Freezing-thawing attenuation coefficient helps evaluate dynamic characteristics of frozen surbage soil

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Tibet, China. Credit: Unsplash/CC0 Public Domain

Chinese researchers recently investigated the evolution features of dynamic stiffness parameters in the small strain range to determine the

effects of freeze-thaw cycles on the dynamic responses of frozen subgrade soil, providing an important reference for assessing the degeneration of engineering properties for frozen subgrade soil exposed to freeze-thaw cycles.

In the "eight vertical and eight horizontal" long-term planning of China's high-speed railway network, more than 50 percent mileage is in the seasonal or deep seasonal freezing area, mainly in northeast, north and northwest and other broad areas of China.

Therefore, researches on the dynamic characteristics of filler (soil) layer used in high-speed railway are very important for rational design, safe operation and maintenance, and disaster prevention and control.

However, the fatigue properties and deterioration mechanisms of the foundation construction of high-speed railway in seasonal freezing region are dominated by the attenuation behaviors of the dynamic characteristics of subgrade soil under the coupling effects of long-term freeze-thaw erosion and high-frequency dynamic loading induced by train operation.

In addition, the high-speed railway design considering the earthquake effects under extreme climate and geological disasters also puts forward higher requirements for dynamic stability of subgrade filler (soil).

To solve these engineering problems, the researchers at the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences (CAS) concentrated on the Honggu-Haidong division of Lanzhou-Urumqi high-speed railway, in which freeze-thaw and geological disasters frequently occur.

They adopted two types of dynamic triaxial tests to study in detail the stiffness behaviors of frozen subgrade soil at small strain ranges and the

dynamic deformation behaviors of frozen subgrade soil under long-term cyclic loadings.

In addition, they also investigated the development characteristics of accumulated plastic strain and resilient modulus of frozen subgrade soil and analyzed the dominant influence law of freezing-thawing process and stress history on its development.

Based on a large number of testing results, the researchers proposed a freezing-thawing attenuation coefficient to evaluate and simulate the influence of freezing-thawing erosion process on the dynamic properties and engineering parameters of frozen subgrade soil.

The simulation results show that the freezing-thawing attenuation coefficient is capable to well describe testing results in wide range of testing conditions.

This investigation provides a reference theoretical model and experimental data for evaluating the deterioration of engineering properties for the subgrade construction of high-speed railway in seasonal freezing region.

This study has been published in *Soil Dynamics and Earthquake Engineering*, titled "Dynamic responses of frozen subgrade soil exposed to freeze-thaw cycles."

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