

# MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-534 (project 607) | July 2024

## Loading and Wetting-induced Settlement of Bridge Approach Embankment Materials in Utah



### the **ISSUE**

The settlement or heave resulting from compression of material within approach embankments for bridges, and compression or heave caused by infiltration of water into embankments, can potentially exacerbate the problem of bumps at the ends of bridges.

### the **RESEARCH**

Laboratory tests were performed on compacted specimens of 10 embankment materials specified by the Utah Department of Transportation using both standard-size and large-scale equipment. The tests consisted of preparing each test specimen to predetermined values of density and water content, and measuring the settlement or heave of the specimen when loaded to simulate the weight of the embankment material above a particular depth within the embankment, and by adding water to simulate water infiltration into the embankment. Test specimens were compacted using a method appropriate for the type of material being tested that also simulated the type of compaction generally used during construction of an actual embankment. Using the results from these tests, settlement or heave of a 30-foot-tall typical embankment was calculated for the different materials, densities, and water contents studied. In addition, recommendations were made to change some aspects of the current UDOT specifications for bridge approach embankment specifications based on the results of the settlement/heave calculations.

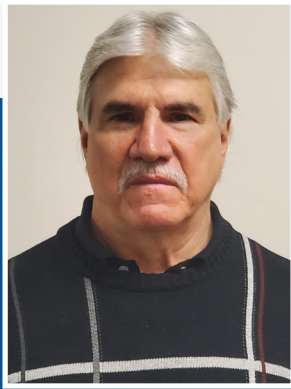


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## Project Title

Loading and Wetting-  
induced Settlement of Bridge  
Approach Embankment  
Materials

## Sponsors | Partners

Utah Department of  
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## the FINDINGS

From the results of the laboratory tests on standard-size specimens consisting of 10 different materials, estimated settlement values caused by compression of the embankment from self-weight and the structural pavement system construction on top ranged from 0.92 to 3.0 inches. Estimated values caused by wetting ranged from a heave of 13 inches to a settlement of 8 inches. Settlement generally increased with a higher load, lower density, and higher water content. Settlement occurred quickly in non-plastic soils and slowly in plastic soils. Heave occurred in only plastic materials (some clay). Three materials were selected for tests using large-scale specimens (which were deemed to be more realistic than tests on standard-size specimens): two high quality non-plastic materials and one lower quality material with low-to-moderate plasticity. These tests resulted in estimated values of loading-induced settlement ranging from 7 to 18 inches, and wetting-induced settlement from 0.07 to 0.17 inches.

## the IMPACT

It is expected that material and construction specifications for approach embankments for bridges will be revised by UDOT and possibly other public agencies. If so, there will likely be a significant reduction of settlement/heave of approach embankments for bridges, mitigating problems with bumps at the ends of newly constructed bridges. This research has greatly enhanced our understanding of the loading and wetting stress-strain characteristics of various types of soil. The research has also provided exposure to many aspects of the transportation field to three graduate students who have worked on this project.

For more information on this project, download the Main report at <https://www.ugpti.org/resources/reports/details.php?id=1237>

For more information or additional copies, visit the Web site at [www.mountain-plains.org](http://www.mountain-plains.org), call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.



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