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# Geomechanics for Energy and the Environment

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## Preface



Tomasz Hueckel celebrates his 70th birthday on 29 December 2015 and this issue of *Geomechanics for Energy and the Environment* is dedicated to him by his friends, former students, and colleagues with great affection and admiration.

The issue contains articles based on presentations given at the Special Session dedicated to Tomasz's anniversary, organized by D. Bigoni, A. Gajo, L. Laloui, G. Maier, Z. Mróz and S. Pietruszczak within the CERMODEL2015 congress, held in Trento, Italy, July 1–3, 2015. The papers have been mostly authored by Tomasz's former students, collaborators and colleagues. We are grateful to them for their enthusiastic participation.

Special thanks go to Lyesse Laloui, co-Editor of the Journal, as without his support and enthusiasm this special issue would not have been possible. We are also grateful to the publishers for their collaboration and to the EU research project PIAPP-GA-2013-609758-HOTBRICKS for sponsoring this issue.



Tomasz Hueckel

Tomasz Hueckel was born in 1945 in Gdańsk, Poland to Zofia and Stanisław Hueckel, who moved there right after the world-war II had ended. His father was a maritime harbor engineer, who joined the effort of rebuilding two destroyed Polish harbors of Gdańsk and Gdynia. He became later a leading academic figure of the town, first a professor at University Politechnic of Gdańsk, and later its Rector, then Director of the Hydro-engineering Institute of the Polish Academy of Sciences. Tomasz grew up in an engineering family, as his brother, Krzysztof, also graduated from Gdańsk Polytechnic as an architect. Tomasz remembers his parents and his childhood with a great fondness. In high school he was interested in archeology, history, journalism and ran a school monthly magazine and a satirical cabaret.

He enrolled and graduated from the Gdańsk Politechnic in Civil Engineering in 1968 with a Master Thesis on "Bending Theory of Hyperbolic Paraboloid Shells". After spending the next two years at the Politechnic as a reader, he left Gdańsk to join the Institute of Fundamental Problems in Technology of the Polish Academy of Science in Warsaw, Poland (or IPPT PAN), which developed a world-renowned school of applied mechanics, with a strong group in plasticity theory, led by Professors Mróz, Olszak, Perzyna, Raniecki, and Sawczuk. Visitors from all over the world to the Institute in those days included: Z.P. Bažant, T. Belytchko, D.C. Drucker, G. Dvorak, G. Fichera, P. Germaine, P.G. Hodge, H.G. Hopkins, G. de Josselin de Jong, J. Kerisel, W.T. Koiter, J. Kravtchenko, E.H. Lee, G. Maier, J. Mandel, S. Nemat Nasser, E.T. Onat, W. Prager, M. Reiner, J.R. Rice, R.S. Rivlin, J. Salençon, P. Wroth, O.C. Zienkiewicz, and many other influential individuals of mechanics of materials of the day. This was a perfect environment for an intellectual growth.

In 1974 Tomasz defended at the Institute of Fundamental Problems in Technology (or IPPT PAN) of the Polish Academy of Science in Warsaw his Ph.D. thesis on some boundary value problems in elasto–plasticity of materials of variable density and development of the idea of elasto–plastic coupling, with Professor Zenon Mróz as

advisor. During the work on the thesis Tomasz had also collaborated with his colleague and friend, experimentalist Andrew Drescher, now Professor Emeritus at University of Minnesota, Minneapolis. The subject of elasto–plastic coupling has re-surfaced several times in literature, in joint work with Davide Bigoni (1991) and then by Bigoni Piccolroaz and Gajo (2006–2008), and even in the context of anisotropic hardening of metals.

In 1975 Tomasz spent 12 months at the Politecnico di Milano as a post-doc fellow of the Italian CNR (Consiglio Nazionale delle Ricerche) under the supervision of Professor Giulio Maier. They worked on conditions of uniqueness and stability of elasto–plastic materials with soil/rock – like strain softening and non-associative flow rule, including elasto–plastic coupling.

Between 1976 and 1981 Tomasz worked on cyclic behavior of soils and rocks in different contexts. First, on soils in a series of papers with Roberto Nova (of Milan) on what they called ‘para-elasticity’, which is an approach through piece-wise hyperelasticity spanned between consecutive stress reversal points with an extra irreversible strain accumulating over the cycles. One of the applications of these developments was to liquefaction of sands and cyclic mobility. Interestingly, the concept of para-elasticity has been resurrected and improved after 30 years by Niemunis et al. (2011), of Karlsruhe. With Zenon Mróz and Andrew Drescher, Tomasz worked also on rock-bursts. This was meant to be a short, consulting stint for them, but resulted in being a fascinating mechanical issue and of a great value for the copper mining industry in Poland, which requested the study and which was plagued with mine explosions, that they did not understand. A criterion of a critical state of the mine pillars that they have developed continues to be used even now.

On the private side, Tomasz married Małgorzata (Margaret) Walicka in 1980 in Warsaw. 40 days before the introduction of the Marshall law in Poland on December 13, 1981, Tomasz and Margaret left Poland heading to Rome. They spent there 2 years, Tomasz working at a Rome outpost of the Polish Academy and at the same time at the University of Rome ‘La Sapienza’, continuing the work on cyclic loading with Professors Giovanni Calabresi and Laura Cavalera. The Hueckels’ daughter Julia, now a lawyer in New York, was born in Rome in 1983. Later in 1983 they moved to Bergamo, Italy, where Tomasz obtained a position at industry, namely at ISMES (originally ‘Istituto Sperimentale Modelli e Strutture’), which was associated with ENEL, at that time a state owned energy monopoly in Italy. He was at the same time a Graduate Professor ‘a contratto’ at Milan’s Polytechnic. At ISMES, he developed with his colleagues (A. Peano, G. Baldi, M. Borsetto and R. Pellegrini) a unique experimental database and a mathematical model of thermo-plasticity for clays in the context of the Italian National Program of Radioactive Refuse Disposal. The experimental data set is still intensely used today, while the model became a standard, which many subsequent authors developed further.

In 1985 Tomasz received a degree of Docteur d’État at the University Polytechnique of Grenoble, France, necessary at that time to obtain an academic position in France,

which was the Tomasz’s plan of the moment. This did not work out, however, and he accepted in 1986 a position of Associate Professor at Duke University at Durham, NC at the Department of Civil and Environmental Engineering, where he works to this day. At Duke, he continued his interest in non-associative and coupled elasto–plastic laws for geomaterials, and the related stability and non-uniqueness issues, working from 1988–1991, with a doctoral student from Italy, Davide Bigoni, now professor at the University of Trento, Italy. He also continued working on the issues of thermo-mechanics of clays on grants from ISMES, with Alberto Peano and Rita Pellegrini of ISMES, and his student Chenmin Ma, but also on the anisotropic elasto–plastic coupling, with E. Tutumluer, and G. Samuelli.

At Duke Tomasz then developed interest in chemo-mechanical coupling, starting from 1990, seeing how much chemical reactions and physico-chemical changes affect the mechanical properties of geomaterials, and hence their behavior. This included work supported by ISMES, on changes in ionic content of clay pore water (Kazimierz Wielki University at Bydgoszcz, Poland, also with Loret and Gajo, 2001); as well as in dissolution and/or precipitation with two-way chemo-mechanical coupling (with Liang Bo Hu, 2007–2009, Matteo Ciantia et al., 2013–2015 and Gajo and Cecinato, 2014–2015). Recent work in that line of research concerns subcritical crack propagation enhanced by chemical softening (with Manman Hu, 2013–2015).

Most recent Tomasz’s interest is in drying of soils (and porous media in general). That includes work with Lyesse Laloui (Lausanne), Liang Bo Hu (Toledo, OH) and Hervé Peron (Lausanne) with a physically based prediction of shrinkage for non-clayey soils, and a criterion for drying cracking. It appears that soil cracking can be directly linked to the air entry, if soil is constrained against shrinkage. This latter result comes from a combined effort out of an experimental study on evaporation of capillary bridges, with Said El Youssoufi and Bolo Mielniczuk (2012–2015) of the University of Montpellier-2. They have discovered that suction in evaporating capillary bridges is very modest and convert into positive pressure prior to bridge rupture.

Tomasz has often acted as a Visiting Professor at Ecole Polytechnique, Paris-Palaiseau, Ecole Nationale Polytechnique de Grenoble, University of Liege, Polytechnic University of Catalunya (UPC), Barcelona, University of Athens, Federal Institute of Technology of Lausanne (EPFL), University of Minnesota, University of Montpellier-2, University of Trento and his alma mater University Polytechnic of Gdańsk.

In 2008 he received John Booker’s Medal from The International Association of Computer Methods in Geomechanics ‘for pioneering work in the area of Environmental Geomechanics, in particular for his seminal papers on thermo-plasticity of geomaterials and on chemo-mechanical coupling’. He was Warren Lecturer (thrice) at the University of Minnesota. He was 2011 Special Lecturer at, and received a Research Medal, from ALERT- Geomaterials.

Tomasz is also a passionate lover of art, enjoying art in all its forms. Quite recently he has revealed his own artistic

talent, kept hidden for nearly sixty years. His first self-portrait dates back to when he was twelve, but was only shown to the public during his presentation at the special session at Cermodel 2015. He developed a very original form of artistic composition based on cutting thin metal foils for obtaining colored drawings, often populated by fantastic beings. Those of us who have the good fortune to

know him are full of admiration for Tomasz's scholarship, creativity, and friendship.

*Guest Editors*  
Davide Bigoni  
Alessandro Gajo

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