Midwest States Pooled Fund Program Consulting Quarterly Summary

Midwest Roadside Safety Facility

04-01-2006 to 07-01-2006

Asphalt Pin Tie-Down in Median Applications

Question

State: MN
Date: 04-19-2006

It doesn't look like we should tie down the Kansas/Iowa/Minnesota Temporary Portable Precast Concrete F Barrier with steel pins and use it for semi- permanent application when it is in the Median?
The steel pins for Tie-Down application you specify in the report are only for when this barrier is going to have traffic on one side, correct?

Response

Date: 04-20-2006
We are not recommending the use of the asphalt tie-down in median installations at this time. Our concern is that pins on the backside of the barrier would create a pivot point and induce rotation of the barrier segments. This action could increase the propensity for impacting vehicles to climb the barrier face and vault over the top. We have entertained the idea of placing pins on both sides of the barrier, but we are concerned about vehicle instability with this type of installation for the same barrier rotation issue mentioned above.

Safety Shape Barriers

Question

State: IL
Date: 04-28-2006

If I recall correctly, Dr. Sicking stated that he prefers other systems to a rigid barrier for safety performance, and also, I think he made reference to some study or documentation showing that lateral offset increases the likelihood of a more direct angle of impact.
We are discussing with one of our District Offices the location of a concrete barrier in a Freeway median. They are building a 6-lane section through an interchange area for inclusion in a future (maybe far in the future) add lanes project on the corridor. Ultimately, the permanent median barrier will be located at the center of the median, about 8 feet off the edge of the inside lane. Until the corridor lane addition is achieved only four lanes will be present and a barrier at the center of the median would be about 20 feet from the edge of the through lane. Another option for them would be to place two lines of temporary concrete barrier, each about 12 from the edge of an inside lane.
We all prefer a concrete barrier in this location due to the high truck traffic (9600 multiple units, and 1600 single unit trucks out of a total ADT of 34700 (2005)). We would like the reference to documentation of the increased likelihood of more direct impacts with increasing offset to the barrier, and also any comments.

Response

Date: 04-28-2006
Unfortunately, it is apparent that I confused many people with the discussion of the relationship between lateral offset and impact angle and another discussion of my concerns over the safety of safety shaped concrete barrier. I will recap my comments below in an attempt to clarify the now very muddy water.

HISTORY

Through the 1970's and into the 1980's, FHWA strongly discouraged the use of concrete barriers in medians more than 30 ft wide.
The concern was that impact angles would increase as the barrier was placed further from the traffic.
As a result of a number of truck penetrations of its W-beam median barrier, the New Jersey Turnpike Authority contracted with TTI, in the mid-1980's to develop a flexible barrier that could be used in wider medians and still provide TL-5 performance. During the process of trying to design a metal barrier that could contain a tractor-trailer truck, it became obvious that the resulting, "flexible" barrier would be rigid with respect to passenger cars. Based upon the results of this study, FHWA realized that it had a choice, either continue to require W-beam and Thrie-beam median barriers in wide medians and accept that heavy trucks will sometimes penetrate the barrier, or allow rigid barriers to be used in wide medians and accept the assumed increase I risk associated with higher impact angles.
About this same time, King Mak completed a study of pole and narrow bridge crashes that indicated a modest increase in impact angle as the hazard was placed further from the travelway.
Due to the extreme severity and high visibility of some of the cross-median truck crashes, (one such crash involving a gasoline tanker killed or seriously injured 33 people) the FHWA concluded that stopping such crashes on high volume freeways was very important.
Hence, FHWA's restrictions against the use of concrete barriers in wide medians were dropped.

The safety shape concrete barrier was developed by GM to prevent sheet metal damage during low angle impacts. The GM Shape as it was called incorporated a 13" high lower curb that would allow an impacting vehicle's tires to climb the barrier without any sheet metal contact for impact angles up to 3 or 4 degrees. Because GM used this barrier only on test tracks where the potential for traffic conflicts are low, most of their crashes were caused by inattention rather than avoidance maneuvers. Hence, the barrier was able to redirect impacting vehicles without damaging the sheet metal during most crashes.
When this barrier was introduced onto the highway, it was found to cause large numbers of rollovers.
In recognition of this problem, the state ofNew Jersey reduced the lower curb to a height of 10" and produced the widely used New Jersey Shape. In the 1970's,
the Southwest Research Institute (SWRI) conducted a parametric study to examine changes in the NJ shape that would reduce rollovers. They studied a number of revisions to the NJ shape, the first configuration was labeled Shape A.
SWRI looked at a number of different versions, finally arriving at what they deemed to be the best, Shape F.
This is the origin of the F Shape barrier and it basically involved reducing the height of the lower curb by another 3 inches.

During the 1980's, King Mak and I studied rollovers associated with concrete safety shaped barriers and found that safety shapes are not very safe.
This study concluded that concrete safety shaped barriers are the most dangerous barriers along our roadsides.
Clearly part of this increased danger is related to the rigidity of the barrier.
However, Mak's findings appear to indicate that the greatest portion of the increased risk was related to rollover frequency.

CURRENT RECOMMENDATIONS

It is generally accepted that there is a modest increase in impact angle as a barrier is placed farther from the travelway. However, the increase in severity with higher impact angles does not outweigh the attendant reduction in crash frequency as the barrier is moved farther from traffic. Hence, agencies are urged to place barriers as far from the travel way as possible within the available geometric limitations (considering roadside and median slope limitations).

Therefore, we strongly recommend that median barriers be placed in the center of the median whenever possible.

Further, our primary concern regarding the use of concrete safety shaped barriers is that the shape was originally designed to limit sheet metal damage and as a result, doesn't provide the maximum level of safety possible for a rigid barrier.

Under a currently funded pooled fund project we are attempting to verify the findings from Mak's study of barrier shape. If that study proves Mak to be correct, we will begin recommending that agencies abandon the safety shaped barriers in favor of more vertical designs.

Thrie Beam Blockouts

Question

State: WI
Date: 05-10-2006

We would like some guidance on the appropriate blockout to use for a standard thrie beam, both for wood posts and steel posts.

WisDOT is working on developing a thrie beam bullnose terminal based on the MwRSF design(report TRP-03-95-00, 6-1-2000) that was approved by FHWA (11-8-2000 letter, HSA-1/HSA-cc68). The blockout for the standard thrie beam construction from posts 9 to 12 is shown as 360 mm (14.17 in) high.

Sheet 2 of Minnesota DOT's Standard No. 5-297.611 "Thrie Beam Bullnose Guardrail for Medians" (dated 8-20-2001), which is based on the approved MwSRF design uses a 22-inch high blockout.

Response

Date: 05-15-2006
Per your inquiry, I have summarized several of the successful thrie beam transition tests that have been conducted according to the NCHRP Report No.
350 requirements. They are as follows:
No. 1 - Wood Post - Wood Blockout
550 mm center rail height
804 mm top rail height
150 mm by 200 mm by 554 mm blockouts
150 mm by 200 mm by 1.9 m posts
0.68 m dynamic deflection
TL-3 pickup truck test (404211-11)
No. 2 - Steel Post - Modified Steel Blockout
610 mm center rail height
864 mm top rail height
W360x33 tapered blockouts
W150 x14 posts
0.71 m dynamic deflection
TL-4 single-unit truck test (404211-5a)
610 mm center rail height
864 mm top rail height
M14x18 tapered blockouts
W6 x9 posts
1.02 m dynamic deflection
TL-3 pickup truck test (471470-30)
No. 3 - Steel Posts - Routed Wood Blockout
550 mm center rail height
804 mm top rail height
150 mm by 200 mm by 554 mm routed blockouts

W150 x14 posts
0.58 m dynamic deflection
TL-3 pickup truck test (404211-10)
In summary, you can use either the long wood blocks, shortened wood blocks, or even the tapered steel blocks in combination with the standard thrie beam guardrail systems after post no. 9.

Bullnose Questions

Question

State: MO
Date: 06-14-2006

See attached for questions.

Attachment: http://mwrsf-qa.unl.edu/attachments/e17b27609bce4ce7d363b172cfcbff57.pdf

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Response

Date: 06-19-2006
I have looked at your bullnose barrier question regarding the distance from the nose of the system to the hazard. Based on a somewhat less conservative approach than our original guidelines, we believe you can reduce the 69.5' minimum distance shown in your drawing to 50'. We do not recommend that you shorten the distance any more than that as it may allow larger vehicles impacting the end of the system to impact your sign supports with significant velocity. The new 50' distance should shorten your installation 19.5' on the narrow side of your median.
As for your second question regarding the red area in your drawings, I am afraid I do not understand. The red area in your drawing is not a critical number. The critical number is the distance from the nose of the system to the rigid hazard. This distance is based on the amount of system deflection we saw in tests of a pickup truck impacting the end of the barrier system under NCHRP Report 350 impact conditions. We do believe that this distance can be safely reduced to 50' if need be as stated above.
