FACT SHEET

Reducing Long-Term Consolidation Settlement from New Embankments

PROJECT TITLE

Reducing Long-Term Consolidation Settlement from New Embankments

STUDY TIMELINE

June 2012 – October 2017

INVESTIGATORS

Steven Bartlett, The University of Utah, PI

Evert Lawton, The University of Utah

Zach Gibbs, The University of Utah

UDOT CONTACTS/CHAMPIONS

Grant Gummow, Geotechnical Engineer

David Stevens, Research Project Manager

Introduction

Primary consolidation, or the short-term soil settlement associated with addition of a bridge-approach embankment or building load, is the main soil compression concern during construction. However, secondary compression of the underlying soils can cause long-term settlement damage to bridges, their foundations and approach embankments, overlying pavements, and other nearby constructed works. Surcharging or preloading of earthen embankments and underlying compressible soils with additional, temporary embankment fill is the most commonly deployed strategy to reduce the magnitude of secondary compression that may occur after construction.

Methodology

A research team from The University of Utah collected and analyzed soil consolidation data from a few past project sites and prepared a research report that discusses the design and implementation of surcharging technology in terms of the required laboratory, field, and engineering evaluations. In addition to the past projects' data that was analyzed, additional laboratory consolidation tests and time-rate tests were performed on fine-grained, cohesive soil samples from a few past project sites located along the Wasatch Front in Utah.

Conclusions

The data obtained from this study plots higher than those reported previously by Ng (1998) on similar soil samples from Utah, suggesting higher amounts of secondary settlement will occur than previously predicted. This observed trend is in better agreement with the long-term settlement performance monitoring data obtained from the I-15 Reconstruction Project from 2000 to 2012 in the northern part of the Salt Lake Valley. Data from the time-rate tests associated with this study correlated well with the research performed by Ng (1998). Also provided in the study report is a recommended method for designing surcharge fills considering post-construction (i.e., secondary compression) settlement.

Potential Impacts and Benefits

The impact of implementing the research results will be observed through improved ride quality at bridge approaches on new projects, resulting from reduced long-term settlement of the embankments due to better-designed embankment surcharges used during fast-tracked construction. Project costs or schedules will likely not be reduced by improving the surcharge design; however, it is anticipated that costs of long-term maintenance of bridge approach areas will be reduced. Ride quality at one of the first bridges to implement the results of the research has been very good so far, the first year following completion of the project. The research results were incorporated in the current UDOT Geotechnical Manual of Instruction in terms of the recommended method for designing surcharge fills. UDOT held a half-day training workshop in January 2019 at no cost for participants to learn details of surcharge design according to the information presented in the research report. About 30 geotechnical design consultants attended the training with some UDOT geotechnical staff and two researcher presenters.

For more information, please contact Grant Gummow at ggummow@utah.gov or David Stevens at davidstevens@utah.gov.

FURTHER RESOURCES

[Link to final report]

[Link to UDOT Geotechnical MOI incorporating this research]