**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Date: \_**12/31/2011**\_\_\_\_\_\_\_\_\_\_\_\_

Lead Agency (FHWA or State DOT): \_ **FHWA** \_\_\_\_\_\_\_\_\_\_\_\_\_

**INSTRUCTIONS:**

*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

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| **Transportation Pooled Fund Program Project #***(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)***TPF(5)216** | **Transportation Pooled Fund Program - Report Period:**□Quarter 1 (January 1 – March 31)□Quarter 2 (April 1 – June 30)□Quarter 3 (July 1 – September 30) X Quarter 4 (October 1 – December 31) **2011**  |
| **Project Title:****Steel Suspension Bridge Vulnerability and Countermeasures** |
| **Name of Project Manager(s):**Eric Munley | **Phone Number:**202-493-3046 | **E-Mail**Eric.Munley@fhwa.dot.gov |
| **Lead Agency Project ID:**TPF(5)216 | **Other Project ID (i.e., contract #):**IAA DTFH61-10-X-30028 | **Project Start Date:**7-12-2010 |
| **Original Project End Date:**7-11-2015 | **Current Project End Date:**7-11-2015 | **Number of Extensions:**None |

Project schedule status:

x On schedule □ On revised schedule □ Ahead of schedule □ Behind schedule

Overall Project Statistics:

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|  **Total Project Budget** |  **Total Cost to Date for Project** |  **Percentage of Work**  **Completed to Date** |
| $2,500,000Funding to date: $950,000 | $796,000 | 32% |

***Quarterly*** Project Statistics:

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|  **Total Project Expenses**  **and Percentage This Quarter** |  **Total Amount of Funds**  **Expended This Quarter** |  **Total Percentage of**  **Time Used to Date** |
| $36,000 (1.4%) | $36,000 | 27% |

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| **Project Description**:This project is a part of FHWA’s security research program for bridges and tunnels. Work is being performed through an Interagency Agreement (IAA) with the US Army Engineer Research and Development Center, Vicksburg, Mississippi. The Department of Homeland Security (DHS) has provided additional support for this effort under an FHWA-DHS IAA. In addition, the DHS has a related research program with the Corps covering a wide range of infrastructure security issues. The coordination of efforts and the exchange of information among the federal agencies and involved bridge owners have been valuable in the ongoing work to reduce the vulnerability of bridges to attack. The aims of TPF (5)216 are to increase the resistance of suspension bridges to an attack on any of their three major components: 1) Towers; 2) Main Cables; 3) Suspenders. This project has extended the work started in Pooled Fund Project 888, *Validation of Numerical Modeling and Analysis of Steel Bridge Towers Subjected to Blast Loadings.* That project not only assessed the accuracy of predictive methods for suspension bridge response to blast loads, but the effectiveness of existing methods to increase resistance to these loads. The current project has extended the range of the previous study to include older types of materials and connection details, and varying material conditions in assessing the response to blast loads. A second part of this project, as in the earlier one, is to test the performance of mitigation methods, but on these older components (These are being obtained from demolished bridges). Based on these tests, accurate assessments of the structure’s performance before-and-after retrofit can be made. The third objective of this project is to develop high performance/lower intrusion countermeasure designs through the use of advanced materials. The low intrusion is significant to bridge owners because the retrofit cannot produce material degradation (e.g., corrosion), interfere with the operation of previously-installed mitigation measures for other hazards (e.g., seismic), or obstruct normal maintenance/inspection operationsThe recommendations of this project must meet a number of design issues that parallel the blast resistance one. One example is the effect of blast mitigation on seismic response mentioned above: Are there practical combined retrofits; and, contact vs. non-contact for separate retrofits. There are several other issues that this project will take into account: Alternate load path survivability; Constructability; Maintenance/Inspection/Removability of security retrofits; and, of course, the added Dead Load.  |
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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):****Task 1 – Towers*** Met with Dr. Mark Horstemeyer of Mississippi State about beginning materials testing for older steels. Found that MSU is already testing modern steels under another contract. Will be able to use this data for comparison with older steels.
* Began high strain rate testing of older steels
* Continued analysis of data from explosive testing of modern and older steels in July.

**Task 2 – Main Cables*** Cold-gas-thruster testing of Ft. Steuben Bridge was performed 12-21 October 2011. The data collected looks very good and is being analyzed by Prof. Duron (Harvey Mudd College – Contract w/COE).
* Received draft report from Prof. Duron on CGT testing at Ft. Steuben Bridge

**Task 3 – Suspender Ropes and Sockets*** Had suspender rope cutting tests delayed due to demolition contractor request. Contractor suggested performing test concurrent with demolition.
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| **Anticipated work next quarter**:**Task 1 – Towers*** Continue data analysis and reporting of results from July tests.
* Continue high strain rate tests of early 20th Century steels.
* Perform second set of 1/7 scale phenomenology tests

 **Task 2 – Main Cables*** Perform follow up non-destructive testing at Ft. Steuben Bridge.
* Meeting scheduled for 27 January 2012 with Prof. Duron to discuss first draft of CGT.
* KEP (Kinetic Energy Penetrator) countermeasure tests are under development.

 **Task 3 – Suspender Ropes and Sockets*** Plan and perform in situ cutting test on Ft. Steuben Bridge in cooperation with demolition contractor.
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| **Significant Results:** ***Note that this study is at an early stage, and that these are expected, based on work to-date*.**The expected range of behavior, in reacting to a blast load, caused by steel type, age, and condition is currently being established. This range is a necessary factor in the design of any countermeasure. Models of the damping effects on the shock wave travelling through a main cable (in varying condition) can only be confirmed on an actual main cable.Response data is being collected to aid countermeasure designers in predicting the reaction of the main cable and towers to a dynamic loss (i.e. not just the fact that one or more are missing) of suspenders. This is directly related to potential loss of the stiffening truss and roadway. |
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| **Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that** **might affect the completion of the project within the time, scope and fiscal constraints set forth in the** **agreement, along with recommended solutions to those problems).**Lead abatement required on specimens obtained from early 20th Century steel bridge members has added significant time and cost. |
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| **Potential Implementation:** The research program has been developed so that its findings can be adapted for immediate use in the design of retrofits to protect suspension bridges from attack on major components (Towers - Main Cables - Suspenders).This adaptation will be made by the bridge owner’s retrofit project team, with COE assistance, through the secure design process developed as part of this project. Note that the findings of this project will not be made available in a general public distribution. Reducing the vulnerability in these three suspension bridge component groups will have an effect beyond that particular type of bridge. At the member level, the blast behavior of components on stay cables or through trusses, for example, have much in common with that of suspender or tower components. The resistance improvements made on the suspension bridge components will be extended and modified for these bridges. The focus of this one project is the retrofit of existing structures. However, the knowledge base developed under this research is also intended to provide State DOTs with useable information in the design of new structures and replacement of components.  |