details are completed and construction of the system is underway.

### **New TL-5 Median Barrier and Anchor**

The reinforcing cage and foundation for the ends of the system are in place. Concrete work will be completed in the 2<sup>nd</sup> Quarter.

### **Termination of Temporary Concrete Barrier**

Construction of this system utilizing 2 driven steel anchors from the existing cable system has been completed. A full-scale test of the system is anticipated on 4/25/07 at the completion of the pooled fund meeting.

### **Development Temporary Concrete Barrier Transition**

Based on the results of the survey, a median transition from temporary barrier to permanent barrier will be developed for this study.

### **Development of a Guardrail Treatment at Intersecting Roadways-Year 3**

The last full-scale angled hit on the nose with a 2270P vehicle was performed on June 27<sup>th</sup>. During deceleration, the vehicle yawed and when nearly stopped, rolled when the rear wheels struck the three-beam. After considerable investigation and LS-DYNA analysis, researchers discovered that post 1 along the secondary side was pulled under the pickup, resulting in vehicle rollover. Design modifications have been incorporated to mitigate this behavior. The system re-construction is planned for the 2<sup>nd</sup> quarter with a retest in the 3<sup>rd</sup> quarter.

### **Testing of Cable Terminal for High Tension Cable (1100C & 2270P)**

Work on this project will commence after testing of the high-tension system.

### **Performance Limits for 6-inch high Curb Placed in Advance in Advance of the MGS**

No progress to date.

## **Paper Studies**

### **Cost-Effective Measures for Roadside Design on Low Volume Roads**

The first field trip was completed during the 3<sup>rd</sup> Quarter. We are currently looking at a second study site.

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

We have submitted the various perturbations of the MGS system to TF-13. We are continuing to work on the backlog of past developments over the next year.

### **Development of Warrants for Median Barrier System**

No progress to date.

### **Cost Effective Upgrading of Existing Guardrail System**

No progress to date.

## **Awaiting Reporting**

### **Evaluation of Transverse Culvert Safety Grate**

The culvert grate on a 3:1 slope performed well with both the 2000P and 820C vehicle.

### **Approach Slopes for W-Beam Guardrails Systems**

As a conclusion of this testing, the MGS guardrail system can safely be located any offset distance from the travel way on slopes of 8:1 or flatter.

### **MGS W-Beam to Thrie-Beam Transition**

Utilizing the fabricated 10-gauge welded asymmetrical thrie-beam section, two full-scale crash tests of this system were performed; a 2000P test and an 820C test. Both tests performed well, meeting all salient criteria. We have prepared a paper for the 2007 TRB meeting based on this project.

### **Evaluation of Rigid Hazards in Zone of Intrusion**

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.

### **Long-Span Design for the MGS Guardrail System**

This system incorporates a 25' clear span, three CRT posts with standard 12" MGS blockouts adjacent to the free span in either direction, and no nested rail. Two successful tests of this system provide evidence of structural capacity and the applicability of the system location with the back of the posts in-line with the traffic side face of the head wall. A report on this project will be initiated. We have prepared a paper for the 2007 TRB meeting based on this project.

### **Flare Rates for MGS W-Beam Guardrail**

This testing has shown that the MGS can be installed at up to a 5:1 flare rate to the travel way. A report on this project will be initiated. We have prepared a paper for the 2007 TRB meeting based on this project.

### **Reports Published this Quarter**

Bielenberg, R.W., ***Dynamic Component testing of Potential Alternative Anchors for the F-Shape Concrete Barrier Steel Strap Tie-Down System***, Letter Report to the Midwest State's Regional Pooled Fund Program, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, April 9, 2007.

Hascall, J.A., Faller, R.K., Reid, J.D., Sicking, D.L., and Kretschmann, D.E., ***Investigating the Use of Small-Diameter Softwood as Guardrail Posts (Dynamic Test Results)***, Final Report to the U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Report No. TRP-03-179-07, Midwest Roadside Safety Facility, Civil Engineering Department, University of Nebraska-Lincoln, March 28, 2007.

Dey, G., Faller, R.K., Hascall, J.A., Bielenberg, R.W., Polivka, K.A., and Molacek, K., ***Dynamic Impact Testing of W152x13.4 (W6x9) Steel Posts on a 2:1 Slope***, Final Report to the Midwest State's Regional Pooled Regional Pooled Fund Program, Transportation Research Report No. TRP-03-165-07, Project No.: SPR-3(017), Project Code: RPPF-05-09 -Year 15, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, March 23, 2007.

Bielenberg, B.W., Faller, R.K., Rohde, J.R., Ried, J.D., Sicking, D.L., and Holloway, J.C., ***Development of Tie-Down and Transition Systems for Temporary Concrete Barrier on Asphalt Road Surfaces***, Final Report to the Midwest State's Regional Pooled Regional Pooled Fund Program, Transportation Research Report No. TRP-03-180-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 23, 2007.

Hascall, J.A., Polivka, K.A., Rohde, J.R., Faller, R.K., Sicking, D.L., and Holloway, J.C., ***Design and Evaluation of an Open Combination Traffic/Bicycle Bridge Railing System***, Final Report to the Midwest State's Regional Pooled Regional Pooled Fund Program, Transportation Research Report No. TRP-03-162-07, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 9, 2007.

Polivka, K.A., Faller, R.K., Holloway, J.C., and Rohde, J.R., ***Safety Performance Evaluation of Minnesota's Temporary Rigid Panel Sign Stand Systems***, Final Report to the Midwest State's Regional Pooled Regional Pooled Fund Program, Transportation Research Report No. TRP-03-166-07, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 8, 2007.

Rohde, J.R. ***Evaluation of Bridge Deck Finishing Alternatives***, Letter Report to the Nebraska Department of Roads, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 6, 2007.

Reid, J.D., ***Analyzing Guardrail System Crash Behavior in Cyprus***, Final Report to the Cyprus Research Foundation, Transportation Research Report No. TRP-03-182-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, December 1, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., Reid, J.D., and Coon, B.A., ***Performance Evaluation of the Permanent New Jersey Safety Shape Barrier - Update to NCHRP 350 Test No. 4-12 (2214NJ-2)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-178-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 13, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., Reid, J.D., and Coon, B.A., ***Performance Evaluation of the Permanent New Jersey Safety Shape Barrier - Update to NCHRP 350 Test No. 3-10 (2214NJ-1)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-177-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 13, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., Reid, J.D., and Coon, B.A., ***Performance Evaluation of the SKT-MGS Tangent End Terminal - Update to NCHRP 350 Test No. 3-34 (2214TT-1)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-176-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 12, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., Reid, J.D., and Coon, B.A., ***Performance Evaluation of the Guardrail to Concrete Barrier Transition - Update to NCHRP 350 Test No. 3-21 with 28" C.G. Height (2214T-1)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-175-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 12, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., Reid, J.D., and Coon, B.A., ***Performance Evaluation of the Free-Standing Temporary Barrier - Update to NCHRP 350 Test No. 3-11 with 28" C.G. Height (2214TB-2)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-174-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 12, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., Reid, J.D., and Coon, B.A., ***Performance Evaluation of the Free-Standing Temporary Barrier - Update to NCHRP 350 Test No. 3-11 (2214TB-1)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-173-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 11, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., and Reid, J.D., ***Performance Evaluation of the Midwest Guardrail System - Update to NCHRP 350 Test No. 3-10 (2214MG-3)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-172-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 11, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., and Reid, J.D., ***Performance Evaluation of the Midwest Guardrail System - Update to NCHRP 350 Test No. 3-11 with 28" C.G. Height (2214MG-2)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-171-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 11, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., and Reid, J.D., ***Performance Evaluation of the Midwest Guardrail System - Update to NCHRP 350 Test No. 3-11 (2214MG-1)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-170-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 10, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., and Reid, J.D., ***Performance Evaluation of the Modified G4(1S) Guardrail System - Update to NCHRP 350 Test No. 3-11 with 28" C.G. Height (2214WB-2)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-169-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 9, 2006.

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Bielenberg, B.W., and Reid, J.D., ***Performance Evaluation of the Modified G4(1S) Guardrail System - Update to NCHRP 350 Test No. 3-11 (2214WB-1)***, Final Report to the National Cooperative Highway Research Program (NCHRP), Transportation Research Board, Transportation Research Report No. TRP-03-168-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, October 6, 2006.