**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Date: \_\_\_\_\_\_10/28/2016\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

**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 #***TPF-5(276)* | **Transportation Pooled Fund Program - Report Period:**Quarter 1 (January 1 – March 31)Quarter 2 (April 1 – June 30)Quarter 3 (July 1 – September 30)Quarter 4 (October 1 – December 31) |
| **Project Title:****Full-Scale Shake Table Testing to Evaluate Seismic Performance of Reinforced Soil Walls** |
| **Name of Project Manager(s):****Lu Saechao** | **Phone Number:****360.705.7260** | **E-Mail**saechal@wsdot.wa.gov |
| **Lead Agency Project ID:** | **Other Project ID (i.e., contract #):****GCB1359** | **Project Start Date:**2012 |
| **Original Project End Date:** | **Current Project End Date:****6/30/2018** | **Number of Extensions:**0 |

Project schedule status:

* 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** |
| $289,937(Ph1 $49,938 & Ph2 $239,999) | $223,310.62(Ph1 $49,938 & Ph2 $173,372.62) |  |

***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** |
|  | See Progress this Quarter section |  |

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| **Project Description**:

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| Phase 1 (completed)The objective of this project is to perform numerical studies and use the LHPOST to investigate the dynamic performance of one or two full-scale (7 m) reinforced soil retaining walls constructed using realistic materials and methods. Considering that these walls will be substantially taller than for any similar previous research (by a factor of 2), a key focus of the proposed research will be on the influence of wall height on overall system response (i.e., stability/deformation) and the distribution of dynamic tensile forces (i.e., seismic demand) in the soil reinforcement. Other focus areas will include dynamic earth pressure on facing elements, effects of dynamic loading on soil-reinforcement stress transfer mechanisms, and permanent deformations after dynamic loading. The tests will be conducted using a unique large soil confinement box (LSCB) that is currently under construction as part of a recently funded NSF grant. The scale of these tests will permit wall construction using realistic soil types, compaction methods, and structural elements. The box will also have a unique design that permits different boundary conditions at the rear of the soil mass, including a water-filled bladder or geofoam layer. Phase 2 (current work)The objective of Phase II is to perform reduced-scale shake table tests and numerical studies to further characterize the seismic performance of MSE abutments. Numerical modeling work will be conducted using FLAC-3D and allow us to extrapolate results from the reduced-scale physical tests to simulate seismic performance of MSE abutments for bridges with spans up to 150 ft. The results of this work will be used to assess whether or not a Phase III investigation, consisting of full-scale MSE abutment tests, will be conducted on the UCSD large outdoor shake table. |
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| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**Task 1 (literature review) is ongoing throughout the duration of the project, and Task 2 (detailed design) was completed this quarter with the design of the transverse loading system. This quarter, several additional triaxial tests were performed on the sand at different densities to help with scaling relationship assessment, the soil-water retention curve was measured to assess the effects of unsaturated conditions on the shear strength of the sand, and pullout tests were performed on the geogrid using different loading rates. Our main efforts this quarter were related to Task 3 (MSE abutment testing program). Three shaking table tests were performed this quarter: Test 2 (increased geosynthetic spacing), Test 3 (reduced geosynthetic stiffness), and Test 5 (steel mesh reinforcement). Testing reports on this test were provided, including the instrumentation plan, the pre-test numerical simulation (Task 5), the reports on the proposed motions, and preliminary analyses of the results (Task 4). This quarter included salaries to support Yewei Zheng, the main PhD student working on the project, Wenyong Rong, a PhD student working on 3D numerical simulations, Woongju Mun, who assisted with the geogrid pullout tests, and the Powell laboratory staff. Several undergraduate assistants helped in the construction of the walls, geogrid pullout testing, and triaxial testing. A summary of the specific tasks that were completed: 1. Soil-water retention curve was measured for the sand under different densities (Task 2).
2. Geogrid pullout testing at different rates (Task 2).
3. Additional triaxial compression tests were performed on the sand under different densities (Task 2)
4. Perform shaking table Tests 2, 3, and 5 (Task 3).
5. Prepared test reports on Tests 2 and 3 for review by CalTrans and pooled fund partners (Task 3).
6. Prepared preliminary analyses of the data (Task 4).
7. Performed preliminary pre-test numerical simulations of Tests 2, 3, and 5 (Task 5).

Budget Note:$26,078.29 of actual expenditures occurred this quarter but was billed against a bill credit received in May 2016. The bill credit was for payment made towards $46,000 of equipment expenses for an October 2015 invoice period. The $46,000 equipment expenses were transferred to a CalTrans account resulting in an equal credit amount on the WSDOT account. |
| **Anticipated work next quarter**:The work plan for the next quarter is to complete Task 3 (MSE abutment testing program)1. Perform the transverse shaking test (Test 6) (Task 3)2. Perform preliminary pre-test numerical simulation of Tests 6 (Task 5)3. Prepare preliminary analyses of the data from Test 6 (Task 4)4. Prepare a preliminary comparison of the results from all of the tests performed to date to check if additional shaking tests should be performed to fill in gaps (Task 3)5. Prepare associated test reports on Tests 5 and 6 for review by CalTrans and pooled fund partners (Task 3) |

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| **Significant Results:** |
| **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).** |

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| **Potential Implementation:**  |