**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Date: \_\_\_\_\_\_4/18/2018\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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) | $260,316.21  (Ph1 $49,938 & Ph2 $210,378.21) |  |

***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** |
|  | $22,591.54 |  |

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| **Project Description**:   |  | | --- | | 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.):**  90% of the Phase 2 work has been completed. The project is on schedule, within budget and on scope. This pooled fund study is leveraging a Caltrans study. UCSD completed the experimental testing program and data interpretation which was submitted as the final report for the Caltran project, closing out the Caltrans part of the project. UCSD is currently finalizing the numerical simulation part of the project which will be submitted as the final report for the pooled fund project.    Task 1 (literature review) is ongoing throughout the duration of the project, and Task 2 (detailed design) and Task 3 (MSE abutment testing program) have been completed. The final report on the experimental testing program was submitted to Caltrans in January 2018 and distributed to the pool fund, which includes a synthesis and interpretation of results as well as appendices of all instrumentation data and photographs of the experiments, so Task 4 is also complete. The main efforts this quarter focused on numerical simulations of the MSE abutments in FLAC2D and FLAC3D (Task 5). Our activities related to numerical modeling include refining the constitutive models for the soil and geosynthetic reinforcements, performing 3D simulations in addition to 2D simulations, incorporating new design-level analyses (K-stiffness method, AASHTO method, limit equilibrium), and development of design recommendations for the seismic response of MSE bridge abutments based on the simulation results. We have now obtained a good match between the 2D numerical simulations in FLAC2D and the results from the shaking table tests, and the main calibration parameter that we selected in addition to the constitutive properties of the soil and geosynthetics is the global damping. Using the calibrated global damping, we are now performing parametric analyses in FLAC2D to understand the effects of different design details on the seismic response of MSE bridge abutments. A problem statement for a full-scale test on the Englekirk shaking table was submitted to Caltrans in February 2018 (Task 6). This quarter included salaries to support Yewei Zheng, a Post-doc, and Wenyong Rong, a PhD student working on 3D numerical simulations, cyclic simple shear testing of the sand, and bender element testing of the sand.  Budget:  $22,591.54 was expended on the project this quarter. |
| **Anticipated work next quarter**:  The main deliverable at the end of the next quarter will be the final report for the project focused on the numerical simulations of the seismic response of MSE bridge abutments. |

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| **Significant Results:**  Final experimental report published. |
| **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:** |