Robert O. Reid
ROBERT O. REID

1921–2009

Elected in 1985

“For pioneering contributions to hydrodynamical theory/applications, wave force analysis, storm tide prediction, tsunami flooding estimation, and for superlative teaching.”

BY ROBERT G. DEAN

ROBERT OSBORNE REID was born on August 24, 1921, in Milford, Connecticut, and died on January 23, 2009, in College Station, Texas. He was elected to the National Academy of Engineering in 1985. He received his B.E. in mechanical engineering from the University of Southern California (1946) and his M.S. degree in oceanography from the Scripps Institute of Oceanography (1948).

He served as a weather officer in the Army Air Corps (1942–1945) and participated in meteorological and oceanographic predictions for the landings in Normandy, France, in the Second World War. Shortly after the landings, he was stationed onshore and continued to contribute to the forecasts. He later served in the Pacific theater. His academic career was spent entirely at Texas A&M University, where he progressed from assistant professor (1951) to distinguished professor (1987) when he retired. Although his contributions to physical oceanography and meteorology were very substantial, including serving as founding editor of the Journal of Physical Oceanography for 11 years, this memoriam will focus primarily on his engineering achievements in practice and education.
Bob was fascinated by physical ocean-related problems and applied his unusual abilities to absorb mathematical principles rapidly. His physical intuition enabled him to rapidly understand the dominant physical forces in a problem, cast them into their most relevant forms, and progress to their solutions. His publications and teaching were characterized by insight, clarity, elegance, and significant advancements. His engineering contributions were carried out with his students and spanned broad areas of the nearshore region; a few representative applications are discussed below.

His early professional career at Texas A&M University occurred at the time of the rapid development of offshore petroleum resources in the Gulf of Mexico and concerns related to wave forces and hurricane storm surges. At that time little was known regarding many of the design challenges as the exploration and development programs progressed from shallow to deep water. His contributions ranged from geotechnical considerations in offshore pipeline design to hydrodynamic loading on offshore platforms during extreme weather conditions. Along with Charles Bretschneider, Bob rapidly advanced the available knowledge related to offshore platform design, including the stability limit for breaking waves in water depths ranging from shallow to deep water, damping of waves as they propagate over various bottom sediment types, and the development and application of methods to transform measurements of irregular water surface profiles to wave velocities and accelerations, the latter being required to compute realistic wave forces.

Bob’s strong analytical skills coupled with his grasp of numerical techniques enabled him to address effectively many problems of engineering interest by advantageously applying the emerging capabilities of computers. These included the wave and storm surge characteristics in Lake Okeechobee, where he and his students analyzed and interpreted data collected by the U.S. Army Corps of Engineers. He developed empirical relationships for the ratio of crest height to wave height, which proved to be in very good agreement with robust nonlinear wave theories developed subsequently.
Additionally, he constructed numerical models of the “canopy effect” that quantifies the reduction in wind stress applied to a water surface due to vegetation extending into the atmosphere.

Along with his then-student Kinjiro Kajiura, Bob was the first to solve the coupled problem of water wave damping by permeable sediments, removing the need for an ad hoc coupling of the separate problem solutions. He contributed to early understanding of the forces induced by waves on offshore structures. Prior to the capabilities to measure water particle velocities under waves and computer capabilities to apply spectral techniques, he applied a technique to objectively design numerical filters, which when convolved with the water surface, yielded the time histories of the water particle velocities and accelerations at any selected elevation within the water column.

Bob addressed many aspects of hurricanes and their effect on nearshore flooding, including the first numerical modeling of hurricane surges penetrating into Galveston Bay. Some of his seminal contributions were only published in research reports and not in refereed journals. To the best of my knowledge, along with a Ph.D. student, John Wanstrath, he developed the first curvilinear coordinate long-wave model, which allowed a much superior fit to the physical boundaries. Along with another student, he developed a numerical model of the entire Gulf of Mexico and portions of the Caribbean to investigate a peculiar phenomenon termed the “forerunner” in which a surge appears at the shoreline well before the winds. Forerunners can cause unpredicted early flooding of and prevent evacuation from low-lying areas. Due to recent measurements of an unusually large forerunner in Hurricane Ike in 2008, there has been a resurgence in interest in the cause(s) of this phenomenon, which is not predicted adequately by modern computer models. Bob showed that a significant component of the forerunner was due to a net increase in water volume in the Gulf of Mexico due to additional water driven through the Yucatan Straits and/or less water flowing out through the Florida Straits.
In other areas some of the early steady-state models predicted hurricane surges considerably lower than those measured at shore. Through graphical application of the method of characteristics, he showed that the amplification was due to a resonance resulting from the hurricane translation speed nearly matching the average speed of a long free wave across the shelf. This application included both linear and nonlinear effects.

Bob was interested in tsunamis and the risks imposed on nearshore areas. He developed and applied the first orthogonal coordinate system, which allowed a conformal mapping approach to the tsunami amplification on an irregularly shaped island. It was found that large observed inundations were primarily controlled by the geometry of the island and adjacent bathymetry and were relatively insensitive to the tsunami approach direction.

His capabilities to advance understanding on engineering problems led a number of companies and agencies to seek his assistance in better understanding these new challenges. He served as a member of the Coastal Engineering Research Board of the U.S. Army Corps of Engineers. This board, comprising three civilians and four high-ranking military, is responsible for guidance and assessment of the Corps research program in coastal engineering. He also served on committees of the National Research Council, especially those related to hurricanes and storm surge prediction capabilities.

Bob mentored many graduate students in physical oceanography and ocean engineering, at both the master’s and the Ph.D. levels, whose later professional careers were enhanced by the examples he set by his curiosity and application of physical principles and mathematical techniques. Indeed, many of us who were fortunate to have benefited by his example of enthusiasm for problems in nature, his approach of representing problems in their most basic form, and the satisfaction of a meaningful solution are forever indebted to him.

A surprise celebration of Bob’s 60th birthday in 1983 was organized at Texas A&M University at which many of his
former students presented papers illustrating their recent work. Bob was very proud of his students and at that time had mentored 55 Ph.D. students. While working with Bob several years later, I commented on this large number. His reply was: “I have supervised an additional number of Ph.D. students since then.” As a student of Bob’s while studying at Texas A&M for my master’s degree in the 1950s, I sometimes felt a bit embarrassed that none of us could ask an intelligent question after one of his thorough lectures. His engineering legacy includes extremely significant contributions to our understanding and design capabilities in the nearshore and a cadre of former students whose lives have been enriched by their association with such an inspiring and productive mentor.

His widow, Marjorie Ferry Reid wrote that she and Bob were married for 62 years and were the parents of 6 children; sons Robert, Russell and Thomas and daughters Nancy and Carol. Their youngest daughter, Maryellen was killed in a tragic accident in 2000. Rob and Russell are architects, and Tom has retired from A.O.L. Nancy is a veterinary assistant and Carol is an artist. Marjorie and Bob were blessed with eight grandchildren and four great grandchildren.