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Caltrans Division of Research, Innovation and System Information

Research Notes

Evaluation of Lateral Pile Resistance near Mechanically Stabilized Earth (MSE) Walls at a Dedicated Wall Site (Phase 2), TPF-5(381)

Further Caltrans' understanding of the interaction between laterally loaded bridge abutment piles and adjacent Mechanically Stabilized Earth walls.

Seismic

AUGUST 2020

Project Title:
Evaluation of Lateral Pile Resistance near Mechanically Stabilized Earth (MSE) Walls at a Dedicated Wall Site (Phase 2), TPF-5(381)

Task Number: 3603

Start Date: August 20, 2018

Completion Date: September 30, 2020

Task Manager:
Yue Wang
Transportation Engineer
Yue.Wang@dot.ca.gov

WHAT IS THE NEED?

The objective of this project is to further our understanding of the interaction between laterally loaded bridge abutment piles and adjacent MSE walls. As is known, bridge abutment piles are frequently surrounded by mechanically stabilized earth (MSE) walls rather than a soil slope.

Piles near MSE walls must be designed for lateral loads from earthquakes and thermal expansion/contraction. In the TPF-5(272) Phase 1 study involving several state DOTs, a series of 31 tests on free-head piles provided p-multipliers as a function of pile spacing which can be used to account for reduced lateral soil resistance due to the presence of an MSE wall.

The research team developed equations to compute the induced force developed in the reinforcements by the lateral pile loading. However, several questions came up when the results of the Phase 1 study were presented to engineers and those responsible for code changes. The objective for this Phase 2 study is to provide closure relative to the outstanding issues from Phase 1.

This study currently underway by the Utah Department of Transportation, is Phase 2 of a multi-phase transportation study with other partner member Departments of Transportation (DOTs) such as FL, KS, MN, NY and WI.

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WHAT ARE WE DOING?

The Phase 1 study included construction of a dedicated MSE wall site in Utah with instrumented piles behind the 20-ft high wall. This wall site will be reused for the Phase 2 testing. Funded tasks for this Phase 2 study include:

1. Excavate the top 6 ft of the soil backfill behind the existing MSE wall.
2. Instrument MSE reinforcements and piles with strain gauges.
3. Re-compact the top 6 ft of the soil backfill behind the existing MSE wall.
4. Conduct cyclic lateral pile load testing.
5. Conduct fixed-head lateral pile load testing.
6. Conduct lateral pile load testing of larger-diameter piles (24-inch diameter), to be newly placed between cut-off existing piles.
7. Conduct lateral pile load testing of a pile group.
8. Develop p-multipliers for Phase 2 lateral pile load testing results, compare these with the Phase 1 results, and update the overall p-multiplier equation as necessary.
9. Develop tensile force equations for Phase 2 lateral pile load testing results, compare these with the Phase 1 results, and update the overall tensile force equations as necessary.
10. Submit a final report that documents the Phase 2 research effort.
11. Report results to Technical Advisory Committee members in video conferences.
12. Make presentations at the American Association of State Highway and Transportation Officals bridge engineers' committee meetings and Transportation Research Board events to aid in national efforts to implement the study results.

WHAT IS OUR GOAL?

The purpose of this project is to evaluate the lateral pile resistance near mechanically stabilized earth (MSE) wall systems at a dedicated wall site.

WHAT IS THE BENEFIT?

This Phase 2 study may provide closure relative to the outstanding issues from Phase 1, using a series of additional tests as a follow-up to the original test series, and to further Caltrans' understanding of the interaction between laterally loaded bridge abutment piles and adjacent MSE walls.

WHAT IS THE PROGRESS TO DATE?

The research team has made the following progress:

- Developed p-multipliers for Phase 2 lateral pile load testing results, compared these with the Phase 1 results, and updated the overall p-multiplier equation as necessary.
- Developed tensile force equations for Phase 2 lateral pile load testing results, compared these with the Phase 1 results, and updated the overall tensile force equations as necessary