Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

10-01-2013 to 12-31-2013

Roadside Barrier Adjacent to Union Pacific Bridge Pier

Question
State: WI
Date: 10-03-2013

Attached is a preliminary layout that avoids placing concrete barrier adjacent to the existing Union Pacific bridge pier (structure B-40-327) as part of the Appleton Avenue project (USH 41) ID 2010-10-70. The draft layout shown in the attachment reflects the discussion during this afternoon's phone conference. To summarize, MGS 3 guardrail with quarter-post spacing is provided along the face of roadway curb adjacent to and 25-feet beyond/south of the bridge pier (46-inches of working width is provided). A 12.5-foot length of MGS 3 half-post spacing is then provided followed by a thrie beam transition which is attached to single slope barrier wall. The single slope barrier wall then tapers at a 14:1 (taper rate in accordance with Roadside Design Table 5-9 for 50 MPH design speed). At the end of the barrier taper a crash cushion is shown. For the north bound direction the distances and tapers are similar.

Note: Potential impacts to existing storm sewer lines and lighting conduit in the area of the proposed guardrail installations will need to be reviewed.

Please provide any comments you may have regarding the proposed layout.

I was wondering if we have quarter post spacing leading into a transition, if it O.K. just to run quarter post spacing throughout the whole thrie beam transition.

Attachment: https://mwrsf-qa.unl.edu/attachments/7e22e574c57de982e1b85303b2c092cd.pdf

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Response
Date: 10-03-2013
I think that ¼-post spacing is acceptable before the ½-post spacing MGS & stiffness transition.

Steel Posts with additional holes

Question

State: WI
Date: 10-07-2013

Have you seen something like this before (especially post 2).
Attachment: https://mwrsf-qa.unl.edu/attachments/53662a2f64cbc535d10eaad24141ab15.JPG

Attachment: https://mwrsf-qa.unl.edu/attachments/f4d1339b2035fc1943b50a86c3843328.JPG

Response

Date: 10-07-2013

It is possible that they are placed for use with nails to control blockout rotation The edge distance to some holes seems narrow as well. The extra holes will not affect guardrail performance. The various holes in Photo 2 are unusual. Maybe these posts were punched incorrectly in line and then re-punched.

Thire beam transition to New York 3 and 4 rail

Question

State: WI
Date: 10-23-2013

WisDOT is looking to add two bridge parapet designs to our inventory. The railing are from New York two and four rail parapets found in

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http://guides.roadsafellc.com/Documents/SBB29d/OtherDocs/404531-NY-2-4RailBridgeRail.pdf >>

One of the issue that we are having is trying to adapt MGS to thrie beam transition to these alternatives. Our regular connection plates does not line up correctly.

Could we install a larger plate to allow for proper connection?

Response

Date: 10-29-2013

It is reasonable to expect that a plate used to connect thrie beam to a steel tube bridge rail may have to be altered for various bridge rail designs (especially the bolt hole locations to attach to the steel tubes). However, we would not recommend enlarging the plate to cover all of the steel tube rails. This would create unwanted snagging points for reverse direction impacts. Instead, any bridge rail components located at heights above or below the thrie beam should be safely flared back away from traffic and/or possibly down to connect to an adjacent tube rail that does go behind the thrie beam rail.

A good reference for this type of connection can be found in a recent TTI test report titled "MASH TL-3 Testing and Evaluation of the TxDOT T131RC Bridge Rail Transition" and dated March of 2013. It can be found on TTI's web site. This document provides details for a MASH TL-3 crash tested thrie beam transition and connection to a 2 tube, steel bridge rail. I believe the NY systems you are looking into are similar to this tested system. Again, the top and bottom rail of the 4-tube configuration would need to be flared to prevent snag and tire interactions.

Temporary Concrete Barrier

Question

State: IL
Date: 11-12-2013

Has there been any crash testing of Temporary Concrete Barrier (TCB), preferably F-shape, placed on top of a raised concrete median with the edge of the TCB aligned with the face of the curb of the median? If so, what was the median height and what were the results of the crash testing? If not, what is your opinion regarding the effectiveness and safety of freestanding TCB placed on a raised, concrete median?

Response

Date: 11-15-2013

At this time, there has been not testing or research into the use of TCB installed on a raised median. However, there are concerns with doing so.

We know from research with other barrier types and curbs that the presence of the curb can affect the stability of the vehicle and the manner in which it interacts with the barrier. We also know that the sloped faces of most TCB designs tend to increase vehicle climb and instability. Thus, there would be concerns that using TCB on a raised median with a curb may create more vehicle climb and instability than desired.

Similar concerns would be present for backside hits in a median installation where the curb would be offset from the barrier face.

Another concern is the availability of relatively flat area behind the barrier to accommodate barrier translation during impact. We have typically recommended that users of TCB's provide 4-6 feet of relatively flat (< 10:1 slope) terrain behind the TCB to allow for dynamic deflection of the barriers. Thus, installation on a raised median would require similar area so that the barriers to not slide off the raise median and become unstable or tip. tipping of the barriers would increase the angle of the barrier face, promoting further vehicle instability.

Guardrail Post attached to Wing Wall

Question

State: IA
Date: 11-15-2013

See red.

1. Should I include washers on top side of the base plate for the threaded rods?

   Yes

2. Would it be okay to add a weep hole near the bottom of the post? If so, what size hole would you recommend and how high above the base plate?

   I would recommend a hole no bigger than ½" diameter and placed on the DS side of the post. You could also cap the top of the post tube to prevent water from entering.

3. For post locations immediately adjacent to the bridge, would you consider this attachment equivalent to the horizontally mounted surrogate post developed for WisDOT? Or would you recommend using the WisDOT design instead?

   They should be similar in performance since they were designed to replace the same transition post. If you have the option, I would utilize the horizontal post design – only because that one has actually been component tested to demonstrate performance.

Attachment: https://mwrsf-qa.unl.edu/attachments/77ea1e73126a71ddb31a3529b7f8d6e6.pdf

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Response

Date: 11-15-2013
Could you guys take a quick look at this detail and provide any comments you might have? I also have a few specific questions for you:
1. Should I include washers on top side of the base plate for the threaded rods?
2. Would it be okay to add a weep hole near the bottom of the post? If so, what size hole would you recommend and how high above the base plate?
3. For post locations immediately adjacent to the bridge, would you consider this attachment equivalent to the horizontally mounted surrogate post developed for WisDOT? Or would you recommend using the WisDOT design instead?

Thanks for your help.

Attachment: https://mwrsf-qa.unl.edu/attachments/77ea1e73126a71ddb31a3529b7f8d6e6.pdf

Temporary barrier to permanent barrier transition for undirectional traffic

Question

State: WI
Date: 11-15-2013

Dear MwRSF,

What modifications should be done to the temporary barrier transition to permanent barrier when there is traffic on both sides of the temporary barrier going the same direction? For example the temporary barrier is used to split traffic at a ramp gore.

I'm assuming that we would need some type of "toe plate" to prevent wheel snag.

Response

Date: 11-15-2013

Previously, MwRSF developed a median transition between free-standing TCB and a rigid concrete parapet. This system was designed for reverse direction traffic only and did not consider similar direction traffic on bolt sides.

In order to develop the transition to work with traffic moving the same direction on both sides, several issues would need to be considered. As noted above, the potential for vehicle snag on the rigid parapet would need to be considered. This would include both snag near the barrier toe and snag along any part of the exposed rigid parapet face. The original design of the system used nested thrie beam on both sides of the transition to reduce the potential for vehicle snag. The angle of that thrie beam and its attachment vary depending on the type of parapet that is connected to.

Thus it would be critical to ensure that the thrie beam and any toe cap that was designed have the correct geometry and capacity to prevent snag and provide safe redirection. Design of the toe plate, the thrie beam connection, potential changes to the alignment of the TCB with the parapet would likely need to be evaluated. In addition, it is likely that these modifications would need to be tested in in order to verify that they performed adequately.

Unanchored Stepped Concrete Median Barrier

Question

State: MO
Date: 11-15-2013

MoDOT regularly places permanent concrete traffic barrier with anchoring dowels omitted, as long as there are 1-3/4 inch minimum lifts of hot mix asphalt (HMA) abutting both barrier faces (Figure 1). The DOT also places stepped (separating different grades) concrete median barriers, but only when they can be doweled into concrete pavement (Figure 1).

A curve's superelevation on a recent add-a-lane project resulted in a hybrid of these two scenarios: a stepped barrier “pinched" in between lifts of HMA (Figure 2). There is a concern that the increased moment arm on the upper side would have a greater propensity to overturn the barrier in a crash.

Please answer the following questions:

1. Is the situation shown in Figure 2 likely to work?

2. If not, what steps should be taken ensure adequate performance?

Attachment: https://mwrsf-qa.unl.edu/attachments/3ec0a246271af1bd979eaf6033a9d1d1.jpg

Attachment: https://mwrsf-qa.unl.edu/attachments/01a17419e459df38fcb169855aa38dbe.jpg

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Response

Date: 11-18-2013

The layout shown in Figure 2 should be adequate to withstand most impacts. Heavy vehicle impacts (e.g., a tractor trailer - TL-5 impact) may cause barrier failures in the form of severe cracking/fracture or rotation/overturning due to the increased load height for impacts on the high side of the barrier. Judging by the reinforcement of the barrier (figure1), I will assume this not a TL-5 barrier. Thus, it should perform as intended. A few notes:

1) the transvers steel stirrups should be extended for the entire height of the barrier, so the height dimension for the V1 bars would vary depending on the median step height and the total height of the barrier.

2) Any barrier height change should not alter the strength of the top portion of the barrier, meaning the location of longitudinal bars should remain fixed with reference to the top of the barrier. If the barrier height is increased significantly, additional longitudinal bars should be added to the extended lower portion of the barrier in conjunction with the extended stirrups.

"Slight" Modification to IL F-shape Temporary Concrete Barrier

Question

State: IL
Date: 11-25-2013

Recent discussions with industry indicates they feel that modifying the corners of the toe of the IL F-shape Temporary Concrete Barrier (TCB) from a 90-degree angle to a 45-degree angle (the exact dimension of this "chamfered" area was not defined) would make TCB less likely to be damaged when setting and relocating. We understand the importance of engaging the corners being part of the crash testing, energy absorption, and deflection performance. How would such a modification by chamfering the corners affect performance results of prior crash testing results and subsequent approval of this barrier as a Test Level 3 device meeting NCHRP 350 requirements?

Response

Date: 11-25-2013

We have observed several other states providing similar types of chamfers on their barrier edges to limit damage to the sections during moving and placement.

Typically, we have seen and approved the use of 3/4" chamfers on the barrier edges and believe that the affect of that size of chamfer on barrier safety performance is minimal.

Similarly, we would not expect a 1" chamfer to affect safety performance and would consider it acceptable. However, larger chamfers (2" or greater) may begin to cause some concern.

TL-3 Railing for Timber Bridge

Question

State: WY
Date: 11-26-2013

We have a very old timber bridge which is not slated for replacement, but would like to upgrade the bridge and approach railing. It is located on a rural 2-lane highway with a posted speed of 65 mph. The length of the bridge is 23 feet. I have attached a few photographs and a very old and hard to read standard plan for which this structure was constructed.

Could you recommend some treatments for bridge railings for this structure? They do not have to be aesthetic in nature. We have considered the use of the MGS long span, but as nearly as I can tell, the structure width is only about 25 feet, so the railing needs to be as flush as possible with the end of the deck. The MGS long span normally requires a post and blockout width (20") plus an assumed wing wall width of around 8 or 9 inches, so it appears the railing would have to be placed around 28" inboard of the end of the deck.

The MGS Low Cost Bridge Rail might be an option if a mounting could be developed with would greatly reduce the stress normally transmitted to a concrete bridge deck, or in this case, to the wood stringers.

If you note in the photos, although there is a timber curb, the roadway appears to be built up above the curb (consequently the rail height is very low). Any help you could provide would be appreciated!

Attachment: https://mwrsf-qa.unl.edu/attachments/6006453ec54a9b364b686a6625cefdd8.pdf

Attachment: https://mwrsf-qa.unl.edu/attachments/58e0ecde38f74a422f3119e871b67326.JPG

Attachment: https://mwrsf-qa.unl.edu/attachments/81429530ffae8eb3741c36f773f49c8b.JPG

Response

Date: 12-10-2013

After a quick review of your pictures and drawings, we see two options for possible treatment of this timber bridge: (1) a long-span system, or (2) an adaptation of the weak-post, MGS bridge rail. Either system would be TL-3 crashworthy. Both have benefits and downfalls as described below.

The benefits of a long-span system would be that the rail itself would not be directly attached to the bridge. Thus, impact loads would not be imparted to the bridge elements. However, use of a long span system would most likely require some soil fill to be added around the abutments to ensure the adjacent posts were properly installed. In addition and as you have already mentioned, the offset of the rail and the edge of the bridge deck would result in a loss of roadway width.

Utilization of the weak-post, MGS bridge rail (or similar variations designed for attachment to culvert headwall) would help to maximize your roadway width by attaching to the outside face of the bridge deck / stringers. However, properly anchoring the sockets which attach the posts to the bridge could prove difficult as soil fill and asphalt overlays may prevent bolting options. Further, anchorage strength may be limited dependent upon the structural integrity of the timber elements you tie into.

Let us know if you would like us to further investigate the specifics for either of these treatment options.

Using a Blockout with MGS Bridge Rail

Question

State: IA
Date: 12-02-2013

In the MGS Bridge Rail report, it is suggested that a 4-inch deep blockout could be used to minimize the chance of snowplow damage to the deck-mounted through bolts. However, it goes on to say that "additional analysis or testing is required before alternate rail mounting details can be recommended." Has this analysis been completed, or is MwRSF in a position to suggest an alternate mounting method at this time? If not, would it be possible to utilize the existing mounting details with a blockout, except with a longer bolt?

Response

Date: 12-10-2013

We have not had the opportunity to investigate the use of blockouts with the MGS bridge rail. The current connection design is based on a connection used for weak post W-beam guardrail without blockouts and has not been evaluated with blockouts.

The concern with the using a blockout and the existing bolt and washer connection is that the small bolt in the design may not be sufficient to support the dead weight or that the disengagement may change. Thus, we believed that further study would be required to investigate the use of spacer blocks prior to introducing them into the design.

TTI has tested an alternative post connection for the MGS bridge rail that uses a deck mounted post. This attachment may not have the same degree of interference with snow plows. However, the design does intrude onto the deck more. See attached.

Attachment: https://mwrsf-qa.unl.edu/attachments/c4b5782a5de583c56f9a3b826c691357.PDF

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

Charpy V-Notch Requirement for Crash Tested Steel Post & Rail System

Question

State: WI
Date: 12-11-2013

For a crash tested steel post and rail sytem for bridges or culverts, are any of the materials used in the components of this system (post, rails, base plates, etc.) required to pass a Charpy V-Notch test for the temperature zone they are to be used in? Does this help provide a more crash-worthy system. I have found some states that call for this on their standard details and was wondering if this is a requirement that all states should be implementing. Thanks for any information you can share.

Response

Date: 01-29-2014

Charpy V-notch testing is used to evaluate the toughness of a given steel. Toughness is generally defined as the energy absorption of the steel during impact loading. The Charpy test evaluates this by impacting a notched specimen with a pendulum type impactor and recording the energy absorbed during fracture. These tests can be run at lower temperatures to evaluate the affect of ductile to brittle transition temperatures on steel. So I can see why some states would have an interest in these types of tests.

Notched-bar impact tests are used to determine the tendency of a material to behave in a brittle manner. This type of test will detect differences between materials which arc not observable in a tension test. The results obtained from notched-bar tests are not readily expressed in terms of design requirements, since it is not possible to measure the components of the triaxial stress condition at the notch. Furthermore, there is no general agreement on the interpretation or significance of results obtained with this type of test. For example, different types of notched specimen tests can generate different transition temperature values, thus making it hard to use as a evaluation criteria.

The Charpy specimen has a square cross section and contains a 45° V notch. The specimen is supported as a beam in a horizontal position and loaded behind the notch by the impact of a heavy swinging pendulum. The specimen is forced to bend and fracture at a high strain rate .

The principal measurement from the impact test is the energy absorbed in fracturing the specimen. After breaking the test bar, the pendulum rebounds to a height which decreases as the energy absorbed in fracture increases. The energy absorbed in fracture is rendered directly from a calibrated dial on the impact tester.

That said, it would be difficult to determine what would be an acceptable performance for the Charpy testing. The Charpy test does not measure ductility directly rather only the drop in fracture energy as temperature drops. Thus, it cannot determine what the ductility of a steel is at a given temperature without further testing.

In addition, I don't believe that we have a clear definition of what type of drop in ductility would be detrimental to the performance of our safety hardware. While there would be some limit, it would likely take further research to define that accurately. We have not defined that to date, and I have no knowledge of barrier failure in accidents that were directly attributable to reduced ductility at low temps. A basic limit could be that the ductility should remain above the limitations for the steel spec for the component. However, additional testing beyond the Charpy test would be needed to define the ductility accurately. Thus, it would be difficult to show that Charpy testing would provide for a more crashworthy system without further research to determine the limits of safe ductility and toughness in our hardware and additional testing outside of the Chary tests to measure that ductility. It would be recommended that research would need to be conducted to define the parameters for the Charpy test evaluation for the roadside safety hardware components in question.

Two of the more critical components in a guardrail are the beam rail and the post. Ductile to brittle transition in steel is largely related to carbon content. I looked at some of our recent material certs from guardrail testing and found carbon contents for those components (A992 for the post and M180 for the guardrail) between 7-20%. These would classify as low carbon steels. While I don't have exact data on these specific steels, general data available on Charpy impact tests for low carbon steels (attached) indicate that carbon contents below 20% will not induce reduced toughness until temperatures around 0 degrees Fahrenheit. Thus, the issue may not even be relevant unless extremely cold temperatures are prevalent.

Attachment: https://mwrsf-qa.unl.edu/attachments/63da3c09ff0b29a454060e8fa1dbb092.jpg

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Pinned PCB

Question

Date: 12-18-2013

Are you aware of any states using your pin and loop in a median application using steel pins driven through the asphalt pavement to minimize deflection? We were wondering if we would need to use 3 steel pins on both sides of each unit (6 per unit) throughout the installation where we needed to reduce deflection, or if the pins could be alternated from side to side (3 per unit - 2 on one side and 1 on other) throughout the installation.

Response

Date: 12-18-2013

Currently, we do not recommend pinning or anchoring both side of the TCB in a tie-down application. Anchoring the barrier on the both sides creates a pivot point on the non-impacted side of the barrier that promotes barrier rotation and tipping and thus promotes vehicle instability. We cannot eliminate this concern without further analysis and/or testing, so we would recommend against it.

MwRSF previously developed and full-scale vehicle crash tested a tie-down system for use on concrete bridge decks and with the redesigned F-shape temporary concrete barriers, as shown in Figure 1. The tie-down system consisted of three 1â...›-in. diameter Grade 2 (ASTM A307) threaded dowel connections embedded approximately 12 in. into the concrete on the traffic side of each of the redesigned F-shape temporary concrete barriers. The barriers were placed 1 in. away from the edge of the concrete bridge deck. During full-scale crash testing with a ¾-ton pickup truck, the barrier safely redirected the pickup truck with minimal barrier deflections. The barrier system and was determined to be acceptable according to the TL-3 safety performance criteria presented in NCHRP Report No. 350.

A second a tie-down system for asphalt road surfaces was also developed at MwRSF that utilized three 1.5-in. diameter x 38.5-in. long ASTM A36 steel pins with 3.0-in. x 3.0-in. x 0.5-in. ASTM A36 steel caps installed in holes on the front face of each barrier segment, as shown in Figure 2. The tie-down design was then installed in combination with sixteen F-shape barriers on a 2-in. thick asphalt pad and crash tested according to NCHRP Report No. 350 test designation no. 3-11. The results showed that the vehicle was safely contained and redirected, and the test was judged acceptable according to the NCHRP Report No. 350 criteria. Barrier deflections for the system were reduced, and all of the barriers in the system were safely restrained on the asphalt road surface.

Both the bolted and asphalt pin tie-down options work by passing the anchors through holes in the toe of the traffic-side face of the PCB. Application of these options to two-way traffic installations has not been recommended in the past due to the need to place anchors on both sides of the barrier system. There are concerns that anchors on the backside of the barrier can create a rotation point when impacted and that may cause increased vertical barrier rotation and potential vehicle instability. CALTRANS testing conducted on the

K-Rail PCB with anchorage on both sides of the barrier indicated that pins on the backside of the barrier system can safely redirect impacting vehicles, but also confirmed that vehicle instability was a problem. MwRSF conducted testing of a median approach transition between free-standing PCB segments and permanent concrete barrier with anchors on both sides of the PCB barrier segments to TL-3 of MASH using two crash tests. Both tests were successful, but the use of anchors on both sides of the barrier did seem to increase instability, especially the testing on the upstream end of the transition. However, it was difficult to determine from the approach transition tests how much of the vehicle instability was due to the transition in stiffness versus the increased rotation of the barriers with anchors on the back side. In addition, the impact occurred in a region where the anchor spacing was varied. Thus, there is potential for the F-shape PCB to perform safely when anchored on both sides for median applications. Finally, it is believed that if the asphalt pin tie-down system were demonstrated to perform safely with anchors on both sides of the barrier, then the bolted tie-down system would perform equally as well due to its increased rotational restraint.

There has been interest in the past from various state DOT's to evaluate the use of pins on both sides, but no formal project has ever resulted.

Let me know if you have further questions.