MIDWEST POOLED FUND PROGRAM

Progress Report - Second Quarter 2009
April 1st to June 30th
Midwest Roadside Safety Facility
Nebraska Transportation Center
University of Nebraska-Lincoln

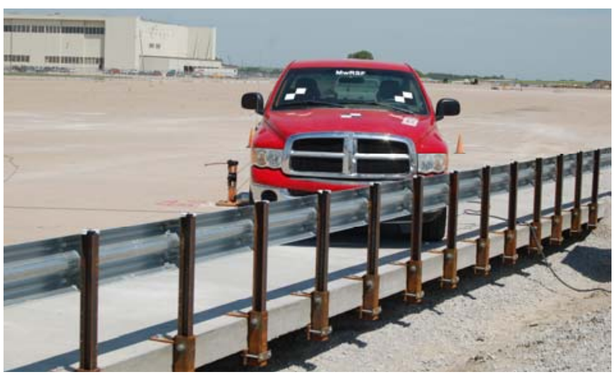
June 30, 2009

Pooled Fund Projects with Bogie or Full-Scale Crash Testing in Past Quarter

Phase I & II Development of a TL-3 MGS Bridge Rail – Program Years 18 and 19

The MGS bridge railing and reinforced concrete deck systems, including the upstream and downstream semi-rigid guardrails and simulated end terminals, were constructed in the Second Quarter of 2009. Two full-scale vehicle crash tests were conducted according to the TL-3 impact conditions found in the MASH guidelines. On June 18, 2009, a 2270P pickup truck impacted the MGS bridge rail with satisfactory results. Following the test, the barrier was reconstructed. On June 26, 2009, an 1100C small car test was successfully performed. Pre- and post-test photographs for the two crash tests are provided below.

In the Third Quarter of 2009, the barrier and deck systems will be removed, and the test site will be restored. In addition, the R&D effort, computer simulation modeling, crash data analysis, evaluation, and test reporting should be completed.



Standardizing Posts and Hardware for MGS Transition – Program Years 18 and 19

In the Second Quarter, dynamic bogie testing of wood posts embedded in soil was continued in order to determine a simplified wood post transition alternative. The post tests were performed in a compacted soil test pit (concrete cutout) placed in the concrete tarmac. The soil pit measured approximately 5 ft wide by 8 ft long. In May 2009, two bogie tests were performed – one on an 8-in. x10-in. by 7-ft long wood post and one on a 10-in. x 10-in. by 7-ft long wood post. In June 2009, six additional bogie tests were performed – two on 8-in. x 10-in. by 7-ft long wood posts and four on 8-in. x 10-in. by 6.5-ft long wood posts. From this testing program, inconsistencies in post-soil behavior were observed when considering the post size and embedment depth. In the Third Quarter of 2009, additional wood posts will be tested in a larger soil area in order to investigate and determine the effect for conducting dynamic post tests in the smaller soil pit while using existing compaction methods.

Performance Limits for a 6-in. High, AASHTO Type B Curb Placed in Advance of the MGS – Program Year 17

On April 8, 2009, a 2270P crash test (test no. MGSC-5) was performed on the MGS placed behind a 6-in. curb using an 8-ft lateral offset. The test was conducted according to the TL-3 conditions and requirements found in the MASH-08 guidelines. During the test, the pickup truck impacted the MGS with a slight upward trajectory of the right-front corner of the vehicle which later began to be redirected with moderate roll toward the barrier system. In this sequence, the right-front wheel was also removed and propelled along and under the truck. As the vehicle was traveling along the barrier system, the vehicle roll toward the barrier increased as well as the upward pitch of the truck's rear end. The vehicle's angular motions, combined with the wheel release and truck travel over an upright loose wheel, likely contributed to the vehicular instabilities and vehicle rollover upon exiting the MGS barrier. With vehicle rollover, the results from test MGSC-5 were deemed unsatisfactory.

Documentation and reporting of the crash test results were begun in the Second Quarter of 2009, as part of a Phase II test report. Additional LS-DYNA computer modeling was performed following the test in order investigate: (1) 2270P impacts into the MGS placed 8 ft behind a 6-in curb using various rail heights and (2) 2270P impacts into a 37-in. tall, MGS relative to the roadway and at various lateral offsets behind the curb. The LS-DYNA analyses will continue in the Third Quarter 2009. In addition, MwRSF will be forwarding a letter to the sponsor states seeking guidance on how to proceed with the project as there are insufficient funds to conduct a re-test. It should be noted that a Phase I final research report was completed in the Second Quarter of 2009.

Phase I – Guidelines for Post-Socket Foundations for Four-Cable, High-Tension, Barrier Systems – Program Year 19

Initially, researchers investigated and examined the existing design configurations for post-socket foundations used with high-tension, cable barrier systems. Subsequently, a design limit or peak load condition was determined for the configuring future post-socket foundations. A prototype 12-in. diameter, reinforced concrete foundation system with a steel sleeve insert was designed using various embedment depths. Three preliminary specimens were constructed using 2, 3, and 5 ft lengths. For the project, all of test specimens are to be subjected to dynamic bogie testing in both weak and strong soil conditions. The bogie testing will evaluate the structural capacity and deformation of the loaded foundation systems.

In June 2009, three dynamic component tests were performed on the initial prototype foundation system when placed in a weak soil condition (sand). Concrete fracture was observed in the 5-ft long test specimen, while only concrete cracking of the shaft was observed in the 3-ft long specimen. A preliminary data analysis was begun. In the Third Quarter of 2009, the test results will be evaluated, and design modifications will be considered prior to proceeding with the bogie testing matrix.

Pooled Fund Projects with Pending Bogie or Full-Scale Crash Testing

Midwest Guardrail System Placed at the Breakpoint of a 2:1 Slope – Bogie Testing Project Using Year 14 Contingency Funds

An MGS system utilizing 9-ft long, W6X9 steel posts spaced at 6-ft 3-in. centers was successfully crash tested utilizing a 2270P Dodge Quad Cab vehicle. The vehicle was safely redirected. A draft report has been prepared and remains under internal review. A TRB paper was presented at the 2008 Annual Meeting of the Transportation Research Board and published in TRR No. 2060.

During the report review process, it was noted some states desired a wood-post alternative for the MGS placed on a 2:1 slope. As such, a very limited dynamic bogie testing program was initiated in order to determine the appropriate length of a 6-in. x 8-in. wood post for placement at the slope breakpoint of a 2:1 fill slope. On March 6, 2009, one dynamic test (test no. MGS2-1PT22) was performed using an 8-ft wood post. During the test, wood post fracture occurred with limited post rotation. Using limited contingency funds, additional bogie tests are planned in the Third Quarter of 2009 in order to finalize the wood post length for this 2:1 MGS application.

Development of a TL-4, Four-Cable, High-Tension, Barrier System for 4:1 V-Ditch Applications

The initial design of the simplified bracket for attaching the cables to the support posts was completed in the Second Quarter of 2009. Final CAD details were sent to the Bennett Bolt Co. for ordering cable attachment prototypes for use in the dynamic component testing program. MwRSF received prototype samples in June 2009 in order to review and make changes, if necessary. Based on the review, the additional prototypes were ordered. Dynamic component testing is anticipated in the Third Quarter of 2009. If those tests show promising results, the 1100C small car re-test may also be conducted later in the Third Quarter.


Testing of End Terminal for Four-Cable, High-Tension Barrier (1100C & 2270P) – Program Year 17

Work on this project will commence after crash testing has been completed on the high-tension, four cable barrier system. It is planned to adapt the breakaway cable lever arm technology, developed during the low tension testing, into the high-tension barrier system. Partial project funding is available in this program. A Year 20 Pooled Fund project has been prepared in order to obtain additional funding to continue the compliance testing program.

Paper Studies

Cost-Effective Measures for Roadside Design on Low-Volume Roads – Program Year 16

The analysis, evaluation, and documentation for treating culverts and trees have been completed. In the Second Quarter of 2009, new cost data was also obtained for evaluating treatment options for the remaining hazards. The analysis of low-volume bridges, and associated treatment options, was completed in the Second Quarter, while the analysis of slopes and ditches was initiated in late June 2009. In the Third Quarter of 2009, the analysis for the treatment of slopes and ditches will be completed. The evaluation and preliminary documentation of bridges, slopes, and ditches will be completed in the Third Quarter.

Submission of Pooled Fund Guardrail Developments to AASHTO TF-13 Hardware Guide

To date, 15 components and 21 systems have been submitted to TF-13 for review and approval. Six systems and four components were approved for the Guide at the September 2008 meeting in Savannah, GA. Two systems and six components were reviewed in September 2008 and are planned to be approved in April 2009. Three additional systems were planned for review and discussion at the spring 2009 AASHTO Task Force 13 meeting. However, it should be noted that funding for this effort has been depleted as on November 2008, and additional funding will be needed to complete the currently planned effort. No additional funding was provided in the Year 20 Program.

Cost-Effective Upgrading of Existing Guardrail Systems – Program Year 17

In June 2009, an MwRSF field investigation team conducted a field survey of selected barrier installations throughout the State of Kansas. As part of this weeklong investigation, more than 60 specific sites were visited, measured, photographed, and documented. The field survey information will be reviewed, compiled, and analyzed in the Third Quarter of 2009. The RSAP analysis may be initiated later in the Third Quarter.

Evaluation of Safety Performance of Vertical and Safety Shaped Concrete Barriers – Program Year 16

The preliminary data analysis indicated that there was little correlation between barrier shape and rollover propensity. However, after a more careful analysis, it became apparent that there was a relationship, but it was being masked by other factors such as traffic volume and operating speeds. In order to control for these complicating factors and determine the effects of barrier shape on rollover rate, some additional data will be needed. In the Second Quarter of 2009, MwRSF obtained some additional crash data and began to perform a more detailed analysis and evaluation. However, no work on this project is planned for the Third and Fourth Quarters of 2009. Work will be re-initiated in the First Quarter of 2010 when key project personnel once again become available.

MGS Implementation – Program Year 18

In 2007, consulting funds were used to assist states with the MGS implementation effort. MwRSF began the effort with a review of CAD details from the Illinois and Washington DOTs. Project correspondence occurred via email with a pre-determined Technical Working group. To date, three subject areas were covered and are as follows: (1) Standard, Half, and Quarter Post Spacing; (2) MGS w/ Curbs and MGS on 2:1 Slopes; and (3) MGS w/ Culvert Applications. A fourth category, MGS Stiffness Transition, will be initiated after the simplified, wood-post transition project is completed. It is estimated that the MGS implementation effort will commence in the Third Quarter of 2009.

Projects Funded by Individual State DOTs and Routed Through NDOR and/or Pooled Fund Program

Iowa RSAP Analysis of Culvert Treatments (Iowa Department of Transportation)

The RSAP analysis of safety treatments for cross drainage culverts has been completed. The analysis examined the safety performance of untreated culverts, extending the culvert out of the clear zone, installing safety grates, and shielding the hazard with W-beam guardrail. The variability in construction costs for extending culvert grates forced this study to focus on identifying accident costs associated with each treatment alternative. Accident costs for each alternative were tabulated for a wide variety of roadway and roadside characteristics. Highway designers can use these tabulated accident costs to calculate benefit-to-cost ratios for each of the safety treatments studied. The analysis appeared to indicate that the use of culvert safety grates was most appropriate for low and medium volume roadways, while culvert extension appeared to provide the most cost beneficial alternative for some high volume facilities. In the Second Quarter of 2009, the final report was completed.

Development of a New, TL-4 Precast Concrete Bridge Railing System (Nebraska Department of Roads)

The original project objective was to develop a TL-4, aesthetic, open concrete bridge railing for use on cast-in-place decks as well as precast deck panels. Due to many factors, existing project funds are insufficient to complete the research study. MwRSF-UNL researchers have been seeking funds to complete this research from alternative sources. In March 2009, an NCHRP IDEA proposal was submitted to seek additional project funds. In June 2009, it was learned that the NCHRP IDEA proposal would not be funded. As such, MwRSF will continue to seek alternative funding sources in the future.

Qualification of Type II and Type I End Terminals for Box Beam (New York DOT)

In 2007, three 1100C full-scale vehicle crash tests were performed on two NYSDOT box beam terminal systems. Previously, a draft test report was prepared, submitted to NYSDOT, and edited. In 2008, a continuation project provided funding for additional crash testing. Three 2270P and one 1100C crash tests were performed. The reporting and documentation for the last four crash tests was added to the original test report. The combined, internal draft report was reviewed by New York personnel in the Second Quarter of 2009. MwRSF began to incorporate NYSDOT edits in late June 2009. A draft final report, incorporating all of the NYSDOT comments for the last four crash tests will be completed in July 2009.

In the Second Quarter of 2009, MwRSF also began preparations on the third phase of the crash testing program. CAD details were revised and submitted to NYSDOT for review and comment. Construction materials for the box beam guardrail and terminal systems were ordered. In the Third Quarter of 2009, two full-scale vehicle crash tests will be performed on the Type IIA box beam end terminal system.

Universal Breakaway Steel Post for Guardrail (Minnesota DOT)

Two full-scale vehicle crash tests were planned for the Fourth Quarter of 2008. Test no. USPBN-1 was performed on November 26, 2008 using a 2000P pickup truck according to test designation 3-38 of NCHRP Report No. 350. During the test, the vehicle was being slowed and redirected. However, the vehicle later overrode the rail and rolled over within the thrie beam bullnose system. After the failed test, MwRSF researchers studied the results and provided recommendations on how to proceed with the project using two different plans. MnDOT committed to providing an additional $10,000 to supplement the existing project funds in order to re-run the 2000P crash test into a modified barrier system. The re-test is planned for the Third Quarter of 2009. In the Second Quarter of 2009, an internal draft report was prepared to document the component testing of breakaway post concepts as well as the first 2000P crash test. This draft Phase I research and test report will be submitted to the sponsor in the Third Quarter of 2009.

Development of a Test Level 1 Timber Curb-Type Railing for Use on Transverse, Timber, Nail-Laminated Deck Bridges (West Virginia DOT)

The project consisted of adapting and modifying a crashworthy TL-1 timber bridge railing system for use on nail-laminated, transverse timber deck bridges, while using the proposed MASH 08 guidelines. Documentation and reporting of the research project has been completed. A final research report was submitted to the West Virginia DOT in the Second Quarter of 2009. A formal request seeking FHWA acceptance will be prepared in the Third Quarter of 2009.

Development of a Test Level 2 Steel Bridge Railing and Transition for Use on Transverse, Timber, Nail-Laminated Deck Bridges (West Virginia DOT)

The project consisted of adapting and modifying a crashworthy TL-2 steel bridge railing system for use on nail-laminated, transverse timber deck bridges, while using the proposed MASH 08 guidelines. Documentation and reporting of the research project was initiated in First Quarter of 2009. Completion of the draft report is now expected in the Third Quarter of 2009. A request seeking FHWA acceptance should also be completed in the Third Quarter of 2009.

Dynamic Testing and Evaluation of a New TCB for FRP Bridge Deck Applications (Kansas DOT)

The project consisted of the crash testing and evaluation of a vertical-face, precast concrete parapet attached to an FRP composite bridge deck system. The research effort was performed according to the Test Level 3 safety performance guidelines found in the Manual for Assessing Safety Hardware 2008 (MASH-08). On March 13, 2009, one 2270P pickup truck test (test no. KSFRP-1) was successfully performed at the target impact conditions of 62 mph and 25 degrees. For this test, the vehicle was safely contained and smoothly redirected in a stable manner. Documentation and reporting of this crash test was continued in the Second Quarter of 2009. The draft report will be sent to the sponsor in July 2009.

Dynamic Evaluation of New York State's Pinned Temporary Concrete Barrier (New York DOT)

The project consisted of the crash testing and evaluation of New York State Department of Transportation's New Jersey shape, temporary concrete barriers attached to a concrete slab using vertical pins on the back-side face. The research effort was performed according to the Test Level 3 safety performance guidelines found in the Manual for Assessing Safety Hardware 2008 (MASH-08). On January 9, 2009, one 2270P pickup truck test (test no. NYTCB-4) was successfully performed at the target impact conditions of 62 mph and 25 degrees. For this test, the vehicle was contained and redirected. However, it should be noted that significant barrier deflections were observed in two segments. In addition, one barrier joint ruptured after the vehicle's rear end impacted the barrier and had exited the region. In the Second Quarter of 2009, a draft report was prepared and submitted to the NYSDOT for review and comment. In June 2009, NYSDOT provided comments for consideration in the report. MwRSF personnel will modify the test report in the Third Quarter of 2009.

In addition, a follow-on study was funded to re-test the TCB when continuously pinned along the back-side barrier face. In the Third Quarter of 2009, the TCB segments will be acquired. In addition, one 2270P crash test will be performed.

Awaiting Reporting

Development of a Temporary Concrete Barrier Transition – Program Year 16

Two pickup truck crash tests were successfully performed on a transition between temporary concrete barrier and permanent concrete median barrier. The evaluation was performed using the MASH-08 guidelines. A draft report should be submitted to the Pooled Fund members for review and comment in the Third Quarter of 2009.

Draft Pooled Fund Reports Completed

Rosenbaugh, S.K., Bielenberg, R.W., Faller, R.K., Reid, J.D., Rohde, J.R., Sicking, D.L., Lechtenberg, K.A., and Holloway, J.C., *Termination and Anchorage of Temporary Concrete Barriers*, Draft Report to the Midwest States' Regional Pooled Fund Program, Transportation Research Report No. TRP-03-209-09, Project No.: SPR-3(017)-Year 16, Project Code: RPFP-06-02, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, June 12, 2009.

Final Pooled Fund Reports Completed

Zhu, L., Faller, R.K., Reid, J.D., Sicking, D.L., Bielenberg, R.W., Lechtenberg, K.A., and Benner, C.D., *Performance Limits for 152-mm (6-in.) High Curbs Placed in Advance of the MGS using MASH-08 Vehicles Part I: Vehicle-Curb Testing and LS-DYNA Analysis*, Final Report to the Midwest States' Regional Pooled Fund Program, Transportation Research Report No. TRP-03-205-09, Project No.: SPR-3(017)-Year 17, Project Codes: RPFP-07-03, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, May 6, 2009.

Draft Reports – Projects Funded by Individual State DOT and Routed Through NDOR and/or Pooled Fund Program

Howard, C.N., Stolle, C.J., Lechtenberg, K.A., Faller, R.K., Reid, J.D., and Sicking, D.L., *Dynamic Evaluation of a Pinned Anchoring System for New York State's Temporary Concrete Barriers*, Interim Draft Report to the New York State Department of Transportation, Transportation Research Report No. TRP-03-216-09, Project No.: TPF-5(193), Supplement #8, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, June 23, 2009.

Stolle, C.J., Zhu, L., Lechtenberg, K.A., Bielenberg, R.W., Faller, R.K., Sicking, D.L., Reid, J.D., and Rohde, J.R., *Performance Evaluation of Type II and Type IIA Box Beam End Terminals*, Interim Draft Report to the New York State Department of Transportation, Transportation Research Report No. TRP-03-203-09, Project No.: C-06-16, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, May 21, 2009.

Final Reports – Projects Funded by Individual State DOT and Routed Through NDOR and/or Pooled Fund Program

Rosenbaugh, S.K., Benner, C.D., Faller, R.K., Bielenberg, R.W., Reid, J.D., and Sicking, D.L., *Development of a TL-1 Timber, Curb-Type, Bridge Railing for Use on Transverse, Nail-Laminated, Timber Bridges*, Final Report to the West Virginia Department of Transportation, Transportation Research Report No. TRP-03-211-09, Project No.: SPR-3(017) Supplement No. 53, Project Code: WV-09-2007-B1, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, May 6, 2009.

<u>Pooled Fund Consulting Summary</u>

Midwest Roadside Safety Facility
April 2009– July 2009

This is a brief summary of the consulting problems presented to the Midwest Roadside Safety Facility over the past quarter and the solutions we have proposed.

Problem # 1 –Guardrail Blockouts

State Question:

I have some questions about beam guard blocks.

1. Should a block be allowed to extend below the rail element. See photo DSC00258.JPG. My first guess is that this should not be allowed because one of the purposes of the block is to prevent wheels from snagging on the post. If the block is allowed to extend below the rail, a vehicle may snag on the block.
2. Is having the block extend above the rail element an issue? See 2nd Photo.

Sincerely,

Erik Emerson P.E.
Standard Development Engineer
Wisconsin Department of Transportation
Office: 608-266-2842
4802 Sheboygan Ave.
Rm 651
P.O. Box 7916
Madison, WI 53707-7916
Erik.Emerson@dot.wi.gov

Figure 1. Guardrail Spacer Blocks

MwRSF Response:

Erik:

Traditionally, wood and plastic blockouts have extended both above and below the W-beam guardrail element. The blockouts have been either 14 or 14.25 in. long. As such, up to 1 in. of blockout may be exposed above and below the rail. For these situations, upper and lower surfaces are either cut to be horizontal or sloped inward as one moves to the back of the block. For thrie beam systems, we have used shortened blockouts or tapered blockouts to allow the lower corrugation to fold back some to reduce wheel/rim loading or to remain vertical when the rail deflects, thus reducing the potential for vehicle climb up the rail face.

Therefore, we do allow blockouts to extend above and below the rail element. For specific designs, we have modified blockouts to improve barrier performance. For your situations, the blockout size should correspond to those blocks approved for use with the guardrail systems in question.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 2 –Bridge Rail Gap Size

State Question:

Ron,
When we cross an expansion joint in a bridge and leave a gap in the bridge rail, what is the largest gap we can leave without considering it a snag point?

The rails are flush with each other, flat faced, and continue for several feet.

Should we allow 3" or a little more?

What width of gap is still acceptable?

Has there been testing to prove a snag or not?

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

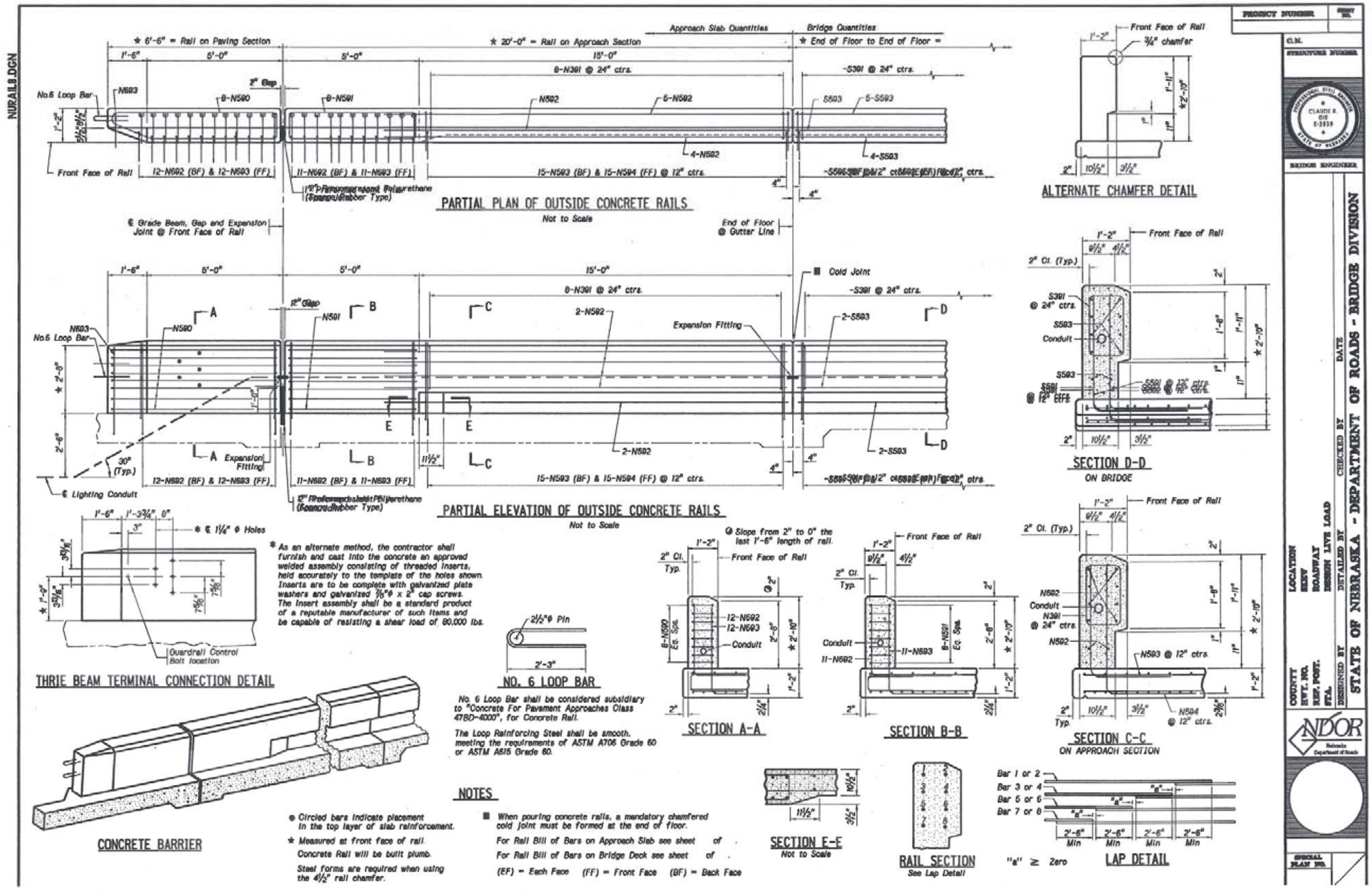


Figure 2. NDOR Concrete Bridge Rail

MwRSF Response:

Many years ago, MwRSF conducted AASHTO PL-1 and PL-2 full-scale crash testing on NDOR's open concrete bridge railing. For this testing program, impacts were performed both at interior sections as well as upstream of an expansion gap. The expansion gap was 4.5" and utilized chamfered edges. The impact angles ranged from 15 to 20 degrees. Although vehicle snag occurred at the downstream exposed edges, it was not sufficient to cause a failure of the tests.

Under the current testing criteria, pickup truck testing is performed at 25 degrees. For the future MASH testing, the impact angle for both the small cars and pickup trucks is 25 degrees. As such, a slight increase in vehicle snag could occur due to the increase in impact angle. Therefore, I would be more inclined to keep the gap width to a maximum of 4". In addition, it is recommended that the edges of the railing at the gap locations be chamfered in order to reduce the propensity for vehicle snag.

Please let me know if you have any questions or comments regarding the information noted herein.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 3 –MGS Post Bolt Hole Location

State Question:

I have a question (below) from Gary Akin of Highway Safety Corp. He notes that the IL Standard for the MGS shows the holes in the posts offset by 1 ¼” horizontally from the vertical centerline of the post. The AASHTO Standardized drawing, and the company drawing show this dimension as 1 1/8”. I have taken a look at the drawings from the report for “Development of the Midwest Guardrail System (MGS) for Standard and Reduced Post Spacing and in Combination with Curbs” and don’t find this dimension shown directly. However, the blockout consistently shows the hole as 1 11/16 from the outer edge of the 6” wide piece. This would leave 1 5/16” from the vertical centerline of the piece.

In the Fall of 2007 we had some discussion through the Pooled Fund group, and I cannot find that this issue was raised. Is this the intent to shift the hole location outward from the center of the post by 1/8” or 3/16”?

David L. Piper, P.E.
Safety Design Engineer
Bureau of Safety Engineering

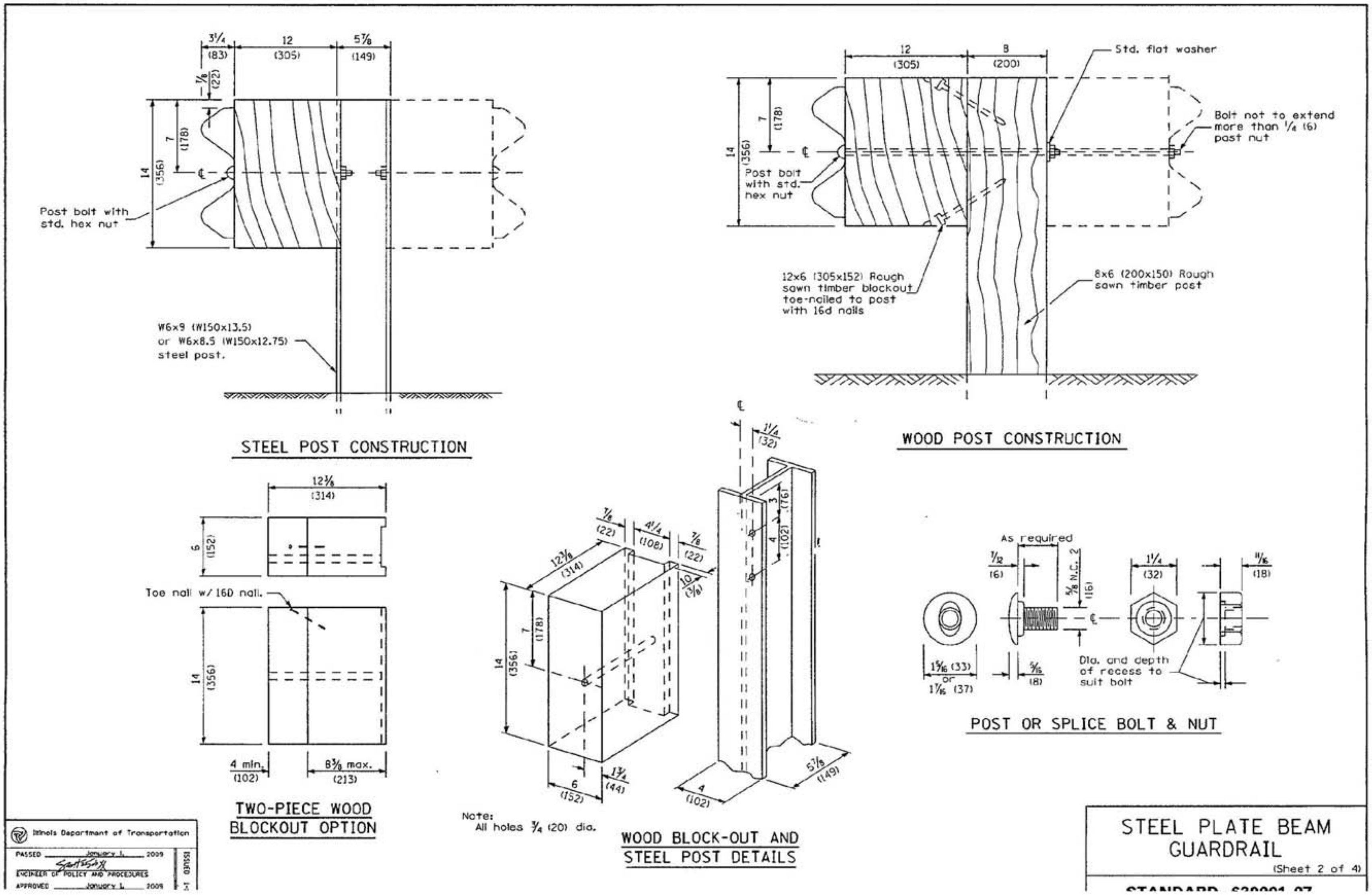


Figure 3. ILDOT Post and Blockout Hole Locations

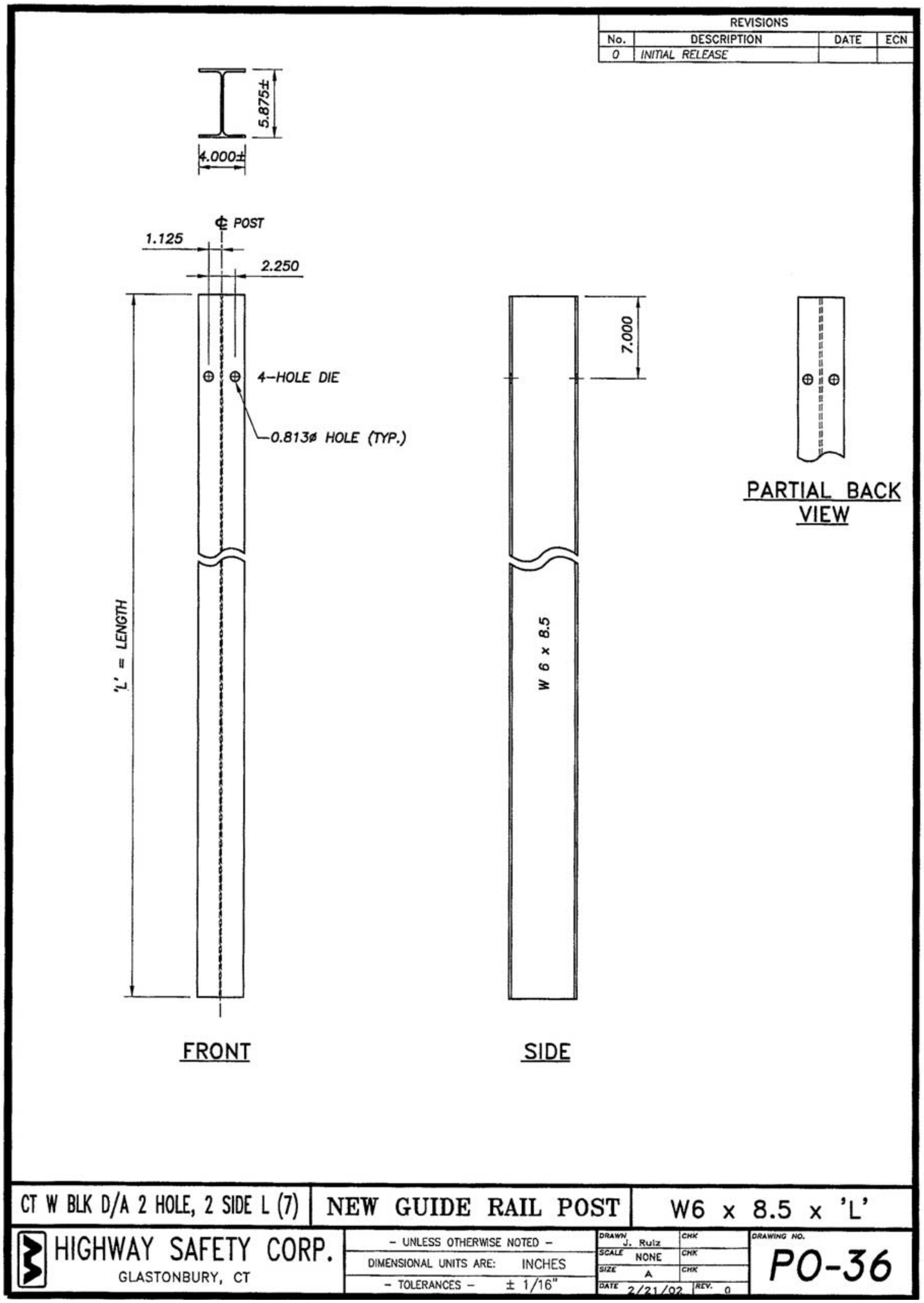


Figure 4. ILDOT Post and Blockout Hole Locations

MwRSF Response:

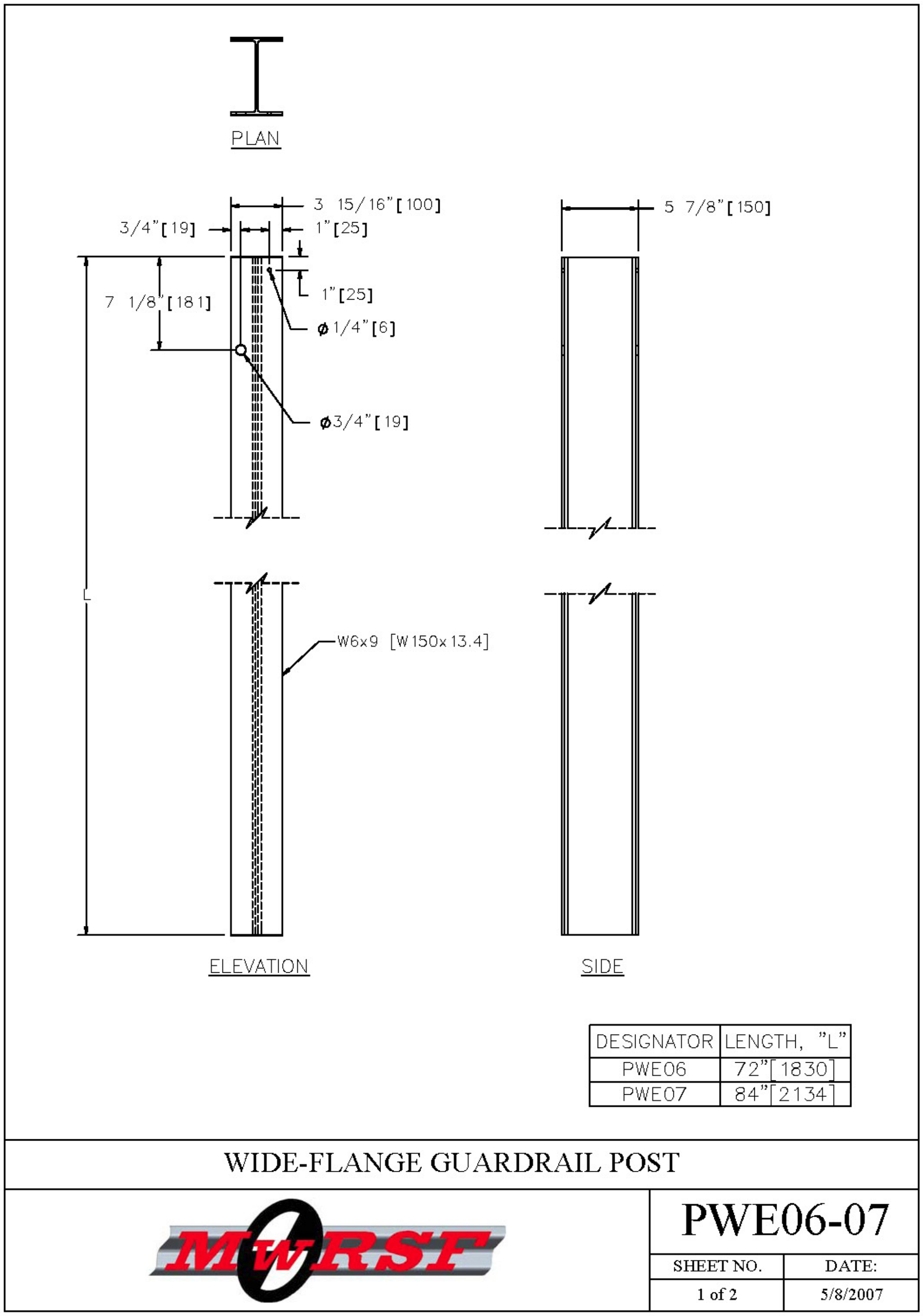
I have reviewed our specs for the MGS posts and the previous hardware guide dimensions and have found the following.

1. I would agree that there are slight discrepancies between what we have shown on our blockout, what your attached details showed, and the hardware guide. I believe that most of the confusion is due to a combination of the use of metric units in the hardware guide, the width of the flange on the W6x9 being 3.94” versus 4”, and measurement of the hole from the center of the post rather than the flange edge. I will attempt to clear this up .
2. I have attached our post and blockout details for the MGS. The post has a ¾” hole located ¾” from the edge of the flange. This would put the hole 1.22” from the center of the post. The hardware guide details for standard w-beam guardrail posts given dimensions of 20 mm form the edge of flange and 30 mm to the center of the post. This would be 0.7874” and 1.1811”, respectively. Thus, these values agree fairly well when considering that the metric conversions often rounded up to the nearest mm. Thus ¾” in the hardware guide is listed as 20 mm. So we believe that our post details have the hole in the correct location. Our blockout details show the bolt hole 1.25” from the center of the block. This would mean that the block is not drawn perfectly centered on the post, but the 0.03” is not something we were going to quibble about.
3. The drawings you supplied show the hole as 1.25” or 1.125” from the center of the post. We believe that the 1.25” dimension is closer to the posts that we spec and tested with and is also closer to the original hardware guide details.
4. I should also note that PO-36 detail you attached shows the post bolt hole as 0.813”. The hardware guide and MwRSF details show a ¾” diameter hole.
5. We would recommend that you use posts with the hole spacing and size similar to our details.

Let me know if you have further questions or comments.

Thanks

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility



PWE_Post_MGS_W6x9_6ft_A36.SLDDRW 5/8/2007

Figure 5. MGS Post and Blockout Hole Locations

SPECIFICATIONS

W–Beam and thrie–beam guardrail posts shall be manufactured using AASHTO M270M (ASTM A709M) Grade 250 steel or ASTM A36/A36M unless corrosion resistant steel is required in which case the post shall be manufactured from AASHTO M270M (ASTM A709M) Grade 50W steel. The dimensions of the cross–section shall conform a W6x9 [W150x13.4] section as defined in AASHTO M160M (ASTM A6M). W6x8.5 [W150x12.6] wide–flange posts are an acceptable alternative that is considered equivalent to the W6x9 [W150x13.4].

After the section is cut and all holes are drilled or punched, the component should be zinc–coated according to AASHTO M111 (ASTM A123) unless corrosion resistant steel is used. When corrosion resistant steel is used the portion of the post to be embedded in soil shall be zinc–coated according to AASHTO M111 (ASTM A123) and the portion above the soil shall not be zinc–coated, painted, or otherwise treated.

DESIGNATOR	AREA in.^{2} [10^3 mm^2]	I_X in.^{4} [10^6 mm^4]	I_Y in.^{4} [10^6 mm^4]	S_X in.^{3} [10^3 mm^3]	S_Y in.^{3} [10^3 mm^3]
PWE06–07	2.68 [1.7]	16.4 [6.83]	2.20 [0.92]	5.56 [91.1]	1.11 [18.2]

Dimensions tolerances not shown or implied are intended to be those consistent with the proper functioning of the part, including its appearance and accepted manufacturing practices.

INTENDED USE

Post PWE06–07 is used with any Midwest Guardrail System (SGR20–23) variations.

CONTACT INFORMATION

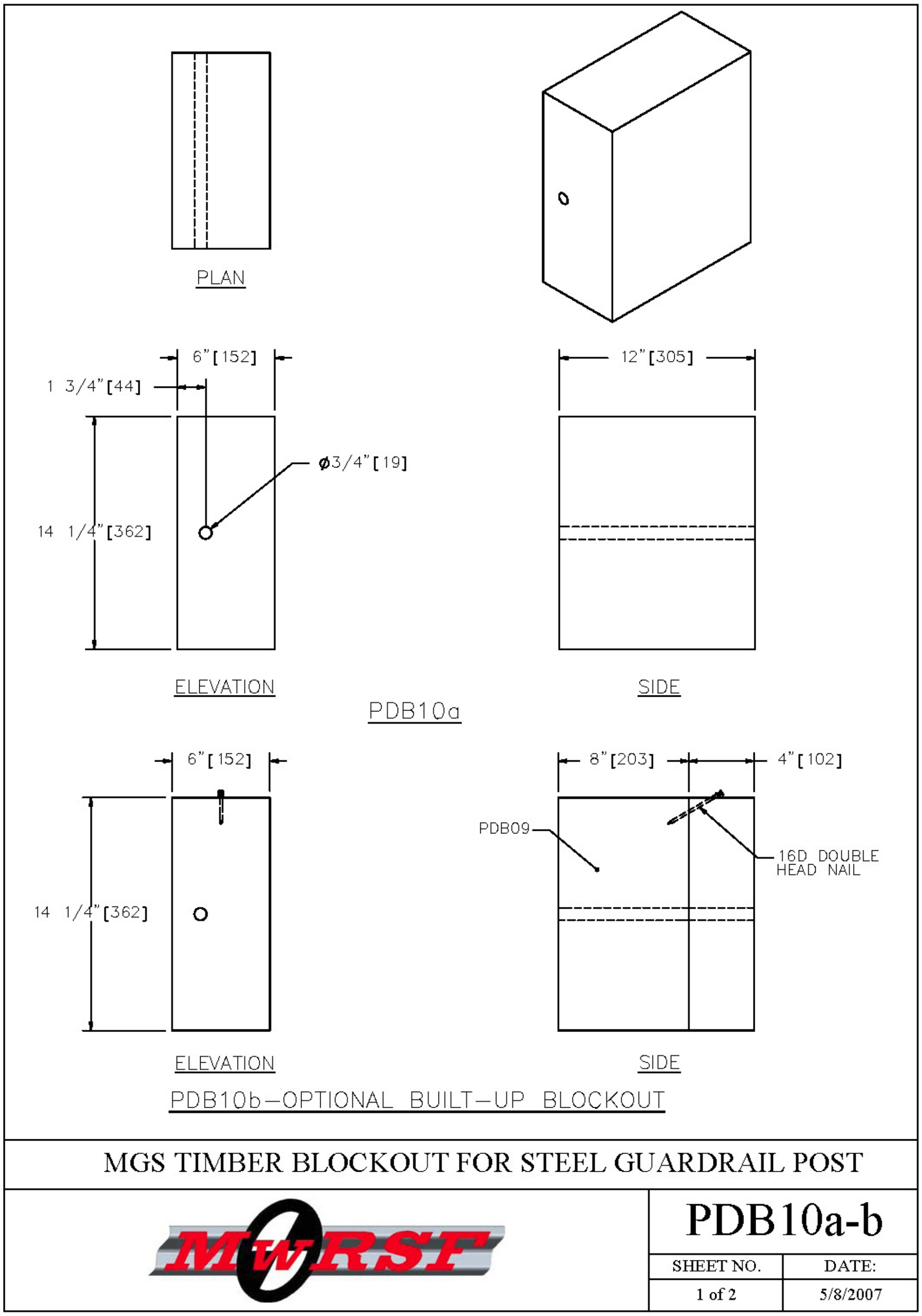
Midwest Roadside Safety Facility
E527 Nebraska Hall
Lincoln, NE 68588–0529
(402) 472–0965
Email: mwrsf@unl.edu
Website: http://mwrsf.unl.edu/

WIDE-FLANGE GUARDRAIL POST

PWE06-07	
SHEET NO.	DATE:
2 of 2	5/8/2007

PWE_Post_MGS_W6x9_6ft_A36.SLDDRW 5/8/2007

Figure 6. MGS Post and Blockout Hole Locations



PDB10ab_blockout_6x12x14.25.SLDDRW 5/8/2007

Figure 7. MGS Post and Blockout Hole Locations

SPECIFICATIONS

Blockouts shall be made of timber with stress grade of at least 1200 psi [8 MPa]. Grading shall be in accordance with the rules of the West Coast Lumber Inspection Bureau, Southern Pine Inspection Bureau or other appropriate timber association. Minimum of SYP Grade No. 1 or better. Timber for blockouts shall be either rough sawn (un-planed) or S4S (surfaced four sides) with nominal dimensions indicated. The variation in size of blockouts in the direction parallel to the axis of the bolt holes shall not be more than ±1/4" [6mm]. Only one type of surface finish shall be used for posts and blockouts in any one continuous length of guardrail.

All timber shall receive a preservation treatment in accordance with AASHTO M-133 after all end cuts are made and holes are drilled.

Dimensions tolerances not shown or implied are intended to be those consistent with the proper functioning of the part, including its appearance and accepted manufacturing practices.

INTENDED USE

This blockout is used with a steel, wide-flange guardrail post (PWE06) in any Midwest Guardrail System (MGS) variations (SGR20-23).

CONTACT INFORMATION

Midwest Roadside Safety Facility
E527 Nebraska Hall
Lincoln, NE 68588-0529
(402) 472-0965
Email: mwrsf@unl.edu
Website: http://mwrsf.unl.edu/

MGS TIMBER BLOCKOUT FOR STEEL GUARDRAIL POST

PDB10a-b	
SHEET NO.	DATE:
2 of 2	5/8/2007

PDB10ab_blockout_6x12x14.25.SLDDRW 5/8/2007

Figure 8. MGS Post and Blockout Hole Locations

Problem # 4 –Steel Bridge Railing Question

State Question:

Ron,

What would be your opinion of installing a steel bridge railing (Illinois 2399 curb-mount) at standard post spacing (6'-3" as tested), but increasing the post spacing at four locations on the bridge in order to accommodate some structural members? Our consultant feels they can limit the maximum post spacing at these locations to 7'-6". Do you think allowing the larger post spacing at these locations would be feasible without additional testing, or should we be investigating other options?

Thanks for your input.

-Chris

Chris Poole, P.E.
Litigation/Roadside Safety Engineer
Office of Design
Iowa Department of Transportation

MwRSF Response:

Chris,

MwRSF feels that increasing the post spacing from 6'-3" to 7'6" in only a few non-adjacent spans is a possible task. However, the bridge rail must be stronger to accommodate the 20% increase in moment due to the elongated post spacing. As such, we recommend the following:

Replace the 4"x4" bottom tube with another 8"x4" tube (the top tube). Thus, the bridge rail would consist of 2 8"x4" tubes. Assuming the top and bottom rail carry equal loads (which it really doesn't – top takes more load), this small change would provide a 30% increase in rail strength - enough to accommodate the 20% increase in moment.

This rail combination should be used throughout the bridge to ensure rail continuity and prevent snag points

Also, keep the bottom of the lower tube at 14" above the roadway. Thus the top of the lower tube is 22" above the roadway (2" gap between rails). This will allow the lower rail to better interact with an impacting vehicle and absorb more of the impact load.

Hopefully this helps your situation.

Scott Rosenbaugh
Midwest Roadside Safety Facility (MwRSF)

University of Nebraska – Lincoln

Problem # 5 – W-Beam Guardrail Over Culvert

State Question:

In 2002, MwRSF published the test results on a guardrail system for use on concrete box culverts. For the design, 1” diameter, ASTM A307 through-bolts were used to anchor the post with welded base plate. However, there may be situations where the bolts cannot be placed through the culvert slab when they fall within the location of the culvert walls. What anchorage alternative would be used in lieu of the through bolts?

What are your thoughts for alternative anchor systems when through-bolting is not applicable?

MwRSF Response:

I have reviewed the archived material for the original R&D W-beam guardrail-culvert program. From this review, I was unable to find documentation on the embedment length for the threaded rods that were used in the bogie testing program on the concrete tarmac. I do believe that our policy has always been to use sufficient length to allow for the epoxy to develop the capacity of the rod material. Practically speaking, I can only assume from past experience that these 1-in. diameter rods would have been at least 10 to 12 in. long. As shown below, these rods would develop an axial capacity of more than 36 kips. Now, it may be possible that the rods did not experience this 36-kip load in each of the two tensile rods as the base plate was designed to yield and control the peak load imparted to the deck. However, it is difficult to determine the actual load imparted to the rods. We do know that the peak lateral post load was 14.68 kips.

If one were to assume that the post rotated about the back edge of the plate and the outer bolt row carried all of the uplift, then the outer tension row would be expected to carry a tension load equal to (14.68 k x 30.025 in.) / 9 in. = 48.97 kips. Thus, each bolt would see approximately 24.5 kips (bolts are closely spaced in the lateral direction too). In addition, if the base plate actually yields, then one would expect the load imparted to the bolts to be reduced somewhat. In any event, one would try to come up with alternatives to carry this axial load at a minimum to ensure that bolt fracture or release does not occur.

For thin concrete culvert slabs, it may be difficult to find anchors than carry this load for 1” diameter rods, especially when two rods must be located close to one another. As such, one solution may be to design a larger plate that can be anchored to the slab with through bolts on the sides of the culvert walls. Then, the post/base plate would need to be anchored to the large, thick plate. Now, it may be necessary to use structural beams and a plate to make the larger mounting system for which to anchor the post/base plate system on its upper surface. This type of system would also allow for bolt heads/nuts on the underside of the surface mounting system. This system would also require that some minimum thickness of soil be available on top of the culvert slab.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 6 – Questions on Thrie beam transitions, nesting of beam guard and thrie beam barrier

State Question:

Dear MwRSF,

I know that you are very busy getting ready for the pool fund meeting. However, I have some questions about transitions to concrete barrier, nesting of rails, and thrie beam barrier.

Transitions to Concrete Barrier

When I look at our detail drawings for thrie beam transitions, I notice that we are requiring a minimum 4’ embedment. In TRP-03-69-98 “Two Approach Guardrail Transitions for Concrete Safety Shape Barriers” posts 1-7 have 4’-4” of embedment.

I’m planning on updating our details to match TRP-03-69-98 for posts 1-7. However, there is note 2 on the detail sheet 1 indicates that if the grading behind the thrie beam transition cannot be provided that the field staff is to use post that are 4’-6” or longer.

I believe using longer post would be warranted in reduced grading situations, but I do not believe that what is in the detail is sufficiently long enough to provide the needed soil resistance to rotation. What would be MwRSF’s recommendation for post length for reduced grading for a structural transition?

I’m planning on adding the 4” tall by 8” wide dike that is below the rail between post 1 to 7. Discussions with staff have indicated that it may be problematic having the post of the transition flush with the dike. They are concerned that it may not be possible to drive the post flush. Is there some tolerance to how close the post can be to the back of the dike?

In some existing installation, staff has omitted a post or posts between posts 1 and 7 to accommodate drainage structures. I will be writing some guidance to discourage the practices, but there could existing installations or unique site-specific situations that may require post or posts to be omitted. In these situations, does MwRSF have a recommendation on what to do?

On page 2 and 3 of the SDD, we currently allow the use of beam guard on the down stream end of a concrete barrier installation. I’m have some concerns that transitioning from concrete barrier to beam guard may be too abrupt. Does MwRSF have any recommendations on what to do on downstream ends of concrete barrier?

Nesting of rails for Beam Guard

I’m currently writing up design guidance requiring the uses of nested beam guard when using 4” mountable curb. One of the questions that has come up is deals with the structural transition. Would using nested beam guard change the overall design of the thrie beam transition?

The second question is: Would using nested beam guard effect how a beam guard end treatment would be attached to the nest beam guard system?
The third question would be: Would a special transition be needed between standard beam guard and nested beam guard?

My first answer to the three question proposed was to say no. However, if MwRSF would provide comment it would be appreciated.

Thrie beam

If a situation developed where 2’ of grading could not be provided behind a Thrie beam barrier run (i.e. not a structural thrie beam transition just regular thrie beam), could the guidance for beam guard with reduce grading (i.e. longer posts at ½ post spacing) be and equal alternative to providing the 2’ of grading behind the post?
Sincerely,

Erik Emerson P.E.
Standard Development Engineer
Wisconsin Department of Transportation

MwRSF Response:

Erik,

See my comments below in red on the various topics.

Dear MwRSF,

I know that you are very busy getting ready for the pool fund meeting. However, I have some questions about transitions to concrete barrier, nesting of rails, and thrie beam barrier.

Transitions to Concrete Barrier

When I look at our detail drawings for thrie beam transitions, I notice that we are requiring a minimum 4’ embedment. In TRP-03-69-98 “Two Approach Guardrail Transitions for Concrete Safety Shape Barriers” posts 1-7 have 4’-4” of embedment.

I’m planning on updating our details to match TRP-03-69-98 for posts 1-7. However, there is note 2 on the detail sheet 1 indicates that if the grading behind the thrie beam transition cannot be provided that the field staff is to use post that are 4’-6” or longer.

I believe using longer post would be warranted in reduced grading situations, but I do not believe that what is in the detail is sufficiently long enough to provide the needed soil resistance to rotation. What would be MwRSF's recommendation for post length for reduced grading for a structural transition?

Currently, MwRSF is exploring the necessary embedment depth of a 6"x8" post on a 2:1 slope to match the force-deflection characteristics of a standard MGS post (40 in. embedment). From recent component testing for the MGS on 2:1 slope project, MwRSF had concluded that a 9 ft long W6x9 was adequate to replace the standard 6 ft long post used in the MGS on flat terrain. However, a test impacting a 9-ft long 6"x8" wood posts on the 2:1 slope resulted in the post breaking early on in the test – (The same result was observed during a test with an 8-ft long wood post on a 3:1 slope). Therefore, the post embedment and/or the post size may need to be altered to achieve the required force-deflection characteristics. Until the data is fully analyzed and a solution is prepared, the bogie testing had been put on hold. This problem should be answered in the near future.

I'm planning on adding the 4" tall by 8" wide dike that is below the rail between post 1 to 7. Discussions with staff have indicated that it may be problematic having the post of the transition flush with the dike. They are concerned that it may not be possible to drive the post flush. Is there some tolerance to how close the post can be to the back of the dike?

I would recommend installing the posts before pouring the curb – that was how the test installation was constructed. In doing so there may be a ½" – 1" gap between the posts and curb from the concrete form. This size of gap would be acceptable. Anything larger could affect the response of the system.

In some existing installation, staff has omitted a post or posts between posts 1 and 7 to accommodate drainage structures. I will be writing some guidance to discourage the practices, but there could existing installations or unique site-specific situations that may require post or posts to be omitted. In these situations, does MwRSF have a recommendation on what to do?

MwRSF would also strongly discourage this practice. Eliminating a post from a transition can result in drastically changing the stiffness characteristics of the transition and can lead to the creation of hazardous pocketing locations. I would try to avoid these situations by moving either: (1) the drainage structure, or (2) extending the concrete barrier to the drainage structure so that the transition does not span over the obstacle.

On page 2 and 3 of the SDD, we currently allow the use of beam guard on the down stream end of a concrete barrier installation. I'm have some concerns that transitioning from concrete barrier to beam guard may be too abrupt. Does MwRSF have any recommendations on what to do on downstream ends of concrete barrier?

The transition of concrete to w-beam rail is not a problem unless there is a possibility of vehicle's traveling in the opposite direction impacting this transition (thus, making it a w-beam to concrete transition). This is detailed on page 1 of these drawings in which an undivided roadway should contain thrie beam transitions at all 4 locations .

Nesting of rails for Beam Guard

I’m currently writing up design guidance requiring the uses of nested beam guard when using 4” mountable curb. One of the questions that has come up is deals with the structural transition. Would using nested beam guard change the overall design of the thrie beam transition?

The thrie beam transition drawings you have sent already prescribe nested thrie beam, so I am unclear on your question. If you are asking if you can use only a single rail instead of nesting the rail… this would have to be evaluated/tested for the particular system in question.

The second question is: Would using nested beam guard effect how a beam guard end treatment would be attached to the nest beam guard system?

YES. End treatments are specifically design for a particular rail. Thus, unless the end treatment was designed for nested rail, only single rail segments should be hung adjacent to the end terminal

The third question would be: Would a special transition be needed between standard beam guard and nested beam guard?

If you are asking if special treatment is needed when going from w-beam to nested w-beam (or thrie to nested thrie), this has not been done previously. However, if this is going to change a transition system design, I would not recommend it without further analysis/testing.

My first answer to the three question proposed was to say no. However, if MwRSF would provide comment it would be appreciated.

Thrie beam

If a situation developed where 2’ of grading could not be provided behind a Thrie beam barrier run (i.e. not a structural thrie beam transition just regular thrie beam), could the guidance for beam guard with reduce grading (i.e. longer posts at ½ post spacing) be and equal alternative to providing the 2’ of grading behind the post?

See response above about current work for posts on slope break points.

Problem # 7 – Questions on Thrie beam transitions, nesting of beam guard and thrie beam barrier - Continued

State Question:

With regards to the nested rail question, the question is: If I have nested beam guard (i.e. I'm not using standard beam guard) going into a "normal" thrie beam transition (i.e. as per the detail), do I need to do something different with the "normal" thrie beam transition because the nested beam guard is stiffer than normal beam guard.

MwRSF Response:

Going from nested guardrail into a transition system with only a single thrie rail should not be a problem. Transitions are sensitive because they go from a relatively “weak” rail section to stiff or “strong” rail section. However, having a nested rail on the front end, or the “weak” section, reduces the difference in stiffness or strength between the two sections, making the transition easier.

Problem # 8 –Evaluation of Safety Treatments for Roadside Culverts Questions

State Question:

Dear MwRSF,

In your study on box culverts, I have some questions:

1. Did the presents of water at the box culvert affect the accident severity? Or did you only look at "dry" box culverts that occasionally fill with water during rain events (e.g. if Figure 6 on page 29 had always has a water depth of 5 to 10' verses 1' would that have and effect on the decision to grate/extend/shield?).
2. A 10x12 box culvert is a single cell 10’ tall by 12’ long box culvert. What impact would multiple cells of the same size have on the analysis?
3. In 3R situations, project staff has made the decision to extend the box culvert only to the minimum 18’clear zone. The 18’ clear zone is from Special Report 214 Practices for Resurfacing, Restoration, and Rehabilitation (TRB). This report is the foundation for most states 3R standards design standards.   In the report, MwRSF is using the values from the RDG for culvert extensions. Is MwRSF indicating that for larger drainage features, such as box culverts, an agency should strive to greater than 18’ clear zone recommended by Special Report 214? If so, what is the basis for the recommendation?
4. Our structure’s department is not hot on the idea of using grates because they are worried that they will “clog up with debris”. Basically, if there is a forest in the watershed they do not want to use grates. Has there been studies on how often box culverts get clogged, or is there guidance on when it is O.K. to use grates even if there is a chance of the box being clogged?

As always, I appreciate your comments

Sincerely,

Erik

Erik Emerson P.E.
Standard Development Engineer
Wisconsin Department of Transportation

MwRSF Response:

Erik,

Standard severities from RSAP were used to describe the box culvert hazard. Although these culvert severities probably were not intended to include water, all severities incorporated into

RSAP have proven to be excessive. And it is reasonable to regard RSAP culvert severities to be representative of having some water in the box.

Adding two or three box culverts in a row would essentially create a longer hazard. Our sensitivity analysis showed that longer hazards create higher cost/benefit ratios for any given safety treatment. Further lengthening the hazard would make moving the culvert farther from the roadway more beneficial relative to the other two treatment options.

With regard to the clear zone offset requirements, the MsRSF had no intention to indicate that the clear zone should or should not be adjusted for 3R work relative to new construction. We chose clear zone limit its used by our sponsor, Iowa, in this study.

Many DOT's have expressed concern over culvert grates becoming clogged and leading to flooding. In a study conducted many years ago, TTI explored this problem and found no evidence of clogging. Unfortunately TxDOT chose not to publish that report. Recall that great bars are 30 inches apart and can span lengths of 20 feet or more. TTI's findings indicated that 2-1/2 foot wide by 20 foot long openings are difficult to clog, even in heavily wooded areas. Iowa has been using grades for a number of years. Perhaps you could contact them to see if clogging has been a problem.

Let me know if you need more information.

Thanks

Dean

Problem # 9 –Guardrail Bolt Length

State Question:

Dear MwRSF,

I received this question from our maintenance staff. It has to deal with bolt length on the back side of beam guard installation. If MwRSF could provide input it would be appreciated.

Erik
-----Original Message-----
From: Zogg, Jerry - DOT
Sent: Thursday, May 28, 2009 3:55 PM
To: Emerson, Erik - DOT
Cc: Wendels, James - DOT
Subject: RE: Standard Specifications Question
Erik,

Wondering if you could forward this to one of your staff who would know reasoning behind a spec so I have a better understanding of purpose?

RE: Guard Rail - bolt length

Issue: The specs call for no more than ½ inch of anchor bolt to protrude beyond the fastening nut. When this spec has been exceeded the guidance is to cut them off, chamfer and restore with zinc coating.

Question: Wondering what the issue is with bolt length and consequences thereof such as performance of the guard rail system if they are not cut? The system in question is on a CTH system utilizing state funding in an effort to bring guard rail up to standards for a detour route. Metal posts and plastic blockouts were used.

Thanks,
James G. Wendels, P.E.
WisDOT, DTSD - North Central Region
Roadway Maintenance Engineer

MwRSF Response:

Erik:

I have reviewed the information provided below and am uncertain as to the direction of the question. Are you referring to the guardrail splice bolts or the guardrail post bolt? For connecting rail ends at a guardrail splice, standard guardrail bolts are used and are specified in AASHTO-AGC-ARTBA hardware guide. There should be no reason to cut or modify these bolts if ordered using the standard hardware. For placing rail and blockouts to posts, standard post bolts are also used to make this connection. These bolts have a specified thread length and should not require cutting or modification when the appropriate length is ordered. For rail to post attachment, the length of the threads extending out of the nut would not need to be limited to 0.5 in. or less for performance reasons. In rare circumstances, a unreasonable long rod could potentially contact the hazard face sooner than if the proper length bolt were used. However, I do not see this as being a big concern. If too long of a bolt were used, it would be difficult to use since the thread length is limited, thus not allowing the nut to be tightened. Are contractors trying to use non-standard bolts which require field modification in order to install the nut? If yes, I recommend that proper bolt length be used with standard guardrail bolts to avoid these field issues.

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 10 –New MGS Transition and Wood Post Inventory

State Question:

Ron,

Would you be able to provide me with the latest drawings of the simplified MGS bridge transition?

Also, I have had a question arise from our parts warehouse regarding 8x8 wood posts and blockouts. Is there still a need for us to stock these, or can we replace any 8x8 wood post and/or blockout with a 6x8 version instead? If so, could we replace only one at a time, or would we need to replace all posts and blockouts within the installation at the same time?

Thanks for your help.

-Chris

Chris Poole, P.E.
Litigation/Roadside Safety Engineer

MwRSF Response:

Chris:

I am copying this email to Karla so that she can direct a MwRSF staff member to get you the latest approach guardrail transition detail for the MGS attached to a thrie beam transition that utilizes a half-post spacing. In the future, MwRSF will provide details on how to adapt the noted transition to thrie beam transitions that use a quarter-post spacing.

With regard to wood posts and blockouts, MwRSF is still evaluating the appropriate wood post size and length for use as a substitute in the simplified, steel-post, stiffness transition. Results from this component testing and analysis should be available within 2-3 months.

As noted at the spring Pooled Fund meeting, 6”x8” by 6’ long wood posts have been approved for use in the MGS as a substitute for the W6x9 by 6’ long steel posts. Although we are confident of their use in the MGS, we were hopeful that the Pooled Fund group would fund the 2270P crash test. Unfortunately, that funding did not come to fruition in the recent meeting due to a prioritization of other projects, such as cable barrier projects. At any rate, Iowa could begin to implement the standard wood post size into the MGS based on the prior FHWA acceptance of the MGS. In addition, Iowa could also implement 6x8 blocks standard guardrail utilizing the 8x8 posts at any time. However, it would be acceptable to use the 6x8 blocks with metric height W-beam rail using 6x8 posts. Finally, you would want to use 6x12 blocks for any MGS installations using W6x8.5 and W6x9 steel posts, or 6”x8” wood posts.

Please let me know whether you have any additional questions or comments regarding the information contained above. Thanks!

Ron

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor

Problem # 11 – Iowa Transition Design Adaptation

State Question:

Not that Iowa is unwilling to change, but how would our current design be modified to apply the findings of your recent project? I have attached the most up-to-date version of our metric-height transition. If this becomes too complicated, we have no reservations about switching to the bigger posts and wider post spacing.

Chris Poole, P.E.
Litigation/Roadside Safety Engineer

MwRSF Response:

Chris,

I have attached a PDF containing MwRSF's recommendations for the transition to the Iowa transition.

The top configuration is the one you sent us yesterday.
The bottom configuration is the transition to the transition that MwRSF tested last year.

The middle configuration takes the 7-ft posts @ 18.75" spacing from the Iowa transition and adds the MwRSF transition to the transition on the upstream end. Note, the U.S. end is now MGS rail and the W – to – thrie transition element has been updated accordingly.

Let us know if you have any questions.

Scott Rosenbaugh
Midwest Roadside Safety Facility (MwRSF)
University of Nebraska – Lincoln

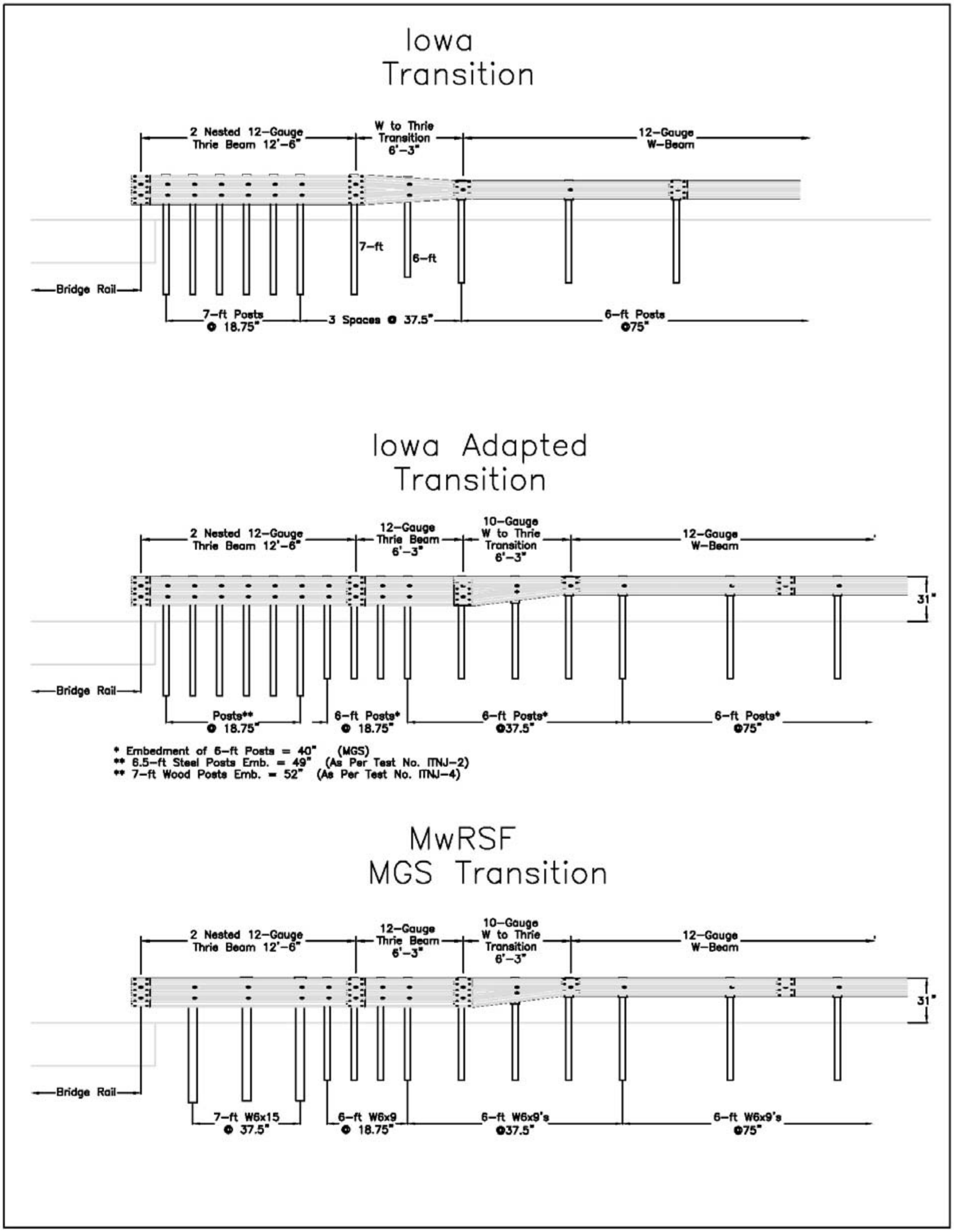


Figure 9. Iowa Transition Design Adaptation

Problem # 12 – Double Blockouts with MGS

State Question:

Can double blockout be used with the MGS in situations where individual posts cannot be installed at the normal offset to the rail due to some obstruction that prevents proper embedment of the post?

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

Hello Phil,

At the Pooled Fund meeting you requested that I send you a response in writing regarding Dr. Sicking's guidance on the use of double blockouts with the MGS system in situations where individual posts cannot be installed at the normal offset to the rail due to some obstruction that prevents proper embedment of the post. MwRSF believes that the MGS system can tolerate double blockouts on one or two posts in this situation. This will change the effective blockout depth from 12" to 24" which should allow for placement of the post outside many obstructions. The use of double blockouts will require the use of a longer post bolt.

If you require further clarification or have any other questions let me know.

Thanks

Bob Bielenberg, MSME, EIT
Research Associate Engineer
Midwest Roadside Safety Facility