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摘要集

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目　录

Geogrid-anchored sheet pile walls; a small-scale experimental and numerical study

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Abstract: The use of geogrids to anchor Sheet Pile Walls (SPW) is relatively new. A series of small-scale tests was performed to investigate the behaviour of geogrid-anchored SPWs subjected to strip footing surcharge loading. Particle Image Velocimetry (PIV) techniques were used to measure soil displacement and analyse the global failure mechanism and dominant soil-geogrid interaction mechanisms. One of the tests was duplicated in a test box that was eight times as wide, showing that the influence of the small width of the test box was acceptably small. A 2D finite element model (PLAXIS) was used to simulate the tests and there was a reasonable match with the test results. The position of the strip footing load, and the length and number of the geogrid anchors, proved to be key factors in determining the bearing capacity. The results provide new insights into the stabilising effect and the effective length of the geogrid anchors, in other words the length along which geogrid-soil friction is mobilised. Contrary to the Dutch design guidelines for reinforced soil walls and conventionally anchored sheet pile walls, the results showed that the geogrid provides resistance in the active zone under the strip footing surcharge loading.

Keywords: Geosynthetics, sheet pile walls, anchorage, physical models, numerical analysis

Investigation of the blast-resistance performance of geotextile-reinforced soil

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Abstract: An explosion on the ground surface can cause considerable damage to underground structures. In this study, a series of experimental and numerical investigations were conducted to examine the performance and reinforcing mechanism of reinforced soil subjected to blast loads. An excavated pit backfilled with sand only (unreinforced soil) and sand reinforced with three layers of geotextiles (reinforced soil) were used as test models in a field explosion test. In the field explosion test, blast pressures in air and soil, ground deformation, and mobilized reinforcement tensile strain were measured. The test results obtained for the reinforced and unreinforced soil were compared to evaluate the effectiveness of using soil reinforcement as a protective barrier against blast loads. The test results indicated that peak blast pressure in the reinforced soil was only 10–28% of those in the unreinforced soil. Two reinforcing mechanisms were identified in this study: the tensioned membrane effect and lateral restraint effect. Moreover, a series of numerical analyses were performed to evaluate the effects of reinforcement parameters on the blast pressure. This study provides useful insights into the application and design of soil reinforcement as an alternative antiexplosion measure to protect underground structures against surface explosions.

Keywords: Geosynthetics, reinforced soil, blast loads, tensioned membrane effect

Centrifuge model and numerical studies of strip footing on reinforced transparent soils

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Abstract: This paper presents the results of centrifuge model tests to investigate the deformation behaviour of unreinforced and reinforced transparent soil foundations under strip loading. A digital image analysis technique was employed to obtain the soil displacement field and strain distribution of reinforcements. Two-dimensional (2D) numerical models were developed and verified using the test results. The soil was modelled as a linearly-elastic perfectly-plastic material with Mohr–Coulomb failure criterion. The reinforcement was characterised using a linearly-elastic model considering rupture behaviour. Moreover, a parametric study was conducted to investigate the load–settlement response of foundations, distribution of reinforcement tension and failure sequence of reinforcements. The experimental and numerical studies show that the results obtained from the numerical simulations are in good agreement with the results of the centrifuge model tests. The 2D finite difference model developed using the user-defined functions coded into the FLAC programme can better simulate the progressive failure of the reinforcement layers in the tests. The failure sequence of reinforcement layers is not affected by the modulus and internal friction angle of soil and the reinforcement length, but is closely related to the combined effect of spacing and number of reinforcement layers and the combined effect of reinforcement stiffness and strength.

Keywords: Geosynthetics, Reinforced transparent soil foundation, Centrifuge modelling, Numerical simulation, Failure mechanism

Mechanisms controlling the hydraulic conductivity of anionic polymer-enhanced GCLs

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Abstract: The hydraulic conductivity (k) of specimens of enhanced-bentonite geosynthetic clay liners (EB-GCLs) comprising anionic polymers permeated with two concentrated salt solutions, 500 mM NaCl and 167 mM $CaCl_2$, was measured to determine the effects of polymer properties and specimen preparation method on the k and the associated roles of polymer retention and elution in dictating the measured k. The results of hydrogel formation tests illustrated that poly(acrylic acid) hydrogel was formed in solutions tested during EB-GCL hydration. A dry sprinkling method of specimen preparation resulted in low k ($\leq 5.5 \times 10^{-11}$ m/s) in multiple EB-GCLs, with a low fraction (≤2.5%) of retained polymer. In contrast, polymer elution from EB-GCLs prepared using a dry mixing method resulted in interaggregate seepage and an increase in k. Higher polymer retention occurred for the wet-mixed EB-GCLs, but did not directly correlate to low k. The long-term k of the EB-GCLs is dependent on several factors, including (i) formation of hydrogel, (ii) mobilization of hydrogel into and blocking of the most conductive pores, (iii) balance of seepage forces and hydrogel crosslink bond strength, (iv) kinetics of hydrogel formation, and (v) adsorption of polymer to the surfaces of the bentonite particles or aggregates of particles.
Keywords: Geosynthetics, anionic polymers, bentonite, enhanced bentonites, geosynthetic clay liners, hydraulic conductivity, hydrogel, polymer elution, polymer mechanisms, polymer modified bentonites, polymer retention, SDG 6: clean water and sanitation, SDG 7: affordable and clean energy, SDG 9: industry, innovation and infrastructure, SDG 12: responsible consumption and production

Behavior of geocell reinforced bed under vibration loading: 3D numerical studies

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Abstract: The manuscript aims to provide numerous insights into the behavior of the geocell reinforced bed subjected to a vibration load. Vibration propagation mechanism, displacement, and stress response of geocell reinforcement have been described. Two different cases, namely, unreinforced and geocell-reinforced beds subjected to a vertical mode dynamic excitation have been analyzed using the finite-difference package FLAC^{3D}. Initially, the developed numerical model was validated with the results of field vibration test. Results revealed that the inclusion of the geocell reinforcement in the foundation bed significantly improves vibration isolation efficacy. The foundation bed strain due to vibration loading was reduced by 67% due to the provision of geocell reinforcement. Based on the observed wave propagation behavior of the geocell reinforced bed, a mechanism was proposed to quantify the diffraction angle and the dispersion distance of induced vibration. The diffraction angle was found to vary between 50° to 63° in the presence of a geocell mattress. The dynamic stress factor calculated using the hoop stress theory was found to vary between 1.5 to 2 for geocell with different infill materials. Further, parametric analysis was performed to understand the effect of geocell geometry on the peak particle velocity (PPV) response of the reinforced bed.

Keywords: Geosynthetics, geocell, infill materials, vibration load, isolation mechanism, FLAC^{3D}