Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

01-01-2017 to 04-01-2017

STB12 - Thrie-Beam Transition to NJ-Shape Concrete Barrier

Question

State: VA
Date: 01-10-2017

I
am working on upgrading VDOT's guardrail systems to the MGS and I cannot find the Thrie Beam Transition drawings that are cited in the FHWA approval letter B-214.

Would
you be able to send me the drawings and crash test reports or point me to where I can find them on the Midwest website?

Thank
you for your time.

Response

Date: 01-10-2017

FHWA letter no. B-214 refers to the downstream portion of the Thrie Beam Approach Guardrail Transition attached to a concrete parapet. In this system, a 4" curb is required for now until other R&D is successfully completed. The report for this testing effort is attached, which corresponded to work performed under the NCHRP study to develop the MASH document.

In addition, it should be noted that the upstream portion of the transition was not tested in this study. Further R&D was later performed to develop, test, and evaluate the upstream stiffness transition. I will need to send you up to four or more additional reports that address that portion of the AGT system. That information will come early next week after the holiday.

Response

Date: 01-11-2017

I sincerely appreciate the information. Do you see any issue with this same transition being used with an F shape or vertical face concrete parapet?

Response

Date: 01-12-2017

Personally, I do not think that it is an issue as long as you ensure that the end cannot be snagged by vehicles. We are working on a standardized buttress that can be used with all AGTs. Also, the upstream and downstream regions would now be required to properly transition stiffness from the semi-rigid rail to the rigid buttress.

Weir question

Question

State: MN
Date: 01-18-2017

Our office of environmental
services is looking to install weir structures, shown in the attachments, in ditches to research retention and flow. These structures would be in the clear zone. Do you know of anything like this that has been analyzed or tested in the past?

Any thoughts would be
appreciated!

Attachment: http://mwrsf-qa.unl.edu/attachments/973054b8b8b3f7da364dd08e1a6d1f54.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/44c630eea309692ff7f8ee164eb7bd31.docx

Attachment: http://mwrsf-qa.unl.edu/attachments/6d5483a04e36e4ae835a15a8ab713100.pdf

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Response

Date: 01-18-2017

I am not aware of any previous testing or analysis of weirs in the clear zone. I do have a couple of thoughts.

1. First, before one considers the weir itself, one would need to consider if the waterway needed to be shielded. If the waterway has slope and depth such that it would not be considered traversable or is deep enough to pose a hazard to an encroaching vehicle, then it would likely be recommended to shield the waterway if it was in the clear zone. The RDG provides guidance on both foreslopes, backslopes, and transverse slopes. Additionally, guidance in the RDG for culverts and cross-drainage structures may apply here as well.

2. In terms of the weir itself, there may be concerns with placement of these structures in the clear zone. First, the structure may pose a deceleration hazard to encroaching vehicles depending on the type of structure used. The

examples you sent did not appear to be extremely strong structures, but this is still a consideration. Similarly, depending on the orientation and structure of the weir, it could pose a vehicle stability risk if placed in the clear zone. However, the extent of these concerns is difficult to determine without further study and details of the various potential weir installations.

3. MwRSF did do some research on erosion control features for WisDOT. This research looked at recommendations for rock ditch liners and check dams. The scope was limited, but it may provide additional insight on the concerns associated with structures in the clear zone and best recommendations for slopes and placement that may be applicable here as well. I have attached the report.

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/0b960bd68d45452feaaa280fbee2496b.pdf

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Working Width for Concrete Barrier (Type F, TL5)

Question

Date: 01-19-2017

I remembered doing this as well, so I looked it up quick this morning. The previous question (# 786 of the Q&A website) dealt with Zone of Intrusion (ZOI) for the 2 TL-5 tests that have been conducted here at MwRSF with 42" tall barriers. The ZOI was estimated from the working width and the barrier width, as shown in the response. Here is the link.

http://mwrsf-qa.unl.edu/view.php?id=786

Attachment: http://mwrsf-qa.unl.edu/attachments/c052b4ff15eaf5b1f5fb744ff25465a2.jpg

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Response

Date: 01-19-2017

I have a question regarding the working width of TL5 concrete barrier and Mr. Rowekamp from MnDOT suggested to contact you. Please see below:

“We are looking to use a TL5 concrete barrier to separate a roadway with heavy commercial traffic from a substructure support.

I am having trouble finding references on the correct setback to use to avoid any collision demand on my pier.

My understanding is that the working width for such kinds of barriers is mainly controlled by the roll of the tractor/van trailer right after it hits the barrier (see picture below).

Do you happen to know the working width for the standard MnDOT Concrete Barrier (Type F, TL5)?"

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/c052b4ff15eaf5b1f5fb744ff25465a2.jpg

MGS Rail Release

Question

State: OH
Date: 01-23-2017

I have several thoughts on the material you sent. We are always glad to get feedback from the states when they observe field impacts on barrier systems.

First, when the MGS was originally designed, one of the areas of improvement targeted for the system was facilitating easier rail release. There was concern that the washers used on older guardrail systems and the double ply of the W-beam at the splice/post connection may have been too strong and could potentially prevent rail release. This could have pulled the rail down during impact and compromised vehicle capture. Thus, the design of the MGS looked at reducing the strength of the post to rail connection. In the final design, it was decided that the repositioning of the splices away from the posts was sufficient to produce the desired rail release. Thus, the design of the MGS was intended to provide a tradeoff between previous rail release forces and easy rail release for safety performance purposes. We do not recommend washers on the rail as that has proven to pull down the rail element and compromise capture. I believe that you noted that in your email as well.

In testing and evaluation of the MGS we have observed disengagement of the rail on some of the most sever impacts and some of the special applications due to increase rail tension loads and reserved bending that pries the rail away from the bolt heads. This has not been a safety issue as it does not affect capture or redirection of the vehicle. Examples of the tests we have observed this in include the long span and omitted post systems among others.

In terms of the examples you sent, they appear to be extreme impacts that may have exacerbated the rail release to some extent.

On the MGS median barrier system impact, the truck and trailer likely represented a high impact severity on the rail due to the increased vehicle mass as compared to the full-scale tests. Of course that would depend on speed and angle. Inspection of the photos shows some flattening of the impact side rail which would indicate is was loaded significantly. Additionally, in order to impact in the region of the guardrail shown a relatively short distance from the median bridge rail, the vehicle would have needed impact at a relatively high angle as well.

The impact may have been non-tracking as well based on the position of the vehicle.It appears from the photos that the rail ruptured, which again would suggest a high impact severity. Once the impact side rail ruptures, the vehicle would impact the backside rail and the posts. This would tend to displace the rail laterally away from the remaining posts and down towards the ground as the impacted posts rotated. This would knock the backside rail to the ground and push the rail away from the adjacent guardrail posts. The backside rail is not designed to provide capture for that system, so I don't believe that the outcome is that surprising given the loading pattern that I can observe in the photos.

For the terminal impacts, it appears that the semi-tractor impacted an energy-absorbing end terminal of some kind. A semi-tractor impact again represents a significantly more severe impact that what the MGS was designed to meet. It also appears that the terminal head was crushed and jammed during the impact. As such, there was potential for increased compressive loading and reverse bending the rail that may have led to the increased disengagement from the rail. We have observed terminal testing on the MGS with approved terminal that have not shown this type of rail disengagement under the MASH and 350 impact conditions. Thus, we think that the level of rail disengagement observed may have occurred due to the extreme nature of the impact.

We have not had specific complaints in the past from state DOT's about large lengths of rail disengagements, but we can monitor for this and try to determine if it is an ongoing issue. Do you know if you observe this in less severe oblique impacts more typical with our TL-3 testing?

Let me know if you want to discuss this further.

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/8ddf2111472ff601d29f9cb803ffefb3.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/a756af293433fc9d92667681b8966f79.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/89b369a941d1ea26447df9aca6f8edd1.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/590b2528c6ede75053e23fffc77e4414.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/a1ce7eca20306bf835a2ef76efbdd31e.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/1e3cd6a93b4ca744152653a513e8b718.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/b4bd62baadb4c2db54ec4bf0b8b412a0.JPG

Response

Date: 01-23-2017

Have any other states reported any issues with MGS? I know that installing washers is not a good solution. I don't have any info on vehicle speed or angle of impact for these crashes.

Have we been getting any negative feedback on the MGS rail systems, or maybe on the elimination of washers? Attached are a few photos of two different accidents on projects that recently installed MGS rail in D-1.

The first involved barrier rail on the Allen 75 project. A pickup truck pulling a trailer struck the rail and actually passed through it and struck an oncoming car headed the opposite direction. As you can see in the photo (inserted below as well) the MGS rail on the opposite side simply got knocked down.

Ted Foster noticed that the bolt head just pulled through the slotted hole. Is this typical of what we are finding on other MGS Barrier rail systems that are struck? Perhaps the addition of the old rectangular washer would help?

Here is another incident on Hancock 75 where a SRT Extruder was hit by a semi. The Extruder is all torn up, and the got bent 180 degrees backward around the posts, but the interesting thing is that another few hundred feet of rail again got knocked off the posts. In this instance, the District replaced twelve panels simply due to the bolt pull-through damage.

So Ted is telling me that once in a while his crews can hammer on the web of the w-beam rail and fix the slotted hole up enough to

rehang the rail, other times they cannot. Basically, sometimes when we get these failures (hits) we have to throw away what seems to be pretty good rail.

Is there a problem state-wide with the MGS rail or the washer elimination?

Attachment: http://mwrsf-qa.unl.edu/attachments/8ddf2111472ff601d29f9cb803ffefb3.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/a756af293433fc9d92667681b8966f79.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/89b369a941d1ea26447df9aca6f8edd1.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/590b2528c6ede75053e23fffc77e4414.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/a1ce7eca20306bf835a2ef76efbdd31e.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/1e3cd6a93b4ca744152653a513e8b718.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/b4bd62baadb4c2db54ec4bf0b8b412a0.JPG

Bullnose System to MGS

Question

State: MN
Date: 01-31-2017

Can an asymmetrical (thrie-beam to
w-beam) section be used to connect the bullnose crash cushion, thrie-beam section to the 31" high MGS standard?
Our standard currently uses a symmetrical section between post 10 and 11 (to go from thrie-beam to 28" high w-beam).

Assume that no curbing will be used.
And in some cases the MGS portion will then connect to an AGT or to another bullnose.

If this can be done, then we also need guidance on post location from the Bullnose system to the MGS portion.

Attached are the current standards for the MnDOT Bullnose and the two types of thrie-beam to w-beam transitions.

Thank you.

Attachment: http://mwrsf-qa.unl.edu/attachments/8a85387e02f77f73129f08e1b416b036.PDF

Attachment: http://mwrsf-qa.unl.edu/attachments/f87d9533a60fd10376c44bb4ee1425d5.PDF

Attachment: http://mwrsf-qa.unl.edu/attachments/cd45bdd7da53d15fb833f8f6a0833e7e.PDF

Response

Date: 02-07-2017

I have some replies to your questions.

We do believe that the asymmetrical W-to-Thrie transition can be used to connect the bullnose to MGS. Our current recommendation would be that the transition section not be added until the end of rail section no. 4 or post no. 10. This is consistent with the detail that you sent. This guidance was based on previous analysis of the length of the deformed rail in the full-scale crash tests.

If transitioning to the MGS, there will be a need to transition the splices to the mid span as well. We believe that this can be accomplished by placing the first post downstream of the asymmetrical W-to-Thrie transition piece at 1/2 spacing and then using standard spacing from that point on. This would correspond to putting in a post at 1/2 spacing after post no. 11 in your detail and then using standard post spacing afterwards.

One final comment with regards to transition from the bullnose to MGS and then to and AGT. We would recommend a minimum of 25 ft of standard MGS between the bullnose and the start of the MGS upstream stiffness transition.

Response

Date: 02-07-2017

Thank you for the response. We just have one more quick question regarding post type (wood to steel) change locations.

We are proposing to change from a wood post (# 10) to steel post (# 11).

Let us know if this post type change location is ok. (See Attached pdf figure).

Response

Date: 02-13-2017

I believe that you can start the use of CRT posts at post no. 9 if you wish. The NCHRP 350 bullnose testing with the UBSP posts used the standard steel posts starting at post no. 9.

Thus, I don't see the use of steel posts at post no. 10 being an issue. We did use 78" long posts in the thrie beam sections rather than the 72" long posts used for the MGS and would recommend those posts in the thrie beam region. We would also recommend that the shorter blockouts used in the bullnose be used throughout the thrie beam region.

Thanks

MGS Working Width

Question

State: VA
Date: 11-30-2016

We are in the process of finalizing our MASH MGS standard details and would like a quick review for the content.

One of the remaining details is the minimum distance either behind the post or from the face of rail to a hazard. Do you have a detail of the distance and how it is measured for the MASH testing or a description similar to page 225 of the NCHRP 350 report?

Thanks

Response

Date: 02-05-2017

The following text is located in MASH with respect to the deflections and working width. They may help serve as basic definitions for you.

“Test article deflections—Report the permanent and dynamic deflections of the test article plus the working width during impact. These measurements normally apply to longitudinal barriers, terminals, crash cushions,

and TMAs. Permanent deflection is the residual lateral displacement of the test article remaining after the impact. Dynamic deflection is the maximum lateral displacement of the test article on the traffic side that occurs during the impact. The working width is the maximum dynamic lateral position of any major part of the system or vehicle. These measurements are all relative to the pre-impact traffic face of the test article. For the working width, the height of the maximum working width should also be documented and reported."

"**working width**—The distance between the traffic face of the test article before the impact and the maximum lateral position of any major part of the system or vehicle after the impact"

Working width would define the distance from the face of the rail to the hazard.

We have fielded questions regarding the variation of the MGS dynamic deflection and working width in the past for several states. Related to that, we have compiled charts of the working width and deflections for the standard system. These can be seen below. A chart with similar values is located in the Roadside Design Guide.

Table 1. Guardrail Testing under Test Designation 3-11.

Testing Agency	Test Number	Testing Criteria	Dynamic Deflection in. (mm)	Working Width in. (mm)
MwRSF	NPG-4	350	43.1 (1,094)	49.6 (1,260)
MwRSF	2214MG-1	MASH	57.0 (1,447)	57.4 (1,457)
MwRSF	2214MG-2	MASH	43.9 (1,114)	48.6 (1,234)
MwRSF	MGSMIN-1	MASH	42.2 (1,072)	48.8 (1,240)

MwRSF	MGSDF-1*	350	60.2 (1,529)	60.3 (1,530)
MwRSF	MGSPP-1*	350	37.6 (956)	48.6 (1,234)
MwRSF	MGSWP-1*	MASH	46.3 (1,176)	58.4 (1,483)
MwRSF	MGSSYP-1*	MASH	40.0 (1,016)	53.8 (1,367)
MwRSF	MGSRF-1*	MASH	55.8 (1,417)	57.4 (1,458)
MwRSF	MGSNB-1**	MASH	34.1 (867)	43.2 (1,097)
TTI	220570-2**	MASH	40.9 (1,040)	44.0 (1,119)
SwRI	GMS-1**	MASH	35.0 (890)	NA
TTI	400001-TGS1**	MASH	38.4 (975)	40.8 (1,036)
Holmes Solutions	057073112**	MASH	41.3 (1,050)	NA

*Guardrail with alternate posts and/or blockouts.

**Guardrail with no blockouts.

Table 2. Guardrail Testing under Test Designation 3-10.

Testing Agency	Test Number	Testing Criteria	Dynamic Deflection in. (mm)	Working Width in. (mm)

MwRSF	NPG-1	350	17.4 (441)	40.3 (1,022)
MwRSF	2214MG-3	MASH	35.9 (913)	48.3 (1,227)
MwRSF	MGSSYP-2*	MASH	22.2 (564)	39.7 (1,008)
MwRSF	MGSRF-3*	MASH	NA	38.4 (975)
MwRSF	MGSNB-2**	MASH	29.1 (740)	34.5 (877)

*Guardrail with alternate posts and/or blockouts.

**Guardrail with no blockouts.

The deflections and working widths listed for the MGS do fluctuate, even for the steel post version with standard 6'-3" post spacing. This fluctuation in the working widths is a reflection of several factors.

1. First, there has been a transition in the soil resistive forces that we use in our full-scale crash tests under MASH. Thus, the original crash testing of the MGS with the 2270P vehicle under 22-14 would have likely used a soil foundation that was less stiff than the soil recommendations that were eventually incorporated into MASH. Thus, there will be some variation of deflection and working width based on the change in the foundation conditions.
2. Second, the table presents tests with both the 2000P and 2270P vehicle types. Again the MGS was developed and tested during the transition between NCHRP 350 and MASH. Thus, the change in pickup truck vehicles represents an approximately 13.5% increase in kinetic energy. This change in impact conditions also accounts for some of the variation you are observing between the working widths and deflections in the full-scale testing.
3. Third, the table here and others in the Roadside Design Guide show deflections for a wide range of MGS systems, including wood and steel post versions as well as several special applications. Thus, the use of different post types, post spacing, slopes, flares, etc… affect the working width numbers.
4. Finally, full-scale crash tests are not an exact science. We have tried over the years to develop test procedures to make crash test results more consistent and repeatable. The current soil standard in MASH

is one part of that effort. However, even with these efforts, there is a certain degree of variation from test-to-test that is difficult to avoid. Thus, full-scale crash tests of two identical MGS systems may result in deflections that vary. This is simply difficult to avoid given all of the potential variation in materials, environmental conditions, soils, and other factors.

While it is clear that deflection and working width data taken from full-scale crash tests can vary for several reasons, we have still not answered the question regarding what values you need to consider for your installations. Our advice here would be to review the available data from the crash tests of most similar systems and error on the side of being conservative. For example, if you have an MGS system installed on a 2:1 slope, then we would recommend using the working width guidance from the full-scale crash test of the 2:1 slope. For standard, steel post installations, we may suggest considering a working width of 60 in. The 60-in. working width corresponds with the upper end of the values observed in the full-scale testing and also allows for some tolerance if the soil for your real world installations in not as stiff as the soil currently specified in MASH. For the wood post versions of the standard MGS system, we would recommend that you refer to the crash tests of the specific wood post system and use those working widths if they are increased over the 60-in. For the ½ post and ¼; post spacing versions of the system, we would recommend using the tested working widths listed in the RDG.

Let me know if this addresses your concerns and if you have further questions.

Single Slope Barrier for Bicycle Rail

Question

State: MN
Date: 02-10-2017

A question has come up regarding the MnDOT Combination Traffic/Bicycle Bridge Rail that MwRSF tested for MnDOT in 1998. This railing was tested as a “breakaway" railing mounted on a 32" tall J or F barrier and passed for TL-4. The link below is from your website and provides more info regarding the railing and the test.

https://mwrsf.unl.edu/reportresult.php?reportId=100&search-textbox=minnesota

As you may know, MnDOT has now transitioned to using a 36" tall single slope barrier with an 11 degree front face slope (example plan sheet attached). We also have standards for a 42" and 54" tall single slope barrier, all meeting TL-4 NCHRP 350 (waiting for eligibility letter from TTI and FHWA to approve as MASH barriers). The new barrier standard is used in conjunction with the MGS 31" tall guardrail.

The question is, can we use the combination traffic/bicycle bridge rail mounted on the back of a 36" tall single slope barrier and still refer to it as approved for TL-4 NCHRP 350?

Attachment: http://mwrsf-qa.unl.edu/attachments/36ad6a7c8fd062161c4a9d5c1d393ddf.pdf

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Response

Date: 02-10-2017
A 32" tall, single slope concrete barrier has been successfully crash tested to the NCHRP report 350 safety criteria. Increasing the height to 36" should not negatively affect the performance of the barrier, and may actually improve vehicle capture for the barrier by reducing the risk of heavy trucks rolling over the barrier.

Your 36" tall single single will also likely decrease the amount of contact/snag between an impacting vehicle

and the steel rail components. The single-slopeed barrier is 4" taller, and 2" wider than the previous J barrier. Additionally, if the bycicile rail is mounted at the same height relative to the ground, it will effectively be placed lower on the barrier compared to the previous (as tested) system. All of these characteristics are likely to reduce vehicle contact with the steel rail components.

Thus, MwRSF would consider the placement of the steel tube bicycle rail on the backside of a 36" single-slope barrier as crashworthy to NCHRP Report 350 TL-4 standards.

W-beam and Thrie Beam Rail Splice Slot Dimensions

Question

Date: 02-10-2017

We have recently received feedback from various states noting a discrepancy between the dimensions of the guardrail splice slot dimensions for W-beam and Thrie beam.

Trinity fabricates their guardrail hardware to the AASHTO M180 specification. In that spec, the rail splice bolt slot is dimensioned as 29/32" x 1 1/8" (23.0 mm x 28.6 mm).

Several MwRSF details have these slots noted as either 1" x 1 1/4" while older hardware guide details note a 24 mm x 30 mm slot.

Can MwRSF provide some feedback regarding the discrepancies in the slot dimensions?

Attachment: http://mwrsf-qa.unl.edu/attachments/540e14d149985dc33ea2bc551f20a46f.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/4ea7c947b454adc27afb602a87bc76c3.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/86b0fd01b790c6130f1bbdeddcda8250.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/5e766db8c09aede58eb663902ea41c18.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/90c0e9c6222d4b9d4a0856229b66a8b7.pdf

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Response

Date: 02-10-2017

We have reviewed the information you supplied regarding the variation in the guardrail splice bolt slot dimensions. We believe that the discrepancy in the slot size is a numerical error on the plans and drawings we have supplied.

Originally, the standard hardware drawing for thrie beam and W-beam were based on the AASHTO M180 spec and the rail slot dimensions were shown as 29/32" x 1 1/8" (23.0 mm x 28.6 mm). Over time, the industry made a temporary push to switch to metric units. At that time, the hardware guide details of the slot dimension changed slightly due to conversion and rounding to 24 mm x 30 mm. Eventually, the metric units were abandoned. At that time it appears that the metric 24 mm x 30 mm slot was again converted and rounded to yield a 1" x 1 1/4" in many MwRSF plans.

MwRSF believes that the slot dimensions should correctly follow the original M180 standard. Additionally, review of MwRSF mill certs and material specifications indicated that the W-beam and thrie beam rail systems designed and evaluated at MwRSF were supplied, fabricated, and tested with guardrail the met the M180 spec and thus had the 29/32" x 1 1/8" (23.0 mm x 28.6 mm) splice slot.

Thus, the other slot dimensions found in other details are errors made due to unit conversion and rounding. This error is only on the CAD details as the tested systems met the M180 spec. MwRSF is working to correct their CAD details and the Hardware guide details that indicate slot dimensions inconsistent with the M180 spec. Additionally, MwRSF would recommend that manufacturers, installers, and DOTs continue to use the original M180 specification as it is consistent with the actual tested barrier systems.

Consruction tolerances for Single-Slope Barrier

Question

Date: 02-15-2017

We have a multi-billion dollar project going on for the Gothals Bridge and the contractor's slip form machine varied off course and we have a barrier that in very isolated places is off by 1 ½ “ in height over 20' of length. Also the batter is also less of a concern for me since one of the last times we worked together we proved through FIE that a barrier that was out some 15 degrees was still acceptable for crash performance. Would you let me know if you have any guidance on acceptable construction tolerances? I have looked through MASH, the RDG, and the Green Book and find nothing. TO make this a bit more complex, it meets the construction tolerances in NJ, but not in NY. I suspect it is more than good for crash performance but want a second set of eyes. Your expertise is appreciated.

Response

Date: 02-16-2017

While I cannot make specific comments regarding the state DOT tolerances on construction, I can comment on the safety performance of the barrier as it pertains to these deviations.

Based on the detail you sent it appears that the barrier in question is a 42" tall single-slope barrier. These barriers have been tested and evaluated at various heights with a 10.8 degree and 9.1 degree sloped face. The 10.8 degree barrier is typically referred to as the Texas single-slope and the 9.1 degree barrier is typically referred to as the California single-slope.

The two tolerance issues you note are barrier height and slope angle. Both of these can affect safety performance.

In terms of barrier height, the sensitivity of the barrier height depends on the Test Level that the barrier was warranted or developed for. For a Test Level 4 (TL-4) or lower test level barrier, height variations of 1.5" would not be an issue. These barriers have currently met TL-4 testing under MASH at heights of 36". For a TL-5

barrier, the height may be more of an issue. These systems have only been successfully tested at heights of 42" or greater. Thus, reduced barrier heights may increase the potential for reduced or compromised capture of the tractor-trailer type vehicles. The exact reduction in height at which containment is compromised has not been determined.

The effect of variation of the barrier slope is more difficult to ascertain. To date, single slope barriers have not been tested with slopes shallower than 11 degrees. Steeper slopes, including vertical faces, have been successfully evaluated. The concern with shallower slopes is that the face of the barrier can promote increased vehicle climb and instability. The point at which the slope angle increase becomes an issue is not fully defined. As such, I cannot say definitively whether or not the slope tolerances pose an issue or not. One would think that minor variations from the 10.8 degree nominal slope would not be sufficient to induce vehicle instability, but the point at which the shallower slope becomes a stability problem has not been fully defined.

Downstream Guardrail Anchorage

Question

State: VA
Date: 02-22-2017

We have recently added the MGS 31" guardrail to our Standard drawings and we received a question about the strut and yoke assembly that was used in the MGS downstream anchorage. I have attached a pdf of the drawing noting the part and the question.

I have looked at the drawings and I cannot figure out if there is any reason for the notch in the yoke. Do you see an issue if the notch is not provided?

Thank you for your time.

Attachment: http://mwrsf-qa.unl.edu/attachments/36c83982f69db0f5870ac3e14503a36e.pdf

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Response

Date: 02-22-2017

The notch shown in our details is based on the struts that we get locally for testing. It is not in there for any structural or performance issue from our side of things.

I don't have details on why it is included, but it may have to do with fabrication or drainage during galvanization.

If you have struts with the same basic structure but without the notch, we see no issues with the safety performance of the strut.

Let me know if you have any other questions.

MGS Long Span Blockouts

Question

State: UT
Date: 02-28-2017

Contractors are
asking if they can use two 8 inch blocks in place of a 12 inch block placed on
the CRT posts within the long span. Would this be acceptable?

Response

Date: 02-28-2017

In the metric-height W-beam long span guardrail, MwRSF incorporated the use of double, 8-in. deep wood blockouts with the three CRT posts adjacent to the long span.

Thus it would seem reasonable that similar double 8" deep blockouts would be acceptable for use on the CRT posts in the MGS long span.

Alternatively, you could use an 8" and a 4" block if you wanted to preserve the 12" depth of the tested system.

Thanks

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paving the face of guardrail or other roadside safety features

Question

State: IN
Date: 03-09-2017

We are considering requests to allow the offset beyond the required shoulder width on the interstate to be unpaved in front of guardrail. Concerns have been expressed that this approach may affect the performance of the barrier. Have there been any studies on the effect of paving or not paving to the face of guardrail?

I did not see information from the MwRSF Q&A site.

Response

Date: 03-13-2017

Thanks for the email inquiry regarding paving up to the guardrail's front face.

With regards to your question, we have not conducted a specific study to evaluate the effect of shoulder paving on both post and guardrail system performance. However, we have conducted a limited number of crash tests where either asphalt or concrete surfacing existed in front of posts.

In general, we try to conduct testing on guardrails with the posts placed a minimum distance away from the roadway edge to eliminate any effects that the surfacing may have on post stiffening. When surfacing is required, we install in a realistic location relative to the posts. For example, we have successfully crash tested (NCHRP 350 and MASH) 31-in. tall approach guardrail transitions with concrete surfacing and curbs placed below the rail and up to the front of the posts. We have also successfully tested (NCHRP 350) 31-in. tall MGS with concrete surfacing and curbs placed below the rail and up to the front of the posts. Unfortunately, we have had an unsuccessful MASH MASH 1100C test when the surfacing continued behind the posts without the use of

leave-outs. These studies involved strong steel posts. When weak steel posts are used, there are fewer concerns.

Overall, I believe that road surfacing placed in front of the rail would not be problematic for 31-in. tall strong-post W-beam guardrail systems. With the tests performed thus far, I have not observed any particular problems worth noting. However, the only true method for evaluating this feature would be to perform testing with and without surfacing to provide direct comparisons between systems.

Response
Date: 03-14-2017

Thank you for your quick reply. Our concern is more that if the surface to the face of the guardrail is not paved, then rutting or erosion of the non-paved surface may cause the vehicle to strike the guardrail in an unexpected manner – perhaps override/underride. Perhaps this is more of a traffic safety/driver control issue than barrier performance, per se. Regardless, I appreciate your input.

Response
Date: 03-16-2017

Thank you for the response!

I had not addressed the soil grading issue. In general, we would assume that the soil shoulder is compacted and graded without excessive rutting or erosion. Although not evaluated in combination with guardrail, excessive rutting or erosion could contribute to increased vehicle instability during the impact event.

Down Stream Anchor TRP-03-279-13

Question

State: UT
Date: 03-16-2017

Utah created a down stream anchor standard drawing according the TRP-03-279-13 document for the Wisconsin DOT Project MGS with Standard Downstream Anchorage System. Our local fabricator has asked if a different strut can be used other than the strut that was tested with this system.

If that is a possibility I have attached a detail sheet of the proposed strut for your review and comment.

Attachment: http://mwrsf-qa.unl.edu/attachments/5419cda80e9105cfb86dd108f8c9cd1f.pdf

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Response

Date: 03-20-2017
The ground strut shown in the attached detail is similar to ones tested with previous end anchorage designs that were evaluated under NCHRP 230 and NCHRP 350. Similar anchor struts have also been observed in use with previous proprietary end terminal designs.

While these struts may have worked in previous designs, their performance with the MGS system is unknown. Early in the development of the MGS, the foundation tubes were extended and the overall anchorage capacity was increased to accommodate higher anchor loads for MASH testing as well as the increased angle of the cable anchor used for the 31" height of the barrier. As such, the anchor capacity of the MGS end anchorage has increased over previous trailing end anchors. Thus, I cannot guarantee that the attached strut detail has sufficient structural capacity to work in the MGS downstream anchorage.

Additionally, I am not aware of any current terminal designs using that specific strut that have conducted a beginning of LON test to verify the strut capacity with a test end anchorage. Thus, we cannot recommend substitution of the tubular strut in place of the current tested strut.

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

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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.

Clipped Guardrail Bolts for MGS

Question

Date: 03-22-2017

We were recently reviewing the MwRSF Pool Fund Questions and Answers section of your website and came across Question #1131 http://mwrsf-qa.unl.edu/view.php?id=1131 from the state of Ohio regarding "rail release" of the MGS. While our team was reviewing state specifications, we also came across some examples of where state specification drawings, utilizing MGS, are using "clipped" post bolts. Please keep in mind that we have only provided a sample of two states specification drawings, there is likely others … based on the information provided below

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See the attached SCDOT and MDOT standard sheets indicating**only** clipped bolts are specified to be used in those states.

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Also attached is a AASHTO M180-4 drawing from 2015 showing**both** clipped bolts and the standard bolts as alternatives.

Additionally attached is the current TF13 FBB01-05 drawing, showing**only** the clipped bolt option.

· From MwRSF TestTRP-03-276-13, the following three (3) images are provided, as a quick sample – which may not be representative of all MwRSF testing. Shows that standard round head guardrail post bolts were utilized and the MTR following those three (3) photographs indicates the post bolts were provided by THP and our nomenclature for clipped bolts is not printed on the MTR.

Are clipped post bolts recommended (or allowed) for use in the MGS?

Attachment: http://mwrsf-qa.unl.edu/attachments/9e1eb26be3b52b765328a6669789bd23.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/aaca6b01bdfc2159d968b7e810bec5b2.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/f660126c8e218bcd381872cd4d8ef380.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/90b10778bbac950c360589976988abc6.PDF

Attachment: http://mwrsf-qa.unl.edu/attachments/9e68a08702368d4d59a1557e8db27f63.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/89d54320954f25af4f3a9f0e7d0207f1.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/177ecda3ffce367a889f27f990e9afb3.pdf

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Response

Date: 03-23-2017

With respect to the clipped bolts, we don't believe that these should pose an issue. We have not typically tested the MGS with clipped bolts in the past. However, the shape of the ovalized shoulder on the bolt forces the bolt to be installed such that the rounded sides of the bolt head overlap the top and bottom edges of the guardrail slot similar to a circular dome head bolt. Thus, release from the middle region of the guardrail slot should be similar for the clipped head bolt. A clipped head bolt may have slightly less overlap on the edge of the guardrail slot as compared to a circular dome head bolt if the bolt is positioned at either end of the slot. However, this release load would still be equal or greater to either bolt head near the middle of the guardrail slot. As such, I don't anticipate an issue using the clipped head version of the bolts with the MGS, and believe that either the standard round head or the clipped head would function acceptably.

It should be noted that the shoulder should be oriented perpendicular to the clipped sides of the bolt. Orientation of the shoulder parallel to the clipped sides would prevent effective attachment of the guardrail to the post.

W-Beam to thrie beam transitions at bridges

Question

State: NJ
Date: 03-30-2017

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?

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

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?

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.

Response
Date: 03-30-2017

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=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.