ANESTIS S. VELETSOS
1927–2018
Elected in 1979

“Contributions to advancement in structural dynamics and earthquake engineering, especially in inelastic behavior and soil-structure interaction.”

BY JACOBO BIELAK AND JOSÉ M. ROESSET

ANESTIS STAVROU VELETSOS, one of the legends of structural dynamics and earthquake engineering, passed away peacefully in Houston surrounded by his family on October 25, 2018. He was 91 years old.

Dr. Veletsos was the Brown & Root Professor in the Department of Civil Engineering at Rice University from 1964 to 2009, and chaired the department from 1964 to 1972. He was a distinguished adjunct professor at the University of Houston (2010–13), and earlier in his career was professor of civil engineering at the University of Illinois at Urbana-Champaign, where he also served on the university’s Center for Advanced Study. He held visiting appointments at the University of California, Berkeley, and at universities in Brazil and India. In addition, he was an active consultant, served on a multitude of advisory panels and boards, and lectured extensively in different parts of the world.

Andy was born of Greek parents on April 28, 1927, in Istanbul, Turkey. He attended the famous Robert College, an American university where Karl Terzaghi taught. In 1948 he graduated with highest honors, earning a bachelor’s degree in civil engineering. He was granted full scholarship to attend the University of Illinois at Urbana-Champaign, where he earned
master’s and PhD degrees in 1950 and 1953. Upon graduation he joined the faculty and became a full professor in 1960.

He did seminal research in all areas of structural dynamics and earthquake engineering involving structures, soils, and foundations as well as tanks filled with fluid or granular materials. In the 1950s and early 1960s, under a project sponsored by AASHTO (the American Association of State Highway Transportation Officials), he conducted the most comprehensive studies to date on the response of bridges to moving loads, combining the development and verification of analytical and computational procedures with experimental work.

In the 1960s he published a number of groundbreaking papers on the linear elastic and nonlinear response of single-degree-of-freedom systems to seismic excitation. He explained how the nonlinear behavior could be understood as a reduction in the stiffness, and thus the natural frequency, of the system and an increase in the energy dissipation or damping. His paper with Nathan Newmark in 1961 on inelastic response spectra, showing how to construct them depending on the relation between the natural frequency of the system and the frequency content of the earthquake, became the basis for seismic design codes adopted all over the world. The importance of this work is clearly illustrated by the fact that it has been repeated many times, sometimes with small variations, other times in almost identical form, but rarely with the clear and meaningful interpretation of the original work.

In the 1970s Andy conducted a series of studies on the dynamic response of foundations and the effect of the foundation on the dynamic, and particularly the seismic, response of a structure. He started with an exact solution for the horizontal and rocking stiffness of a circular foundation on the surface of a linear elastic half space, first obtaining accurate solutions shown in graphs and then approximate expressions and tables that could be used in engineering practice, with the curves corresponding to these expressions plotted with the exact solutions to show their validity. He explained the meaning of the real part of the solution and its variation with frequency as representing the effects of stiffness and inertia (leading to
equivalent models with a spring and a mass proposed by later authors) and the imaginary part as representing the loss of energy by radiation of the waves away from the foundation. He proceeded with the determination of the dynamic stiffness of foundations under vertical and torsional excitations and with the solution for a viscoelastic foundation.

His work on seismic soil-structure interaction, elucidating the effect of foundation flexibility on the response of the structure, showed how, again, the effect could be understood as a reduction in the effective stiffness of the system and a potential increase in the energy dissipation. While some authors assumed that the effects would always be beneficial, reducing the forces in the structure (something that was generally true when dealing with very stiff nuclear power plants and the typical smooth design spectra of the regulatory guides), Andy explained that this would not always be true: whether the effects were beneficial or detrimental depended on the relation between the natural frequencies of the system and the frequency content of the earthquake.

The response of rigid and flexible retaining walls to seismic excitation was another topic in which Andy’s work represented a significant contribution, allowing comparison of analytical solutions with those resulting from the Mononobe-Okabe method commonly used in practice and to study the effect of various parameters.

Following the example of George Housner, Andy conducted a number of studies on the seismic response of tanks filled with fluid (e.g., liquefied gas) or granular material. His studies revealed the difference between the hydrodynamic forces created by a fluid inside a tank and those due to a fluid surrounding the tank.

His research over the years improved understanding of the responses of structures and structure-foundation systems to various forms of dynamic excitation, and led to practical methods of analysis and design for such systems. Two essential characteristics of his work are that it always combined exact analytical solutions with the derivation of simplified but accurate methods that could be used in practice, and
his explanations were presented with exceptional clarity. He authored or coauthored more than 140 publications, mostly in structural and foundation dynamics and earthquake engineering, and his findings had a tremendous influence on the practice of earthquake engineering.

For his pioneering work in structural dynamics and the dynamics of soil-structure and fluid-structure interaction he was recognized with numerous prestigious honors. From the American Society of Civil Engineers (ASCE) he received the Norman Medal (1958 and 1990), Walter L. Huber Civil Engineering Research Prize (1961), Nathan M. Newmark Medal (1978), Ernest E. Howard Award (1990), Raymond C. Reese Research Prize (1993), and Theodore von Karman Medal (2001). He also was selected for the George W. Housner Medal (1997) of the Earthquake Engineering Research Institute, the institute’s highest honor, given in recognition of sustained leadership and contributions to earthquake engineering and earthquake risk mitigation. He was elected to the NAE in 1979 and served on several committees, including the Earthquake Engineering Research Committee (1981–83), Committee on Computational Mechanics (1981–84), and Academic Advisory Council (1995–98); and he was a member of the Texas Academy of Medicine, Engineering, & Science and an honorary member of ASCE. He also received an honorary doctorate from the University of Patras in Greece. Throughout his career, Andy found no more gratifying professional experience than recognition from his peers and organizations that he admired and respected greatly.

In addition to his abilities as a researcher, Andy was an extraordinary teacher with the same outstanding clarity in his class lectures and oral presentations. With his students he was exacting but patient, and sought to ensure that all clearly understood the principles behind their research.

Notwithstanding his accomplishments and honors, he was a very modest and wonderful human being who spent considerable time mentoring younger researchers. He derived great pleasure from his interactions with his talented students and valued colleagues.
To convey the esteem in which Andy was widely held, we quote here from the tributes of various colleagues on the occasion of Andy’s passing.

Reginald DesRoches, the William and Stephanie Sick Dean of Rice University’s George R. Brown School of Engineering: “A handful of people have transformed the field of earthquake engineering over the past century. Andy was certainly one of them, a true giant in the field.”

Anil K. Chopra, a world-renowned expert in structural dynamics and earthquake engineering: “[E]very...paper he published [was] enlightening intellectually and a stellar example of what a journal paper should be.... I wish to express my deep appreciation to Andy Veletsos for his influence on my professional growth. Through his research, writing, and lectures, he influenced my teaching and research philosophy.... Andy Veletsos’ death marks the passing of a giant in earthquake engineering. But he will live on through his writings and many PhD students from all over the world.”

Guillermo D. Hahn, who studied under Andy to earn his MS and PhD in civil engineering at Rice: “The significance of Professor Veletsos’ engineering contributions cannot be overemphasized, and his research and accomplishments truly speak for themselves. Equally, I cannot overemphasize the value and preciousness of his contributions in the classroom, the office, and beyond—educating, guiding, and interacting with students and colleagues through teaching and research. It is remarkable that Professor Veletsos is able to motivate and activate your thinking and mobilize your spirit and soul.”

Jethro W. Meek: “Dr. Veletsos was internationally regarded as one of the greatest authorities in the area of structural dynamics—one may count his equals on the fingers of one hand! Such ‘academic giants’ are in many cases just as well known for their arrogance and inflated egos as for their scientific accomplishments. Not so Dr. Veletsos. He was a man sure enough of his worth that he was the very model of humility and friendliness.”

Andy’s greatest joy outside of his profession was being with his family. He is survived by his devoted wife of 52
years, Katherine (née Economou), daughters Ann Marie and Melinda, and four grandchildren.

In conclusion, as Jethro Meek wrote, “I like to believe that when one stands before the Pearly Gates, St. Peter will ask only one question, ‘Did you give more than you took?’ Andy, in his humble way, would probably reply, ‘I don’t know—but I did my best.’ And then St. Peter would certainly answer, ‘Nonsense, Andy—come right on in. Of late there’s been a disturbing vibration in these Pearly Gates, and you’re just the expert on structural dynamics we need to fix them!’”