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**	**12/31/08**
Principal Investigator(s)	*Technical Contact*		
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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**	**75%**	**78%**

Objective

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

Project Progress:

1. Wall 13 - the second full-scale reinforced soil wall of Phase 5 testing at RMC has been constructed, tested and excavated. A full report in the form of a MSc thesis for Walls 12 and 13 has been prepared. A copy of the thesis has been forwarded to Tony Allen in hard copy and electronic versions.

2. A paper was published in the journal Ground Improvement that investigates the accuracy of the current Coherent Gravity Method for steel reinforced soil walls. This paper clearly identifies the influence of backfill strength and compaction on reinforcement loads in these structures and contains practical recommendations for design engineers. A similar paper is in press with the ASCE Journal of Geotechnical and Geoenvironmental Engineering. The latter paper demonstrates that the current AASHTO Simplified Method is sufficiently accurate for steel strip reinforced soil walls.

3. The new modified K-stiffness Method has been verified against an extended database of case studies and a paper has been published in the journal Geosynthetics International. Our project database now includes 42 case studies. Many of the new case studies are from unpublished Japanese research reports that have only recently been made available.

4. A sophisticated constitutive soil model (Lade's model) has been implemented in our FLAC numerical code and verified against RMC test walls. A paper is in second-round review with the ASCE Journal of Geotechnical and Geoenvironmental Engineering that demonstrates the influence of soil model on wall performance. This paper will be the keystone reference paper for future journal papers by providing background validation to the use of our FLAC model to carry out parametric analyses to extend our physical database to a wider range of wall types, reinforcement layers and types, different soils etc. Three papers have or will shortly appear in conferences using this new code. A version of this paper is in press as a Chapter in the book "Linear and Non Linear Numerical Analysis of Foundations, (J. Bull editor), Taylor & Francis".

5. Three papers that report the results of some of the RMC tests walls have been submitted to peer-reviewed journals.

Bathurst, R.J., Nernheim, A., Walters, D.L., Allen, T.M., Burgess, P. and Saunders, D. Influence of Reinforcement Stiffness and Compaction on the Performance of Four Geosynthetic Reinforced Soil Walls, Geosynthetics International

Bathurst, R.J., Nernheim, A., Allen, T.M., Walters, D.L., Vlachopoulos, N. and Burgess, P., Influence of Reinforcement Spacing on the Performance of Three Geosynthetic Reinforced Soil Walls, ASCE Journal of Geotechnical and Geoenvironmental Engineering

Nernheim, A., Bathurst, R.J., Allen, T.M., Walters, D.L. and Nelson, R. Influence of facing batter on the performance of three geosynthetic reinforced soil walls, Canadian Geotechnical Journal

These papers include a comparison of predicted versus measured reinforcement loads using the AASHTO and current K-stiffness Methods. The papers demonstrate the much improved accuracy of the K-stiffness Method over the current AASHTO Simplified Method for geosynthetic reinforced soil walls.

6. Materials have been order for construction of Wall 14 (Phase 5) – WWM – wrapped face wall with silty-sand backfill.

7. Wall foundation and in-soil earth pressure cells used in the RMC test walls were calibrated for in-situ conditions.

8. The following paper won the R.M. Quigley award by the Canadian Geotechnical Society for the best paper published in the Canadian Geotechnical Journal in 2007 “Miyata, Y. and Bathurst, R.J. 2007. Development of K-stiffness method for geosynthetic reinforced soil walls constructed with c-ϕ soils. Canadian Geotechnical Journal, Vol. 44, No. 12, 1391-1416.”

9. The Public Works Research Institute (PWRI) in Japan is planning the construction of 4 full-scale walls to investigate the accuracy of the K-stiffness Method in the context of Japanese design practice. Dr. Bathurst is working with Dr. Y. Miyata in Japan to provide input for this study.

New Period Proposed Activity:

Construction of Wall 14 (Phase 5) will commence shortly.

A paper that demonstrates the influence of toe stiffness on wall behavior will be submitted shortly. The paper describes both the results of physical measurements and numerical parametric analyses of reinforced soil walls and demonstrates again the improved accuracy of the K-stiffness method to predict working loads in reinforced soil walls compared to predictions using current practice

Data from RMC walls and our larger database of field walls has been synthesized to isolate the influence of connection loads on wall performance. A draft paper will be produced in the last quarter.

A numerical database will be completed by the end of the year and the results used to fill in the gaps in the K-stiffness Method.

The use of synthetic data for this purpose will appear at a conference in September.