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Abstract:

The foundations of photovoltaic stents in seasonally frozen regions suffer from uneven frost heave in winter, and the screw piles are widely used to reduce frost diseases. A one-dimensional frost heave model testing was conducted to assess the frost jacking characteristics of several screw piles and a no-helix pile embedded in highly frost-susceptible soil, and the temperature field, jacking displacement and force characteristics were analyzed. The results indicated that when the boundary temperature was −10 ℃/−20 ℃, the freezing depth can reach as much as 15.26 cm and 26.78 cm, respectively. The frost jacking ratio η_j (ultimate jacking displacement divided by freezing depth) was a reasonable indicator in terms of anti-frost jacking ability. Specifically, η_j of large half-helix pile was the least, with a value of 1.03 %, and η_j of multi-helix pile was even larger than that of pile with no helix. Geometric parameters including the location of the top helix, diameter, pitch, etc., were crucial to the development of frost jacking. The jacking displacement appeared to be a linear function of the freezing depth. Considerable frost jacking force (13.8 kN) was measured on multi-helix pile, much greater than those of other piles. It was found that the helices in the frozen layer increased the jacking force greatly. Due to insufficient anchoring of the helices, the pile types (except multi-helix pile) had little effect on jacking force-freezing depth relation. After thawing, the residual force can dissipate completely, whereas the residual ratio (residual displacement divided by ultimate frost jacking) remained above 50 %. The optimal design of screw piles was discussed in light of these analyses.

Keywords: model test; screw piles; frost jacking; seasonal frost