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(542)	_ 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:
Passive Force Behavior for Skewed Bridge Abutments During Combined Lateral and Rotational Loading

Name of Project Manager(s):	**Phone Number:**	**E-Mail**
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Lead Agency Project ID: FINET program pending, ePM PIN pending UDOT PIC No. PL05.542	**Other Project ID (i.e., contract #):** UDOT Contract No. (pending)	**Project Start Date:** September 2024 (TPF study #)
Original Project End Date: December 2027	**Current Project End Date:** December 2027	**Number of Extensions:**

Project schedule status:

X On schedule _ 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 = $385,000.00 Obligated to date = $0.00 (contract pending)	Contract spent = $0.00 Contract support = $0.00 Total spent = $0.00	0%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter (contract)	Total Amount of Funds Expended This Quarter (contract)	Total Percentage of Time Used to Date (project)
0%	$0.00	0%

Project Description:

As part of pooled fund study TPF-5(264), led by UDOT and supported by FHWA and a few other state DOTs, large-scale passive force-deflection tests were performed on a simulated bridge abutment to investigate the effect of skew angle on passive force behavior. Tests were conducted at abutment skew angles of 0°, 15°, 30°, and 45° with a backwall that was 11 ft wide and 5.5 ft tall. Backfills included sand and sandy gravel compacted to 95% of the modified Proctor maximum dry unit weight. Test results indicate that the passive force decreases significantly as the abutment skew angle increases to 45° relative to non-skewed walls. The results also indicate that the reduced passive force for a skewed abutment, $P_{p(skew)}$, can be predicted using a simple reduction factor, R_{skew}, multiplied by the passive force for a non-skewed abutment with the same roadway width. The skew reduction factor was relatively consistent for all soil types, wingwall styles, and backfill width-to-height ratios investigated. The Phase II part of the previous study included testing of additional backfill materials and an inclined loading (push-and-rotate) condition for a 30° skew angle. No significant effect on the passive force skew reduction factor was observed in the inclined loading testing that involved relatively small rotation.

Based on the previous study results, the skew reduction factor has already been implemented in the Caltrans Seismic Design Criteria, along with geotechnical guidelines for Oregon DOT and UDOT. However, as designers have started applying this approach, several questions have arisen. For example, in most of the field abutment tests, the simulated bridge abutment was forced to move longitudinally into the backfill soil. In contrast, during earthquake loadings, the abutment has been observed to rotate. Although this rotation angle is quite small, it can lead to a significant difference in longitudinal displacement from the edges of the abutment from rotation. This would be expected to lead to a triangular distribution of pressure on the backwall of the abutment. Designers want to know (1) if the skew reduction factors remain the same when rotation is involved, and (2) if it is necessary to distribute the passive force non-uniformly along the backwall of the abutment.

The objective of this new study is to assist with the calibration of numerical models by conducting a series of large-scale skewed abutment, passive force-displacement tests with enough abutment offset from rotation to evaluate the skew reduction factor and backwall pressure distribution. The maximum rotation and displacement would be larger than in the previous testing. As availability allows, the tests would be conducted at the same Salt Lake Airport test site used in the previous study.

Planned tasks for this new study are as follows:

(1) Analysis of the existing abutment to determine acceptable rotation and loading scheme,
(2) Performance of large-scale skew abutment tests,
(3) Analysis of test results including determination of passive force reduction factors,
(4) Comparison with longitudinal test results and modifications,
(5) Supplemental numerical analysis of parameters affecting results,
(6) Preparation of interim and final reports, and
(7) Dissemination of results, including presentations at AASHTO committee meetings.

In Task 2, lateral load tests will be performed on the simulated bridge abutment with skew angles of 0°, 15°, 30°, and 45° relative to the direction of loading. The backfill will consist of concrete sand compacted to 95% of the modified Proctor maximum dry unit weight to provide direct comparisons with the previous tests performed with longitudinal loading. The passive force provided by the backfill will be determined by loading the abutment before and after compacting backfill behind the abutment. As with previous tests, the applied lateral force, abutment displacement and rotation, pressure on the backwall, vertical and horizontal movement of the backfill, and location of the failure surfaces in the backfill will be measured.

UDOT intends to hire a firm or university as the prime consultant through qualifications-based selection in the UDOT General Engineering Services Pool, Research Work Discipline. The technical advisory committee (TAC) for the study currently includes representatives from UT, CA, ID, NY, SC, and WA state DOTs.

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

Tasks – Not yet finalized for contract. See a preliminary list above.

Meetings – No TAC meetings were held this quarter.

Contract – Pending.

Funding – UDOT worked on setting up the project in our accounting system and FMIS.

Anticipated work next quarter:

Tasks – Not yet finalized for contract. See a preliminary list above.

Contract – Pending. UDOT will develop a draft scope of work for the contract RFQ.

Funding – Partner agencies are requested to transfer their 2024/2025 funding commitment amounts to UDOT to use in setting up the initial contract with a research team.

Significant Results:

None yet.

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).

None.

Potential Implementation: