Simplified elastic approach for three-dimensional pile group displacements induced by nearby tunneling operation

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Abstract This paper introduces a simplified method to obtain the three-dimensional soil displacement field caused by tunneling, which is subsequently applied to the analyses of piled foundations nearby. Soil displacements around the tunnel heading are idealized by the spherical contraction model, while the cylindrical contraction model is adopted to simulate the response far away from the heading. The two deformation mechanisms are combined through a shape function, with the parameters determined using a heuristic algorithm and comparisons with numerical analyses. To validate the proposed approach, the displacement fields estimated by the simplified solution and the pile group analyses are compared with three-dimensional finite difference simulations, and favorable comparisons are obtained for ground movements, pile deflections, axial forces and bending moments. The proposed approach is computationally efficient, and the presented work forms the basis which can be further explored to develop design charts for deformation parameters under various tunnel geometries and soil conditions. These may then be used for quick evaluation of the complete displacement field around the tunnel.

Keywords: tunneling; cavity contraction; soil-pile interaction; 3D displacement field

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