

**VISCOPLASTIC MODELLING OF EMBANKMENTS ON SOFT SOILS**

by

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## DECLARATION

I hereby declare that this submission is my own work and to the best of my knowledge it contains no material published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at UNSW or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by colleagues, with whom I have worked at UNSW or elsewhere, during my candidature, is fully acknowledged.

I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation and linguistic expression is acknowledged.

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## ABSTRACT

A major instrumented geosynthetic reinforced approach embankment was constructed to 5.5 m elevation above ground, with prefabricated vertical drains, over a soft compressible clay deposit at Leneghan, Newcastle, Australia in May 1995. The field monitoring of settlements for over six years shows that the embankment manifests significant creep. The instrumentation, field performance and the finite element analyses for predicting the long-term performance of this embankment are described in this thesis.

The maximum settlement of 1.1 m was observed one year after the completion of construction. However, the embankment continued to settle at a rate of 0.4 mm/day for the next 5 years. The horizontal displacements of 0.09-0.14 m at various locations and the maximum reinforcement strains of 0.67% were recorded.

A numerical model was developed to perform a fully coupled large deformation elasto-viscoplastic finite element analysis for this performance prediction based on creep model proposed by Kutter and Sathialingam (1992). The foundation soil was modelled with creep material behaviour using six noded linear strain triangular elements. A well-documented case history – Sackville embankment, New Brunswick, Canada was analysed using this model as a benchmark problem and the model was found to predict all the behaviour characteristics reasonably well.

The results obtained from finite element analysis using this model are shown to be in reasonable agreement with the observed performance of Leneghans embankment in terms of settlements, horizontal displacements, excess pore pressures and geosynthetic strains. But, the prediction of settlements was less than satisfactory beyond April 1999.

Finite element analyses were performed to study the sensitivity of this embankment behaviour on the variation of hydraulic conductivity values and geosynthetic reinforcement properties. This sensitivity study indicated that the  $k_v$  variation, the  $k_h/k_v$  ratio and the nominal values of geosynthetic properties adopted in the benchmark analysis are reasonable enough for the long-term behaviour prediction.

**DEDICATION**

to my family

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