Obituary: Nicholas Neocles Ambraseys 1929-2012

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Obituary for Géotechnique

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Nicholas (Nick) Ambraseys was born in Athens (Greece) on 19th January 1929 and died peacefully at his home in Putney (London, United Kingdom) on 28th December 2012 at the age of 83.

Nick Ambraseys attended the National Technical University of Athens, receiving his diploma in Rural Engineering in 1952. Following this and service in the Royal Hellenic Navy, he moved to Imperial College in London to study in the Soil Mechanics section of the Department of Civil Engineering for his Diploma of Imperial College and later his PhD, which he was awarded in 1958. During this period Nick's work was supervised by Profs Alan Bishop and Alec Skempton, through whom he became involved with the analysis of large dams then under construction in the Himalayas (e.g. at Mangla, Pakistan). Nick's PhD thesis was entitled 'Seismic stability of earth dams', in which he developed the theory and practice of elastic response analysis of earth dams to earthquake dynamic loading. He also introduced the concept of permanent displacements into geotechnical slope analysis. The concept of permanent displacements was later developed further by Nathan Newmark, with whom Nick, collaborated after his thesis, into what is now known as the sliding-block technique. This approach was described in Newmark's Rankine lecture in 1965. The linear elastic solution of dam response (or one-dimensional shear beam analysis) was expanded by Sarada Sarma, first of many PhD students supervised by Nick, and jointly published in volume 17 of Geotechnique. This paper was awarded the British Geotechnical Society Prize. Nick had a strong grip on mathematics and, perhaps more importantly, the physical implications of mathematical solutions. This was evident in his early papers and in his later studies on liquefaction of soil layers and subsequent post-seismic dissipation of pore-water pressures. His intrinsic understanding of soil properties, both as equivalent-linear elastic and non-linear inelastic materials, was abundantly clear. He first promulgated the idea, and put into words during an invited lecture at the Fifth World Conference on Earthquake Engineering in Rome in 1973, that the seismic inertial force on structures is controlled by the strength of foundation materials. Before this, it was taken for granted that structures on weaker soil foundations

should be designed for stronger forces, while in reality, weaker soils limit the inertial force on the structures at the expense of permanent deformation of the foundations. His love for and use of simplified analyses, like the sliding-block technique, was evident in several ground-breaking papers. His ability to find fitting analogies for complex phenomena was also to be found in his conversation. For example, he compared the behaviour of particles undergoing soil dilatancy to the behaviour of commuters all struggling to get off a packed Tube (London Underground) train. Recognising his contribution to geotechnical earthquake engineering and engineering seismology, Nick was invited by the British Geotechnical Society to deliver the 44th Rankine lecture entitled 'Engineering Seismology and Soil Mechanics' in 2004.

Following a few years at universities in Greece and in the United States of America he returned to Imperial College and remained there until his death. He was made Professor of Engineering Seismology in 1974. In 1968 he established the Engineering Seismology section in the Department of Civil Engineering and from 1971 to 1994 he led this section. In 1994 he officially retired from this position but he remained very active as an Emeritus Professor and his publications continued at an undiminished rate. Even during the last few months of his life he continued working and collaborating on various research topics, including the stability of ancient Greek columns.

While working on the Mangla Dam project, he began studying historical accounts of earthquakes, particularly those that had occurred in the eastern Mediterranean region, stretching from the Balkans all the way to the Himalayas. It is in this field where he arguably made his greatest contributions. His meticulous study of historical documents on earthquakes that occurred in the eastern Mediterranean and elsewhere (e.g. Central America) is second-to-none and he published many dozens of articles and books on this painstaking work. In 2009 his *magnum opus* on eastern Mediterranean seismicity (entitled 'Earthquakes in the Mediterranean and Middle East: a multidisciplinary study of seismicity up to 1900'), comprising almost 1000 pages, was published by Cambridge University Press.

Since he remained, at heart, an engineer he continued working on: geotechnical earthquake engineering studies, the assessment of earthquake ground motions and various other topics, in addition to undertaking research on historical-described and instrumental-recorded earthquakes. Nick made significant advances in the collection and analysis of strong-motion (accelorometric) data. He started the routine collection, processing and assessment of these data and associated parameters (metadata) in 1971. In those days collection and use of strong-motion data was difficult, time consuming and uncommon due to analogue instruments and the lack of electronic communications to facilitate data transfer but through Nick's contacts and tenacity the collection of data grew. This task continued through various projects and initiatives from the 1970s to early 2000s. It culminated with the publications in 2000 and 2004 of freely-available CD ROMs of strong-motion data and their reassessed parameters and in 2002 the establishment of the Internet Site for European Strong-motion Data. Often through his supervision of postgraduate students, he returned in later decades to problems in geotechnical earthquake engineering, particularly slope stability and liquefaction. For example, in the late 1980s and early 1990s he published various articles on earthquake-induced ground displacements providing predictive equations that are still used in practice today. Also in general use, are his equations to predict the maximum distance at which liquefaction may occur, presented in the inaugural biennial Mallet-Milne Lecture (organised by the UK's Society for Earthquakes and Civil Engineering Dynamics) in 1987.

In all his activities he sought to act as a bridge between earth sciences and engineering and between research and practice. These studies were enlightened by the knowledge and insights he gained during dozens of post-earthquake field missions in various parts of the world, many of which were under the aegis of UNESCO. These missions led to a series of reports that had an impact on the reconstruction of the cities affected (e.g. Skopje and Managua). He was awarded in 1998 the Freedom of the City of Skopje in recognition of the field work that he

undertook in the aftermath of the devastating 1963 Skopje earthquake and the advice that he provided to the local authorities. His great ability with languages (fluent in three or four and comprehension of many others) facilitated all of these works and helped sustain good contacts with people of many nationalities. His vast experience of practical earthquake problems was put to good use through consultancy for large-scale engineering projects, such as dams and bridges in seismically active regions.

In recognition of his lifetime of achievements and his ability to cross over disciplines, he received fellowships from prestigious institutions in both engineering and earth sciences. For example, he must be one of a very small group to have been a fellow simultaneously of: the Royal Academy of Engineering, the Institution of Civil Engineers, the Geological Society and the Royal Geographical Society. He also accumulated various awards, again both in engineering and earth science, e.g.: the Busk Medal for Scientific Discovery from the Royal Geographical Society (1975), the Mercenary Award of the European Association of Earthquake Engineering (1975) and the Harry Fielding Reid Medal of the Seismological Society of America (2006). From his election in 2003, he was one of only two members from engineering of the First Section of the Academy of Athens and he divided his time between London and Athens.

His great scholarship, practical insight and wisdom were best demonstrated during relaxed discussions in small groups, often accompanied by him cleaning and refilling his pipe. Although learned and with a serious air, he peppered his conversation with interesting and amusing asides, anecdotes and observations. He had a mischievous sense of humour, which is demonstrated by his love of the films of Jacques Tati, in particular Les Vacances de Monsieur Hulot.

Nick Ambraseys contributions to engineering seismology and (geotechnical) earthquake engineering were immense, wide-ranging and spanned almost 60 years. The worldwide community in these fields owe him a great debt and he will be greatly missed. He is survived by his wife, Xeni.

Key references (a complete list of publications is available at: http://cires.colorado.edu/~bilham/NicksPubs/NicksPubs.html)

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