**Meeting Minutes**

**Roadside Safety Pooled Fund**

**November 16 & 17, 2010**

**Kent, Washington**

Attendance: **TTI** - Roger Bligh, Lance Bullard, **FHWA** - Will Longstreet **Washington** - Dave Olson, Rhonda Brooks, Rod Erickson, Brad Manchas, Jerry Althauser, **Alaska** - Jeff Jeffers, **Minnesota** - Mike Elle, **Louisiana -** Paul Fossier, **Tennessee -** Ali Hangul, **Pennsylvania** - Mark Burkhead, **SAIC** – Brian Chandler

Following a night of heavy winds and scattered power outages, the business meeting began at 8:30 A.M. in the WSDOT’s Kent Maintenance Facility. The meeting began with introductions, followed by a meeting overview and agenda review.

There was brief discussion on potential “new” states that may be interested in joining the Pooled Fund. Hawaii, Ohio, Montana, and Florida were mentioned as states that had shown some interest through discussions with current members.

There was a brief discussion about communication improvements. There was a suggestion to add a spreadsheet to the TTI web-page summarizing status of all projects. It was also suggested that the spreadsheet indicate whether there was an FHWA acceptance letter issued for each project. Another suggestion was to provide a direct link to FHWA’s acceptance letter where appropriate.

Rhonda Brooks provided a financial summary of the Pooled Fund commitments and unexpended dollars from previous contributions. Rhonda identified $158,900 in unexpended funds and anticipated $175,000 in FY 2010 contributions. She suggested that the members target $300,000 to $325,000 for research projects in FY 2011.

Following the financial summary, Roger Bligh provided a status update for completed and active projects.

**Status of Projects**

Project – *Posts in Mow Strips* – Task AL - **COMPLETED**

This project evaluated various methods for controlling vegetative growth along the base of the guardrail, while still permitting normal performance of the guardrail posts. The final report summarizing this work is complete and the report and test data were submitted to FHWA for acceptance. Over the past year, The FHWA issued an acceptance letter dated April 14, 2010. The FHWA letter approves the urethane foam, rubber mat & pop-out concrete wedge.

Project – *Evaluation of Field Applied Fittings for Cable Barrier & Conversion to High Tension* – Task AK – **REPORT COMPLETED, BROCHURE PRODUCTION REMAINS**

This project focused on conversion of a low tension cable barrier system to a high tension system through removal of the spring compensators and low tension terminals, installation of high tension terminals, and increasing the cable tension to 5,500 lbs @ 70 deg F. The project also evaluated the addition of a 4th cable to reduce under-ride potential. A full scale crash test successfully restrained the ¾ ton pickup in a 3 cable system conversion.

Over the past year, the project was completed, with a report issued in July and posted on the website. The report included two retrofit manuals for conversion of the generic 3-rope system to: a high tension 3-rope system, and a high tension 4-rope system.

* Remaining Task(s) – In conjunction with the project monitor, TTI will prepare a package for submission to FHWA for an acceptance letter. (this was done in December 2010) Project brochure is needed.

Project – *Crash Wall for MSE Walls* – Task AP – **DRAFT REPORT IN REVIEW**

The objective of this project is to develop a crash wall for placement in front of MSE wall to protect the MSE wall from vehicular impact forces. A TL4 design has been analyzed using a single unit truck evaluated using MASH criteria. This project has developed a design using an 8’ high wall 8” thick, constructed from reinforced concrete. A model was developed and evaluated using simulation. This design appears to accomplish the goals of the project. Over the past year, a draft report was developed and circulated for review and comments in September 2010.

Project - *Synthesis of Beam Guardrail Deflection Characteristics* - Task AW – **DRAFT REPORT IN PROGRESS**

This project builds upon work done for the AASHTO Roadside Design Guide to evaluate different beam guardrail system designs and presents deflection characteristics determined from previous crash testing. It includes different post spacing, nested rail, single ply rail, 10 gauge rail, 12 gauge rail, and different mounting heights. A total of 46 previous crash tests were reviewed and tabulated in a spreadsheet. Additional communication with guardrail manufacturers is on-going. A draft report is being prepared.

Project – *Short Radius T-Intersection* – Task AJ – **STUDY COMPLETE, FHWA ACCEPTANCE LETTER REQUESTED, BROCHURE PRODUCTION REMAINS**

This project is evaluating short radius guardrail designs for use at T-Intersections. A TL-3 design appears to be out of reach. A TL-2 design based on previous testing conducted for Yuma County, AZ in 1989 offers a solution for lower speed facilities. An FHWA Acceptance Letter was requested in August 2010.

* Remaining Task – Project brochure is needed.

Project – *Guardrail on Slopes – Phase 2* – Task AT – **IN PROGRESS**

The objective of this project is to evaluate beam guardrail designs suitable for placement in front of or on slopes 2H:1V or flatter. In phase one of this project, the ¾ ton pickup was restrained and redirected, but did not remain upright. The test results are being used to refine the models for the pickup and the soil to enhance the accuracy of the simulation. Further testing will continue using MASH criteria to refine the design through simulation before proceeding with full scale testing.

Project – *Anchored Temp Concrete Barrier Systems for Limited Deflections* – Task AB – **COMPLETED, FHWA ISSUED ACCEPTANCE LETTER**

This project and final report were completed in 2009. Over the past year FHWA issued an acceptance letter dated April16, 2010 for the barrier anchorage system.

Project - *Anchoring Temporary Concrete Barrier on Asphalt or Soil* – Task AY – **IN PROGRESS**

This project builds upon work completed in Task AB, Anchored Temp Concrete Barrier Systems for Limited Deflections. This work evaluates similar anchorage methods appropriate for use in asphalt pavement or on soil. (SEE Task AZ for additional detail)

Project - *Transition for Anchored Temporary Barrier System* – Task AZ – **IN PROGRESS**

This project also builds upon work completed in Task AB, Anchored Temp Concrete Barrier Systems for Limited Deflections. The purpose is to develop a transition for the approach to the anchored section of the barrier to reduce snagging potential. Because of there are some tasks common to Projects AY & AZ, portions of these projects have been analyzed jointly. Determining anchor pin pull-out forces for soil and asphalt bases, followed by FE modeling and simulation of the anchorage methods has been the initial focus for these projects. At this time is appears that anchor pins in soil are inadequate, and more than 2” of asphalt is needed to develop sufficient resistance.

Project – *Lake Pontchartrain Bridge Rail* – Task AN – **COMPLETE**

This project identified a crashworthy steel post and rail design to replace concrete bridge rail damaged by Hurricane Katrina. A rail system was identified and system modification and attachment details were developed specific for the Lake Pontchartrain Bridge.

Project – *F-Shape Barrier with Drain Holes* –Task AR – **COMPLETE, BROCHURE PRODUCTION REMAINS**

This project evaluated an F-shape bridge railing with 6” high drainage slots for their potential for wheel snagging. The barrier is comparable to a TxDOT design used to accommodate wildlife crossings. The evaluation is complete and the final report was issued in October 2010.

* Remaining Task(s) – Project brochure is needed.

Project - *Sign & Light Standard Foundation when Installed on Slopes* – Task AV – **IN PROGRESS**

This project is developing a subsurface concrete foundation with a steel stub post extending to ground line, as a foundation for steel signs and light standards mounted on slopes. The steel stub post terminates with a slip base and is designed for use on slopes 2H:1V or flatter. This design reduces the potential for vehicle snagging on a larger diameter concrete foundation while reducing the need for grading around the base. Initial efforts have focused on small sign base, with details for larger sign supports to follow.

Project – *Single Slope Barrier with Pin & Loop Connections* – Task AS – **PROJECT COMPLETE, CRASH TEST WAS UNSUCCESSFUL**

*This project evaluated two issues. A single slope barrier utilizing a pin & loop connection, similar to what Oregon has used in their F-shape barrier. It also evaluated wheel snagging potential for a drainage scupper in the bottom of the barrier. The design was analyzed, crash testing was simulated and full crash testing ensued. The vehicle was redirected but rolled multiple times. Although the test was unsuccessful, the drainage scupper opening did not snag the wheel, and does not appear to have been a factor in the vehicle overturning. The designated funding for this project has been exhausted*.

TTI has provided a cost estimate for the next phase of work in pursuit of a successful crash test.

Project - *Guardrail over Box Culvert – Phase 2* – Task AX – **EVALUATING DESIGN MODIFICATION FROM PHASE 1 WORK**

This project continues the development of previous work conducted under Phase 1 of this project. The objective is to develop a guardrail design with standard 6 ft-3 in. post spacing suitable for use over low-fill box culverts. The phase 1 crash testing retained the pickup but ruptured the rail element and FHWA has indicated that this is an unacceptable outcome. The next iteration of this project is evaluating a design that raises the rail height to 31” and looks at moving the rail splices to mid-span to see if this resolves the issue with rail rupture.

Project - *Sign & Light Standard Foundation when Installed on Slopes* – Task AV – **WORK IN PROGRESS ON SMALL SIGN SUPPORT**

This project develops a subsurface concrete foundation with a steel stub post extending to ground line, as a foundation for steel signs and light standards mounted on slopes. The steel stub post terminates with a slip base. This design will reduce the potential for vehicle snagging on a larger diameter concrete foundation that extend to or about ground line. This project will conduct an Engineering analysis of impact and wind loads.

**FHWA Direction Regarding G-4 W-beam Barrier Systems**

Will Longstreet provided an overview of a May 17 FHWA memorandum regarding rail height for the G-4 Guardrail system. Although this barrier system is often referred to as 27 inch high guardrail, analysis has shown that the minimum mounting height needs to be 27 ¾.” The (old) 27” height number comes from a metric conversion and subsequent rounding. Recent analysis indicates that this barrier does not meet TL3 performance requirements when installed with a top of rail height of 27”. This memorandum also suggests that states should consider adopting a 31” mounting height for all new installations.

Will also provided some clarification on FHWA acceptance letters issued under NCHRP 350 criteria. Projects that were ongoing as of October 2009 may pursue acceptance under NCHRP 350 criteria. Projects started after October 2009 are to be developed under MASH criteria. Requests for FHWA acceptance letters under NCHRP 350 criteria are to be submitted to FHWA by end of December 2010. As a minimum, the request letter and a data sheet are to be submitted by that date. Submittal of the full report is due no later than Jan. 31, 2011. Will also cautioned against submitting CD’s or other heat sensitive media through the US Mail. These items go through the Brentwood postal facility where anthrax was found a couple of years ago. All mail through this facility is now subjected to heat levels that will destroy CDs and similar media.

**Safety Performance Presentations (what is working well and/or what are the safety needs in your state?)**

*Washington*

Jerry Althauser provided a maintenance perspective on how roadside hardware decisions affect maintenance operations. Jerry identified service life as an issue, because many times items are placed with an expectation of 15-20 years of service, but may actually remain in place well beyond 30 years. Age and deterioration of some of these products frequently means more costly repairs in these later years. Crew exposure is also a concern for items that require extensive repair when struck. New devices that require specialized maintenance equipment are a financial strain on maintenance budgets when those devices are overlooked in deciding to implement new systems. Without the right equipment there is an increased risk of strains or other injuries to maintenance personnel.

Dave Olson provided performance safety summaries on WSDOT’s experience with cable median barrier and centerline rumble strips. A review of nearly 200 miles of median barrier installations reveals a 64% reduction in serious injury median crashes and 44% reduction in fatal median crashes. High tension median barrier installations have reduced cross median events to 3.7% of the total hits, compared to 2.2% for concrete barrier. WSDOT has approximately 1500 mile of centerline rumble strips in place. Studying those locations where the rumble strips have been in place for at least 16 months reveals a 48% reduction in fatal & serious injury cross centerline collisions and a 44% reduction in all cross centerline collisions. Cross centerline collisions where drivers were asleep or fatigued were reduced by 75%.

Rod Erickson provided a summary of WSDOT’s use of 31” high guardrail systems. Washington began installing 31” guardrail in 2007 and now has well over 500 miles in place. WSDOT has found that the cost of the 31” guardrail is a few cents cheaper (per L.F) than the 27” high G-4 system. WSDOT policy is to use 31” guardrail in all new installations, with consideration given to extending existing runs of 27” high rail. WSDOT has 15 standard plans for the various components of the 31” guardrail.

*Louisiana*

Paul Fossier recapped Louisiana’s experience with rehabilitating Lake Pontchartrain Bridge Rail following the damage caused by Hurricane Katrina. The redesigned rail system required demolition of the existing rail, rebuilding from the top of curb. The reconstructed railing consists of two steel tubes mounted on steel posts anchored to the curb at 6’-3” spacing.

Paul also reported on recent activities of the AASHTO Technical Committee for Roadside Safety (TCRS). The update of the AASHTO Roadside Design Guide will be circulated for balloting in the fall of 2010. MASH testing references have been added. It contains a new chapter for Low Volume Roads. New research activities under consideration include:

* + Guideline for design and shielding of bridge piers – consideration of increased loads
  + Guidelines for slope traversability and vehicle rollover
  + Characteristics of work zone barrier crashes
  + Curbs used in conjunction with guardrail terminals and impact attenuators
  + Injury and fatality causation during rigid barrier impacts

Paul provided a summary of ongoing research projects of interest to and supported by the TCRS.

*Tennessee*

Brian Chandler of SAIC provided a summary of a recent project to develop a safety implementation plan for addressing roadway departure collisions in Tennessee. Tennessee had experienced 3904 roadway departure fatalities from2004 through 2008. With an average of 780 roadway departure fatalities per year, they targeted a 10% reduction in 5-7 years. Their approach evaluated various fatal crash types and then selected locations with the best combinations of high effect (focus on crash counts) and high effectiveness (focus on over-represented crashes). Ultimately they constructed a countermeasure matrix that estimated implementation costs and crash reduction numbers. Ali Hangul reports that this effort resulted in an implementation plan that safety managers have a high degree of confidence will get them to their target reduction levels.

**November 17, 2011**

*Pennsylvania*

Mark Burkhead reported on Pennsylvania’s experience with developing a guardrail installers training program. The target audience is installers rather than designers. Many of the products were brought in on trailers so that attendees could work through concerns in a hands-on environment. FHWA has been involved in this course development and the expectation is that the training would be available nationally. Contact Will Longstreet to make arrangements for other states. Mark reported that overall this has been well received. PennDOT is considering using this training as part of their certification process. A companion course for designers was developed with discussions addressing installations errors and materials issues. Mark provided PowerPoint Slides of their training course. PennDOT developed a pocket field guide as a reference for installers and inspectors. Mark will provide a web page link for this publication when it is posted on-line.

*Minnesota*

Mike Elle provided an overview of research underway (or recently completed) through a pooled fund program at the University of Nebraska – Midwest Roadside Safety Facility (MwRSF). Nebraska Department of Roads is the lead agency for this pooled fund. Mike provided a brief overview of the following projects:

* Midwest Guardrail System (MGS) placed 6 feet behind 6” curb with a 37” rail height relative to the roadway – Successful crash test (MASH TL-2)
* MGS testing at 34” and 36” mounting heights – Successful crash tests with small car (MASH TL-3)
* Thrie beam bullnose with breakaway steel posts – Successful crash tests with small car and pickup (NCHRP 350 TL-3)
* Impact evaluation of brass breakaway couplings – Pendulum testing has been unsuccessful thus far

In addition to these active projects, there are projects pending to evaluate:

* MGS with 6” by 8” timber posts
* MGS on steel posts with no blockouts
* Non-proprietary 4 strand cable barrier suitable for 4H:1V slopes
* Guidelines for cable barrier post foundation sockets
* Testing of 4 strand cable barrier terminal
* Paper study – Cost-effective safety measures for low-volume roads
* Paper study – Guardrail developments – submissions to Task Force -13 Hardware Guide
* Paper study - Cost-effective upgrades for existing guardrail systems
* Paper study – Safety performance evaluation of vertical and safety shaped concrete barriers
* Paper study – MGS implementation
* Paper study – LS-DYNA modeling enhancement funding

*Alaska*

Jeff Jeffers identified a few issues that Alaska is dealing with regarding roadside safety. Mail boxes within the design clear zone is a concern, and Alaska currently has no enforceable policy or program. Their primary means of addressing non-crashworthy mail boxes is when the department replaces them on capital improvement projects. Alaska has established 4 safety corridors over the past 4 years, where they have applied the coordinated efforts to address Enforcement, Education, Engineering, and Emergency Response (4-E’s). These projects appear to have significantly reduced collisions that resulted in major injuries and fatalities. Jeff reported on Alaska’s use of shoulder and centerline rumble strips, resulting in crash reductions of 20%-25% for non-ice/snow crashes. They have targeted safety corridor projects and NHS highways with adequate shoulder width and pavement structure for rumble strip application. They are now looking at second tier of priorities based on crash experience. All existing pedestrian signals are being upgraded with pedestrian countdown timers. New installations will include the countdown timers. Alaska is also retrofitting traffic signals with permissive flashing yellow arrows for left turns. They have targeted about 50 intersections in Anchorage, Fairbanks and Juneau.

**Presentation of New Research Proposals**

Lance Bullard provided TTI’s review of the feasibility and estimated costs for the projects proposed for FY 2011.

AK/24 – *Mailbox Hazard & Risk Assessment*

This project would collect and analyze crash data for mailbox collisions, evaluate permitting requirements and enforcement policies regarding placement, and develop tools that states could use to assess risk. This project will focus on a literature search, crash data analysis, and development of policy options. No crash testing is anticipated in this project. TTI estimates $35,000 for this project.

LA/20 - *Development of a Generic Omni-Directional Breakaway Single-Post Sign System for round posts up to 5” diameter*.

This proposal would develop a single post sign support utilizing a 5” diameter steel support. This would reduce the need to rely on proprietary designs for this purpose. Phase 1 would develop the design and conduct static and pendulum testing. Phase 2 would subject the design to 2 full scale crash tests, and Phase3 would develop wind loading tables and conduct addition static testing. TTI estimates $47,000 for Phase 1, $100,000 for Phase 2, and $20,000 for Phase 3 of this project.

LA/26 – *Rebar Locator for Pinned Precast Barrier Application*

This project would evaluate non-destructive testing methods for determining rebar placement in bridge decks/roadway slabs. This is necessary when boring holes in bridge decks for drop-in anchor pins for precast concrete barrier. The project will investigate equipment/user costs, advantages/disadvantages of various methods. The project will test various methods and develop recommendations for use. TTI estimates $30,000 for this work.

MN/23 – *Testing of Alternate Portable Concrete Barrier Connecting Pin*

This project would develop and test two modified connecting pin designs to be used for connecting the SWC09 concrete barrier system. The pin design is intended to aid in removal when the barrier are under tension and to provide for better worker safety when traffic is operating on one side of the barrier system. TTI estimates $25,000 to $30,000 for this project.

PA/30 – *Structure Mounted W-Beam Median Barrier*

This project would design a double faced W-beam median barrier suitable for mounting on a structure. Both new and retrofit options would be investigated. This design would be used in narrow median applications with two-way traffic on a single structure. TTI estimates $48,000 for design analysis and crash simulation work.

PA/31 – *W-beam Restrained Temporary Concrete Barrier*

This project would evaluate the crashworthiness of using standard W-beam rail bolted to the back of the barrier to restrain temporary barrier with no positive connection between barrier sections (PA’s slot and plate method) by using a nested w-beam sections bolted across the barrier joints using ¾” diameter bolts. The bolts would extend completely through the barrier and would be shimmed to accommodate when the sections would be placed on a radius. TTI raised some concerns over the use of w-beam panels for this role and recommended an analysis of other methods to achieve similar end result. TTI estimated $20,000 to evaluate alternative designs.

PA/32 – *Bridge Approach Transition Retrofits*

The objective of this research is to provide options for modified bridge approach transitions to existing structures with battered abutments and/or wingwalls. The battered wall configuration presents below-grade conflict with guardrail post placement. This project would identify the most common configurations where this conflict is likely, and develop designs suited for those most common occurrences. TTI estimates $59,000 for Literature Search, Engineering and Crash Simulation.

TN/27 – *Single Slope Half Size Concrete Barrier Wall for Protecting Sound Barrier Walls or MSE Walls*

This project would explore the use of a single slope barrier with a vertical back as a crash absorbing panel to be used in front of Mechanically Stabilized Earth (MSE) walls or Sound Barriers to protect these structures from impact loads. The project would develop a model and conduct computer simulation to determine the crash worthiness of such a barrier when offset in front of the structure and backfill placed in between. TTI estimates $34,000 for design analysis and crash simulation.

TN/28 - *Split Single Slope Median Wall for Grade Separation*

When widening of an existing divided highway with depressed median, adding inside lanes into the depressed median area is the preferred method, since it requires no additional ROW. However extending the pavement at super elevations often necessitates the use of a retaining wall along with the concrete median barrier to deal with the resultant grade separation between opposing traffic lanes. This project would evaluate the use of back to back vertical back, single slope barrier walls placed. Engineering analysis and simulation would be used to evaluate crash-worthiness and stability of this concept. TTI estimates $30,000 for the analysis and simulation.

WA/25 - *Field Inspection Technique for Guardrail Beam Integrity*

FHWA’s Roadside Safety Hardware webpage posts frequently asked questions. In response to a question asking about the continued use of weathering steel guardrail, FHWA stated that weathering steel beam guardrail may be used if the owner agency adopts a frequent periodic inspection. This project would identify a means for non-destructive testing of existing guardrail runs. This project would evaluate products and develop a recommended testing procedure, with FHWA participation during the development process. TTI estimates $40,000 for this project.

WA/29 - *Crash Testing Single Slope Concrete Barrier with Drainage Scuppers – Phase 2*

A Washington project conducted phase one of this work, which evaluated the crashworthiness of a single slope barrier with pin & loop connections and 9” high by 28” long drainage opening (scuppers) to facilitate sheet flow drainage under the barrier. The full scale crash test was unsuccessful as the impacting vehicle rolled after being redirected by the barrier. The barrier deflection appears to have been excessive, but there was no wheel snagging induced by the scupper opening. Phase 2 would evaluate a larger, stiffer pin to reduce movement at the barrier joints. Reduce barrier movement is expected to improve vehicle stability upon exiting the barrier system. TTI estimates $50,000 for this project which will include full scale crash testing of the barrier.

LA/22 - *Anchoring Temporary Concrete Barrier to Rigid Bridge Rail*

This proposal would build upon work completed in a previous task, anchoring F-shape concrete barrier to concrete pavement with drop in anchor pins. The purpose is to develop a transition for the approach to permanent concrete barrier or bridge rail to reduce snagging potential. Estimated cost is $30,000. (TTI estimates $90,000 for this work)

**Selection of Research Projects for Next Year**

After the presentation of the proposals, each member state was asked to rank their top five projects. Each contributing state representative was asked to assign 5 points to their highest priority project, 4 points for their second priority, etc. with declining point values down to 1 point for their 5th ranked priority. Individual state scores were added together to determine the total points for each research proposal and the highest point score reflected the group’s top priority. The projects were ranked in priority order and selected for the next research cycle until the costs equaled $300,000 to $325,000. Projects selected for the next round of research are:

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| --- | --- | --- | --- |
| **Rank** | **Project** | **Estimated Cost** | **Project Monitor** |
| 1 | Transition for Anchored Temporary Barrier to Permanent Concrete Barrier | $85,000 | Paul Fossier |
| 2 | Crash Testing Single Slope Barrier with Drainage Scuppers | $50,000 | Rod Erickson,  Dave Olson |
| 3 | Mailbox Hazard and Risk Assessment | $35,000 | Jeff Jeffers |
| 4 | Determining a Field Inspection Technique for Guardrail Beam Integrity | $40,000 | Dave Olson |
| 5 | Half SS in Front of Sound Barrier Wall - Design Analysis & Simulation - TL3 | $34,000 | Ali Hangul |
| 6 | Rebar Locator for Pinned Precast Barrier Application | $30,000 | Paul Fossier |
| 7 | Single Slope Wall - Eng. Analysis & Simulation | $25,000 | Ali Hangul |

The funds available to invest in research over the coming year are estimated to be $300,000 to $325,000. The estimated total for the projects listed is $299,000. The next priority project is estimated to be $59,000.

Next year’s meeting is planned for College Station, Texas in the November time frame.