Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

01-01-2012 to 04-01-2012

Mitchell Interchange Standpipe Protection

Question

State: WI
Date: 01-02-2012

Dear MwRSF,

Below is an email from one of our major project teams who are building some tunnels as we speak. They are having an issue with the stand pipes. Do you have any suggestions

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Subject: Mitchell Interchange Standpipe Protection

As discussed last week, the Mitchell Interchange Construction team is looking at options to enhance standpipe protection within Tunnel construction at the request of the City of Milwaukee Fire Department. MFD is requesting "the maximum, reasonable, protection and/or isolation of the standpipe outlets from vehicular damage".

Currently the standpipe system has been protected with 7" (+/-) lateral offset to connection fittings in Tunnel 3. Tunnel 1 and 2 will have nearer to 10" of lateral offset to standpipe that is located about 18" above the top of barrier. Our construction team has dismissed the potential to change to vertical face barrier due to potential increased damage to vehicles involved in a crash.

Construction team has identified that we have met NFPA requirements:

9.3.3 " Fire department connections shall be protected from vehicular damage by means of bollards or other approved barriers.

9.4.3 " Hose connections shall be located so that they are conspicuous and convenient but still reasonably protected from damage by errant vehicles or vandals

Team has discussed locating bollard, or some physical protection on top of the barrier at the same offset as the standpipe fittings. You offered some hesitation with that alternative in our phone call last week, and also potential to look at other alternatives. Can you look into, and get me an assessment on physical protection alternatives " bollard and other?

Appreciate your help in advance.

Attachment: http://mwrsf-qa.unl.edu/attachments/b356354daed958a76c6523a410167e27.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/759ee16d7de6a00bd4351160d852d918.jpg

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Response

Date: 01-09-2012

We are unaware of any special protection barrier systems that have been designed and tested for use in shielding water values which extend off of the tunnel side walls and above the vehicular barriers. However, if safety treatment is desired, it would seem possible to design steel or reinforced concrete structures which anchor to the top of the concrete parapet and possibly to tunnel wall in order to prevent vehicle snag, and even occupant snag, on the pipe hardware.

If this barrier option is considered, then the upstream and downstream ends should be sloped to mitigate snag concerns as the additional protective barrier which falls within the zone of intrusion. As noted above, these systems could be attached to barrier or tunnel.

Alternatively, it may be reasonable to consider design changes to the pipe system, such as to recess more the structure (i.e., 2 outlets and handle for valve) within the tunnel side walls, thus greatly reducing concerns for vehicle snag, and even occupant snag, on the pipe structure.

Please let me know if you have any further questions or comments regarding the information provided above.

Response

Date: 01-11-2012

After looking at the standpipe issues further, we are concerned that the standpipe can be impacted based on the ZOI for the barrier in questions. In order to address this, I came up with the concept attached. It consists of telescoping tubes that shield the stand pipe. Access to the stand pipe would only require removing the drop pins and sliding the middle tube into the larger side tubes.

This design should protect the standpipe from interaction with impacting vehicles. I have not fleshed out the anchorage details yet, but I wanted to get some feedback from you on the concept.

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/7257adccfdfbdec1fd4fd4865196d0ed.PDF

Response

Date: 02-24-2012

The fire department didn't like the standpipe design. Construction team is asking if we could use the top portion of our combination rail design. I've attached a link to the railing details.

http://on.dot.wi.gov/dtid_bos/extranet/structures/LRFD/standards/3005.pdf>

Response

Date: 03-05-2012

I believe that the railing design shown can prevent interaction with the stand pipe as desired. However, we have seen potential for horizontal railings to promote vehicle instability when mounted on single slope barriers. In previous pedestrian rail testing on a 32" single slope, we found that the horizontal railings provided vertical restrain on the front corner of the vehicle which caused it to roll towards to the barrier and become unstable enough to rollover. Please refer to the attached report.

We would have concerns for the railing shown potentially affecting vehicle stability. I don't recall the speeds in this areas. Obviously, if the speed were limited to TL-2 type speeds, then the concern becomes much less.

This was the rationale behind the design we sent previously having a solid front face.

Short radius

Question

State: NE
Date: 12-28-2011

Q about the w-beam perpendicular to the lanes of traffic beyond the short radius.
Should the CRT posts be placed on the portion of the guardrail which is perpendicular to the traveled way within the clear zone?
Or can these be full strength posts?

Response

Date: 01-04-2012
The NDOR variation of the short radius guardrail system appears to be somewhat based on the original Yuma County (YC) curved barrier system that was crash tested and evaluated by SwRI researchers. In terms of CRT posts, it would be appropriate to carry out the CRT posts along the secondary length at least as far as utilized in the original YC crash testing program.
More recently, TTI researchers conducted an LS-DYNA analysis and investigation of a modified YC system according to the NCHRP Report No. 350 TL-2 impact conditions. Following this effort, the modified YC system was submitted to and accepted by FHWA. Copies of the acceptance letter and research report are attached.
At this time, neither the YC or modified YC designs have been adapted to 31" tall W-beam guardrail systems nor accepted by FHWA.

Attachment: http://mwrsf-qa.unl.edu/attachments/9f9c7edd970a68761aa2e153c5d7ba62.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/9f9c7edd970a68761aa2e153c5d7ba62.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/9f9c7edd970a68761aa2e153c5d7ba62.pdf

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MGS Steep Slope

Question

State: IA
Date: 01-11-2012

Due to right-of-way restrictions, we have a steep slope situation on a bridge replacement project where we will need to install steel beam guardrail. Design speed of the roadway is 60 mph and the traffic volumes are in the 1500 vpd range.

In your opinion, would it be satisfactory to install the MGS on a 10:1 pad such that a 1.5:1 foreslope begins 24 inches behind the face of rail? Also, could this same cross section be used throughout our approach guardrail transition (see attached BA-201 drawing)?

Thanks
Attachment: http://mwrsf-qa.unl.edu/attachments/c3d06842442ba2752ba64f14344c3342.pdf

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Response

Date: 01-11-2012

See my comments below!

Due to right-of-way restrictions, we have a steep slope situation on a bridge replacement project where we will need to install steel beam guardrail. Design speed of the roadway is 60 mph and the traffic volumes are in the 1500 vpd range.

**For steep slope hazards, MwRSF previously developed two W-beam guardrail systems " one for metric-height rail and one for the MGS. In both scenarios, the steel post was centered at the SBP.

In your opinion, would it be satisfactory to install the MGS on a 10:1 pad such that a 1.5:1 foreslope begins 24 inches behind the face of rail?

**As noted above, the MGS option is being considered where a 10:1 roadside slope is followed by a steep 1.5:1 fill slope. For this configuration, the MGS could be installed with as little as 2¾ in. of mostly level terrain behind the steel post in advance of the SBP. This scenario would likely provide similar post-soil behavior to that of a steel post installed at SBP of 2:1 fill slope. Thus, it would be recommended to utilize the MGS System for 2:1 Fill Slopes for your guardrail system used in the application presented above.

Also, could this same cross section be used throughout our approach guardrail transition (see attached BA-201 drawing)?

**At this time, we do not have a design solution for approach guardrail transitions placed with the steel/wood posts located at or near steep slopes. For these scenarios, our first choice would be to modify the fill behind the posts in order to provide 24 in. of generally flat terrain behind the posts. If that cannot be provided, then we would need to investigate whether another surrogate post (larger and/or longer) could provide comparable post-soil behavior to the original transition post founded in level terrain. Although the later could be done, it would certainly require additional analysis and possibly some additional bogie tests. Please let us know whether you desire MwRSF to further explore the second option. Thanks!

P.S. " On another note, the CAD details provided in the attached pdf file depict the use of the wedged-shape drainage curb below the thrie beam rail. In the original testing program, the curb ended at the midpoint of the symmetrical W-beam to thrie beam transition section and started the taper to the ground at the thrie beam end of the section. All crash testing was performed near the bridge end, and no testing was performed near the start of the W-beam to thrie beam transition section. Later, the MGS stiffness transition was developed for use in combination to a thrie beam transition with half-post spacing but without a curb. This stiffness transition was adapted to other common AGTs. Your detail depicts the curb to end at the start of the asymmetrical transition section. Due to concerns for the small car to wedge under the rail, the concrete curb should preferably end at the thrie beam end.

Response

Date: 01-12-2012

See my comments in blue below!

Due to right-of-way restrictions, we have a steep slope situation on a bridge replacement project where we will need to install steel beam guardrail. Design speed of the roadway is 60 mph and the traffic volumes are in the 1500 vpd range.

**For steep slope hazards, MwRSF previously developed two W-beam guardrail systems " one for metric-height rail and one for the MGS. In both scenarios, the steel post was centered at the SBP.

****OK

In your opinion, would it be satisfactory to install the MGS on a 10:1 pad such that a 1.5:1 foreslope begins 24 inches behind the face of rail?

**As noted above, the MGS option is being considered where a 10:1 roadside slope is followed by a steep 1.5:1 fill slope. For this configuration, the MGS could be installed with as little as 2¾ in. of mostly level terrain behind the steel post in advance of the SBP. This scenario would likely provide similar post-soil behavior to that of a steel post installed at SBP of 2:1 fill slope. Thus, it would be recommended to utilize the MGS System for 2:1 Fill Slopes for your guardrail system used in the application presented above.

****OK

Also, could this same cross section be used throughout our approach guardrail transition (see attached BA-201 drawing)?

**At this time, we do not have a design solution for approach guardrail transitions placed with the steel/wood posts located at or near steep slopes. For these scenarios, our first choice would be to modify the fill behind the posts in order to provide 24 in. of generally flat terrain behind the posts. If that cannot be provided, then we would need to investigate whether another surrogate post (larger and/or longer) could provide comparable post-soil behavior to the original transition post founded in level terrain. Although the later could be done, it would certainly require additional analysis and possibly some additional bogie tests. Please let us know whether you desire MwRSF to further explore the second option. Thanks!

****Our ROW is so restricted on this project that we are unable to provide 24 inches of flat terrain behind the posts throughout the AGT. Having you conduct some additional analysis and/or testing would be desirable, but I'm doubtful our project timeline would allow for that. Would you be able to provide a ballpark estimate of how much time such an analysis might take?

P.S. " On another note, the CAD details provided in the attached pdf file depict the use of the wedged-shape drainage curb below the thrie beam rail. In the original testing program, the curb ended at the midpoint of the symmetrical W-beam to thrie beam transition section and started the taper to the ground at the thrie beam end of the section. All crash testing was performed near the bridge end, and no testing was performed near the start of the W-beam to thrie beam transition section. Later, the MGS stiffness transition was developed for use in combination to a thrie beam transition with half-post spacing but without a curb. This stiffness transition was adapted to other common AGTs. Your detail depicts the curb to end at the start of the asymmetrical transition section. Due to concerns for the small car to wedge under the rail, the concrete curb should preferably end at the thrie beam end.

****Thank you for pointing this out. We should modify our standard to show the curb ending under the thrie beam. Note, however, that extending the curb through and beyond the asymmetrical transition section is unavoidable in some cases due to drainage requirements. When a curb is required in this region, it has been a long-standing practice of ours to limit the height of the curb to 4 inches. Obviously, the slope at the bottom of the rail is more pronounced on the new asymmetrical transition compared to the old symmetrical one, but I'm not aware of any issues coming up regarding the wedging of small cars under the old transition (or the new one, for that matter). Of course, it might still be an issue. Maybe this is something we could investigate further (with pooled fund money perhaps). Seems like it would fit in well with a proposal to study the necessity of the 4-inch curb at the guardrail/bridge rail interface...

Response

Date: 01-13-2012

See comment's below in **green**.

Due to right-of-way restrictions, we have a steep slope situation on a bridge replacement project where we will need to install steel beam guardrail. Design speed of the roadway is 60 mph and the traffic volumes are in the 1500 vpd range.

**For steep slope hazards, MwRSF previously developed two W-beam guardrail systems " one for metric-height rail and one for the MGS. In both scenarios, the steel post was centered at the SBP.

****OK

In your opinion, would it be satisfactory to install the MGS on a 10:1 pad such that a 1.5:1 foreslope begins 24 inches behind the face of rail?

**As noted above, the MGS option is being considered where a 10:1 roadside slope is followed by a steep 1.5:1 fill slope. For this configuration, the MGS could be installed with as little as 2¾ in. of mostly level terrain behind the steel post in advance of the SBP. This scenario would likely provide similar post-soil behavior to that of a steel post installed at SBP of 2:1 fill slope. Thus, it would be recommended to utilize the MGS System for

2:1 Fill Slopes for your guardrail system used in the application presented above.

****OK

Also, could this same cross section be used throughout our approach guardrail transition (see attached BA-201 drawing)?

**At this time, we do not have a design solution for approach guardrail transitions placed with the steel/wood posts located at or near steep slopes. For these scenarios, our first choice would be to modify the fill behind the posts in order to provide 24 in. of generally flat terrain behind the posts. If that cannot be provided, then we would need to investigate whether another surrogate post (larger and/or longer) could provide comparable post-soil behavior to the original transition post founded in level terrain. Although the later could be done, it would certainly require additional analysis and possibly some additional bogie tests. Please let us know whether you desire MwRSF to further explore the second option. Thanks!

****Our ROW is so restricted on this project that we are unable to provide 24 inches of flat terrain behind the posts throughout the AGT. Having you conduct some additional analysis and/or testing would be desirable, but I'm doubtful our project timeline would allow for that. Would you be able to provide a ballpark estimate of how much time such an analysis might take?

****I suspect 1-2 days would be adequate to acquire and review prior bogie testing data and perform simple hand calculations. However, if we cannot find sufficient information and results from prior bogie tests, then a bogie testing program would be needed. At this point, staff could look into this issue later this month.**

P.S. " On another note, the CAD details provided in the attached pdf file depict the use of the wedged-shape drainage curb below the thrie beam rail. In the original testing program, the curb ended at the midpoint of the symmetrical W-beam to thrie beam transition section and started the taper to the ground at the thrie beam end of the section. All crash testing was performed near the bridge end, and no testing was performed near the start of the W-beam to thrie beam transition section. Later, the MGS stiffness transition was developed for use in combination to a thrie beam transition with half-post spacing but without a curb. This stiffness transition was adapted to other common AGTs. Your detail depicts the curb to end at the start of the asymmetrical transition section. Due to concerns for the small car to wedge under the rail, the concrete curb should preferably end at the thrie beam end.

****Thank you for pointing this out. We should modify our standard to show the curb ending under the thrie beam. Note, however, that extending the curb through and beyond the asymmetrical transition section is unavoidable in some cases due to drainage requirements. When a curb is required in this region, it has been a long-standing practice of ours to limit the height of the curb to 4 inches. Obviously, the slope at the bottom of the rail is more pronounced on the new asymmetrical transition compared to the old symmetrical one, but I'm not aware of any issues coming up regarding the wedging of small cars under the old transition (or the new one, for that matter). Of course, it might still be an issue. Maybe this is something we could investigate further (with pooled fund money perhaps). Seems like it would fit in well with a proposal to study the necessity of the 4-inch curb at the guardrail/bridge rail interface...

****Small car wedging started to occur with 1100C vehicle on stiffness transition project. However, the test results were satisfactory. Now, if we add a lower curb, it is our opinion that performance could be potentially degraded as wedging and snag could be accentuated. Also, the 2270P vehicle would contact MGS slightly higher while reaching stiffer region. We believe 2 tests would be needed to evaluate curb in advance of asymmetrical part. Also, it would be beneficial to test Iowa transition near bridge end but without curb. Future research would be extremely helpful to investigate whether or not these potential concerns are real.**

Strength Properties Of Guardrail Posts

Question

State: WA
Date: 01-17-2012

We've been asked if we could provide a material strength comparison between steel and wood posts. This is about the material properties rather than the guardrail system performance. Dave and I looked at this briefly in a few resources. One of these we looked at particularly was the "Task Force 13 Standardized Hardware Guide" which lists inertial properties of these post materials and also a stress grade for the wooden posts (see below links).
https://www.aashtotf13.org/Files/Drawings/pwe01-04.pdf
https://www.aashtotf13.org/Files/Drawings/pde01-08.pdf
We are wondering how we can formulate a meaningful comparison between these post material types and their associated performance. Is there anything in your past work with pendulum testing etc. that would help simplify a response to this question? Also, please share any studies/reports you may know of.
We predominately use 6 x 8 Douglas fir Grade No. 1 or 6 x 8 Hem Fir Select Structural grade as a comparable post to the W 6 x 9.
Thanks for any help.

Response

Date: 02-02-2012
I have some comments and information regarding wood and steel posts with respect to the MGS below. Hopefully it will help you with your decision process.
As with all strong-post W-beam guardrail systems, the MGS system dissipates energy through the deflection and deformation of the rail and the rotation of the posts in the soil. If the posts have do not rotate in the soil and absorb energy, the bulk of the impacting vehicle's energy will be absorbed by the W-beam element, thus increasing the tensile force in the rail. If the force increases beyond the capacity of the rail, it will fail, allowing the impacting vehicle to pass through. Therefore, the posts must have sufficient structural capacity to displace founding soils and absorb energy. Wood and steel posts can both serve this function, but they do have inherent differences.
Numerous bogie tests have been conducted on steel, rectangular wood, and round wood guardrail posts in both soil and a cantilever sleeve. In addition, many full-scale tests have been conducted with both types of posts using standard W-beam and the MGS. I have attached a thesis done in the past here at MwRSF that has a pretty complete literature search on steel and post testing up until 2005 for your reference. The general trend was that the two types of posts behaved very similarly, with some tests suggesting steel posts were better and others suggesting wood posts were better. So previous research suggests only minimal performance differences.
That said, the section and material for the steel and wood posts create distinct differences that should not be ignored. W6x8.5 steel posts have very distinct strong and weak axis bending capacities due to the "I" shape design of the section. However, steel posts do not fracture and tend to bend and absorb energy when impacted in either the strong or weak axis if the surrounding soil is sufficiently strong. Wood posts tend to generate slightly higher soil rotation forces. Wood posts also tend to fracture if the soil resistive forces exceed the capacity of the post. Wood posts also has a higher degree of material variability due to splits, checks, knots, etc...

So how do these differences translate to their performance in guardrails system? That takes further explanation. First, there is a difference in wood post and steel post behavior in the weak axis. In the case of the steel post, the weak axis impact would tend to have some limited rotation in the soil and then yield and bend the post. In a wood post weak axis impact, the post would also rotate in the soil to some degree and then would tend to fracture. Looking at the post capacities, the wood post would likely tend to generate higher peak loads during a weak axis impact, but the energy the post absorbs would be largely dependent on how much the post rotated in the soil prior to fracture. For the steel post, the peak loads would be somewhat lower based on the weak axis capacity of the two posts in question, but the energy absorbed may be higher than the wood post due to the post deformation developing more consistent load over the weak axis deflection. So while the wood post may generate higher weak axis accelerations, the steel post may absorb more energy and create larger changes in velocity. Thus, both posts have some competing negative aspects in their weak axis behavior, but testing has not indicated that either post has a significant advantage or disadvantage or that these effects are detrimental to overall system performance.

In a strong axis post impact, the post behavior is different for steel and wood posts. In a strong axis loading of the post, both posts will tend to rotate through the soil. Wood posts have been shown to have slightly higher soil rotation forces in the strong axis, but the effect is minimal on performance. If the soil forces do not exceed the capacity of the post section, then the two posts performance should be fairly similar in the strong axis. If the post in embedded in a very strong soil or frozen soil, then the performance of the post varies more depending on the type of post. When post-soil interaction forces exceed the capacity of a steel post, the steel post yield and deforms. This deformation of the steel post continues to dissipate energy, although the forces and energy are higher than those seen with soil rotation. A wood post will fracture if the post-soil interaction forces are high enough to exceed the capacity of the postThe lack of fracture is important to the performance of the wood post. If post-soil resistance forces exceed the capacity of a wood post, the post fractures and ceases to dissipate energy during an impact. That said, we have run numerous full-scale crash tests with wood posts where the post fractured in the impact area and the performance of the system was still acceptable.

With respect to the MGS system, there are several types of post loading occurring. Some posts are loaded primarily in the lateral direction like the bogie testing. Most of the posts are undergoing a combined load that involves mainly lateral load with some twisting and longitudinal loading of the post. We believe that the majority of the posts in the system are undergoing the combined loading. Finally some posts are being loaded directly along the weak axis of the post due to the vehicle impacting it. In addition, most of the posts impacted along the weak axis will have deflected laterally along the strong axis prior to being impacted by the vehicle. Under combined loading, steel posts tend to twist during impact and fail due to lateral/torsional buckling of the section. When we have conducted simulation analysis in past projects comparing wood and steel post versions of the MGS, we have found that a 10-15 percent reduction in the strong axis moment capacity of the steel posts accounts for the twisting of the steel posts. This reduction has correlated very well with our full-scale crash testing results. We don't see the effect of the steel post twisting as being very different from the wood post when deflected laterally. In addition, the use of a wood post that generates slightly higher lateral resistive forces would not be a concern for the performance of the MGS. We have tested several systems which would bear this out. For example, the original MGS system tested with W6x8.5 posts worked very well and had a dynamic deflection of 43.9" when tested according to MASH. When we tested the MGS with ¼ post spacing, it generated a safe redirection with a much lower deflection of 17.6". Thus, a small increase in post lateral stiffness for wood posts would not be cause for concern.

We have tested several wood post MGS systems including round wood posts made from ponderosa pine and Douglas fir, and 6"x8" white pine posts. These systems all performed similarly to the steel post MGS and no issues were observed with occupant risk values or vehicle stability. In addition, conducted testing of the MGS with 6"x8" SYP posts in the past year with both the 1100C and 2270P vehicles. Comparing the 2270P tests with 6"x8" SYP and W6x8.5 posts, we observed very similar performance in terms of vehicle stability and redirection. Dynamic system deflections were 43.9" for the steel post system and 40" for the wood post system. Very similar performance. I have attached videos at the link below of the steel and wood post testing for you to compare.

The file 'Wood vs steel MGS.zip' (189.0 MB) is available for download at
http://dropbox.unl.edu/uploads/20120216/ef4e8177e06a0405/Wood%20vs%20steel%20MGS.zip
for the next 14 days.
It will be removed after Thursday, February 16, 2012.
In summary, we believe that there is little difference in system performance for the MGS with respect to steel and SYP wood posts. While the post sections have some differences in terms of how the perform, these differences do not seem to have a large effect on the overall performance of the system.
The above discussion refers to SYP posts. You had a comment below regarding Douglas fir and Hem fir posts. The Hem Fir Select Structural and Grade 1 Douglas fir have very similar strength to SYP post, albeit around 11% lower. We have successfully tested the MGS with 6"x8" White Pine posts that were roughly 37% lower strength than the SYP posts. Thus, I would see no issues with using the Douglas fir and Hem fir materials in a 6"x8" wood post in the standard MGS system. Other specialty systems, MGS on slopes, or long span for example, might require further analysis and thought prior to using the alternative posts.
Let me know if you have further comments or questions.

Attachment: http://mwrsf-qa.unl.edu/attachments/f33501f76016b0a8099061918191480f.pdf

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Tall Curb at Bridge Approach

Question

State: IA
Date: 01-23-2012

We would like to update the approach guardrail to MGS at these existing bridge ends. Would we still be able to install our standard AGT given the height of the existing curbs? If not, would you recommend grinding the curb down, or should we investigate the use of a w-beam (rather than thrie-beam) AGT here?

Attachment: http://mwrsf-qa.unl.edu/attachments/4c0409e56544bb18abb8f3ac72920a6c.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/e28b3a041eb74093f5061823e39b5785.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/4ae2e2d5a611e338c99e01f5b6386058.jpg

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Response

Date: 02-14-2012
Considering the existing concrete curb measures up to 12 in. tall, we would recommend that you remove it and replace it with the standard 4 in. wedge curb. Then, it would be appropriate to implement the modified thrie beam approach guardrail transition with new MGS stiffness transition. For now, we are also guiding the State DOTs to end the concrete curb on the thrie beam end of the asymmetrical section in order to reduce concerns for vehicle snag under the sloped rail. Please let me know if you have any more questions or comments on this matter. Thanks!

Response

Date: 02-15-2012
We can remove the 12-inch curb on the approach to the bridge and replace it with a 4-inch curb. However, the 12-inch curb will still be present on the bridge. Should we transition the 4-inch curb up to 12 inches say, in the last foot prior to the bridge? Or is there another method we should employ to mitigate the snagging potential? Or is snagging here not a concern?

Response

Date: 02-16-2012
I think there are two options.
First, you might consider tapering the brush curb back toward the face of the vertical wall as long as rebar does not get in the wall of the grinding. Then, there would be no curb at the end of the parapet but instead a vertical face. You may also need to taper the end of the wall to reduce concerns for wheel snag there. We prepared draft CAD details for this which are contained in a FHWA approval letter associated with the original Iowa transition but directed to TxDOT. Let me know if you need these details.
Second, you might consider adding a 1-2 ft long RC buttress and foundation which eliminates the curb in front of the vertical parapet and has a tapered end to reduce wheel snag concerns, similar to above.
Can you accommodate any of these ideas?

Charts from Guardrail Need paper in Transportation Research Record 1599

Question

State: WI
Date: 01-25-2012

I'm thinking of adding some of the charts from Guardrail Needs: Embankments and Culverts by Dan Wolford and Dean Sicking (Transportation Research Record 1599) to our FDM. Does MwRSF have these charts in a spreadsheet?

If not I'll have to try replicate it myself (not as accurate).

After thinking about it some more. I believe that Dr. Sicking put together a report for NDOR on this subject. Would it be possible to get a copy of the whole report?

Thanks

Response

Date: 01-27-2012

I am attaching an electronic copy of the MwRSF-NDOR research report. Please let me know if you need anything else.

Attachment: http://mwrsf-qa.unl.edu/attachments/183aefe4b972a8b16478f526a696309c.pdf

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Concrete median barrier on bridge

Question
State: MN
Date: 01-27-2012

We have a bridge joint repair project coming up and could use some advice on how to address our concrete median barrier situation. Hope you can help.

This bridge is a 4 lane bridge (2 lanes each way) divided by an 32" F-Shaped median barrier (non-reinforced). See attached file: fig7130e.pdf. During the repair project, traffic will be diverted to one side of the bridge with 2 way traffic. We expect the posted speed will be 45 mph. Shoulder width in the median lane is 1'.

Approximately 6' of concrete median barrier, 3' on either side of joint, will be temporarily removed for joint repair access. It's our intention to install a 12.5' length of standard thrie beam, plus terminal connectors in this span. The thrie beam and connectors will be located flush with the top of the barrier. The concrete median barrier will be replaced after the joint is repaired. See attached file: BarrierJointRepairDetails.pdf for details.

Does this work as an acceptable solution to maintain work zone and driver safety during construction? If not, do you have (or know of) any other potential solutions to this situation? Any comments you have would be appreciated.

Thanks for your help in this matter.

Attachment: http://mwrsf-qa.unl.edu/attachments/f4998f5ff02ee547b6e373941144e6c4.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/88ecb969584d99652bd6612943171c77.pdf

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Response
Date: 02-13-2012
Attached is a proposed revision to your installation for spanning the gap in your median barrier.

Just to recap our phone conversation today regarding the design.

1.We concur that if the traffic on the barrier is on one side only and the work crews need access to the back side, then the nested thrie beam and lower angled plate are only needed on the traffic side face of the barrier.

2. We would limit speeds in this area to 45 mph and would prefer lower speeds than that if possible.

3.We prefer the use of nested 12 gauge thrie beam over the use of a single 10 gauge section as it provides for increased bending strength and capacity.

Let me know if you have any further comments or concerns. I have attached a revised detail showing the system with the hardware on only a single side.

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/f34a79b1c36c26b4d6f3b169a5dce382.pdf

Temporary Barrier Thrie Beam Connection

Question

State: WI
Date: 02-09-2012

Below is an email from one of our contracting associations.

I would like MwRSF to review question #2.

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2) Temporary Barrier Thrie Beam Connections
A) 1st detail showing the use of 7/8" bolts and bolting back to back.
AA) Problems of field drilling with rebar interference
B) 2nd detail showing the use of 3/4" anchors and back to back Thrie
Rail Assemblies offset
C) Why is single sided Temp. Thrie Connections not acceptable for
single side traffic
D) Use of 3/4" Concrete Anchors

Attachment: http://mwrsf-qa.unl.edu/attachments/8bdfc38fe767db5b5ecaa07a1a0d9b9d.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/5955730fe3aa883ecb6edcad03f75be1.pdf

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Response

Date: 02-10-2012

I will try to address the questions under number 2 below.

2) Temporary Thrie Beam Connections
A) 1st detail showing the use of 7/8" bolts and bolting back to back.
AA) Problems of field drilling with rebar interference

- There may be issues with rebar interference when through bolting the thrie beam pieces on the end of the TCB approach transition. The degree of interference will depend on the reinforcement of the barrier that is attached to. I believe that we were able to avoid interference on the PCB sections. We would allow the thrie beam to be adjusted a foot or so longitudinally along the barriers to prevent rebar interference if necessary.

B) 2nd detail showing the use of 3/4" anchors and back to back Thrie
Rail Assemblies offset

- The offset shown is used to prevent interference of the mechanical anchors. If the ends of the thrie beam on each side are not offset, the anchors will interfere.

C) Why is single sided Temp. Thrie Connections not acceptable for single side traffic

- The double sided thrie beam is used even with single sided traffic to increase the stiffness of the connection between the PCB and the rigid barrier. It also serves to prevent snag, but obviously only one side of the thrie beam is effective for that. The use of both sides is primarily for stiffening of the joint.

D) Use of 3/4" Concrete Anchors

- Not sure what the question is here. The system was tested with ¾" dia. x 6" long Powers Fasteners Wedge Bolt anchors.

Cable Terminal Anchor Bracket

Question

State: NE
Date: 06-30-2011

We are trying to get this fabricated and need some changes discussed at your level.
(See Figure 1.jpg)

Attaching the cable plate to the base plate:
What is the weld symbol at the bottom right of this sketch referring to?
Can I remove the weld symbol? I think it is redundant from the one below on the 1/8" / 3/8" on the bottom right.
(See Figure 2.jpg)

Lever Retaining Cable3/8" is shown in the report: should this be smaller/ more flexible?
I seem to recall this being a fairly limp cable, 3/8" would be stiff.
Smaller would hold the lever to keep it from flying into traffic, and breakaway if snagged on the impacting vehicle.
Unsure of size of cable (See Figure 3.jpg) " found in Pooled Fund Progress 2005 V3.ppt
3/8" was used on the short radius system (See Figure 4.jpg)

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

Attachment: http://mwrsf-qa.unl.edu/attachments/fc20b9add7acfee5a8fa31c7a17fa278.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/2fef786004fdc5df16f3539f24e85786.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/fd207d031adbbef299ebc79c464907c3.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/aa319f1a2c0e6c3ceec7952243ddf0e1.jpg

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Response

Date: 02-09-2012

Responses are shown below inred.

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

While I agree that the top weld symbol is redundant, the weld symbol on the lower drawing has the top and bottom welds reversed. The 1/8" fillet weld should be on the bottom of the weld specification. The arrow side of the detail is shown on the bottom, while the opposite side is detailed on the top.

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

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

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

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

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

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

Attachment: http://mwrsf-qa.unl.edu/attachments/86d54827cad89ced97a0826b8a6286c5.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/86d54827cad89ced97a0826b8a6286c5.jpg

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Thrie Beam Bullnose Post Length after Post 9

Question

State: KS
Date: 02-10-2012

What is the allowable post length for the crash tested options for thrie beam guardrail systems? We wlould like to know what post length is acceptable beyond post 9/10 in bullnose. We would like to use 6 ft.

Response

Date: 02-11-2012
We reviewed the prior research and found that three different thrie beam configurations have met the 350 safety standards. They are listed below. Upon inspection, it would seem appropriate to maintain the use of 6.5 ft long posts for the standard wood post thrie beam guardrail.

Summary

1. Standard Thrie Beam (G9) system did **not pass 350 -** 6.5 ft W6x9 posts with 21.5" long W6x9 blockouts w/ 32" rail height
2. Modified Thrie Beam = 6'-9" long W6x9 posts with 49.5" embedment and 18" deep M14x18 blockouts w/ 33.6" rail height
    a. Tested to TL-3 and Tl-4
3. Thrie beam with 6'-9" long W6x9 posts with 49.5" embedment and 6"x8"x21.8" long routed wood blocks passed NCHRP 350 w/ 31.65" rail height
4. Thrie beam with 78" long 6"x8" SYP posts and 6"x8"x21.8" long routed wood blocks passed NCHRP 350 w/ 31.65" rail height

Short answer, 81" long posts for steel and 78" long wood have passed.

Temporary Barrier advice

Question

State: OH
Date: 02-14-2012

Sending this question to you since your name is on the paper...

Based on the June 18, 2003 research report,*Deflection Limits for Temporary Concrete Barriers*, Ohio has followed a 2' offset general standard.

However, we have an upcoming project on our Cleveland Innerbelt bridge on I-90 (main freeway through downtown), that has some additional criteria/concerns:
Temporary Concrete Barrier will be separating 6 lanes of opposing traffic: 2 Eastbound, 4 Westbound. 50mph.
This phase of traffic will be on a new bridge deck, waiting for a 2nd bridge to be constructed for the traffic in the opposite direction.
Project duration may be DECADES depending on funding for the 2nd bridge. Thus we are facing a potential semi-permanent installation using temporary barrier.

The discussion is whether or not to anchor the temporary barrier. Obviously, the bridge guys would prefer not to put anchor holes in their brand new deck.

- Your report based on Iowa's Temp Concrete Barrier...Roadside Design Guide indicates NCHRP 350 deflection 45"; while Ohio's barrier deflected 66" when tested.
- Another point in the report, bottom of page 1*"traffic lanes of less than 3-m (10-ft) wide are rare, and a 600-mm (2-ft) lateral barrier displacement would not intrude significantly into the paths of oncoming traffic."* I interpret this to mean that even if the path of oncoming traffic is reduced (temporarily until the barrier is moved back) to as little as 8' wide, the risk of an accident from opposing traffic is still low. Was that the intention?
- Another point to consider is the length of temporary barrier on the bridge " approx. 4200 feet has quite a bit more mass holding it in place as compared to the couple hundred ft test section. Yet with 4 lanes of westbound traffic, we anticipate the potential for increased impact angles
- Cross section sketch of barrier placement attached