

Fourth Quarter 2003 Progress Report
Midwest Roadside Safety Facility
Mid-States Regional Pooled Fund
January 29, 2004

YEAR 11

Steel H-Beam Temporary Barrier Rail and Connections

Polivka, K.A., Bielenberg, R.W., Faller, R.K., Sicking, D.L., Rohde, J.R., Reid, J.D., and Holloway, J.C., *Development of a Steel H-Section Temporary Barrier for Use in Limited Deflection Applications*, Final Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-120-03, Project No. SPR-3(017)-Year 11, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, May 30, 2003.

Development of a Guardrail Treatment at Intersecting Roadways

Bielenberg, B.W., Faller, R.K., Holloway, J.C., Reid, J.D., Rohde, J.R., and Sicking, D.L., *Phase II Development of a Short-Radius Guardrail for Intersecting Roadways*, Final Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-137-03, Project No. SPR-3(017)-Year 11, Project Code: RPPF-01-02, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, September 9, 2003.

Continued testing of the system will utilize funding under Year 13 of the pooled fund program.

Triple-Cable Barrier End Terminal and Anchorage Assemblies

The retest of the cable anchor release system will utilize funding under Year 14 of the pooled fund program.

Transition from Standard W-Beam Guardrail to Stiffened Bridge Transition

Reporting of the retest of this system utilizing the Midwest Guardrail System W-beam rail is reported in Year 12.

Low Profile Bridge Rail for Test Level 2 Applications

Polivka, K.A., Faller, R.K., Sicking, D.L., Rohde, J.R., Reid, J.D., and Holloway, J.C., *Development of a Low-Profile Bridge Rail for Test Level 2 Applications*, Final Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-109-02, Project No. SPR-3(017)-Year 11, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, August 20, 2002.

This Quarterly Report will be the last one reporting on Year 11 of the pooled fund. The remaining contingency funds in this year will be spent on the retest of the MGS W-beam to Stiffened Bridge Transition Project which will be reported in Year 12.

YEAR 12

Non-Proprietary Steel Beam Guardrail System – Year 2

Results of this project will be reported in conjunction with Year 13 results.

Development of a Guardrail Treatment at Intersecting Roadways-Year 3

Construction of this system will resume after some significant snow accumulation melts. Testing is reasonably expected in the second quarter of 2004. The system, augmented by an anchor placed near the center of the radiused section, will utilize a release mechanism similar to the cable terminal currently being tested under Year 14. This anchor will significantly reduce system deflection during impacts on either side of the radiused section and should still allow the system to capture a vehicle impacting on the “nose”.

Portable Aluminum Work Zone Signs

The bogie testing for this project has been completed. A submission to FHWA seeking approval has been sent. Polivka, K.A., Faller, R.K., Holloway, J.C., and Rohde, J.R., *Safety Performance Evaluation of Minnesota's Aluminum WorkZone Signs*, Final Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-107-01, Project No. SPR-3(017)-Year 11, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, January 29, 2002.

Currently, MwRSF researchers are coordinating with the MnDOT to conduct additional bogie and/or crash tests on other work-zone devices.

Single-Faced Concrete Barrier

Several steel reinforcement options were developed for the 42” and 51” heights for the ½-section safety shape parapet. Design of the barrier to foundation attachment details was completed in the 4th Quarter. An internal draft was reviewed and will be submitted to the States in the 1st Quarter of 2004.

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

The revised design of this transition is shown on the next page. Construction and testing of the system are planned late in the 1st Quarter or early in the 2nd Quarter of 2004. The 820C test will be performed subsequent to a successful initial test to evaluate the asymmetrical transition section.

Three-Strand Cable Median Barrier

A full-scale test of the median barrier utilizing a 4 woven cable design and M8X6.5 posts on 6' centers was completed on July 2, 2003. The vehicle was smoothly redirected but upon exiting the system, a roll was induced by interaction with a post. While the lateral stiffness of these “M” posts is lower than the typical S3X5.7 post, they present a substantially bigger target with the reduced post spacing, thus increasing the vehicle interaction with the posts. Bogie tests on this system were conducted to evaluate the effects of the cable weaving on this failure. Currently, we are evaluating alternative cabling schemes for their impact on stability, looking at several non-woven configurations. Prior to the early December snows evaluation of hook bolts was being undertaken. After a thaw, this work will continue.

Year 13

Generic W-Beam Guardrail with Curb

Polivka, K.A., Faller, R.K., Sicking, D.L., Reid, J.D., Rohde, J.R., Holloway, J.C., Bielenberg, B.W., and Kuipers, B.D., *Development of the Midwest Guardrail System (MGS) for Standard and Reduced Post Spacing and in Combination with Curbs*, Draft Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-139-04, Project No. SPR-3(017)-Years 10, 11, 12-13, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 17, 2004.

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

Construction of this system is underway. The initial 2000P is planned for the 1st Quarter of 2004.

Evaluation of Rigid Hazards in Zone of Intrusion

A full-scale TL-3 crash test was performed on July 25, 2003 of a luminaire pole mounted on top of a single-slope concrete barrier. The vehicle was smoothly redirected with modest contact with the pole. The pole remained upright with minimal cosmetic damage. All salient safety criteria were met. Based on this test and the previous TL-4 test, similarly-designed luminaire poles rigidly mounted on top of safety shape barriers appear to be acceptable. Consideration of the debris is important. The pole in the initial TL-4 test was detached, landing adjacent to the backside of the barrier. For applications where the dislodged pole could present a safety hazard, this design would not be acceptable. An additional TL-4 test of a luminaire pole mounted on the deck behind the barrier is planned for early in the 2nd Quarter of 2004 after completion of the Open Railing tests described above.

Three-Cable Guardrail

In light of the results of the median barrier test performed this quarter, options for this project are currently being considered.

Non-proprietary Guardrail System – Additional Test

Polivka, K.A., Faller, R.K., Sicking, D.L., Reid, J.D., Rohde, J.R., Holloway, J.C., Bielenberg, B.W., and Kuipers, B.D., *Development of the Midwest Guardrail System (MGS) for Standard and Reduced Post Spacing and in Combination with Curbs*, Draft Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-139-04, Project No. SPR-3(017)-Years 10, 11, 12-13, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 17, 2004.

Kansas Temporary Barrier Redesign and Test

Polivka, K.A., Faller, R.K., Rohde, J.R., Holloway, J.C., Bielenberg, B.W., and Sicking, D.L., *Development and Evaluation of a Tie-Down System for the Redesigned F-shape Concrete Temporary Barrier*, Final Report to the Midwest States Regional Pooled Fund Program, Transportation Report No. TRP-03-134-03, Project No. SPR-03(017)-Year 13, Sponsoring Agency Code RPRP-03-06, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, NE, August 22, 2003.

System for Stiffening New Guardrail System

Polivka, K.A., Faller, R.K., Sicking, D.L., Reid, J.D., Rohde, J.R., Holloway, J.C., Bielenberg, B.W., and Kuipers, B.D., *Development of the Midwest Guardrail System (MGS) for Standard and Reduced Post Spacing and in Combination with Curbs*, Draft Report to the Midwest State's Regional Pooled Fund Program, Transportation Research Report No. TRP-03-139-04, Project No. SPR-3(017)-Years 10, 11, 12-13, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, February 17, 2004.

YEAR 14

Development of a Four-Strand High-Performance Cable Barrier

Follows work under Year 12.

Evaluation of Transverse Culvert Safety Grate

Bogie testing of various configurations were planned for the 4th Quarter. This testing will commence after the current snow melts.

Flare Rates for W-Beam Guardrail

The objectives of this research are to evaluate the effect of increased flare rates on impact performance and identify optimal flare rates that minimize total crash costs. A literature review of flare rates, including relevant crash testing and standards, is in progress and is approximately 70% complete. Additionally, baseline Barrier VII models for the standard W-beam guardrail and for the MGS W-Beam guardrail system are under development. These models will be used to perform a flare rate variation study.

Approach Slopes for W-Beam Guardrails Systems

No Progress

Concept Development of a Bridge Pier Protection System for Longitudinal Barrier

No Progress

Retest of Cable End Terminal

The retest of the cable anchor system was performed on 10/10/03. As shown in the photos below, the anchor mechanism released as anticipated. As the vehicle progressed into the system it began to yaw and roll. As shown in the last sequential photo, the vehicle ultimately rolled causing the test to be deemed a failure. Further analysis of this test using bogie testing with an 820C vehicle has shown that the S3X5.7 post has sufficient lateral bending capacity to initiate this roll. We are currently investigating this and will propose additional work under Year 15 of the pooled fund.



OUTSTANDING ISSUES:

Strength Requirements for a Wood Post W-Beam Guardrail System

A final report for this project is anticipated in the 1st Quarter of 2004. Based on both clear wood and dynamic post testing it is recommended that the alternative species considered, white pine and red pine, would be acceptable for use if the nominal post sizes were 6X10.875" and 6X9.375", respectively.

SUPPLEMENTAL PROJECTS:

Transitions and Deflection Limiting Modifications for the Kansas Type F3 Concrete Temporary Barrier

This project was initiated with two goals. First, it was necessary to develop a tie-down system to limit the deflection of the barrier system when placed on an asphalt concrete surface with some sort of restraint mechanism. Second, it was deemed necessary to transition from free standing barrier to barrier bolted to a bridge deck.

Based on simulation utilizing results of the bogie testing completed last quarter, it was determined that the barrier system appears to meet the deflection objectives of the study utilizing a 2" asphalt pad with the barrier restrained utilizing the three existing holes on the impact face with 1.5" diameter, 3' long A36 pins. We anticipate testing this system soon after asphalt becomes available this spring.

Minnesota Sound Wall Rail

This project was initiated to design and test a railing system for MnDOT's sound wall system in situations where the wall was placed in the clear zone. A glulam rail system was designed and modeled during the 4th Quarter of 2003, details are shown on the following page. Materials for the full-scale 2000P test have been acquired and full-scale testing is anticipated early in the 2nd Quarter of 2004, hopefully on the afternoon of the second day of the Annual Pooled Fund Meeting in Lincoln.