Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
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Project No.:	RPFP-06-01 – SPR-3(017) Supplemental #35
Project Title:	Cost Effective Measures for Roadside Design
Starting Date:	July 1, 2005
Completion Date:	December 31, 2011
Principal Investigator:	Rohde, Sicking, Reid, Faller
Co-PIs & Team Members:	Lechtenberg
Author:	K. Lechtenberg

Progress:

Task	% Completed
1. Field study of roadside hazards on low-volume roads	100
2. Compilation of field study findings	100
3. Selection of common roadside hazards for analysis	100
4. RSAP analysis and evaluation of selected roadside hazards	100
5. Research report	50

Activity This Quarter:

Previously, a field study was conducted to document roadside hazards found on low-volume roads. Following this field study, the most common hazards were selected for further treatment analysis. The analysis, evaluation, and documentation of treatment options for culverts, trees, bridges, and slopes/ditches found along low-volume roadways has been completed. A draft report has been prepared and is undergoing internal review.

During this quarter, internal review of the draft research report has continued.

Activity Next Quarter:

Complete internal review of the draft research report. Submit draft report to Pooled Fund member states for review and comment. Publish the final research report.

Problems/Comments:

Due to a shifting of staff priorities, work of reviewing the internal draft report was greatly diminished.

Total Percentage of Project Completion:

It is anticipated that 85% of the research effort has been completed.

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Project No.:	RPFP-06-01 // SPR-3(017) Suppl. #35
Project Title:	Termination of Temporary Concrete Barrier
Starting Date:	7/1/2005
Completion Date:	12/31/2011
Principal Investigator:	Rohde, Sicking, Faller, Reid
Co-PIs & Team Members:	Bielenberg
Author:	Bielenberg

Progress:

Task	% Completed
1. Computer simulation to determine LON and anchorage	100
2. Design of anchorage system	100
3. Full-scale crash testing with 2270P	100
4. Documentation and analysis of test results	100
5. Summary report, final CAD details, FHWA approval letter	95

Activity This Quarter:
(Provide an informative summary of tasks/activities that occurred this quarter)

Prior to this quarter, MwRSF had completed the design and full-scale crash testing of the termination and anchorage for temporary concrete barrier. In addition, the summary report of the system was completed and submitted to the sponsors. During the last quarter, progress focused on finishing a few final tasks. A request for federal approval of the termination and anchorage for temporary concrete barrier was submitted to FHWA during this quarter. FHWA has received the request and is in the process of evaluating it. MwRSF also worked on compiling the CAD details required for submission of the termination and anchorage for temporary concrete barrier to the Hardware Guide. The draft version of these CAD details is finished and is currently under internal review.

Activity Next Quarter:
(Provide an informative summary of the tasks/activities that are planned for the following quarter)

The only work remaining in this project is to finalize the CAD details for the Hardware Guide. After internal review and editing of the details, the CAD will be submitted to the AASHTO Hardware Guide committee for review and incorporation.

Problems/Comments:

There are no problems or issues to report at this time.

Total Percentage of Project Completion:

95%

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Project No.:	RPFP-06-02 // SPR-3(017) Suppl. #35
Project Title:	Develop Temporary Concrete Barrier Transition
Starting Date:	7/1/2005
Completion Date:	12/31/2011
Principal Investigator:	Rohde, Sicking, Faller, Reid
Co-PIs & Team Members:	Bielenberg
Author:	Bielenberg

Progress:

Task	% Completed
1. Poll of sponsors to determine critical transition need	100
2. Computer simulation to determine LON and anchorage	100
3. Design of anchorage system	100
4. Full-scale crash testing with 2270P	100
5. Summary report, final CAD details, FHWA approval letter	95

Activity This Quarter:
(Provide an informative summary of tasks/activities that occurred this quarter)

Prior to this quarter, MwRSF had completed the design and full-scale crash testing of the temporary concrete barrier transition. After review and consultation with the sponsoring states, a transition between F-shape temporary concrete barrier and a permanent, single-slope concrete barrier was chosen as the critical transition design for development and testing. In addition, the summary report of the system was completed and submitted to the sponsors. During the last quarter, progress focused on finishing a few final tasks. A request for federal approval of the temporary concrete barrier transition was submitted to FHWA during this quarter. FHWA has received the request and is in the process of evaluating it. MwRSF also worked on compiling the CAD details required for submission of the temporary concrete barrier transition to the Hardware Guide. The draft version of these CAD details is finished and is currently under internal review.

Activity Next Quarter:
(Provide an informative summary of the tasks/activities that are planned for the following quarter)

The only work remaining in this project is to finalize the CAD details for the Hardware Guide. After internal review and editing of the details, the CAD will be submitted to the AASHTO Hardware Guide committee for review and incorporation.

Problems/Comments:

There are no problems or issues to report at this time.

Total Percentage of Project Completion:

95%

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Project No.:	RPFP-07-01 – SPR-3(017) Supplement #38
Project Title:	Cost-Effective Upgrading of Existing Guardrail Systems
Starting Date:	February 26, 2007
Completion Date:	December 31, 2012
Principal Investigator:	Reid, Rohde, Sicking, Faller
Co-PIs & Team Members:	Lechtenberg, Rosenbaugh
Author:	K. Lechtenberg

Progress:

Task	% Completed
1. Field study of existing guardrail installations	100
2. Compilation of field study findings	100
3. Selection of installations to investigate	100
4. Sensitivity study to decrease the size of the analysis matrix	100
5. RSAP analysis	50
6. Research report	10

Activity This Quarter:

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 one week investigation, more than 60 specific sites were visited, measured, photographed, and documented. A review and compilation of the field survey information was completed in the Fourth Quarter of 2009. An analysis of the field data was initiated in the Fourth Quarter of 2009. Due to a shifting of staff priorities, work was greatly slowed in early 2010. However, analysis of field data was completed in the Third Quarter of 2010. A sensitivity study using RSAP, initiated to decrease the size of the analysis matrix, was completed in the Third Quarter of 2010. A containment level analysis to determine the appropriate severity indices was completed during the Fourth Quarter of 2010. The analysis matrix was also completed during the Fourth Quarter.

During this quarter, evaluation of the RSAP analysis was undertaken. Additional RSAP analysis utilizing runout lengths as shown in the updated Roadside Design Guide was initiated. Documentation of the research study was initiated.

Activity Next Quarter:

The additional analysis using runout lengths denoted in the updated Roadside Design Guide will be completed. A draft report of research study will be completed.

Problems/Comments:

The analysis was completed with the longer runout lengths. Thus, additional analysis will be completed with the shorter runout lengths that will be published in the updated Roadside Design Guide

Total Percentage of Project Completion:

It is anticipated that 75% of the research effort has been completed.

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Project No.:	SPR-3(017) Suppl.#38 2611120090004 - RPFP-07-03
Project Title:	Performance Limits for 6in High Curb in Advance of MGS w/update
Starting Date:	2007-02-26
Completion Date:	2012-12-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Rohde, Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1. Project work and final report finished in 2010	100%
2. FHWA acceptance request and approval	0%
3.	
4.	
5.	

Activity This Quarter:

Placed in student queue to accumulate FHWA package.

Activity Next Quarter:

Re-evaluate if there is a precise system we can request approval for from FHWA. If there is one then: (1) Assign task to student, (2) student to prepare packet, and (3) submittal to FHWA.

Problems/Comments:

Student staff is assigned to higher priority projects.

Total Percentage of Project Completion: 98%

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Project No.:	SPR-3(017) Suppl.#38 2611120090007 - RPFP-07-06
Project Title:	Cable Guardrail End Terminal Development using 350 Update Vehicles
Starting Date:	2007-02-26
Completion Date:	2012-12-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Rohde, Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1. Background and literature review	100%
2. Design and analysis	50%
3. Full-scale testing	0%
4. Report	0%
5.	

Activity This Quarter:

Background and literature review was completed.

LS-DYNA simulation of full-scale 3-cable terminal test CT-4 was completed.

CT-4

54 ms 172 ms 384 ms

CT4-8 ($yaw_{initial}$ = 10 deg/s)

55 ms 175 ms 390 ms

Activity Next Quarter:

Perform simulation parameter studies with the 3-cable terminal model to better determine causes of poor performance and possible design modifications to improve performance. Of primary interest are cable tension, impact location, debris impacted by the vehicle during the early stages of the event, and initial yaw rate of the vehicle.

Begin development of the 4-cable high tension terminal system based on the 3-cable terminal simulation study.

Problems/Comments:

Detailed design and full-scale testing for this project cannot be started until the High Tension Cable Barrier System is completed.

This is Phase I of the project. Phase II was funded in Year 20: TPF-5(193) Suppl. #21 2611211028001 – RPFP-10-CABLE-3.

Total Percentage of Project Completion: xx%

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Project No.:	RPFP-08-02, SPR-3(017) Suppl. #44
Project Title:	Continued Development of a High-Tension, Four-Cable, Median Barrier System for Use in 4:1 DV itches (Year 18 program)
Prior Funding:	Original Cable Median Barrier R&D in Years 12, 14, & 16
Starting Date:	9/1/2007
Completion Date:	12/31/2011
Principal Investigator:	Reid, Rohde, Sicking, and Faller
Co-PIs & Team Members:	Bielenberg, Lechtenberg, Holloway, Meyer, and Rosenbaugh
Author:	Faller, R.K.

Progress:

Task	% Completed
LS-DYNA computer simulation modeling of cable barrier systems	100
Static-pull testing on cable brackets	100
Dynamic bogie testing of cable brackets and bolting hardware	100
Dynamic bogie testing of cable posts in soil	100
Dynamic bogie testing of cable anchor bracket and cable splice	100
Barrier construction and crash test 4CMB-1 (2270P)	100
Barrier construction and crash test 4CMB-2 (1100C)	100
Combine test results with report containing test no. 4CMB-3	100
Internal review and editing of combined research and test report containing test nos. 4CMB-1 through 4CMB-3	90

Activity This Quarter:

Minor editing of the research and test report was conducted this quarter.

Activity Next Quarter:

The draft report containing the results from test nos. 4CMB-1 through 4CMB-3 will be completed in the Second Quarter of 2011.

Problems/Comments:

No problems are anticipated.

Total Percentage of Project Completion:

At this time, it is anticipated that 98% of the effort has been completed.

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Project No.:	RPFP-08-07, SPR-3(017) Suppl. #49
Project Title:	MGS Implementation (Year 18 program)
Starting Date:	9/1/2007
Completion Date:	12/31/2011
Principal Investigator:	Reid, Rohde, Sicking, and Faller
Co-PIs & Team Members:	
Author:	Faller, R.K.

Progress:

Task	% Completed
Standard, Half, and Quarter Post Spacing	100
MGS with Curbs and MGS with 2:1 Slopes	100
MGS with Culvert Applications	100
MGS Stiffness Transition	0

History

In 2007, Pooled Fund 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 with Curbs and MGS on 2:1 Slopes; and (3) MGS with Culvert Applications. A fourth category, MGS Stiffness Transition, was delayed in order to await the completion of a simplified, steel-post and wood-post approach guardrail transition.

The final reporting of the simplified, steel-post, approach guardrail transition system attached to the MGS was completed in the Fourth Quarter of 2010. The wood post R&D effort is nearly completed, including dynamic bogie post testing, Barrier VII analysis, and documentation/reporting. This noted research study is planned for completion in March/April 2011.

Activity This Quarter:

No substantial progress to report.

Activity Next Quarter:

The MGS implementation effort will commence in the Second Quarter of 2011 after the simplified, wood-post transition report has been finalized.

In order to make preparations for this activity to commence in April 2011, MwRSF requests that NDOR accumulate contact information (i.e., names and email addresses) for those willing to participate in the discussions involving the implementation of the MGS.

Problems/Comments:

No problems to report at this time. Since the initial MGS implementation discussions occurred in 2007, MwRSF plans to review the initial topics again.

Total Percentage of Project Completion:

At this time, it is anticipated that 70% of the effort has been completed.

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Project No.:	RPFP-09-01, TPF-5(091) Suppl. #1 (Year 19 Program)
Project Title:	New Funding for High-Tension, Cable Barrier on Level Terrain with New Cable Attachment
Prior Funding:	Original Cable Median Barrier R&D in Years 12, 14, 16, & 18
Starting Date:	8/15/2008
Completion Date:	7/31/2011
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Bielenberg, Lechtenberg, Holloway, Meyer, and Rosenbaugh
Author:	Faller, R.K.

Progress:

Task	% Completed
Continued dynamic bogie testing of simplified cable bracket hardware and cable posts in soil with test documentation and reporting (10 budgeted – 43 conducted)	95
BARRIER VII Computer Simulation	0
Barrier construction and crash test 4CMB-4 (1100C)	75
Barrier construction and crash test 4CMB-5 (2270P)	20
Crash test documentation & reporting (4CMB-4 and 4CMB-5)	10

Activity This Quarter:

On December 22, 2010, MwRSF conducted a 1100C small car retest on the high-tension, four-cable median barrier system with modified cable bracket located in a 4:1 V ditch and 4 ft away from the ditch bottom and up the back slope. The 1100C small car retest (test no. 4CMB-4) was successfully performed using the TL-3 safety performance guidelines found in MASH. In the First Quarter of 2011, the electronic data analysis for test no. 4CMB-4 was mostly completed.

In the First Quarter of 2011, MwRSF began construction of the cable barrier system, including the modified cable bracket, at two locations – (1) 12 ft laterally away from the slope break slope adjacent to the roadway edge and for use with the TL-3 2270P pickup truck test (4CMB-5) and (2) 4 ft laterally away from the backside slope break point and for use with the 1100C small car test (4CMB-6). At the present time, the warmer temperatures have melted the snow and thawed the soil surface in the ditch, thus resulting in a muddy work environment not conducive to post installation and slope grading.

Activity Next Quarter:

The final data analysis, test documentation, and reporting for test 4CMB-4 will be completed in the Second Quarter of 2011.

The series of two full-scale vehicle crash tests noted above will be performed as soon as the sloped ditch section dries sufficiently to complete construction. These tests (4CMB-5 and 4CMB-6) will carry over into the funding allocated in the Year 20 program. Please note that test no. 4CMB-6 is not budgeted herein but will be performed using continuation funds.

The draft research and test report covering the dynamic component testing program will be reviewed and edited in the Second Quarter of 2011.

Problems/Comments:

The level of remaining project funds will not be sufficient to complete the crash testing, demolition, and reporting of test no. 4CMB-5 due to the extensive component testing program utilized to develop a simplified cable-to-post bracket. As such, the required testing and reporting effort for test no. 4CMB-5 will be continued into the Year 20 continuation project funds. In addition, test no. 4CMB-6 will be conducted using any available cable barrier R&D funds contained in the Year 20 continuation projects.

As project funds are being used to continue the R&D effort in a V ditch, future project funds will be required to conduct the barrier testing program on level terrain.

Total Percentage of Project Completion:

At this time, it is anticipated that 60 percent of the project has been completed.

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Project No.:	RPFP-09-02, TPF-5(091) Suppl. #2
Project Title:	Phase I – Guidelines for Post Socketed Foundations for Four-Cable, High-Tension, Barrier Systems
Starting Date:	8/15/2008
Completion Date:	7/31/2011
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Rosenbaugh
Author:	Rosenbaugh, S.K.

Progress:

Task	% Completed
1. Literature Review on Previous Systems	100%
2. Socket Design and Analysis	75%
3. Fabrication and Bogie Testing of Post Sockets	50%
4. Analysis of Test Data	50%
6. Written Report	30%

Activity This Quarter:

Previously, 4 socketed foundation designs were evaluated through dynamic bogie testing. All 4 of these first round designs experienced heavy damage in the form of concrete fracture and plastic deformation of the reinforcing steel. As a result, new reinforcement designs were configured to provide additional strength to the socketed foundation.

This quarter, drawings for the Round 2 (4 new designs) post socket foundations configurations were completed. The sockets are currently being fabricated.

Work continued on assembling the Phase I research report which will document the first round of design and testing.

Activity Next Quarter:

Dynamic bogie testing of the new post sockets will be conducted in the 2nd or 3rd quarter of 2011. Upon completion of the bogie tests, the data will be analyzed and conclusions shall be made concerning the strength and design of the 2nd generation of socketed foundations.

Problems/Comments:

No problems are anticipated

Total Percentage of Project Completion:

At this time, it is anticipated that 25% of the project effort has been completed.

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Project No.:	RPFP-09-03, TPF-5(091) Suppl. #3
Project Title:	Further Development of the MGS Transition to the Transition Using Fewer Components
Starting Date:	8/15/2008
Completion Date:	7/31/2011
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Rosenbaugh, Polivka
Author:	Rosenbaugh, S.K.

Progress:

Task	% Completed
1. Literature Review	100%
2. Bogie Testing Program	100%
3. Data Analysis	100%
4. BARRIER VII Analysis	100%
5. Written Report	80%

Activity This Quarter:

The BARRIER VII analysis of the equivalent wood post system was completed. The analysis involved 45 identical impact scenarios on both a calibrated steel stiffness transition model and an equivalent wood post stiffness transition model. The only difference between the two versions of the system were the posts, which were swapped out as listed below.

6 ft long W6x9 posts:	6 ft long 6”x8” wood posts
7 ft long W6x15 posts:	6.5 ft long 8”x10” wood posts

The analysis showed that the equivalent wood post stiffness transition resulted in a small but consistent reduction in deflection, pocket angle, and potential wheel snag than the original steel stiffness transition. Thus, no adverse effects were foreseen for the wood posts and the wood post stiffness transition was expected to have similar safety performance characteristics as the full-scale crash tested steel post stiffness transition. Subsequently, the wood post system was recommended for use as a MASH TL-3 safety barrier.

Activity Next Quarter:

Recommendations will be made regarding the attachment of the upstream stiffness transition to various other wood post transitions. The draft report for the equivalent wood post stiffness transition shall be completed, and it will be sent out to the States for review/editing.

Problems/Comments:

No anticipated problems.

Total Percentage of Project Completion:

At this time it is estimated that 95% of the research effort has been completed.

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Project No.:	TPF-5(091) Suppl.#5 2611211009001 - RPFP-09-05
Project Title:	Annual LS-DYNA Enhancement Support Year 3
Starting Date:	2008-08-15
Completion Date:	2011-07-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1. Update the end anchorage model of the MGS.	50%
2.	
3.	
4.	
5.	

Activity This Quarter:

Due to several other projects requiring LS-DYNA simulations using some version of the MGS, it was decided to use funds from this project to improve the MGS model currently being used at MwRSF. Chosen to be the first portion of the model to be updated was the end anchorage.

Images of the old and newly developed end anchorage model to be used for MGS simulations are shown in Figures 1 – 3. The entire model was totally re-done, including all parts now being included and more precise geometry.

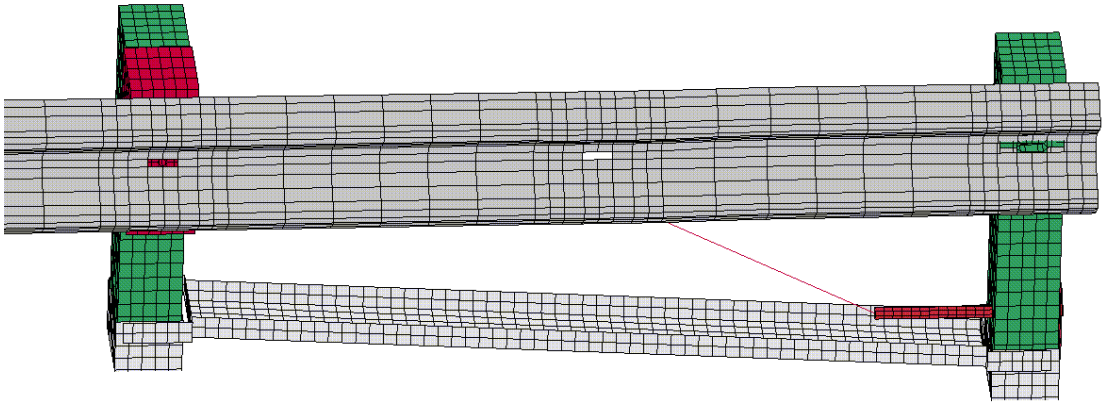

Figure 1. Old Terminal Model used for MGS Simulations

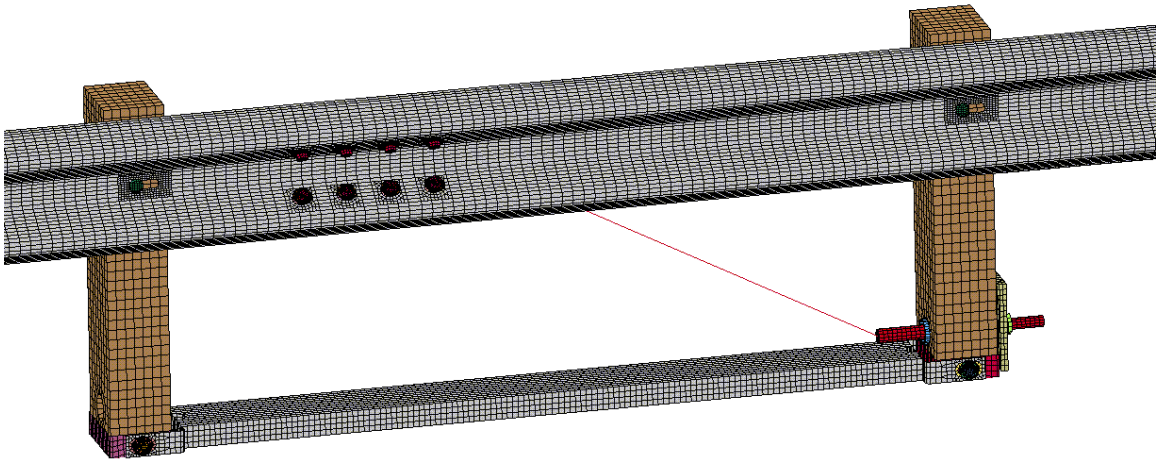

Figure 2. New Terminal Model used for MGS Simulations

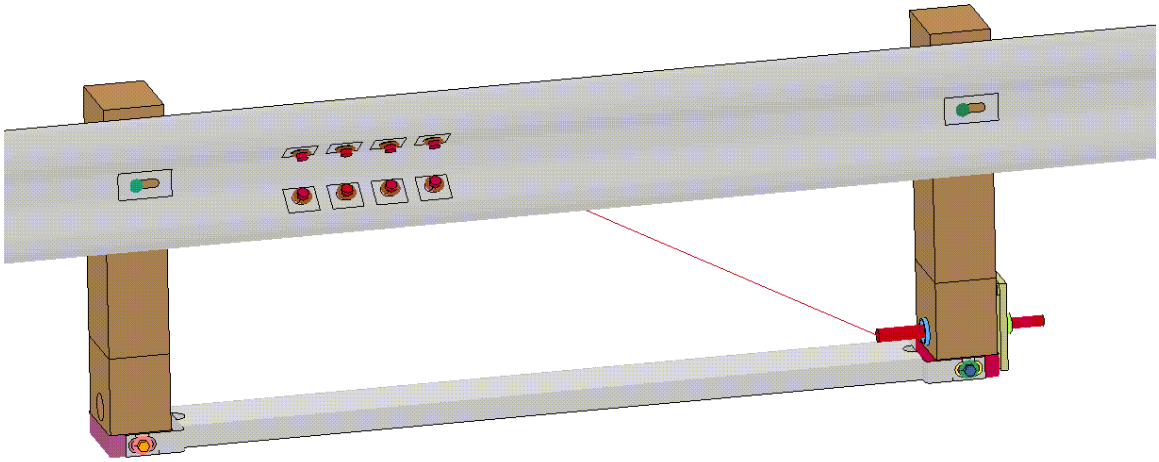

Figure 3. New Terminal Model used for MGS Simulations – mesh turned off

Activity Next Quarter:

Bogie testing on the end anchorage system is scheduled for next quarter under a separate project. This testing will provide physical behavior of the system during impact, including loads through the components and connections. Additionally, the movement through the soil of the anchorage will be captured. Results from the bogie testing will be used to calibrate and validate this new model.

Incorporate the new anchorage model into the MGS model and perform various studies on it to ensure it is behaving as required.

Problems/Comments:

Total Percentage of Project Completion: xx%

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Project No.:	RPFP-09-06 – TPF-5(091) Supplement #6
Project Title:	Phase II – Development of an MGS Bridge Rail
Starting Date:	August 15, 2008
Completion Date:	July 31, 2011
Principal Investigator:	Reid, Sicking, Faller
Co-PIs & Team Members:	Lechtenberg, Bielenberg, Rosenbaugh, Holloway
Author:	K. Lechtenberg

Progress:

Task	% Completed
1. Design of low-cost bridge rail	100
2. Simulation of design	100
3. Full-scale crash testing with 2270P and 1100C	100
4. Documentation and analysis of test results	100
5. Research report, final CAD details, FHWA acceptance	85

Activity This Quarter:

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 TL-3 full-scale vehicle crash tests were successfully performed according to the MASH guidelines. The final research report was completed in August 2010.

During this quarter, progress focused on finishing a few final tasks. MwRSF worked on compiling the CAD details required for submission of the MGS bridge rail to the Bridge Rail Guide. The draft version of these CAD details is finished and is currently under internal review.

Activity Next Quarter:

A request for federal acceptance of the MGS bridge rail will be submitted to FHWA as well as finalizing the CAD details for the Bridge Rail Guide.

Problems/Comments:

There are no problems or issues to report at this time.

Total Percentage of Project Completion:

It is anticipated that 90% of the research effort has been completed.

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Project No.:	RPFP-10-POLE, TPF-5(193) Suppl. #18
Project Title:	Impact Evaluation of Free-Cutting Brass Breakaway Couplings
Starting Date:	7/1/2009
Completion Date:	7/31/2012
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Rosenbaugh, Polivka,
Author:	Rosenbaugh, S.K.

Progress:

Task	% Completed
1. System Component Fabrication and Test Site Preparation	100%
2. Pendulum Testing	100%
3. Data Analysis and High Speed Test Extrapolation	100%
4. Determination of Pole Size/Weight Limits	100%
5. Written Report	100%
6. FHWA Acceptance	50%

Activity This Quarter:

Previously, a total of 7 pendulum tests spread over 3 rounds of testing were conducted at the Valmont Pendulum Testing Site. The test data was analyzed and extrapolated to predict the high speed test results. Conclusions were then made concerning the allowable size and weight limits for both steel and aluminum poles in combination with the brass couplings. The final report was completed in December 2010.

This quarter, we have been waiting to hear back regarding FHWA's acceptance of the brass couplings within the recommended size limits detailed in the research report. We have had conformation that FHWA received the acceptance package.

Activity Next Quarter:

Acceptance letter with FHWA shall be finalized. Also, ILL-DOT will be contacted regarding the production of drawings for the Task Force-13 breakaway support guide.

Problems/Comments:

No anticipated problems

Total Percentage of Project Completion:

It is anticipated that 98% of the research effort has been completed.

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Project No.:	RPFP-10-CABLE-1, TPF-5(193) Suppl. #19
Project Title:	Phase II – Guidleines for Post Socketed Foundations for Four-Cable, High-Tension, Barrier Systems
Starting Date:	7/1/2009
Completion Date:	7/31/2012
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Rosenbaugh
Author:	Rosenbaugh, S.K.

Progress:

Task	% Completed
1. Socket Design and Analysis	0%
2. System Fabrication and Test Site Preparation	0%
3. Dynamic Component Testing	0%
4. Data Analysis	0%
5. Written Report	0%

Activity This Quarter:

At this time, no work has been completed on Phase II. Work will begin on Phase II of the project as soon the Phase I project is completed.

Activity Next Quarter:

Continuation of the Phase I work.

Problems/Comments:

N/A

Total Percentage of Project Completion:

The Phase II project has not yet begun.

Midwest States Pooled Fund Program
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Project No.:	RPFP-10-Cable-2, TPF-5(193) Suppl. #20 (Year 20 Program)
Project Title:	Replacement Funding for High-Tension Cable Barrier on Level Terrain
Prior Funding:	Original Cable Median Barrier R&D in Years 12, 14, 16, 18, & 19
Starting Date:	7/1/2009
Completion Date:	7/31/2012
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Bielenberg, Lechtenberg, Holloway, Meyer, and Rosenbaugh
Author:	Faller, R.K.

Progress:

Task	% Completed
Barrier construction in V-ditch	5
1100C Small car retest in V-ditch (4 CMB-6)	0
Crash test documentation & reporting (4CMB-6)	0

Activity This Quarter:

In the First Quarter of 2011, MwRSF began construction of the cable barrier system, including the modified cable bracket, at two locations – (1) 12 ft laterally away from the slope break slope adjacent to the roadway edge and for use with the TL-3 2270P pickup truck test (4CMB-5) and (2) 4 ft laterally away from the backside slope break point and for use with the 1100C small car test (4CMB-6). At the present time, the warmer temperatures have melted the snow and thawed the soil surface in the ditch, thus resulting in a muddy work environment not conducive to post installation and slope grading.

Activity Next Quarter:

The series of two full-scale vehicle crash tests noted above will be performed as soon as the sloped ditch section dries sufficiently to complete construction. These tests (4CMB-5 and 4CMB-6) will carry over into the funding allocated in the Year 20 program. Please note that test no. 4CMB-6 was budgeted herein, but sufficient funds will not be available due to test no. 4CMB-5 charges being carried forward to this project.

Problems/Comments:

The level of remaining project funds will not be sufficient to complete the crash testing, demolition, and reporting of test no. 4CMB-6 due to the extensive component testing program utilized to

develop a simplified cable-to-post bracket. As such, the required testing and reporting effort for test no. 4CMB-5 will be continued into the Year 20 continuation project funds. In addition, test no. 4CMB-6 will be conducted using other available funds in the Year 20 cable barrier R&D projects.

As project funds are being used to continue the R&D effort in a V ditch, future project funds will be required to conduct the barrier testing program on level terrain.

Total Percentage of Project Completion:

At this time, it is anticipated that 5 percent of the project has been completed.

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	TPF-5(193) Suppl.#21 2611211028001 - RPFP-10-CABLE-3
Project Title:	Development of Crash-Worthy HT 4 Cable Terminal
Starting Date:	2009-07-01
Completion Date:	2012-07-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1.	
2.	
3.	
4.	
5.	

Activity This Quarter:

Activity Next Quarter:

Problems/Comments:

This is Phase II of the project. Phase I was funded in Year 17: SPR-3(017) Suppl.#38 2611120090007 – RPFP-07-06.

No reporting on this phase of the project will be done until Phase I is complete; see that project for status.

Total Percentage of Project Completion: 0%

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	TPF-5(193) Suppl.#22 2611211029001 - RPFP-10-MGS
Project Title:	Maximum MGS Guardrail Height
Starting Date:	2009-07-01
Completion Date:	2012-07-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1.	
2.	
3.	
4.	
5.	

Activity This Quarter:

The documentation and reporting of the testing program was initiated in the First Quarter.

Activity Next Quarter:

Complete the first draft of the full-scale crash testing report. Determine plan for the Barrier-VII and LS-DYNA analysis effort that was to follow after the full-scale testing.

Problems/Comments:

On June 29, 2010, MwRSF conducted one small car crash test (test no. MGSMRH-1) into a 34-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 safety performance guidelines of MASH. The small car was successfully contained and redirected. Photographs for this test are shown below. On September 9, 2010, a second small car test (test no. MGSMRH-2) was conducted into a 36-in. tall Midwest Guardrail System (MGS) using an 1100-kg Kia Rio according to the TL-3 MASH safety performance guidelines. Again, the small car was successfully contained and redirected.

Total Percentage of Project Completion:

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	TPF-5(193) Suppl.#24 2611211031001 - RPFP-10-LSDYNA
Project Title:	LS-DYNA Modeling Year 4
Starting Date:	2009-07-01
Completion Date:	2012-07-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1.	
2.	
3.	
4.	
5.	

Activity This Quarter:

Activity Next Quarter:

Problems/Comments:

This is a continuation of Year 3 and thus, no progress to report until funds are exhausted in that project.

Total Percentage of Project Completion:

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-MGS-1 – TPF-5(193) Supplement #31
Project Title:	Wood Post for MGS
Starting Date:	July 1, 2010
Completion Date:	December 31, 2013
Principal Investigator:	Reid, Sicking, Faller
Co-PIs & Team Members:	Lechtenberg, Bielenberg, Rosenbaugh, Holloway
Author:	K. Lechtenberg

Progress:

Task	% Completed
1. Full-scale crash testing (MASH 3-10 and 3-11)	15
2. Analysis and documentation of test results	0
3. Research report	0
4. Hardware guide drawings and FHWA acceptance	0
5.	

Activity This Quarter:

Previously, CAD details were completed and construction materials were acquired.

No activity occurred this quarter.

Activity Next Quarter:

Construction will occur with potential crash testing toward the later part of the quarter.

Problems/Comments:

The same test pit is being used for Project No.:RPFP-11-MGS-3 – TPF-5(193) Supplement #33, Project Title: MGS without Blockouts. This system will be constructed and tested following the completion of the aforementioned project.

Total Percentage of Project Completion:

It is anticipated that 2% of the research effort has been completed.

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-MGS-2, TPF-5(193) Suppl. #32
Project Title:	MGS Guardrail Attached to Culverts
Starting Date:	7/1/2010
Completion Date:	12/31/2013
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Rosenbaugh
Author:	Rosenbaugh, S.K.

Progress:

Task	% Completed
1. State Survey on Culvert Design	0%
2. System Design	0%
3. Component Fabrication and Test Site Preparation	0%
4. Dynamic Testing and Data Analysis	0%
5. Final Design and Culvert Recommendations	0%
5. Written Report	0%

Activity This Quarter:

Work has not yet begun on this research project.

Activity Next Quarter:

Work next quarter will begin with the survey of culvert designs used in the various Pooled Fund States.

Problems/Comments:

N/A

Total Percentage of Project Completion:

No work has begun on this research project

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-MGS-3 – TPF-5(193) Supplement #33
Project Title:	MGS without Blockouts
Starting Date:	July 1, 2010
Completion Date:	December 31, 2013
Principal Investigator:	Reid, Sicking, Faller
Co-PIs & Team Members:	Lechtenberg, Holloway
Author:	K. Lechtenberg

Progress:

Task	% Completed
1. Full-scale crash testing (MASH 3-10 and 3-11)	40
2. Analysis and documentation of test results	0
3. Research report	0
4. Hardware guide drawings and FHWA acceptance	0
5.	

Activity This Quarter:

Previously, CAD details were completed and construction materials were acquired. The barrier system was installed for the first crash test.

No activity occurred this quarter.

Activity Next Quarter:

Crash testing of the first system will occur. Repair of system for second crash test with potential for second test to occur toward the end of the quarter.

Problems/Comments:

There are no problems or issues to report at this time.

Total Percentage of Project Completion:

It is anticipated that 8% of the research effort has been completed.

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-MGS-4, TPF-5(193) Suppl. #34
Project Title:	Asses Standardized Weld Detail
Starting Date:	7/1/2010
Completion Date:	12/31/2013
Principal Investigator:	Reid, Sicking, and Faller
Co-PIs & Team Members:	Rosenbaugh
Author:	Rosenbaugh, S.K.

Progress:

Task	% Completed
1. Survey of State Weld Details/Recommendations	0%
2. Design and Analysis of Culvert Post attachment/Weld	0%
3. Dynamic Component Testing	0%
4. Data Analysis and Conclusions	0%
5. Written Report	0%

Activity This Quarter:

Work has not yet begun on this research project.

Activity Next Quarter:

Work next quarter will begin with a survey of the Pooled Fund States current weld practices and recommendations.

Problems/Comments:

N/A

Total Percentage of Project Completion:

No work has begun on this research project.

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-BULLNOSE // TPF-5(193) Suppl. #35
Project Title:	Universal Steel Breakaway Post for Thrie Beam Bullnose
Starting Date:	7/1/2010
Completion Date:	12/31/2013
Principal Investigator:	Sicking, Faller, Reid
Co-PIs & Team Members:	Bielenberg
Author:	Bielenberg

Progress:

Task	% Completed
1. Full-scale Crash Testing	100
2. Analysis and documentation of test results	100
3. Summary report	100
4. Hardware Guide drawing and FHWA approval submittal	75
5.	

Activity This Quarter:
(Provide an informative summary of tasks/activities that occurred this quarter)

This research project provided continuation funding for the development and testing of a universal breakaway steel post for the thrie beam bullnose barrier system. The initial development and crash testing was performed under a recent MnDOT research study using the NCHRP Report No. 350 safety performance guidelines.

Following the completion of two successful full-scale crash tests in the fall, MwRSF completed the analysis and documentation of the crash test results. In addition, a summary report detailing the results from the crash tests was finalized and submitted to the sponsors.

Schmidt, J.D., Sicking, D.L., Faller, R.K., Reid, J.D., Bielenberg, R.W., and Lechtenberg, K.A., *Investigating the Use of a New Universal Breakaway Steel Post - Phase III*, Final Report to the Midwest States Regional Pooled Fund Program, MwRSF Research Report No. TRP-03-244-10, Project No.: TPF-5(193), Supplement No. 35, Project Code: RPFP-11-BNOSE - Year 21, Midwest Roadside Safety Facility, University of Nebraska-Lincoln, Lincoln, Nebraska, December 16, 2010.

The results from the development and testing program were also presented at the 2011 Transportation Research Board AFB20 Committee meeting. A request for federal approval of the universal breakaway steel post for the thrie beam bullnose barrier system was submitted to FHWA

during this quarter. FHWA has received the request and is in the process of evaluating it. MwRSF also worked on compiling the CAD details required for submission of the universal breakaway steel post for the thrie beam bullnose barrier system to the Hardware Guide. The draft version of these CAD details is currently being created.

Activity Next Quarter:
(Provide an informative summary of the tasks/activities that are planned for the following quarter)

The only work remaining in this project is to finalize the CAD details for the Hardware Guide. After the initial draft of the Hardware Guide CAD details are completed and reviewed internally, the CAD will be submitted to the AASHTO Hardware Guide committee for review and incorporation.

Problems/Comments:

There are no problems or issues to report at this time.

Total Percentage of Project Completion:

90%

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	TPF-5(193) Suppl.#37 2611211050001 - RPFP-11-LSDYNA
Project Title:	LS-DYNA Modeling Year 5
Starting Date:	2009-07-01
Completion Date:	2012-07-31
Principal Investigator:	Reid
Co-PIs & Team Members:	Sicking, Faller
Author:	John D. Reid

Progress:

Task	% Completed
1.	
2.	
3.	
4.	
5.	

Activity This Quarter:

Activity Next Quarter:

Problems/Comments:

This is a continuation of Year 4 and thus, no progress to report until funds are exhausted in that project.

Total Percentage of Project Completion:

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-TF-13 – TPF-5(193) Supplement #38
Project Title:	Annual Fee to Finish TF 13 and FHWA Standard Plans
Starting Date:	July 1, 2010
Completion Date:	December 31, 2013
Principal Investigator:	Reid, Sicking, Faller
Co-PIs & Team Members:	Lechtenberg
Author:	K. Lechtenberg

Progress:

Task	% Completed
1. Prepare CAD details for Hardware Guide	50
2.	
3.	
4.	
5.	

Activity This Quarter:

This project is used to supplement the preparation of the TF-13 format CAD details. Previously, it was determined that there are 13 systems and 11 components that need to be prepared in the TF-13 format. Three (3) of the 13 systems were reviewed at the September 2010 TF-13 meeting.

Revisions were made to the three (3) reviewed system drawings. Preparation of the CAD details for the other systems and components occurred.

Activity Next Quarter:

Continue to prepare the TF-13 CAD details for the remaining 8 systems and 11 components. Submit the completed ones to AASHTO TF-13 for review during their spring 2011 meeting.

Problems/Comments:

At the present time, standard TF13-format CAD details are now required and subjected to review and comment by TF 13 members. This review is taking place during the TF-13 meetings which occur twice a year. After the initial review, the drawings are edited and then reviewed again at a later meeting. Once the CAD details are deemed acceptable and meet TF 13 guidelines, they are integrated into the electronic, web-based, version of the existing barrier hardware guide.

Consequently, it requires a minimum of 6 months to get a drawing accepted for inclusion in the hardware guide; that is if there are only minimal edits to be made to the drawing. Sometimes, TF-13 requires a second review and more edits, thus adding another 6 months on to the time for its acceptance. For example, five (5) of the 13 systems were submitted for review during the September 2010 meeting. However, the allotted time only allowed the review of three (3) of the systems. Thus, the other two (2) were held and will be reviewed during the May 2011 meeting. Depending on the number of systems in queue to be reviewed, some may not be reviewed at the May meeting and will have to be held until the fall meeting. Thus, some drawings may be in the review state at TF-13 for over a year before they are even looked at for the first time.

Total Percentage of Project Completion:

It is anticipated that 50% of the research effort has been completed.

Midwest States Pooled Fund Program
Quarterly Progress Report – First Quarter 2011
March 15, 2011

Project No.:	RPFP-11-CONSULT // SPR-3(017) Suppl. #37
Project Title:	Annual Consulting Services Support
Starting Date:	7/1/2010
Completion Date:	12/31/2013
Principal Investigator:	Sicking, Faller, Reid
Co-PIs & Team Members:	Bielenberg
Author:	Bielenberg

Progress:

Task	% Completed
1. Respond to sponsor inquiries and provide quarterly summary	50
2.	
3.	
4.	
5.	

Activity This Quarter:
(Provide an informative summary of tasks/activities that occurred this quarter)

This project allows MwRSF to be a valuable resource for answering questions with regard to roadside safety issues. MwRSF researchers and engineers are able to respond to issues and questions posed by the sponsors during the year. Major issues discussed with the States have been documented in our Quarterly Progress Reports.

In the past quarter MwRSF has responded to a series of state inquiries. The Quarterly Progress Report summarizing these responses is attached to this document.

Activity Next Quarter:
(Provide an informative summary of the tasks/activities that are planned for the following quarter)

MwRSF will continue to answer questions and provide support to the sponsors during the upcoming quarter. In the past, several states have requested that MwRSF devise a method for making the archived responses searchable. MwRSF is currently attempting to make the archived responses searchable from our web site and hope to have that effort complete by the end of the upcoming quarter.

Problems/Comments:

There are no problems or issues to report at this time.

Total Percentage of Project Completion:

50%

Pooled Fund Consulting Summary

Midwest Roadside Safety Facility
January 2011 – March 2011

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 – Alternative F-shape Barrier Connection Pin Detail

State Question:

Will (Will Longstreet, FHWA),

Per our discussion last week, I am sending you a request for your consideration and approval of two Portable Concrete Barrier (PCB) Connecting Pin designs.

Minnesota uses an F shaped, 12.5' long, pin and loop, portable concrete barrier system. The design was developed by Midwest Roadside Safety Facility. The supporting FHWA acceptance letters are, B-41 for the original design, and B-122 for the current design. Our design matches the current design, as proposed for the Barrier and Hardware Guide (SWC09) through task force 13. See attached (SWC09 10-29-08.pdf).

The current connector pin is located at
http://aashtotf13.tamu.edu/Guide/Hardware/Components/FMW02.pdf

We have been told by our construction office that the current connector pin design is difficult to work with when installed. Especially when there is tension in the barrier system, thus having the effect of locking the pins into the loops. Construction personnel often use hammers to tap the pins loose, which in turn causes damage to the upper plate of the connecting pin design (FMW02).

Our two proposed options are a "T" shaped pin and a "Cane" shaped pin. See the attached drawing (pin_11_22_10.pdf). Both proposed designs provide the same 1.25" diameter and 25" long vertical pin design as FMW02. The proposed changes are to the top configurations of the bars only. The "T" shaped top is the preferred design, however the "Cane" shaped top is less expensive to make, and still provides the necessary durability in the field.

Also attached is our proposed standard 8337C plate (StandardPlateReviewForm_8337C_Draft.pdf). Our intention is to allow all three connecting pin types within our standards provided you approve. Our Proposed 8337C plate 3 of 3, will be revised to include all three options.

I also cc'd Bob Bielenberg with MwRSF as we discussed. (Bob feel free to call me if you have any questions.).

Please let me know if you have any questions or need additional information.

Thanks

Michael Elle, P.E.
Mn/DOT - Office of Technical Support

MwRSF Response:

Hello Michael,

We have looked through your proposed pin designs and we have a couple of comments/concerns.

1. We believe that the T-handle design would work acceptably, but we are concerned with the weld between the main pin and the T-handle. The current pin design has a ¼" fillet weld on the top of the plate. This is a weld length of approximately 7.875" and a weld area of 1.39 in^2. The top of the pin can be loaded with significant vertical loads as the barriers rotate adjacent to one another, especially in a tie-down or anchored configuration. Thus, we are concerned that the T-handle pin does not have sufficient weld area to handle vertical loading similar to the tested pin and plate design. Our experience in welding round sections perpendicular to one another has found it very difficult to develop load capacity.
2. We also have concerns with the cane type pin. The concern with the cane pin is the short extension on the cane pin could be pulled into the loops and compromise the joint under high loads. The bent end of the pin would be free to rotate when installed and could be in a position that allows it to be pulled into the loops when loaded, or large barrier and joint deflections could pull the relatively short bent end into the loops.
3. If the issue at hand is damage to the plates at the top of the pin, increasing the plate thickness should address that.

Please contact me with any comments/questions.

Thanks

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

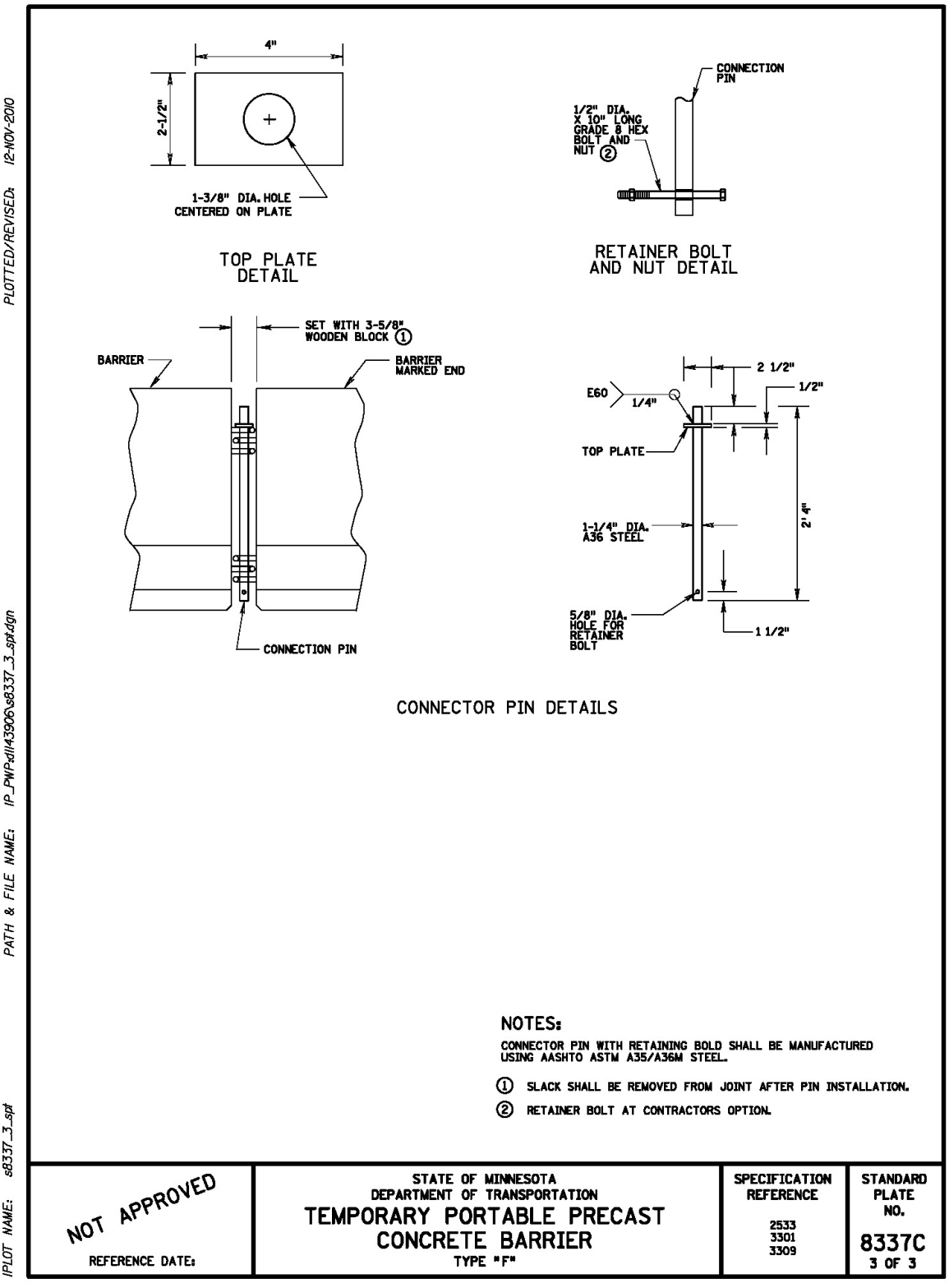


Figure 1. Current F-shape Barrier Pin Design

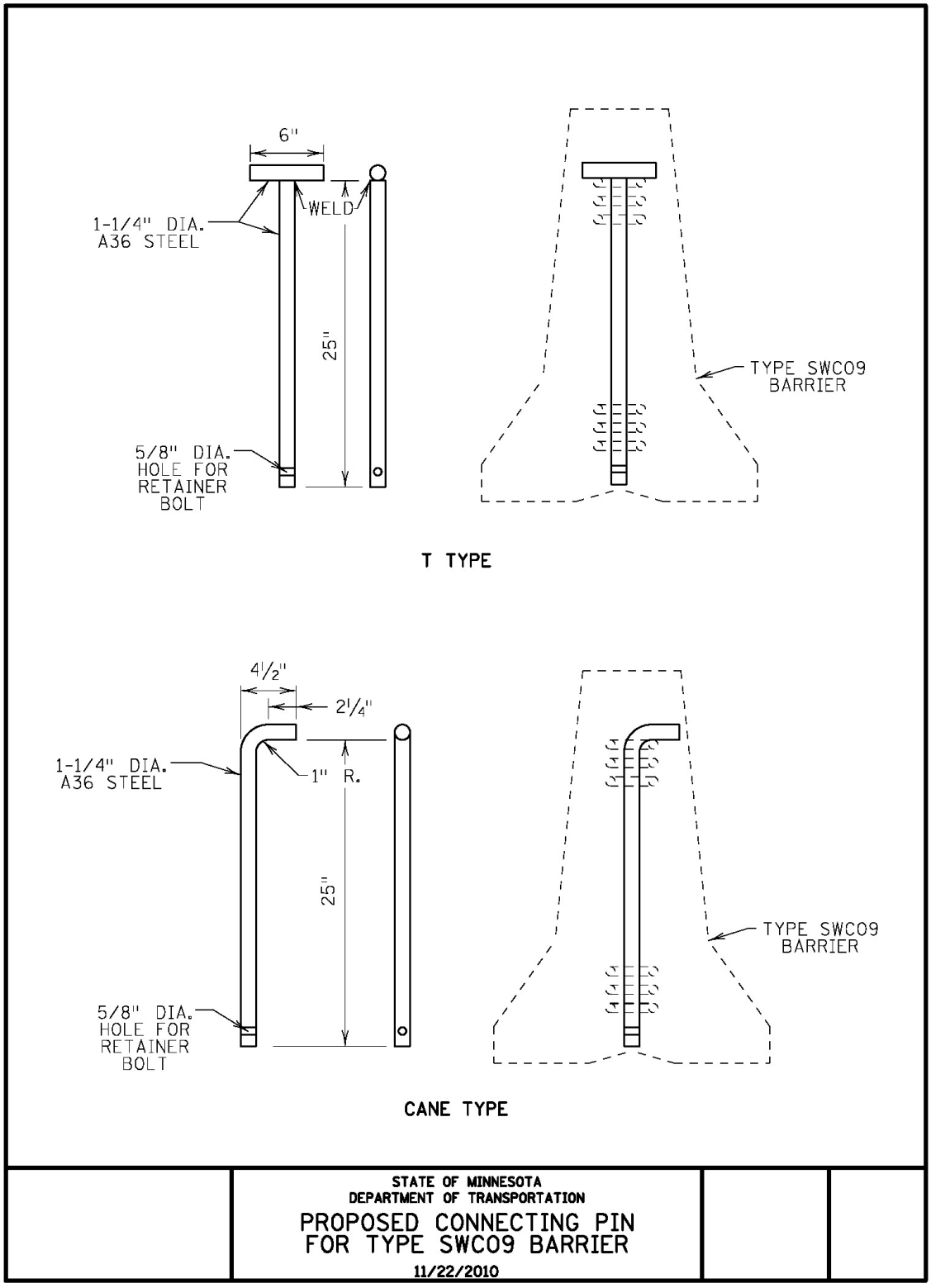


Figure 2. Proposed F-shape Barrier Pin Designs

Problem # 2 – Alternative F-shape Barrier Connection Pin Detail - Part II

State Question:

We would like to pursue some type of "T" bar option. I would like to propose that you consider taking out the 2 ½ " of bar between the 4"x2.5"x0.5" plate and the top 6" horizontal bar. The 4"x2.5"x0.5" plate could be welded on both sides, but on the top of a 2' 1-1/2" bar, and then the 6" long horizontal "T" top could be welded to the plate, extending 1" beyond either side of it. The 6" top could be round or square stock.

There seems to be a discrepancy with the drawings. The AASHTO link and B-122 (2003) show only a one sided weld for the plate to the pin. B-41 (1997) shows welding on both sides of the plate. Do you know which one is correct since one gives twice the weld area as the other?

If only one side needs to be welded, the plate could be brought up to the T handle and welded on the bottom without worrying about welding the handle for retrofit use if the pin length is acceptable.

Minnesota uses an F shaped, 12.5' long, pin and loop, portable concrete barrier system. The design was developed by Midwest Roadside Safety Facility. The supporting FHWA acceptance letters are, B-41 for the original design, and B-122 for the current design. Our design matches the current design, as proposed for the Barrier and Hardware Guide (SWC09) through task force 13. See attached (SWC09 10-29-08.pdf).

Thanks

Michael Elle, P.E.
Office of Technical Support

MwRSF Response:

Hi Michael,

I have given some additional thought to the T-top connection pin for the F-shape barrier. I have included some additional comments below.

1. First, I have reviewed the T-pin design that you have proposed which includes a 2.5"x4"x1/2" plate welded to the top of the 1.25" diameter connection pin. The T-pin is then welded to the top of this plate. I don't see any issues with this design. The F-shape barrier was originally tested to NCHRP 350 with a top plate mounted exactly as you propose. I have attached details. If the restraining plate at the top of the pin is attached with lower capacity welding than the original design that was tested, there concern that the top cap could disengage from the pin and allow the pin to exit the connection loops. This in turn would eliminate the integrity of the connection. However, because you are welding the top plate with the same weld used in the tested design, there should be no

strength issues and attachment of the T-pin should be acceptable. Thus, I believe that your proposed design should function acceptably.

2. We also discussed the T-pin design that has currently been made by your barrier fabricators. This design consists of a 1.25" diameter T-pin welded directly to the top of the 1.25" diameter connection pin. Again, the concern here is that the T-pin may not be connected to the connection pin with sufficient weld to have similar capacity to the tested design and ensure that the T-pin does not disengage from the connection pin during an impact. We cannot determine exactly what the loads were on the top plate during testing of the original pin. Thus, we must require that any modification of the connection pin must have similar or greater capacity.

   I do not believe that it is possible to get sufficient weld area (and corresponding weld capacity) in the fabricators design to match the tested pin. The strength and capacity of a given weld is determined by the throat area of the weld. Weld throat area can be determined by the formula At= .707hl. In this formula, At is the throat area, h is the height of the weld, and l is the weld length. The tested pin cap was attached to the connection pin with a throat area of 1.39 in^2. Thus, we would require that the attachment of the T-pin to the connection pin have similar throat area and weld capacity.
3. It may be possible to retrofit the existing T-pins that have been fabricated. I have attached a detail for a proposed retrofit. This retrofit would attach the tested pin plate to the pin using the standard ¼" fillet weld on the bottom. The plate could be slid up the pin from the bottom. Then the plate would be welded to the T-pin on top with a flare bevel weld along the length of the plate. This would require checking to make sure the retrofitted pin still extended into the barrier loops (had the same effective length) as the tested design. Let me know what you think.

With respect to the weld details, there are different weld details floating around out there. There are currently three details.

1. The original pin cap was welded with the cap flush with the top of the 24.5" long pin. The cap was welded to the pin with a ¼" fillet weld on the bottom of the cap and the top of the cap was welded to the pin with a flare bevel weld. This pin design was used when the free-standing barrier was originally tested to NCHRP Report 350.
2. The pin cap weld configuration was used when the steel strap tie-down was developed for the F-shape PCB. At that time, we used a 27 ¾" pin that mounted the cap plate 1" below the top of the pin. This cap was attached with ¼" fillet welds on both the top and bottom of the plate.
3. The remaining F-shape PCB testing was conducted with a 28" long pin with the pin cap mounted 2.5" below the top of the pin. The pin cap for this design was welded with a ¼" fillet weld on the top of the pin cap only. This pin was a design originally submitted directly to us by KsDOT when we switched from the two loop to three loop connection design. It was used in both the MASH testing and the other tie-down and transition testing conducted at MwRSF.

Based on the different configurations above, we have typically recommended that the second configuration with top and bottom fillet welds be used. However, the single fillet weld design

has passed the free-standing barrier MASH test, and it was used in all of the tie-down and transition designs excluding the steel strap tie-down. Thus, it would be okay to use the third pin configuration as long as you did not plan to use the steel strap tie-down. The steel strap tie-down would still require the second pin design.

My previous weld areas were calculated based on the second pin design. If you went with the third option, then your revised T-pin design would require ½ the weld area. This would be a throat area of 0.694 in^2. I don't believe that you can get that much weld area with the welding of the T handle directly to the pin. Thus, some form of retrofit would still be needed. However, the retrofit I proposed could be simplified by only using the fillet weld on the underside of the pin cap and then welding the T-handle to the top of the pin cap plate. No filler weld needed on the top of the pin cap to attach it to the pin.

Thanks

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

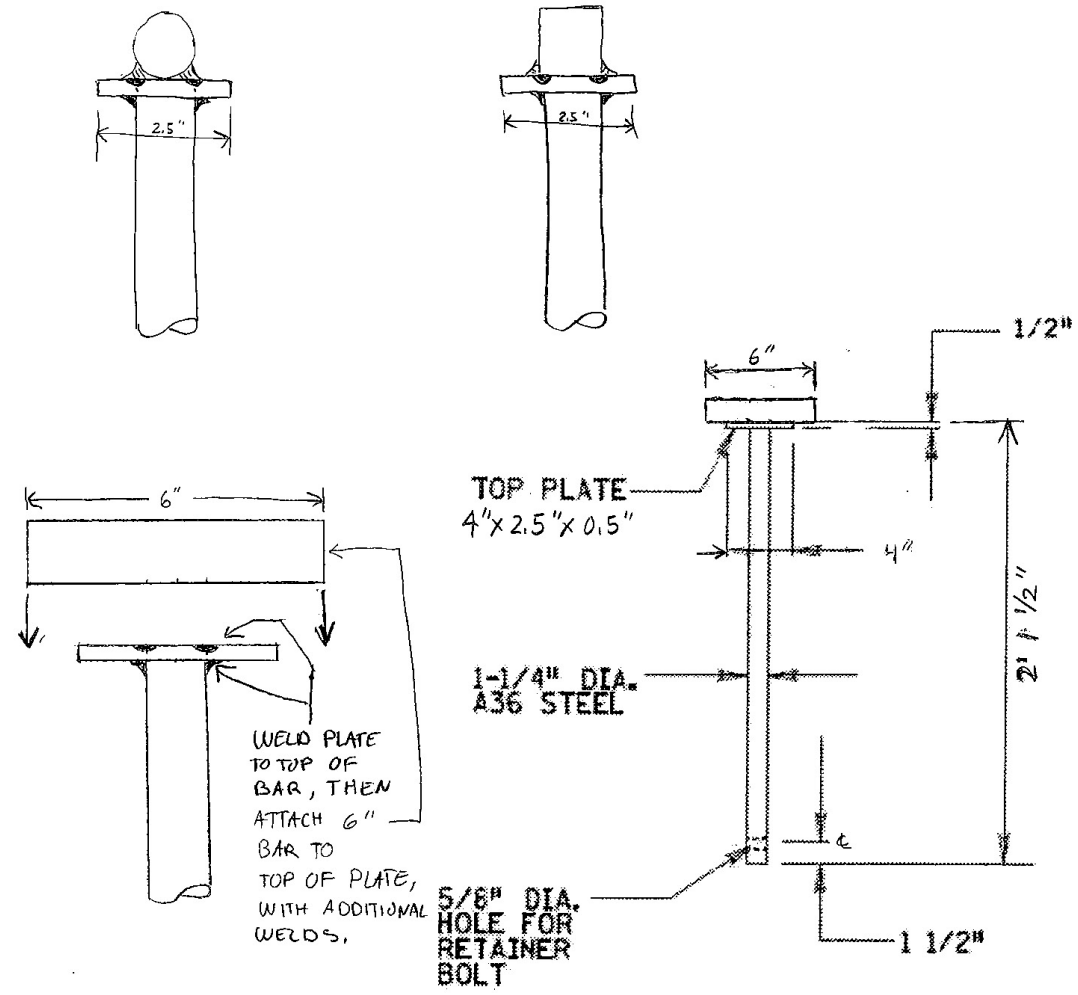


Figure 3. MnDOT Proposed T-Pin Solution

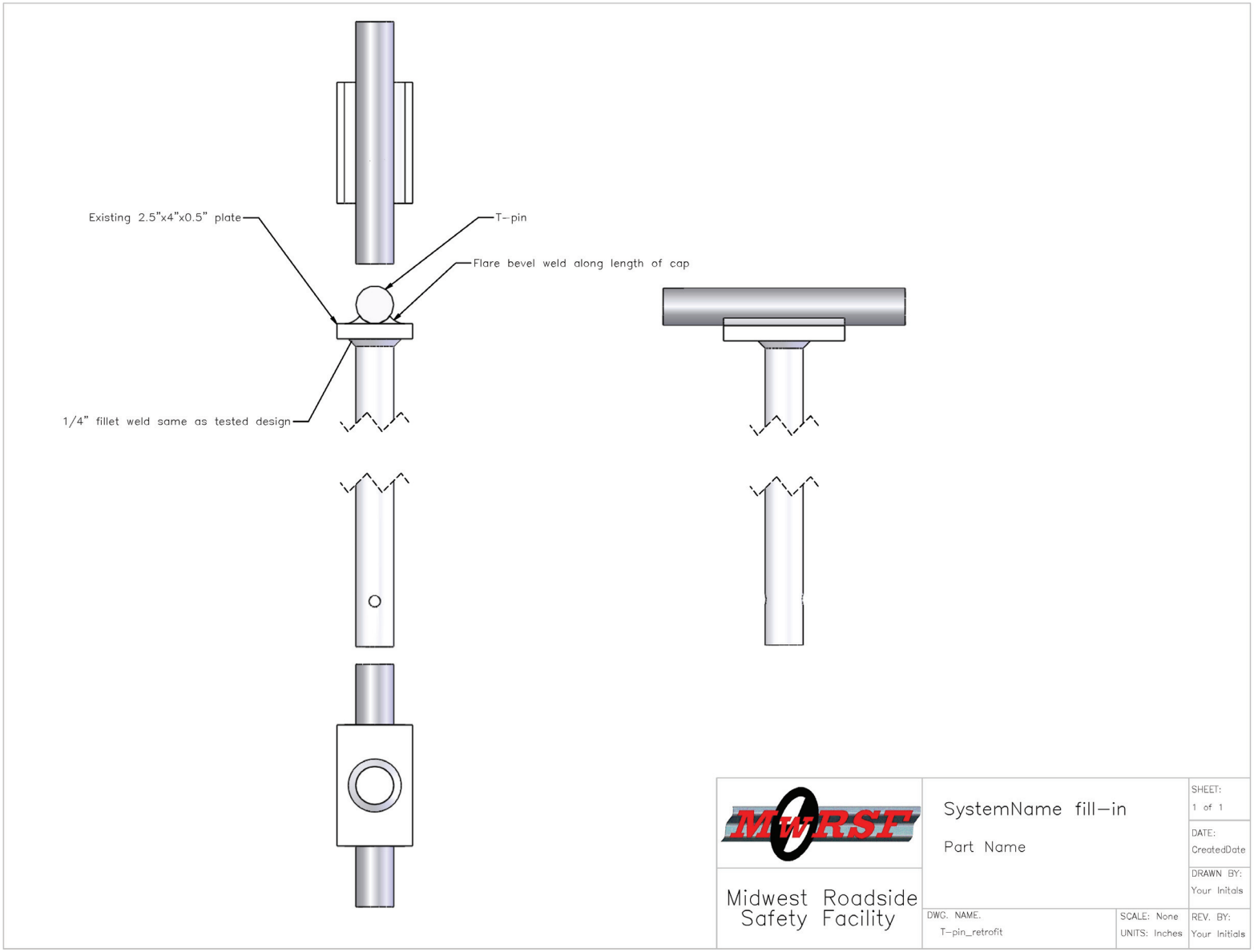


Figure 4. MwRSF Proposed T-Pin Retrofit Design

Problem # 3 – Alternative F-shape Barrier Connection Pin Detail - Part III

State Question:

Bob and Will,

We have put together a design which is similar to what Bob had suggested below. Please see the attached PDF.

We are proposing that the plate be attached with the ¼" fillet weld on the underside of the pin plate. We are not proposing any additional welding on the top side of the plate. The proposed modified pin design does state that this design is not to be used with the steel strap tie down.

Before I move this forward internally, I just wanted to make sure you both are ok with it, and that it will likely be accepted by the FHWA.

Thanks

Michael Elle, P.E.
Office of Technical Support

MwRSF Response:

Hi Michael,

The detail looks consistent with our discussions, and I have no issues using this pin.

Thanks

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

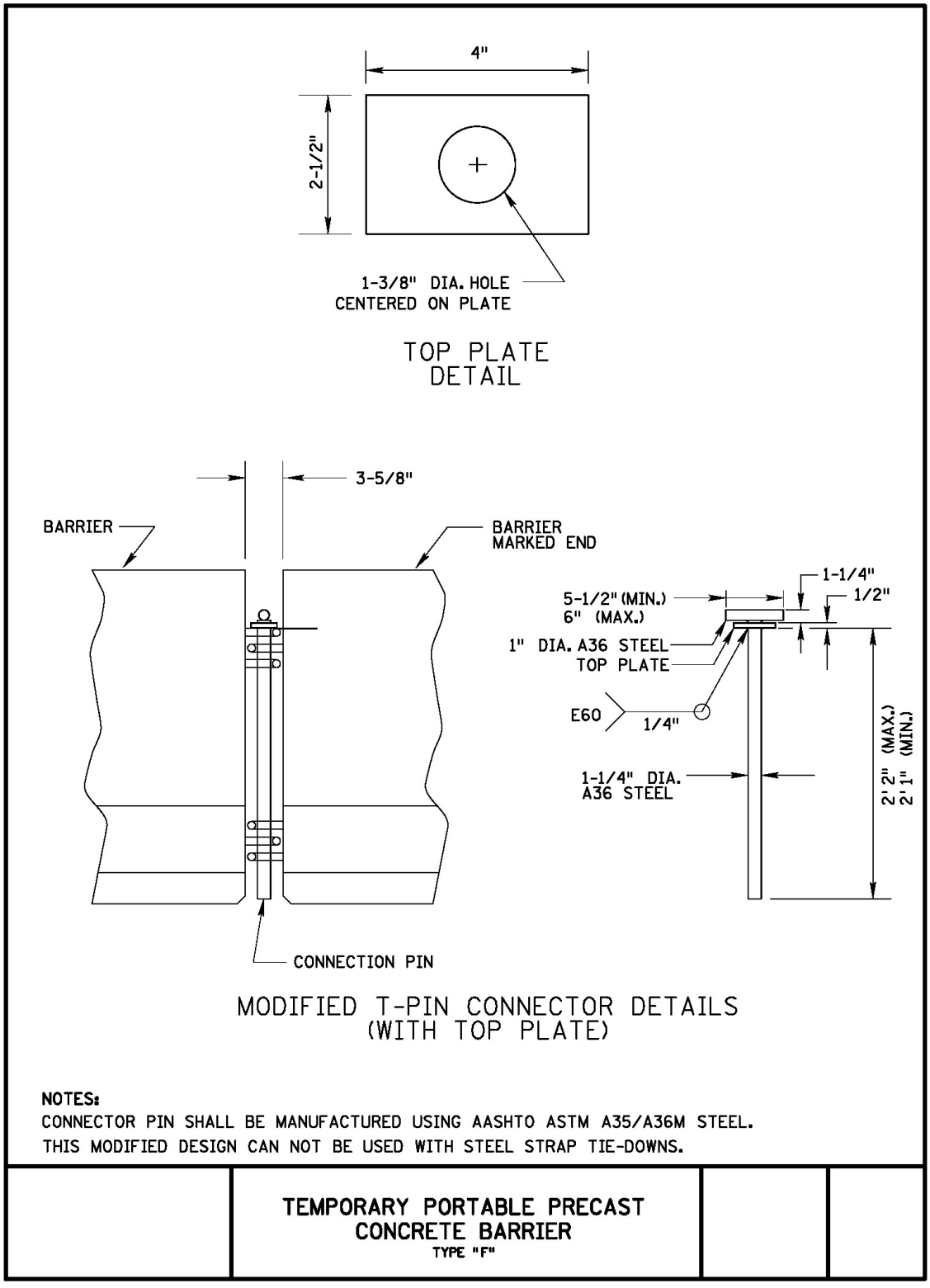


Figure 5. Final MnDOT Connection Pin Design

Problem # 4 – Snow Gate Modifications – Additional questions

State Question:

Bob,

Would you please provide your thoughts on the additional snow gate modifications proposed by our field staff? If the sleeve is not used, is there a minimum length of post?

Thanks,

Jonathan P. Marburger, P.E.
Road Squad Leader
KDOT-Bureau of Design
marburger@ksdot.org
Phone: 785-296-3890
Fax: 785-296-4302

From: Lee Holmes
Sent: Monday, December 13, 2010 3:37 PM
To: Robert Weiss; Gregg Wicker; Jerry Glassman; Joe Capo; Jonathan Marburger; Michael Terry; Thad Vincent
Cc: Rod Lacy; Scott King
Subject: Snow Gates

Bob: Here are my comments:

1. I do not think the road closed sign needs to be hinged.
   - (Since the "Road Closed" sign will not be facing the motorist when the gate is open, I agree with a non-hinged sign.)
2. Gregg does not want us to drill holes in the gate tubing so I think we can use "U" bolts.
   - (I am hesitant to approve "U" bolts since the NCHRP testing did not include "U" bolts. I will copy Scott King and Rod Lacy on this as they are our testing gurus.)
3. I need someone's input on the 5' sleeve for the hold back post. Do we need this AND it we use an existing 4x4 sign post with or without the sleeve is that OK?
   - (My recommendation is to follow the design as tested.)
4. We want to put multiple locks on the snowgate, for multiple agencies. I think we could put the angle iron shelf on the post with both top and bottom using a threaded stub so a nut/wing nut can be run down to hold the gate tight in the wind – then a chain with multiple locks can be used somewhere else.
   - (Sounds reasonable.)

Scott/Rod: What do you think about using "U" bolts instead of drilling holes in the gate tubing as noted in No. above?

Lee Holmes, P.E.

State Traffic Signing Engineer
Bureau of Transportation Safety & Technology

MwRSF Response:

Hi Jonathan,

I have added some comments below in green.

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

From: Lee Holmes
Sent: Monday, December 13, 2010 3:37 PM
To: Robert Weiss; Gregg Wicker; Jerry Glassman; Joe Capo; Jonathan Marburger; Michael Terry; Thad Vincent
Cc: Rod Lacy; Scott King
Subject: Snow Gates

Bob: Here are my comments:

1. I do not think the road closed sign needs to be hinged.
   - (Since the "Road Closed" sign will not be facing the motorist when the gate is open, I agree with a non-hinged sign.)
   - The hinge on the road closed sign is not an impact safety performance issue. As such we are okay if the sign is not hinged.
2. Gregg does not want us to drill holes in the gate tubing so I think we can use "U" bolts.
   - (I am hesitant to approve "U" bolts since the NCHRP testing did not include "U" bolts. I will copy Scott King and Rod Lacy on this as they are our testing gurus.)
   - I see no issue to using u-bolts attach the sign to the tubing as long as the capacity of the u-bolt is equal or greater than the bolts used in the original design.
3. I need someone's input on the 5' sleeve for the hold back post. Do we need this AND it we use an existing 4x4 sign post with or without the sleeve is that OK?
   - (My recommendation is to follow the design as tested.)
   - With regards to the hold back post, the post is designed to fracture when impacted. As such, any alternative configuration would need to have a develop loads when impacted similar to the 4x4 post in the foundation tube used in the original design. Thus, we would not recommend a hold back post with greater strength than the one that was tested. If you would rather not use the foundation tube, then we would recommend that you embed the hold back post 5' such that is has similar resistance to rotation in the soil as the tested setup.
4. We want to put multiple locks on the snowgate, for multiple agencies. I think we could put the angle iron shelf on the post with both top and bottom using a threaded stub so a nut/wing nut can be run down to hold the gate tight in the wind – then a chain with multiple locks can be used somewhere else.
   - (Sounds reasonable.)

- Nothing to add here.

Problem # 5 – Wisconsin to Illinois Temporary Concrete Barrier Connection

State Question:

Bob,

We would like to connect the F-shape PCB designs from Wisconsin and Illinois, but the two designs have slightly different loop locations which can make them difficult to attach. Can you comment on the connections between these two sections?

Sincerely,

Ken T. Kiepczynski, P.E.
Assistant Project Leader / Traffic Leader
I-94 N-S Freeway Construction

MwRSF Response:

Hi Ken,

I have reviewed the details you sent. I am familiar with the Illinois barrier. In the past, I reviewed the Illinois PCB for Erik Emerson. Based on testing of similar barriers, I noted to him that it should provide acceptable performance.

At that time, the issue of connecting the Illinois PCB to the Wisconsin PCB did not come up. We have concerns about connection of the different barrier segments. As you noted, the height of the loops in the two barrier design creates interference. Thus, one of the barriers would have to be shifted vertically to connect the segments. This causes several problems. First, the shifting of the barriers would not allow for the loops to be in the correct orientation to provide the double shear connection (i.e., two loops in one direction with a third loop sandwiched between them). This creates a situation where the pin loading is significantly different than the tested pin and may create problems. In addition, shifting of the barrier would also force the loops to rest on one another and create additional bending loads in the loops. This is also undesired. Finally, the vertical shifting of the barrier would create a situation where the barrier is not sitting flush on the ground. This would reduce barrier friction on the ground and accentuate the potential for the barrier segment to rotate backward vertically. This could potentially increase barrier deflections and vehicle instability.

With this in mind, we cannot recommend connection of the two different barrier sections without modification to the barrier segment. If you want to connect the Illinois PCB to the Wisconsin PCB, we would suggest fabricating a transition barrier segment that repositions the barrier connection loops to attach to each barrier type at the correct height.

Please contact me with questions or comments.

Thanks

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

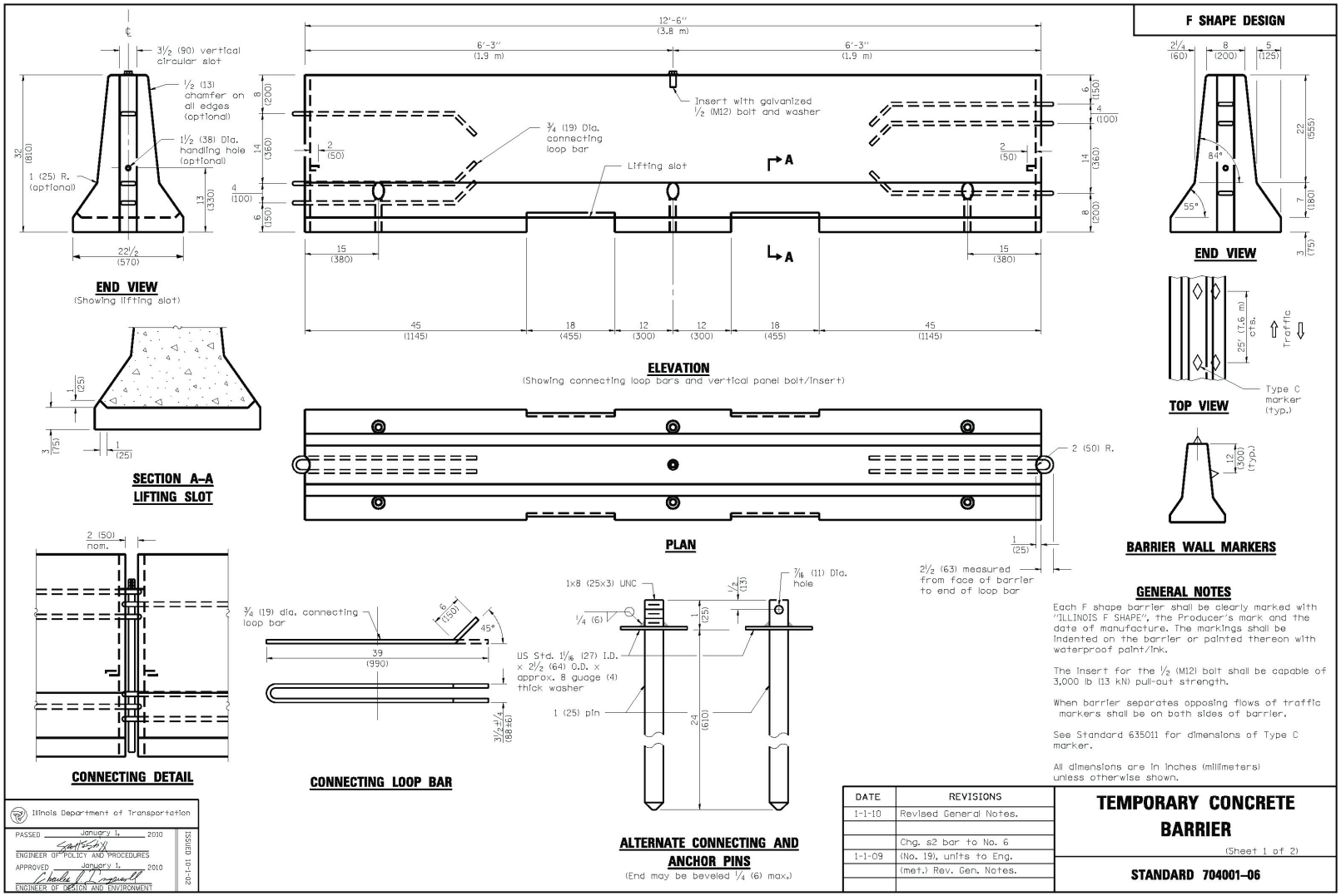


Figure 6. Illinois PCB Details

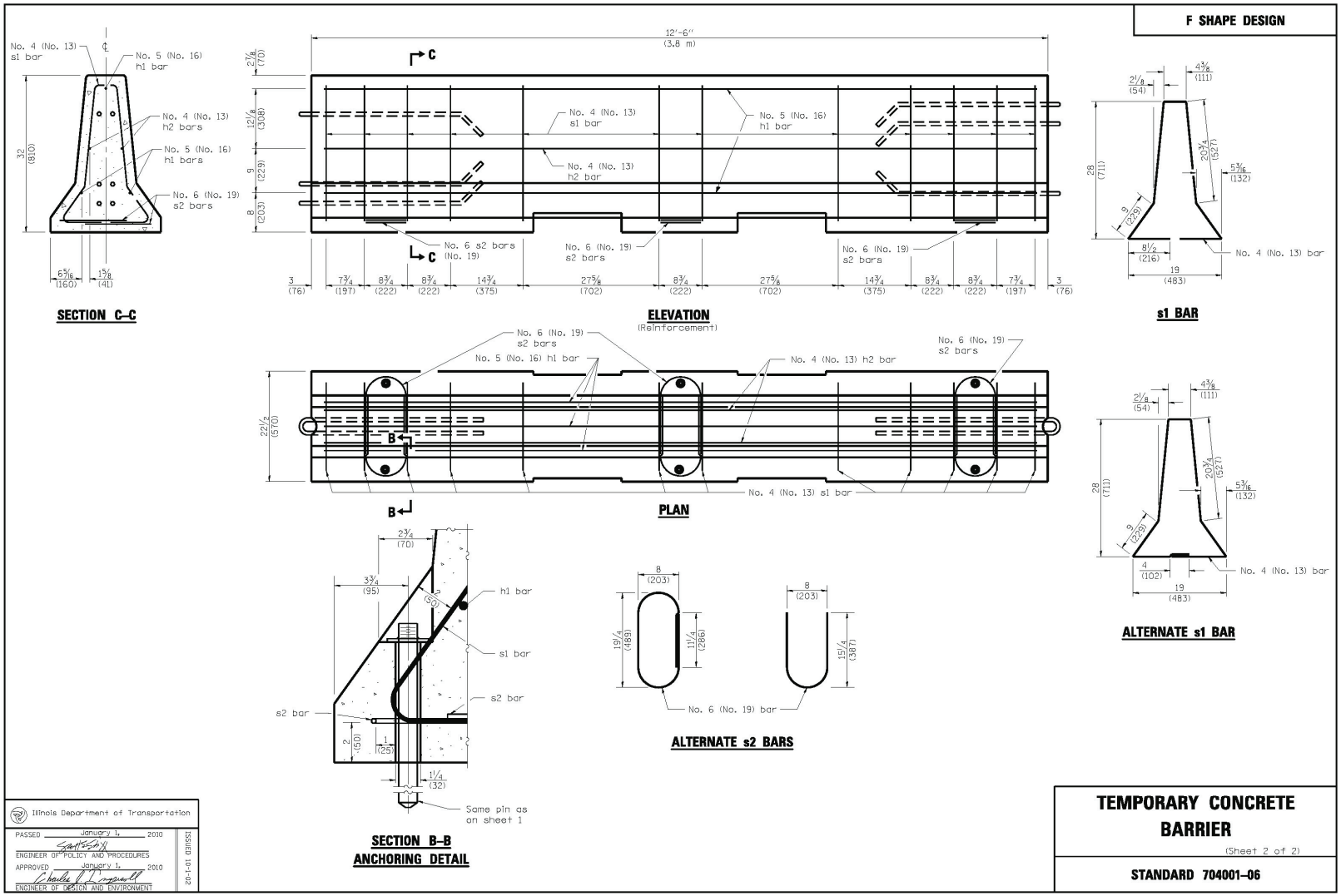


Figure 7. Illinois PCB Details

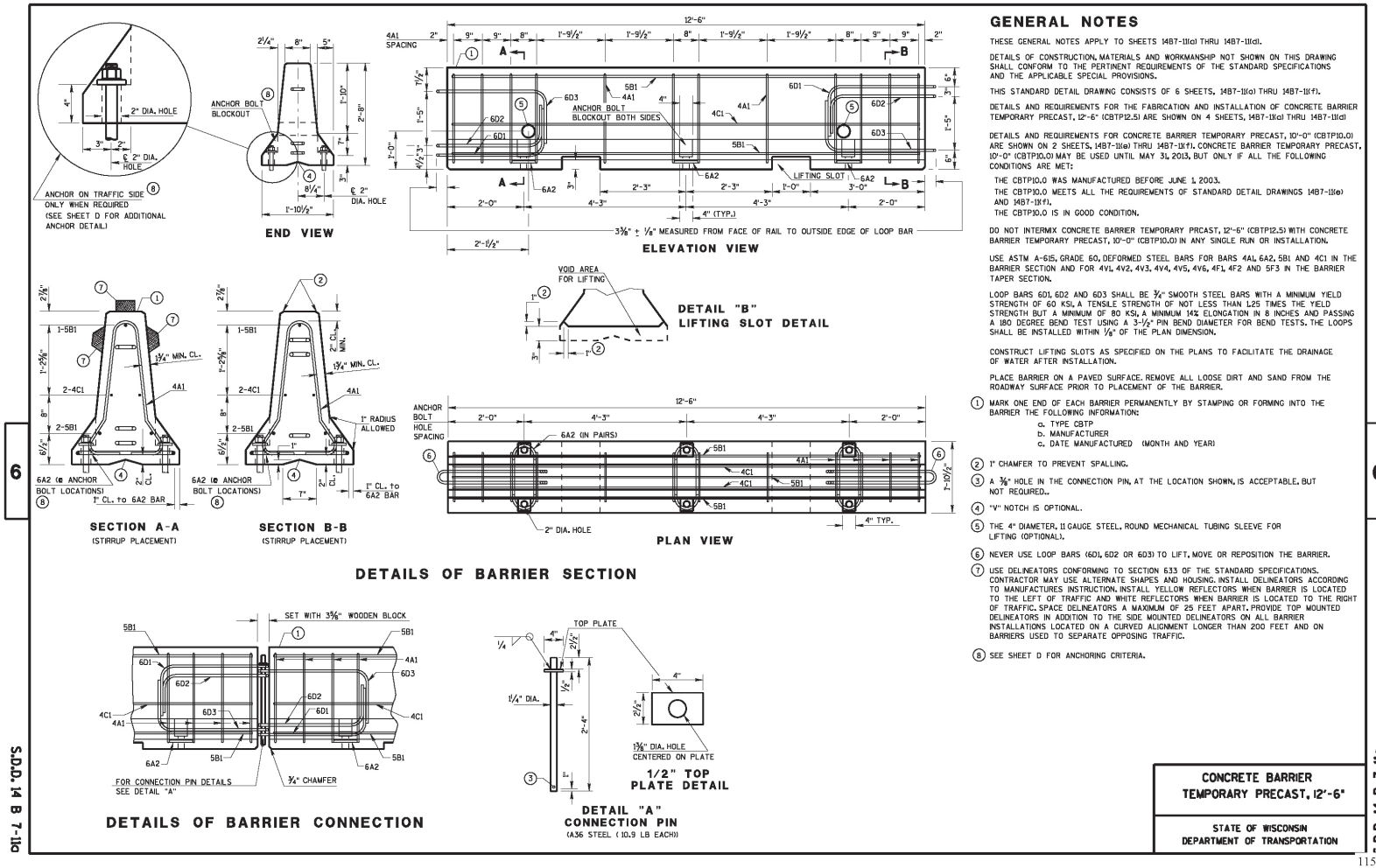


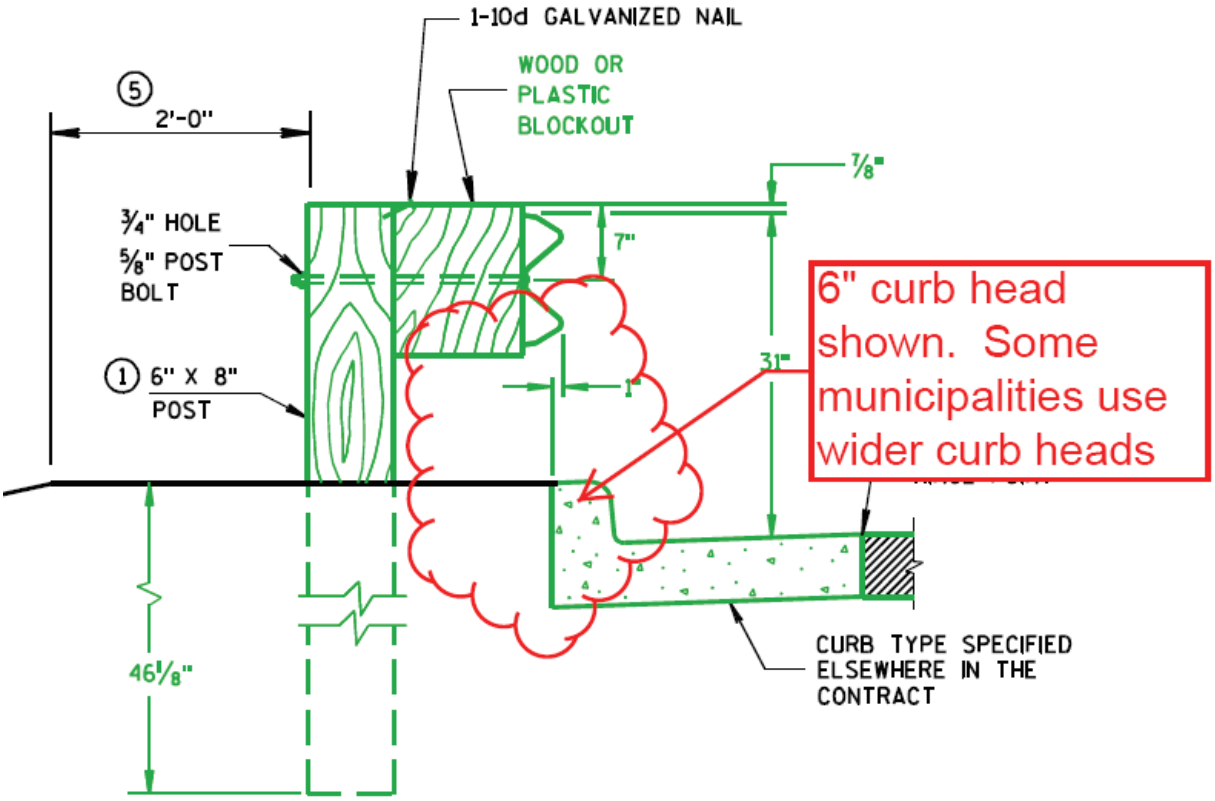
Figure 8. Wisconsin PCB Details

Problem # 6 – MGS Curb Offset Clarification

State Question:

Dear MwRSF,

The crash test drawings for MGS with curb indicate that the face of rail should be 1 inch behind the back of curb (see attached). In some municipalities in our state like to use curb with a wider head. When wider curb heads are being used, is the 1" off of back of curb important or would it be better to have the face of rail 5" from the front face of the curb head?



Sincerely,

Erik Emerson P.E.
Standards Development Engineer-Roadside Design
Wisconsin Department of Transportation

MwRSF Response:

The offset for the curb installation was set such that the front face of the guardrail was offset 6" from the vertical center of the curb.

The CAD in the report is confusing and is only valid for a curb setup with the width we used. The offset should be controlled by the center of the vertical face of the curb and the face of the guardrail.

Thanks

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

Problem # 7 – NCHRP Report 665 Question

State Question:

Ron - can you please confirm or refer to the appropriate person a couple of items regarding Table 89 in NCHRP Report 665. We have been waiting for the AASHTO Roadside Safety Committee to adopt Dean's recommendations for some time now. Please confirm the following:

1. We use a design speed of 75mph for freeways that are signed for 75mph - according to the text we can use the 70mph design speed in Table 89 for 70mph and higher. We will label the Design Speed column as 70mph and higher.
2. We use 65 mph design speed for urban freeway design. Interpolate between the 60-70 mph values in the table.

As always, thanks for your assistance. Terry

Terry H. Otterness, P.E.
Technical Support Engineer
Roadway Design Section

MwRSF Response:

Hello Mr. Otterness,

I am responding to your query to Dr. Ron Faller at MwRSF about NCHRP 665 guidelines. He referred the question to Dr. Sicking, Daniel Albuquerque, and myself.

I conversed with Dr. Sicking about the use of interpolation with Table 89 of NCHRP Report 665. He confirmed that the use of the 70 mph design speed runout lengths would be acceptable for use on roadways with speeds of 75 mph, and the 70 mph speed limit may be referred to as 70 mph and higher. He also confirmed that interpolation between the 60-70 mph range for runout length design on roads with speed limits of 65 mph would be acceptable.

I apologize for the delay in answering this question. Thank you for your patience.

Cody S. Stolle, M.S.M.E., E.I.T.
Graduate Research Assistant
Midwest Roadside Safety Facility

Problem # 8 – Openings in Concrete Median Barrier

State Question:

Ron,

The IL Tollway has openings in the concrete median barrier to allow emergency vehicles to make a U-turn. These openings vary from 100' to 130' measured between the ends of the concrete barrier wall. Each blunt end is protected by an impact attenuator which is either a GREAT or a Quadguard. During construction projects when vehicles are riding on the inside shoulder there is a desire to fill in this median opening. In the past, several methods have been used. One way was to remove the attenuators and place precast temporary barrier wall sections in the opening. To completely fill in the opening, one section of wall had to be cut to fit. Making the connection between the temporary barrier wall and permanent median barrier was difficult because of the different widths.

Another method was to use precast barrier wall sections placed on a diagonal within the opening so that the barrier did not need to be cut and also so there was no blunt end to protect. One drawback to this method was that the temporary barrier wall extends onto each inside shoulder. The temporary barrier was not attached to the existing median barrier or to the attenuators.
As you can see, each of these options has problems. I know MwRSF has tested several connections between temporary barrier wall and permanent concrete barrier. Is there a TL-3 system that we can employ to safely fill in these median openings for the duration of the project? The system should accommodate:

1. 32" F-shape temporary barrier wall, 22.5" wide at base
2. 32" Jersey shape or 42" F-shape permanent median barrier, 36" wide at base
3. Possible presence of slotted drain in the center of median opening running parallel to roadway.

Thanks for your help.

Tracy Borchardt
AECOM --- IL Tollway GEC

MwRSF Response:

Hi Tracy,

We do have a system for transitioning between free-standing PCBs and rigid, concrete median barrier. I have attached a report detailing its design and testing.

The file 'TRP-03-208-10.pdf' (27.7 MB) is available for download at
http://dropbox.unl.edu/uploads/20110215/3ba8220ff29b4d18/TRP-03-208-10.pdf
for the next 14 days.
It will be removed after Tuesday, February 15, 2011.

I believe that this system can be used in your situation.

You may note that it might be more desirable to simply anchor or pin all of the barriers in the installation rather than use the transition. However, we have seen in past testing that pins on the backside of a barrier may cause excess rotation and tipping of the barrier which in turn can produce vehicle instability. Thus, we currently do not recommend pinning on both sides of the PCB when placed in the median except for the transition section which we tested.

This issue of anchoring barriers in the median comes up a great deal and is something that we need to test in order to be confident that it is safe.

Thanks

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

Problem # 9 – Attachment of Temporary Concrete Barrier to Bridge Rails

State Question:

Ron,
What are the latest approved methods of attaching concrete protection barrier to Bridge rail?

Phil TenHulzen PE
Design Standards Engineer
Nebraska Dept. of Roads

MwRSF Response:

Phil:

MwRSF developed roadside and median transitions between free-standing F-shape TCB and rigid barrier. Both systems utilized a series of pinned TCBs with varied pin quantities over four segments and in combination with thrie beam guardrail. The median version also had a special steel sloped transition cap to fit between 32 and 42 in. barrier. Both designs have been reported, and Bob has submitted requests for seeking FHWA acceptance. I am not aware of any other

systems which transition TCBs to concrete bridge rail. In the past, we have offered recommendations for running TCBs past the bridge rail, including length and lateral offset.

Please let me know if you have any other questions regarding the information contained herein.

Ron

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

Problem # 10 – 54 Inch Barrier Length Necessary Before Pier

State Question:

Dr. Faller,

Our team is currently designing a 54 inch barrier wall for abutting or intruding bridge piers. We plan on providing a transition length for the change from a 32 to a 54 inch high barrier. However, we would like to know if you could offer an opinion on the length of 54 inch barrier required before encountering the pier? I have attached a sketch to illustrate the location of the length desired by our team. We would sincerely appreciate any assistance that you could offer to us on this matter!

Thank you for all of your help!

Todd Powell, PE
Florida Department of Transportation
Roadway Design

MwRSF Response:

Todd:

We have been able to discuss the FLDOT situation for shielding a bridge pier/abutment with a Test Level 5 (TL-5) highway barrier system. From your sketch, it is apparent that the FLDOT is seeking guidance regarding the recommended length of 54-in. tall, TL-5 barrier in advance of the tall hazard (i.e., critical pier/abutment).

To date, there is virtually no specific guidance for reasonably determining the length-of-need barrier protection for tractor-trailer impacts into bridge piers. Currently, AASHTO requires that 54-in. tall barriers be used to shield piers when placed close to the pier. Alternatively, 42-in. tall barriers have been recommended in situations when sufficient lateral clearance is provided between the barrier and pier. These recommendations have been made to prevent high-energy, tractor-trailer vehicles from impacting piers and causing catastrophic damage.

We understand that this AASHTO requirement can be quite costly to the DOTs, especially when considering the infrequent number of tractor-trailer impacts and high number of piers requiring shielding. As such, we have prepared our best guidance based on engineering judgment and experience with the understanding that a more refined recommendation would require further research.

In any event, we start with the assumption that the TL-5 impact condition involves a tractor-trailer vehicle striking a barrier at 50 mph. A TL-5 barrier would be used within the length-of-need to shield the pier and prevent a tractor-trailer vehicle from striking the pier. In your situation, the 54-in. tall barrier would be used per its limited lateral clearance. Upstream from the 54-in. tall barrier, a TL-3 rigid, reinforced concrete barrier with structurally-adequate anchorage would be connected to the TL-5 barrier and used to prevent errant passenger vehicles from encountering the pier/abutment structure.

TL-3 barriers measuring 32 in. tall are not capable of containing and redirecting tractor-trailer vehicles impacting at the TL-5 condition. However, we believe that these TL-3 barriers would be capable of dissipating significant energy to slow down the heavy vehicle, thus greatly reducing the severity and potential for tractor-trailer impact events into bridge piers. In addition, these TL-3 barriers would likely scrub-off speed during the initial contact with the front and upper barrier faces, and then again after the heavy vehicle had rolled onto its side behind the barrier and continued to slide toward the pier structure. As such, it was our goal to greatly reduce the tractor-trailer vehicle's impact speed with the pier under situations involving TL-3 barrier override or penetration in advance of the TL-5 barrier and pier structure.

It is our hope that the severity of the vehicle crash into pier could be greatly reduced, such as that occurring with a speed reduction from 50 to 25/30 mph. For an initial speed of 50 mph, we would expect to scrub off at least 5 mph prior to landing on the back side of the barrier. With the vehicle on the barrier's back side and potentially on its side, a trailer-trailer vehicle would then be further slowed with friction losses through vehicle drag (i.e., sliding and/or soil plowing). Using a coefficient of friction of 0.5 and a reduced initial speed of 45 mph, we calculated the distance over which the vehicle's speed would be further slowed to 25 to 30 mph. From this simple analysis, the required distance ranged from 75 to 94 ft. As such, we selected a distance of 85 ft for the full-height, 54-in. tall TL-5 barrier found upstream from the pier. Adjacent to the barrier, a 14-ft 8-in. long sloped transition segment would be utilized to transition the concrete barrier from 54 to 32 in. using a 8:1 slope, thus resulting in a total upstream combined length of approximately 100 ft excluding the TL-3 barrier.

In summary, we have utilized engineering judgment and experience to configure the length of a TL-5 tall concrete barrier system for protecting bridge piers – 84 ft of full-height barrier and 15 ft of transition to sum to 100 ft. Please note that this length-of-need guidance is likely conservative and is not based on any economic analysis.

If you have any questions regarding these preliminary recommendations, please feel free to contact either Dean Sicking at 402-472-9332 or myself at (402) 472-6864. Thanks again!

Respectfully,

Ron

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

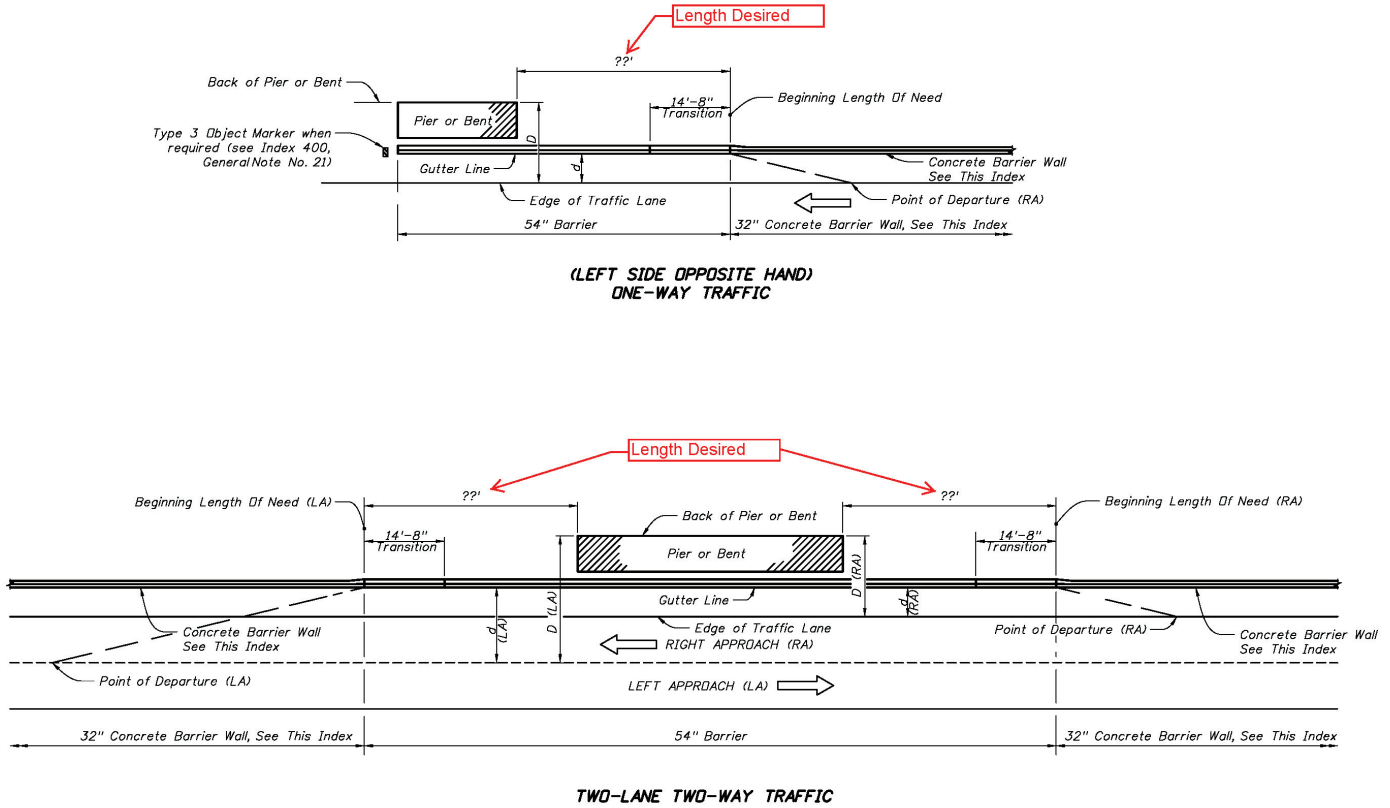


Figure 9. Proposed FLDOT Barrier Length Adjacent to Pier