Nationwide zonation and durability assessment of China's plateau infrastructure under freeze–thaw cycles

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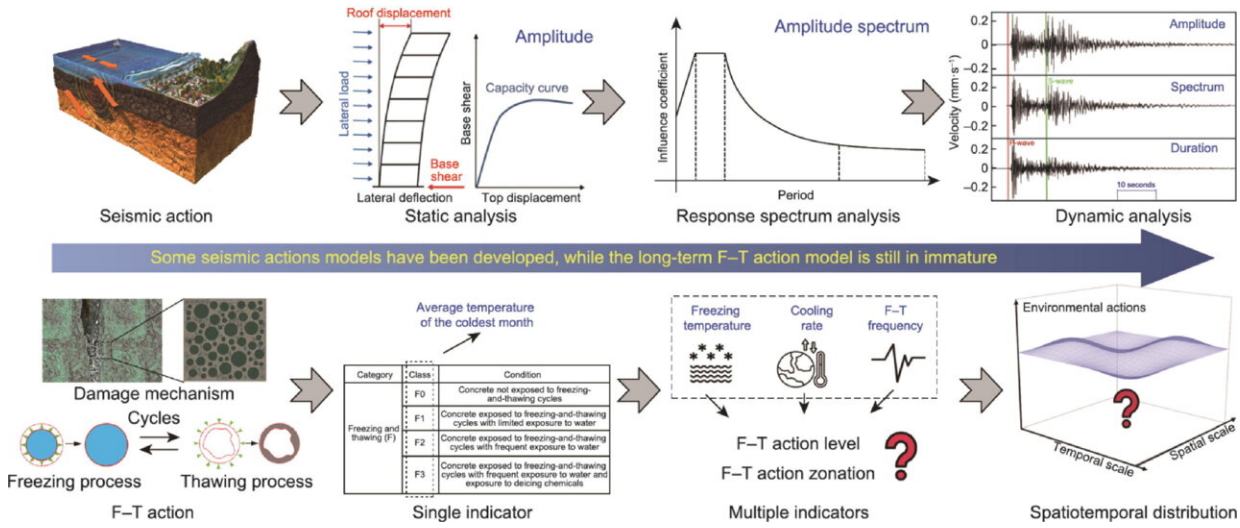

Analogies between seismic and F–T environmental actions. Credit: Tiejun Liu et al.

In a bid to tackle the enduring problem of infrastructure durability in the face of relentless freeze–thaw (F–T) cycles, a team of researchers have published a study in *Engineering*. The study, titled "Analysis and Zonation of Freeze–Thaw Action in the Chinese Plateau Region

Considering Spatiotemporal Climate Characteristics," focuses on the Chinese Plateau region, where the harsh effects of F–T cycles on concrete structures have led to concerns regarding their aging and subsequent performance deterioration.

The authors of the study emphasize that the existing national standards for designing frost-resistant concrete structures are insufficient, as they rely primarily on the coldest monthly average temperature without accounting for the intricate spatiotemporal variations, amplitude, and frequency of F–T cycles.

To address this shortcoming, the researchers introduce an advanced spatiotemporal distribution model, which employs statistical analysis and spatial interpolation techniques to analyze the long-term impact of F–T action on infrastructure.

One of the key contributions of the study is the nationwide zonation it creates for F–T action levels. By employing cluster analysis, the researchers were able to categorize the country based on freezing temperatures, temperature differences, and the number of F–T cycles experienced in different regions.

This zonation offers a nuanced understanding of the varying degrees of stress placed on infrastructure across China's vast landscape.

Additionally, the study explores the correlation between natural environmental conditions and laboratory-accelerated tests through the use of hydraulic pressure and cumulative damage theories.

The researchers develop a user-friendly visualization platform that allows for easy access to meteorological data, facilitates environmental

characteristic analyses, and computes the similarity between natural and laboratory F–T action scenarios.

The platform promises to be a game-changer for engineers and policymakers, providing them with the tools necessary to make informed decisions about the maintenance and design of concrete structures in the challenging plateau region.

The study's findings are expected to contribute significantly to enhancing the quantitative durability design of infrastructure, ultimately prolonging the service life of vital transportation networks in China.

This research not only offers a blueprint for improving the resilience of infrastructure in the Chinese Plateau region but also serves as a template for other regions grappling with similar environmental challenges.

As climate change continues to impact global weather patterns, the development of such innovative solutions is crucial in ensuring the sustainability and longevity of transportation networks worldwide.

More information: Tiejun Liu et al, Analysis and Zonation of Freeze-Thaw Action in the Chinese Plateau Region Considering Spatiotemporal Climate Characteristics, *Engineering* (2024). DOI: 10.1016/j.eng.2024.04.016

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