MONITOR

Recently in *Geotechnical Engineering*

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The following are a selection of papers published recently in *Geotechnical Engineering* that readers of *Ground Improvement* may find of particular interest. The selection covers issues published from January to October 2002.

Finite-element analysis of a compensation grouting field trial in soft clay

T. I. Addenbrooke, J. C. W. Ong, D. M. Potts
Geotechnical Engineering, 2002, **155**, No 1 (January), 47–58.

This paper presents the details of, and results from, finite-element modelling of a monitored field trial of compensation grouting in Singapore Marine Clay. The numerical results are compared with the ground surface response and the pore water pressures that were monitored during the trial grouting programme. Notable features of the field trial were that: (a) the ground heave achieved during a one-day grouting cycle reduced during the subsequent three-day rest period before the next grouting cycle commenced; and (b) the excess pore water pressures generated during that one-day grouting cycle dissipated to almost zero during the three-day rest period. The Imperial College Finite Element Program was used to analyse this field trial. The method for the modelling of compensation grouting is described. Two alternative grout propagation models are compared, one of which produces a good match with the field recorded heave data, and the other with the field recorded pore pressure data. The hydraulic boundary conditions are also varied to look at the consolidation behaviour. It is concluded that the proposed finite-element model can reproduce field behaviour if excess pore pressures can dissipate to the injected grout itself. The analyses also suggest that the direction of grout propagation in the field probably varies as the grout is pressurised.

The observational method—learning from projects

A. J. Powderham
Geotechnical Engineering, 2002, **155**, No 1 (January), 59–69.

Simplicity is at the heart of the observational method. Its basis is straightforward and it is an inherently natural approach to address uncertainty. The focus on prediction, monitoring, feedback, and teamwork also creates a strong opportunity for learning. Applications typically involve underground construction and temporary works. The objectives are to save cost or time while maintaining an acceptable level of safety. Application of the method was pioneered by Terzaghi and the principles were formally set down by Peck in his 1969 Rankine lecture. Possible modes of failure must be carefully assessed and controlled, particularly those of a sudden or brittle nature, or those that could lead to progressive collapse. Safety is essential and a high degree of certainty in project performance and schedule is generally required. The observational method overcomes the limitations of conventional design by evaluating feedback from actual conditions. This paper describes how simple measurements were central to resolving complexity and controlling risk. It presents three recent case histories featuring the 'progressive modification' approach which removed barriers that may have prevented the opportunity to apply the observational method.

The use of compensation grouting in tunnelling: a case study

S.-W. Lee
Geotechnical Engineering, 2002, **155**, No 2 (April), 101–109.

At the London Docklands Light Railway Lewisham Extension (DLR-LWE) twin tunnelling project, compensation grouting was carried out beneath sensitive structures to prevent excessive settlement due to tunnelling. However, excessive grout injections might exert extra loads on the tunnels underneath. This issue has become a major concern for tunnelling and grouting contractors after a report by the UK's Health and Safety Executive in 2000, which listed grouting force as one of the possible factors that might have caused the collapse of the London Heathrow Express tunnels in 1994. This paper presents the extensive field monitoring data compiled by the tunnelling contractor on surface and building settlements as well as tunnel lining deformations caused by compensation grouting. It will be shown that the final corrected building settlements, incorporating compensation grouting, were about 5 mm. In the case of greenfield settlement the maximum observed settlement was less than 15 mm, a criterion specified by London Underground Ltd. The settlement trough parameters were found to deviate slightly from the proposed ones, probably because of the layered ground conditions. Field monitoring data revealed that the ground disturbance caused by the first tunnel construction had resulted in more ground settlement during the construction of the second tunnel. It was difficult to understand the observed modes of tunnel lining deformations caused by compensation grouting, owing to the monitoring techniques used and the layered ground conditions. Nevertheless, the maximum observed tunnel diameter change was only 8 mm, less than 1% of tunnel diameter change. In conclusion, the surface and building settlements as well as the tunnel lining deformations were all within the criteria specified by London Underground Ltd. This indicates that the tunnelling contractor had carried out good tunnelling work.

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Foundation design for the refloat of the Maureen steel gravity platform

P. Broughton, R. L. Davies, T. Aldridge, T. Carrington
Geotechnical Engineering, 2002, **155**, No 2 (April), 111–118.

The Maureen Oil Field, located in the UK sector of the North Sea, was developed in the early 1980s, with the installation of the world's largest steel gravity platform, together with the installation of an export pipeline to an offshore concrete articulated loading column. Production in the field ceased in October 1999, and the facilities at the Maureen location were removed in the summer of 2001 as part of the decommissioning process. The largest element for removal and decommissioning was the steel gravity platform of about 1100 MN (110 000t). This paper describes all the geotechnical engineering works, associated with the hydraulic skirt extraction/jacking of the gravity platform from the seabed, which were executed prior to the refloat and tow of the platform to deep water inshore moorings, together with a summary of results from the actual skirt extraction/jacking process, which was executed in June 2001.

Briefing: What is the matter with geotechnical engineering?

J. Atkinson
Geotechnical Engineering, 2002, **155**, No 3 (July), 155–158.

In this essay the author argues that education in the basic theory of structures, hydraulics and geotechnics is being neglected in favour of training in the practical aspects of geotechnical engineering and an over-reliance on design codes and standards.

Three-dimensional effects in the construction of a long retaining wall

S. Gourvenec, W. Powrie, E. K. De Moor
Geotechnical Engineering, 2002, **155**, No 3 (July), 163–173.

Although long retaining walls are usually analysed in the permanent condition by means of a plane strain analysis, three-dimensional effects may be significant in limiting ground movements at certain stages during construction. This is particularly true for embedded diaphragm-type retaining walls propped at formation level. In this paper, a three-dimensional finite element analysis representing a typical construction sequence for such a wall is compared with a corresponding plane strain analysis and field data from the A4/A46 Batheaston–Swainswick bypass. The results are used to assess the significance of three-dimensional effects during construction, and suggest how these can be utilised to minimise ground movements.

A comparison between tube-a-manchette and lance grouting to assist tunnel excavation through chalk

T. G. Newman, J. L. Ingle
Geotechnical Engineering, 2002, **155**, No 3 (July), 175–186.

A road tunnel 13·5 m in diameter and 800 m long has recently been constructed, through chalk, as part of the Ramsgate Harbour Approach Road Scheme. For the first time in the United Kingdom tunnelling has involved primary support being provided by a system of prevaults followed by the installation of an unreinforced concrete lining. This paper describes how an iterative grouting solution was evolved in response to unstable ground conditions during the early phases of tunnelling. As the tunnel drive progressed, and greater knowledge of the engineering behaviour of the chalk was gained, decisions were made to carry out trial injections using the tube-a-manchette and lance methods. These were installed from the surface in areas where it was perceived that future problems might occur. A comparison is drawn between the efficiency and relevance of the two systems in the ground conditions encountered on site.

Retaining walls built with scrap tyres

A. S. F. Sayão, L. V. Medeiros, A. C. C. F. Sieira, D. M. S. Gerscovich, and V. K. Garga
Geotechnical Engineering, 2002, **155**, No 4 (October), 217–219.

A technique for building gravity retaining walls using scrap tyres is presented. This technique has been used successfully for stabilising natural slopes in Brazil. Experience with a 60 m long, 4 m high soil-tyre retaining wall in Rio de Janeiro is documented. The wall was built in horizontal layers, with scrap tyres tied together with rope or wire and filled with available local soil. Construction was monitored by displacement guages and pressure cells in four cross-sections with different materials or dimensions for the wall. A 2 m soil surcharge was placed on the backfill, and the displacement responses at the four sections were compared. It is shown that the soil-tyre wall can be considered as an attractive alternative for slope stabilisation, because it combines the mechanical strngth of tyres with the low cost of building materials such as local soil and scrap tyres.'

Groundwater control for construction in the Lameth Group

M. Preene and T. O. L. Roberts
Geotechnical Engineering, 2002, **155**, No 4 (October), 221–228.

Excavations in the Lambeth Group often encounter groundwater problems. This is related to the variable nature of the Lambeth Group soils and the presence of permeable water-bearing layers of sand, silt and gravel, where groundwater inflows can lead to instability. The permeability of the water-bearing layers can vary within a wide range. The pore water pressure and associated piezometric head in each layer can be difficult to predict, as the piezometric profile may diverge from the hydrostatic, under the influence of underdrainage from the Chalk Group and Thanet Sand formation, which forms the lower aquifer beneath the Lambeth Group. Stability of excavations can be improved by using groundwater control techniques to reduce pore water pressures in permeable layers. Suitable methods, inluding active and passive pressure relief and underdrainage are discussed, and case histories presented.