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)* SPR-3(017) Suppl. #37	**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: Annual Consulting Services Support		
Name of Project Manager(s): Ron Faller, John Reid, Bob Bielenberg	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611211056001	**Other Project ID (i.e., contract #):** RPFP-11-CONSULT	**Project Start Date:** 7/1/2010
Original Project End Date: 12/31/13	**Current Project End Date:** 12/31/13	**Number of Extensions:** 0

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
$39,774.00	$34,326.00	100%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$13,139.00	

Project Description:

This project allows MwRSF to be a valuable resource for answering questions with regard to roadside safety issues. MwRSF researchers and engineers are able to respond to issues and questions posed by the sponsors during the year. Major issues discussed with the States have been documented in our Quarterly Progress Reports.

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

In the past quarter MwRSF has responded to a series of state inquiries. The Quarterly Progress Report summarizing these responses is attached to this document.

MwRSF also continued development of a website for the consulting effort during the past quarter. This website allows the states to submit problems directly to the website. MwRSF will then respond to the consulting problems through the website, and the problems and responses will be archived in a searchable database. Previously, a prototype of the website was submitted to the states for review. Their comments were implemented into the website this quarter.

Currently, the website is going through final review before becoming active. This work should be completed by the end of September 2011. MwRSF will notify the states early in October when the wedsite is ready for use with login information and instructions.

Anticipated work next quarter:

This marks the end of the Year 21 annual consulting effort. State questions and support will continue to be provided in the next quarters through a Year 22 consulting effort. MwRSF will continue to answer questions and provide support to the sponsors during the upcoming quarter. In addition, MwRSF will continue the effort to finalize the consulting services website and aid the states in getting familiar with it.

Significant Results:

A quarterly summary of the consulting effort is provided with this document.

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).

None.

Potential Implementation:

None.

Pooled Fund Consulting Summary

Midwest Roadside Safety Facility
July 2011 – September 2011

This is a brief summary of the consulting problems presented to the Midwest Roadside Safety Facility over the past quarter and the solutions we have proposed.

Problem # 1 – Backing Plate for Thrie Beam Attachment to Concrete Parapet

State Question:

WisDOT would like to know if we are required to have a backing plate on the backside of our parapet for our thrie beam transitions. The plate is 12"x18"x3/8" thick and has hols for the bolts used to connect the thrie beam end shoe.

Erik Emerson P.E.
Standards Development Engineer-Roadside Design
Wisconsin Department of Transportation

MwRSF Response:

Hi Erik,

These plates have been used in the past to act as a washer and distribute load over areas that may have spalled out on the backside of the parapet. We believe that it is perfectly appropriate to use plate washers for the same application rather than the plate. We have recommended similar washer plates to Iowa. A 2.5"x2.5"x0.375" or 3"x3"x/375" washer plate should work fine.

Let me know if you need anything else.

Thanks

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility

Problem # 2 – Extra Blockouts

State Question:

We have a project that will be removing the bridge rails and upgrading the bridge rails to a 32" corral rail (Kansas type of bridge rail). Attached to the old bridge rail is what you see in the picture. It appears that the contractor some time ago was allowed to use triple and double blockouts to avoid the pavement and curb and gutter. We are trying to minimize the project cost and avoid reconstructing some of the pavement and curb and gutter in order to provide a more

typical single blockout guardrail installation at this location. I recall that double blockouts can be used but limited to a certain amount of post locations. Also, what about the use of triple blockouts, limited to one post? I appreciate your help.

Thanks,
Scott King

MwRSF Response:

Hi Scott,

We have looked over the extra blockout issue that you sent. In the past, we have recommended no more than one triple 8" blockout installation very 50' for guardrail installations. This is based on concerns that the ability of the triple blockout to transmit load to the post would be compromised for large deflections. With regards to transitions, we have used a similar rationale and have limited the installation of triple blockouts to a single post in the transition at limited locations. For your installation shown, we believe that the number of consecutive triple blockouts is likely too many. In addition, the use of steel blockouts further complicates the issue, because they are more likely to buckle and fold under load during the impact and compromise the load transfer to the post.

Double 8" blockouts pose much less of an issue as we have tested them in certain systems with good results and the depth is only 4" more that the MGS blockout depth. That said the use of

double steel blockouts still poses an issue due to block collapse. We would recommend that the steel blockouts be gusseted to prevent collapse under load. This would apply to the triple block installation as well.

I should also note that when steel blockouts are used, we are recommending the use of backup plates to reduce the potential for guardrail rupture.

For the installation shown, we would recommend moving up the posts closer to the curb if possible to eliminate the triple blockouts. In addition, if you are planning on replacing the bridge rail, we would recommend realigning the transition and bridge to reduce the number of extra blockouts needed.

Let me know if you need anything else.

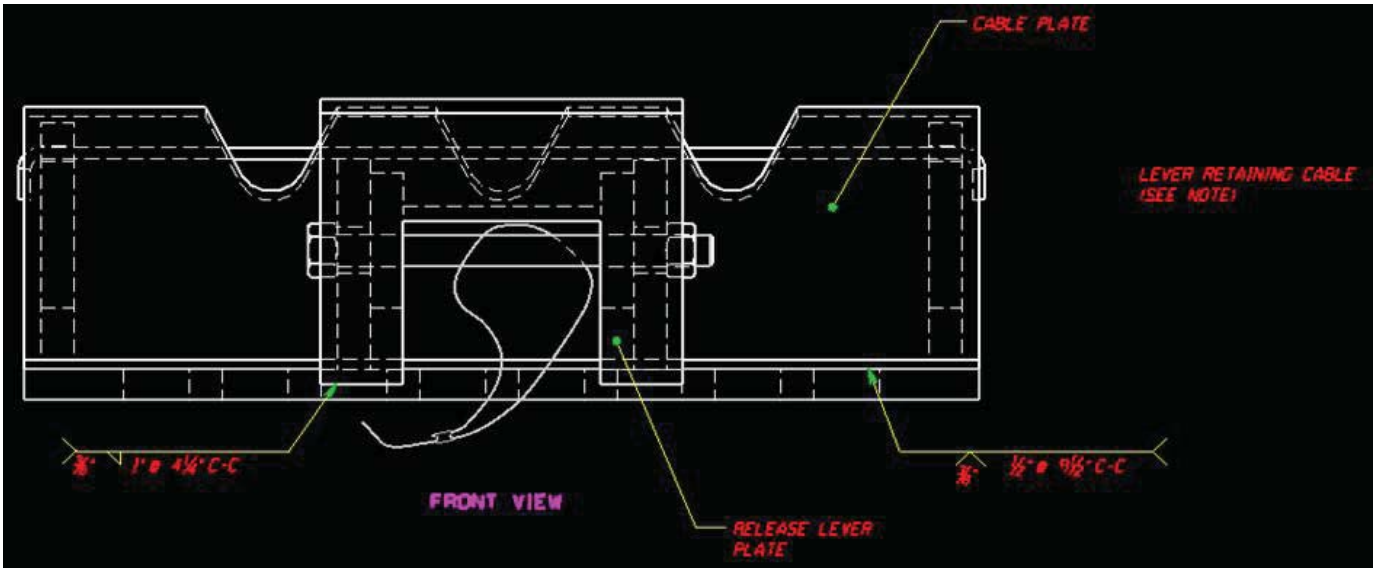
Thanks

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility

Problem # 3 – Cable Terminal Anchor Bracket

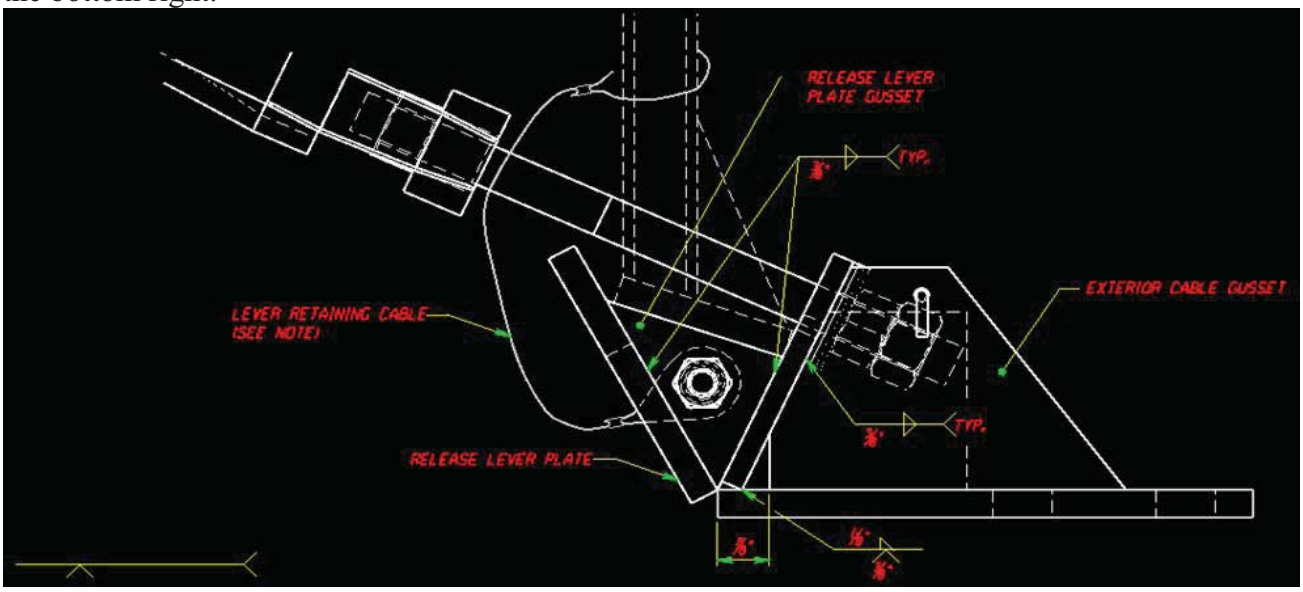
State Question:

Ron,
We are trying to get this fabricated and need some changes discussed at your level. Preferably today??



Attaching the cable plate to the base plate:
What is the weld symbol at the bottom right of this sketch referring to?

Can I remove the weld symbol? I think it is redundant from the one below on the 1/8” / 3/8” on the bottom right.



Lever Retaining Cable 3/8” is shown in the report: should this be smaller/ more flexible?
I seem to recall this being a fairly limp cable, 3/8” would be stiff.
Smaller would hold the lever to keep it from flying into traffic, and breakaway if snagged on the impacting vehicle.

Unsure of size of cable (above) – found in Pooled Fund Progress 2005 V3.ppt
3/8” was used on the short radius system (below)

The ¾” hole used in the small gusset plates out front is too large to place at the location shown & still allow a weld on the bottom side, the metal gets too thin.
The bolt used to retain the lever we don’t see dimensioned: can I change this to a ½” bolt and use a 5/8” hole?
If so I would raise it 1/8” and move 1/8” right- this will allow enouph metal to weld too.

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

MwRSF Response:

Responses are shown below in red.

Attaching the cable plate to the base plate: What is the weld symbol at the bottom right of this sketch referring to? Can I remove the weld symbol? I think it is redundant from the one below on the 1/8” / 3/8” on the bottom right.

While I agree that the top weld symbol is redundant, the weld symbol on the lower drawing has the top and bottom welds reversed. The 1/8" fillet weld should be on the bottom of the weld specification. The arrow side of the detail is shown on the bottom, while the opposite side is detailed on the top.
Lever Retaining Cable 3/8” is shown in the report: should this be smaller/more flexible? I seem to recall this being a fairly limp cable, 3/8” would be stiff. Smaller would hold the lever to keep it from flying into traffic, and breakaway if snagged on the impacting vehicle.

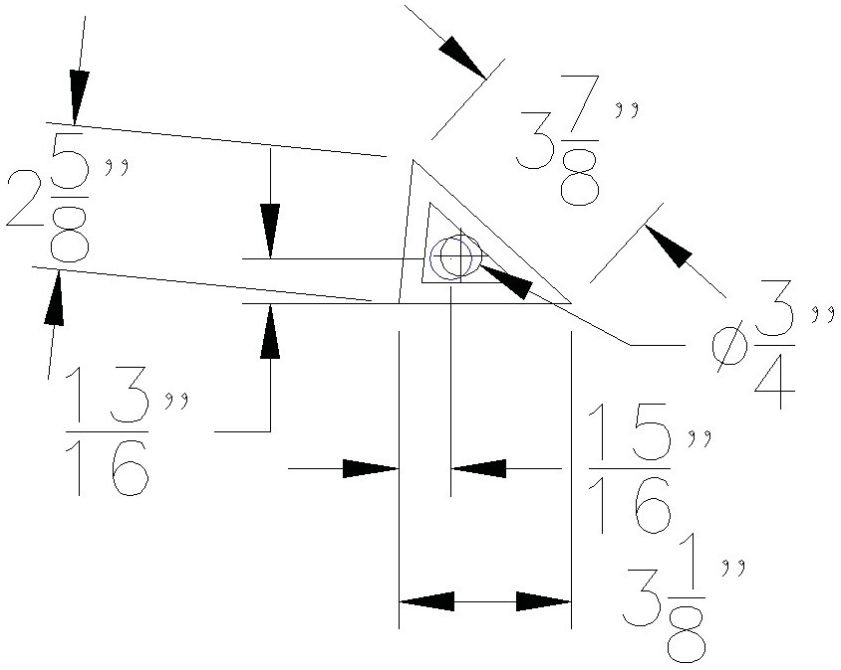
Your first attached photograph corresponds to a low-tension, three-cable end terminal test, test no. CT-3. The lever retaining cable was added to the system between test nos. CT-2 and CT-3 to address the occupant compartment penetration caused by the free-flying cable release lever. While the report states that the cable was 3/8", the initial as-tested cable size was smaller (if I remember correctly, it was likely 5/16") and utilized different clamping methods. However, during test no. CT-3, the lever retaining cable ruptured, thus allowing for the cable release lever to travel downstream with the vehicle. The lever retaining cable was increased to 3/8" for test no. CT-4. During that test, the cable again ruptured allowing the cable release lever to travel downstream but without occupant compartment problems.

The lever retaining cable was also used in test no. SR-5 for the R&D effort pertaining to the short radius guardrail system, where a 3/8" cable was utilized and did not rupture. For test no. SR-5, the cable release lever was retained.

Based on the hardware used in test no. CT-4, we believe that the 3/8” size should be maintained within the actual system. I can attach the FHWA acceptance letter CC-111 which contains additional CAD details regarding the retainer cable hardware.

The ¾” hole used in the small gusset plates out front is too large to place at the location shown & still allow a weld on the bottom side, the metal gets too thin. The bolt used to retain the lever we don’t see dimensioned: can I change this to a ½” bolt and use a 5/8” hole? If so I would raise it 1/8” and move 1/8” right- this will allow enough metal to weld too.

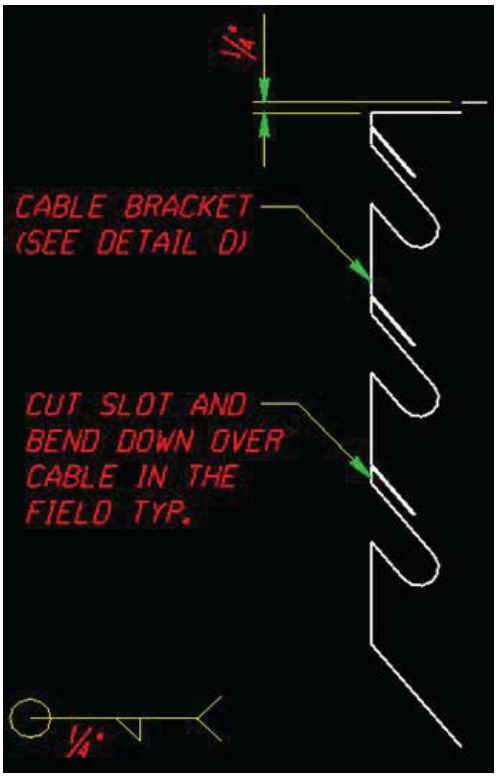
Response:
On the first page of the cable guardrail plans and near the top-left corner, the retainer bolt is specified as being a 5/8" diameter, Grade 5 hex head bolt, 10" long. Based on the bending strength of the cable, I would not recommend lowering its diameter to a ½” bolt. Technically speaking, the 3/8” wire rope could impart a bending load to the middle of the bolt that exceeds the yield and plastic bending capacities. The shear capacity of 1 or 2 planes would be adequate with 5/8” bolt. A ½” bolt would not have sufficient shear strength if shifted to one side. Bending strength is also much weaker. At this time, I would not recommend using a smaller diameter bolt. We may need to re-examine the bolt strength for a cable loop positioned in the center of the bolt as well. As for the ½” gusset plates, the current bolt placement does interfere with the weld. We have drawn a second line in the shape of the gusset but inwardly offset by 3/8" to show the interference. By adjusting the hole position, one can minimize the interference without having to alter the hole and bolt specifications. For this configuration, the hole was moved down 1/16" and to the left 3/16". The proposed location for the hole is shown in the attached detail.



Problem # 4 – Cable Hanger Post Tab Issue

State Question:

Another change requested to the Cable Guardrail:
The slot cut to hold the cable on the end post breaks off "every time" in the field.
If we allow a hole in the cable bracket & a light weight clip placed in the hole, is this still a system which will meet NCHRP 350?



Would a 3/16" - 4" brass rod bent in a U and bent over on the back side after installation work as a light weight holding device?

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

MwRSF Response:

Phil:

It would appear that the original FHWA approval letter used 5 mm brass rods to hold each cable within the slot. Thus, a similar pin design would be acceptable.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 5 – Low Tension Cable Guardrail Tension Settings and Other Items

State Question:

Ron,

I am reviewing the research for low tension cable guardrail.
Cable guardrail heights: 30”, 27”, & 24”
Line Posts: S3x5.7 – 5’-3” with
Inline anchor Includes Posts 1-7 & spring compensators on one end when less than 1000’ on both ends run of guardrail is between 1000’ to 2000’.
15’ is the length of need from the anchor base plate.

Cable compensator table from our old plan unsure of origin:

PRIOR TO FINAL ACCEPTANCE BY THE STATE, THE FOLLOWING VALUES SHALL BE USED TO TIGHTEN THE TURNBUCKLES, DEPENDING ON THE TEMPERATURE AT THE TIME OF THE ADJUSTMENT.

TEMPERATURE (°F)	SPRING COMPRESSION
120° to 110°	1"
109° to 100°	1¼"
99° to 90°	1½"
89° to 80°	1¾"
79° to 70°	2"
69° to 60°	2¼"
59° to 50°	2½"
49° to 40°	2¾"
39° to 30°	3"
29° to 20°	3¼"
19° to 10°	3½"
9° to 0°	3¾"
-1° to -10°	4"
-11° to -20°	4¼"

NOTE: SPRING COMPRESSION FROM UNLOADED

Design guidance:
Grading protected by cable guardrail:

For grading 1:1.5 and steeper: slope requires using 4’ max. post spacing & 4’ minimum grading @ 10:1 max. behind the cable– as tested MwRSF

For grading 1:1.5 to 1:3 slope requires using 16’ max. post spacing & 2’ minimum grading @ 6:1 max. grading behind the cable as stated in the Roadside Design Guide.

Distance to fixed object:
Post spacing 4’ – no items closer than 9’.
Post Spacing 8’ - no items closer than 11’.
Post spacing 16’ – no items closer than 12’.

Short radius placement:
Post spacing of 16’ may be used on radii longer than 715’.
For radii 443’ to 715’ use 12’ post spacing.
Cable should not be installed on radii less than 443’

Do you concur with this implementation of cable guardrail?

Thanks

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

MwRSF Response:

The table contents contain the revised spring compression settings for cable guardrail tensioning based on research performed by the New York DOT in 1985. These tension values match the tabulated tensioning guidelines presented in Table 1 of that report. The reference for that report is as follows:

Kenyon, W.D., Cable Guiderail Tension, Interim Report on Research Project 166-1 to the Federal Highway Administration, Research Report 124, Engineering Research and Development Bureau, New York State Department of Transportation, State Campus, Albany, New York, July 1985.

I am reviewing the research for low tension cable guardrail.

- Cable guardrail heights: 30”, 27”, & 24”
  Correct
- Line Posts: S3x5.7 – 5’-3”
  Correct
- Inline anchor Includes Posts 1-7
  Correct
- Spring compensators on one end when less than 1000’ and on both ends for run of guardrail between 1000’ to 2000’.
  Correct, according to the New York DOT report referenced above

- 15’ is the length of need from the anchor base plate.
  Correct

Other items will be addressed in future. Thanks!

Ron Faller
Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 6 – Curbs Under Transitions

State Question:

Dear MwRSF,

We are using the thrie beam transition to rigid barrier developed in TRP-03-210-10. This transition was crash tested without a curb under it. Some other thrie beam transitions that MwRSF has crash tested used a sloped 4-inch curb.

Is it possible to use a 4” sloped curb similar to the previous crash tests with the transition in TRP-03-210-10?

Sincerely,

Erik Emerson P.E.
Standards Development Engineer-Roadside Design
Wisconsin Department of Transportation

MwRSF Response:

Erik,

I am assuming that you are referring to the curb detailed in TRP-03-69-98. If so, I do not believe that the addition of the 4” sloped curb would cause any adverse effects. However, be sure to use the same geometry for the curb, i.e., the height, slope, and length of the curb should not exceed that dimensions illustrated in the noted report. Note, this will keep your curb downstream of the asymmetrical transition piece and within the thrie beam rail sections for the newer transition. Further, the lateral placement of the curb must be as detailed in the original report (with the back of the curb adjacent to the face of the post).

Scott Rosenbaugh
Midwest Roadside Safety Facility (MwRSF)
University of Nebraska – Lincoln

Problem # 7 – Foothills Parkway Aluminum Railing and a Modified Version of the Foothills Parkway Railing

State Question:

Dear MwRSF,

Our structures department received a bridge plan with a unique bridge rail (see pages 2-4 of attached PDF). It appears to be similar to the Foothills Parkway Aluminum Railing that MwRSF crash tested in 1994. However, we don't have a good copy of the crash test report (most of the pictures are gone).

The modified rail is being used on a raised sidewalk and needs to be tall enough to prevent pedestrians/bikes from falling off the bridge (that is why they added an extra railing). It will be used on a roadway with a posted speed of 35 mph.

Would it be possible for MwRSF to provide some feedback about the rail modifications. I know that I do not like what they are planning to due by the light pole. Dave Nelson expressed some concerns about the reinforcement of the concrete under the rail.

Unfortunately, we would need to have comments back to the city by Thursday at the latest.
Thanks,

Erik Emerson P.E.
Standards Development Engineer-Roadside Design
Wisconsin Department of Transportation

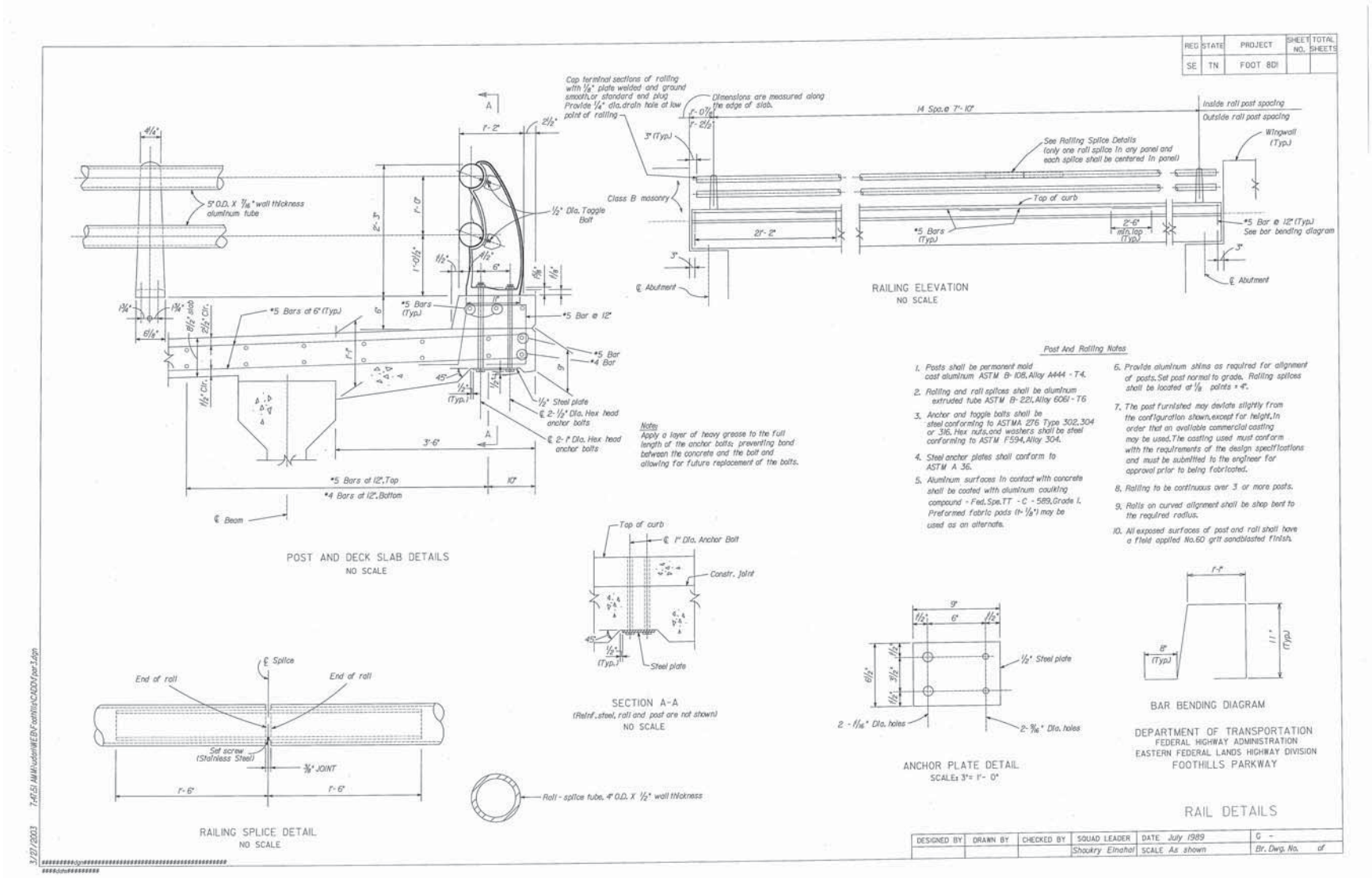


Figure 1. Foothills Parkway Aluminum Railing

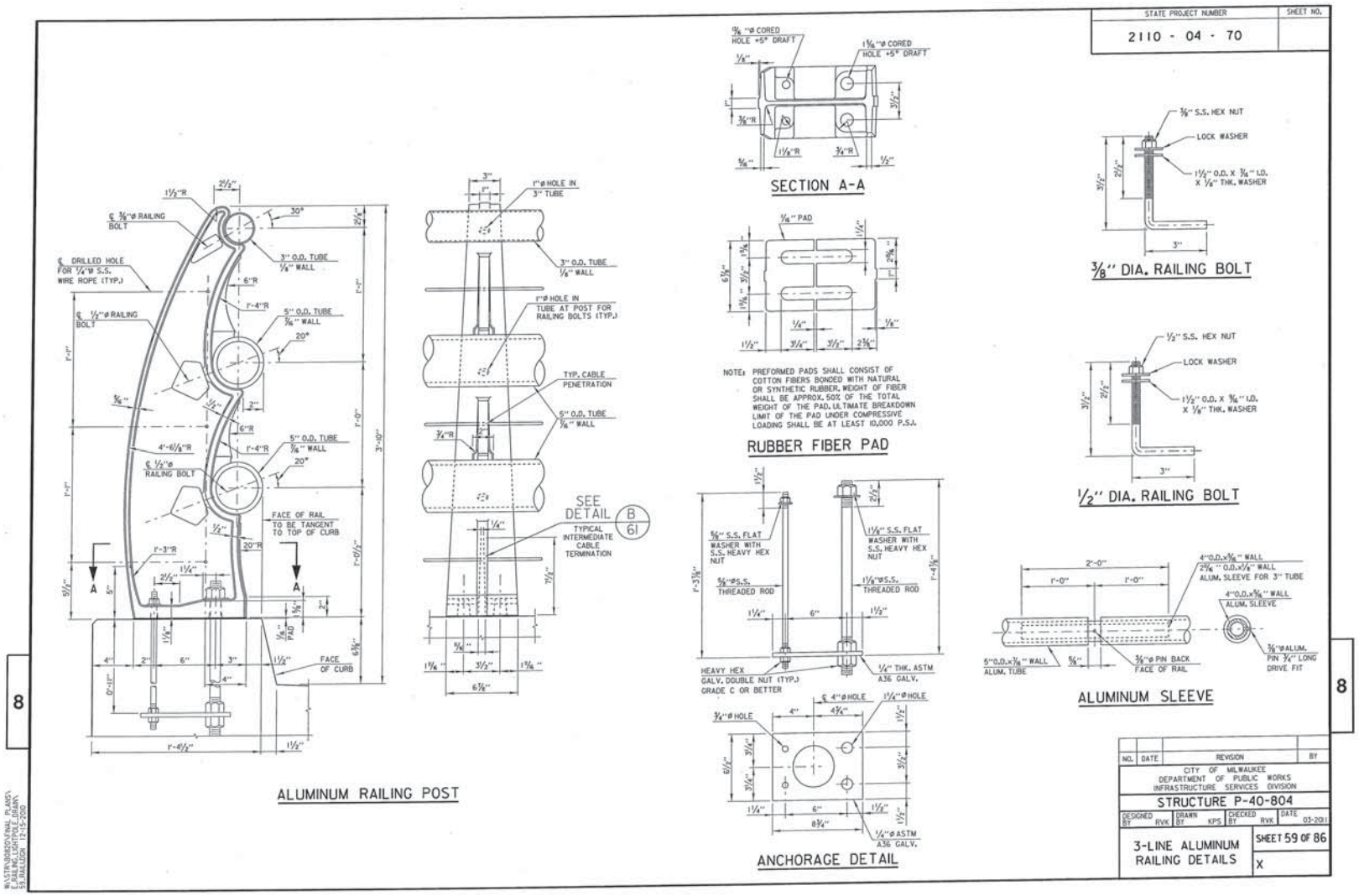


Figure 2. Foothills Parkway Aluminum Railing

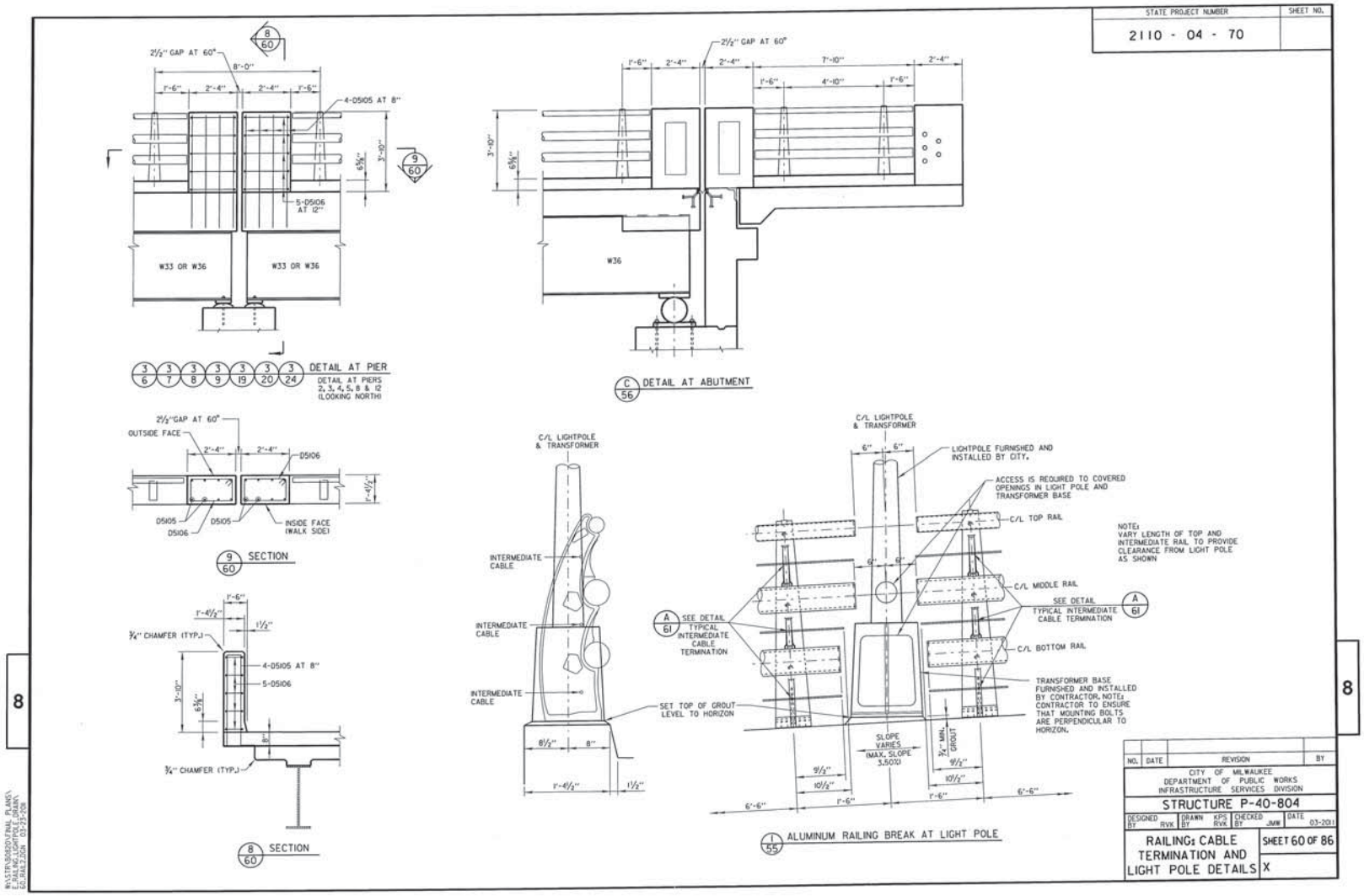


Figure 3. Foothills Parkway Aluminum Railing

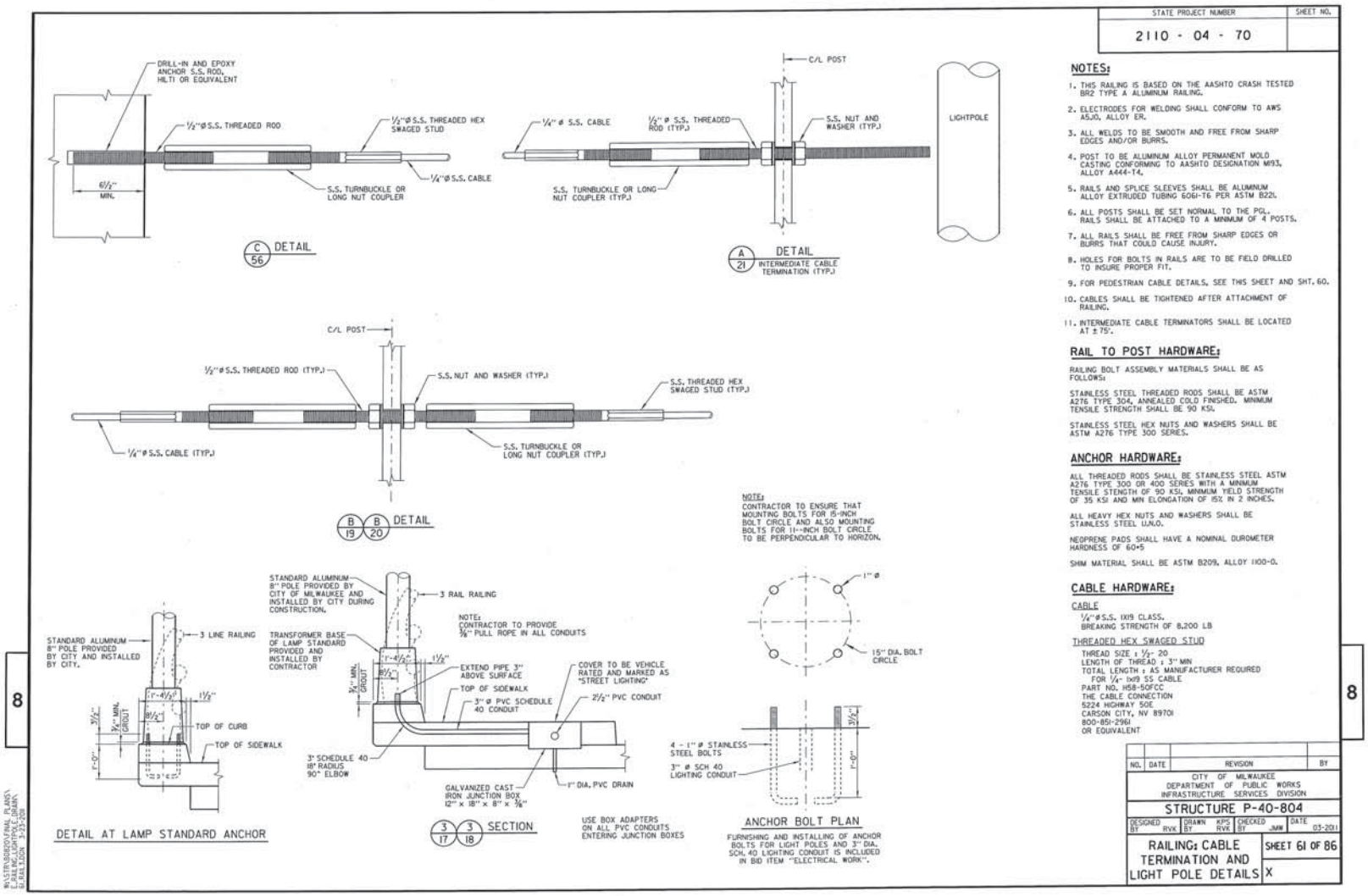


Figure 4. Foothills Parkway Aluminum Railing

MwRSF Response:

Hello Erik!

I have briefly reviewed your enclosed materials. From my best recollection, MwRSF crash tested the 2-tube Foothills Parkway Aluminum Bridge Railing (FPAR) in the early 90s according to the 1989 AASHTO Guide Specifications for Bridge Railings using Performance Level 1 (PL-1). In this testing, MwRSF conducted two pickup truck tests and one small car test. After an initial failed pickup truck test, the longitudinal aluminum tubes were sized up to double the wall thickness to 7/16 in. and modify the post anchorage system.

The proposed 3-Line Aluminum Railing utilizes one additional tubular rail section above the top rail provided in the FPAR system. Although the additional rail will provide increased barrier capacity, it may also result in higher vehicle loading to the barrier system, including the anchorage hardware within the concrete curb. At the present, no reinforcement details are provided for the concrete curb and deck to help demonstrate that equivalent or greater anchorage capacity is provided. Further, the new design concept contains three cables which pass through the web of the posts in addition to new structure on the face of the posts. Discontinuities have been incorporated into interior regions of the tubular railing system in order to accommodate vertical light pole systems. It is uncertain as to how these modifications will affect the safety performance of the railing system under the new MASH impact safety standards. With so many changes, one should consider testing at gaps and ends, something that was raised to the sponsor but not addressed or funded in the 1990 FHWA Guardrail Testing II program. These concerns remain for the ends as well as at any gap where poles exist.

These are my initial thoughts on this matter. If you have further questions, please feel free to contact us at your earliest convenience. Thanks!

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 8 – Guardrail on Short Bridge

State Question:

Ron,

We've got a situation where we will be updating the guardrail at a very short bridge (34 feet – see attached pics) and we'd like to carry the thrie-beam across it. Do you guys have a preferred method of attaching guardrail to a vertical parapet like this, and what would be your recommended blockout depth? Note that we will not be modifying the parapet ends in any way.

In the alternative, do you have any other suggestions on how to treat this bridge? Potential candidate for the MGS bridge rail? What about using guardrail with base-plated posts?

Thanks,

-Chris

MwRSF Response:

Chris:

There have been a few retrofit bridge rails that have included the placement of blocked-out thrie beam on the front face of decorative concrete parapets with some type of curbing. In your situation and depending on test level, you may be able to utilize blocked-out W-beam or thrie beam across the bridge. I assume that you are upgrading the approach guardrail transitions as well. If the parapet stays, there is no reason to use posts with base plates on the deck surface nor the MGS bridge rail. At this time, we have not retrofitted existing deck edges with the new system. However, I would not be too concerned with post placement sufficiently away from deck edge by using cored hole within interior deck region.

If the parapet is sufficiently strong, then it may be most cost-effective to retrofit rail across front face.

If you desire options for this method, , I am enclosing a small pdf file which contains the cover pages for the noted reports as well as general design details for the retrofits bridge rails. Please let us know if you need any other information. The references are listed below.

Crash Tests of R4 Retrofit and Open Parapet Bridge Rails - Final Report, Report No. FHWA-MI-RD-92-01, ENSCO, Inc., Springfield, VA, February, 1992.

Gripne, D.J., "Washington State Department of Transportation Development of a Bridgerail Retrofit Program", Transportation Research Record 1198, Transportation Research Board, Washington, D.C., 1988, pp. 45-54.

Buth, C.E., and Menges, W.L., Crash Testing and Evaluation of Retrofit Bridge Railings and Transition, Report No. FHWA-RD-96-032, Texas Transportation Institute, Texas A&M University, College Station, TX, January, 1997.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 9 – Guardrail on Short Bridge – Part II

State Question:

Thanks for the info, Ron. Our situation is a little different than what the research has covered, so I'd like your opinion on something. Notice in the photos that our parapet is essentially vertical throughout the length of the bridge, with a 1- to 2-inch lip curb near the bottom. We would like to install a blocked-out thrie beam across the bridge, using our standard guardrail transition (http://www.iowadot.gov/design/SRP/IndividualStandards/eba201.pdf) at each end. My concern with this is the possibility of vehicle snagging at the parapet ends. What depth of blockout would you recommend using on the bridge in order to minimize the snagging potential?

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Chris Poole, P.E.
Roadside Safety Engineer
Office of Design

MwRSF Response:

Chris:

Based on the prior approved Iowa AGT attached to a safety-shape parapet (B-47 and B-47A) and a vertical parapet (B-47B), I would utilize a minimum blockout depth of 4 in. on the face of the concrete parapet. This recommendation is based on previously provided a chamfer corner and/or tapered end of 1 to 2 in. behind the parapet face. Thus, if the toe extends up to 2 in. in front of parapet, one would need at least 4 in. of blockout on parapet face. In order to provide some factor of safety, you may consider using a 5-in. blockout depth on the parapet face. Once you traverse past the ends, would you be either (1) anchoring thrie beam to face with end shoe flush or (2) carrying thrie beam across entire bridge?

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 10 – Guardrail on Short Bridge – Part III

State Question:

We will be carrying 10-gauge thrie-beam across the length of the bridge using 4-inch blockouts. One of the reports you sent showed 10-foot spacing between blockouts, while another showed 6'-3" spacing. Do you see any problem with reducing the spacing to 3'-1½", or should I just stick with 6'-3"?

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Chris Poole, P.E.
Roadside Safety Engineer
Office of Design

MwRSF Response:

I am fine with using a 3'-1½" blockout spacing on the bridge.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 11 – Guardrail on Short Bridge – Part IV

State Question:

Ron,

We are actually considering removing the vertical parapet on one of our slab bridges and replacing it with a version of the MGS bridge rail. This particular slab bridge has a deck thickness of approximately 24 inches, so we are looking into the feasibility of side-mounting the tubes that hold the posts. Are you aware of any other states that have tried this yet? If not, do you have any suggestions beyond those that were published in the report?

Thanks,

-Chris

,,,,,, ,,,,,, ,,,,,, ,,,,,, ,,,,,, ,,,,,,

Chris Poole, P.E.
Roadside Safety Engineer
Office of Design

MwRSF Response:

Chris:

At this time, I am not aware of any states which have adapted the MGS bridge rail for use on existing bridge decks with substantial thickness, such as 24 in.

With such a thick deck, one would think that two transverse epoxied rods could be designed to rigidly attach the tube to the outer vertical surface without causing excessive concrete fracture given sufficient deck reinforcement, anchor depth, and upper concrete cover. The lower end of the tube certainly could be side-mounted on the deck edge.

Alternatively, one could likely drill/core concrete holes in the upper deck surface which are sufficiently away from deck edge. Post could be placed cored holes on new steel hardware to receive bridge post ends. New steel hardware may consist of steel pipe with welded lower end plate to fill bottom and an upper welded ring at top to set sleeve depth. The galvanized hardware would be epoxied into thick depth to prevent washer penetration into concrete edges around pipe.

Water could sit in closed pipe without concern. If concerned, then fill pipe with grout around post. Grout could be replaced after impacts.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 12 – TCB Anchorage Transitions

State Question:

Ron,

Does MwRSF have any recommendations regarding TCB anchorage transitions for the following situations?

1. Transition from free-standing TCB to TCB using the strap anchorage
2. Transition from TCB using the strap anchorage to TCB using the stake anchorage

Thanks,

MwRSF Response:

Chris:

Our recommendations are contained below.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor
Does MwRSF have any recommendations regarding TCB anchorage transitions for the following situations?

1. Transition from free-standing TCB to TCB using the strap anchorage

   In the past, we have recommended that an approach transition does not need to be applied when freestanding barriers are attached to the steel strap tie-down system designed for use on concrete roadways and bridge decks.

2. Transition from TCB using the strap anchorage to TCB using the stake anchorage
   Our best recommendation here would be to use the transition from free-standing to rigid barrier. The strap tie-down still has approximately 33" of deflection, so the transition is still needed. The transition should work better because the upstream end will have lower deflections.

Problem # 13 – Overlays and Transitions to Rigid Barriers

State Question:

Dear MwRSF,

Lately, I have had string of overlay projects where an overlay is matching into an existing bridge. The existing bridge rail is at the correct height above the existing deck. If we match into the existing bridge rail at least part of the thrie beam would have to be installed at a lower level to match into the existing bridge rail and transition to the correct height.

Has a thrie beam transition been crash tested at a lower height than 31-inch and passed TL-3 or TL-2 crash testing?

Do you know of any options to matching thrie beam into an existing barrier when the roadway is getting an overall and the bridge is not?

Sincerely,

Erik Emerson P.E.
Standards Development Engineer-Roadside Design
Wisconsin Department of Transportation

MwRSF Response:

Erik:

See below for my quick thoughts!

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Lately, I have had string of overlay projects where an overlay is matching into an existing bridge. The existing bridge rail is at the correct height above the existing deck. If we match into the existing bridge rail at least part of the thrie beam would have to be installed at a lower level to match into the existing bridge rail and transition to the correct height.

Has a thrie beam transition been crash tested at a lower height than 31-inch and passed TL-3 or TL-2 crash testing?

**I am not aware of crash testing on reduced-height thrie beam AGTs at either TL-2 or TL-3. At TL-2, I would expect that a 2-in. overlay could possibly be accommodated in the transition region. Since the bridge rail and deck are at the appropriate elevations, it would seem reasonable to consider milling down the road surface prior to adding new surface overlay.

Do you know of any options to matching thrie beam into an existing barrier when the roadway is getting an overall and the bridge is not?

**Consider shifting guardrail and AGT blockouts upward on posts and capping bridge rail with similar height adjustment for at least 150-200 lineal ft beyond roadway overlay and onto bridge. Then, the height adjustment for bridge rail could be gradually ended.

Problem # 14 – PCB Overlap Offset

State Question:

I believe this question has been asked in the past, but I can not find it in the Q&A's in the quarterly reports.

ODOT rates the deflection of our unanchored 32" portable concrete barrier at 5.5' from the face of barrier. We know it is not a good idea to install unanchored PCB against rigid concrete Jersey or SS barrier. Our direction has been to leave 3.5' of space between the PCB and the rigid barrier to allow for deflection and to prevent the PCB from rotating. My understanding is, if unanchored PBC is placed against rigid concrete wall it is like pinning only the back side of PCB. What if we install PCB against guardrail? Since guardrail is semi-rigid will it deflect and not allow the PCB to rotate. Another scenario would be when one run of unanchored PCB is installed against another run of unanchored PCB. Let me know if these scenario's have been tested, if not your opinions would be helpful.

On another note is anyone going to the TCRS meeting in Rapid City, SD next month.

Respectfully,

Michael Bline, P.E.
Standards and Geometrics Engineer
Office of Roadway Engineering

MwRSF Response:

Hi Michael,

In the past, we have generally recommended using a 2’ offset between overlapping barriers when using PCB in front of another barrier system. Historically, we have recommended the overlapping method in situations where TCBs are to be placed in front of a rigid end of a concrete parapet. This recommendation was given prior to the development of several in-line attachments between freestanding and permanent concrete barriers. For the overlapped option, we stated to use 8 barrier sections beyond the end of the permanent barrier with a 2-ft gap between the freestanding and permanent barriers in order to reduce the propensity for vehicle pocketing and snag on the upstream barrier end. For overlapping TCBs, it would seem reasonable to use an overlap of at least 8 or 9 barrier segments for each run – front and back.

However, I believe that the gap between both barrier runs could be reduced to 6 to 12 in. or so due to both barrier systems being freestanding, thus reducing the propensity for vehicle snag/pocketing. If limited space exists at the roadside edge for the overlapped option, one may consider the slight flaring of the rearward (shielded) TCB system in order to save space near the shoulder.

I don't believe that we have ever given recommendations regarding TCB placed directly in front of guardrail. Based on the rail geometry, the guardrail would act to resist the rotation of the barrier on the sloped face of the section prior to the toe of the barrier butting up against the base of the post. This would suggest that it is allowable to place the PCB directly against the guardrail. However, doing so will stiffen the deflection of the PCB significantly. Thus, if the PCB mounted in from of the guardrail has free-standing PCB on the upstream end, you will need to use an approach stiffness transition to prevent pocketing and instability.

Let me know if that addresses you questions,

Thanks

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility

Problem # 15 - MGS Long Span Blockout Length

State Question:

Ron,
14 ¼" blockouts were used/ dimensioned in the testing of the TRP-03-187-07.
Please email/ document for me that the 14" standard blockout will be acceptable when used in this system.

Thanks

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

MwRSF Response:

Phil:

Historically, 6"x8" and 6"x12" timber blockouts have utilized lengths ranging from 14" to 14 ¼" when used in W-beam guardrail systems. MwRSF has typically showed the longer length. However, satisfactory impact performance would be expected with either blockout length.

As such, the MGS long-span system would perform in an acceptable manner with using 14" or 14 ¼" section lengths. Please let me know if you have any questions regarding the information contained herein.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 16 – Bolt Specifications for Attachment of Thrie Beam to Concrete Parapet

State Question:

Dear MwRSF,

I'm working on updating our standards on attaching thrie beam to rigid barriers. I understand that A325 bolts and A449 bolts are acceptable alternatives.

We have situations where we will need to drill through parapets and bolt on the back side. In general, we would need a bolt about 14.5 inches long. In some of these situations, a standard A325 bolt may not have enough threading to allow for a tight connection between the thrie beam and concrete barrier.

I know that we could specify the following to solve these situations:

Use a shorter A325 bolt.
Specify an A449 bolt that is fully threaded.

I did some searching around on the web. I had some difficulties finding standard sizes of A325 or A449 bolts. Many of the bolts I found where too short to be used (9 inches or shorter) or where a different standard (SAE…)

The questions I have are:

What are the standard bolt lengths for A325 and A449? Or what source should I get to verify standard bolt lengths?
Are there other standards of bolts that we could use?
Would it be possible to specify a galvanized threaded rod?
Could we use some of the research on epoxy into bridge deck research to connect thrie beam to a bridge parapet.

From my brief look on the web, if galvanized threaded rods are common. If a galvanized rod could be used instead of a specially ordered A449 or A325 bolt, the department could save some costs.

Sincerely,

Erik Emerson P.E.
Standards Development Engineer-Roadside Design
Wisconsin Department of Transportation

MwRSF Response:

Hi Erik,

I have put some responses below in red.

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility
130 Whittier Building
2200 Vine St.
Lincoln NE, 68583-0853
402-472-9064
rbielenberg2@unl.edu

Dear MwRSF,

I'm working on updating our standards on attaching thrie beam to rigid barriers. I understand that A325 bolts and A449 bolts are acceptable alternatives.

We have situations where we will need to drill through parapets and bolt on the back side. In general, we would need a bolt about 14.5 inches long. In some of these situations, a standard A325 bolt may not have enough threading to allow for a tight connection between the thrie beam and concrete barrier.

I know that we could specify the following to solve these situations:

Use a shorter A325 bolt.
Specify an A449 bolt that is fully threaded.

I did some searching around on the web. I had some difficulties finding standard sizes of A325 or A449 bolts. Many of the bolts I found where too short to be used (9 inches or shorter) or where a different standard (SAE…)

The questions I have are:

What are the standard bolt lengths for A325 and A449? Or what source should I get to verify standard bolt lengths?
I don't know of standard bolt lengths for A325 and A449. A325 is a structural bolt standard that generally uses shorter thread lengths to increase the shear strength of bolts used in structural

connections. It also uses a heavy hex head standard. On many websites, such as Portland Bolt and Fastenal, they recommend that if you cannot find an A325 bolt that meets your need, then you can switch to A449. In fact, in Section 1.5 of the A325 specification it states "for bolts of other configurations and thread lengths with similar mechanical properties (to A325), see Specification A449."

From past experience, we have custom ordered variable length A325 bolts from various manufacturers. As such, you should be able to obtain quotes for most reasonable lengths for 1-in. increments. Second, if thread length is an issue, you could use several ¼–in. thick plate washers on the back side of the parapet to allow for the nut to be tightened on the threads. It may also be possible to epoxy longer female inserts into the concrete parapet for use with the bolts, although further investigation would be required. Can you let us know what bolt lengths would typically be required to pass through the concrete parapets? With this information, we could assist with obtaining quotes for your required lengths.

That said, I cannot find much on standard lengths for A325 bolts. The longest lengths I could find were 14" and 10.5". There were no in between sizes. Thus, I would try contacting Fastenal, Portland Bolt, and Bennett Bolt to see what options are available.

Are there other standards of bolts that we could use?
If you are looking for a substitute for A325, then A449 is the best replacement grade available as the A325 spec noted above. SAE Grade 5 also has similar mechanical properties, but like A449 may not have the exact same bolt head specification.

If you want to stick with A325 bolts, Portland Bolt's website notes that they can custom build A325 bolts. I am guessing that will cost more, but you will likely be able to spec a length and thread length.

Would it be possible to specify a galvanized threaded rod?
In terms of capacity, there are several threaded rod material grades that would work. However, I have concerns that the extra threaded rod that would protrude on the traffic side face of the connection would become a vehicle snag hazard. Thus I would not recommend the use of the threaded rods. SAE Grade 5 and ASTM A193 B7 would be sufficiently strong.

Could we use some of the research on epoxy into bridge deck research to connect thrie beam to a bridge parapet.
There is some potential to use the epoxy anchor research or other inserts to anchor the thrie beam. We did just that with the TCB transition to anchor the thrie beam to the single slope barrier. However, we have not done this to date with approach guardrail transitions. In order to do so, we would need to look at the type of attachment (epoxied threaded rod, epoxied threaded insert with a bolt, or a mechanical anchor), the depth of the section, and the effect of edge distance and anchor spacing. Thus, I believe that there is a potential to do this kind of attachment, but we would need to do some additional analysis.

From my brief look on the web, if galvanized threaded rods are common. If a galvanized rod could be used instead of a specially ordered A449 or A325 bolt, the department could save some costs.

Problem # 17 – Bolt Specifications for Attachment of Thrie Beam to Concrete Parapet – Part II

State Question:

As a follow on question, WiSDOT had a question regarding the use of fully threaded A325T bolts versus partially threaded A325 bolts for connection of thrie beam and W-beam to concrete parapets.

MwRSF Response:

Hi Erik,

As we discussed on the phone, you had a question regarding the use of fully threaded A325T bolts versus partially threaded A325 bolts for connection of thrie beam and W-beam to concrete parapets.

As we discussed on the phone, the only concern that I had was that a fully threaded section would have reduced shear capacity as compared to a partially threaded one.

In order to check this concern I calculated the capacity of the end shoe versus the capacity of the 7/8" A325T bolts. I examined the tensile capacity of the thrie beam end shoe versus as well as the bearing failure of the end shoe anchor holes. It turns out that the bearing failure of the end shoe holes is the limiting value (i.e. the end shoe will fail under bearing failure at the anchor holes long before its tensile capacity is exceeded). As such, the A325T bolts should be acceptable as long as the shear capacity of the 7/8" A325T bolts is greater than the bearing capacity of the end shoe anchor holes.

The shear capacity of the 7/8" A325T bolts is several times greater than the bearing capacity of the thrie beam end shoe bearing capacity, thus the use of the 7/8" A325T bolts should be acceptable.

Let me know if you have further questions or concerns.

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility

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)* SPR-3(017) Supplement #35	**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: Cost Effective Measures for Roadside Design		
Name of Project Manager(s): Rohde, Sicking, Reid, Faller, Lechtenberg	**Phone Number:** 402-472-9070	**E-Mail** kpolivka2@unl.edu
Lead Agency Project ID: 2611130069002	**Other Project ID (i.e., contract #):** RPFP-06-01	**Project Start Date:** 7/1/2005
Original Project End Date: 12/31/11	**Current Project End Date:** 12/31/11	**Number of Extensions:** 4

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
$103,514	$64,722	85

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$3,049	

Project Description:

The relatively low levels of safety associated with low-volume roads have been well documented over the last 20 years. Many low volume roads have high posted speed limits and virtually no clear zone. Further, narrow pavements and sharp horizontal curves tend to increase the frequency of ran-off-road events. Even though there have been many papers written on this topic, there have been very few efforts to actually develop guidelines and recommendations for implementing roadside safety treatments on low volume roads. Instead, most of the studies have identified a shopping list of feasible safety improvements with no real guidance regarding when each item should be implemented. Guidelines for safety improvements can be developed with a combination of a benefit/cost analysis program like RSAP and a significant amount of engineering judgment.

The objectives of this study include to 1) identifying common hazardous roadside situations associated with low-volume roads, 2) determining if any cost effective safety treatments are available and 3) developing guidelines for when the safety treatments are recommended.

Tasks

1. Field study of roadside hazards on low-volume roads
2. Compilation of field study findings
3. Selection of common roadside hazards for analysis
4. RSAP analysis and evaluation of selected roadside hazards
5. Research report

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

Internal review of the draft research report has continued, but at a very slow rate due to a shifting of staff priorities.

Anticipated work next quarter:

Complete internal review of the draft research report. Submit draft report to Pooled Fund member states for review and comment. Publish the final research report.

Significant Results:

Rural roadways (ADT < 500 and speed ≥ 55 mph) were surveyed and it was determined that common hazards along these types of roadways are culverts, trees, slopes, ditches, and bridges. Thus, these were the hazards evaluated with a benefit-to-cost analysis. Some sample results include: (1) culverts - remove headwall structures not shielded or transitioned to guardrail; (2) trees - remove trees 6" or greater in diameter located within 10' of roadside; (3) slopes and ditches - install barrier for most 1.5:1 & 2:1 slopes; and (4) bridges – leave existing rail for long bridges, install approved system for short bridges.

Tasks	% Complete
1. Field study of roadside hazards on low-volume roads	100%
2. Compilation of field study findings	100%
3. Selection of common roadside hazards for analysis	100%
4. RSAP analysis and evaluation of selected roadside hazards	100%
5. Research report	50%

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).

Due to a shifting of staff priorities, work of reviewing the internal draft report was greatly diminished. The project was extended through the end of 2011 in order to submit the draft report to the States for review and to complete the final report.

Potential Implementation:

This study will identify safety improvements that are applicable to a number of common hazards found along low volume roads. Guidelines will also be presented that provide objective criteria for determining when these safety improvements should be considered. The identified safety treatments and guidelines for their implementation will provide designers a set of tools for improving safety on low volume roads. This effort could potentially result in language that could be included in the Roadside Design Guide to provide guidance for roadside safety design on low-volumes, similar to the Geometric Guidelines for Very Low-Volume Local Roads published by AASHTO and intended to be incorporated into a future update of the Greenbook.

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)* SPR-3(017) Suppl.#35	**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: Termination of Temporary Concrete Barrier		
Name of Project Manager(s): Reid, Sicking, Faller, Bielenberg	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611130069003	**Other Project ID (i.e., contract #):** RPFP-06-02	**Project Start Date:** 7/1/2005
Original Project End Date: 12/31/2011	**Current Project End Date:** 12/31/2011	**Number of Extensions:** 4

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
$73,334.00	$73,334.00	99%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0.00	

Project Description:

The research objective of this study was to design, test, and evaluate an economical method for terminating and anchoring the upstream end of TCB systems. The termination should provide adequate anchorage to allow for the beginning of the LON to be on or near the system's first barrier segment. The termination and anchorage design was developed for use with the Kansas F-shape TCB that is currently used by several states participating in the Midwest Pooled Fund Program. This effort was performed in accordance with the Test Level 3 (TL-3) guidelines found in the Manual for Assessing Safety Hardware (MASH).

The research objectives were achieved by performing several tasks. First, a review of previous full-scale crash tests on temporary concrete barriers was performed in order to estimate the loads that would be applied to an anchorage system during vehicle impacts. Next, an anchorage system was developed using standard roadside safety hardware. Computer modeling and simulation was used to analyze, design, and modify the anchorage system to meet the specific needs of the temporary barrier system during high-energy, pickup truck impacts. Fourth, one full-scale vehicle crash test was performed using a 2,270-kg pickup truck at the target conditions of 100 km/h and 25 degrees when impacting near the upstream end of the system. The results were then analyzed, evaluated, and documented. Finally, conclusions and recommendations were made that pertain to the safety performance of the new termination and anchorage system for use with the Kansas F-shape temporary concrete barrier system.

Task	% Completed
1. Computer simulation to determine LON and anchorage	100
2. Design of anchorage system	100
3. Full-scale crash testing with 2270P	100
4. Documentation and analysis of test results	100
5. Summary report, final CAD details, FHWA approval letter	98

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

Prior to this quarter, MwRSF had completed the design and full-scale crash testing of the termination and anchorage for temporary concrete barrier. In addition, the summary report of the system was completed and submitted to the sponsors. During the last quarter, MwRSF obtained the federal approval letter for this system. FHWA approval letter B221 was received by MwRSF documenting the FHWA approval of the system. MwRSF also worked on compiling the CAD details required for submission of the termination and anchorage for temporary concrete barrier to the Hardware Guide. The Hardware Guide details were reviewed at the AASHTO Task Force 13 meeting on May 25th, and the comments and edits from that meeting were implemented.

The Hardware Guide details were submitted for a second review at the AASHTO Task Force 13 meeting on September 12th. Suggested revisions to the details were minor.

Anticipated work next quarter:

The only work remaining in this project is to finalize the CAD details for the Hardware Guide. The final edits for the drawings will be made this quarter and the final details submitted to AASHTO. At this time the project will be completed.

Significant Results:

None.

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).

None.

Potential Implementation:

A termination and anchorage system was designed for use with the upstream end of free-standing, TCB and later was evaluated using full-scale vehicle crash testing. This termination and anchorage system allowed for a significant reduction in the number of barrier segments required upstream from the length of need and for use in anchoring a free-standing TCB system. The anchorage system was configured to effectively constrain the end of the TCB system for impacts as far upstream as the first anchored barrier segment. Full-scale crash testing demonstrated that the impacting vehicle was safely and smoothly redirected, and the test was judged acceptable according to the TL-3 safety criteria set forth in MASH. This system has been accepted by FHWA as noted above. Guidelines for the implementation of the system were provided in the summary report.

The new termination and anchorage system provides users with increased safety and flexibility during placement of TCB systems. The termination and anchorage system should result in shorter installation lengths for TCBs, fewer vehicle impacts into the barrier system, and an overall reduction in the cost of the installation.

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)* SPR-3(017) Suppl.#35	**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: Develop Temporary Concrete Barrier Transition		
Name of Project Manager(s): Reid, Sicking, Faller, Bielenberg	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611130069003	**Other Project ID (i.e., contract #):** RPFP-06-07	**Project Start Date:** 7/1/2005
Original Project End Date: 12/31/2011	**Current Project End Date:** 12/31/2011	**Number of Extensions:** 4

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
$120.764.00	$120.764.00	99%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0.00	

Project Description:

The objective of this research study was to identify the most prominent transition scenario between TCB and other types of barriers and develop a TCB transition for the highest priority situation. The transition design was to be developed for use with the Kansas F-shape TCB (Polivka et al. 2003, Polivka et al. TRP-03-173-06 2006) that is currently used by several states participating in the Midwest Pooled Fund Program. This effort was performed in accordance with the Test Level 3 (TL-3) guidelines found in the Manual for Assessing Safety Hardware (MASH), First Edition [AASHTO 2009].

The research objective was achieved through the completion of several tasks. First, a survey of the Midwest States Regional Pooled Fund members was conducted to identify the most prominent transition need with respect to temporary concrete barriers. Next, the researchers designed a temporary concrete barrier transition for the most prominent need. After the transition design was developed, a computer simulation modeling was undertaken to analyze and determine the Critical Impact Points (CIPs) for the transition. Two full-scale vehicle crash tests were performed on the transition system. The crash tests utilized ½-ton pickup trucks, each weighing approximately 2,270 kg. The targeted impact conditions for the tests were an impact speed of 100.0 km/h and an impact angle of 25 degrees. Next, the test results were analyzed, evaluated, and documented. Finally, conclusions and recommendations were made that pertain to the safety performance of the design for a temporary concrete barrier transition.

Task	% Completed
1. Poll of sponsors to determine critical transition need	100
2. Computer simulation to determine LON and anchorage	100
3. Design of anchorage system	100
4. Full-scale crash testing with 2270P	100
5. Summary report, final CAD details, FHWA approval letter	99

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

Prior to this quarter, MwRSF had completed the design and full-scale crash testing of the temporary concrete barrier transition. After review and consultation with the sponsoring states, a transition between F-shape temporary concrete barrier and a permanent, single-slope concrete barrier was chosen as the critical transition design for development and testing. In addition, the summary report of the system was completed and submitted to the sponsors. MwRSF recieved FHWA approval of the temporary concrete barrier transition on August 19th, 2011 in letter no. HSST-B41A. MwRSF also worked on completing the CAD details required for submission of the temporary concrete barrier transition to the Hardware Guide. The Hardware Guide details were reviewed at the AASHTO Task Force 13 meeting on May 25th, and the comments for that meeting were implemented.

The Hardware Guide details were submitted for a second review at the AASHTO Task Force 13 meeting on September 12th. Suggested revisions to the details were minor.

Anticipated work next quarter:

The only work remaining in this project is to finalize the CAD details for the Hardware Guide. The final edits for the drawings will be made this quarter and the final details submitted to AASHTO. At this time the project will be completed.

Significant Results:

FHWA acceptance of the transition between F-shape temporary concrete barrier and a permanent, single-slope concrete barrier was received in letter HSST/B-41A on August 19, 2011.

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).

None.

Potential Implementation:

The barrier system developed during the TCB research described herein was an approach transition between free-standing TCBs and permanent concrete median barriers. An analysis of common median barrier geometries identified the critical median barrier design for the approach transition as the 1,067-mm tall CA single-slope median barrier due to its height as compared to the F-shape TCB. Full-scale crash testing at CIP locations demonstrated that the impacting vehicle was safely and smoothly redirected, and the testing of the approach transition was judged acceptable according to the TL-3 safety criteria set forth in MASH. This new design provides a means of safely transitioning from free-standing TCBs to permanent median barriers.

This system has been accepted by FHWA as noted above. Guidelines for the implementation of the system were provided in the summary report.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraska Department of Roads

INSTRUCTIONS:

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Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)*	**Transportation Pooled Fund Program - Report Period:**
SPR-3(017) Supplement #35	☐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: Evaluation of Safety Performance of Vertical & Safety Shaped Concrete Barriers		
Name of Project Manager(s): Rohde, Sicking, Reid, Faller	**Phone Number:** 402-472-9070	**E-Mail** kpolivka2@unl.edu
Lead Agency Project ID: 2611130069009	**Other Project ID (i.e., contract #):** RPFP-06-08	**Project Start Date:** 7/1/05
Original Project End Date: 12/31/11	**Current Project End Date:** 12/31/11	**Number of Extensions:** 4

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
$69,295	$87,025	95

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$4,922	

Project Description:

Many accident studies have been conducted that show injury and rollover rates for concrete safety shaped barriers are much higher than for other barrier systems. Computer modeling and testing have shown that vertical concrete barriers should produce fewer rollovers and it is believed that this reduction should lead to fewer injuries. However, due to the limited use of vertical concrete barriers there have been no successful accident studies that verify these predictions. Virtually all of Iowa's bridge rails are now either vertical concrete barriers or a safety shape design. Accident records from Iowa's bridge rail crashes should provide a direct comparison between the performance of safety shaped and vertical concrete barriers.

Objective: Analyze accident records from Iowa's bridge rails to the safety performance of vertical and safety shaped concrete bridge railings.

Tasks:

1. Literature review on concrete barriers, rollovers, ran-off-road crashes, and occupant and vehicle safety
2. Acquire accident reports for all bridge rail related accidents in the State of Iowa
3. Identify which accidents actually involve a bridge railing
4. Create data base of accident information for bridge rail crashes
5. Analyze data base to determine added risk associated with safety shaped concrete barriers when compared to vertical concrete barriers
6. Research report

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

The draft report was completed and submitted to the Pooled Fund member states for review and comment.

Anticipated work next quarter:

Once comments (if any from the Pooled Fund States), the final research report will be published.

Significant Results:

Task	% Complete
1. Literature review on concrete barriers, rollovers, ran-off-road crashes, and occupant and vehicle safety	100%
2. Acquire accident reports for all bridge rail related accidents in the State of Iowa	100%
3. Identify which accidents actually involve a bridge railing	100%
4. Create data base of accident information for bridge rail crashes	100%
5. Analyze data base to determine added risk associated with safety shaped concrete barriers when compared to vertical concrete barriers	100%
6. Research report	90%

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).

This project required collecting an additional 6 years of data since the relationship between barrier shape and rollover propensity was being masked by factors such as traffic volume and operating speeds. No work occurred during the Third and Fourth Quarters of 2009 due to shifting of priorities for key project personnel and the need to obtain advanced analysis techniques. Limited data was received for bridge accident sites located on county roads thus the study was limited to bridges located on State maintained highways.

Potential Implementation:

Quantifying the safety implications of utilizing safety shaped barriers versus vertical concrete barriers would provide direction for future concrete barrier development efforts and motivation for highway designers to utilize the safer of the two alternatives.

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)*	**Transportation Pooled Fund Program - Report Period:**
SPR-3(017) Supplement #38	☐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: Cost Effective Upgrading of Existing Guardrail Systems		
Name of Project Manager(s): Reid, Rohde, Sicking, Faller, Lechtenberg	**Phone Number:** 402-472-9070	**E-Mail** kpolivka2@unl.edu
Lead Agency Project ID: 2611120090002	**Other Project ID (i.e., contract #):** RPFP-07-01	**Project Start Date:** 2/26/07
Original Project End Date: 12/31/12	**Current Project End Date:** 12/31/12	**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
$92,084	$51,477	85

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$9,608	

Project Description:

Existing guardrail installations are often substandard in some way, such as low height, inappropriate post spacing, or inadequate length. Although it is desirable to upgrade substandard barriers to meet current guidelines, available funding is often insufficient to achieve this goal. However, the safety performance of many existing guardrail systems can be greatly improved by eliminating only the most significant deficiencies. In general it is often desirable to implement low cost/high benefit improvements at sites where a complete upgrade cannot be justified. Unfortunately, highway agencies have the potential for creating a liability risk when guardrail is upgrading without bringing it up to current guidelines. Therefore, agencies cannot make any improvements to an existing guardrail or terminal unless it is upgraded to meet current recommendations. As a result, many guardrail systems remain in place for many years with identifiable deficiencies.

Objective: Develop guidelines for upgrading of existing guardrail installations that do not meet current criteria.

Tasks:

1. Field study of existing guardrail installations
2. Compilation of field study findings
3. Selection of installations to investigate
4. Sensitivity study to decrease the size of the analysis matrix
5. RSAP analysis
6. Research report

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

An internal draft report was completed. Review of the internal draft report began.

Anticipated work next quarter:

A draft report of research study will be completed. Submit draft report to Pooled Fund member states for review and comment.

Significant Results:

A field survey of more than 60 barrier sites in Kansas revealed deviations from standard guardrail systems with guardrail height being the most prominent issue as well as different hazards that these systems were protecting. To account for the different guardrail height in the RSAP models containment index (CI) had to be changed. The CI was derived from past crash test results and LS-DYNA simulations of the MGS with a 25" rail height at speeds of 100, 70, and 60 km/h with 2000P and 2270P. The 2000P and 2270P were contained at 60 km/h and 70 km/h. respectively.

Task	% Complete
1. Field study of existing guardrail installations	100%
2. Compilation of field study findings	100%
3. Selection of installations to investigate	100%
4. Sensitivity study to decrease the size of the analysis matrix	100%
5. RSAP analysis	100%
6. Research report	50%

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).

The original analysis was completed with the longer runout lengths. Thus, additional analysis was completed with the shorter runout lengths that were published in the updated Roadside Design Guide.

Potential Implementation:

The guardrail removal and upgrading guidelines developed under this study will provide highway designers with a very important middle ground option between doing nothing and a complete upgrade of deficient guardrail. This middle ground option should provide most of the benefits of a complete upgrade at a much reduced cost. Further, the guidelines will eliminate the potential for increased liability currently associated with using a less-than-complete guardrail upgrade.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE 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)* SPR-3(017) Suppl.#38	**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: Testing of Cable Terminal for High Tension Cable (1100C & 2270P)		
Name of Project Manager(s): Reid, Rohde, Sicking, Faller	**Phone Number:** 402-472-3084	**E-Mail** jreid@unl.edu
Lead Agency Project ID: RPFP-07-06	**Other Project ID (i.e., contract #):** 2611120090007	**Project Start Date:** February 26, 2007
Original Project End Date:	**Current Project End Date:** December 31, 2012	**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
$100,563	$13,509	15%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

Project Description:

Objective: Redesign the cable release mechanism and foundation of the three cable end terminal to accommodate four high tension cables.

Tasks
1. Background and literature review - completed
2. Design and analysis - in-progress
3. Full-scale testing
4. Report

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

Task 2. Details for a bogie test of the 4-cable high tension terminal system under consideration were developed. This bogie test will assess the cable release mechanism with high cable tension. The bogie test is in queue at the MwRSF.

Minimal work was completed this quarter due to project personnel being assigned to other projects.

Anticipated work next quarter:

Task 2. Bogie testing on the end anchorage system is scheduled for next quarter. LS-Dyna simulation of this bogie test is to be completed and used to help determine details of the entire system. Full-scale testing recommendations will be made.

Significant Results:

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).

Final design details and full-scale testing for this project cannot be conducted until the High Tension Cable Barrier System is completed.

Potential Implementation:

The revised terminal will provide a non-proprietary end terminal for high tension barrier cable systems.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Midwest Roadside Safety Facility, UNL

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)* SPR-3(017) Supplement #44	**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: Continued Development of a High-Tension, Four-Cable, Median Barrier System for Use in in 4:1 V-Ditches (Year 18)		
Name of Project Manager(s): Reid, J.D., Sicking, D.L., & Faller, R.K.	**Phone Number:** 402-472-6864 (Faller)	**E-Mail** rfaller1@unl.edu
Lead Agency Project ID: RPFP-08-02 (2611120095003)	**Other Project ID (i.e., contract #):** SPR-3(017) Supplement #44	**Project Start Date:** September 1, 2007
Original Project End Date: December 31, 2009	**Current Project End Date:** December 31, 2011	**Number of Extensions:** 3

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
$167,237 (original)	$172,639 (includes contingency)	99

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$1,636 (1%)	$1,636	99

Project Description:

Task	% Completed
LS-DYNA computer simulation modeling of cable barrier systems	100
Static-pull testing on cable brackets	100
Dynamic bogie testing of cable brackets and bolting hardware	100
Dynamic bogie testing of cable posts in soil	100
Dynamic bogie testing of cable anchor bracket and cable splice	100
Barrier construction and crash test 4CMB-1 (2270P)	100
Barrier construction and crash test 4CMB-2 (1100C)	100
Combine test results with report containing test no. 4CMB-3	100
Internal review and editing of combined research and test report containing test nos. 4CMB-1 through 4CMB-3	96

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

Minor work was completed on the R&D report documenting test nos. 4CMB-1 through 4CMB-3.

Anticipated work next quarter:

The draft report containing the results from test nos. 4CMB-1 through 4CMB-3 will be completed in the Fourth Quarter of 2011. The project will be closed in December 2011.

Significant Results:

The cable barrier system described herein has been subsequently modified and subjected to additional crash testing under a follow-on study. The subsequent crash testing will be documented in a different report.

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).

No problems are anticipated at this time.

Potential Implementation:

These research results will not likely be implemented as the barrier configuration has been modified.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Midwest Roadside Safety Facility, UNL

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)* SPR-3(017) Supplement #49	**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: MGS Implementation (Year 18)		
Name of Project Manager(s): Reid, J.D., Sicking, D.L., & Faller, R.K.	**Phone Number:** 402-472-6864 (Faller)	**E-Mail** rfaller1@unl.edu
Lead Agency Project ID: RPFP-08-07 (2611120095008)	**Other Project ID (i.e., contract #):** SPR-3(017) Supplement #49	**Project Start Date:** September 1, 2007
Original Project End Date: December 31, 2009	**Current Project End Date:** December 31, 2011	**Number of Extensions:** 3

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
$15,928 (original)	$10,249	74%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$604 (4%)	$604	74%

Project Description:

This project consists of MGS implementation assistance and guidance for the Pooled Fund member states. Four general categories were initiated for the MGS. They are as follows:

Task	% Completed
Standard, Half, and Quarter Post Spacing	100
MGS with Curbs and MGS with 2:1 Slopes	100
MGS with Culvert Applications	100
MGS Stiffness Transition	0

In 2007, Pooled Fund consulting funds were used to assist states with the MGS implementation effort. MwRSF began the effort with a review of CAD details from the Illinois and Washington DOTs. Project correspondence occurred via email with a pre-determined Technical Working group. To date, three subject areas were covered and are as follows: (1) Standard, Half, and Quarter Post Spacing; (2) MGS with Curbs and MGS on 2:1 Slopes; and (3) MGS with Culvert Applications. A fourth category, MGS Stiffness Transition, was delayed in order to await the completion of a simplified, steel-post and wood-post approach guardrail transition.

The final reporting of the simplified, steel-post, approach guardrail transition system attached to the MGS was completed in the Fourth Quarter of 2010. The draft reporting of wood post R&D effort will be completed in the summer of 2011, including dynamic bogie post testing and Barrier VII analysis. Following State DOT review and comment in the summer 2011, the final report will be published in the fall of 2011. After this time, the MGS implementation activities will commence.

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

Minor work was completed on the review and comment of MGS standard plans from the States of Kansas and Nebraska.

Anticipated work next quarter:

The MGS implementation effort will continue in the Fourth Quarter of 2011 after the simplified, wood-post transition report has been finalized. The project will be closed in December 2011.

In order to make preparations for this activity to commence in the fall of 2011, MwRSF previously requested that NDOR accumulate contact information (i.e., names and email addresses) for those willing to participate in the discussions involving the MGS implementation.

Significant Results:

To date, MwRSF has provided review and comment regarding the MGS standard plans for Washington, Illinois, Kansas, and Nebraska and for 3 out of 4 categories.

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).

No problems are anticipated at this time.

Potential Implementation:

MwRSF's review and comment has assisted several State DOTs with the advance implementation of the MGS.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Midwest Roadside Safety Facility, UNL

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(091) Supplement #1	**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: New Funding for High-Tension, Cable, Barrier System on Level terrain with New Cable Attachment (Year 19)		
Name of Project Manager(s): Reid, J.D., Sicking, D.L., & Faller, R.K.	**Phone Number:** 402-472-6864 (Faller)	**E-Mail** rfaller1@unl.edu
Lead Agency Project ID: RPFP-09-01 (2611211005001)	**Other Project ID (i.e., contract #):** TPF-5(091) Supplement #1	**Project Start Date:** August 15, 2008
Original Project End Date: July 31, 2011	**Current Project End Date:** July 31, 2011	**Number of Extensions:**

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
$219,260 (original)	$219,260	100

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$0 (0%)	$0	100

Project Description:

Task	% Completed
Continued dynamic testing of simplified brackets & posts in soil w/ documentation and reporting	
- 10 budgeted tests – 43 tests conducted	100
Barrier construction and crash test 4CMB-4 (1100C)	100
Barrier construction and crash test 4CMB-5 (2270P)	100
Crash test documentation & reporting (4CMB-4 and 4CMB-5)	85

Since these project funds were exhausted in a prior quarter, the continued work and completion of these tasks will be charged to subsequent cable barrier contingency projects.

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

Minor work was completed on the R&D report documenting test nos. 4CMB-4 and 4CMB-5 but charged to a follow-on contingency project.

Anticipated work next quarter:

The draft report containing the results from test nos. 4CMB-4 and 4CMB-5 will be completed in the Fourth Quarter of 2011 under a contingency project. The project was closed in July 2011.

Significant Results:

The cable barrier system incorporated a modified cable-to-post bracket that was successfully tested and evaluated with a 1100C small car under the TL-3 impact safety standards of MASH. The subsequent crash testing will be documented in a different report.

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).

The funds for this project were previously exhausted and deemed insufficient to complete the crash testing, demolition, and reporting of test no. 4CMB-4 and 5 due to the extensive component testing program utilized to develop a simplified cable-to-post bracket. As such, these efforts were continued with either the Year 20 continuation, Year 21 contingency, and/or future Year 22 project funds.

Potential Implementation:

These research results demonstrated that the new cable bracket worked well to capture a 1100C vehicle when used in combination with a barrier placed near the bottom of a 4:1 V-ditch. The new cable bracket will likely be used in future high-tension cable barrier systems.

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(091) Suppl. #2	**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: Phase I - Guidelines for Post Socketed Foundations for 4-Cable, High-Tension, Barrier Systems		
Name of Project Manager(s): Reid, Faller, Sicking, Rosenbaugh	**Phone Number:** 402-472-9324	**E-Mail** srosenba@unlserve.unl.edu
Lead Agency Project ID: 2611211006001	**Other Project ID (i.e., contract #):** RFPF-09-02	**Project Start Date:** 8/15/2008
Original Project End Date: 7/31/2011	**Current Project End Date:** 7/31/2012	**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
$73,549	$24,870	90%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$10,520	

Project Description:

High-tension cable barriers often incorporate socketed post foundations to simplify repair of the system after an accident. Barrier posts are designed to slide in and out of a ground socket for easy replacement of damaged components. Unfortunately, there have been numerous examples of socketed post foundations that are damaged during a cable barrier crash. In most cases, socket damage requires repair crews to either replace the socket itself or drive a post directly into the soil adjacent to the damaged component. Either situation defeats the purpose of using sockets and greatly increases the time necessary to restore a damaged barrier. The increased repair time translates into higher maintenance costs and increased risk to repair crews working adjacent to high-speed facilities.

Many existing socketed post foundation designs are constructed by drilling a hole in the soil, placing a steel sleeve in the hole, and backfilling with Portland cement concrete. Many of these designs do not have sufficient reinforcement to resist impact loads that are transmitted into the socket. Further, many of the sockets are too short to resist frost heave that can push the posts out of the ground. Thus, there is a need for general design guidelines that states can incorporate to assure that socketed post foundations perform as intended when used in the field.

Objectives/Tasks:

1. Conduct literature review on previous/current high-tension, cable systems.
2. Design new socket foundations for barrier posts.
3. Fabrication and dynamic testing of socketed foundations.
4. Analysis of test data and evaluation of socketed foundation designs.
5. Provide a written report documenting all work and conclusions.

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

Work this quarter continued on assembling the Phase I research report which will document the first round of dynamic testing and evaluation. The report will also contain the recommendations and designs for the second round testing of the socketed foundations. A draft report was completed and is currently under internal review.

Anticipated work next quarter:

The Phase I report will be finalized and sent out to the Pooled Fund member States.

Dynamic bogie testing of the redesigned socketed foundations will be conducted. Upon completion of the bogie tests, the data will be analyzed and conclusions shall be made concerning the strength and design of the 2nd generation of socketed foundations.

Significant Results:

Previously, 4 socketed foundation designs were evaluated through dynamic bogie testing. All 4 of these first round designs experienced heavy damage in the form of concrete fracture and plastic deformation of the reinforcing steel. As a result, 4 new reinforcement designs were configured to provide additional strength to the socketed foundation. The 4 new designs for the socketed post foundations were fabricated and are currently waiting to be tested.

Objectives/Tasks:	% Complete (Phase I only)
1. Conduct literature review on previous/current high-tension, cable systems.	100%
2. Design new socket foundations for barrier posts.	100%
3. Fabrication and dynamic testing of socketed foundations.	100%
4. Analysis of test data and evaluation of socketed foundation designs.	100%
5. Provide a written report documenting all work,conclusions, and recommendations.	80%

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).

Additional (matching) funds for this project were obtained through a Mid-America Transportation Center program. This matching funding was used during the first round of design, testing, and evaluation for the socketed foundations. However, some of the original funding for this remains as it was not used until the MATC funding was depleted. As a result, the continuing work which would have been conducted under Phase II of the project is being charged to the Phase I project until the funds are gone. Further, the project was extended solely to ensure the remaining funds would be accessible after the original completion date.

Potential Implementation:

Upon successful completion of this project, State DOT's will have the option to use a socketed post foundation for cable barrier system posts. The socketed foundation will allow for quick, easy, and inexpensive repairs to damaged sections of the barrier.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Nebraksa 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(091) Suppl. #3	**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: Further Development of the MGS Transition using Fewer Components		
Name of Project Manager(s): Reid, Sicking, Faller, Rosenbaugh	**Phone Number:** 402-472-9324	**E-Mail** srosenba@unlserve.unl.edu
Lead Agency Project ID: 2611211007001	**Other Project ID (i.e., contract #):** RPFP-09-03	**Project Start Date:** 8/15/2008
Original Project End Date: 7/31/2011	**Current Project End Date:** 12/31/2011	**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
$78,288	$76,926	98

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$5,435	

Project Description:

In 2008, MwRSF undertook a project to develop a transition between MGS guardrail and thrie beam, approach transitions using only standard steel and wood posts. Work began focusing on the steel post version of the stiffness transition, and a design configuration was selected for full-scale testing. However, during the first crash test, the upstream anchorage fail prematurely due to substandard wooden posts with large knots in the critical region. As a result, it was necessary to re-run the full-scale crash test before continuing with the evaluation process. The full-scale test re-run effectively used up the funds that were previously designated for developing the wood post alternative to the steel post system. Therefore, this project was necessary to fund the work required to develop the wood post equivalent to the standardized steel post stiffness transition.

Objectives / Tasks

1. Literature review
2. Bogie testing program and data analysis
3. BARRIER VII Analysis
4. Written report / Hardware Guide drawings

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

The draft report was completed by MwRSF and sent out to the States for review. Edits and comments have been received, and the report is going through a final revision. Also, Hardware Guide drawings have been developed for both the steel and wood post versions of the stiffness transition and have been submitted to Task Force 13 for approval.

Anticipated work next quarter:

The States' comments and edits will be implemented into the final report. Also, a package will be sent to FHWA asking for acceptance of the wood post version of the stiffness transition. Finally, any necessary edits to the Hardware Guide drawings shall be made.

Significant Results:

Through the literature review and the bogie testing program, wood post equivalents were found for the two sizes of steel posts utilized in the successfully crash tested stiffness transition. Wooden 6"x8" posts were found to perform similarly to the steel W6x9's (both having a 40" embedment depth). Also, wooden 8"x10" posts embedded 48" were found to provide the resistance of the steel W6x15's which were embedded 54" into the ground. The propensity for premature fracture in both 8"x8" and 6"x10" posts lead to these sizes not being recommended as equivalent posts.

The wood post equivalents were determined to provide slightly more resistance to rotation than the original steel posts. However, BARRIER VII models of the stiffness transitions illustrated that the performance of the wood post system (in terms of vehicle snag, pocketing, and deflections) was equivalent or better than the steel post system.

Objectives / Tasks	% Complete (wood post version only)
1. Literature review	100%
2. Bogie testing program and data analysis	100%
3. BARRIER VII Analysis	100%
4. Written report / Hardware Guide drawings	95%

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).

The project was extended through the end of 2011 in order for the project to remain open through the FHWA acceptance process and the acceptance of the Hardware Guide Drawings.

Potential Implementation:

the development of these stiffness transitions will provide State DOT's: (1) the missing transition segment between standard MGS and thrie beam approach transitions, (2) a stiffness transition that requires only the standard line posts already in stock, and (3) the option to use either steel or wooden posts through the length of the guardrail system.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(091) Supplement #6	☐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:		
Phase II - Development of an MGS Bridge Rail		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Lechtenberg, Bielenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211010001	RPFP-09-06	8/15/08
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
7/31/11	12/31/11	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
$157,256	$139,024	100

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$578	

Project Description:

The MGS system has been tested in a long-span guardrail application. In this design, the back of the guardrail posts were placed on a line that was tangent with the culvert head wall and three posts were omitted to span a maximum distance of approximately 25 ft. A largely unmodified MGS guardrail, without supporting posts in the 25 ft span, was able to contain a 5000 lb pickup. The impacting vehicle did extend some distance beyond the culvert head wall, but the MGS guardrail was able to safely pull it back onto the travelway. Another potential solution for bridges or culverts that are longer than 25 ft is to attach the guardrail posts to the edge of a bridge deck or the back of a culvert head wall. In this situation, the face of the guardrail would be placed approximately 15 in. from the edge of the bridge deck or approximately 9 in. beyond the face of the culvert head wall. This type of bridge railing will provide a low cost alternative that should provide adequate levels of protection for many rural highways.

Objective: Develop an MGS bridge rail for use on bridges and culverts that are longer than 25 ft. The design details should be developed for attaching to most bridge deck and culvert headwall applications.

Tasks:

1. Design of low-cost bridge rail
2. Simulation of design
3. Full-scale crash testing with 2270P and 1100C
4. Documentation and analysis of test results
5. Research report, final CAD details, FHWA acceptance

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

A request for federal acceptance of the MGS bridge rail was submitted to FHWA in July. The CAD details and packet of information for the Bridge Rail Guide was compiled and submitted to AASHTO TF-13 for inclusion in the Bridge Rail Guide.

Anticipated work next quarter:

None as all work has been completed.

Significant Results:

Task	% Complete
1. Design of low-cost bridge rail	100%
2. Simulation of design	100%
3. Full-scale crash testing with 2270P and 1100C	100%
4. Documentation and analysis of test results	100%
5. Research report, final CAD details, FHWA acceptance	100%

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).

There are no problems or issues to report at this time.

Potential Implementation:

A low-cost, MGS bridge rail that attaches to the edge of a concrete bridge deck would provide a very cost effective treatment of many rural bridges. Further cost savings could be realized through the elimination of the approach guardrail transition system by keeping the bridge rail stiffness close to that of the approach guardrail. Finally, this sort of low-cost system would be appropriate on many rural highways with moderate or low traffic volumes depending to some extent on the Test Level used in the development process.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #18	☐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:		
Impact Evaluation of Free Cutting Brass Breakaway Couplings		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Rosenbaugh	402-472-9324	srosenba@unlserve.unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211025001	RPFP-10-POLE	7/1/2009
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
7/31/2012		

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
$37,461	$59,364	100%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$445	

Project Description:

Breakaway couplers are commonly used to mitigate impacts between errant vehicles and luminaires or support poles placed at the edge of the roadway. However, existing breakaway couplers also have several disadvantages. All existing breakaway couplers are proprietary in nature and can be prohibitively expensive. Moreover, existing steel couplings do not have consistent energy absorption as a function of temperature due to the effect of the ductile to brittle transition temperature properties of the steel. Finally, many existing steel couplings are galvanized. Once the zinc is depleted, the coupling begins to corrode, which can potentially change the severity of the notch and altering its fatigue strength. Thus, there exists a need for a new breakaway coupler design that reduces costs and eliminates the disadvantages for existing steel, breakaway coupler designs.

A study was performed at the Illinois Department of Transportation to determine the energy absorption characteristics of a free-cutting brass hexagon, which has sharp internal threads. Based on results from preliminary component testing and evaluation, it is now necessary to determine whether the couplings provide acceptable safety performance when installed with actual support structures. Therefore, pendulum testing is necessary to determine the safety performance of the brass couplings when attached to large luminaire poles or other support structures according to current impact safety standards.

Objectives / Tasks
1. Component fabrication and test site preparation
2. Pendulum testing
3. Data analysis and high speed test extrapolation
4. Determination of pole size/weight limits
5. Written Report
6. FHWA Acceptance

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

MwRSF has received the FHWA acceptance letter for use if the brass couplings under the recommended limitations described in the final report.

Also, the Hardware Guide drawings were completed.

Anticipated work next quarter:

none

Significant Results:

After 2 rounds of unsuccessful tests and 2 redesigns, the final design for the breakaway brass couplings was developed. Through the use of pendulum testing and the high-speed extrapolation analysis procedures, limitation on pole sizes and weights were determined for the acceptable use of the brass couplings. These recommendations are shown in the conclusions section of the report.

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).

After the first round of testing was unsuccessful, additional funds were needed to continue the evaluation process (additional testing). However, the testing needed to be completed very quickly do to the expiring time table for FHWa acceptance of safety hardware tested to NCHRP Report no. 350 guidelines. As a result, the Pooled Fund members opted to use contingency funds to continue work on the project.

Potential Implementation:

With the FHWA acceptance, State DOT's can use the brass couplings as an economical alternative to proprietary breakaway couplings on luminary support poles.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #19	☐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:		
Phase II - Guidelines for Post-Socketed Foundations for 4-Cable, High-Tension, Barrier System		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Rosenbaugh	402-472-9324	srosenba@unlserve.unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211026001	RPFP-10-CABLE-1	7/1/2009
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
7/31/2012		

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
$92,207	$2,559	10%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0	

Project Description:

This project is the second Phase of a project which was undertaken the year previous - split up due to available funds in previous year not being sufficient to cover entire project.

High-tension cable barriers often incorporate socketed post foundations to simplify repair of the system after an accident. Barrier posts are designed to slide in and out of a ground socket for easy replacement of damaged components. Unfortunately, there have been numerous examples of socketed post foundations that are damaged during a cable barrier crash. In most cases, socket damage requires repair crews to either replace the socket itself or drive a post directly into the soil adjacent to the damaged component. Either situation defeats the purpose of using sockets and greatly increases the time necessary to restore a damaged barrier. The increased repair time translates into higher maintenance costs and increased risk to repair crews working adjacent to high-speed facilities.

Many existing socketed post foundation designs are constructed by drilling a hole in the soil, placing a steel sleeve in the hole, and backfilling with Portland cement concrete. Many of these designs do not have sufficient reinforcement to resist impact loads that are transmitted into the socket. Further, many of the sockets are too short to resist frost heave that can push the posts out of the ground. Thus, there is a need for general design guidelines that states can incorporate to assure that socketed post foundations perform as intended when used in the field.

Objectives/Tasks:

1. Design new socket foundations for barrier posts.
2. Fabrication and dynamic testing of socketed foundations.
3. Analysis of test data and evaluation of socketed foundation designs.
4. Written report documenting all work and conclusions.

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

Work this quarter continued on assembling the Phase I research report which will document the first round of dynamic testing and evaluation. The report will also contain the recommendations and designs for the second round testing of the socketed foundations. A draft report was completed and is currently under internal review.

The revised socketed foundation designs were fabricated, and the test site was prepped for the second round of dynamic testing (bogie pit filled with sand) .

Anticipated work next quarter:

The Phase I report will be finalized and sent out to the Pooled Fund member States.

Dynamic bogie testing of the redesigned socketed foundations will be conducted. Upon completion of the bogie tests, the data will be analyzed and conclusions shall be made concerning the strength and design of the 2nd generation of socketed foundations.

Significant Results:

Phase I of this project included the evaluation of 4 new socketed foundation designs. All 4 of these first round designs experienced heavy damage in the form of concrete fracture and plastic deformation of the reinforcing steel. As a result, 4 new reinforcement designs were configured to provide additional strength to the socketed foundation. The 4 new designs for the socketed post foundations were fabricated and are currently waiting to be tested.

Objectives/Tasks:	% Completed (Phase I and II)
1. Design new socket foundations for barrier posts.	35%
2. Fabrication and dynamic testing of socketed foundations.	35%
3. Analysis of test data and evaluation of socketed foundation designs.	20%
4. Written report documenting all work and conclusions.	15%

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).

Additional (matching) funds for Phase-I of this project were obtained through a Mid-America Transportation Center program. This matching funding was used during the first round of design, testing, and evaluation for the socketed foundations. Thus, some of the original Phase-I funding remains as it was not used until the MATC funding was depleted. As a result, the continuing work which would have been conducted under Phase II of the project is being charged to the Phase I project until the funds are gone. No time has been charged to the Phase II project to date.

Potential Implementation:

Upon successful completion of this project, State DOT's will have the option to use a socketed post foundation for cable barrier system posts. The socketed foundation will allow for quick, easy, and inexpensive repairs to damaged sections of the barrier.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Midwest Roadside Safety Facility, UNL

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) Supplement #20	**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: Replacement Funding for High-Tension, Cable, Barrier on Level Terrain (Year 20)		
Name of Project Manager(s): Reid, J.D., Sicking, D.L., & Faller, R.K.	**Phone Number:** 402-472-6864 (Faller)	**E-Mail** rfaller1@unl.edu
Lead Agency Project ID: RPFP-10-02 (2611211027001)	**Other Project ID (i.e., contract #):** TPF-5(193) Supplement #20	**Project Start Date:** July 1, 2009
Original Project End Date: July 31, 2012	**Current Project End Date:** July 31, 2012	**Number of Extensions:**

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
$52,888 (original)	$52,888	100

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$36,804 (70%)	$36,804	100

Project Description:

Supplemental Funding Tasks	% Completed
Barrier construction and system removal – 4CMB-5 & 4CMBLT-1	100
Barrier construction – 4CMB-6 (halted as post design may change)	40
Crash test no. 4CMB-5	100
Crash test no. 4CMBLT-1	100
Test no. 4CMB-4 reporting	85
Test no. 4CMB-5 reporting	85
Test no. 4CMBLT-1 reporting	25

These project funds were used to start and continue work on several tasks even though only replacement funding for one test was initially included herein. As such, the continued work and completion of these noted tasks will be charged to subsequent cable barrier contingency projects.

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

Work was completed on the data analysis and reporting of test nos. 4CMB-4, 4CMB-5, and 4CMBLT-1. System removal/demolition for the test 4CMB-5 and system construction/removal/demolition for test 4CMBLT-1 was completed and charged to Year 21 contingency funds and/or Year 22 project funds.

Anticipated work next quarter:

The draft report containing the results from test nos. 4CMB-4, 4CMB-5, and 4CMBLT-1 will be completed in the Fourth Quarter of 2011 under a contingency and supplemental funding projects. The project will be closed in 2011.

Significant Results:

The cable barrier system incorporated a modified cable-to-post bracket that was successfully tested and evaluated with a 1100C small car under the TL-3 impact safety standards of MASH. The modified cable barrier system was later tested and evaluated with a 2270P pickup truck in the 4:1 V-ditch and a 1500A passenger sedan on level terrain. From this testing, it was demonstrated that further design modifications were needed.

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).

The funds for this project were exhausted while continuing the development and testing of a high-tension cable barrier system. As such, these efforts were continued with using the Year 21 contingency and/or Year 22 project funds.

Potential Implementation:

These research results demonstrated that the new cable bracket worked well to capture a 1100C vehicle when used in combination with a barrier placed near the bottom of a 4:1 V-ditch. The new cable bracket will likely be used in future high-tension cable barrier systems.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE 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.#21	**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:
Additional Funding to Complete Development of a Crash-Worthy Terminal for Midwest Four-Cable, HT, Barrier System

Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller	402-472-3084	jreid@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
RPFP-10-CABLE-3	2611211028001	July 1, 2009
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
July 31, 2012	July 31, 2012	0

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
$159,193	$26,787	15%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

Project Description:

Objective: Redesign the cable release mechanism and foundation of the three cable end terminal to accommodate four high tension cables.

This is Phase II of the project. Phase I was funded in Year 17: SPR-3(017) Suppl.#38 - "Testing of Cable Terminal for High Tension Cable (1100C & 2270P)"

No reporting on this phase of the project will be done until Phase I is complete; see that project for status.

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

Anticipated work next quarter:

Significant Results:

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).

Final design details and full-scale testing for this project cannot be conducted until the High Tension Cable Barrier System is completed.

Potential Implementation:

The revised terminal will provide a non-proprietary end terminal for high tension barrier cable systems.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE 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.#22	**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: LS-DYNA Modeling Year 4		
Name of Project Manager(s): Reid, Sicking, Faller	**Phone Number:** 402-472-3084	**E-Mail** jreid@unl.edu
Lead Agency Project ID: RPFP-10-MGS	**Other Project ID (i.e., contract #):** 2611211029001	**Project Start Date:** July 1, 2009
Original Project End Date: July 31, 2012	**Current Project End Date:** July 31, 2012	**Number of Extensions:** 0

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
$166,953	$110,637	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

Project Description:

Objective: Identify an upper bound on the acceptable height of the Midwest Guardrail System (MGS).

Tasks
1. Full-scale crash testing - completed
2. Report on full-scale crash testing
3. Analysis phase

Note: The analysis phase of this project is being supplemented by NDOR project SPR-1(12) M318,"Maximum Safe Guardrail Height"

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

Task 2. Draft of the full-scale crash testing report was completed and is under internal review.

Task 3. Ray Julin, a graduate research assistant at MwRSF, began working on the analysis phase of this project. Work began on project planning, literature search, and Barrier VII and LS-Dyna analysis of the standard MGS. This analysis of the standard MGS will serve as the baseline models for analysis of the raised systems. The B-VII and LS-Dyna models being used had been previously been developed by MwRSF. In this project, those models are being fine-tuned for studying the specific problem on hand.

Anticipated work next quarter:

Task 2. Completion of the full-scale crash testing report is anticipated.

Task 3. The literature review will be completed, analysis of the baseline models will be completed, and initial models for the 34" and 36" height rail systems will be developed and analyzed. These initial models will be the foundation for performing future analysis, including using different vehicle models in the simulations and varying the height of the rail to heights other than what has been tested.

Significant Results:

On June 29, 2010, MwRSF conducted one small car crash test (test no. MGSMRH-1) into a 34-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 safety performance guidelines of MASH. The small car was successfully contained and redirected.

On September 9, 2010, a second small car test (test no. MGSMRH-2) was conducted into a 36-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

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).

No problems have been encountered to date.

Potential Implementation:

Clearly defined limits on the upper height for MGS guardrail will allow states to accurately determine when a guardrail is too high, either as a result of improper installation or frost heave. Further, a clearly defined upper height will be very helpful when determining acceptable MGS placement guidelines on moderate slopes or behind curbs.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE 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.#24	**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: LS-DYNA Modeling Year 4		
Name of Project Manager(s): Reid, Sicking, Faller	**Phone Number:** 402-472-3084	**E-Mail** jreid@unl.edu
Lead Agency Project ID: RPFP-10-LSDYNA	**Other Project ID (i.e., contract #):** 2611211031001	**Project Start Date:** July 1, 2009
Original Project End Date: July 31, 2012	**Current Project End Date:** July 31, 2012	**Number of Extensions:** 0

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
$37,634	$12,940	34%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date

Project Description:

The objective of this research effort is to set up an annual modeling enhancement program funded by the Pooled Fund Program States to address specific modeling needs shared by many safety programs. Funding from this project would go towards advancement of LS-DYNA modeling capabilities at MwRSF. The exact nature of the issues to be studied would be determined by the most pressing simulation problems associated with current Pooled Fund projects.

Current work addresses two main areas:
Task 1. Updating the end anchorage model of the MGS.
Task 2. Customizing vehicle models for cable on slope and v-ditch projects.

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

Task 1. Bogie testing on the end anchorage system is scheduled for next quarter under a separate project. This testing will provide physical behavior of the system during impact, including loads through the components and connections. Additionally, the movement through the soil of the anchorage will be captured. Results from the bogie testing will be used to calibrate and validate this new model. Note, however, that this testing has been scheduled for the last two quarters and for various scheduling reasons has not received high enough priority to be completed as of yet.

Task 2. Vehicle models of the 820c, 1100c, 2000p and 2270p were prepared specifically for studying 4-to-1 and 6-to-1 v-ditch behavior. The one major problem encountered was described in last quarter's progress report. Specifically, the 2270p model developed an instability in the connection between the front panel and bracket of the truck bed. This occurred when using the truck model on 4-to-1 slope for the high tension cable project. Two fixes were found to be successful: (1) provide a stronger connection by adding more spot welds between the two parts and (2) switch to a fully integrated element formulation for the two parts. The second fix was chosen for the model to move forward with on projects using the 2270p.

Anticipated work next quarter:

Due to teaching schedules at UNL, no work will be charged to this project during the next quarter.

Significant Results:

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).

No problems have been encountered to date.

Potential Implementation:

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #31	☐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:		
Wood Post for MGS		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Lechtenberg, Bielenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211045001	RPFP-11-MGS-1	7/1/10
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
12/31/13	12/31/13	0

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
$121,215	$40,098	45

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$34,835	

Project Description:

Although the Federal Highway Administration has approved the use of the MGS with both W6x9 steel and 6x8-in. wood posts, no rectangular standard southern yellow pine post designs have been subjected to full-scale crash testing according to the MASH criteria. Eventually this testing needs to be conducted to verify the MGS performance with the most common wood post used in the United States.

Objective: Verify that 6x8-in. southern yellow pine wood post option for MGS has similar characteristics to the steel post MGS.

Tasks:

1. Full-scale crash testing (MASH 3-10 and 3-11)
2. Analysis and documentation of test results
3. Research report
4. Hardware guide drawings and FHWA acceptance

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

On August 3, 2011, MwRSF conducted one pickup crash test (test no. MGSSYP-1) into a 31-in. tall Midwest Guardrail System (MGS) with standard southern yellow pine wood posts using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

On September 13, 2011, MwRSF conducted one small car test (test no. MGSSYP-2) into a 32-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

Data analysis of the first test was initiated.

Anticipated work next quarter:

Data analysis of test nos. MGSSYP-1 and MGSSYP-2 will be completed. The reporting of the two crash tests will be initiated. The system will be removed.

Significant Results:

On August 3, 2011, MwRSF conducted one pickup crash test (test no. MGSSYP-1) into a 31-in. tall Midwest Guardrail System (MGS) with standard southern yellow pine wood posts using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

On September 13, 2011, MwRSF conducted one small car test (test no. MGSSYP-2) into a 32-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

Task	% Complete
1. Full-scale crash testing (MASH 3-10 and 3-11)	100%
2. Analysis and documentation of test results	40%
3. Research report	0%
4. Hardware guide drawings and FHWA acceptance	0%

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).

The same test pit was used for Project No.:RPFP-11-MGS-3 – TPF-5(193) Supplement #33, Project Title: MGS without Blockouts. The wood post MGS system was constructed and tested following the completion of the aforementioned project. However, there are no additional problems or issues to report at this time.

Potential Implementation:

Full-scale crash testing and verification of the safety performance of the southern yellow pine post MGS system will provide designers with increased confidence when specifying a rectangular wood post option for the MGS. In addition, specifying wood posts can be a less costly alternative to steel posts in some areas, and wood posts may provide for a more aesthetic treatment.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #32	☐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:		
MGS Guardrail Attached to Culverts		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Rosenbaugh	402-472-9324	srosenba@unlserve.unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211046001	RPFP-11-MGS-2	7/1/2010
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
12/31/2013		

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
$91,071	$1,960	5%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$1,290	

Project Description:

Some cross-drainage culverts are wider than 24 ft and therefore cannot be treated with a long-span guardrail system. Although it is acceptable to utilize the deformable, top-mounted post attachment design developed for metric height guardrail under NCHRP Report No. 350, many existing culverts are too narrow to accommodate the loss of roadway width that comes with a top mounted system. Recently, the MGS Bridge Railing system was successfully developed and crash tested using the TL-3 MASH guidelines. The bridge railing system attaches to the exterior, vertical edge of reinforced concrete decks. It is believed that this bridge railing system could be adapted to mount to the backside face of an existing culvert headwall. The objective of this research effort is to develop an MGS guardrail system that attaches to the outside vertical face of the culvert headwall for box culverts greater than 24 ft wide.

Objectives / Tasks

1. Literature review of current culvert designs
2. Design of MGS attachment to face of headwall
3. Dynamic bogie testing
4. Data analysis and evaluation
5. Written report documenting all design work, testing, and conclusions

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

The literature review began with a collection of standards and specifications from each of the Pooled Fund states. These documents are currently being complied to identify common and critical culvert characteristics including culvert geometry, headwall geometry, and reinforcement.

Anticipated work next quarter:

The literature review shall be completed and a critical culvert design will be selected. This culvert and headwall design will then be utilized during the barrier attachment design and testing effort.

Significant Results:

Literature review has begun on the Pooled Fund states' culvert standards and specifications.

Objectives / Tasks	% Complete
1. Literature review of current culvert designs	70%
2. Design of MGS attachment to face of headwall	0%
3. Dynamic bogie testing	0%
4. Data analysis and evaluation	0%
5. Written report documenting all design work, testing, and conclusions	0%

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).

none

Potential Implementation:

Development of a new attachment for the MGS system to low-fill culverts will allow designers to install the MGS system on culverts wider than 24 ft without reducing the width of the overall roadway. In addition, it is anticipated that the new attachment design on the outside of the headwall will reduce construction and maintenance costs.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #33	☐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:		
Wood Post for MGS		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Lechtenberg, Holloway	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211047001	RPFP-11-MGS-3	7/1/10
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
12/31/13	12/31/13	0

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
$157,655	$70,243	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
	$49,786	

Project Description:

The oversized blockout used with the MGS design is one reason that the guardrail has demonstrated a 100 percent increase in redirective capacity as compared to conventional guardrail systems. However, there are some locations where roadway width is insufficient to accommodate a 12-in. blockout. A number of proprietary adaptations of the MGS design have been developed that do not utilize a blockout, thereby providing more useable roadway in constricted sites. A non-blocked version of the MGS should be feasible for use in those locations with constricted roadway widths.

Objective: Develop a MASH version of the MGS without blockouts for standard steel posts using standard components. If modifications to the system such as post to rail attachment are deemed to be necessary, the new components should be able to replace the existing components for all new construction and repair applications. By changing the standard components in the supply chain, it should be possible to minimize the risk of utilizing the wrong components in a no blockout design.

Tasks:

1. Full-scale crash testing (MASH 3-10 and 3-11)
2. Analysis and documentation of test results
3. Research report
4. Hardware guide drawings and FHWA acceptance

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

The system was removed. Data analysis of test nos. MGSNB-1 and MGSNB-2 was completed. The reporting of the two crash tests was initiated.

Anticipated work next quarter:

An internal draft report will be completed. Review of the internal draft report will be initiated.

Significant Results:

On May 15, 2011, MwRSF conducted one pickup crash test (test no. MGSNB-1) into the Midwest Guardrail System (MGS) without blockouts using a 2270-kg Dodge QuadCab according to the TL-3 safety performance guidelines of MASH. The pickup was successfully contained and redirected.

On June 15, 2011, MwRSF conducted one small car test (test no. MGSNB-2) into the Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

Task	% Complete
1. Full-scale crash testing (MASH 3-10 and 3-11)	100%
2. Analysis and documentation of test results	100%
3. Research report	50%
4. Hardware guide drawings and FHWA acceptance	10%

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).

There are no problems or issues to report at this time.

Potential Implementation:

Narrow roadways will benefit from a non-proprietary non-blocked out system by making more roadway width available while still providing acceptable guardrail performance. Additionally, a non-proprietary alternative to the existing non-blocked out guardrails would eliminate problems associated with identifying and properly repairing proprietary 31-in. tall guardrail systems.

It should be noted that, even if the MGS is made to function without a blockout, the 12-in. block would still be recommended where there was adequate space existing along the roadside. The blockout greatly improves the barrier's capacity to contain and redirect high-energy impacts with high c.g. vehicles.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #34	☐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:		
Assess Standard Weld Detail		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Rosenbaugh	402-472-9324	srosenba@unlserve.unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211048001	RPFP-11-MGS-4	7/1/2012
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
12/31/2013		

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
$10,000	$443	

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$260	

Project Description:

In 2001, the Midwest Roadside Safety Facility (MwRSF) successfully developed a guardrail connection for low-fill culverts according to the Test Level 3 (TL-3) safety performance guidelines found in NCHRP Report No. 350. After evaluating several base plates, bolts, and weld combinations with undesirable results, a final configuration was chosen which consisted of a ½-in. plate attached with a 5/16-in. three-pass fillet weld on the critical flange and a 1/4-in. fillet weld on the web and back-side flange. The final post design was successfully tested and evaluated using both dynamic component bogie testing and full-scale vehicle crash testing.

During the implementation of the W-beam guardrail system for attachment to concrete box culverts, various State Departments of Transportation have raised questions concerning the use of the three-pass fillet weld on the critical flange. As such, there exists a need to re-examine the use of the three-pass weld and determine whether a simplified alternative weld detail could be used in combination with the rigid post attachment.

Objectives / Tasks
1. Literature review of current practices
2. Design of new weld detail
3. Dynamic testing and analysis
4. Written Report containing design work, testing, and conclusions

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

A review was conducted on (1) the current weld standard, (2) Illinois and Nebraska's adaptations of the weld standard, and (3) multiple fabricators' recommendation for the weld. From this review, the top 4-5 designs were submitted to the Pooled Fund States for their consideration. The most favored weld design will be selected for testing.

Anticipated work next quarter:

Based on the responses from the Pooled Fund States, a weld design will be selected. Dynamic testing will then be used to evaluate the new weld design.

Significant Results:

Awaiting states' responses to possible weld configurations.

Objectives / Tasks	% Completed
1. Literature review of current practices	85%
2. Design of new weld detail	20%
3. Dynamic testing and analysis	0%
4. Written Report containing design work, testing, and conclusions	0%

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).

None

Potential Implementation:

The development of a simplified, standard weld detail will be compatible with the culvert-mounted, W-beam guardrail system and available for use on low-fill concrete box culverts.

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. #35	**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: Universal Steel Breakaway Post for Thrie-Beam Bullnose		
Name of Project Manager(s): Reid, Sicking, Faller, Bielenberg	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611211049001	**Other Project ID (i.e., contract #):** RPFP-11-BNOSE	**Project Start Date:** 7/1/2010
Original Project End Date: 12/31/13	**Current Project End Date:** 12/31/13	**Number of Extensions:** 0

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
$134,631.00	$81,219.00	90%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$2,214.00	

Project Description:

This research project provided continuation funding for the development and testing of a universal breakaway steel post for the thrie beam bullnose barrier system. The initial development and crash testing was performed under a recent MnDOT research study using the NCHRP Report No. 350 safety performance guidelines.

Task	% Completed
1. Full-scale Crash Testing	100
2. Analysis and documentation of test results	100
3. Summary report	100
4. Hardware Guide drawing and FHWA approval submittal	90

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

Following the completion of two successful full-scale crash tests in the fall, MwRSF completed the analysis and documentation of the crash test results. In addition, a summary report detailing the results from the crash tests was finalized and submitted to the sponsors.

Schmidt, J.D., Sicking, D.L., Faller, R.K., Reid, J.D., Bielenberg, R.W., and Lechtenberg, K.A., Investigating the Use of a New Universal Breakaway Steel Post - Phase III, Final Report to the Midwest States Regional Pooled Fund Program, MwRSF Research Report No. TRP-03-244-10, Project No.: TPF-5(193), Supplement No. 35, Project Code: RPFP-11-BNOSE - Year 21, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, December 16, 2010.

The results from the development and testing program were also presented at the 2011 Transportation Research Board AFB20 Committee meeting. A request for federal approval of the universal breakaway steel post for the thrie beam bullnose barrier system was submitted to FHWA. MwRSF has discussed the system with FHWA officials and the approval is was granted in letter CC-68A.

In the past quarter MwRSF continued to to finalize the CAD details for the Hardware Guide. After the initial draft of the Hardware Guide CAD details are completed and reviewed internally, the CAD will be submitted to the AASHTO Hardware Guide committee for review and incorporation.

Anticipated work next quarter:

The only work remaining in this project is to finalize the CAD details for the Hardware Guide. After the initial draft of the Hardware Guide CAD details are completed and reviewed internally, the CAD will be submitted to the AASHTO Hardware Guide committee for review and incorporation.

Significant Results:

FHWA acceptance of the Universal Steel Post Thrie Beam Bullnose system was received in letter HSST/CC-68A on August 19, 2011.

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).

None.

Potential Implementation:

Based on the performance of the UBSP post in the tests developed and tested in this work, the researchers believe that the UBSP post is a suitable alternative for the wood, CRT post used in the original bullnose median barrier system. Because the system performance with the UBSP posts was nearly identical to that observed with CRT posts, no additional constraints or caveats need to be applied when using the alternative UBSP post. In addition, the original design and implementation recommendations remain applicable to the modified bullnose system with UBSP posts. FHWA agree with this assessment and gave federal acceptance of the bullnose. Thus, the system is ready for implementation.

In addition, the satisfactory performance of the UBSP post in the bullnose median barrier system would suggest that there is potential for the UBSP post to serve as a surrogate in other CRT applications, such as in the long-span guardrail system and guardrail end terminals. There may also be potential for using this type of technology for guardrail systems installed in mow strips or encased in pavement. However, further analysis and testing would be required to verify its performance in these other applications.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE 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.#37	**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: Annual LS-DYNA Modeling Enhancement Support		
Name of Project Manager(s): Reid, Sicking, Faller	**Phone Number:** 402-472-3084	**E-Mail** jreid@unl.edu
Lead Agency Project ID: RPFP-11-LSDYNA	**Other Project ID (i.e., contract #):** 2611211050001	**Project Start Date:** July 1, 2010
Original Project End Date: December 31, 2013	**Current Project End Date:** December 31, 2013	**Number of Extensions:** 0

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
$35,901	0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
0	0	0

Project Description:

This is a continuation of TPF-5(193) Suppl.#24, "LS-DYNA Modeling Year 4" and thus, no progress to report until funds are exhausted in that project.

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

Anticipated work next quarter:

Significant Results:

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).

Potential Implementation:

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #38	☐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:		
Annual Fee to Finish TF-13 and FHWA Standard Plans		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Lechtenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211051001	RPFP-11-TF-13	7/1/10
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
12/31/13	12/31/13	0

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
$2,500	$2,499	100

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$1,813	

Project Description:

Each year, the Midwest States Pooled Fund program sponsors several roadside safety studies at the Midwest Roadside Safety Facility (MwRSF) of the University of Nebraska-Lincoln. Some of these research efforts result in the development of new roadside safety features. As part of this effort and on behalf of the member states, MwRSF seeks FHWA acceptance for those devices or systems meeting current impact safety standards. In the future, FHWA will require standard Task Force (TF) 13-format CAD details along the typical system details when requests for hardware acceptance are made.

MwRSF prepares 2-D and/or 3-D CAD details for newly developed roadside safety features that are subjected to full-scale vehicle crash testing. The CAD details used to describe the as-tested systems or components are not always prepared and presented in the same format as now required by AASHTO TF 13 and FHWA. As such, additional CAD details and background information must be prepared when FHWA acceptance is sought under MASH or when the new system or associated components are submitted for inclusion in the electronic version of the barrier hardware guide.

Objective: For all new barrier hardware, the member states request that MwRSF seek formal FHWA acceptance and placement of standardized TF-13 CAD details in the electronic version of the highway barrier guide. This funding shall be used to supplement the preparation of the TF-13 format CAD details.

Tasks:

1. Prepare CAD details for Hardware Guide

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

Completed preparation of the TF-13 CAD details for the remaining 8 systems. Revised the 5 reviewed system drawings per the comments received. During the September 2011 AASHTO TF-13 meeting, 3 of the revised drawings were approved and 2 of the revised drawing were conditionally approved once a few additional modifications are made.

The 2 bridge rail system drawings were submitted to the AASHTO TF-13 Bridge Rail Guide for review and inclusion. The one component drawing was submitted to the AASHTO TF-13 Luminaire Guide for review and inclusion.

Anticipated work next quarter:

None as all funds have been used in this project. The remaining work to be completed will be completed under Project No. RPFP-12-TF13 – TPF-5(193) Supplement #49, Project Title: Annual Fee to Finish TF-13 and FHWA Standard Plans.

Significant Results:

This project is used to supplement the preparation of the TF-13 format CAD details. Previously, it was determined that there are 13 systems and 11 components that need to be prepared in the TF-13 format. During discussions with the AASHTO TF-13 subcommittee in July 2011, new components had to be generated from the existing system drawings. Thus, the original 11 components became 32. Two of the systems and one component had limited work that need to be completed on the drawings as they were to be included in the Bridge Rail Guide and Luminaire Guide, respectively.

To Date:
13 systems - 3 approved, 2 conditionally approved, 8 to be reviewed
32 components - 32 to be reviewed

Task	% Complete
1. Prepare CAD details for Hardware Guide	100%

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).

At the present time, standard TF13-format CAD details are now required and subjected to review and comment by TF 13 members. This review is taking place during the TF-13 meetings which occur twice a year. After the initial review, the drawings are edited and then reviewed again at a later meeting. Once the CAD details are deemed acceptable and meet TF 13 guidelines, they are integrated into the electronic, web-based, version of the existing barrier hardware guide. Consequently, it requires a minimum of 6 months to get a drawing accepted for inclusion in the hardware guide; that is if there are only minimal edits to be made to the drawing. Sometimes, TF-13 requires a second review and more edits, thus adding another 6 months on to the time for its acceptance. For example, five (5) of the 13 systems were submitted for review during the September 2010 meeting. However, the allotted time only allowed the review of three (3) of the systems. The other two (2) were reviewed during the May 2011 meeting. Thus, some drawings may be in the review state at TF-13 for over a year before they are even looked at for the first time.

TF-13 is in the process of developing an online review system which will expedite the review process and allow more systems to be reviewed prior to their semi-annual meetings. Then at the TF-13 meetings it will be a final review and vote on if the drawings are ready to be implemented into the online guide.

Funding from Project No.: RPFP-12-TF13 – TPF-5(193) Supplement #49, Project Title: Annual Fee to Finish TF-13 and FHWA Standard Plans will now be used to complete the remaining systems.

Potential Implementation:

Newly-developed highway safety hardware will be contained in the electronic, web-based guide, thus promoting the standardization of barrier hardware across the U.S. and abroad.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #44	☐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:

Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I

Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Bielenberg, Lechtenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211064001	RPFP-12-CABLE1&2	7/1/11
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
6/30/14	6/30/14	0

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
$233,262	$3,754	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$3,754	

Project Description:

This project is an extension to previous projects (RPFP-08-02: Four-Cable Median Barrier in 4:1 V-Ditch; RPFP-09-01: New Funding for High-Tension Cable Barrier on Level Terrain with New Cable Attachment; and RPFP-10-CABLE-2: Replacement Funding for High-Tension Cable Barrier on Level Terrain).

Original Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system for use in 4H:1V sloped medians.

Revised Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system placed 0 to 4 ft away from the slope break point of a 6H:1V sloped medians.

Tasks:

1. Full-scale crash testing (MASH 3-10)
2. Full-scale crash testing (MASH 3-11)
3. Full-scale crash testing (Additional MASH 1500A)
4. Analysis and documentation of test results
5. Research report (s)
6. Hardware guide drawings and FHWA acceptance

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

On August 10, 2011, MwRSF personnel and members of the Midwest States Pooled Fund Program participated in a conference call to discuss the funded research and development projects pertaining to high-tension, cable barrier systems for use on relatively-flat and sloped medians. Following the conference call, a letter dated August 15, 2011 was sent to the members of the Midwest States Pooled Fund Program seeking State DOT guidance on the continued development of a high-tension, cable barrier system for relatively-flat and sloped median applications. As the result of the guidance from the member States, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6H:1V but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011). A planning and design meeting of MwRSF personnel is scheduled for September 23rd to discuss design modifications for the design placed 0 to 4 ft away from the slope break point of a 6H:1V sloped median.

The data analysis of test nos. 4CMB-4, 4CMB-5, and 4CMBLT-1 was completed. An internal draft report of test nos. 4CMB-4 and 4CMB-5 was completed. An internal draft report of test no. 4CMBLT-1 was completed. Review of both internal draft reports was initiated.

Anticipated work next quarter:

Design modifications will be investigated. CAD drawings of the modified system will be prepared. Redesigned system will be constructed. Crash testing could occur toward the end of the next quarter.

Complete internal review of the draft research report of 4CMB-4 and 4CMB-5. Complete internal review of the draft research report of 4CMBLT-1. Submit both draft report to Pooled Fund member states for review and comment.

Significant Results:

As the result of the guidance from the member States in August 2011, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6H:1V instead of 4H:1V but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011).

Task	% Complete
1. Full-scale crash testing (MASH 3-10)	0%
2. Full-scale crash testing (MASH 3-11) - 4CMB-5	100%
3. Full-scale crash testing (Additional MASH 1500A) - 4CMBLT-1	100%
4. Analysis and documentation of test results	70%
5. Research report - 4CMB-4 and 4CMB-5	75%
6. Research report - 4CMBLT-1	75%
7. Research report	0%
8. Hardware guide drawings and FHWA acceptance	0%

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).

This project is an extension to previous projects (RPFP-08-02: Four-Cable Median Barrier in 4:1 V-Ditch; RPFP-09-01: New Funding for High-Tension Cable Barrier on Level Terrain with New Cable Attachment; and RPFP-10-CABLE-2: Replacement Funding for High-Tension Cable Barrier on Level Terrain).

It should be noted that the test conducted with the 1500A on the system placed on level terrain (Test No. 4CMBLT-1 conducted on June 14, 2011) was charged to the Project No.:RPFP-11-CONT – TPF-5(193) Supplement #39, Project Title: Pooled Fund Year 21 Contingency even though it was one of the tests funded in Project No.:RPFP-12-CABLE1&2 – TPF-5(193) Supplement #44, Project Title: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I, V-Ditch. At the time this test was conducted, Year 22 funds were not available for use. The funds in the above mentioned contingency funds were available and were to be used to fund part of Phase II of this project.

As the result of the guidance from the member States in August 2011, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6H:1V but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011). Depending on the simulation results and future modifications to the proposed MASH test matrices, up to seven full-scale crash tests may be required, including three level terrain tests.

Potential Implementation:

The successful completion of the development, testing, and evaluation of the Midwest four-cable, high-tension, median barrier in sloped medians will allow the member states to implement a non-proprietary, high-tension, cable system along our nation's highways and roadways. The successful completion of this project along with the non-proprietary four-cable, high-tension, median barrier on level terrain and cable guardrail end terminal would help to assure acceptance by FHWA and improve its chances for widespread implementation.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #45	☐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:

Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase II

Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Bielenberg, Lechtenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211065001	RPFP-12-CABLE1&2	7/1/11
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
6/30/14	6/30/14	0

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
$91,800	$0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0	

Project Description:

The Midwest Roadside Safety Facility (MwRSF) has been conducting research for the Midwest States Regional Pooled Fund Program to develop a non-proprietary, high-tension, four-cable, median barrier that is capable of being used anywhere in a V-ditch with 4H:1V side slopes. Three tests still remain to complete the test matrix of the cable barrier system in a V-ditch. In addition, the four-cable, high-tension, median barrier has never been tested on level terrain. There is a concern that FHWA may not approve this design without testing on flat ground, especially when considering the wide cable spacing and increased cable heights. Further, the barrier deflections observed in crash tests performed in a 4H:1V V-ditch are likely higher than would be observed on flat ground. Crash testing of the barrier installed on level terrain would identify barrier deflections and working widths that can be expected when the barrier is used in narrow medians with gentle slopes and would allow for better performance comparisons between the Midwest four-cable barrier and other proprietary systems.

Objective: To complete the development, testing, and evaluation of the four-cable, high-tension, median barrier system for use on level terrain.

Tasks:

1. Full-scale crash testing (MASH 3-10 and 3-11)
2. Analysis and documentation of test results
3. BARRIER VII calibration and analysis for alternate configurations
4. Research report
5. Hardware guide drawings and FHWA acceptance

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

On August 10, 2011, MwRSF personnel and members of the Midwest States Pooled Fund Program participated in a conference call to discuss the funded research and development projects pertaining to high-tension, cable barrier systems for use on relatively-flat and sloped medians. Following the conference call, a letter dated August 15, 2011 was sent to the members of the Midwest States Pooled Fund Program seeking State DOT guidance on the continued development of a high-tension, cable barrier system for relatively-flat and sloped median applications. As the result of the guidance from the member States, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6:1 but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011). A planning and design meeting of MwRSF personnel is scheduled for September 23rd to discuss design modifications for the design placed 0 to 4 ft away from the slope break point of a 6:1 sloped median.

Anticipated work next quarter:

None.

Priorities set by the Pooled Fund member States are for the continued development of a high-tension, cable barrier system for relatively-flat and sloped median applications was to focus on the four-cable barrier system for use on sloped medians as steep as 6:1 but still placed 0 to 4 ft away from the slope break point.

Significant Results:

Task	% Complete
1. Full-scale crash testing (MASH 3-10 and 3-11)	0%
2. Analysis and documentation of test results	0%
3. BARRIER VII calibration and analysis for alternate configurations	0%
4. Research report	0%
5. Hardware guide drawings and FHWA acceptance	0%

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).

A portion of this project ($91,089 is not included in the project budget shown on page 1) will be funded with Project No.: RPFP-11-CONT – TPF-5(193) Supplement #39, Project Title: Pooled Fund Year 21 Contingency.

It should be noted that the test conducted with the 1500A on the system placed on level terrain (Test No. 4CMBLT-1 conducted on June 14, 2011) was charged to the above mentioned contingency funds even though it was one of the tests funded in Project No.:RPFP-12-CABLE1&2 – TPF-5(193) Supplement #44, Project Title: Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier Phase I, V-Ditch. At the time this test was conducted, Year 22 funds were not available for use. The funds in the above mentioned contingency funds were available and were to be used to fund part of this project (Phase II).

As the result of the guidance from the member States in August 2011, it was decided the four-cable barrier system would be developed for use on sloped medians as steep as 6:1 but still placed 0 to 4 ft away from the slope break point (Plan B from letter dated August 15, 2011). Depending on the simulation results and future modifications to the proposed MASH test matrices, up to seven full-scale crash tests may be required, including three level terrain tests.

Potential Implementation:

The successful completion of the development, testing, and evaluation of the Midwest four-cable, high-tension, median barrier on level terrain will allow the member states to implement a non-proprietary, high-tension, cable system along our nation's highways and roadways. In addition, the crash testing of the four-cable, high-tension, median barrier on level terrain would also provide a more complete understanding of barrier performance (i.e., dynamic deflections, working width, etc.) when used in relatively flat, narrow medians. The crash results from the level terrain testing will be used in combination with computer simulation to evaluate the effects of reduced post spacing. The successful completion of this project along with the non-proprietary four-cable, high-tension, median barrier in V-ditch and cable guardrail end terminal would help to assure acceptance by FHWA and improve its chances for widespread implementation.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #46	☐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:		
Completion of the Development and Evaluation of the Midwest Four-Cable, High-Tension, Median Barrier - Phase III		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Bielenberg	402-472-9064	rbielenberg2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211066001	RPFP-12-Cable 1&2	7/1/2012
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
6/30/2014		

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
$199,626	$0	0%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0	

Project Description:

This project is an extension to a previous project (RPFP-07-06, titled "Cable Guardrail End Terminal Development using 350 Update Vehicles")

In a previous Pooled Fund Project, a cable end terminal consisting of three cables was designed and successfully crash tested according to NCHRP Report 350 criteria. That end terminal was designed for a low tension system. Further, MwRSF has also been working to develop a non-proprietary, high-tension, cable barrier system. Thus, there is a need to adapt this terminal for use in high-tension cable systems while also being satisfying the safety performance standards of MASH.

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

Work on this project was conducted and charged to project RPFP-07-06, titled "Cable Guardrail End Terminal Development using 350 Update Vehicles". Once funds are depleted from the noted project, time will begin to be charged to this project.

Anticipated work next quarter:

extensive work / testing of anchorage system not expected until barrier system is fully developed

Significant Results:

extensive work / testing of anchorage system not expected until barrier system is fully developed

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).

extensive work / testing of anchorage system not expected until barrier system is fully developed. Thus, this project is on hold.

Potential Implementation:

The successful completion of the development, testing, and evaluation of a non-proprietary crashworthy guardrail end terminal, will allow the member states to implement a non-proprietary, high-tension, cable system along our nation's highways and roadways. The successful completion of this project along with the development of the non-proprietary, high-tension, cable barrier system would help to assure acceptance by FHWA and improve its chances for widespread implementation.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Suppl. #47	☐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: MGS Culvert Attachment with Epoxied Rods		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Bielenberg, Rosenbaugh	402-472-9324	srosenba@unlserve.unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211067001	RPFP-11-MGS-4	7/1/2011
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
6/30/2014		

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
$19,935	$0	0%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0	

Project Description:

MwRSF has previously developed a TL-3 guardrail system for use on low-fill culverts and according to the NCHRP Report No. 350 safety performance criteria. In this application, the steel guardrail posts were anchored to the top of the culvert slab using through bolts in combination with a base plate that is welded to the bottom of the posts. However, problems can arise when the guardrail post coincides with the location of a vertical support wall found inside the culvert. For this scenario, through bolts cannot be utilized to anchor the guardrail posts to the culvert slab since there is unavailable space to place the lower bearing plate or access the lower end of the through bolt. Instead, it is necessary to use an alternative anchorage option, such as a threaded rod anchored into the culvert slab and upper region of the vertical wall. Unfortunately, no design recommendations exist for using epoxied anchor rods to attach the steel posts to the top of the culvert slab. A small research study is needed to evaluate suitable epoxied anchor rods for use with the W-beam guardrail over culvert system.

In 2010, the Midwest Pooled Fund States funded a small project to determine an alternative, standard weld detail which simplifies the post-plate attachment for the guardrail system mentioned above and to evaluate the new weld detail through both analysis and bogie testing. The proposed project herein is to act as a supplement to the current project, RFPF-11-MGS-4.

Objectives / Tasks
1. Literature review
2. Design of epoxied anchors
3. Dynamic testing and analysis of design
4. Written report containing all design, analysis and conclusions

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

Work has not begun on this project

Anticipated work next quarter:

A literature review of epoxied rod strength shall be conducted and design work shall commence.

Significant Results:

work has not yet begun.

Objectives / Tasks	% Completed
1. Literature review	0%
2. Design of epoxied anchors	0%
3. Dynamic testing and analysis of design	0%
4. Written report containing all design, analysis and conclusions	0%

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).

None

Potential Implementation:

The development of an epoxied anchor rod alternative to the original through bolt anchorage of the culvert guardrail posts will allow the system to be installed anywhere across the top slab of the concrete culvert, regardless of the location of interior, culvert walls.

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. #48	**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: Pooled Fund Center for Highway Safety		
Name of Project Manager(s): Ron Faller, John Reid, Bob Bielenberg	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611211068001	**Other Project ID (i.e., contract #):** RPFP-12-PFCHS-1	**Project Start Date:** 7/1/2011
Original Project End Date: 6/30/14	**Current Project End Date:** 6/30/14	**Number of Extensions:** 0

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
$24,859.00	$0.00	0%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0.00	

Project Description:

Many of MwRSF's inquiries from members of the Midwest States Pooled Fund program can be answered based upon prior pooled fund or other research. Further, even though answers to pooled fund inquiries are normally routed to all pooled fund states in the quarterly progress report, there are numerous repeat questions every year. The quarterly summaries are helpful to member states, but they are temporary and not well organized by the type of question or specific topic. Many pooled fund inquiries could be answered through the development of a Center of Highway Safety web site. This web site would provide an organized and searchable summary for all State inquiries and MwRSF reports as well as CAD details pertaining to Pooled Fund crash tested systems. This safety center would also be helpful to non-member states with problems or inquiries similar to those identified by the member states.

A dedicated and well-maintained Pooled Fund Center for Highway Safety web site would provide for all of these needs. It would provide for a searchable database of previous MwRSF inquiries and solutions, a searchable online listing of downloadable research reports, and a searchable archive of CAD details for crash tested and/or approved systems and features. Through MwRSF's relationship with the Nebraska Transportation Center (NTC), experienced personnel can be hired to perform website design, programming, as well as provide reliable website hosting facilities. However, the development, maintenance, operation, and hosting of the web site will require funding. It is anticipated that the costs to develop, operate, maintain, and host a Pooled Fund Center for Highway Safety web site would be $24,859.00 in funding for FY 22.

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

This project has not yet started.

Anticipated work next quarter:

In the coming quarter, MwRSF will begin the process of developing the Pooled Fund Center for Highway Safety website. The process will begin by collecting input from the state DOT's regarding what type of technical information they would like to see on the site, what format they would like to have it in, and how they would like to setup access to those materials.

Once the state comments are collected and reviewed, MwRSF will begin preliminary planning for the website with the website development people at UNL.

Significant Results:

None.

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).

None.

Potential Implementation:

The Pooled Fund Center for Highway Safety web site would provide immediate access to a wide library of roadside safety materials for designers and engineers, including reports, CAD details, etc. It would also provide a searchable database of previous solutions and responses to prior Pooled Fund inquiries and problems. The web site would also be available through controlled access to state DOT's around the country which would promote improved roadside safety.

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)*	**Transportation Pooled Fund Program - Report Period:**
TPF-5(193) Supplement #49	☐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:		
Annual Fee to Finish TF-13 and FHWA Standard Plans		
Name of Project Manager(s):	**Phone Number:**	**E-Mail**
Reid, Sicking, Faller, Lechtenberg	402-472-9070	kpolivka2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211069001	RPFP-12-TF13	7/1/11
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
6/30/14	6/30/14	0

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
$3,993	$1,190	10

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$1,190	

Project Description:

Each year, the Midwest States Pooled Fund program sponsors several roadside safety studies at the Midwest Roadside Safety Facility (MwRSF) of the University of Nebraska-Lincoln. Some of these research efforts result in the development of new roadside safety features. As part of this effort and on behalf of the member states, MwRSF seeks FHWA acceptance for those devices or systems meeting current impact safety standards. In the future, FHWA will require standard Task Force (TF) 13-format CAD details along the typical system details when requests for hardware acceptance are made.

MwRSF prepares 2-D and/or 3-D CAD details for newly developed roadside safety features that are subjected to full-scale vehicle crash testing. The CAD details used to describe the as-tested systems or components are not always prepared and presented in the same format as now required by AASHTO TF 13 and FHWA. As such, additional CAD details and background information must be prepared when FHWA acceptance is sought under MASH or when the new system or associated components are submitted for inclusion in the electronic version of the barrier hardware guide.

Objective: For all new barrier hardware, the member states request that MwRSF seek formal FHWA acceptance and placement of standardized TF-13 CAD details in the electronic version of the highway barrier guide. This funding shall be used to supplement the preparation of the TF-13 format CAD details.

Tasks:

1. Prepare CAD details for Hardware Guide

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

Completed preparation of the TF-13 CAD details for the remaining 8 systems. Revised the 5 reviewed system drawings per the comments received. During the September 2011 AASHTO TF-13 meeting, 3 of the revised drawings were approved and 2 of the revised drawing were conditionally approved once a few additional modifications are made.

The 2 bridge rail system drawings were submitted to the AASHTO TF-13 Bridge Rail Guide for review and inclusion. The one component drawing was submitted to the AASHTO TF-13 Luminaire Guide for review and inclusion.

Anticipated work next quarter:

Revise the 2 conditionally approved systems. Review and revise (if necessary) the remaining 6 system drawings for the Barrier Guide based on comments received on the reviewed drawing. Submit the remaining 6 system drawings and 31 component drawings to AASHTO TF-13 Barrier Guide for review.

Significant Results:

This project is used to supplement the preparation of the TF-13 format CAD details. Previously, it was determined that there are 13 systems and 11 components that need to be prepared in the TF-13 format. During discussions with the AASHTO TF-13 subcommittee in July 2011, new components had to be generated from the existing system drawings. Thus, the original 11 components became 32. Two of the systems and one component had limited work that need to be completed on the drawings as they were to be included in the Bridge Rail Guide and Luminaire Guide, respectively.

To Date:
13 systems - 3 approved, 2 conditionally approved, 8 to be reviewed
32 components - 32 to be reviewed

Task	% Complete
1. Prepare CAD details for Hardware Guide	100%

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).

Funding from Project No.: RPFP-11-TF-13 – TPF-5(193) Supplement #38, Project Title: Annual Fee to Finish TF-13 and FHWA Standard Plans used prior to starting this project.

At the present time, standard TF13-format CAD details are now required and subjected to review and comment by TF 13 members. This review is taking place during the TF-13 meetings which occur twice a year. After the initial review, the drawings are edited and then reviewed again at a later meeting. Once the CAD details are deemed acceptable and meet TF 13 guidelines, they are integrated into the electronic, web-based, version of the existing barrier hardware guide. Consequently, it requires a minimum of 6 months to get a drawing accepted for inclusion in the hardware guide; that is if there are only minimal edits to be made to the drawing. Sometimes, TF-13 requires a second review and more edits, thus adding another 6 months on to the time for its acceptance. For example, five (5) of the 13 systems were submitted for review during the September 2010 meeting. However, the allotted time only allowed the review of three (3) of the systems. The other two (2) were reviewed during the May 2011 meeting. Thus, some drawings may be in the review state at TF-13 for over a year before they are even looked at for the first time.

TF-13 is in the process of developing an online review system which will expedite the review process and allow more systems to be reviewed prior to their semi-annual meetings. Then at the TF-13 meetings it will be a final review and vote on if the drawings are ready to be implemented into the online guide.

Potential Implementation:

Newly-developed highway safety hardware will be contained in the electronic, web-based guide, thus promoting the standardization of barrier hardware across the U.S. and abroad.

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. #50	**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: Annual Consulting Services Support		
Name of Project Manager(s): Ron Faller, John Reid, Bob Bielenberg	**Phone Number:** 402-472-9064	**E-Mail** rbielenberg2@unl.edu
Lead Agency Project ID: 2611211070001	**Other Project ID (i.e., contract #):** RPFP-12-CONSULT	**Project Start Date:** 7/1/2011
Original Project End Date: 6/30/14	**Current Project End Date:** 6/30/14	**Number of Extensions:** 0

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
$36,543.00	$0.00	0%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
	$0.00	

Project Description:

This project allows MwRSF to be a valuable resource for answering questions with regard to roadside safety issues. MwRSF researchers and engineers are able to respond to issues and questions posed by the sponsors during the year. Major issues discussed with the States have been documented in our Quarterly Progress Reports and all questions and support will now be accessible on a MwRSF Pooled Fund Consulting website.

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

This project has not yet started as the previous quarter was funded under the Year 21 Consulting Services project.

Anticipated work next quarter:

MwRSF will continue to answer questions and provide support to the sponsors during the upcoming quarter. In addition, MwRSF will continue the effort to begin the implementation the consulting services website and aid the states in getting familiar with it.

Significant Results:

None

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).

None.

Potential Implementation:

None.

TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): NE 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. #51	**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: Annual LS-DYNA Modeling Enhancement Support		
Name of Project Manager(s): Reid, Sicking, Faller, Bielenberg	**Phone Number:** 402-472-3084	**E-Mail** jreid@unl.edu
Lead Agency Project ID: RPFP-12-LSDYNA	**Other Project ID (i.e., contract #):** 2611211071001	**Project Start Date:** July 1, 2011
Original Project End Date: June 30, 2014	**Current Project End Date:** June 30, 2014	**Number of Extensions:** 0

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
$36,543	0	0

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
0	0	0

Project Description:

This is a continuation of TPF-5(193) Suppl.#37, "Annual LS-DYNA Modeling Enhancement Support" and thus, no progress to report until funds are exhausted in that project.

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

Anticipated work next quarter:

Significant Results:

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).

Potential Implementation:

Midwest States Pooled Fund Program
Quarterly Progress Report – Third Quarter 2011
September 19, 2011

DRAFT REPORTS – POOL FUND

Rosenbaugh, S.K., Schrum, K.D., Faller, R.K., Lechtenberg, K.A., Sicking, D.L., and Reid, J.D., *Development of the Wood-Post MGS Approach Transition*, Draft Report to the Midwest States Regional Pooled Fund Research Program, MwRSF Research Report No. TRP-03-243-11, Project No. TPF-5(193)-Year 19, Project Code: RPFT-09-03, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, July 12, 2011.

FINAL REPORTS – POOL FUND

None

DRAFT REPORTS – PROJECT RUN THROUGH POOL FUND, FUNDED BY INDIVIDUAL STATE

Schrum, K.D., Albuquerque, F.D.B., Sicking, D.L., Faller, R.K., and Reid, J.D., *Roadside Grading Guidance*, Draft Report to the Wisconsin Department of Transportation, MwRSF Research Report No. TRP-03-251-11, Project No. TPF-5(193) Supplement #13, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, July 27, 2011.

Jowza, E.J., Faller, R.K., Mongiardini, M., Sicking, D.L., and Reid, J.D., *Crash Testing of Various Erosion Control Features – Phase I: Preliminary Guidelines*, Draft Report to the Wisconsin Department of Transportation, MwRSF Research Report No. TRP-03-249-11, Project No. TPF-5(193) Supplement #17, Project Code: RPF-WISC-6, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, June 30, 2011.

FINAL REPORTS – PROJECT RUN THROUGH POOL FUND, FUNDED BY INDIVIDUAL STATE

None

DRAFT REPORTS – FHWA PROJECT

McGhee, M.D., Faller, R.K., Rohde, J.R., Lechtenberg, K.A., Sicking, D.L., and Reid, J.D., *Development and Evaluation of the Non-Blocked, Midwest Guardrail System (MGS) for Wire-Faced, MSE Walls*, Draft Report to the U.S. Department of Transportation, Federal Highway Administration, Central Federal Lands Highway Division, MwRSF Research Report No. TRP-03-235-11, Project No. DTFH68-07-E-00010, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, July 6, 2011.

Homan, D.M., Thiele, J.C., Faller, R.K., Rosenbaugh, S.K., Rohde, J.R., Arens, S.W., Lechtenberg, K.A., Sicking, D.L., and Reid, J.D., *Investigation and Dynamic Testing of Wood and Steel Posts for MGS on A Wire-Faced MSE Wall*, Draft Report to the U.S. Department of Transportation, Federal Highway Administration, Central Federal Lands Highway Division, MwRSF Research Report No. TRP-03-231-11, Project No. DTFH68-07-E-00010, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, July 6, 2011.

FINAL REPORTS – FHWA PROJECT

None

Midwest States Pooled Fund Program
Quarterly Progress Report – Third Quarter 2011
September 19, 2011

DRAFT REPORTS – POOL FUND

Rosenbaugh, S.K., Schrum, K.D., Faller, R.K., Lechtenberg, K.A., Sicking, D.L., and Reid, J.D., *Development of the Wood-Post MGS Approach Transition*, Draft Report to the Midwest States Regional Pooled Fund Research Program, MwRSF Research Report No. TRP-03-243-11, Project No. TPF-5(193)-Year 19, Project Code: RPFT-09-03, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, July 12, 2011.

FINAL REPORTS – POOL FUND

None

DRAFT REPORTS – PROJECT RUN THROUGH POOL FUND, FUNDED BY INDIVIDUAL STATE

Schrum, K.D., Albuquerque, F.D.B., Sicking, D.L., Faller, R.K., and Reid, J.D., *Roadside Grading Guidance*, Draft Report to the Wisconsin Department of Transportation, MwRSF Research Report No. TRP-03-251-11, Project No. TPF-5(193) Supplement #13, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, July 27, 2011.

Jowza, E.J., Faller, R.K., Mongiardini, M., Sicking, D.L., and Reid, J.D., *Crash Testing of Various Erosion Control Features – Phase I: Preliminary Guidelines*, Draft Report to the Wisconsin Department of Transportation, MwRSF Research Report No. TRP-03-249-11, Project No. TPF-5(193) Supplement #17, Project Code: RPF-WISC-6, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, June 30, 2011.

FINAL REPORTS – PROJECT RUN THROUGH POOL FUND, FUNDED BY INDIVIDUAL STATE

None

DRAFT REPORTS – FHWA PROJECT

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FINAL REPORTS – FHWA PROJECT

None