

Performance-based design in geotechnical engineering

A reprise of the 52nd Rankine Lecture

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ABSTRACT

Engineering design consists of a sequence of decisions which should satisfy the client's objective performance requirements. This lecture will argue that an assessment of geotechnical performance must involve ground displacements, and that the traditional approach of specifying safety factors is potentially wasteful. In particular, the Limit State Design (LSD) approach adopted in the Eurocodes will be shown to lack objectivity and therefore to be inadequate to the needs of clients and society at large. Improvements will be proposed through the adoption of Mobilizable Strength Design (MSD) principles in which the designer explicitly considers the stress-strain behaviour of the ground.

Central to the MSD approach will be an assessment of the possible deformability and strength of the soil that lies within the anticipated deformation mechanism of the proposed geo-structure. Displacements are then calculated by applying the principle of conservation of energy to the deformation mechanism. This leaves the designer with an implicit assessment of deformations before any other checks which might later be made by Finite Element Analysis (FEA), and ensures that the intended design performance can always be checked by monitoring during construction. Examples of the application of MSD will include earth retaining structures, slopes and foundations.

Malcolm Bolton is Professor of Soil Mechanics at Cambridge University, and has been Director of the Schofield Centre for Geotechnical and Construction Modelling since 1995. He is currently Head of Civil, Structural and Environmental Engineering. He is a Fellow of the Royal Academy of Engineering and holds various prizes of the UK Institutions of Civil and Structural Engineering, and the British Geotechnical Association. He was founding chairman of the ISSMGE Technical Committee on Geo-Mechanics from Micro to Macro (GM3). He has collaborated on piles with the Giken company of Japan for 17 years, and is the founding chairman of the International Press-In Association. He served on the Slope Stability Technical Review Board for the Hong Kong Government, and acts as a consultant in relation to soil-pipeline interactions on the sea bed. He helped to draft BS8002 Earth Retaining Structures, and has over 200 publications on topics ranging from fundamental soil mechanics to a wide variety of geotechnical engineering applications.