Project Title	*Agmt./Task No.*	*Item No.*	*Agency Bgt. No.*
SPR-3(072) Strength and Deformation of Mechanically Stabilized Earth (MSE) Walls at Working Loads and Failure	**SPR-3(072)**		
Research Agency	*Start Date*	*Estimated Completion*	*Revised Completion*
Royal Military College of Canada	**12/1/99**	**04/30/04**	**12/31/11**
Principal Investigator(s)	*Technical Contact*		
Richard Bathurst	**Tony Allen (360) 709-5450**		
WSDOT Program Manager	*FHWA or Other Technical Contact*		
Kim Willoughby (360) 705-7978	**Debbie Lehmann (360) 753-9482**		
Funding Source	*Schedule Status*		
WA, NY, ID, CA, WY, ND, MN, OR, AZ, AK	☐ On schedule ☐ Ahead of schedule ☒ On revised schedule ☐ Behind schedule		
Research Area			
Geotechnical			

Original Estimated Cost	*Revised Cost*	*% Funds Expended*	*% Work Completed*
$360,104	**$690,000**	**100%**	**99%**

Objective

Develop a design procedure for the internal stability of MSE walls, especially those reinforced with geosynthetics.

Project Progress:

1. The following papers (book chapters) were accepted in peer-reviewed journals or books and/or are now in press:

Bathurst, R.J., Huang. B. and Allen, T.M. Interpretation of installation damage testing for reliability-based analysis and LRFD calibration, *Geotextiles and Geomembranes* (in press)

Bathurst, R.J., Huang, B. and Allen, T.M. 2010. 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).

2. The following papers were published:

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 (June) 373-384

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, 885-904.

3. The following papers were submitted (or resubmitted) to journals for publication:

Ezzein, F.M. and Bathurst, R.J. A transparent sand for geotechnical laboratory modeling. ASTM *Geotechnical Testing Journal*

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*

4. The following papers were written, published or accepted for publication in forthcoming conferences:

Bathurst, R.J., Huang. B. and Allen, T.M. LRFD Calibration of Steel Reinforced Soil Wall, ASCE *Geofrontiers 2011*, Dallas 13-16 March 2011.

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., Bathurst, R.J. and Konami, T. 2010. Uncertainty of load-resistance models in design of multi-anchor reinforced soil walls. 9th *Japan Society of Materials Science annual symposium on ground improvement*, Fukui, Japan, 18-19 November, 6 p, (in Japanese)

Yang, K-H., Zornberg, J.C. and Bathurst, R.J. 2010. Mobilization of reinforcement tension within geosynthetic-reinforced soil structures. *Earth Retention Conference 3 (ER2010)*, ASCE Geo-Institute, Bellevue, Washington 1-4 August, 11 p.

5. The following papers are tentatively accepted pending resubmission.

Miyata, Y., Bathurst, R.J. and Konami, T. Evaluation of two anchor plate capacity models for MAW systems, *Soils and Foundations*

Miyata, Y. and Bathurst, R.J. Measured and predicted loads in steel strip reinforced soil walls in Japan, *Soils and Foundations*

Bathurst, R.J., Miyata, Y. and Konami, T. Limit states design calibration for internal stability of multi-anchor walls, *Soils and Foundations*

6. The following keynote paper was prepared and submitted for presentation at Earth Retention Conference 3 (ER2010) in Bellevue, Washington, 1-4 August 2010:

Bathurst, R.J., Miyata, Y. and Allen, T.M. 2010. Invited keynote paper, Facing displacements in geosynthetic reinforced soil walls. Earth Retention Conference 3 (ER2010), ASCE Geo-Institute, Bellevue, Washington 1-4 August, 18 p.

7. The following additional papers were completed in full and publication-ready as part of the PhD thesis of Dr. Bing Huang. These papers will be submitted in sequence to peer-reviewed journals:

Huang, B., Bathurst, R.J. and Allen, T.M. Interpretation of laboratory creep testing for reliability-based analysis and load and resistance factor design (LRFD) calibration

Huang, B., Bathurst, R.J. and Allen, T.M. Load and resistance factor design (LRFD) calibration for geogrid pullout limit state using the AASHTO Simplified Method

Bathurst, R.J., Huang, B. and Allen, T.M. Load and resistance factor design (LRFD) calibration for rupture limit state using the AASHTO Simplified Method

Huang, B., Bathurst, R.J. and Allen, T.M. Load and resistance factor design (LRFD) calibration for geosynthetic rupture and pullout limit states using the K-stiffness Method

8. The principal investigator gave two invited lectures:

British Geotechnical Association Annual Invited Lecture, Institution of Civil Engineers, London, UK, October 2010.
Invited Plenary Speaker: ASCE Earth Retention Conference 3 (ER2010). Bellevue Washington, August 2010.

9. Dr. Bathurst and colleague Dr. Miyata in Japan won the 2010 TECHNICAL ACHIEVEMENT AWARD of the Japan Chapter of IGS for their work on introducing the K-stiffness Method to Japan.

10. Wall 14 data was reduced.

New Period Proposed Activity:

1. Funding for the project was fully expended 31 December 2010.

2. Continue with large-scale transparent soil pullout box testing.

3. Continue with development of numerical database that will be used to fill in data gaps for further refinement of the K-stiffness Method.