**TRANSPORTATION POOLED FUND PROGRAM**

**QUARTERLY PROGRESS REPORT**

Date: \_\_\_\_\_\_January 1, 2012\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Transportation Pooled Fund Program Project #**  *SPR-3(072)* | | **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:**  **Strength and Deformation of Mechanically Stabilized Earth (MSE) Walls at Working Loads and Failure** | | | |
| **Name of Project Manager(s):**  **Kim Willoughby** | **Phone Number:**  **360.705.7978** | | **E-Mail**  willouk@wsdot.wa.gov |
| **Lead Agency Project ID:** | **Other Project ID (i.e., contract #):**  **GCA4533** | | **Project Start Date:**  1998 |
| **Original Project End Date:** | **Current Project End Date:**  **12/31/2012** | | **Number of Extensions:** |

Project schedule status:

□ On schedule □ On revised schedule □ Ahead of schedule X Behind schedule

Overall Project Statistics:

|  |  |  |
| --- | --- | --- |
| **Total Project Budget** | **Total Cost to Date for Project** | **Percentage of Work**  **Completed to Date** |
| $690,000 | $690,000 (pooled fund)  Over $1.5 million (other funding) | 98% |

***Quarterly*** Project Statistics:

|  |  |  |
| --- | --- | --- |
| **Total Project Expenses**  **and Percentage This Quarter** | **Total Amount of Funds**  **Expended This Quarter** | **Total Percentage of**  **Time Used to Date** |
| 0 | 0 | 0 |

|  |
| --- |
| **Project Description**:  Phases 1 through 3 are complete and Phase 4 is nearing completion. The work performed under this pooled fund study has developed an improved method for internal stability design of MSE retaining walls, the K-Stiffness method. This method appears to produce a more cost-effective design for MSE walls as compared to the AASHTO Simplified Method. The K-Stiffness method has only been developed and validated for high quality sandy backfill soils. The next two phases will extend the K-Stiffness method to 1) marginal quality backfill materials (silts and silty sands) and 2) full-scale field walls that will be monitored for validation. The validation of the K-Stiffness method for marginal quality backfill materials and monitoring full-scale walls is necessary to incorporate this method into the AASHTO LRFD design specifications.  Phase 5 will 1) construct and test two full-scale walls with non-select fill, 2) update the report on the physical testing of walls 1 through 11 (tested in phases 1 through 4) based on the experience with the instrumented SR 18 walls in Washington state, and 3) update the numerical modeling of walls 1 through 11 and carry out a parametric analyses. Phase 6 will 1) construct and test one full-scale wall with non-select fill, 2) perform data reduction, interpretation, numerical modeling, parametric analysis, and report on the physical testing of the two walls constructed in Phase 5, 3) perform data reduction, interpretation, numerical modeling, parametric analysis, and report on the physical testing of the wall constructed in Phase 6, 4) investigate the effect of material type on in-soil stiffness, 5) update the K-Stiffness method based on results from the walls constructed in Phases 5 and 6 and to include seismic design, and 6) produce a final report on Phases 1 through 6. |

|  |
| --- |
| **Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**  Researchers continue with the large-scale transparent soil pullout box testing and the development of a numerical database that will be used to fill in data gaps for further refinement of the K-stiffness method. |
| **Anticipated work next quarter**:  Continue finalizing the work that is being performed and put together the draft report. |

|  |
| --- |
| **Significant Results:**  Multiple papers have been written and published on this work:  Miyata, Y. and Bathurst, R.J. 2012. Measured and predicted loads in steel strip reinforced c- soil walls in Japan, *Soils and Foundations*, Vol. 52 No. 1 (in press)  Ezzein, F. and Bathurst, R.J. 2011. A transparent sand for geotechnical laboratory modeling, ASTM *Geotechnical Testing Journal* (in press)  Bathurst, R.J., Miyata, Y. and Konami, T. 2011. Limit states design calibration for internal stability of multi-anchor walls, *Soils and Foundations* Vol.51 No.6 (in press)  Miyata, Y., Bathurst, R.J. and Konami, T. 2011. Evaluation of two anchor plate capacity models for MAW systems, *Soils and Foundations* Vol.51 No.5 (in press)  Bathurst, R.J., Huang, B. and Allen, T.M. 2011. Load and resistance factor design (LRFD) calibration for steel grid reinforced soil walls, *Georisk* (in press)  Bathurst, R.J., Hatami, K. and Alfaro, M.C. 2011 Geosynthetic-reinforced soil walls and slopes - seismic aspects, (S.K. Shukla Ed.): Geosynthetics and Their Applications, (2011) Thomas Telford Ltd., London, UK, 61 p (in press).  Bathurst, R.J., Huang, B. and Allen, T.M. 2011. Interpretation of installation damage testing for reliability-based analysis and LRFD calibration, *Geotextiles and Geomembranes*, Vol. 29, No. 3, pp. 323-334  Miyata, Y., Bathurst, R.J., Konami, T. and Dobashi, K. 2010. Influence of transient flooding on multi-anchor walls, *Soils and Foundations*, Vol. 50, No. 3, pp. 371-382.  Huang, B., Bathurst, R.J., Hatami, K. and Allen, T.M. 2010. Influence of toe restraint on reinforced soil segmental walls, *Canadian Geotechnical Journal*, Vol. 47, No.8, pp. 885-904.  3. The following papers were submitted (or resubmitted) to journals for publication:  Bathurst, R.J., Huang. B. and Allen, T.M. Interpretation of laboratory creep testing for reliability-based analysis and load and resistance factor design (LRFD) calibration, *Geosynthetics International*  Bathurst, R.J., Huang. B. and Allen, T.M. Load and resistance factor design (LRFD) calibration for geogrid pullout limit state using the AASHTO Simplified Method, *ASCE Journal of Geomechanics*  Huang, B., Bathurst, R.J. and Allen, T.M. Load and resistance factor design (LRFD) calibration for steel strip reinforced soil walls, ASCE *Journal of Geotechnical and Geoenvironmental Engineering*  Ezzein, F. and Bathurst, R.J. 2011. Development of a geosynthetic pullout test apparatus with transparent granular soil, 2011 *Pan-Am CGS Geotechnical Conference*, Toronto, Canada  Miyata, Y., Bathurst, R.J. and Konami, T. Influence of Model Accuracy on Load and Resistance Factor Calibration of Multi-anchor Walls, *IGSR 2011*, June 2011, Munich, Germany  Miyata Y., Hirakawa D., Tada T., Konami T. and Bathurst R.J. 2011. ICT-field observation system for LRFD calibration of reinforced soil walls. *Annual Japanese Geotechnical Conference*, 2 p, (in Japanese) |
| **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).**  Dr. Bathurst is working to complete all the work to finish up this project. The continued funding does not come from this pooled fund. |

|  |
| --- |
| **Potential Implementation:**  When finished, the goal is to incorporate the K-stiffness method into the AASHTO specifications. |