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Optimum design of shallow foundation using finite element analysis

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In this study the potential of structural optimisation of shallow foundations using finite element (FE) analysis has been explored. Structural optimisation can be divided into three categories, topology optimisation, shape optimisation and dimension optimisation. The focus in this study will be on the numerical optimisation of shape and dimensions of shallow foundations to create more cost effective designs. The use of structural optimisation on geotechnical applications is rather un-explored to date, however the potential of structural topology optimisation has been explored in an earlier study [1].

When designing large constructions finite element analyses are often used to analyse both the foundation and the structural elements of concrete and steel. Unfortunately, separate finite element models are often used to analyse the geotechnical and structural aspects of the design. This can lead to drawbacks in the design of the foundation as separated calculations leads to loss in synergistic effects between the soil and the structural elements, resulting in a non cost-efficient design. A more efficient procedure would be to use one finite element model to perform both the geotechnical and structural calculations of the foundation.

By creating a joint FE-model for both the structural and the geotechnical analyses and using parameterised design features this study explores the potential of numerical optimisation with regards to shallow foundations. The foundation is optimised according to current building regulations aiming in more efficient material usage and more economic design. The possibilities of the joint FE-model are explored by formulating a numerical optimisation algorithm over the construction parameters in the model. Earlier work has demonstrated the possibility to formulate numerical optimisation algorithms to deliver effective solutions in geotechnical applications [2].

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