# COASTAL ENGINEERING 2010

Proceedings of the 32nd International Conference

# COASTAL ENGINEERING 2010

**30 June – 5 July 2010**
**Shanghai, China**

**edited by**
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**Abstract**: This *Proceedings* contains 363 papers and 29 posters presented at the 32nd International Conference on Coastal Engineering, which was held in Shanghai, China, 30 June to 5 July 2010. The *Proceedings* is divided into seven parts: Keynote; Waves; Swash, Nearshore Currents, and Long Waves; Sediment Transport and Morphology; Coastal Structures; Coastal Management, Environment, and Risk, and Posters. The individual papers cover a broad range of topics including theory, numerical and physical modeling, field measurements, case studies, design, and management. These papers provide engineers, scientists, and planners state-of-the-art information on coastal engineering and coastal processes.

# Foreword

The 32nd International Conference on Coastal Engineering (ICCE 2010) was held in Shanghai, China, 30 June to 5 July of 2010. The Local Organizing Committee, led by Xie Shileng, Ge Jiufeng, Dou Xiping, and Zuo Qihua, is acknowledged for their dedicated preparation over many years that led to a successful conference with broad participation. Six-hundred attendees from 38 countries gathered at the Shanghai International Convention Center to discuss research and applications in coastal engineering. The papers contained in this *Proceedings* cover a wide range of topics including waves; swash, nearshore currents, and long waves; coastal management, risk, and environmental restoration; sediment transport and morphology; and coastal structures. The authors have provided state-of-the-art contributions, and this volume could not be produced without their commitment to solving coastal engineering challenges. The members of the ASCE/COPRI Coastal Engineering Research Council (CERC) and the ICCE 2010 Technical Review Committee reviewed 725 abstracts and selected the 418 paper and 55 posters that were presented at the conference. The dedication of the Council members has led to the continued high quality and popularity of the International Conference on Coastal Engineering.

Preparation of these proceedings would not be possible with the assistance of many colleagues. Thank you to Prof. Robert A. Dalrymple, CERC Chairman, and Prof. Billy L. Edge, CERC Vice Chairman, for their guidance and encouragement. Thanks to Ge Jiufeng for answering my many requests for information and for his gracious hospitality in Shanghai.

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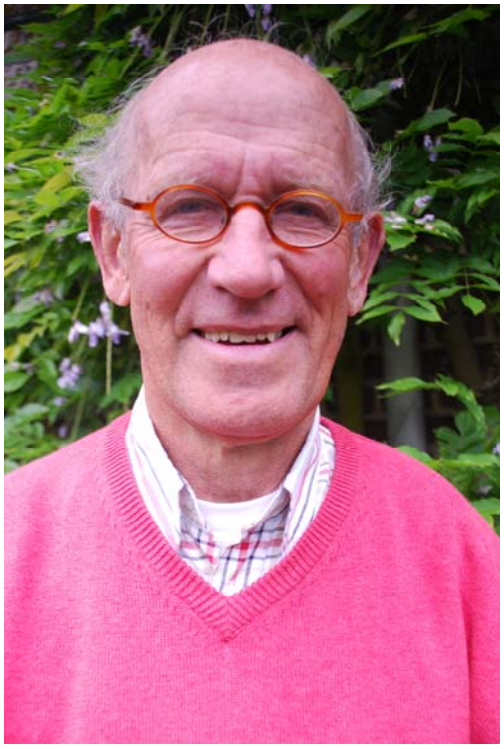
## Proceedings Dedication



This ***Proceedings*** is dedicated to Professor Jurjen A. Battjes, Delft University of Technology. His dedication to coastal engineering in general and to the International Coastal Engineering Conference in particular has greatly improved our profession. Some of his most impressive contributions to our field have been published in the ICCE Proceedings, long before the relevance of journal publications were becoming dominant.

Prof. Battjes is Emeritus Professor of Fluid Mechanics at Delft University of Technology (DUT). He headed the Fluid Mechanical Section of the Faculty of Civil Engineering for more than 20 years. Before joining DUT in 1966, he joined the University of Florida, Gainesville, as an Assistant Professor in the Laboratory of Coastal Engineering. He then returned to Delft and became Associate Professor in 1973 upon which he was awarded a full professorship in 1980, which he held until his retirement in 2004. To many professionals in the field his contributions may well be recognized by the development of SWAN, an open source code for Shallow WAter waves in the Nearshore. He advised many institutions in the Netherlands, such as Delft Hydraulics, Rijkswaterstaat and consultant institutions such as Arcadis, RoyalHaskoning, DHV, and Witteveen and Bos.

Prof. Battjes has earned numerous awards, in 1970: Prize “Fundatie van de Vrijvrouwe van Renswoude” (for research on wind waves); in 1975:Appointed to the Royal Dutch Academy of Sciences; in 1990:International Coastal Engineering Award (ASCE); in 1998:"Leermeester" Prize for outstanding performance in teaching and research; in 1999: Oceanography Award of the Society for Underwater Technology; in 1999: Bronze Medal of Honour of Delft University for 25$^{th}$ academic promotion; in 2004: Silver Medal of Honour of Delft University; and in 2004: Knight in the Order of the Lion of the Netherlands

This dedication honors Prof. Battjes’s service to the coastal engineering profession and to the ICCE.

Contributed by Marcel Stive

## IN MEMORIAM

### Leon E. Borgman

16 February 1928 – 5 February 2007

Leon E. Borgman, distinguished emeritus professor of Geology and Geophysics and Statistics, University of Wyoming, was the father of modern ocean-wave statistical analysis. In his early career in the 1950's and 1960's he was employed with the Shell Development Company as an oceanographic engineer and as a professor at the University of California, Davis, and the University of California, Berkeley. During this period Leon defined the leading edge of research on extreme wave statistics and extreme wave forces and was very effective at bringing research through to practical application. He moved to the University of Wyoming in 1970 as professor of geology and statistics

Through the 1970's, Leon comfortably expanded his interests to paleoclimatology, statistical simulation for geophysical modeling, geostatistics of mineral deposits and environmental assessment, and fracture mechanics while continuing his ocean wave statistical research. Leon was well known in several disciplines for his extraordinary ability to use cutting-edge statistical theories and concepts to solve complex engineering and scientific problems. His extraordinary diversity of technical interests provided Leon with a unique, profound understanding of the stochastic characteristics of natural phenomena. He was also well known for producing widely used computer programs for ocean, coastal-wave, and storm surge analyses and simulations, as well as geophysical and groundwater analyses and simulations.

In the 1980's and 1990's, Leon was the first and primary proponent of empirical statistical methods for both the ocean wave/storm surge and geophysical engineering fields. His empirical methods and associated computer programs (e.g., Empirical Simulation Technique or EST) are routinely used by engineers throughout the world. Leon retired in 1997. Leon mentored many students, both at university and in the greater engineering community. After his retirement and until the time of his death, he was a private consultant and continued to tenaciously and tirelessly solve difficult technical problems. Routine emails from Leon in the middle of the night surprised many of us who worked with him during those final years.

Leon was the recipient of numerous honors and awards, including the University of Wyoming's George Duke Humphrey Distinguished Faculty Award in 1981 and the International Coastal Engineering Award from the American Society of Civil Engineers in 1994. In 1998, he was recognized for professional distinction by the Offshore Technology Research Center (Texas A&M University) and was inducted into the Texas A&M Technology Hall of Fame. In 1999, Leon became the first University of Wyoming faculty member ever inducted into the National Academy of Engineering

Leon had many outside interests and was an accomplished calligrapher, custom knife maker, dog trainer, rock collector, and was an avid outdoorsman. Leon's extraordinary analytical abilities left us with a wonderful legacy, and his broad-mindedness, humanity, spirit, kindness and friendship that will be sadly missed.

Contributed by Jeffrey Melby

## IN MEMORIAM

### Charles L. Bretschneider

1920 – 27 September 2009

It would have been hard to predict the life trajectory of Charles L. Bretschneider from his beginnings in Red Owl, South Dakota. However, he never lost the plain good sense and can-do attitude that were part of his early life on what was still then the American Frontier.

His horizons expanded considerably with his service in the U.S. Army Air Corps in India, Burma, and China during World War II. After the war, Charles Bretschneider honed his new interest in meteorology and oceanography with a B.S. in Physics from Hillsdale College in Michigan, an M.S. in Civil Engineering from the University of California at Berkeley, and a Ph.D. in Oceanography from Texas A&M. He then made significant contributions to the field of coastal engineering through service to the U.S. Army Corps of Engineers — especially with respect to the U.S. Gulf of Mexico coast and the U.S. East coast. Dr. Bretschneider also has a distinguished record as an international engineering and legal consultant.

Meanwhile in Hawaii, the U.S. Army Corps of Engineers established the J.K.K. Look Laboratory of Oceanographic Engineering to study tsunamis — especially their effects on the Hilo Bay coastline. This laboratory was turned over to the University of Hawaii in 1964 and formed the basis for establishing the Department of Ocean Engineering. Dr. Charles Bretschneider was chosen to head one of the first of its kind academic program. He soon attracted a distinguished international faculty and launched the department that continues to this day, to bring students and visiting scholars from all over the world to Hawaii.

Dr. Bretschneider had a deep — essentially intuitive — understanding of the physical phenomena in the fields of meteorology, oceanography, and ocean engineering. This understanding often led him to new blinding insights which he would calmly proclaim and then let his graduate students work out the details. Dr. Bretschneider was awarded the ASCE Walter L. Huber Prize in 1959 and the Moffatt-Nichol Harbor and International Coastal Engineering Award in 1988. Dr. Bretschneider retired from the department he founded in 1995 but kept in touch through his friend, Edith Katada — the original Departmental Secretary who typed his original employment forms.

Contributed by Han Krock

## IN MEMORIAM

**Robert Osborne Reid**
24 August 1921 – 23 January 2009

**Bob Reid (standing) with colleague Basil Wilson in their early years at Texas A & M.**

Although Robert (Bob) Reid's main contributions were in Physical Oceanography, he advanced fundamental understanding of many continental shelf and nearshore engineering problems at a time when oil exploration was progressing into deeper and deeper waters and the risks associated with hurricanes and tsunamis were being recognized.

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 predict storm surges resulting from hurricanes. Prior to capabilities available to measure water particle velocities under waves and computer capabilities to apply spectral techniques, he developed and applied a technique to objectively design numerical filters, which when convolved with the water surface, yielded time histories of the water particle velocities and accelerations at any selected elevation within the water column, there providing a basis for analyzing measured wave forces. 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.

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 above the water level. He and his students developed and applied the first boundary fitted coordinate systems for hurricanes and tsunamis.

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 meaningful solutions are forever indebted to him.

Contributed by Robert Dean

## IN MEMORIAM

### Torben Sørensen

2 December 1927 – 26 August 2009

Torben Sørensen, the founder and Director of the Danish Hydraulic Institute DHI from 1964 to 1996, passed away on 26 August 2009.

Profound knowledge of hydraulics and geotechnical and civil engineering - especially with regard to the coastal environment - combined with a unique talent for leadership and excellent business acumen were the qualities he used to build the Institute, which under his direction reached recognition worldwide. For this achievement Torben Sørensen was honored with the International Coastal Engineering Award in 2000.

Torben Sørensen was demanding, but fair; he expected much from his staff but he also cared for them in difficult times, almost as a father; and he was proud, just like a father, when the young engineers presented new methods and findings. He inspired people to do wonders in their fields. He had the gift to see who, among people around him, had visions of the future and who could do things to transform these visions into reality. He was totally honest and always defended what was technically correct, rather than what was just politically acceptable.

Torben Sørensen was from his earliest years fascinated by the profession of port engineering, his father being the founder of a Danish consulting engineering firm that specialized in marine works. Torben Sørensen finished his studies at the Technical University of Denmark in 1952 and worked for three years in consultancy. The late fifties/early sixties was a period when major marine works were planned in Denmark, and Torben Sørensen was employed as a research engineer at the coastal Engineering Laboratory at the Danish University to assist Professor Lundgren, who had initiated the transformation of Danish port and coastal engineering from mainly empirically-based disciplines to a research-oriented specialty. In 1964 the Danish Hydraulic Institute DHI was formed with Torben Sørensen as its director. His vision was not only to provide Danish society with professional services, but also to create an international business, which could be a forefront for Danish expertise within hydraulic engineering.

During the following decades computational hydraulics took off with the ever increasing strength of computers. DHI adopted this new technology early, which would later prove to become an indispensible tool for the engineering and decision-making world. Computational hydraulics was the answer to Torben Sørensen's vision for the future of hydraulics, and he created the stimulating environment at DHI for this development.

Torben Sørensen realized the value and necessity of research and development and continuously strived for achieving even more accurate tools and methods. He was a strong proponent of the Danish technological service system, which provided a unique basis for conveying research and applications from academia to support the engineering profession. This also came to expression in the many projects conceived by society as a whole. For several years he served as Chairman of the Council of Danish Technological Service Institutes.

We are sure that many in the hydraulics research community will continue to appreciate him, respect him, and admire him. And many people will be thankful for his friendship and the opportunities he created. All honor to his memory!

Contributed by Asger Kej, Jens Kirkegaard, and Ida Brøker

## IN MEMORIAM

### Donald Keith Stauble

21 April 1947 – 26 August 2009

Don Stauble, a research scientist and coastal geomorphologist at the US Army Engineer Research and Development Center's Coastal and Hydraulics laboratory (CHL), lost his battle with a debilitating blood disease on 26 August 2009.

Don graduated with a B.S. in Geology from Temple University, a M.S. in 1971 in Oceanography from the Florida State University, and a PhD in 1978 in Environmental Science from the University of Virginia. He was a professor and taught in the Department of Oceanography and Ocean Engineering at Florida Institute of Technology from 1978 to 1987. During this period he also developed guidelines on physical engineering aspects for beach restoration projects in Florida that are still being used.

In 1987, Don joined the Coastal Engineering Research Center (CERC) of the US Army Corps of Engineers as a physical research scientist and remained in that organization as the CERC later became CHL. Don spent the next twenty-two years conducting scientific investigations on a broad array of coastal problems throughout the country.

At CERC and CHL, Don was both a practicing scientist and a team leader, often mentoring others and helping them as their careers took shape. The list of problems, research discoveries, and projects that Don worked on cover almost every coastal setting from the Great Lakes through the Gulf coast and on both East and West coasts. In recent years he had been involved in analyzing the impact of coastal structures in modifying beach processes, developing beach replenishment monitoring programs, assessing the inter-relationship between coastal inlets and the beach, developing more sophisticated ways for managing and analyzing coastal data, and in helping to improve coastal risk management by building on lessons from Hurricane Katrina.

Don's career spanned over thirty years as a teacher, researcher, problem solver, and scientist. He was a passionate and meticulous researcher who was constantly acquiring new knowledge and developing new understandings of how beaches behaved and why the coast is the way it is. Don would throw himself into trying to document, dissect, and analyze every aspect of the coastal condition. And then he would very effectively and patiently translate that knowledge through his writings and teachings so others might understand. He was a quiet, kind, and gentle man, generally unflappable, and a good friend to all who chance might cause to cross his path. However, when on the beach with shovel and sample bag in hand, Don would revert to an excited kid. He would collect samples and explain to any and all what they showed about this most complex of geological settings. Gathering data on beaches and figuring out what it meant was the work that Don most loved. Through the body of his work Don effectively used his scientific discipline to bring the insights of geology to address and help resolve engineering challenges associated with human modified coasts. In his quiet and methodical way, Don helped to ease the boundaries between science and engineering necessary for rational beach and coast management. Don leaves behind an extended family of Corps co-workers and colleagues who will miss him dearly.

Don authored over 30 publications including book chapters, journal articles, and conference papers. Throughout his life Don also used his talents to support his local community. He was a long-term volunteer fireman and served as a leader in supporting and operating his community volunteer fire district. He was also an accomplished musician who played the trumpet in community brass bands.

Contributed by Joan Pope

## Acknowledgments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**Cover Photo: The Waigaoqiao Port in Shanghai**


**The Flow Splitting Project of the Yangtze River Estuary Deep-Water Channel Training Project**

**The Yangshan Port in Shanghai**

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