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Thermo-mechanical response of a cast in situ displacement energy pile

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Displacement cast in situ Fundex (DCSF) energy piles are a new type of energy pile with the advantages of convenient construction, simple manufacturing, low vibration, and low noise and cost. This work focuses on the response of a stand-alone DCSF energy pile under different mechanical loads simultaneously with the operation of a ground source heat pump through a series of full-scale field tests. After applying an axial load on the pile head (60% of the bearing capacity), the pile was subjected to ten thermal cycles. The effects of mechanical load and the impact of temperature on the mechanical capacity of the DCSF energy pile were investigated.

The results indicate that the cyclic thermal loadings induce a progressive increase in the compressive stress of piles. Furthermore, a residual compressive stress was observed and attributed to the drag-down effects of the surrounding soil.

During cooling phase, the tensile stress induced by thermal load decreased drastically due to the shrinkage of the near soils, leading to an insignificant effect on the energy pile during cooling. The maximum thermo-mechanical axial compressive stress in the foundations was approximately 1.55 MPa, well within structural limits and not expected to affect the building.

Progressive pile head displacement was observed indicating that thermal creep can affect pile head displacement at higher working loads.