Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

07-01-2006 to 10-01-2006

F-shape Barrier Strap Tie-Down Bolt Size

Question

State: KS
Date: 07-06-2006

I am trying to finalize our standard details for the strap anchor option on the F3 barrier system. While working on the details for the RED HEAD Multi-SET II anchor I noticed a discrepancy in the bolt length. All of the details I have received to date show a 2.25" Grade 5 bolt through the strap and into the anchor. However, when I look at the anchor specifications, the threading inside of the anchor is only 1.25 inches deep. So, if the anchor is embedded the 3 3/16", which is also the length of the anchor, and it is threaded for 1.25" with 1/2" of plate steel for the strap, the bolt could not be any longer than 1.75", unless the anchor is embedded at least 3 11/16" (the top of the anchor is ½" below the top of the pavement).
Can you shed some light on this issue, or some additional details on how the anchor was installed for the test?

Response

Date: 07-10-2006
KsDOT has brought an issue to our attention regarding the bolt length used in the F-shape PCB Strap Tie-Down design. This design uses the RedHead Multi-Set II Drop-In anchor to anchor the steel retainer straps to the concrete bridge deck. We used a ¾" dia. drop-in during our testing that had an embedment of 3 3/16" and a threaded depth of 1 ¼". When we tested the system, MwRSF used a 2 ¼" long x ¾" dia. Grade 5 hex bolt. The system test was successful, and we specified that bolt size for our final plans. When looking at the anchor geometry, KsDOT noticed that we had ½" more length on our bolt than the threaded length of the anchor and wondered if that was an issue. MwRSF contacted engineers at RedHead about this question. The response from RedHead was that they did not advise using bolts that threaded farther into the anchor than the 1 ¼" thread depth. Their concern was that using bolts with longer lengths could cause excess expansion of the base of the anchor and potential fracture of the tabs at the base of the anchor. This would cause a possible reduction in anchor capacity.
Based on this new information, we are recommending that the states revise their details for this system to reflect the use of 1 ¾" long x ¾" dia. Grade 5 hex bolts with the drop-in anchors to eliminate any potential problems with the anchors.

Florida Temporary Barrier Questions

Question

State: FL
Date: 08-22-2006

1. Can ASTM A706 rebar be substituted for all the A615 rebar in FTB's, and if so, can the A706 rebars be tack welded together without compromising the crashworthiness of the design?
A fabricator down here wants to tack weld pre-tied rebar cages together to make them more rigid and easier to handle when they are placed into the forms. It appears he wants to fabricate his own homemade "welded wire fabric". I am concerned about doing this in a precast yard and not a factory environment. If we mandate that the welders be certified and that AWS welding procedures be used, I think we would also need to require A706 rebar. Currently we require A706 rebar for the connector loops only as it is a more ductile steel and can better accommodate the tight bend radius.
2. On another project, the contractor has proposed using the proprietary 1" diameter high strength (A449) anchor bolts shown on page 11 of the following attachment in lieu of the 1.25" diameter F1554 Grade 36 anchor bolts specified on our standard:
What do you think of using a smaller diameter, higher strength bolt than that used in the crash tests? The contractor is also proposing to use an adhesive that we have not classified as a "high strength" adhesive.
We only allow "high strength" adhesives for this application due to the shallow embedment depth of the anchor bolts necessitated by our 7" to 8"
deck thicknesses.
I would like to allow this type of proprietary bolt, maybe the same 1.25"
diameter as was used in the crash tests though, because the bolts can be easily removed from the bridge deck when the barrier is removed or relocated.

Response

Date: 08-23-2006
I have made some comments for you below inred.

1. Can ASTM A706 rebar be substituted for all the A615 rebar in FTB's, and if so, can the A706 rebars be tack welded together without compromising the crashworthiness of the design?
I see no reason that you should not be able to substitute the A706 for the A615 as long as long as the grade of steel stays the same or is better and there are no changes in bar sizes or lengths. The A706 should have better ductility and should not pose any other issues.
A fabricator down here wants to tack weld pre-tied rebar cages together to make them more rigid and easier to handle when they are placed into the forms. It appears he wants to fabricate his own homemade "welded wire fabric". I am concerned about doing this in a precast yard and not a factory environment. If we mandate that the welders be certified and that AWS welding procedures be used, I think we would also need to require A706 rebar. Currently we require A706 rebar for the connector loops only as it is a more ductile steel and can better accommodate the tight bend radius.
With regard to tack welding the rebar, I don't see a huge problem with it either as long as you hold the contractor to similar quality controls as those observed by welded wire fabric manufacturers. It appears from you email that you plan to do that. As long as the tack welds are not compromising the capacity of the rebar or causing stress concentrations, it should not be an issue.
2. On another project, the contractor has proposed using the proprietary 1" diameter high strength (A449) anchor bolts shown on page 11 of the following attachment in lieu of the 1.25" diameter F1554 Grade 36 anchor

bolts specified on our standard:
What do you think of using a smaller diameter, higher strength bolt than that used in the crash tests? The contractor is also proposing to use an adhesive that we have not classified as a "high strength" adhesive. We only allow "high strength" adhesives for this application due to the shallow embedment depth of the anchor bolts necessitated by our 7" to 8" deck thicknesses.
I would like to allow this type of proprietary bolt, maybe the same 1.25" diameter as was used in the crash tests though, because the bolts can be easily removed from the bridge deck when the barrier is removed or relocated.
For our design and testing of the bolt through tie-down, we specified a 1.25" dia. A307 threaded rod. The rod was embedded approximately 12" into the concrete with a high strength epoxy. The epoxy and embedment depth were chosen such that the full strength of the threaded rod was developed. In this case the threaded rod ultimate strength was 60 ksi and the threaded area was 0.969 in^2 which yields a maximum load of approximately 58 kips.
The Kelligrout specs you sent suggest that for the A449 1" dia. bolt proposed you need 9.5" of embedment to develop the strength of the bolt. The bolt capacity for the A449 1" dia. bolt corresponds to a ultimate strength of 120 ksi and a threaded area of 0.606. This would correspond to a capacity of 72.72 kips. Therefore the tensile capacity of the bolts is not an issue.
We are concerned with the bending capacity of the anchor rods. The bending section of the 1" diameter rod is approximately 50% less than that of the 1.25" dia. rod. So while the strength of the rods is different, the ultimate bending capacity of the 449 anchor is actually slightly lower than the A307 rod. We did get significant bending of the anchors in the full-scale testing and thus are leery of using the smaller diameter anchor. In addition, the A449 anchor is made of high strength steel that has lower ductility than the A307. This translates to lower energy absorption during the impact and an increased potential for bolt failure. The smaller diameter of the 1" anchor also increases the bending load because of the increased clearances in the holes of the barrier. Because of these concerns, we would not recommend the 1" dia. A449 anchor at this time.
The grout itself seems acceptable. I looked at the specs for the grout on their web page and it appears that they can achieve the full strength of the 1.25" dia. A307 rod with 12" of embedment.
As an alternative, we did develop a bolt through option that bolts through the bridge deck with washers and nuts underneath. This system is easier to remove than the epoxy system.

Guardrail Transition to a Bridge

Question

State: KS
Date: 09-05-2006

We have a guard fence transition to a bridge that was recently hit. This will be repaired per our maintenance policy.
My question is:
1. Can we use double blockouts in the portion where the curb is in front of the guard fence for the full length of the guard fence to bridge rail transition section? How many posts can have more than one blockout and is there a limit, i.e. some may want to use three blocks on several posts. I am looking into the height of the bridge rail to see if we can get thrie beam on it.

Attachment: http://mwrsf-qa.unl.edu/attachments/27b9dffe9945d993ee60cfb37604bb20.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/ae7e8acc6b376f051734d18a9f62507d.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/1100950ae76c8fd181d687858a1582d8.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/02a2612a74d048a490598c2f90e40ce5.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/71a452268dd73684f3c51bdee1a3065b.JPG

Attachment: http://mwrsf-qa.unl.edu/attachments/3d2b710571de71a57898ec42dd99bcec.JPG

Response

Date: 09-07-2006
I have reviewed the photos you sent and I believe we can retrofit your installation to improve it significantly. I have attached a schematic of our proposed modifications. We are basically proposing that you blockout the existing system using 24" deep spacer blocks (basically three standard 8" deep blocks in series). We have used 16" blocks on several systems in the past with no problems and we believe that 24" of spacer block is okay as well. We are also recommending that you replace the first 12'-6" section of w-beam with nested 12-gauge thrie beam. Then a W-thrie transition section would be placed between the nested thrie and the standard w-beam. This layout would make you installation very similar to theIowa transition developed by the Pooled Fund and would increase the safety of the installation greatly. After the W-thrie transition section, the spacer blocks could be reduced incrementally to taper the w-beam to meet the existing installation.

Attachment: http://mwrsf-qa.unl.edu/attachments/f57cf1ffe1ef13043665acc3267e08f1.jpg

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MGS in a Median

Question

State: OH
Date: 09-26-2006

I have a project where I think I can get the MGS installed. However it would be a two-sided run on one side of a median. The barrier guardrail would be on the top of the slope on one side of the median, and the backside would be at the top of a 6:1 median slope and about 24 feet from the other side travelled lanes. Can the MGS be used in a two-sided barrier situation? Would the median side rail require a rub rail?

Response

Date: 09-26-2006
we believe that it would be acceptable to use the MGS in a median situation with the W-beam rail blocked out on both sides of the posts. Although the additional W-beam rail may provide some limited stiffening of the guardrail design, we do not believe that stiffening to be significant nor do we have evidence that suggesting that it would degrade MGS safety performance.

For your specific median geometry, are you referring to a situation that resembles "Illustration 2 or 4" on page 6-15 of the roadside design guide? Please clarify your median situation for us.

Second and based on my understanding of your specific application, it is our recommendation that you not use a rubrail with the MGS in a median application.

Response

Date: 09-27-2006
The situation in which I would like to use the Midwest Guardrail (MGS) on GRE-35 resembles Illustration 2 in the RDG, with both slopes being 6H:1V with the ditch squarely in the center of the median for most of the project length.

The project is on a limited access expressway with a 30 foot wide median that now has sufficient ADT to move it up into the barrier warranted section of RDG Figure 6-1 on page 6.2.
The project now has a history of cross median accidents so we would like to protect it.
I have ruled out cable in favor of more typical protection (w-beam).
The project length is about 7 miles, with some remaining intersections.
Most of the median slopes are 6:1 but there are about 20 existing drainage inlets that have a localized depression up to maybe 3:1.
When barrier guardrail at the top of one side of the median was proposed, the thought was to level out those depressions so that no slope would be greater than 6:1.

Some pictures are attached.

I've talked to a colleague about using double sided guardrail in this situation (as ODOT only uses double sided guardrail with 10:1 slopes on both sides of the barrier run).
With one of the sides on our proposed run to be at the top of a 6:1 slope, he suggested using a rub rail on that guardrail face.

Any comments would be appreciated.

Attachment: http://mwrsf-qa.unl.edu/attachments/b7458f5df63b2c674fae29b99ae5694c.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/2be8aae35168c90448c0bc71787a635d.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/2f9734fd4f5a6fdb8bbec6acce279091.jpg

Attachment: http://mwrsf-qa.unl.edu/attachments/fa07eb74428b0c8c3f1fd6353e651e0c.jpg

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Response

Date: 09-27-2006

Thanks for the clarification. I had originally assumed that you were dealing with a situation that resembled "Illustration 2." For the 30-ft wide median with 6H:1V side slopes, it is only necessary to consider median crossovers since the noted median slopes are relatively flat and clear. As such and using Illustration 2, one would place the median barrier system on the top side of either of the 6H:1V slopes. With the barrier system at the top of the slope, vehicles traversing the centerline ditch would not be expected to underride the barrier on the upslope 15-ft away or so from the ditch center. Therefore, we do not believe that it would be appropriate to use a rubrail in combination with the MGS at this location. In addition, rubrails, used in combination with thrie beam transitions, have not been met with a high degree of success when evaluated by large pickup truck impacts.
