**Meeting Minutes**

**Roadside Safety Pooled Fund**

**November 15 & 16, 2011**

**TTI – College Station, Texas**

Attendance: **Washington** **-** Dave Olson, Rhonda Brooks, **Louisiana -** Paul Fossier, Justin Peltier, **Minnesota** **-** Mike Elle, **Pennsylvania** - Mark Burkhead, **Tennessee -** Ali Hangul, **Texas -** Rory Meza, Wade Odell, **FHWA** **-** Dick, Albin, Stephen Ratke, **TTI** **-** Roger Bligh, Lance Bullard, Rebecca Haug, Dusty Arrington, Nauman Sheik, Akram Abu-Odeh, William Williams, Michael Brackin, Chiara Silvestri

Participation by Teleconference: **Alaska** **-** Jeff Jeffers, **California -** John Jewell**, Washington -** Rod Erickson, **FHWA** **-** Will Longstreet

The business meeting began at 8:30 A.M. in the Texas Transportation Institute’s Riverside 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. West Virginia has expressed an interest, and Donna Hardy was hoping to attend but was unable to participate this time. Rory Meza (later joined by Wade Odell) participated from Texas, as Texas is evaluating the possibility of re-joining the group.

Rhonda Brooks provided a financial summary of the Pooled Fund commitments and unexpended dollars from previous contributions. Rhonda identified $220,000 in unexpended funds and anticipated FY 2012 contributions. She suggested that the members target $275,000 to $300,000 for research projects in FY 2012.

There was a brief discussion about communication improvements. TTI staff, particularly Wanda Menges, were commended on the improvements made to the web site over the past year. The state members reported that the webpage now offers the level of information they were looking for and that the updates are happening in a timely manner. (Great job Wanda!).

Following these discussions, TTI staff provided a status update for completed and active projects, with the principal investigators reporting on their projects.

**Status of Projects**

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. Task AB focused on barrier placement on concrete pavement of bridge slabs at least 7” thick. This project evaluates drop-in/driven pin anchorage methods appropriate for use in asphalt pavement or on soil. Initial work on this project indicates that anchor pins in soil and thin asphalt pavements did not provide sufficient pull out resistance. (See Task AZ for additional detail). Note: Approximately one week after the November 15/16, 2011 meeting a full scale crash test was conducted on asphalt pavement with a successful outcome.

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 greater than 2” of asphalt is needed to develop sufficient resistance. The focus of this work will be on a transition for concrete pavements. This project is looking at different pin placement configurations in the transition section.

Project – *Anchoring Temporary Concrete Barrier to Rigid Bridge Rail* – Task BH – **IN PROGRESS**

This project builds upon work completed in Task AB, Anchored Temporary Concrete Barrier Systems for Limited Deflections. This project is developing a transition for the approach to permanent concrete barrier or bridge rail to reduce snagging potential. This design focuses on a MASH Test Level 3 design for barrier placed on concrete pavement or bridge deck. Several pinning configurations were evaluated using the barrier design from Task AB. Simulations were used to help identified a preferred configuration. A full scale crash test of this design was scheduled to coincide with this annual meeting. See **Full Scale Crash Test for Transition for Anchored Temporary Barrier System – Task AZ** on subsequent page(s).

Project – *Field Inspection Technique for Guardrail Beam Integrity* – Task BC – **IN PROGRESS**

On their Frequently Asked Questions webpage dealing with Barriers, Terminals, Transitions, Attenuators and Bridge Railings, FHWA states that weathering steel beam guardrail may be used if the owner agency adopts a frequent periodic inspection and replacement schedule. Some of the states using weathering steel guardrail are not experiencing the levels of rail corrosion that prompted this direction from FHWA. Many of those states wish to continue using and installing weathering steel guardrail. This objective of this project is to identify a means for non-destructive testing of existing guardrail runs. This project is evaluating products and developing a recommended pass/fail testing procedure. An FHWA representative will be participating during the development process. A draft survey has been developed and will be circulated to gather information about experiences with weathering guardrail across the country. 200 LF of rail has been donated for testing purposes. CalTrans can/will provide some samples with lap splices. Five devices have been identified for evaluation and that list was later reduced to three.

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, with the face of the rail aligned with the break point of a 2H:1V slope. In phase one of this project, the ¾ ton pickup was restrained and redirected, but did not remain upright. In phase 2 of this project, the phase 1 test was used to recalibrate the model. The model was refined with a smaller mesh, followed by simulation of a crash test. The rail system has been redesigned using a 31” high rail, 8’ long posts, 8” blockouts, and standard 6’-3” post spacing. A full scale test with the MASH pickup (test 3-11) is planned.

Project – *Single Slope Half Size Concrete Barrier Wall for Protecting Sound Barrier Walls or MSE Walls* – Task BA – **IN PROGRESS – DRAFT FINAL REPORT PRODUCED**

This project is evaluating 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 is developing a TL-3 design, comparing a single slope barrier placed directly in front of the wall with a barrier separated from the wall by 18” of backfill between the back of barrier and the front of the wall.

Project – *Synthesis of Beam Guardrail Deflection Characteristics* – Task AW – **COMPLETE**

This project is similar to work previously 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 53 previous crash tests were reviewed and tabulated in a spreadsheet. The project is complete and the final report is posted on the website. Akram gave a demonstration of one of the spreadsheets showing a tabulation of crash tests. The spreadsheets (one for metric and one for US units) are set up to facilitate filtering to isolate various rail system characteristics.

Project – *Mailbox Hazard & Risk Assessment* –Task BE – **IN PROGRESS**

Mailboxes are generally placed closer to roadways than most any other object, yet little is known about their influence on crashes. This project is evaluating the risk associated with mailbox supports. The project recently implemented a survey inquiring about policies, regulations, and the availability of crash data. 28 states responded to the survey, 18 have crash data available. The next steps in the project will compare those states with policies against those states that do not have specific policies for mailbox placement. Mailbox crashes and injury severity will be compared with other fixed object crashes.

Project – *Rebar locator for Pinned Concrete Barrier Application* – Task BF – **IN PROGRESS**

This proposal is building upon work completed in TASK AB, Anchored Temporary Concrete Barrier Systems for Limited Deflections. When the holes are laid out for barrier anchorage with the drop-in pins, it is critical that they not damage the reinforcing steel in a bridge deck or bridge approach panel. This project is looking to identify a non-destructive test for determining the location of reinforcement within an existing slab. TTI has been exploring a variety of different tools for this purpose, including ferrodectors, cover meters, and ground penetrating radar. Ferrodetectors may be useful up to 4 ½” of depth. Cover meters can reach to 6 inches, and ground penetrating radar tools would be appropriate for depths up to 12”. Company representatives from Hilti came to TTI to demonstrate a ground penetrating radar unit. The unit scanned a series of test grids to identify the position of steel in an upper and a lower mat. The Hilti unit was also able to graph the bar placement in 3-dimensional illustration. Additional evaluation of the strengths of the various tools remains, as does a cost assessment of these tools.

Project – *Split Single Slope Median Wall* – Task BG – **IN PROGRESS**

This project explores the use of two independent single slope barriers to provide a median barrier on split level highways.  This study is analyzing the structure and stability of the wall, as well as finite element modeling to determine its crashworthiness. The use of two independent half size single slope barrier walls, backing up to each other, provides design and construction flexibility as shoulder elevations vary along the road.  This type of design and construction provides an economical way to construct a median wall on split elevation highways. TTI has evaluated 3 designs including two independent single slope barrier panels, a single panel using the vertical face along the upper roadway, and a double-sided monolithic section. In each case, the maximum height was established at 112 ½”. Crash simulation work is underway.

The night before the 2010 meeting in Kent WA, there was a major wind storm knocking out power to several areas in the greater Puget Sound area. The folks at TTI were able to top this storm, by arranging a similar weather event during the meeting at TTI, which also knocked out the power. It appears that TTI staff were just intending to demonstrate their resilience, as they soon had the electronic presentations back on track, running off a portable generator. Well played!

During the power interruption, Mark Burkhead distributed copies of their recently completed Roadside
Safety Pocket Guide. This publication is used by PennDOT inspectors, guiderail installers, and maintenance staff.

Project – *Lake Pontchartrain Bridge Rail* – Task AN – **COMPLETE MOVING INTO CONSTRUCTION PHASE**

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. This research project was completed in 2009, based on the Illinois 2399-1 Bridge Rail. The construction project has been advertised. It is anticipated that the bridge will be closed for 4 months for the rail construction.

Project – *Crash Testing Single Slope Concrete Barrier with Drainage Scuppers* – Phase 2 – Task BD **– CRASH TEST COMPLETE (FAILED TEST), FINAL REPORT REMAINING**

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. Phase 2 evaluated a larger, stiffer pin to reduce movement at the barrier joints. Engineering analysis indicated that reduced barrier movement was expected to improve vehicle stability upon exiting the barrier system. A second full scale crash test was conducted in late September 2011. Although the barrier deflection was reduced a bit, the issues with vehicle instability remain. The vehicle also overturned in this test. It appears that some of the objectives outlined in this study may not be achievable using the pin & loop connections. WSDOT will need to regroup, and look at other connection options. Roger suggested the X-bolt design and facilitated a discussion between Dave (WSDOT) & Gary (TTI) about experiences with installing and maintaining barriers connected with the X-bolt design.

Project – *Guardrail over Box Culvert – Phase 2* – Task AX – **11/11/11** **CRASH TEST PASSED – FINAL REPORT REMAINING**

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 evaluated 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. This test was conducted just a few days prior to the meeting and was a successful test. The rail element did experience some tearing in the vicinity of a post flange, initiated by the impact tire. The final report remains, along with an FHWA acceptance letter submittal package.

Project – *Sign & Light Standard Foundation when Installed on Slopes* – Task AV – **ENGINEER ANALYSIS MOSTLY COMPLETE – FINAL REPORT 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. This design will reduce the potential for vehicle snagging on a larger diameter concrete foundation that extends to or above ground line. This project is conducting an Engineering analysis of impact and wind loads. The Engineering analysis on this project is largely complete. There is some work remaining to address impact loads and to assess a “dent bolt” configuration for wind and impact loads. Work has started on the final report.

Project – *Contingency Account for Research Implementation* – Task AU – **Funds Expended**

The dollars set aside for the webpage work and production of project brochures have been expended. A short discussion ensued to determine the appropriate amount to set aside for ongoing work. The group decided to set aside $15,000 for continuation of these activities.

**Full Scale Crash Test for Transition for Anchored Temporary Barrier System – Task AZ**

On November 16, 2011 TTI conducted a full scale crash of the Transition for Anchored Temporary Barrier System. The test was MASH test 3-11, with the quad-cab pickup striking the barrier at a 25 degree angle and a speed of 100 kph. The vehicle was contained and redirected, but did not remain upright. The barrier was pinned to the concrete pavement with drop-in pins. Preliminary indications are that excessive deflection of the barrier contributed to the instability.

**Presentation of New Research Proposals**

State representatives outlined their proposed research projects followed by TTI staff reports on the feasibility and estimated costs for the projects proposed for FY 2012.

AK/38 – *W-beam Bridge Rail for Temporary Timber Deck Bridge Installations*

It is difficult to get materials into remote locations in Alaska that lack highway access. Alaska DOT has use heavy timbers for bridge decking in some of these locations. Although anchored portable concrete barrier would be a reasonable choice for bridge railing, it is difficult and expensive to get it to many of these remote locations. This project would develop a w-beam or thrie beam anchorage system suitable for use on timber bridge decks on low speed, low volume routes. Steel posts through-bolted thru the bridge deck should be a consideration in this design. TTI staff estimate $25,000 for Engineer Analysis, $65,500 for construction of a test installation, and $36,000 for a TL-3 test.

LA/20 – *5” Single-Post Generic Multi-Directional Slip Base Sign System*

This proposal would develop a generic multidirectional single post sign support utilizing round steel posts up to 5” in diameter. This would reduce the need to rely on proprietary designs for this purpose. TTI estimates $10,000 for a literature search and engineering analysis, $107,500 for design, construction, static testing, followed by full scale MASH testing.

LA/35 – *Barrier Protection for Bridge End due to Roads/Driveway/Object Conflicts*

Because there are often roads, driveways, or other constraints in the immediate proximity of bridges, approach rail transitions continue to be one of the most troublesome locations for meeting a recognized standard application. This project would strive to develop a short (10’?) TL3 generic attenuator that will connect directly to the blunt end of a concrete bridge rail. While this may theoretically be possible, it is a very difficult task. TTI estimates $50,000 for design and analysis, and as much as $400,000 for construction and a battery of crash tests. TTI staff suggested a best practices study, which could be done for approximately $20,000.

LA/36 – *Transition for Anchored Temporary Concrete Barrier in Asphalt Pavement*

This project would is similar to Task BH Transition Design for Anchored Concrete Barrier to Rigid Concrete Barrier except that it would be designed for use on asphalt pavements. This could be as basic as static and pendulum testing to determine an equivalent strength to the concrete pavement installation. On the high end, it could carry through as far as a full scale crash test. TTI estimates $13,500 for the static and pendulum testing, $50,000 for full design and analysis, $15,000 for installation construction and $40,000 for a crash test.

LA/45 – *Temporary Precast Barrier over Large Bridge Joint*

This project would develop an attachment detail for F-Shape barrier units that need to span a large bridge joint. A pinned barrier connection would likely over-stress the barrier connection in this situation. A design such as a steel cap spanning the joint may be an appropriate solution. Louisiana DOT could supply the F-Shape barrier needed for this project. TTI estimates $73,000 for this project.

LA/46 – *Temporary Precast Concrete Barrier with Pinning Holes on Both Sides*

Task AB Anchored Temp Concrete Barrier Systems for Limited Deflections, developed an anchoring mechanism that used drop-in pins for anchorage on concrete pavements or on a concrete bridge deck. The design from Task AB used pins that were dropped in only from the traffic side of a barrier. That project did not develop a design for pin placement from either (or both) sides of the barrier, which results in a directional installation with little opportunity to swap barrier end for end. This project would provide greater flexibility in application. TTI agrees with Louisiana’s estimate of $15,000 for this design work.

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/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 wing walls. 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.

PA/37 – *Small Bridge Barrier/Guide Rail Transition Retrofits*

The objective of this research is to provide a cost-effective crashworthy barrier retrofit system using w-beam rail blocked out from the original concrete baluster (“pigeon hole”) bridge rail. Bridges would range from 10’ to about 40’ long. This design should not require significant modification of the existing concrete rail. An FHWA acceptance letter would be desired at the conclusion of a successful project. TTI estimates $25,000 for assessment and strength analysis, and $43,000 for computer simulation, interpretation and report writing.

WA/39 – *Non-crashworthy Anchorage for 31” Guardrail*

The objective of this project is to develop a generic anchor for placement outside the clear zone or at the trailing end of a guardrail run that would not be subjected to leading end impacts. The design is expected to be less expensive than a proprietary crashworthy terminal. This design is expected to be used with 31” high rail systems. During the course of this discussion, it was clear that Texas DOT recently tested such a design, similar to a Breakaway Cable Terminal. The anchor cable and bracket are standard parts and the strut is non-proprietary. They haven’t asked FHWA for acceptance of this design, and don’t plan to. Texas DOT representative were asked if they had any reservations about other states asking FHWA for acceptance of such a design. They responded that they did not. Some of the Task AU dollars could be used to help package a submittal for FHWA. This project was pulled from further consideration by the Pooled Fund states.

WA/40 – *Buried in Backslope Guardrail for 31” Guardrail*

Buried in backslope terminals were developed for 27” (27 ¾”) guardrail systems. Although there are some states that have modified this design for use with a 31” system, no such design has an FHWA acceptance letter. This project would evaluate the design(s) for the 27” system and the testing of these designs, followed by a determination of further assessment needs. TTI staff suspect that there are sufficient differences between the 27” and 31” high systems to warrant an independent analysis of this design for use with a 31” high system. They estimate $18,000 for engineering analysis, and $50,000 for finite element modeling.

WA/41 – *Quantifying the Benefits of Blockouts with 31” Guardrail*

31” high guardrail systems have been developed with 12” post blockouts, 8” blockouts, and with no post blockouts. It is presumed that the systems with blockouts and increased blockout size are associated with increased cost. This project would strive to compare the performance of these various designs to determine if the benefits vary from system to system. This would help designers select systems based solely on cost savings. A crash data analysis approach was suggested in this project. TTI suggest that this might be a challenge, because it has historically been difficult to obtain data from states for this level of analysis. Additionally, some of the systems identified are relatively new and there are limited miles installed with little crash history. If data is available, TTI estimates the cost of this project would be $55,000.

TN/43 – *TL-4 Design and Analysis for Sloped Median Wall for Grade Separations*

This project would build upon the work of Task BG Split Single Slope Median Wall. This concept would utilize precast single slope barrier segments as a retaining wall to provide elevational separation between adjacent roadways when widening to the median. This most typically occurs on superelevated curves. While Task BG evaluated the potential use as a retaining wall, it did not explore how the system might be affected by crashes with larger vehicles. This project will evaluate the stability of such a wall application under TL-4 impact loads. TTI estimates $20,000 for engineering analysis, finite element analysis and production of final report.

TN/44 – *MASH Full Scale Crash Test Level 3 for Sloped Median Wall for Grade Separations*

This project would also build upon the work of Task BG Split Single Slope Median Wall, by conducting a full scale crash test on median wall. This project would compliment Task BG by clarifying whether the barrier performs as predicted under actual impact loads of TL3 vehicles. Crash test is anticipated to be on the short side of the barrier/wall. TTI staff estimate $60,000 for construction and $41,000 for the crash test. It was suggested that this barrier had previously been crash tested sufficiently under other applications that perhaps this project is unnecessary. Perhaps an acceptance letter should be added to the current project (Task BG).

Task AZ – *Crash Test of Anchored Barrier Transition*

Following the failed crash test for Task AZ, there was a discussion about how the feasibility and cost of continuing this project. TTI staff are optimistic about a successful outcome. It was estimated that $60,000 would be required to redesign and conduct another crash test.

**Project Selection Results**

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 the anticipated funds available. Projects selected for the next round of research are:

|  |  |  |  |
| --- | --- | --- | --- |
| **Rank** | **Project** | **Estimated Cost** | **Project Monitor** |
| 1 |  Best Practices Study – Barrier protection at Bridge Ends where road approaches and driveways conflict with installations  | $20,000 | Dave Olson |
| 2 | Design and Analysis for Sloped Median Walls for Grade Separations (Analysis, FE & Reporting) | $20,000 | Ali Hangul |
| 3 | Buried in Backslope Guardrail Terminal for 31” guardrail (Eng. & FE Analysis) | $68,000 | Rod Erickson (WA) |
| 4 | Crash Test of Anchored Barrier Transition | $60,000 | Paul Fossier |
| 5 | 5” Single Post Generic Multi-Directional Slip Base Sign System | $10,000 | Mike Elle |
| 6 | Transition for Anchored Temporary Concrete Barrier System on Asphalt Pavement | $13,500 | Paul Fossier |
| 7 | W-beam Bridge Rail for Temporary Timber Bridge deck installations | $25,000 | Jeff Jeffers |
| 8 | Temporary Precast Concrete Barrier with Pinning Holes on Both Sides | $15,000 | Paul Fossier |
| 9 | Small Bridge Barrier/Guide Rail Retrofits | $25,000 | Mark Burkhead |

Note: Shaded row is contingency project – funding is dependent on final contributions and reassessment of available $.

The funds available to invest in research over the coming year are estimated to be $275,000 to $300,000. The estimated total for the top eight projects listed is $231,500.

Next year’s meeting is planned for Pennsylvania in the mid to late October time frame. Thanks for taking this on Mark.

**WASHINGTON**

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