Robert V. Whitman

ROBERT V. WHITMAN

1928–2012

Elected in 1975

"For pioneering in soil dynamics, especially in predicting and controlling earthquake effects on constructed facilities."

BY CHARLES C. LADD

ROBERT V. WHITMAN, professor emeritus of civil and environmental engineering at the Massachusetts Institute of Technology (MIT), died of Parkinson's disease on February 25, 2012, at his home in Lexington, Massachusetts, at age 84. He was world-renowned for his expertise and leadership in soil dynamics and geotechnical earthquake engineering, as an engineering educator, and for his dedication to public service.

Bob Whitman was born of academic parents on February 2, 1928, and raised in a small town near Pittsburgh, where building small dams in a backyard creek prompted his desire to become a civil engineer. After earning a BS degree (1948) in civil engineering from Swarthmore College, he attended MIT for his graduate studies in civil engineering, in hydraulics and structural engineering (SM 1949) and in structural dynamics for his doctorate (ScD 1951). He then joined Professor Donald Taylor's geotechnical group, which sought his knowledge of dynamics to study the effects of nuclear blasts on underground structures for the design and construction of long-range missile facilities. This switch initiated Bob's illustrious career in the new discipline of soil dynamics, which included service on Air Force advisory panels for the earliest of the hardened missile complexes and then for developing stable foundations

for long-range radar stations to track incoming missiles. His research then expanded to the general problem of designing foundations with vibrating loads. Two ASCE (1967) papers coauthored with the late F.E. (Bill) Richart Jr., which treated the problem as a rigid disk resting on an elastic half-space, represented a fundamental breakthrough in the understanding of foundation dynamics. Bob became one of the pioneers and leading experts in the area, and generations of MIT students benefited from drafts of his book on soil dynamics.

After two years with Taylor as a research engineer/associate, Bob was appointed assistant professor of civil engineering and remained on the MIT faculty for the next 40 years until he retired in 1993 as professor emeritus. Early on at MIT, he met a draftswoman–interior designer, Elizabeth (Betsy) Cushman, whom he married in 1954 shortly before attending the Navy's Officer Candidate School in Newport, Rhode Island. They moved to Hawaii where he served in the Civil Engineer Corps at the Pearl Harbor Naval Shipyard until late 1956.

The devastating 1964 earthquakes in Alaska and Niigata, Japan, stimulated research on the effects of ground shaking on the potential liquefaction of water-saturated sand (i.e., its loss of strength and load-bearing capacity) and associated damage to buildings and related infrastructure. Bob's initial technical contributions to this new discipline of geotechnical earthquake engineering included developing the analytical method (in 1953 when hired by Professor Taylor, who was consulting on slope stability problems along the Panama Canal) that was adopted for the well-known and still widely used Newmark "sliding-block analysis" to estimate the movement of earth slopes during earthquakes. He then went on to independently develop a method similar to the Seed-Idriss Simplified Procedure to predict the potential for soil liquefaction based on in situ tests for assessing the sand's resistance to shaking; draw the first national earthquake hazard maps (i.e., contours of equal probabilities for peak ground acceleration) utilizing probabilistic predictions developed by the USGS; and draft the 1985 National Research Council (NRC) report *Liquefaction of Soils During Earthquakes*, which still serves as a general

guide for earthquake liquefaction analyses. Bob also served for five years as chair of ASCE's Technical Council on Lifeline Earthquake Engineering and received its C. Martin Duke Award (1992).

During his transition from soil dynamics to earthquake engineering, Bob coauthored with MIT colleague Professor T. William (Bill) Lambe the classic textbook *Soil Mechanics* (1969). Its unique organization, developed by Bob, had three principal parts, treating dry soil, wet soil with steady state flow, and wet soil with transient flow (e.g., consolidation). Of Bob's many accomplishments, he was "probably proudest of that book," which many believe provides even today the best reference for teaching and learning the fundamental principles of soil mechanics.

Bob pioneered in the application of probability-based risk analyses to earthquake engineering by considering the uncertainties both in the occurrence and magnitude of earthquakes and in the resulting damage as a function of building type and local soil conditions. This approach was initiated in cooperation with Bob's MIT colleague, the late C. Allin Cornell, who had unique expertise in using stochastic models to represent earthquake loadings on and damage to buildings. Together, they developed damage probability matrices that ingeniously integrated the likelihood of occurrence of seismic events (the hazard matrix) and the resulting levels of damage to different types of buildings (the damage matrix). This new seismic-design decision analysis framework enabled rational risk assessments, i.e., comparison of the cost of earthquake damage with the cost (level of seismic design) to mitigate the damage. This approach formed the basis for new seismic provisions in building codes, the first outside California being the 1975 Massachusetts code headed by Bob, and eventually led to the current probability-based design practice. Awards recognizing this work include Bob's election to the NAE in 1975, followed by Allin Cornell's election in 1981.

Bob was one of the brightest stars in the Earthquake Engineering Research Institute (EERI), which was established

in 1948 by the late George W. Housner and several others to promote earthquake engineering and now has some 3,000 members. He was the only person, other than Housner, to have been EERI's President (1985–87), Distinguished Lecturer (1994), Honorary Member (1997), and Housner Medal recipient (2010). Bob used his term as president to further promote a nationally applicable, standardized methodology for estimating losses from earthquakes (prior work had been largely confined to California). He chaired the NRC panel that prepared the 1989 report *Estimating Losses from Future Earthquakes*, which laid the groundwork for the new loss methodology structure. Bob then led the committee that oversaw the development of the computer-based software program called HAZUS Earthquake. This program, funded by the Federal Emergency Management Agency (FEMA), was intended to guide government agencies in both earthquake mitigation (i.e., seismic provisions in building codes) and disaster response planning, but it was soon also adopted in engineering practice. The program calculates seismic hazard, evaluates the likely damage to buildings and other infrastructure facilities, and estimates both direct and indirect losses resulting from this damage. Bob's technical and policy contributions played a key role in the development of HAZUS, which FEMA expanded to include floods and hurricanes.

Bob Whitman was widely admired for his leadership and commitment to public service. His brilliant analytical and insightful mind enabled him to identify key issues, express them clearly, and then present viable solutions to problems ranging from the highly technical to largely political. His leadership at the national level included more than 40 years of near-continuous service on committees, advisory boards, panels, and workshops for the NAE, NRC, National Science Foundation, Department of Defense, and other agencies, in addition to the EERI and ASCE. At MIT, he headed the geotechnical and structural groups and was also well known for his role as parliamentarian at faculty meetings, especially during the Vietnam War–era student uprisings. And for his

hometown of Lexington, Massachusetts, Bob spent countless evenings over four decades as an elected member of the annual town meetings and as chairman of either the Zoning Board of Appeals or the Permanent Building Committee. When asked why he engaged in so many activities, he replied "they were interesting challenges and I couldn't stay away from them."

Bob Whitman's contributions, beyond those associated with soil dynamics and earthquake engineering, included development of one of the first computer programs for slope stability analyses; pioneering application of probabilistic concepts for risk analysis in geotechnical engineering as set forth in his ASCE Karl Terzaghi Lecture (1981); and leadership in establishing centrifuge testing facilities in the United States for geotechnical research.

Honors included the Karl Terzaghi Award (1987) for contributions to geotechnical engineering, the Croes Medal (1994) recognizing an outstanding paper from all civil engineering disciplines, and the Seed Medal (2007) for contributions to geotechnical earthquake engineering, all from ASCE, and an honorary doctorate from Swarthmore College (1990).

Although admired for his sharp mind and dedication to teaching, research, and public service, because of Bob's modesty few knew the full extent of his activities and contributions, even among his family and faculty colleagues. But his graduate students appreciated his warmth and mentoring, and, if from abroad, holiday meals with his family. The MIT geotechnical faculty and alumni fondly remember the annual end-of-school celebration parties hosted by the Whitmans, which were always blessed with gorgeous spring weather to supplement wine and badminton.

Notwithstanding Bob's hectic schedule, he was an ideal companion for wife Betsy and always a caring father. The Whitmans spent summer vacations, and then entire summers after his retirement, on a small island off the southern coast of Maine, with lots of sailing, tennis, and golf, and a cottage with ample room to house the expanding family. Bob was

also a train buff. He and Betsy travelled extensively across the United States and Europe, and Bob was the proud builder of an elaborate HO scale model train system.

In addition to his wife Betsy of 57 years, Bob is survived by two married daughters (a middle daughter, Martha, died at age two). Jill Whitman Marsee has two sons, followed an academic career in earth and marine sciences, and lives near Tacoma, Washington. Gwen Whitman Kaebnick has two daughters and specialized in university administration until she switched to teach 4th grade in White Plains, New York.

Acknowledgments

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