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Calibration of Resistance Factors for Reliability-Based Design of Driven Piles Considering Unsaturated Soil Effects

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Abstract : The highly recommended approach to design, known as the load and resistance factor design (LRFD) method, employs the geotechnical resistance factor (GRF) for shaping pile foundation designs. Within the standard process for designing pile foundations, geotechnical engineers commonly adopt a design strategy rooted in saturated soil mechanics (SSM), often disregarding the impact of unsaturated soil behavior. This oversight within the design procedure leads to the omission of the enhancement in shear strength exhibited by unsaturated soils, resulting in a more cautious outcome in design results. This research endeavors to present a methodology for fine-tuning the GRF used for axially loaded driven piles in Winnipeg, Canada. This is achieved through the application of a well-established probabilistic approach known as the first-order second moment (FOSM) method while also accounting for the influence of unsaturated soil behavior. The findings of this study demonstrate that incorporating the influence of unsaturated conditions yields an elevation in projected bearing capacity and recommends higher GRF values in accordance with established codes. Additionally, a novel factor referred to as phy has been introduced to encompass the impact of saturation conditions in the calculation of pile bearing capacity, as guided by prevalent static analysis techniques.

Keywords : unsaturated soils, shear strength, LRFD, FOSM, GRF
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