Research Project Descriptions

UTC Project Information	
Project Title	**Tangential Heave Stress Acting on Deep Foundations in Cold Regions**
University	Texas Tech University
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Funding Source(s) and Amounts Provided (by each agency or organization)	SPTC: $60,192 Texas Tech University: $60,700
Total Project Cost	$120,892
Agency ID or Contract Number	DTRT13-G-UTC36 SPTC 15.1-17
Start and End Dates	7/01/2016 – 6/30/2017
Brief Description of Research Project	**PROBLEM**: When the ground temperature drops below the freezing point, a bond is formed by ice between the foundation material and the frozen soil, and this process is called adfreezing. As cold temperatures further penetrate into the ground, the frost-susceptible soil surrounding the pile heaves and hence the initial bond between pile and soil is overcome. Soil then slides along the pile for the rest of the frost heave period and the sliding motion of the soil pulls the pile upward. The upward shear force is called tangential heave force, and the upward shear stress induced by frozen soil is the tangential heave stress. Values of tangential heave stress reported in the literature show very large variability, by several orders of magnitude, causing a pile design depth to differ greatly depending on the selected values. The uncertainties mainly come from lack of proper understanding of ice-soil-pile interaction and absence of standardized tests for measurement of tangential heave stress. Deep foundations in cold regions should be designed in such a way that shaft resistance provided by soils below the frost depth is greater than the tangential heave force induced by soils above the frost depth. When tangential heave stress is not properly considered in design, foundations experience significant upward movement which may jeopardize the structural integrity of transportation infrastructure. **PROPOSED SOLUTION**: The research study will quantify the effect of key variables on tangential heave stress through a well-controlled, lab-scale, instrumented model pile test program in a soil tank. Evaluation of tangential heave stress acting on the model pile and load-transfer

	behavior along the pile will be investigated using strain gages and LVDTs attached to the pile in a temperature-controlled environmental chamber. Special emphasis will be placed on observations of pile-soil interface behavior before and after the adfreeze bond is broken. The study will make a significant contribution to the body of knowledge of cold regions engineering by evaluating tangential heave stress under different temperature gradients and soil conditions. This will help foundation engineers identify and select suitable design values of tangential heave stress for deep foundations in cold regions. In particular, the testing system and procedure may serve as a standard test method to more reliably determine peak and residual values of tangential heave stress.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	
Impacts/Benefits of Implementation (actual, not anticipated)	
Web Links • Reports • Project website	