Public Abstract
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Numerical Investigation of Load Transfer Mechanism in Slopes Reinforced with Piles
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Prediction of loading on piles in slopes reinforced with piles (piled-slopes) is important in order to properly calculate the stability of piled-slopes. One of the major concerns in evaluating stability of piled-slopes is the limit soil pressure that can be developed at the pile-soil interface, or the pressure at which the soil will fail by flowing around or between piles ("flow" failure mode). Most current methods used to predict the limit soil pressure produce inconsistent results. The loading on piles predicted using the currently available theories may differ significantly.

The objective of the research work is to use numerical analyses to evaluate the limit soil pressure on the pile, to evaluate the load transfer mechanism for vertical and inclined piles under fixed and free rotating conditions, and to evaluate alternative means for estimating mobilized and limit loads on piles in piled-slope problems under drained conditions.

It is found that limit forces predicted using two-dimensional (2-D), plane strain and three-dimensional (3-D) analyses differ substantially as a result of differences in vertical stresses developed in the soil adjacent to the pile. The computed limit force on piles in piled-slopes is sensitive to a number of factors including the pile-soil interface roughness, pile spacing, modeling techniques (2-D or 3-D), and constitutive model, provided that soil strength parameters and unit weight remain constant. It is found that for the 3-D model, which includes both the sliding and anchorage zones, the limit soil pressure calculated in the sliding zone for the "flow" failure mode is approximately equal to that predicted using the three times the Rankine passive pressure (Broms, 1964) as long as the pile spacing to diameter ratio is 4 or greater. It is concluded that 2-D, plane strain analyses of a horizontal slice is not suitable for evaluation of mobilized or limit lateral loads on piles in the sliding zone of piled-slopes due to unreasonable vertical constraints which produce unrealistic changes in vertical stresses. The 3-D model analysis, including both the sliding and anchorage zones, with "free" rotating and translating piles is a better and a more realistic method for modeling the actual piled-slope problems. Not only does it provide accurate limit lateral loads on piles in the sliding zone, but it also provides better understanding in the load transfer mechanism in both the sliding and anchorage zones.