TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency: Utah Department of Transportation

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 #	**Transportation Pooled Fund Program - Report Period:**
TPF-5(433)	_ Quarter 1 (January 1 – March 31, 2024) _ Quarter 2 (April 1 – June 30, 2024) **X Quarter 3 (July 1 – September 30, 2024)** _ Quarter 4 (October 1 – December 31, 2024)

Project Title:
Behavior of Reinforced and Unreinforced Lightweight Cellular Concrete for Retaining Walls

Name of Project Manager(s):	**Phone Number:**	**E-Mail**
David Stevens	801-589-8340	davidstevens@utah.gov
Lead Agency Project ID: FINET 42096, ePM PIN 17824 UDOT PIC No. UT18.404	**Other Project ID (i.e., contract #):** UDOT Contract No. 20-9367	**Project Start Date:** May 21, 2020 (contract)
Original Project End Date: September 30, 2022 (scope)	**Current Project End Date:** January 31, 2025 (scope)	**Number of Extensions:** 5

Project schedule status:

_ On schedule **X** On revised schedule _ Ahead of schedule _ Behind schedule

Overall Project Statistics:

Total Project Budget	**Total Cost to Date for Project**	**Percentage of Work Completed to Date**
Total commitments = $337,500.00 Obligated to date = $337,500.00 (incl. $7,500 state match on FHWA contrib.) Contract amount = $325,578.00 Remaining on contract = $94,845.00	Contract spent = $230,733.00 Contract support = $664.71 Total spent = $231,397.71	94%

Quarterly Project Statistics (on this contract):

Total Project Expenses and Percentage This Quarter	**Total Amount of Funds Expended This Quarter**	**Total Percentage of Time Used to Date**
0%	$0.00	93%

Project Description:

Roadway widening over existing walls and embankments, conflicts with settlement-sensitive utilities, and accelerated schedule delivery have increased demands for alternative lightweight fill materials. Engineers and contractors are increasingly considering Lightweight Cellular Concrete (LCC) backfills for abutments, embankments, and Mechanically Stabilized Earth (MSE) retaining walls; however, the absence of a consistent design methodology has led to a wide range of design approaches with no consensus standard. The most common class of LCC used in previous highway projects does not strictly behave like a soil or like concrete and must be investigated as a new material for engineering applications. Controversy exists within the industry regarding whether LCC should be modeled as a frictional or a cementitious (cohesive) material. In addition, earth pressures for retaining wall design and potential failure mechanisms of LCC are poorly understood for retaining wall applications, including uncertainty in LCC interaction with internal wall reinforcement in MSE wall applications.

Objective: Measure engineering design parameters and failure mechanisms for unreinforced and reinforced LCC backfills based on large-scale laboratory tests.

Funded tasks for this study include the following:
1. Literature review and survey
2. Basic material properties lab testing
3. Unreinforced LCC large-scale testing
4. Reinforced LCC large-scale testing:
    - Reinforced LCC Test 1 – MSE wall with LCC backfill,
    - Reinforced LCC Test 2 – MSE wall with LCC backfill against soil slope,
    - Reinforced LCC Test 3 – MSE wall test with lower strength LCC backfill,
    - Reinforced LCC Test 4 – Pull-out tests on MSE wall, and
    - Reinforced LCC Test 5 – MSE wall test with welded-wire reinforcement
5. Compare results with design methods
6. Final Reports for (a) the unreinforced LCC test and (b) the reinforced LCC tests
7. Meetings and dissemination of results

The Principal Investigators for this study are Dr. Kyle Rollins of Brigham Young University and Ryan Maw, a principal engineer at Gerhart-Cole, Inc. The technical advisory committee (TAC) for the study currently includes representatives from UT, CA, KS, LA, MI, NY, OR, and WA state DOTs and FHWA. TAC meetings will be held periodically during the study and are currently planned to be web conferences.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Task 1 – 70% complete. Continued the literature review and survey.
Task 2 – 100% complete.
Task 3 – 100% complete.
Task 4 – 100% complete.
Task 5 – 95% complete. Completed (and shared for TAC review) two detailed Interim Reports on the Welded-wire reinforcement LCC MSE test, and on Slope stability and high pressure pull-out testing.
Task 6 – 85% complete. Continued work on the Draft Final Report for the reinforced LCC tests.
Task 7 – 70% complete.

Contract – The contract scope end date was extended to January 2025 for completion and review of final reports.

Anticipated work next quarter:

Task 1 – Continue the literature review and survey.
Task 2 – Completed.
Task 3 – Completed.
Task 4 – Completed.
Task 5 – Address TAC comments in the updated interim reports that were recently and previously reviewed.

Task 6 – Address TAC comments in the updated Final Report for the unreinforced LCC test. Finish work on the Draft Final Report for the reinforced LCC tests.
Task 7 – Consider holding another TAC update meeting (virtual) after the Draft Final Report for the reinforced LCC tests is completed.

Contract – No changes to the contract are planned for this quarter.

Significant Results:

Additional study reports are being prepared for TAC review. The plan and status for the study reports are shown below:

- **Short Interim Reports: (to post final on TPF website; BYU's format; UDOT won't publish)**
  - Unreinforced LCC testing (posted on TPF website)
  - Reinforced LCC Test 1 – MSE wall with LCC backfill (posted on TPF website)
  - Reinforced LCC Test 2 – MSE wall with LCC backfill against soil slope (posted on TPF website)
  - Reinforced LCC Test 3 – MSE wall test with lower strength LCC backfill (posted on TPF website)
  - Reinforced LCC Test 4 – Pull-out tests on MSE wall (posted on TPF website)
  - Reinforced LCC Test 5 – MSE wall test with welded-wire reinforcement (posted on TPF website)

- **Detailed Interim Reports: (to post final on TPF website; BYU's format; UDOT won't publish)**
  - 1st MSE LCC test (draft received and TAC reviewed)
  - Sliver fill MSE LCC test (draft received Nov. 2023 and TAC completed basic review)
  - Lower strength MSE LCC test (draft received Jan. 2024; TAC doing basic review)
  - Pull-out resistance (draft received Jan. 2024; TAC doing basic review)
  - Welded wire reinforcement (draft received Sept. 2024; TAC doing basic review)
  - Slope stability (draft received Sept. 2024; TAC doing basic review)

- **Short Report: (to post final on TPF website; BYU's format; UDOT won't publish)**
  - Pile lateral analysis in MSE LCC (expected after the draft final Reinf. LCC report below)

- **Final Reports: (to post final on TPF website; UDOT's format; UDOT will publish)**
  - Unreinforced LCC RCC tests (draft received and TAC reviewed)
  - Reinforced LCC tests (Lit. review, summary of all reinforced tests, comparison of all tests, pull-out resistance, and slope stability) (draft expected around mid-Nov. 2024)

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).

No delays at this time. Testing and analysis for this research were allowed to continue at BYU with additional health precautions related to COVID-19.

Potential Implementation:

None yet.