Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

05-01-2016 to 07-29-2016

Installation of MGS Long Span on Arched Culvert

Question
State: WI
Date: 05-02-2016

We have an installation proposed for the MGS long span across an arched culvert. The long span was chosen as the arched culvert limited the embedment depth.

However, the culvert has a secondary issue in that the CRT posts are against the culvert headwall.

What are your thoughts on this type of installation?

Attachment: http://mwrsf-qa.unl.edu/attachments/9e9f29dd38dea41f55af92a82ac3de6c.pdf

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Response
Date: 05-05-2016

We are concerned that placing the CRT post against the headwall may adversely affect the performance of the breakaway post and the overall behavior of the long span. CRT's do dissipate some energy through soil rotation and placement of the post against the headwall will affect that rotation significantly.

In previous situations like this we have recommended a minimum offset of 1 ft between the back of the post and the headwall to allow for that rotation.

The only other option I can think of is to use the MGS weak post system. However, it is unlikely that we can get those posts embedded sufficiently over the top of the culvert arch. Thus you would need to move the line of the guardrail closer to the slope and attach the weak posts to the culvert directly.

MGS Deflection Reduction

Question
State: UT
Date: 05-03-2016

Its it possible to reduce the MGS deflection to 12 inches measured from back of post to hazard? Such as nested rail with quarter post spacing or use larger posts similar to w-beam to parapet transition designs?

Thank you for your time,

Response
Date: 05-05-2016

We do not have any data to support the reduction of the MGS deflection to the level of 12 inches measured from back of post to hazard. During NCHRP 350 TL-3 testing of the MGS, we evaluated a ¼ post spacing system that had a dynamic deflection of 17.6" and a working width of 36.7".

The working width value is taken from the front face of the guardrail. As such, this would correspond to a clear distance from the back of the post to the hazard of only 15.4".

There is potential to further reduce that deflection through the use of larger posts and or nested guardrail. However, we have not developed that kind of system to date. In order to determine what the deflection reduction would be and the effect on the overall performance of the barrier, further analysis and/or crash testing may need to be conducted on a modified system.

Double-faced to Single Face MGS Transition

Question
State: MO
Date: 05-05-2016

Please review the attached email regarding how to transition between the median version of the MGS to two separate MGS installations and provide any guidance or suggestions.

thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/26c0bc1094be4b2b2a4b4f7443189529.pdf

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Response
Date: 05-05-2016

I looked at your detail. As you noted, there is more leeway currently to omit a post in the MGS due to the test we ran last year. Thus, I follow the thinking you guys were using. However, we still have two concerns.

1. There is some concern that the deflected guardrail can impact the back side of the offset posts. This loading of the rail across a corner or an edge of a post has shown the potential to cause rail rupture. Thus, there is some concern that the offset posts may degrade system performance.

2. There is also concern that the posts that are offset longitudinally may interfere with each other when one side is impacted. In tested of a PCB transition system and recent research we have been doing regarding minimum light pole offsets for the MGS, we have observed that the deflected post movement can be restricted by objects just downstream of the post as it is deflected. This can potential lead to reduced deflection, pocketing, and snag.

   To alleviate these concerns, we would recommend using extended blockouts on a single post as the two rails widen out at whatever flare you chose up to a maximum of 15:1. This should be acceptable up to a blockout depth of 24". Two separate posts can be used as soon as you reach a minimum offset from the face of the guardrail to the backside of the opposite post of 43".

   I have attached a schematic of what that looks like for a 15:1 flare starting with 8" deep blockouts.

   Let me know what you think and we can discuss things further.

   Attachment: http://mwrsf-qa.unl.edu/attachments/9153cfccf615a36a16a48f023aeb3a55.jpg

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Wood and Composite Blocks MGS

Question
State: UT
Date: 05-09-2016

The RDG section 5.4.1.7 MGS,
states that Wood Blocks are used and testing documents I have read
state "White Pine".

Are composite blocks allowed
to be used with the standard MGS system?

Regarding the 25 feet span
that required 12 inch blocks, would composite blocks appropriate as
well?

Thank you for your time,

Response
Date: 05-09-2016

We have largely tested the MGS with 12-in. SYP wood blocks. We have conducted some testing with 12-in. WP wood blocks as well. I do not believe that we have used recycled blocks in our tests but may have conducted component tests on recycled blocks that may be applicable. I somewhat recall that E-Tech Testing Services conducted testing on a recycled MGS blockout several years ago. I will ask my colleagues whether 12-in. blocks have been fabricated and tested with the MGS. The MGS was only tested with wood blocks thus far. Without testing, I am uncertain about using a different blockout with the 3 CRTs on each side of the long span and believe that testing may potentially need to be performed.

Working width of MGS median barrier

Question
State: OH
Date: 05-10-2016

ODOT would like to install a two sided MGS barrier guardrail in a relatively narrow median. We typically use a minimum barrier clearance to an obstacle of 5 feet, measured from the face of the barrier to the obstacle, for both barrier guardrail and normal MGS. Would a two sided barrier type guardrail be stiffer than normal MGS? With 12" blockouts, the width of the system would be around 3 feet. To keep part of the barrier or a vehicle that strikes the barrier from protruding into the opposing traveled way, what would be a reasonable working width? Would there be any problems associated with using half or quarter post spacing with a barrier guardrail in the median?

Response
Date: 05-10-2016
A two-sided or median type MGS system would be slightly stiffer and have lower deflections than a standard MGS system due to the rail on both sides of the barrier.

At this time, the MGS median barrier with 12" blockouts was deemed NCHRP 350 compliant with an FHWA eligibility letter based on a submission we made comparing the MGS system to other previously tested median barrier designs.

Subsequent to that eligibility letter, TTI performed two MASH tests on a version of the 31" tall MGS median barrier with 8" deep blockouts (see attached). Testing with the 2270P found a dynamic deflection of 39" and a working width of 55". The dynamic deflection is about 11% lower than the 43.9" dynamic deflection we observed in the original MASH testing of the MGS. However, the working width is slightly higher, as the original MGS MASH test found a working width of 48.6" The difference in the working widths is likely due to the additional width of the median system as compared to the roadside version.

Based on this, the best working width guidance we have is the 55" number from the TTI testing. We cannot recommend reducing this value using reduced post spacing without full-scale crash testing based on concerns for rail rupture observed in the 1100C test performed on the system by TTI. In the 1100C test of the 31" tall MGS median barrier with 8" deep blockouts. the vehicle was safely capture and redirected, but a tear that extended 2/3 to 3/4

through the first rail splice downstream of impact was observed. We have seen similar tearing in select MGS small car tests due to what we believe is combined loading of the splice due to the lateral rail loading and vertical loading/bending of the splice due to the small car body being wedged under the rail. For example, the first test of the upstream end of the MGS AGT stiffness transition with a 4" tall wedge curb had a similar rupture that caused the test to fail. Thus, there is concern that further stiffening of the barrier through reduced post spacing may increase the rail loads and lead to a complete rail rupture. As such, we would recommend full-scale crash testing to evaluate reduced post spacing versions of the MGS median barrier prior to implementing reduced post spacing.

Let me know if you have further questions or comments.

Attachment: http://mwrsf-qa.unl.edu/attachments/2327ec399e4402d7954403f325fa3916.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/2eec3c45bcdbdddf32c691d396448b96.pdf

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Cover Plate for Gaps in Concrete Barrier

Question
State: WY
Date: 05-10-2016

A question I posed before the Pooled Fund Website in 2013 concerned a method of transferring load between a concrete bridge barrier and an approach concrete barrier. Shown below in red is a part of Midwest response:

"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."

Could you send me a copy of details of this? What is the maximum gap you can cover with this type of design?

Response

Date: 05-17-2016

We recently had a student look through State DOT standard plans and drawings for such cover plates. I have attached the drawings that were located. Other states do something similar, but it may not be in the standards.

These cover plates are largely untested, so the gap sizes that they can cover is not really known. Allowable gap size would be dependent upon plate and barrier shape, plate thickness, attachment hardware, and test level. We should know a lot more about such devices in a year or two as we currently have a Pooled Fund project to explore PCB gap hardware – YR 26 project.

Attachment: http://mwrsf-qa.unl.edu/attachments/5c9e13ef7d0415c507f7bf60af04c380.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/ffb71e5f1e4da36da3de77d6a663fa97.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/81fdddc49c864bbe54ad53918e3f2c12.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/a8528d3e6fba070354827f7347d959a7.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/8af6d0b4e98afaa56a93e94ddecab6a0.pdf

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Guardrail Transition to MGS

Question

State: IN
Date: 05-11-2016

In Ohio, they have a standard drawing showing a transition from existing guardrail to MGS, see attachment. This transition adjusts for the height difference between the two systems within 25 ft and moves the spice from the post to the midspan. This standard uses a 3'-1.5" post pacing closest to the existing guardrail. I have seen on the Q&A page that you have addressed the transition question before (1076) and did not recommend placing a 3'-1.5" post spacing to keep the 12'-6" standard w-beam sections. Rather you suggested that the height transition be completed within 25 ft with splices at the posts, develop the 31 inch height for one 12'-6" w-beam section, and then drop a post to start the midspan slices. This would make the transition 53'-1.5". Have there been other discussions that have led to the Ohio standard being acceptable?
Attachment: http://mwrsf-qa.unl.edu/attachments/8b6b6d3e18802a106062616484f0ca11.pdf

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Response

Date: 05-19-2016
Hello.

The guidance in 1076 is currently our best guidance in terms of transitioning from G4(1S) systems to the MGS without using a odd length rail section to transition from splices at the posts to midspan splices. Keep in mind that these recommendation our based on our engineering judgment and past knowledge of the impact performance of W-beam guardrails systems in MASH and NCHRP 350 testing. Thus, our recommendations tend to represent our best case for performance as is is difficult to anticipate at what point we reach system limits without testing. Other design iterations may still work. So, we are not suggesting that other transitions are not feasible, but rather that we have more confidence in the recommended transition.

That is not to say that other designs may not work. However, none of these types of transitions have ever been crash tested, so we tend to err on the side of caution when making these recommendations. The transition we suggested in question 1076 is similar to a recently tested MGS system with an omitted post

that was evaluated to MASH TL-3. Thus, we have confidence that a similar scenario will work to transition between the splices.

The transition you have shown from Ohio appears to add an additional post at reduced spacing to achieve the splice adjustment. This appears to occur in the G4(1S) section of the guardrail. This may be acceptable, but we might recommend a couple of improvements.

1. Currently, we are not as confident in using the additional post method to transition between G4(1S) systems to the MGS in the G4(1S) section of the guardrail. Based on previous testing, the G4(1S) system is at or near its limits with respect to TL-3 MASH impacts. We recommended transitioning the splices in the MGS region as the MGS has proven more robust that the G4(1S) system in a variety of crash test scenarios, and it seems more conservative to apply any splice transition in the more robust guardrail system.
2. The extra post shown for transitioning the splice is currently shown directly adjacent to a splice. We would adjust this slightly as the splice tends to be the weak point in a guardrail system. Thus, we would place the extra post adjacent to the midspan post and have no reduced post spacing at the splice. This should lower the loading on the critical location of the splice in the rail. - See attached.
3. As noted in 1076, we would not recommend this until you have completed the height transition and have a minimum of 12.5' of 31" rail.

You could also do the additional post splice transition noted above in the G4(1S) section of the guardrail, but locating the transition in that region is less conservative than the approach in 1076 or the 31" guardrail post adjustment noted here.

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

Attachment: http://mwrsf-qa.unl.edu/attachments/99cbb020631141d1f57733c1f046b770.jpg

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dimension tolerances and W6x9

Question
State: WI
Date: 06-03-2016

To All,

I got a request from a manufacturer to approved there shop drawings for steel post in the thrie beam transition.

I when through their drawings, my drawings and your drawings. It appears that the manufacturer's one of the dimensions are about 3/32" of an inch off.

To me this does not appear to be an issue. But, it does bring up a good questions:

1. What dimension tolerances does MwRSF use in their drawings? Should states have similar tolerances in their drawings?
2. We allow the contractors to use W6x9 or W6X8.5 in the MGS thrie beam transition. MwRSF has only W6X8.5 in the MGS thrie beam transitions. Is W6X9 acceptable in the MGS thrie beam transition?

Response
Date: 06-03-2016
It is not entirely clear what dimension on the post is 3/32" off the detail. However, the discrepancy could could from a couple of areas.

First, our plans show the actual dimensions of a W6x8.5 post to the nearest 1/16". These vary slightly from the actual decimal values for the post. Additionally, W-shapes are generally referenced or shown using simplified values rather than the actual values. Thus, a W6x8.5 is usually listed as 6" deep by 4" wide when the actual dimensions are 5.83" and 3.94", respectively.

As you noted, the difference could also be due to W6x9 posts versus W6x8.5 posts. We have been using these posts for several years as it came to our attention that they are what is generally supplied for guardrail applications. They are very similar, and you may have received W6x9 posts in reality.

We do not believe that the performance of the barrier is affected in any significant way using W6x9 versus W6x8.5. The overall dimensions are nearly identical and the section properties are only 10% different. Thus, we don't see any issues with using the W6x9 posts in lieu of the W6x8.5 posts.

We do not post dimensional tolerance for standard structural parts in our plans. The AISC steel manual does list acceptable tolerances for W-shapes. This would be the best place to start for tolerances. See attached.

Attachment: http://mwrsf-qa.unl.edu/attachments/9c575806585446aaaee8aa7ea2aceb94.pdf

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Response
Date: 07-12-2016
We have further reviewed the dimensional tolerance issue noted previously. It appears that the discrepancy has to do with the location of the post bolt hole along the width of the post flange.

Review of the plans, previous hardware guide details, and plans from full-scale crash tests suggest that the 3/32" you note is based on how the hole placement is measured. The original 1979 Guide to Standardized Highway Barrier Rail Hardware denotes the location of the hole as 1 1/8" from the center of the post. Later revision of in the 1995 AASHTO Guide to Standardized Highway Barrier Hardware denotes the hole location using both the 1 1/8" from the center of the post dimension and a dimension 3/4" from the edge of the flange.

These two locations for the hole are not the same. Using the 1 1/8" from the center of the post dimension yields a distance from the center of the hole to the the edge of the flange of 0.845". This is the source of the 3/32" difference you noted.

MwRSF has typically detailed our hole locations from the edge of the flange based on standard CAD practices. Also, this provides a slightly lower distance to the flange edge for structural loading. However, most manufacturers specify the hole locations from the center of the flange based on manufacturing procedures. We believe that there is little functional difference between these values and either is acceptable.

It should be noted that the AISC allowable tolerances for W-sections allows for variations in flange width and hole placement that may affect the location of the hole. According the AISC, flange width can vary +1/4" to -3/16" and the web can be offset as much as 3/16" from the center of the flange. These variations along with manufacturing tolerances on the hole fabrication may place the hole closer to the edge of the flange than 3/4". To the best of our knowledge, the affect of the W-section tolerances on the post hole distance to the edge of the flange has not been a safety issue with respect to barrier performance.

Attachment: http://mwrsf-qa.unl.edu/attachments/a846e1326f11538eae630ce5a4ace6ec.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/27ba565d2cceae89d533d6c6d5739229.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/f94c817a1728211f699f40b9a9f29e0f.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/4105044e6607cf840ebcdd163d05102f.pdf

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Box beam barrier

Question
State: OH
Date: 06-07-2016

Ohio has a high wind and snow area on a causeway where box beam barrier was installed in a narrow median.
I didn't know we had this system in Ohio until it was damaged and the district office wasn't sure how to repair it.
Which leads us to several questions:

1)
This system appears to be common in New York and Wyoming. Do you know the status of this system as far as MASH compliance?

2)
Should and can this system be raised to reflect the increased height of other barrier systems and if so how high?

3)
Can this system be used with an inlet or post socket instead of a soil plate when continuing over a structure?

Thanks!

Attachment: http://mwrsf-qa.unl.edu/attachments/8f19e9a6a641daba06f034c22312a29b.JPG

Response
Date: 06-08-2016

I have replied to you questions regarding box beam barriers below in red.

1) This system appears to be common in New York and Wyoming. Do you know the status of this system as far as MASH compliance?

Box beam guardrail has been evaluated to MASH TL-3. Previous MASH full-scale crash testing was conducted on the G3 box beam guardrail system and New York's box beam terminal design found that

box beam systems with top mounting heights of 27 in. (685.6 mm) were capable of safely redirecting 2270P vehicles under TL-3 impact conditions.

With respect to the 1100C vehicles, recent cable barrier testing with S3x5.7 posts have shown a potential for laceration and penetration of the vehicle floorboard by the free edges of the post. According to MASH, this is sufficient cause for failure of the test based on penetration of the occupant compartment. To the best of our knowledge, this has not been evaluated through MASH testing of box beam with the 1100C vehicle.

http://mwrsf.unl.edu/researchhub/files/Report60/TRP-03-203-10-Vol1.pdf

http://mwrsf.unl.edu/researchhub/files/Report60/TRP-03-203-10-Vol2.pdf

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w157.pdf

2) Should and can this system be raised to reflect the increased height of other barrier systems and if so how high?

Box beam median systems were evaluated under NCHRP Report no. 350 with small car vehicles at 28" top mounting heights. Without further analysis, it would be difficult to recommend heights above this even though the potential for them to perform adequately exists

3)
Can this system be used with an inlet or post socket instead of a soil plate when continuing over a structure?

Because box beam is a weak post guardrail system, the main resistive force and energy absorption is derived from yielding and deformation of the post. Weak post systems typically depend much less on displacement of the post through soil. As such, cable barrier systems commonly have substituted sockets in place of deeper embedment posts or soil plates and demonstrated similar behavior. In terms of box beam guardrail, there is some potential that the use of as socketed foundation could alter post deformation and deflection slightly, and we have not observed this practice used box beam in any past crash tests. However, based on the performance of cable barrier systems with sockets, it would seem that the performance of a socketed post box beam system would be very similar to a standard system with posts and soil plates.

SD Concrete End Block and multiple transitions to High Tension Cable Barrier

Question
State: SD
Date: 06-21-2016

See
attachments. I included a .dgn file as the .pdf is not very good.

Since I was instructed that South Dakota MUST utilize a transition from MGS to High Tension Cable Barrier and in the interim time period when there is NO MASH alternative for a transition from MGS to High Tension Cable Barrier, I drew a long transition from the SD concrete bridge end block to Nested Thrie Beam to MGS to W Beam to High Tension Cable Barrier.

Pleaselook at what I have and provide any recommendations as there is probably something that could be made better. We need a transition from the SD concrete end block and this may eliminate one of the 7' long 6"x8" wood posts. We did not want to use the larger (10"x10"?) wood post transition. We are interested in only using wood posts and blockouts. We did not want to have a separation from the MGS to cable barrier as we may have traffic in the opposite direction at times and want the cable attached to the W Beam. The W Beam to high tension cable barrier transition is drawn using the Trinity transition from W Beam to 4 Cable High Tension Barrier.

I can't wait until the pooled fund gets a MGS to Midwest High Tension Cable Barrier Transition MASH tested and approved. Much will need to be done prior to the transition testing though.

On another note, I noticed multiple places in the crash test reports that the wood blockout is dimensioned as 6"x12"x14 ¼" as used in the MGS. I see many states use 6"x12"x14" blockouts. Is it proper to use the 14 ¼" dimension?

Thanks for looking at the suggested long transition,

Attachment: http://mwrsf-qa.unl.edu/attachments/2ec5ebafb672fdb0af660b5779e7b63d.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/5ff898e4ca506d4c6e3d0db6b736767b.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/b93692c6dec989ffe46c9c0e7313c1f5.zip

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Response
Date: 07-11-2016

First, I looked at the cable to W-beam transition that you are proposing to use based on the Trinity design. The detail you sent doesn't show all of the small details of the transition, but I have a few thoughts.

1. We have had concerns about the currently accepted high-tension cable barrier transition designs and have noted them in the past. There may be some advantage to a high tension cable to W-beam transition in that these cable barriers have a lower deflection than typical cable barriers. This creates a less dramatic stiffness change in the transition and would also reduce the potential for interaction with the terminal end. But we also have concerns.

    a. First, the adequacy of the anchorage of the downstream ends of the cable barriers in these systems is largely unknown. Recall that the testing of the South Dakota cable to W-beam transition displayed two instances where cable anchorage was partially lost and reduced. Expectation for the high tension cable to W-beam transition design would have to be even higher anchor loads, yet these anchorages have not been tested.

    b. Second, the increased tension in the cables could increase the potential for vehicle snag at the point in the transition where the cable and W-beam barriers come together.

    c. Next, cable heights and for the high tension cable barriers are generally significantly higher than the 27" top cable height used on the previously tested transitions.

    d. Finally, the hardware pieces used to transition the cables to the W-beam vary greatly and have not been evaluated.

2. If you are basing the design off of the Trinity system that has an FHWA approval letter, then I would recommend that you follow as closely to the accepted design as you can. I have attached the letter. Note that the Trinity system uses 10 gauge W-beam and is for a three cable system in the letter. I cannot see the rail type or the anchorages that you are using, but I would follow these guidelines as they are what is in the letter. I don't have any details or approval for the 4-cable transition.

With respect to the AGT details.

1. What you are showing seems consistent with the MASH upstream stiffness transition we have previously developed and tested with the wood post version of the Iowa AGT. This should be fine. However, if I understand correctly, you wish to omit post 1 due to the shape of your parapet. This may be problematic due to lack of support for the thrie beam and the potential for the omitted post to increase the potential for vehicle snag on the parapet. The original, tested Iowa transition connected the thrie beam to the parapet at approximately 20" from the end of the parapet which left around 11.5" between the center of post no. 1 and the parapet.

2. Your parapet attaches the thrie beam farther back which does not appear to allow for the placement of post no. 1. As such, there are a couple of potential options:

    a. Move the thrie beam end show connection closer to the end of the parapet to allow for the placement of post no. 1. This would allow for installation of the transition as tested. However, you may have reasons for not doing this currently.

    b. One could omit post no. 1 as you have shown. In order for this to have potential to perform safely, we would recommend that the offset from post no. 2 to the parapet be less than or equal to the 11.5" noted above. This should help reduce snag. There is some concern that omitting post no. 1 will affect the overall deflection and stiffness of the system and may lead to increased snag. However, this can't be easily investigated without further effort. For this installation, we would also recommend that a wood or steel spacer be placed under the thrie beam in the 18" long, flared back portion of the parapet to provide support for the thrie beam. This should help reduce the snag potential and aid in the transition performing closer to the tested design. The rail can be bolted through the spacer and the parapet to keep things in place.

With respect to the blockout dimensions. Our details tend to show the 14 ¼" number, but we don't believe that a 14" blockout height is an issue if you have them in that size.

Thanks

Attachment: http://mwrsf-qa.unl.edu/attachments/d363be4c02f480807db8e9c8ed169ab6.jpg

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Repair of posts embedded in concrete

Question
State: OH
Date: 06-27-2016

We have several old existing bridge terminal assemblies on low volume roads which use posts embedded in concrete. When a single post is damaged and requires repair, our maintenance crews pull the old concrete, set a new post and then pour new concrete. They would like to eliminate the concrete work. Would a single post not set in concrete cause a performance problem? Are there other post depth or thickness options that would perform in a similar fashion to the embedded concrete post?
Attachment: http://mwrsf-qa.unl.edu/attachments/206a7336aedfaf871b313d34050b58a7.pdf

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Response
Date: 06-29-2016
To answer your question, changing from a post embedded in concrete to a post embedded into soil only could certainly change the performance of the system. To counter the loss of stiffness when removing the concrete, you would have to increase the post size and/or increase the embedment depth of the post. Unfortunately, I do not have any data on the strength and resistance capacity of these posts embedded in concrete. Consequently, we don't have a target strength/resistance to shoot for when designing a retrofit for these posts. Additionally, the strength provided by a W6x15 steel post will be significantly different than that of a 6"x8" wood post. So, I'm not really sure were to even start with a retrofit post.

After a quick literature search, I cannot find any documentation on the development, analysis, or testing of these guardrail-to-bridge rail transitions. In comparing them to the transitions that have eligibility letters from FHWA, I have concerns about the crashworthiness of these systems to either MASH or NCHRP Report 350 safety standards. As such, I would not recommend new installations utilize these designs. Taking it a step further, if you have to repair one of these transitions, it may be easier to just tear out all of these concrete embedded posts and install a new NCHRP 350 approved transition system (one that doesn't include concrete posts). Transitions that the FHWA had previously noted as meeting NCHRP 350 criteria can be found on their website - in the acceptance letters and two Technical Advisory Memos. See the following links:

http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/
http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/techadvs/archive/t504026/
http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/techadvs/archive/t504034/

Bolts in asymmetrical transition section

Question
State: IA
Date: 07-12-2016

When testing, does MwRSF use two bolts for the center post of the asymmetrical section or just one? I would default to assuming two or there wouldn't be a need to have the bottom hole, but I've seen other states with just one in the top slot and I can't find a definitive answer.

I've seen some drawings where there will be a nail near the bottom hole to prevent rotation with a wood blockout and wood post but since MwRSF typically tests with steel posts, that wouldn't apply. However, I'm not sure if the nail would be needed as it would be a thrie-beam blockout and the weight distribution may keep the blockout from rotating anyway. Thoughts?

Response
Date: 07-13-2016

All of the MASH testing of the the asymmetrical W-to-thrie beam transition piece was conducted with only the top post bolt installed. This was done partially because standard thrie beam posts will not have a post bolt hole in the correct location for the lower slot in the rail, and to allow for the blockout in that location to rotate and reduce snag. Thus we would recommend using only the single bolt in that location.

We don't have evidence that using both bolts is an issue, but we recommend using only the top bolt to be consistent with the full-scale crash tests.

MGS Long-Span post depth

Question
State: OH
Date: 07-12-2016

We have a location where we are trying to use MGS long-span to its maximum 25' span length. Even at that length, we are unable to embed the posts adjacent to the culvert (posts 3 and 4) more than 2 - 2.5'. Do we have any post options (adding concrete, additional posts, ...) that could be substituted for a fully embedded post?

Thanks!

Attachment: http://mwrsf-qa.unl.edu/attachments/99a1f86bdf929f32fa29943abaceae75.pdf

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Response
Date: 07-13-2016
Currently we do not have reduced CRT post depth options for the MGS long span system. CRT posts are designed to develop forces in the soil that fracture the post at one of two hole locations, one at groundline and a second 15.75" below groundline.

In the long span system, the post functions by supporting the barrier adjacent to the unsupported span and then releasing to prevent barrier pocketing as the vehicle moves from the unsupported span to the standard MGS. The concern would be that reducing the embedment of the first post adjacent to each end of the span could allow increased deflection of the MGS which may affect barrier performance negatively.

Thus, we do not recommend using shorter than tested embedment depths for the CRT posts at this time.

Non-Blocked MGS and Terminals

Question
State: IL
Date: 07-14-2016

The Illinois Department of
Transportation is developing a new Highway Standard to implement the

non-blocked MGS. We are also updating design guidance in the Bureau of Design and Environment Manual according to the Implementation Guidance section of “SAFETY PERFORMANCE EVALUATION OF THE NONBLOCKED MIDWEST GUARDRAIL SYSTEM (MGS)", TRP-03-262-12. In that guidance we do not find any limitations or guidance on transitions to end treatments (anchors or crashworthy ends.) We do note a requirement for placing at least 25 feet of MGS with blockouts between the asymmetrical transition from thrie beam to w-beam at an approach guardrail transition and the non-blocked MGS. From this, our interpretation is that the non-blocked system does not introduce constraints for connection to an MGS downstream anchor or to a proprietary crashworthy end terminal. However, review of manufacturer literature for various proprietary crashworthy end terminals shows some variance and uncertainty.

From this, it appears that we should consult with the various manufacturers regarding their guidance for connection and/or transition to the non-blocked MGS. Do you think this is the appropriate course, and what are your comments and suggestions?

Response
Date: 07-14-2016

We cannot make recommendations regarding the omission of blockouts within proprietary terminal systems. Typically these systems have used blockouts in there as-tested configuration, so it is difficult to anticipate their performance without them in place and the performance may vary between different types of terminals. Thus, we would recommend keeping the as-tested blockout configuration.

As far as transitioning blockout depth from existing terminals to non-blocked guardrail, we would recommend the following approach. Begin transitioning blockout depth no sooner than 12.5' from the end of the terminal system. At that point, you can transition the blockout depth from 8"or 12" to 0".

With respect to trailing end terminals, we believe we need to be conservative as well. Previous MASH testing we conducted on the trailing end terminal impact 31.25' from the end with the pickup truck and 9.375' from the end with the small car. We believe that the presence of blockouts may affect the results of both of these tests in terms of vehicle stability, vehicle capture, vehicle snag, and/or occupant risk measures. As such, we would recommend not converting to the non-blocked system until 50' from the final anchor post in the trailing end terminal.

Thanks

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mounting beam guard on top of box culvert

Question
State: WI
Date: 07-28-2016

We have a contractor that wishes to use 3/4" x 6.25" carbon steel wedge anchors verses epoxy anchors for the details MwRSF developed in TRP-03-114-02 and TRP-03-278-13.

Contactor indicates the following in their submittal

Arbor Green would like to use a mechanical wedge
anchor for the mounting of guardrail posts to the top of box culvert between
the WB Beltline ramps and Broadway St. Specifically,
we would like to use a 3/4"x 6.25" carbon steel wedge anchor. The data sheet I have provided shows pullout
strengths well in excess of the plan notes per bolt, and there will be 4 bolts
in each plate.

Attachment: http://mwrsf-qa.unl.edu/attachments/23b224d3baf75a7dac55af2c12d83477.pdf

Attachment: http://mwrsf-qa.unl.edu/attachments/3457a84322f52f1b34c43c2305ac9318.docx

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Response

Date: 07-28-2016

The attached detail showed an anchorage that was dynamic component tested in report TRP-03-278-13. It consisted of 1" dia. A307 bolts anchored into a minimum of 4,000 psi concrete to a depth of 8" using an epoxy with a minimum bond strength. The dynamic testing found that this configuration was capable of developing the moment capacity of the post and was acceptable for use with the previously crash tested culvert mounted guardrail system.

The original anchorage consisted of 1" dia. A307 bolts that were through bolted into the top of the culvert. In order to be conservative and in lieu of dynamic testing, we have required that any alternative anchor must meet the ultimate capacity of the as-tested design. For the 1" dia. A307 bolts, that would correspond to an ultimate tensile load of 36.4 kips.

The proposed TruBolt wedge anchors do not appear to have sufficient capacity. 3/4"dia. TruBolt wedge anchors have a maximum capacity of 17.7 kips at the length/embedment noted above in 4,000 psi concrete. Even the largest diameter TruBolt wedge anchors only develop 26.5 kips in 4,000 psi concrete. Thus, we are unable to recommend the alternative anchor at this time.

It may be possible that the TruBolt anchor could function acceptably, but some form of dynamic component testing would be needed to verify the performance similar to report TRP-03-278-13.

Attachment: http://mwrsf-qa.unl.edu/attachments/221cbd0d54482cda86c44ee89f82e882.pdf