Congress on Numerical Methods in Engineering
Lisboa, June 29 to July 02, 2015

RESUMO N° 33

NUMERICAL SIMULATION OF CONSOLIDATION IN LAYERED SOILS UNDER VARIABLE LOADS

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Keywords: Soil Consolidation, Numerical Solution, Settlement, Network Method

An efficient and reliable model based on electrical analogy is presented for the simulation of consolidation processes in layered soils. The numerical simulation of the network model, a standard method whose application is already extended to other engineering fields, takes advantages of the powerful computational algorithms that are implemented in the simulation codes of electric circuits which are capable of solving sharp non-linear processes with relatively small computational times. The proposed model is applied for the solutions of transient and steady state settlements for soils under constant and time dependent loads. The numerical and analytical solutions are successfully compared for the problem of one layer soil.

The design of the model starts from the finite difference equation that derives from the spatial discretization of the partial differential equation of soil consolidation. As all the terms of the equation are linear, they are implemented by simple electrical components (resistors or capacitors) allowing a direct numerical calculation. By using a suitable analogy between geotechnical and electric variables (effective pressure and electric potential), the terms of the equation are considered as currents that converge in the only node of the network where they are balanced according to the topology of the equation. The potential in the node adjusts providing the pressure solution in order that the balance is fulfilled. Heterogeneities are assumed in the model by defining successive layers while variables (time dependent) loads are introduced by defining explicit (linear or non-linear) or piece-wise functions as the output of voltage generators that are implemented by software. Numerical simulation provides (time dependent) settlements and effective pressures with errors below 1% in each cell for grids of the order of 50 volume elements.