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Mechanical-Reliability Coupling for a Bearing Capacity Assessment of Shallow Foundations

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Abstract : The impact of uncertainties on the performance assessment of shallow foundations is often significant. The need of the geotechnical engineers to a more objective and rigorous description of soil variations permitting to quantify these uncertainties and to incorporate them into calculation methods led to the development of reliability approaches. In this context, a mechanical-reliability coupling was developed in this paper, using a program coded in Matlab and the finite element software Abaqus, for the bearing capacity assessment of shallow foundations. The reliability analysis, based on the finite element method, assumed both soil cohesion and friction angle as uncertain parameters characterized by normal or lognormal probability distributions. The inherent spatial variability of both soil properties was, then, taken into account using 1D stationary random fields. The application of the proposed methodology to a shallow foundation subjected to a centered vertical loading permitted to highlight the proposed process interest. Findings proved the insufficiency of the conventional approach to predict the foundation failure and a high sensitivity of the ultimate loads to the soil properties uncertainties, mainly those related to the friction angle, was noted. Moreover, an asymmetry of both displacement and velocity fields was obtained.

Keywords : mechanical-reliability coupling, finite element method, shallow foundation, random fields, spatial variability
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