

Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

10-01-2004 to 12-31-2004

Minnesota Safety Workshop Problems

Question

State: MN

Date: 11-03-2004

Note: The following five problems were submitted for a safety workshop given at MnDOT.

Problem # 1: Treatment of a 6-ft deep pond at the edge of the clear zone

It was stated that the clear zone for this obstacle was at or very near to the edge of the 6-ft deep pond. Actually, only the downstream end of the pond was within the clear zone and technically requiring protection based solely on the clear zone concept. However, if one followed that policy and did not protect the upstream end with an appropriate length of need of guardrail protection, would the agency open themselves up to future tort liability? This may be the case since a reasonable engineer and/or designer would likely have protected the entire pond hazard and culvert end with only a small increase in guardrail length.

It was stated that cable barrier was placed down the 10:1 slope in conformance to standards for locating guardrail on slope. Two feet behind the cable barrier posts, the slope changed to a variable slope ranging between 2:1 to 5:1. For the steeper slopes, the three cable barrier may not be capable of safely redirecting the 2000P vehicle at the TL-3 impact condition as it traverses the steeper slopes. Due to this fact, it may have been more appropriate to protect the hazard with strong post W-beam guardrail with an acceptable end terminal. This alternative may have been preferred since the steeper 2:1 slopes on the back side of the posts can be accommodated with this new barrier system.

Response

Date: 11-03-2004

Problem #1

Attachment: <https://mwrsf-qa.unl.edu/attachments/e976e4b22502cd7741031f78b77010af.pdf>

Response

Date: 11-03-2004

Problem #2

Attachment: <https://mwrsf-qa.unl.edu/attachments/361ce7bb93a7b51452020a77b1dbc27c.pdf>

Response

Date: 11-03-2004

Problem #3

Attachment: <https://mwrsf-qa.unl.edu/attachments/63f4b6755b20c0ca098866986b2b3a60.pdf>

Response

Date: 11-03-2004

Problem #4

Attachment: <https://mwrsf-qa.unl.edu/attachments/627e4fab889b2f980dfb3147cf82b590.pdf>

Response

Date: 11-03-2004

Problem #5

Attachment: <https://mwrsf-qa.unl.edu/attachments/4f2609f88e58c53f5a3e66296f182943.pdf>

Unsupported W-beam Guardrail Lengths Greater than 6'-3"

Question

State: MN

Date: 11-19-2004

Please comment on strong post W-beam guardrail systems with unsupported spans greater than 6'-3". This is related to options for W-beam guardrail installations where a post needed to be left out or could not be installed.

Response

Date: 11-19-2004

I am sending you an email response that I had sent in response to a similar question. I hope that this new information will help answer your question on unsupported guardrail spans greater than 6 ft - 3 in. Please note that the question raised to us previously related to long span guardrail systems in general and the associated nesting requirements for the W-beam rail adjacent to the unsupported span. Your question was very similar in that you desired comment on a strong-post, W-beam guardrail system where one post was left out. For a quick answer, you may want to jump to the last paragraph. In summary, with current W-beam systems, we believe that you will need to nest the W-beam guardrail over the unsupported length and carrying the nesting into adjacent regions. At this time, the length of this nested rail for spans less than 25 ft is undetermined nor optimized for impacts with pickup trucks at the TL-3 conditions. In the future, we believe that the use of the MGS, in combination with long-span systems, may actually allow us to significantly reduce and/or eliminate the need for nested W-beam rail.

Per my previous email response:

Recently, you had asked me to consider what reduced nested guardrail lengths would be acceptable for long-span guardrail systems placed over shorter culverts (i.e., with only one post (12.50-ft span) or two posts (18.75-ft span) left out).

Currently, we use 100 ft of nested rail for the 25-ft long-span system which resulted in 37.50 ft of nested rail on each side of the unsupported span. Obviously, shorter nested rail lengths will be acceptable when the unsupported span is reduced from 25 ft to either 12.50 or 18.75 ft. Three general approaches could be utilized for considering the shorter span alternatives. They are as follows:

Option 1 - A very conservative approach, which results in significant overkill in the design, would use 100 ft of nested rail for all long-span systems (i.e., 25 ft or shorter spans) in the absence of any new research (crash testing or computer simulation modeling). Personally, I would not recommend this approach since excess nested rail would be used for systems not requiring it. However, some states may choose to be very conservative and employ this solution. For clarity, this approach would consist of the following:

25.00-ft span: 100.00-ft nested rail

18.75-ft span: 100.00-ft nested rail

12.50-ft span: 100.00-ft nested rail

Option 2 - A moderately conservative approach would use the same length of nested rail on each side of the unsupported span or 37.50 ft. For shorter spans, this would result in a total nested rail length equal to 75.00 ft plus the length of the unsupported span. Prior MwRSF testing showed that the 37.50 ft of nested rail on each side of the span would be adequate for reducing and/or eliminating the potential for rail rupture when used in combination with a 25-ft span. As such, I believe that this same nested requirement would also be more than adequate for the 12.50 and 18.75-ft spans. For clarity, this approach would consist of the following:

25.00-ft span: 100.00-ft nested rail
18.75-ft span: 93.75-ft nested rail
12.50-ft span: 87.50-ft nested rail

Option 3 - A slightly more aggressive approach would use a reduced nested rail requirement on each side as shorter unsupported rail spans are encountered since it is recognized that dynamic deflections and critical rail stresses will likely be contained within a shorter region. In the absence of a BARRIER VII computer simulation effort or any compliance testing, I am personally unwilling to recommend this option. Please note that I am not stating that this option, or even one more aggressive yet, will not perform in an acceptable manner. I am just unwilling to recommend such a leap without further validation/verification. However, I will provide it for clarity below:

25.00-ft span: 100.00-ft nested rail (37.50 ft of nested rail on each side)
18.75-ft span: 81.25-ft nested rail (31.25 ft of nested rail on each side)
12.50-ft span: 62.50-ft nested rail (25.00 ft of nested rail on each side)

Finally, it should be noted that the relocation of the rail splice and/or implementation of the MGS guardrail system for culvert applications may help to reduce the nesting requirements from what is shown in all three options above. However, those nesting reductions can only be verified with full-scale crash testing according to the NCHRP Report No. 350 criteria, computer simulation modeling, and/or combinations thereof. It should be noted that several Pooled Fund States have inquired about this same topic in the past, that of which must be resolved in a future funded research study. If you have any questions regarding this matter, please feel free to call or email me at your convenience. Dean would also concur that options 1 and 2 are too conservative and even the final option (option 3) may be actually over designed.

Rectangular Washers and Reduced Post Spacing

Question

State: IL

Date: 11-23-2004

Illinois no longer uses the rectangular plate washers behind the bolt holding guardrail to blockouts for the 6'-3" post spacing. However, it has been pointed out that we still use this on the double face guardrail, and I have noted that we still use this washer on guardrail installations with 3'-1½" post spacing.

The inquiry regarding the double faced guardrail was referred to FHWA before coming to me, and it was suggested that it would probably be better to eliminate it from that application.

I am aware that the Midwest Roadside Safety Facility has conducted testing of the reduced post spacing of W-beam guardrail on 2:1 slope breaks. (October 2000 report entitled "Development of a W-Beam Guardrail System for Use on a 2:1 Slope.")

Did that application use the washers at the posts? From the photos you sent me on disk earlier, it appears that these washers were not used.

Based on the FHWA comments and pending your reply, we are considering removing these washers from our applications of both the double faced guardrail, and from the reduced post spacing design.

Response

Date: 11-24-2004

For the strong-post, W-beam guardrail system installed at the slope break point on a 2H:1V fill slope, you are correct in stating that the system utilized a reduced or half-post spacing. In addition, the noted guardrail system was designed and installed **without** the use of any rectangular washers on the traffic-side face of the rail element. Rectangular washers are no longer recommended on guardrail systems as their use can lead to the rail being pulled down to the ground during system deformation and post rotation, thus resulting in an increased potential for override of semi-rigid barrier systems. The use of these washers are obviously more critical in guardrail systems that are subjected to higher deformations and where guardrail release from the posts is desired. For stiffer guardrail systems, such as the three beam approach guardrail transition system, their use is much less of a concern since large barrier deflections generally do not occur.

Over the last several years, MwRSF researchers have been involved in the development, testing, and evaluation of many corrugated steel beam guardrail systems, including those using both standard and reduced post spacing designs. For all of these guardrail systems, MwRSF has **not** implemented the use of rectangular washers on the rail face and has no plans to do so in the future. As such, we concur with the suggestion made by FHWA.
