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DISASSEMBLY RESPONSE OF LATERAL PILE-SOIL INTERACTIONS ADJACENT TO TUNNELLING: A NUMERICAL INVESTIGATION

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Abstract

Tunnel excavation induces stress redistribution and deformation in the surrounding soil, weakening the lateral bearing capacity of adjacent piles and potentially resulting in engineering failures. Therefore, accurately evaluating the mechanism of lateral pile-soil interaction induced by tunnelling is important. This study numerically investigated the pile-soil interaction p-y curves of a pile adjacent to tunnelling in sand, clarifying the evolution mechanisms of the passive-side (away from the tunnel), the active-side

(adjacent to the tunnel), and the resultant p-y curves, and examining the effects of excavation parameters on the evolution of p-y curves. The results showed that the evolution of the passive pile p-y curves can be divided into two stages: the excavation-induced unloading stage and the pile-soil deformation stage. Both the passive-side and active-side p-y curves evolved synchronously: both the resultant and passive-side soil forces initially increased and subsequently decreased with increasing lateral pile displacement, whereas the active-side soil resistance initially decreased and then increased. During tunnelling, the peak resultant and passive-side soil forces increased and then decreased, while the active-side soil resistance initially decreased and subsequently increased, with all reaching their respective extreme values when the tunnel face reached the pile's centreline. Moreover, both the passive-side soil force and active-side soil resistance exhibited opposite trends in response to changes in tunnel diameter, volume loss, tunnelling speed, and the pile-tunnel distance, but exhibited similar trends in response to changes in cover depth and pile diameter.

Keywords:

Tunnel Excavation, Pile–Soil Interaction, P–Y Curves, Lateral Bearing Capacity, Numerical Investigation