DEM Investigation of Geogrid Reinforcement Mechanisms

Aim of the research project

Geogrids have been widely used in dealing with geotechnical problems. However, due to the varying elastic-plastic properties of geogrids and soils as well as the complicated interface behavior between geogrid and soil, the geogrid reinforcement mechanisms have not been investigated conclusively up to now. Therefore, this research project aims to investigate the compound behavior of geogrid reinforced soil under different loading conditions using the discrete element method (DEM), which has particular advantages of capturing detailed insights into the geogrid–soil interface.

Methods and results

Pull-out tests and large scale biaxial compression tests of geogrid reinforced soil are carried out at RWTH Aachen University, investigating the compound behavior of geogrid reinforced soil under the two main loading conditions. In pull-out tests, modified geogrids with varying numbers of transverse members are used so that the geogrid frictional and bearing resistance can be quantified.

In order to gain further insights into the geogrid–soil interface behavior, corresponding DEM investigations are conducted using Particle Flow Code (PFC) 2D. Both geogrid and soil are modeled with discrete particles. A piecewise linear model has been proposed and successfully used in previous DEM investigations to represent the nonlinear tensile strength behavior of geogrids. The load transfer behavior between geogrid and soil can be investigated by bond force and displacement distributions along the geogrids. Additionally, the geogrid reinforcement mechanisms within the composite material can further be investigated by visualizing the bond force distributions along the geogrid and the contact force distributions in the specimen as well as the development of shear zones in unreinforced and geogrid reinforced soil. Moreover, the geogrid–soil interactions will be investigated under cyclic wheel loads. Thereby, the geogrid reinforcement mechanisms can also be illustrated comprehensively under cyclic loading conditions.

Development of shear zones in biaxial tests

(a) Unreinforced soil  (b) Geogrid reinforced soil

In English only