Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

07-01-2013 to 10-01-2013

TCB Transitions to Permanent Barriers

Question
State: IA
Date: 06-10-2013

I have the following questions regarding TCB transitions to permanent concrete barriers/bridge rails:

1. In the tested median configuration, the thrie beam rails were attached to the first TCB section such that the front-side end shoe was located 45-1/4" from the end of the TCB section. Regarding the general placement of these thrie beam rails, could you provide a minimum and maximum recommended overlap distance for the rails to be installed onto the TCB section? i.e., how close to each end of the TCB section can the thrie beam rails be attached? Consider that Iowa specifies the use of 6'-3" long thrie beam rails in some cases.

2. When is it necessary to install additional anchor bolts at the midpoint of the nested thrie beam rails? These bolts were present in the median testing but not in the roadside testing. If these bolts are necessary, must they engage the TCB section, or can they engage the permanent barrier instead? Must these bolts be located at the midpoint of the thrie beam rails, or could they be shifted upstream or downstream some distance (to the next set of rail slots)? Would these bolts be necessary when using 6'-3" thrie beam sections?

3. For the median transition, would it be acceptable to use a 2-inch thick asphalt pad that extends 24 inches behind the TCB instead of the as-tested 3-inch pad? Thanks!

Response
Date: 07-01-2013

I have the following questions regarding TCB transitions to permanent concrete barriers/bridge rails:

1. In the tested median configuration, the thrie beam rails were attached to the first TCB section such that the front-side end shoe was located 45-1/4" from the end of the TCB section. Regarding the general placement of these thrie beam rails, could you provide a minimum and maximum recommended overlap distance for the rails to be installed onto the TCB section? i.e., how close to each end of the TCB section can the thrie beam rails be attached? Consider that Iowa specifies the use of 6'-3" long thrie beam rails in some cases.

   In the design and testing of the TCB to median barrier transition, MwRSF selected a 12'-6" long thrie beam to connect across the joint to provide increased stiffness and reduced the potential for vehicle snag on the edge of the concrete barriers. The 12'-6" section was chosen because it was more common and would fit across a wide variety of barrier sections.

   With regards to placement of the thrie beam rail, we would prefer that it be centered over the joint when using the 12'-6" thrie beam section. This provides for more even load distribution over the joint between barrier types.

   We do believe that a 6'-3" thrie beam section can be used in lieu of the 12'-6" section. The shorter thrie beam should not adversely affect the joint stiffness and may improve it slightly due to placement of the end shoe anchorage closer to the edges of the barriers. The 6'3" section may prove more difficult to flex to meet the TCB on the backside of the transition, but it should still be achievable. Because of the reduced length of the 6'-3" thrie beam, MwRSF believes that the section could be mounted with the end shoe closer to the edge of the permanent barrier and extending onto the TCB. The end shoe anchorage would need to be placed inside the outermost stirrup on the permanent barrier. This would help reduce issues with flexing the beam to attach to the back of the TCB. We don't believe that we would want to offset the thrie beam closer to the end of the TCB section.

2. When is it necessary to install additional anchor bolts at the midpoint of the nested thrie beam rails? These bolts were present in the median testing but not in the roadside testing. If these bolts are necessary, must they engage the TCB section, or can they engage the permanent barrier instead? Must these bolts be located at the midpoint of the thrie beam rails, or could they be shifted upstream or downstream some distance (to the next set of rail slots)? Would these bolts be necessary when using 6'-3" thrie beam sections?

   We believe that the anchor bolts are needed at the midpoint of the thrie beam rails to increase the stiffness of the joint across the barrier types. Recall in the roadside testing, we evaluated a system that had similar shapes and a TCB connection pin in place. Thus, the stiffness of the joint was not as critical. For the median transition, we have differing barrier shapes between the TCB and permanent barrier and no connection between them other than the thrie beam.

We would recommend that the anchorages engage the TCB section as it is the more flexible part of the system.

We would not recommend shifting these bolts away from the tested location a significant distance. Changing the location from the joint between the barrier systems would change the stiffness of the joint. We would recommend that they be used with the 6'-3" section. Thus, this may require an additional hole to be fabricated in the shorter thrie beam section.

3. For the median transition, would it be acceptable to use a 2-inch thick asphalt pad that extends 24 inches behind the TCB instead of the as-tested 3-inch pad?

Two inches of asphalt should be sufficient rather than the three inch pad. Previous component testing of the asphalt pins found little difference between the forces developed in 2 or 3 inches of asphalt.

Bullnose Configuration

Question

State: NE
Date: 07-09-2013

The Bullnose post layout for posts 8 – 10 is for the posts to land on the joints.

Our thrie-beam post layout is similar to the new MGS (joints between the posts).

Should we switch the layout between post 7 & 8 or 10 & 11 beyond the bullnose (as tested)?

Attachment: https://mwrsf-qa.unl.edu/attachments/e8f3a8a303dece9982aedf63ff531874.pdf

---

Response

Date: 09-12-2013

The bullnose configuration should remain the same as was used in the full-scale crash testing program through Post no. 9. As such, I believe that you could either use a midpost between 9 & 10 or 10 & 11 for the thrie beam.

Guardrail Connection Geometry

Question

State: MN
Date: 07-18-2013

A while back MnDOT had a conference call with you guys to discuss various issues related to barriers. One particular issue we discussed was the slope of the top of a tall (TL-5) concrete F barrier at a guardrail connection. Based on the discussions, MnDOT decided that for such barriers taller than 34", we would use a barrier top slope no steeper than 1:8 at barrier terminations and guard rail connections. We have since begun the process of updating our standards to reflect this change, but this has led to another question…

In the attached drawing (pages 1 & 2), we show 2 barrier top slope options in the red boxed area (one dashed line, one solid line). The dashed line indicates the slope of the barrier if we match the geometry from our typical barrier end sections for barriers less than or equal to 34 inches in height (the typical barrier end condition is shown on the 3rd page, in red boxed area), the second option shown on pages 1 & 2 is a solid line with a 1:8 slope that terminates at a height of 2'-5" above the roadway surface. Any opinion on which of these 2 options is preferred for a TL-5 barrier?

I'll also be contacting you again in the near future to set up a conference call to discuss options for developing a new single slope barrier standard for MnDOT. It's likely we'll propose a slope that doesn't match that of states like Wisconsin, Texas, and California. I'll send out more info regarding this issue next week.

Attachment: https://mwrsf-qa.unl.edu/attachments/974b4cfea09fec1a7549914be89f625f.pdf

---

Response

Date: 07-18-2013

From the attached details, I would say that I prefer the solid gray line versus the dashed gray line. It is flatter for passenger vehicles and less likely to allow the engine hood/front quarter panel to excessively gouge/grind on the upper surface. We will be available for the future discussions as well.

Temporary concrete barrier & guardrail overlap

Question

State: OH
Date: 07-23-2013

Can you send me that simulation video (in .wmv, I cannot open the .avi's) of the guardrail/temporary barrier overlap failure? I want to provide highlights to our Work Zone Traffic Managers…

The simulation was for an unanchored guardrail end, correct?

However, per our conversation the other day…

-When it does have a downstream anchor, the Guardrail is redirective at post #6 from the end.

-Unanchored Temp Concrete Barrier is redirective about 100' from the end of a run (in general is that for either direction?)

-so basically if I have these 2 barriers overlap for at least 130', and the guardrail has room to deflect without impacting the temp concrete barrier it would be crashworthy…?

Attachment: https://mwrsf-qa.unl.edu/attachments/8498a713848e183490bcd6470f274e03.png

---

Response

Date: 07-24-2013
I have attempted to address your questions in red below.

Videos can be downloaded below. The guardrail and PCB were unanchored

The file 'Presentation.zip' (118.1 MB) is available for download at
http://dropbox.unl.edu/uploads/20130807/cc7d87f5e1ef6c06/Presentation.zip
for the next 14 days.
It will be removed after Wednesday, August 7, 2013.

However, per our conversation the other day…
-When it does have a downstream anchor, the Guardrail is redirective at post #6 from the end.

This should be true for the MGS with the downstream anchor that we investigated in TRP-03-279-13.

-Unanchored Temp Concrete Barrier is redirective about 100' from the end of a run (in general is that for either direction?)

Yes. We currently have no better answer for the beginning of LON for PCB systems other than eight 12.5' segments from the end of the system. It may well be shorter, but the research to determine that has yet to be done. Note the a 5' offset is shown. This should be a working width number and should represent the distance from the face of the rail to the toe of the PCB.

-so basically if I have these 2 barriers overlap for at least 130', and the guardrail has room to deflect without impacting the temp concrete barrier it would be crashworthy…?

This should be true for the most part. The only concern is that it is not well defined what happens when the vehicle impacts inside the last 30' of the guardrail and gates through. The interaction of the vehicle gating through the end terminal and impact the PCB's has not been fully defined. However, this setup is likely the best option for overlap of the barriers that we currently have. Note that this would only be good for one direction of traffic as shown.

Strength requirements for temporary barrier epoxy anchors

Question

Date: 07-26-2013

What
are the strength requirements for using epoxy to anchor temporary barrier to a bridge deck based off the research report you guys did for WisDOT.

Response

Date: 09-12-2013

We conducted the epoxy anchor testing in the report using HILTI HIT - RE 500 SD epoxy. This material has a bond strength of 1800 psi. All of the anchor capacities that we calculate or tested in the report are based on that bond strength number. Thus, we it would be reasonable to assume that higher bond strength materials should provide equivalent or better anchorage.

Material Property	Hilti HIT-RE 500 SD	Adhesives Technology HS2000	Adhesives Technology Ultrabond 1	Adhesives Technology Ultrabond 3	Simpson ET	
Bond Strength	1,800 psi (12.4 MPa)	2,400 psi (16.5 MPa)	1,640 psi (11.3 MPa)	1,960 psi (13.5 MPa)	2,030 psi (14.0 MPa)	
Compressive Strength	12,000 psi (82.7 MPa)	15,260 psi (105 MPa)	10,990 psi (75.8 MPa)	10,110 psi (69.7 MPa)	13,390 psi (92.3 MPa)	
Compressive Modulus	220 ksi (1.52 GPa)	322 ksi (2.22 GPa)	214 ksi (1.48 GPa)	201 ksi (1.39 GPa)	658 ksi (4.54 GPa)	
Tensile Strength	6,310 psi (43.5 MPa)	7,080 psi (48.8 MPa)	6,790 psi (46.8 MPa)	7,840 psi (54.1 MPa)	-	
Elongation at Break	2.00%	1.50%	1.90%	1.60%	-	
Heat Deflection Temperature	146 °F (63.3 °C)	152 °F (66.7 °C)	134 °F (56.7 °C)	138 °F (58.9 °C)	168 °F (75.6 °C)	

Bond strength is not the only factor. Concrete strength plays a role as well. The compressive strength of the concrete used in these component tests may be higher than the typical strength of concrete bridge decks. Thus, some decrease in the capacity of the anchors would be expected for lower strength concrete. This decrease in strength would likely be offset to some extent by the presence of reinforcing steel in the bridge deck.

Thanks

TTI TL-2 transitions 9-1002-8

Question

State: WI
Date: 07-30-2013

TTI used a block that is 8 inches deep. Given recent crash testing with 8 and 12 inch block in beam guard, would 12 inch deep blocks be ok.

Response

Date: 08-02-2013
We do not see any reason why 12" deep blocks would not work acceptably in this TL-2 transition.

---

flaring beam guard transitions to permanent barrier

Question

State: WI
Date: 08-05-2013

I know that flaring a beam guard transition is not what we want to do. However if the concrete barrier that the beam guard transition is connecting to is flaring is that OK?
Attachment: https://mwrsf-qa.unl.edu/attachments/811be0314a1cbad7b6589d8193ebacbb.pdf

---

Response

Date: 08-06-2013
Flaring an approach guardrail transition is not the most desirable layout and typically not recommended. However, for very shallow angle flares (e.g., 15:1), the performance of the system may not be affected.

Beam guard bolt through box culvert deck option

Question

State: WI
Date: 08-05-2013

In TRP-03-114-02 you used a bottom washer plate to bolt through.

Instead of using this washer plate can square plate washers be used?

Can this detail modified to accept MGS mounting heights?

Response

Date: 08-06-2013
There should not be any issues with using square plate washers. It is recommended to utilize the same thickness, 1/4"

Yes, raising the rail height to 31" has been allowed. The post should be extended with all other dimensions (base plate, weld, bolts, soil fill, and half post spacing) remaining the same.

Connection of Free Standing 42-Inch Conc. Barrier to Concrete Bridge Rail at Expansion Joint

Question

State: WY
Date: 08-05-2013

We are replacing some expansion joints on bridges on I-80 where we have 42-inch single slope barrier both on the bridge decks and in approach of the bridge. The approach barrier has a 10-inch deep footing and the barrier is fairly heavily reinforced. The bridge barrier is tied into the deck and should have adequate end condition support. Several years ago we decided to use the New York Portable Concrete Barrier Key to connect the approach barrier to the bridge barrier at expansion joints to provide transfer of the lateral forces from one barrier to the next. It appears New York modified the key cap before MwRSF did some recent testing for New York.

Now days, we use a deeper footing similar to what MwRSF developed for the 42" nearly vertical barrier with head-slap consideration to provide full end condition support. It is not practical to replace the footing for these installations while only replacing the expansion joints. My question is, do you think this existing key style connection is adequate to provide sufficient support at the end of the approach barrier given the depth of the footings and reinforcing?

Attachment: https://mwrsf-qa.unl.edu/attachments/94852bfed38d602438bb8a07d67a2db1.pdf

---

Response

Date: 08-23-2013
First off, your median barrier drawing shows a reduced stirrup/transverse steel space within 5 ft of the end. Assuming that the dowels between the barrier and the foundation slab are placed at every stirrup location, I think that the end of the barrier could perform as a TL-3 barrier on its own. The key connection would only strengthen the joint. As for TL-4 and TL-5, you would probably need a connection to transfer the load across the expansion joint.

The key connection shown in the drawing concerns me in that it may not transfer load between the two sides until a significant deflection occurs. The slots in the tubes are oversized by 1/2" and the I-shaped key can rotate within the tubes as the barrier is deflecting. Thus, this connection may not load right away causing significant deflections and damage tot he barrier prior to load transfer (unless the tubes are very close together). However, the connection is still better than having nothing at all.

In looking at the connection, I would make a few changes to tighten up the joint to load quicker in shear (narrower slots in the tubes, wider flanges on the drop in I-section, things like that). However, I have not seen any testing of this type of connection between two permanent barriers, so it is difficult to say how well it performs and how much load it can take. Therefore, I defer to you and your State's crash records as a means of evaluating the effectiveness of the connection.

If you feel that the connection is in need of improvement, a number of states have utilized a design that

resembles a steel plate/shell that is bent to the shape of the barriers, placed over the top of the adjacent barrier ends, and bolted down on both sides. Of course, the bolts are placed in slots so that the joint can expand and contract. This type of connection would ensure a quicker load transfer as well as prevent vehicle snagging on the barrier ends if the expansion joint opens up.

Design Questions Regarding Transitions and Curbs

Question

Date: 08-07-2013

I have responded to your questions below in red. Call or email me if you want to discuss them further.

I have also attached some research reports that I refer to below.

The file 'transition reports.zip' (109.0 MB) is available for download at
http://dropbox.unl.edu/uploads/20130821/35ad79a8d2da171a/transition%20reports.zip
for the next 14 days.
It will be removed after Wednesday, August 21, 2013.

1) The Traffic Barrier Terminal transition from a bridge rail or concrete parapet wall is usually a thrie beam apparatus. In IL, when a curb extends under the first section of the barrier, it can be affixed to the end of the parapet (TYPE 6). If there is no curbing, the thrie beam extends an additional section onto the structure (TYPE 6B). So I draw the conclusion that the curb is also a safety feature over just a drainage diversion – I assume it possibly help redirect and contain an errant vehicle. So, is there a curbing depth and width that is required, especially if it was test crashed for acceptance? Sometimes, it will be connected to the approach pavement, and other times it will be next to an asphalt shoulder. If it is part of the pavement, it will be doweled in; if it is next to asphalt shoulder / pavement, in order to retrofit at this point in time, they will have to excavate it and form it up presumably with no reinforcement.
   So, a) are my assumptions correct in that the curb is actually a safety feature adding to the deflective capabilities?, and b) what kind of curb is specified / depth / width / curb and gutter (B6-18) as “crash tested"?
   - I have reviewed your details and believe that your current type 6 transition is a combination of the MGS upstream stiffness transition that we developed in TRP-03-167-07 and the Iowa transition that used quarter post spacing. However, it appears that you may have modified things lsihgtly in terms using longer posts in the quarter post spacing region.
   - For your information, we have developed newer versions of that upstream stiffness transition that can be used that are shorter and use fewer post types. I have attached reports dealing with the steel and wood post versions of those newer transition designs (TRP-03-210-10 and TRP-03-243-11) You may want to consider these details in order to simplify your approach transition details.

- You are correct that the curb has an effect on transition performance. However, the effect varies depending on the transition. Some approach transitions such as the Iowa transition with ¼ post spacing were designed and tested with a curb. In these cases, the curb served to help limit vehicle snag on the end of the concrete parapet. Some tests have shown that removal of these curbs can degrade the performance of the transition. That said, it is our belief that improved design of the concrete end section through shape and tapering can reduce snag to a manageable level without the need for a curb in most cases. However, the exact design and geometry of such an end section have not been formalized, so the use of the curb is still recommended for certain transitions such as the one you currently use. We are working on coming up with improved concrerte end section details as part of the Pooled Fund consulting effort in the near future.
- The curb that we currently have used in most transitions is a 4" tall wedge curb. We have recently tested a version of the MGS approach transition with this curb extended past the W-thrie transition rail as shown in the attached detail. We have not done testing with the more vertical shape curbs you have shown in your details. We would recommend the wedge curb if possible, but we believe that the more vertical curbs you have shown would have the potential to perform acceptably for a 4" height. We would not recommend curbs over 4" tall as their effect on the approach transition has not been evaluated.
- Note that the 4" wedge curb is believed to be acceptable as long it terminates prior to the W-thrie transition piece in the details you have shown. As noted above, we have tested extended curbs, but we found that nested W-beam rail was required to prevent rupture as shown in the attached detail.
- As far as omitting the curb, removal of the curb depends largely on the design of the transition, its dynamic deflection, and the shape and geometry of the concrete parapet end. As noted above, we believe that transitions can be made to work with and without curbs, but for now, we are generally recommending that systems tested with curbs keep them in place.

2) In installing sand barrels for permanent protection at bridge piers, I was told that some are allowing the barrels to remain on wooden pallets (4" height), as an end loader cannot get access to them from underneath with the pallets. Is that acceptable / other states doing that / what about the safety performance and crash worthiness with the pallets in place? Do you see a safety problem with leaving them atop the wooden pallets?
   - We have not heard of other states placing 4" pallets underneath the sand barrels. It was our understanding that the barrels were put in place unloaded and then filled with sand. There is some potential concern that placement of the barrels on a raised platform may affect the performance of the system by affecting vehicle stability and the location of the barrier CG's relative to the impacting vehicles. However, you would need to contact the sand barrel manufacturers to get a definitive answer on that.

Attachment: https://mwrsf-qa.unl.edu/attachments/e28a69986e865df39d2b712dd5eb78eb.pdf

Attachment: https://mwrsf-qa.unl.edu/attachments/02a3dc5a04fe18fdb8756b1b5216119a.pdf

Response
Date: 08-07-2013

Can you provide me with clarification on two issues, please?

1)

The Traffic Barrier Terminal transition from a bridge rail or concrete parapet wall is usually a thrie beam apparatus. In IL, when a curb extends under the first section of the barrier, it can be affixed to the end of the parapet (TYPE 6). If there is no curbing, the thrie beam extends an additional section onto the structure (TYPE 6B). So I draw the conclusion that the curb is also a safety feature over just a drainage diversion – I assume it possibly help redirect and contain an errant vehicle. So, is there a curbing depth and width that is required, especially if it was test crashed for acceptance? Sometimes, it will be connected to the approach pavement, and other times it will be next to an asphalt shoulder. If it is part of the pavement, it will be doweled in; if it is next to asphalt shoulder / pavement, in order to retrofit at this point in time, they will have to excavate it and form it up presumably with no reinforcement.

So, a) are my assumptions correct in that the curb is actually a safety feature adding to the deflective capabilities?, and b) what kind of curb is specified / depth / width / curb and gutter (B6-18) as “crash tested"?

2)

In installing sand barrels for permanent protection at bridge piers, I was told that some are allowing the barrels to remain on wooden pallets (4" height), as an end loader cannot get access to them from underneath with the pallets. Is that acceptable / other states doing that / what about the safety performance and crash worthiness with the pallets in place? Do you see a safety problem with leaving them atop the wooden pallets?

Attachment: https://mwrsf-qa.unl.edu/attachments/e28a69986e865df39d2b712dd5eb78eb.pdf

Attachment: https://mwrsf-qa.unl.edu/attachments/02a3dc5a04fe18fdb8756b1b5216119a.pdf

Movement of cable anchors

Question

State: OH
Date: 08-12-2013

We need your opinion on an issue we are noticing with some of our Nucor Cable End anchors. Some background:

Nucor now has 2 types of cable guardrail end anchors (see attached PDFs). The TTI version which we like. And the Barrier Systems version, which we've had issues with.

Typically these systems were installed in the summertime, and we first notice the issue the following spring. It seems when the ground thaws and gets softer, and the snow has melted, but it is still cold enough to have higher tension values, we were getting some movement in the anchors. The contractor who does 90% of our cable installations in Ohio says he doesn't skimp on the foundations, but adds a little more concrete than even the shop drawing calls for just to be more conservative. Based on some of the photos I'm not entirely convinced that was actually happening in the field…

The attached .jpgs show varying amounts of gaps between the soil and the foundations of the anchors. We are debating the replacement of these anchors that have signs of shifting or movement. Certainly these systems have been getting impacted over the past year(s) and have been performing satisfactorily. We just don't really know how critical of an issue we have. The bottoms of the anchor foundations should still be below the freeze/thaw depth. We plan to keep an eye on them to see if they are creeping any more over time, or if it was just a one springtime thing.

How much movement or shifting do you think we can allow on these anchors before needing to replace them? I know Indiana has had some issues with this anchor in the past completely pulling out. We had a couple of poor installations that did, too, upon the initial tensioning. But since this occurred while the contractor was still on site, we were able to have it resolved immediately. Now we just aren't sure what to do for the one that seemed to have creeped a little bit over time.

Thanks for any advice.

Attachment: https://mwrsf-qa.unl.edu/attachments/1a84e399ddc6ce7ab0ccb75e5c4fadc2.pdf

Attachment: https://mwrsf-qa.unl.edu/attachments/4748fb596fdff6b777c43d11b644e926.pdf

Attachment: https://mwrsf-qa.unl.edu/attachments/19a31c32f4a5ff9fb35c1705f7552848.JPG

Attachment: https://mwrsf-qa.unl.edu/attachments/750fbf523e847d640ae269092c673a1d.JPG

Attachment: https://mwrsf-qa.unl.edu/attachments/8dfc9da2dfd25106c7330ae36d115733.JPG

Attachment: https://mwrsf-qa.unl.edu/attachments/495d668f0818e17b2e529fb678347bcc.JPG

Attachment: https://mwrsf-qa.unl.edu/attachments/389938be74cc99ba9f54add710137005.jpg

---

Response

Date: 08-12-2013

From a brief review of the photographs and design details, several points are worth noting.

First, the diameter of the concrete shafts are approximately equal, but the TTI shaft is embedded around 20 in. more used in the New Zealand system.

Second, the TTI system has an individual anchor for each cable, while the NZ system has all cables directed into the anchor system.

Third, the NZ upward shaft movement appears to be a function of the relative distance away from the third shaft location. The third shaft location appears to be a rotation point around which shafts 2 and 1 are incrementally jacked upward and out of the hole. This upward movement or easier shaft movement may be occurring during high loading events, re-tensioning of cables after impact events, creep after consolidation of soil on inward side of anchor holes over time or during impact events which may increase gaps around concrete shaft, or combinations thereof. The load path in the NZ system may seem more conducive for lifting end concrete shaft out of the holes.

Deeper concrete shafts would likely eliminate this phenomenon in the NZ system. I would suggest raising this concern with Nucor so that they are aware of this situation and can fix it in future installations, or even existing systems where soil and environmental conditions make it easier to occur.

Our preliminary thoughts would be that replacement may be appropriate if the end shaft has raised nearly 2 in. or so. However, it may be beneficial to also pose this question to the manufacturer to get their thoughts on the potential for degraded barrier performance when shafts 1 and 2 are already jacked above grade.

Guardrail posts in concrete

Question
Date: 08-16-2013

Can the MGS be placed in
concrete with a leave-out behind the posts? The contractor in Alabama
installed posts through 8" diameter holes, and our Division Office in
Montgomery wants to know 1) is that is OK? or 2) if not, what can be done
about it? I referenced the TTI work on GR posts in rock, and suggested
the contractor could core another 8" hole behind the post, but the MWRSF should
be the final authority on that retrofit scheme.

Response
Date: 08-16-2013

In my opinion, I believe that the MGS can be placed in mow strips if an adequate leave-out is utilized to allow sufficient post rotation without hanging up along the sides or prematurely making contact at the back of the hole. I think that it would be helpful to provide between 8" to 10" of ground line clear distance behind the steel post and the back end of the concrete hole surface based on an effective post resistance occurring through a lateral distance of 16" to 20" at a mid-rail height of 25" above grade. The post rotation point was assumed to occur at 2/3 of the 40" embedment depth.

A second 8" diameter hole may be capable of providing the effective depth if the post sits more toward the front of the first hole. If the holes are drilled separately, then more post rotation distance can be achieved to ensure 8 to 10". However, the wedges between two hole diameters would need to be cut/chipped off to provide smooth side walls so as to not catch the post while deflecting. We had recommended and tested something like this for the post in rock configuration that is in the same FHWA memo – Case 1. It is better to provide extra clear width on the sides of the posts as well. For this situation, I think that it can be made to work with a second hole and shaving out the material between hole. A larger diameter back hole would be even better, if that is possible. For new construction, it would be good to continue to use the TTI recommendations for leave-outs for width.

Shallow Post Embedment

Question

State: IA
Date: 08-19-2013

We are utilizing the 31" wood post MGS at this location and we have approximately 37" of soil depth to the top of the box culvert. Other than attaching steel posts to the culvert, what options would you suggest?

Attachment: https://mwrsf-qa.unl.edu/attachments/0c29961b4e75f76781afaea12ffbd7bc.pdf

Attachment: https://mwrsf-qa.unl.edu/attachments/ec89ac1f0c996e9c22be7f43aa1740a9.pdf

---

Response

Date: 08-19-2013

I think that you have a few options.

First, three round, wood-post MGS options are available using Ponderosa Pine, Douglas Fir, and Southern Yellow Pine species in varying diameters based on species. The round-post alternatives were successfully crash tested under the NCHRP Report No. 350 safety standards in combination with a substantial static and dynamic component testing effort. The post embedment depth for each species was 37 in. As such, a round-post option could be used on your culverts now.

The MGS was originally crash tested under NCHRP Report No. 350 when soil strength was not as strong as now provided under the new MASH testing criteria. Per my recollection and from an older MGS R&D bogie testing program in early 2000s, the average post-soil resistance was just under 7 kips through 15 in. of post deflection, which resulted in crashworthy 350 guardrail system. Now and using MASH soil criteria, the average post-soil resistance was around 9.5 kips through 15 in. of post deflection, as reported in “Dynamic Testing of MGS W6x8.5 Posts at Decreased Embedment", report no. TRP-03-271-12, December 17, 2012. For these efforts, the load height was 24-7/8 in. with an embedment depth of 40 in. In this same guardrail post study, a reduced post embedment depth of 36 in. was investigated to explore post performance in maximum height guardrail systems. For this depth, the average post-soil resistance was about 8.5 kips through 15 in. of post deflection, which is higher than provided for the successful 350 testing of the MGS.

Based on a MASH high-strength soil condition and test noted above, I would expect the standard MGS to meet both the TL-3 NCHRP 350 and MASH safety criteria for using a 36-in. embedment for steel posts spaced on 6'-3" centers. Of course, the safety performance can only be verified through full-scale crash testing. We will be conducting a 2270P test on MGS at SBP of 2:1 with 6-ft long posts in near future. This crash test, along with a successful outcome, would help to support this opinion.

With a reduced post-soil resistance in actual field installations, it would also be acceptable to place the MGS with steel posts spaced at half-post spacing using a 36-in. embedment depth. The extra posts placed in midpoints may provide a factor of safety for the condition of a shallower post in combination with a potentially weaker soil condition than provided by stiff MASH soil.

As such, I think that you have 3 alternatives for consideration – wood posts, 36" embedded posts at standard spacing, and 36" embedded posts at half spacing.

Let me know if you have any questions or comments about the information noted above.

Attachment: https://mwrsf-qa.unl.edu/attachments/e2571b3b23cc1ba319550f24d5a33511.pdf

---

MGS comb curb

Question
Date: 08-23-2013

I
have a question for you in regards to B-133.

Current
(2011) AASHTO GDHS 6th Ed., Section 4.4.2 ‘Curb Configurations'

provides
specification of Type B curb (see below) and referenced in B-133.

The
Type B curb height ‘range' is 4in.- 6in.. Since B-133 specifies ‘Type B

Curb',
might the install tolerance of 31" MGS combination curb be consistent

w/2011
AASHTO GDHS Type B curb of 4in.- 6in. height?

Attachment: https://mwrsf-qa.unl.edu/attachments/1b7acb5cb9b0d6d04ee9786db8ceae6b.jpg

---

Response
Date: 08-23-2013
The MGS was installed with the face of the rail 6" back from center of the curb face of a 6" tall type B curb. The rail height for that installation was set at 31" from the toe of the curb. We selected the 6" tall type be curb for testing as we believed that this represented a more severe curb for use on high speed roadways. The only more severe curb standard is a 6" vertical curb, but we did not believe that that was applicable for TL-3 situations.

Based on the fact that the MGS was tested with the more sever curb, we have typically recommended that shorter curb heights and less severe wedge type curbs will perform safely when used with the MGS and the same rail face to curb offset.

Let me know if you need further information.

bolt specification question

Question

State: WI
Date: 09-10-2013

WisDOT is putting together a detail for double faced thrie beam based on SGM09. The SGM 09 detail uses FBX16a bolts to connect the modified steel block to the steel post. The guidance in the standardized guide for barrier hardware indicates that FBX16A bolts require the use of ANSI B18.2.1 and ANSI B1.1 for Class 2A tolerances.

Why is ANSI specification being used instead of ASTMs?

I was also trying to dig up guidance on the nuts and washers for this bolt as well and have not had much luck. Do you have this information or could direct me to the correct sources

I know that contractors and construction staff are use to looking for ASTMs or AASHTO's specifications and I'm trying head off phone calls (e.g. is this the correct stuff, why did you use this verses this, why did you use an outdated materials specification….).

Thanks

Response

Date: 09-11-2013

The bolt spec you are looking at in SGM09 is referenced in metric because at the time of the hardware guide publication, there was a push to switch to metric units.

For FBX16a, the hardware guide requires **ASTM F568M** Class 4.6 bolts for galvanized hardware. **ASTM F568M** is an ASTM International standard for metric bolts, screws and studs. Class 4.6 refers to the grade. ASTM F568 defines materials used for manufacturing a broad category of fasteners with a wide variety of materials strengths. All metric fasteners are made using materials that are specified in ASTM F568.

The Class 4.6 specification is essentially the same grade as the ASTM A307 spec. It does not require heavy hex bolt and nut configuration, but I can see no problem with using heavy hex or structural bolt sizing. ASTM A307 can be obtained in heavy hex or standard configurations. A307A is standard bolts and A307 B is heavy hex.

Nuts for ASTM A307 are A563A Heavy Hex or A563A Hex and washers are F844.

Development of TL-3 Transition Between Concrete Barrier and Guardrail

Question

State: CT
Date: 09-13-2013

I found an excerpt about the subject project and I'm very interested in obtaining additional information. Not sure if you remember me …I have attended a few Task Force 13 meetings in the past. In any event, I created a detail to transition guiderail to TPCBC that has been used a bit here in CT and its gaining popularity with the contractors and designers. For me to have any wide spread use of it or for me to be able to make it a standard detail, I need to find crash test information to support its use.

As it turns out, there isn't a large amount of information for this application. However, I did find your project, details from Virginia DOT in their GRIT manual, a detail from Oregon, and one from Georgia. I have attached my detail for your use and information. Specifically, if you can help I am looking for the following:

1. Does the barrier the rail is attached to need to be anchored? Does more than one barrier need to be anchored?
2. Is a rubrail required?
3. Can this detail be used for both Jersey shape and F-shape TPCBC?
4. Is it necessary for the element to be 10ga?
5. Are block outs necessary?

Thank you for any time or input you can give.

Response

Date: 12-10-2013

I am currently working on the guardrail to TCB transition project that we have through NDOR. I would agree with you that there is very little testing or previous development of these kinds of transitions. We are working on a transition between G4(1S) guardrail and the F-shape PCB used by the majority of the Midwest Pooled Fund states. Currently we are conducting LS-DYNA simulations of various design alternatives. The work is not yet complete, but I can make sure to get you the report when it is finished in near the end of 2013/beginning of 2014.

As for your questions, see below.

1. Does the barrier the rail is attached to need to be anchored? Does more than one barrier need to be anchored?

    a. We are currently attempting to transition between the barriers without anchoring the TCB sections. We are not finished with the analysis, but it appears reasonable that it could be done. However, we currently are overlapping the guardrail past the flared TCB segments approximately 2-3 TCB segments. In addition, we are mounting spacer blocks between the rail

and PCB to improve their interaction in the region were they overlap. We have also used a kicker beam off the end of the TCB to get the end of the system moving more quickly. It appears that you are attempting to connect the two systems end to end. We were concerned about this type of installation due to concerns with snag on the TCB end. We also believe that it is important to get the TCB and guardrail moving together near the end of the system to prevent pocketing.

2. Is a rubrail required?

    a. It may help reduce snag on the TCB end in your case. We have not observed issues with vehicle snag on the end of the barrier in our design iterations as we have overlapped the two systems sufficient to prevent it.

3. Can this detail be used for both Jersey shape and F-shape TPCBC?

    a. Because the design you have shown has not been tested, I cannot recommend its use. I would have concerns with the stiffness transition used and snag on the end of the TCB section as it is shown in the detail. However, I do believe that a design that was successfully tested for F-shape barrier may be acceptable for NJ shapes as well depending on the design of the TCB section and the connections.

4. Is it necessary for the element to be 10ga?

    a. We are currently looking at both single and nested systems with thrie beam and W-beam. Both types have shown some advantages and disadvantages depending on the design of the transition. Thus, I can't say with certainty whether or not the 10 gauge rail or nesting is necessary.

5. Are block outs necessary?

    a. The blockouts on the W6x8.5 posts can only help in this installation.

I don't want to provide too much guidance on your design until we have a chance to finish the analysis we are currently doing. That said, I would have some concerns with the lack of overlap of the guardrail and PCB, the potential for snag on the end of the PCB section, and the use of the quarter post spacing between the weak posts and the TCB.

Thanks

Curb termination or transition below MGS stiffness transition

Question

State: WI
Date: 09-18-2013

When utilizing the 4" curb under the MGS stiffness transition to a thrie beam approach guardrail transition, where is the appropriate location to either terminate the curb or transition to a taller 6" curb (e.g., the MGS system designed to use behind a 6" curb)?

Response

Date: 09-18-2013

The 4" curb should be extended out from the bridge parapet, through the entire transition area including all 1/2 post (37.5") spacings, and continue through a minimum of one full post (75") spacing. Thus, termination of the curb or a transition to a 6" curb may occur within the 2nd full post spacing upstream of the stiffness transition.

Additionally, it is recommended to utilize a minimum length of 3 ft to transition from a 4" wedge shaped curb to a 6" high, AASHTO Type "B" curb. The 3 ft length would also apply for the termination length (transitioning from a 4" curb to no curb).
