Experimental validation of vibration-excited subsidence model of seasonally frozen soil under cyclic loads

Miao Wang, Shangjiu Meng, Xiaoming Yuan, Yiqiang Sun, Jian Zhou

PII: S0165-232X(16)30325-1
DOI: doi:10.1016/j.coldregions.2017.11.001
Reference: COLTEC 2478

To appear in: *Cold Regions Science and Technology*

Received date: 9 November 2016
Revised date: 24 August 2017
Accepted date: 3 November 2017

Please cite this article as: Miao Wang, Shangjiu Meng, Xiaoming Yuan, Yiqiang Sun, Jian Zhou , Experimental validation of vibration-excited subsidence model of seasonally frozen soil under cyclic loads. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Coltec(2017), doi:10.1016/j.coldregions.2017.11.001

Experimental validation of vibration-excited subsidence model of seasonally frozen soil under cyclic loads

Wang Miao[1,2], Meng Shangjiu[1,2,3*], Yuan Xiaoming[1,2], Sun Yiqiang[3], Zhou Jian[3]

1. Institute of Engineering Mechanics, China Earthquake Administration, Harbin 150080, China;

2. Key Laboratory of Earthquake Engineering and Engineering Vibration of China Earthquake Administration;

3. College of Civil Engineering and Architecture, Harbin University of Science and Technology, Harbin 150080, China

*Correspondence: iemmsj@163.com; Tel: +86 15046106155

Abstract: Validation of the vibration-excited subsidence model is limited for seasonally frozen soil. Based on constant-amplitude load tests by a new low-temperature triaxial device under realistic confining pressure, amplitudes of dynamic stress, consolidation and freezing methods, we determined the residual strain behavior and validated the vibration-excited subsidence model of frozen soil during frozen period considering the influence caused by temperatures, loading amplitudes and loading cycles. Results show that the residual strain during the frozen period increased with increasing cycles of loading, but decreased with decreasing temperatures. The residual strain development model indicates that residual strain increased dramatically in the initial loading cycles followed by a gradual increase over time. In most cases, the frozen soils tested are not failing that the developing curves of residual strains under different temperatures develop nearly parallel after certain cycles of loading. Residual strain was fairly sensitive to the negative temperatures at large amplitudes of dynamic stress, and the influence of low temperature was limited after a critical temperature in −5°C -−10°C. The two-parameter exponential model is able to express exactly the change rule of vibration-excited subsidence under different temperature. With the increase of dynamic stress amplitude, parameters *A* and *B* increase rapidly, especially when the soil approaches the failure state. In contrast, parameters *A* and *B* decrease as temperature decreases, but decrease little as the temperature decreases below the critical temperature. Our test layout overcomes previous testing limitations such as excessively large consolidating pressure and dynamic loading so that the test results are more consistent with the real conditions of seasonally frozen soil. The vibration-excited subsidence of subgrade in seasonally frozen soil regions could be predicted through this model.

Keywords: seasonally frozen soil; vibration-excited subsidence; residual strain; cyclic loads; low-temperature dynamic triaxial test