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. #109	☐ 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):	**Phone Number:**	**E-Mail**
Ron Faller, John Reid, Bob Bielenberg	402-472-9064	rbielenberg2@unl.edu
Lead Agency Project ID:	**Other Project ID (i.e., contract #):**	**Project Start Date:**
2611211130001	RPFP-16-CONSULT	10/1/2016
Original Project End Date:	**Current Project End Date:**	**Number of Extensions:**
9/30/19	9/30/19	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
$56,310.00	$23,877.88	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
	$13,334.45	

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 are accessible on a MwRSF Pooled Fund Consulting web site.

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 has been attached to this document. The summary will also be available for download at the recently completed MwRSF Pooled Fund Consulting web site - http://mwrsf-qa.unl.edu/

We are continuing to work with and improve the MwRSF Pooled Fund Consulting web site as our experience with it grows. We would ask that all Pooled Fund member states use the new site from this point forward for their inquiries and to contact us with any issues they experience with the web site.

Anticipated work next quarter:

MwRSF will continue to answer questions and provide support to the sponsors during the upcoming quarter.

We would ask that all questions be submitted through the web site so that they can be answered and archived therein.

http://mwrsf-qa.unl.edu/

Significant Results:

A quarterly summary of the consulting effort was provided and users can use the web site to search and find responses as well.

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.

Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

04-17-2017 to 08-02-2017

Follow up question to Q/A #393

Question
State: IA
Date: 04-24-2017

We have been allowing the substitution of 6" x 8" posts when replacing older 8" x 8" post installations for a while now (Q/A #393 dated May 2009) but there have recently been discussions about whether the vacated hole needs to be filled and tamped before driving a 6" x 8" post in or whether a 6" x 8" post can be placed in the hole and only the remaining 2" gap be filled and tamped. Our concern is that standard soil strength would be difficult to achieve if only tamping 2", given the small space in which to work, but it has been requested and we wanted to get your thoughts.

Response
Date: 04-25-2017

We would concur that attempting to reinstall the 6x8 post in the excavated 8x8 hole and fill and compact the remaining 8"x2" space would be difficult to effectively achieve.

As such, we would prefer that the 8x8 hole be backfilled and tamped prior to installing the 6x8 post. This should provide for more consistent post installation and behavior.

Mow Strips

Question
State: VA
Date: 04-27-2017

1. Do you currently have a separate pay item(s) for w-beam to thrie beam stiffness transitions at bridges? Yes

2. Will you be using a separate pay item(s) for w-beam to thrie beam stiffness transitions at bridges after MASH implementation? Yes

3. If you answered yes to question 1 or 2 above, what are your separate pay items called? Do you use a separate pay item for approach and trailing ends?

```
2505-4008300   STEEL BEAM G'RAIL
2505-4008410   STEEL BEAM G'RAIL BAR TRANS SECT, BA-201
2505-4021010   STEEL BEAM G'RAIL END ANCHOR, BOLTED
```

4. Are you now or in the future (due to MASH implementation) using a separate pay item(s) for stiffening the guide rail where a fixed object (IE: utility pole, pier, sign structure, etc) is less than 4 feet from face of rail element? If yes, what are your separate pay items called. We do not currently use a separate bid item for that. Locations are just noted in the plans.

Response
Date: 04-27-2017

Dave/ All,

1. … Pay item(s) … for w-beam/ thrie beam @ bridges? NDOR pays for a “Bridge Approach Section" (25') which includes the W-THRIE BEAM TRANSITION SECTION & nested thrie bean leading to the bridge rail – Standard plan 740.

2. … using a separate pay item(s w-beam/ thrie beam trans. @ bridges after MASH implementation? Yes:

3. (a) … what are your separate pay items called? “Bridge Approach Section" & “Special Bridge Approach Section" for thrie beam Plan 741.

   When not part of a “Bridge Approach Section" we use “W-THRIE BEAM TRANSITION SECTION“

   (b) … separate pay item for approach and trailing ends? Yes; Approach: End Treatments Type I (parallel) or II (taper 4' away) these are listed in the contract as to what is allowed, Trailing: “END ANCHORAGE ASSEMBLY" includes; 2 – posts, cable assembly, strut & yoke assembly, etc.

4. (a) … stiffening the guide rail when object is less than 4 feet from face ? we pay for extra posts; using 3'1.5" post spacing.

   (b) … separate pay items called. “Guardrail posts"

Average Unit Prices: http://www.roads.nebraska.gov/business-center/business-opp/hwy-bridge-lp/item-history/

Standard plans: http://www.roads.nebraska.gov/business-center/design-consultant/stand-spec-manual/

Standard plans 700 ‘s

Special plans: 7000 ‘s

Response
Date: 04-27-2017

We are working on our miscellaneous installation details for our new MGS standard. After discussions during our pooled fund meeting last week, it is apparent that the paving details under the rail are critical. We currently do not have a leave-out detail for our 27 ¾" w-beam guardrail.

How is your state handling this issue? It appears that some states are saw cutting or coring a leave-out and adding a low strength sealant after the post is installed to prevent weed growth. This seems to be a labor intensive process.

Other states specify a 2" thick asphalt mow strip without any leave-outs. Does anyone have any in-service data on this method?

Bob: Any thoughts?

Thanks

Response
Date: 04-27-2017

We have provided guidance on this topic in the past. We have typically referred to FHWA Memo B64b (see attached). The memo encapsulated previous research done at MwRSF, TTI, and CALTRANS regarding leave outs and fill materials.

I have attached the memo and the previous related research reports.

In addition, we did work on a weak post version of the MGS for installation in mow strips. This would be an alternative that would not require leave outs.

The link to a zip file with that research and the information above can be accessed at the link below.

https://unl.box.com/s/yn8spztfk6whv3qke2acenz5kyn37rw4

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/72b43d259199d8837fc3dc96d57266b9.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/de6e936463620538976e753dcd31866c.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/36a504a20ff289c06d9c12d1d42c9e27.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/0c8f4d68fa22fbdc13ede6aa3f22c1d8.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/532d7efa772b80b7b4566c00798fe4fd.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/2f0c0893b5f967e705c3d4fd8f303a0f.pdf

---

Response
Date: 04-28-2017

David,

See Illinois responses below in RED.

Midwest States Pooled Fund members,

NJDOT currently does not use a separate pay item for the W-beam to thrie beam transitions at bridges. The cost for these transitions are included in the price of the guide rail. Now that NJDOT will be switching to the 31" MGS after 12/31/2017, these transitions are significantly longer than the NCHRP 350 transitions and we are considering separate pay items.

Can you please answer the following questions on the practice in your state:

1. Do you currently have a separate pay item(s) for w-beam to thrie beam stiffness transitions at bridges? YES

2. Will you be using a separate pay item(s) for w-beam to thrie beam stiffness transitions at bridges after MASH implementation? YES

3. If you answered yes to question 1 or 2 above, what are your separate pay items called? Do you use a separate pay item for approach and trailing ends?

   Connection to a concrete parapet or other concrete structure is TRAFFIC BARRIER TERMINAL, TYPE 6. This is Highway Standard 631031.

   Connection to a steel bridge rail is called TRAFFIC BARRIER TERMINAL, TYPE 6A. This is Highway Standard 631032.

   Connection to a concrete structure and not using a curb is called TRAFFIC BARRIER TERMINAL, TYPE 6B. This is Highway Standard 631033.

   You can review these at our Highway Standards: http://www.idot.illinois.gov/doing-business/procurements/engineering-architectural-professional-services/Consultants-Resources/highway-standards-and-district-specific-standards

   You can find the coded pay items here: https://www.google.com/url?q=http://www.idot.illinois.gov/Assets/uploads/files/Doing-Business/Specialty-Lists/Highways/Design-%26-Environment/Coded-Pay-Items/January-16-2015-Letting/CodedPayItemsHwy20150116.pdf&sa=U&ved=0ahUKEwjPrcOY6f7SAhXh5oMKHQhxDuEQFggHMAE&client=internal-uds-cse&usg=AFQjCNE8bvrnXfiy4U8l7oWNqlnH6-j74Q

4. Are you now or in the future (due to MASH implementation) using a separate pay item(s) for stiffening the guide rail where a fixed object (IE: utility pole, pier, sign structure, etc) is less than 4 feet from face of rail element? If yes, what are your separate pay items called.

   Yes, guardrail with 6'-3" post spacing is STEEL PLATE BEAM GUARDRAIL, TYPE A. Guardrail with 3'-1 ½" post spacing is called STEEL PLATE BEAM GUARDRAIL, TYPE B. We do not have guardrail post spacing of 1' 6 ¾" depicted on a Standard, but it could be included as a plan detail with a unique pay item. Both Type A and Type B are shown on Highway Standard 630001 at the same link referenced above.

Response
Date: 04-28-2017

1. Yes, WisDOT has separate bid items.

2. Yes, WisDOT will use separate bid items.

3. 614.2500 MGS Thrie Beam Transition

4. Yes, we use separate bid items when there is a need for reduced working width. We use to not have separate bid items. Low and behold contractors and field staff were not stiffening the beam guards when they should have or not providing enough of it.

Bid items are:

614.2300 MGS Guardrail 3 (normal post spacing)

614.2310 MGS Guardrail 3 HS (Half post Spacing)

614.2320 MGS Guardrail 3 QS (Quarter post Spacing)

We tell designer they are responsible for providing appropriate working width. If they don't it is Errors and Omissions on their part.

We use a different bid items for a number of situations (e.g. areas with reduced grading, long spans…).

Steel Thrie Beam Bullnose

Question
State: WV
Date: 03-20-2017

We are
developing plans to install a number of Thrie Beam Bullnoses on twin structures
and a few questions have come up I hope You can help me with. Attached is the detail Midwest developed. Our only changes are some drafting and adding a note to clarify the gauge of the Thrie Beam.

(1) On the Steel Thrie Beam length a
"STANDARD WOOD BLOCK", (8"X6"X14" blockout) is called for at Post Nos. 9-12 and
beyond Post 12. We are developing a Special Detail (soon to be a Standard) for Modified Thrie Beam. We would like to use the tested Modified Thrie Beam for the run between Post 12 and the Thrie Beam Transition. Do You have any concerns using the tested Modified Thrie Beam for this instead of the "STANDARD WOOD BLOCK"?

I
am proposing to use the steel blockout with the clipped web as tested in the development of Modified Thrie Beam in lieu of the 14" deep blockout.

(2) Typically, when guardrail comes off the
End Wall there is a very short length that is parallel to the roadway and a

taper away from the shoulder begins. Is it acceptable to place a taper on the Thrie Beam Transition and length of "Steel Thrie Beam"? Also, where should the centerline of the bullnose be in relation to the centerline of the roadway.

Some of these
proposed bullnose terminals are in a curve. These curves are not extreme curves since it is an arterial roadway, but still there are some alignment issues to deal with as shown below.

Was all the
testing performed in tangent sections?

Attachment: http://mwrsf-qa.unl.edu/attachments/d52c0430d662427af070a147abd08fbe.png

Attachment: http://mwrsf-qa.unl.edu/attachments/8b20de49e26ded33468afbbf4046dc21.png

Attachment: http://mwrsf-qa.unl.edu/attachments/28b8a81e4c4b95c8c04a53f1ec0d48de.png

Attachment: http://mwrsf-qa.unl.edu/attachments/4ecf9b267db28ed0acf5fa21f44e363b.pdf

---

Response
Date: 04-27-2017

We are actually in the process of the MASH evaluation of the thrie beam bullnose for the Midwest Pooled Fund. I have some comments below in red.

I also noted that you have a note on your plans that “THE USE OF STEEL POSTS ON THE BULLNOSE IS NOT ALLOWED". We do have a version of the bullnose with breakaway steel posts if you are interested in seeing it. Let me know.

Thanks

We are developing plans to install a number of Thrie Beam Bullnoses on twin structures and a few questions have come up I hope You can help me with. Attached is the detail Midwest developed. Our only changes are some drafting and adding a note to clarify the gauge of the Thrie Beam.

(1) On the Steel Thrie Beam length a “STANDARD WOOD BLOCK", (8"X6"X14" blockout) is called for at Post Nos. 9-12 and beyond Post 12. We are developing a Special Detail (soon to be a Standard) for Modified Thrie Beam. We would like to use the tested Modified Thrie Beam for the run between Post 12 and the Thrie Beam Transition. Do You have any concerns using the tested Modified Thrie Beam for this instead of the “STANDARD WOOD BLOCK"?

I am proposing to use the steel blockout with the clipped web as tested in the development of Modified Thrie Beam in lieu of the 14" deep blockout.

The modified thrie beam blockout could likely be used in that region. We typically have allowed standard thrie beam construction starting at post no. 9 in the system. We tested the system with shortened wood blockouts based on previous experience with thrie beam transitions that suggested that the shortened blockouts perform better than full length blockouts. Modified thrie beam blockouts have a similar shortened profile.

Modified thrie beam blockouts have only been evaluated to NCHRP 350. This is true of the bullnose as well. Thus, they can likely be used adjacent to the bullnose system. New Jersey and CALTRANS are currently looking for partners to evaluate the modified thrie beam system to MASH TL-3 if that is something West Virginia would be interested in.

One important note is that the modified thrie beam blockouts require the use of a backup plate to prevent the potential for stress concentrations and rail rupture when the W-beam folds around the blockout.

(2) Typically, when guardrail comes off the End Wall there is a very short length that is parallel to the roadway and a taper away from the shoulder begins. Is it acceptable to place a taper on the Thrie Beam Transition and length of "Steel Thrie Beam"? Also, where should the centerline of the bullnose be in relation to the centerline of the roadway.

We would not recommend flaring of the approach guardrail transition. These systems have never been evaluated tapered or flared and there are concerns that flaring them would increase the potential for pocketing and snag. We do believe you could flare the thrie beam guardrail once you were a minimum of 12-6" (one rail segment) past the end of the approach guardrail transition. This would mean 12-6" past any reduced posts spacing, non-standard posts, or nested or 10 gauge rail sections. The attached report has a schematic of such an installation. http://mwrsf.unl.edu/researchhub/files/Report120/TRP-03-95-00.pdf

We also developed wide designs for the bullnose. They are in the attached report but they do not have an FHWA eligibility letter.

I am not sure I follow what you mean by the position of the bullnose relative to the centerline?

Some of these proposed bullnose terminals are in a curve. These curves are not extreme curves since it is an arterial roadway, but still there are some alignment issues to deal with as shown below.

Was all the testing performed in tangent sections? Yes.

Attaching guardrail to flared bridge wingwalls

Question
State: MO
Date: 05-01-2017

I have a design group that is
wanting to flare the end of a bridge rail (at the wing wall) and then attach the approach rail system on a 24:1 flare in an effort to open up sight distance for a nearby gravel approach. The bridge width is around 26 feet wide (11 foot lanes with 2 foot shoulders). This is a lower volume roadway, with something around 500 ADT I am told.

Can you comment on the use of
the entire rail system on a flare using our current designs for bridge rail, barrier wall attachment, thrie beam stiffness transition, the transition to W-Beam, a small run of MGS rail and then the energy absorbing end terminal all being planned to be on a 24:1 flare from the bridge end?

I have concerns at the bend in
the bridge rail that starts the flare on structure that it might create a
critical point on the bridge. Are these concerns warranted? Also,
is there reason for concern about pocketing or other crash concerns on the
flared approach transition to the flared bridge rail?

Any comments you may have on the
topic or guidance to related research or other state design standards that
might have a flared approach rail system would be appreciated.

Attachment: http://mwrsf-qa.unl.edu/attachments/7777fd594a28dd9cf57e22bd918c0b99.pdf

---

Response
Date: 05-02-2017

For installations where a bridge rail with limited space for approach guardrail and an end terminal on the upstream end of an installation, a flared approach guardrail transition may be desired to reduce runout length. Currently, guidance exists for flaring the Midwest Guardrail System (MGS) away from the roadway. However, no research or full-scale crash testing of flared approach guardrail transitions has been conducted under the NCHRP Report No. 350 or MASH evaluation criteria.

Approach guardrail transitions are sensitive systems, as the gradual increase in lateral stiffness along the transition length is critical to its safety performance. Improper designs or abrupt changes in lateral stiffness can result in guardrail pocketing, vehicle instabilities, and vehicle snag on the rigid bridge rail/parapet. Additionally, seemingly small changes to a crashworthy guardrail transition (e.g., the shape of the downstream parapet, the addition or removal of a curb below the guardrail, and/or the removal of a single post within the system) have led to failed crash tests and inadequate system designs. Due to the sensitivity of these systems and the limited knowledge about their performance in flared configurations, current guidelines are to place guardrail transitions tangent to the roadway.

Previous testing of flared guardrail systems and tangent transitions lead to several concerns related to flared transitions. Flaring of the transition would increase the effective impact angle, which would raise the potential for vehicle snag, pocketing, and vehicle instabilities. Increases to the loads imparted to the barrier would also be expected, which could lead to rail rupture.

MwRSF recently developed an upstream stiffness transition for use with previously-approved thrie-beam approach guardrail transitions and the MGS. As part of that research, the use of flared guardrail adjacent to the transition region was addressed. MwRSF recommended a minimum of 25 ft of tangent MGS to be used between the upstream end of the asymmetrical W-beam-to-thrie beam transition section and the start of the flared section (i.e., the bend between flare and tangent sections). No flaring of the actual transition was recommended without further research.

Full-scale crash testing of the MGS upstream stiffness transition with the 1100C vehicle indicated that wedging of the vehicle occurred under the asymmetrical W-to-thrie beam transition section, resulting in vehicle snag on the posts. While decelerations were below critical levels, there may be potential for increased occupant risk values as the flare rate increases for the critical small car impact. Finally, the use of flared transitions may increase the potential for vehicle instability due to the increased impact angle, increased vehicle snag, and the increased potential for pocketing. Therefore, a flared guardrail transition would need to be evaluated for impacts to the upstream W-to-thrie stiffness transition as well as near the downstream end attachment to a rigid buttress.

MwRSF is currently working on the development of a standardized end buttress for guardrail transitions that can connect any crashworthy, thrie-beam guardrail transition to various bridge rail shapes. The goal of the project was to develop a buttress that reduces snag potential and pocketing concerns by flaring the face of the buttress. Because of its increased safety performance, the standardized end buttress may allow for guardrail transitions to be safely flared by alleviating some snag and pocketing concerns near the rigid parapet associated with the increase in impact angle. However, the new buttress design would not alleviate snag and pocketing concerns near the upstream end of the transition.

The MGS has been tested under NCHRP Report No. 350 at flare rates up to 5:1, so thus use of 24:1 flares with the LON portion of the MGS would not be a concern. However, impacts near the end anchorage have not been evaluated at higher flare rates.

FHWA has allowed the installation of tangent, energy-absorbing terminals at flares of 25:1 over 50' minimum at TL-3. The flare you note here would slightly exceed that.

Thus, we cannot currently recommend flaring of the AGT and guardrail system directly off the bridge end for TL-3 applications based on the concerns above. These concerns may not be as substantial when considering a low-volume road application like you have with the potential for lower speeds and ADT's. In these applications, impact conditions may be less severe and the concerns noted above would be reduced.

Please let me know if you have further comments and/or questions.

Thanks

Temporary anchor application

Question
State: MN
Date: 05-01-2017

We have a contractor request to substitute an anchor bolt for our portable concrete barrier tie-down strap anchor.

See the attached PPCMB Anchor Plan.pdf, the detail is on the middle top of the sheet.

This anchor would be used in leu of the 3/4" drop in anchor outlined in the detail. The anchor is a 3/4" diameter anchor and would have a similar embedment in the detail 3-1/2" or greater.

Please take a look at the anchor properties and let us know
if you have any concerns with this be used in place of the standard tested
anchor.

Thanks

Mike,

Please find the attached submittal package for our Screw
Bolt+ anchor. This anchor would be used
in leu of the 3/4" drop in outlined in the detail that I had attached in
previous emails. The anchor is a
3/4" diameter anchor and would have a similar embedment in the detail
3-1/2" or greater. As I mentioned
in our conversation it's fully removable and outperforms the drop in anchor in
this application.

Our contractor has the project and is looking for a more
user friendly anchor for this application. As stated it has better performance
values in shear as well as tension.

Also, for the roadway it is fully removable after the barrier is no longer in use. Please let me know if there is anymore information needed to be able to use this anchor for the application.

http://www.powers.com/submittal_generator/generate_submittal.php

Attachment: http://mwrsf-qa.unl.edu/attachments/9945a10971fa8559ca2adb9b468c2aa5.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/b2852aa4937c48d6795d0c32a3af5ce6.pdf

---

Response
Date: 05-02-2017

Hi Mike,

We looked at alternative anchors for the steel strap tie-down in some previous research for KDOT. I have attached a letter report that details that work.

During that work, we looked at several mechanical anchor alternatives like the one you sent. We found that those anchors compared well to the drop-in style anchors in terms of tensile capacity, but tended to have trouble developing the required shear loads. The difference in shear capacity was largely attributed to the larger diameter of the sleeve used for the drop-in and the higher grade steel used for the drop-in bolt.

Two potential mechanical anchor alternatives were identified.

1. Red Head Large Diameter Tapcon (LDT) 0.75-in. diameter x 4.5-in. long

2. Simpson Titen HD 0.75-in. diameter x 5.0-in. long

In the case of the Screw-Bolt+, we would need to ensure that the anchor could match a tensile capacity of 18.7 kips and a shear capacity of 25.6 kips that was found for the drop-in anchor used in the original crash testing of the system. We have used the approach that any replacement anchor must meet or exceed the capacity of the tested anchors in order to ensure similar performance. The shear capacities of the Screw-Bolt+ anchor are currently limited to 24.3 kips, so it would fall just beneath the tested anchorage. This anchor is very similar to the Wedge Bolt anchor used by Powers Fasteners, which did not meet the shear load criteria in the KDOT work. Thus, we could not recommend it at this time.

However, either of the alternative anchorages noted in the attached study are acceptable.

Let me know if you have any further questions.

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/96084b4dc6b4e0ba5b9d30abd291ce22.pdf

---

Chain link fence on top of barrier

Question
State: IA
Date: 05-17-2017

Good afternoon!

We have been
approached by our Rail office to review available designs for putting chain link fence on top of barriers to prevent materials from falling onto the tracks below. Since the fence is adjacent to vehicular traffic, as opposed to pedestrian traffic, there is some concern on my part regarding what testing needs to be done to support this application for MASH.

In 1997, FHWA published *Crash Testing and Evaluation of Retrofit Bridge Railings and Transition – FHWA-RD-96-032* (attached) that discussed a PL-2 testing of a 32" New Jersey shaped fence/barrier combination rail. Reviewing the PL-2 testing criteria suggests it would be equivalent to a point somewhere between TL-2 and TL-3. Iowa has used this design in urban areas where a TL-2 speed is present but there is a growing need to have something available at TL-3 speeds.

A recent search for available designs yielded the following:

1. color:#595959"> Iowa - attached is an Iowa example from a recent project

2. color:#595959"> Nebraska - http://www.roads.nebraska.gov/media/2912/bopp-manual.pdf (pdf page 437)

3. color:#595959"> Minnesota - http://www.dot.state.mn.us/bridge/pdf/lrfdmanual/section13.pdf (pdf page 6 lists as TL-2 for Design 5-397.212)

http://www.dot.state.mn.us/bridge/pdf/cadd/files/bdetailspart2/pdf/fig7119e.pdf
for drawing

I'm curious to
get your take on the following:

1. color:#595959"> What test level a PL-2 may be considered
equivalent to for NCHRP 350 and/or MASH.

2. color:#595959"> How high the concrete barrier would need
to be in order to not need the chain link attachment tested for TL-3 conditions
because we would not expect the TL-3 vehicle to interact with the fence (44
inches, 54 inches,?)

3. color:#595959"> What MASH tests would need to be
considered to verify the combination barrier met TL-3 conditions, as well as
estimated project costs and timeframe. This presumes building the resulting
barrier from question 2 is undesirable or infeasible given design or
construction constraints.

Thank you!

Attachment: http://mwrsf-qa.unl.edu/attachments/242bcb20017a1e79c1a971aa9ef0ae82.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/c734b633da9ffbe55efddbf70752e329.pdf

---

Response
Date: 05-19-2017

There are concerns with mounting fence structure on concrete barriers. First, the vehicle may interact with the fence structure causing snag. This may pull the fence down on the vehicle or cause deceleration or instability of the vehicle that is undesirable. it is essentially a zone of intrusion issue with the vehicle interacting with the fence.

We looked at this several years ago in a Pooled Fund proposal for Illinois, but the project was never funded. We also commented on a fence for 32" barrier for Illinois based on a FLDOT design tested at TTI under PL-2 as you mentioned in your email. See link - http://mwrsf-qa.unl.edu/view.php?id=174

As to your questions:

1. What test level a PL-2 may be considered equivalent to for NCHRP 350 and/or MASH.

a. AASHTO PL-2 is a lower speed and angle than the NCHRP 350 TL-3 testing requirements. Thus, we would consider PL-2 somewhere between TL-2 and TL-3. With the increased speed and angle, we would expect that the ZOI and potential for interaction with fence structures would increase with the angle having the largest effect. While arguments have been made in the past regarding PL-2 barriers equivalency with TL-3 based on test results and comparisons of barrier capacity and geometry, that argument may be more difficult here due to the concerns for increased interaction with the attached fence.

2. How high the concrete barrier would need to be in order to not need the chain link attachment tested for TL-3 conditions because we would not expect the TL-3 vehicle to interact with the fence (44 inches, 54 inches,?)

a. We have not formally determined this, but we have investigated it in the past for a couple of states. We looked at ZOI values for single slope and F-shape barriers at various heights for Wisconsin and Florida. In this we recommended that the ZOI for a single slope and safety-shape barriers under NCHRP 350 TL-3 were zero for 42" tall barriers. Again, these were estimates based on our best knowledge at that time and do not consider the MASH vehicles. Additionally, TL-4 ZOI values would NOT be zero for the 42" tall single slope and safety-shape barriers.

b. For vertical barriers, our best guidance has been based on a TTI TL-3 test of a 42" tall, vertical shape aesthetic barrier. This testing had ZOI values of 1.4 and 1.7 ft. We have noted in the past that ZOI for vertical

barriers may be higher than those for single slope and safety shapes due to differences in the vehicle roll. Top of hood heights for the 2000P vehicles tended to be around 42"-43" while for the 2270P vehicle the hood heights are more in the 45-48" range. Based on this, we would anticipate that the height of the barrier may need to be above 48" in order to eliminate ZOI concerns. However, this has not been verified to date.

c. TTI has tested a 42", vertical, open concrete bridge rail to MASH with the 2270P vehicle. (https://www.roadsidepooledfund.org/wp-content/uploads/2017/01/9-1002-15-5-T224Submittal.pdf) Video and sequential photos from that test suggest that the vehicle extended over the top of the rail approximately 8-10". This would seem to further suggest that vertical barrier heights to eliminate ZOI may be 48" or more.

3. What MASH tests would need to be considered to verify the combination barrier met TL-3 conditions, as well as estimated project costs and timeframe. This presumes building the resulting barrier from question 2 is undesirable or infeasible given design or construction constraints.

a. Evaluation of a vertical parapet fence combination would likely require a single test, MASH test 3-11 to evaluate vehicle interaction with the fence and evaluate the barrier to TL-3. Small car testing would not be required.

Let me know if that answers you questions or if you need more information/discussion.

Attachment: http://mwrsf-qa.unl.edu/attachments/a063115c044ec7113cd4f9c2073c9cdc.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/fb9779194e81f7931bf0286b7d8025ed.png

Attachment: http://mwrsf-qa.unl.edu/attachments/2d5fa476aa798b8f253ddd8ff07c22cc.wmv

---

Retrofit post for approach transitions

Question
State: WI
Date: 05-17-2017

A contractor has asked if the welded connection in the attached drawing could be switched to a bolted connection. There have been locations where the flume is skewed. This skew flume and needing to line up with the post location needed in the thrie beam transition makes it difficult to use the standard set up.

Attachment: http://mwrsf-qa.unl.edu/attachments/5959a257b50d436ce3ceb445c9f651f6.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/9f6848c66a349d1e4bd81903d68c8a04.pdf

---

Response
Date: 05-18-2017
It would likely be difficult to provide a bolted option for the plate attachment to the I-section beam as the bolts would likely interfere with the blockout.

A potentially simpler option would be to increase the length of the plate and slot the holes for the blockout attachment to provide the adjustment needed.

Another alternative would be to slot the holes attaching the cross beam to the support posts to allow the beam to be adjusted.

There is concern that if we slide the surrogate post too close to one of the offset support posts, we will be loading only one side or post of the surrogate post frame and may not get the desired lateral force of a post mounted midway between the supports.

We believe that a + or – 6" toleration on the plate location would be acceptable and still provide for loading of both of the posts on the support structure.

Attachment: http://mwrsf-qa.unl.edu/attachments/b14bfbe40aa2d24c318f76cc38454ab0.jpg

---

Response
Date: 05-18-2017

Could they use a button head bolt and provide a recess in the wooden block?

My guess if we got too wild with the location of the plate there could be eccentric loading issue on the beam.

Response
Date: 05-19-2017

I think that would work as well. Just thought that the slots would be easier.

Comparing MGS bridge transitions

Question
State: IA
Date: 05-17-2017

Good morning!

In reviewing
the Iowa and MwRSF MGS bridge transitions (attached email and pdf from May 2009), I have a couple of questions as we inch closer to MASH dates:

1. In talking to Chris Poole about the
attached email, he suggested that I seek confirmation regarding MASH compliance for the Iowa transition specifically. While I presume that it would be an equivalent or even slightly stiffer design compared to the MwRSF transition, for the sake of confirmation and supporting documents, I ask that the Iowa MGS transition be reviewed for MASH compliance at TL-3. The as-published standard is available at https://iowadot.gov/design/SRP/IndividualStandards/eba201.pdf.

2. I would also like to publish the MwRSF
version for cases where we have multiple post conflicts within the thrie-beam. The half post spacing provided would occasionally solve some of our pipe issues that interact with multiple posts at quarter post spacing. In preparing to do so, I'm wondering what the equivalent wood post dimension would be for the W6x15s. We currently view 6" x 8" wood posts and W6x9 steel posts as equivalents.

As always, your
time and effort are greatly appreciated.

Attachment: http://mwrsf-

qa.unl.edu/attachments/3866dc0f4a3874850c881c3dc551e3fb.pdf

Response
Date: 05-18-2017

My responses are below in red

Good morning!

In reviewing the Iowa and MwRSF MGS bridge transitions (attached email and pdf from May 2009), I have a couple of questions as we inch closer to MASH dates:

1. In talking to Chris Poole about the attached email, he suggested that I seek confirmation regarding MASH compliance for the Iowa transition specifically. While I presume that it would be an equivalent or even slightly stiffer design compared to the MwRSF transition, for the sake of confirmation and supporting documents, I ask that the Iowa MGS transition be reviewed for MASH compliance at TL-3. The as-published standard is available at https://iowadot.gov/design/SRP/IndividualStandards/eba201.pdf.

The Iowa transition was previously successfully tested to MASH TL-3 as part of the NCHRP Project 22-14 (02). The test report is TRP-03-175-06 and should be available on our website.

As I was looking at your standards, I noticed that you have multiple buttress options. One of these options (Type B) appears to extend the longitudinal distance of the taper/slope on the rigid buttress and eliminates the transition post adjacent to the buttress (Post 15). This extends the unsupported span length of the thrie beam rail by 10 inches or so, effectively reducing the rail stiffness near the buttress. This may increase the propensity for snagging on the concrete buttress. Transitions with longer unsupported span lengths have been successfully crash tested, but they typically involved larger posts (by cross section) spaced at 37.5" centers – similar to the transition utilized by MwRSF for the development of the W-to-thrie stiffness transition.

2. I would also like to publish the MwRSF version for cases where we have multiple post conflicts within the thrie-beam. The half post spacing provided would occasionally solve some of our pipe issues that interact with multiple posts at quarter post spacing. In preparing to do so, I'm wondering what the equivalent wood post dimension would be for the W6x15s. We currently view 6" x 8" wood posts and W6x9 steel posts as equivalents.

There was a study conducted to develop a wood post alternative for the steel post transition. It recommended the use of 6.5-ft long 8"x10" posts as the alternative for the 7-ft long W6x15 posts. The report no. is TRP-03-243-11 and should be available on the website.

TBR deflection

Question
State: IA
Date: 05-17-2017

Good afternoon!

In preparation for MASH deadlines, I've begun to review the history of NCHRP 350 guidance and what has(n't) been documented yet for MASH. One item that came up during review of *Deflection Limits for Temporary Concrete Barriers* (http://mwrsf.unl.edu/researchhub/files/Report243/TRP-03-113-03%20(revised).pdf) was the adjusted deflection using an 85th percentile impact. As I understand, the full impact for NCHRP 350 was 45.3 inches (perhaps originating in part from http://mwrsf.unl.edu/researchhub/files/Report158/TRP-03-64-96.pdf), which we have rounded to 48 inches on our standard (Table A on page 3 of https://iowadot.gov/design/SRP/IndividualStandards/eba401.pdf),

and for less than severe drop-offs, an 85th percentile deflection of 24 inches was likely appropriate (page 14).

In reviewing your recent *Development of a Retrofit, Low-Deflection, Temporary Concrete Barrier System* (http://mwrsf.unl.edu/researchhub/files/Report287/TRP-03-295-14.pdf), Table 1 on page 5 of the report suggests that expected deflection of the system under full MASH conditions has increased to 79.6 inches but I couldn't find a similar statement regarding the 85th percentile for the non-steel tube "prior" condition. Are you aware of what this recommendation is or will this need to be a separate modeling project similar to NCHRP 350 efforts? As I understand, with the steel tube system, full deflection is 40.7 inches (page 247) and the 85th percentile at 24 inches (page 248).

Thank you!

Response
Date: 05-18-2017

Hi Khyle,

We just looked at this as part of an project for NDOR on reduced PCB system lengths. We estimated the MASH TL-3 85% impact severity deflection ay 68" for a system length of 16 barriers or more.

See the attached report.

http://mwrsf.unl.edu/researchhub/files/Report331/TRP-03-337-17.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/000975242cee1c7c81eea6c048f58244.png

---

MGS Longspan Question

Question
Date: 05-19-2017

I know that you have crashed tested the MGS without blockouts successfully. Can the MGS Long span guardrail be used without blockouts with back of the posts flush with the face of the hubguard outside the limits of the RCB? We are using this on a low volume roadway in California.

How much tolerance is there for the hubguard to extend above the pavement for a long span MGS installation?

Thank you.

Rod

Response
Date: 05-20-2017

We have not crash tested the MGS Long-Span System without the use of blockouts on the three CRT posts adjacent to the 25-ft span. As such, I would not suggest placing the railing system farther back than was used in the successful MASH crash testing program. As I recall, we did test one of the two MASH tests with the back side aligned with the traffic-side face of the headwall. Still, wood blockouts were used on the front face of the CRT posts. Removal of blockouts would farther locate the vehicle off of the culvert edge, which has not been evaluated.

With regards to non-blocked MGS near MGS Long-Span, general guidance has suggested that the non-blocked MGS could begin one span (6 ft - 3 in.) away from the outermost CRT post as long as sufficient level, or approximately level, terrain exists

behind the posts. This guidance has been included in MwRSF Report No. TRP-03-262-12.

Let us know if you have any further questions or comments.

TL-6 Median Barrier Delineation

Question
State: UT
Date: 06-06-2017

UDOT has an at grade TL-6 barrier constructed within the median of I-70. I have attached the design. There is a desire to better delineate the barrier other than using just Linear Delineation System panels. We are concerned that if a saddle mount sign is used on top of the barrier then the tanker trailer will be ruptured during impact.

Are you aware of additional methods for delineating this type off barrier?

Thank you for your time,

Attachment: http://mwrsf-qa.unl.edu/attachments/9d4a43f963f5a2cd5d4499fd6d2733d9.pdf

---

Response
Date: 06-07-2017

I am aware of two studies that investigated barrier-mounted signs. CALTRANS performed a study that crash tested a sign with unacceptable safety performance. TTI also conducted a multi-phase study that simulated several systems and then evaluated those systems with crash testing. I believe that a few configurations provided acceptable performance.

In terms of delineators, I would believe that reflectors or sheeting could be safety applied to the posts and the depressions in the upper rail. I do not have any specifics for types of reflectors or sheeting. However, I do not think that they would pose a risk to passenger vehicles or the tank.

One thought may be to contact 3M or other manufacturers to inquire about products for this special application. Would you like for us to have a student investigate further options?

Temporary Concrete Safety Barrier (Installation Best Practices)

Question
State: KS
Date: 06-21-2017

I participate in a Traffic Control Review Team here at KDOT where we go out and look at projects under construction. Mostly I ride along to review general roadside safety, TCSB, temporary guardrail, etc. types of installations.

One thing that has come up this year that hasn't come up before has to do with our free standing TCSB installations. I noticed, in some cases, the contractors weren't tensioning the free standing TCSB after it had been placed and the pin was dropped through the loops (i.e. the pin could be freely removed if I lifted it out with my hand). From other conversations on this topic, my recollection is best practice is to tension or pull the barrier tight after installation so it will immediately engage a vehicle during an impact. Is that correct?

When I looked back through the original Temporary Type F3 crash testing report I didn't see the tensioning or pulling mentioned there and I didn't find a question where this had already been asked on the consulting site so now I'm not sure what the best practice is; tension the TCSB or just set it and drop the pin where the pin can be freely removed. I guess my thought is if the barrier isn't tensioned there may be a delay in the barrier engaging the vehicle and the working widths might be greater compared to a pre-tensioned or pulled installation.

Any guidance will be helpful. Just as a side note I noticed my old e-mail is still registered with the Pooled Fund Member's only site. If you respond via e-mail my new e-mail is thomas.rhoads@ks.gov.

Thanks,

Tom

Response
Date: 06-23-2017

We typically recommend and test our PCB installations with the joints pulled tight. As you noted above, this helps the barriers engage more quickly when impacted.

The F-shape PCB that KDOT uses was tested this way as well in both the NCHRP 350 and MASH tests. Thus, we recommend installation of the barriers in a similar manner in the field. It is believed that not pulling the joints tight will not adversely affect the overall performance of the barrier to redirect vehicles. However, there may be some increase in deflection and working width if the barrier segments take longer to engage. The magnitude is a little difficult to estimate without further analysis, but it may be in the 10%-20% increase range.

Thanks

MGS Transition Maximum Height

Question
State: IN
Date: 06-27-2017

INDOT has a bridge mounted thrie rail that has a top rail height of 2'-10" (34"). INDOT would like to use the MASH tested MGS stiffness transition but we were not sure if the top rail height of the transition could be raised to 34"? We see that the MGS guardrail passed the MASH testing for the car at 36" and the truck at 34" but was sure if the transition could be raised to 34". I thought I saw something in the FAQ about raising the transition for overlays but could not find it. Attached is a PDF of INDOT's current transition between the bridge thrie rail and strong post w-beam.
Attachment: http://mwrsf-qa.unl.edu/attachments/ecfc0fbbf5d135c38787bd6a15e61809.pdf

---

Response
Date: 06-30-2017

Recently, MwRSF successfully tested a 34" tall thrie beam transition to a concrete parapet to MASH TL-3 (both small car and pickup truck tests were conducted). The tested design utilized a symmetric W-to-thrie transition segment to transition from the 34" tall thrie beam down to 31" tall MGS, similar to what you are showing here. The standardized transition buttress had a tapered front edge below the rail with a lateral offset of 4.5". From your drawing, it appears that your bridge rail utilizes 8" blockouts on the bridge rail posts. Since 8>4.5, this should mitigate vehicle/tire snag at the transition to bridge rail location. Thus, I think this transition design could be safely implemented with a few important criteria listed below.

First, I do not know much about this bridge rail you are using and don't recall ever seeing crash tests on a 34" thrie beam bridge rail. So, my first comment is that the bridge rail should be a crashworthy system. Second, the spacing between the outside bridge post and the first transition post is very important when analyzing snag potential. The 34" system had an unsupported span length of 29.5" between the transition post and the concrete buttress. Thus, you will want to utilize a similar or reduced distance for the length between the bridge post and the 1st transition post.

MGS 8" offset block

Question
Date: 06-27-2017

Looking through MwRSF FAQ's, the following indicates the MGS 12" block system passed

the TL-3 testing with offset 6" from the vertical center of the curb. The FAQ also implies this

system is good for offsets varying from 0" (flush) to 6". [https://mwrsf-qa.unl.edu/view.php?id=479]

OK here's my question -

With successful testing of the MGS 8" offset block (TamTI), can you tell me if this system also

applicable to same as above for 12" offset blocks?

Thanks.

Response
Date: 06-28-2017

We have not made any specific recommendations regarding the use of MGS with 8" blockouts adjacent to curb.

Currently the testing of 31" guardrail adjacent to curbs is limited to:

1. NCHRP 350 TL-3 MGS with 12" deep blockouts with the face of the rail installed 6" behind the midpoint of a 6" tall Type B curb.

2. MASH TL-3 MGS with 12" deep blockouts MGS and a top mounting height of 37 in. above the roadway, offset 8 ft behind a 6-in. high AASHTO Type B Curb – failed

3. MASH TL-2 MGS with 12" deep blockouts MGS and a top mounting height of 37 in. above the roadway, offset 6 ft behind a 6-in. high AASHTO Type B Curb – passed

4. MASH TL-3 T-31 with no blockout with the face of the rail installed 5" behind the midpoint of a 4" tall asphalt curb

We have not conducted MASH TL-3 testing with the MGS adjacent to curb. That is planned for later this summer.

Reduction of the blockout depth raises concerns due to increased snag on the posts and reduction in rail height during the impact that may compromise vehicle capture. We evaluated the MGS without blockout on lever terrain we noted the following with respect to curb installations.

The MGS was successfully crash tested and evaluated with the front face of the W-beam rail placed 6 in. (152 mm) behind the front face of a 6-in. (152-mm) tall concrete curb according to the NCHRP Report No. 350 TL-3 criteria using a 2000P pickup truck. However, vehicular impacts into guardrail placed adjacent to curbs may contact the barrier face with an increased bumper height and trajectory. As noted above, the mounting height of a blocked MGS can be critical for satisfactorily containing and redirecting a 2000P pickup truck, especially when the front bumper and impact-side wheels become airborne early in the impact event. Further, it has been noted that a non-blocked guardrail system will allow the top rail height to decrease immediately after post rotation. Therefore, a non-blocked MGS adjacent to a concrete curb is not recommended for use without further analysis and crash testing.

One would expect that an 8" blockout would perform similarly to the 12" blockout with respect to curbs, and that both would perform better than an unblocked system. The T-31 test above would seem to indicate that as well. However, because we have no MASH testing with the 12" blockout and the 6" offset, we cannot say for certain. We believe that blockout depth aids in capture and maintaining the rail height and

reduces post snag, but we cannot say at what point reduction of the offset degrades system performance to the point that it is compromised.

A better option would likely be to place the face of the MGS guardrail with 8" blockouts flush with the face of the curb. Previous NCHRP 350 testing of the G4(1S) (8" blockout) found that it passed NCHRP 350 TL-3 when impacted with the face of the rail flush with a 4" wedge curb. Thus, it would seem reasonable to expect that the MGS would work as well when placed with the face of race flush with the face of curb when used with a 6" type B curb due to its increased mounting height.

Thanks

Question regarding omitted post dimension

Question
State: IA
Date: 07-10-2017

In reviewing
MGS with an Omitted Post (TRP-03-326-16),
I'm struggling with a dimension provided on page 57 dealing with trailing end anchorages (Figure 32 layout c). On there you dimension 43.75' away from the end anchor and then add another 12.5' section of w-beam similar to the other layouts. However, the dimension to the next post within the figure and repeated again at the top of page 58 is 75'. I was expecting to see 62.5'. Can you explain why 75' was used?

As always,
thanks for your assistance!

Response
Date: 07-11-2017

I went back through our recommendations. It appears that the 75' number is a typo. The distance to the first omitted post should be the 43.75'+12.5'+6.25' = 62.5'.

I apologize for the confusion. The text uses the correct rationale, but adds the numbers up incorrectly.