The Maurice A. Biot Lecture

Department of Civil Engineering & Engineering Mechanics, Columbia University
Engineering Mechanics Institute, ASCE

Plastic Behaviors of Geomaterials and Their Application to Static and Dynamic Problems

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November 21, 2023 (2-3 pm)
644 S.W. Mudd Building

Abstract: Biot developed a theory for fluid saturated porous media. Applying Biot theory, elasto-plastic analyses for both static and dynamic problems of geomaterials are carried out via finite element methods. For static problems, dynamic relaxation methods are applied. Special considerations are given to element types, with anti-hourglass scheme, to avoid both shear and dilatancy lockings. Constitutive models developed for geomaterials contain non-associated strain hardening-softening elasto-plasticity. A strain softening material model is used with the features of post-peak strain-localization into a shear band with a specific width. Visco-plastic (new Iso-tach model and TESRA, temporary effect of strain rate and acceleration) models are also developed. The consolidation analyses of sequential excavation and setting-up of struts for sheet piles in soft ground are carried out. Dynamic progressive failure analysis of small embankment dams of dry sand on shaking table is carried out. The computations of existing fill-type dams are also carried out by total stress elasto-plastic constitutive model and effective stress constitutive model by taking into account the pore water pressure build-up. The developed models are successfully validated with the field measured response.

Biosketch: Professor Tadatsugu Tanaka received his BS degree in Agricultural Engineering from the University of Tokyo in 1968, and Doctor of Agricultural Sciences degree from University of Kyoto in 1977. Before taking up his position at Meiji University in 1988, he was a research engineer at National Research Institute of Agricultural Engineering. He was a professor of Biological and Environmental Engineering at the University of Tokyo (1999-2009). His research involves hydraulic structures, geotechnical engineering, including application of computer methods to geomechanics. He was a member of Science Council of Japan and past president for various organizations: Japanese Society of Irrigation, Drainage and Reclamation Engineering (2004), President of Japan Association of Rural Solutions for Environmental Conservation and Resource Recycling (2006), and Japanese Society of Dam Engineering (2012). He has published over 150 technical papers in refereed journals and international conference proceedings. He co-authored the book “Three-Dimensional Elastoplastic Analysis in Geomechanics”. He was the recipient of awards from several organizations, including the Japanese Society of Irrigation, Drainage and Reclamation Engineering, Japanese Geotechnical Society, Japan Association of International Commission of Agricultural and Biosystems Engineering, Japanese Dam Engineering, PAWEES 2011 International Award, and Japan Prize of Agricultureal Sciences. Professor Tanaka continues to serve in various technical committees under the Ministry of Agriculture, Forestry and Fisheries.

The Maurice A. Biot Lecture was established at Columbia University in 2004 in remembrance of the late Professor Maurice Anthony Biot and his renowned achievements as an engineer, physicist, and applied mathematician. Biot was a professor of mechanics at Columbia University in the period 1937-1945.