USACE'S COASTAL ENGINEERING CERTIFICATE PROGRAM

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Mr. José E. Sánchez is the Director of the Coastal and Hydraulics Laboratory (CHL) at the U.S. Army Engineer Research and Development Center (ERDC) in Vicksburg, MS. ERDC R&D supports the Department of Defense and other federal agencies in military and civilian projects. Principal research mission areas include Warfighter support, installations, environment, water resources, and information technology. CHL is the national laboratory for the specialized professional field of coastal and hydraulic engineering. Research is conducted primarily in Vicksburg, Miss., with one field location in Duck, NC. As director, Sanchez leads a team of more than 200 researchers, support staff and contractors. He is responsible for planning, directing, and coordinating a multi-million dollar research program; developing new and strategic research program areas in coastal and hydraulics; and managing physical facilities with a total area of 1.5 million square feet. Ongoing projects range from design guidance to three-dimensional numerical models to produce cutting-edge products for successful coastal and inland water resources management. Prior to his current position, Sánchez served as chief of Asset Management, Headquarters, U.S. Army Corps of Engineers, and was responsible for developing, coordinating, and executing an integrated national plan and investment strategy for maintenance and recapitalization that improved reliability and minimized the risk of more than $200 billion in water resource infrastructure assets critical to the United States. Sánchez has more than 10 years experience as a research hydraulic engineer in CHL, responsible for planning, conducting, and reporting on a variety of complex hydraulic investigations utilizing both physical and numerical models. The majority of studies focused on navigation lock filling and emptying system evaluation, design, surface and groundwater hydrology, and computational fluid dynamics. He has also served as a consultant and as technical advisor in several international research efforts. Sánchez received bachelor's and master's degrees in Civil Engineering from the University of Puerto Rico in 1993 and 1995, respectively, and is a graduate of the Federal Executive Institute. He is a registered professional engineer in Mississippi and a member of the World Association for Waterborne Transport Infrastructure (PIANC) and the Transportation Research Board. He is founder of the Mississippi Professional Chapter, Society of Hispanic Professional Engineers and has authored or co-authored numerous publications. He has received the Hispanic Engineer National Achievement Award Conference's Civil Engineering Distinction Award, Superior Civilian Service Award, Commander's Award for Civilian Service, Achievement Medal, Emerald Honors' Special Recognition, and has been twice recognized by Hispanic Business magazine as one of the 100 most influential Hispanics in the United States.

U.S. Army Corps of Engineers
Coastal Engineering Certificate Program

Abstract

The coastal engineering discipline is one of the smallest engineering disciplines in the United States despite the expanding need for expertise in this field. An increase in density of population and infrastructure along the coast, coastal tourism world-wide, new frontiers exposed to coastal forcing in the northern latitudes, and changing frequency and intensity of coastal storms due to a changing climate are just some of the many reasons why well-trained coastal engineers are needed. The U.S. Army Corps of Engineers has initiated a program to increase the professional competency in the Corps work force, called the Corps of Engineers Coastal Engineering Certificate Program (CECEP). This paper reviews components of the CECEP and discusses future considerations to advance the coastal engineering profession in the United States

Overview

The U.S. Army Corps of Engineers (USACE or Corps) consists of 39 District offices in the United States and Territories that serve the Nation's civil works and military needs, and the Engineer Research and Development Center (ERDC), one of the premier engineering and scientific research organizations in the world. ERDC has seven laboratories, four of which are located in Vicksburg, Mississippi, on the Waterways Experiment Station (WES) campus. ERDC's role is to conduct research and development in support of military and civil works missions of the Corps and provide these advancements to District offices to implement at site-specific projects. District personnel involved in planning, designing, and implementing projects have backgrounds ranging from the sciences and engineering fields to planning and policy.

ERDC provides optional training to advance the knowledge base of laboratory engineers and scientists. Opportunities range from on-site classes offered by universities through the WES-ERDC Graduate Institute, temporary reassignments to field offices, and long-term training (LTT) in which employees relocate for a year at a higher learning institute. The purpose of this paper is to discuss a new format for professional development in coastal engineering, the Corps of Engineers Coastal Engineering Certificate Program (CECECP), which will be available to all Corps employees. First presented herein is a review of the history of training opportunities provided by ERDC, and then discussed is the motivation for offering the new CECECP. The anticipated course schedule over the next 5 years is presented with discussion of the other elements of the CECECP. In the conclusion there are suggestions for future advancement of the coastal engineering profession.

History and motivation

The Coastal Engineering Research Board (CERB)[*], originally called the Beach Erosion Board, has guided basic and applied coastal engineering research and development activities in the Corps since the 1930s. Coastal engineering education has been a topic of concern at CERB meetings, leading to formation of the first coastal engineering education initiatives in the Corps. At the 44th CERB Meeting in Sausalito, California, 4–6 November 1985, LTG E. R. Heiberg gave a Charge to the Board concerning the need for coastal engineering education. A working

[*] http://chl.erdc.usace.army.mil/dirs/events/405/23%20Simmons%2088CERB2011.pdf

group was formed to further discuss the implementation of coastal engineering training as implemented by the ERDC-WES Graduate Institute, which evolved into the Coastal Engineering Education Program (CEEP).

The CEEP consisted of classes offered by the Coastal Engineering Research Center (CERC), one of the ERDC laboratories, and Texas A&M University (TAMU) towards a master's degree in ocean-coastal engineering for Corps employees. The program was designed such that District employees took classes from TAMU and CERC over a 1-year period. Students spent one semester on the TAMU campus in College Station, Texas, one semester at CERC in Vicksburg, Mississippi, and took courses and gained field experience at the Field Research Facility, a Corps coastal research branch in Duck, North Carolina. A thesis project was also conducted during the program. Training and travel costs were the responsibility of individual Districts or ERDC. The first CEEP graduating class was in the fall of 1991 with four graduates, followed by one in the spring of 1992, three in the fall of 1994, one in the fall of 1995, and five graduates in the fall of 1997. The program eventually became too costly for Districts to support employee offsite deployment for a year and to devote funds to travel and training and was discontinued in the late 1990s.

Another option for continuing education for on-site personnel is the ERDC-WES Graduate Institute. The Graduate Institute has provided master's- and doctorate-level courses since 1986 via video teleconference and on-site lectures from three universities: Mississippi State University (MSU), TAMU, and Louisiana State University (LSU). Facilities in the ERDC-WES Graduate Institute offer real-time and recorded video-teleconference and in-person lectures by professors from the universities and adjunct professors from ERDC. Fifty-two ERDC employees are also adjunct professors, with 38% of the classes taught by adjunct professors at ERDC. Undeclared and matriculating students have been primarily from ERDC with some participation from the Corps Vicksburg District office and local science-consulting firms. As of 2013, a total of 257 students has graduated with degrees in science and engineering fields with the majority in civil engineering, followed by computer science and geotechnical degrees[*]. Table 1 presents the degree programs offered by the ERDC-WES Graduate Institute.

Table 1. University degrees offered by ERDC-WES Graduate Institute.

University	Degrees offered by ERDC-WES Graduate Institute*
Louisiana State University	• Engineering Sciences • Environmental Studies • Experimental Statistics

Mississippi State University	• Civil Engineering
	  o Environmental
	  o Geotechnical
	  o Hydraulics
	  o Structural
	• Computer Engineering
	• Electrical Engineering

[*] Personal communication, Director of ERDC's Graduate Institute, 25 September 2013.

	• Industrial Engineering • Master of Engineering • Geosciences • Business Administration
Texas A&M University	• Ocean Engineering • Oceanography

* http://www.erdc.usace.army.mil/careers/trainingandeducation/thegraduateinstitute.aspx, accessed 22 Jan 2014.

Full-time employees that are taking classes typically take one class per semester, allowing completion of coursework for a master's degree in approximately 2 years. Partial coursework can also be conducted towards a doctoral degree, although universities require one-year residency for completion of a doctorate. Master's and doctoral thesis topics are usually work-related with both an ERDC mentor and university advisor. Defense of the thesis and coursework is typically conducted at the university, after which the student is awarded the degree and may choose to graduate with on-site students.

The ERDC also offers a competitive opportunity for LTT in which selected employees are relocated for a period of time (typically a year) to study a topic of value to ERDC. Employees can be approved to take classes towards a doctoral degree at a university, learn with industry partners, or engage in other developmental assignments at Districts, institutes, and facilities. As discussed previously, employees who have completed their coursework towards a doctoral degree typically choose a dissertation topic related to ERDC work and complete it in the years following their return to the ERDC campus.

Need for professional development in coastal engineering

In an evaluation of U.S. graduate education opportunities in coastal, ocean, and marine engineering, Whalin and Pang reviewed the history of the profession and emphasized how the decline in the profession has affected the national economy and may be a security threat in the future.[3] Despite the fact that the coastal engineering profession was initiated in the United States in the 1930s, and was strong through the mid-1970s, data indicate that the United States has lost leadership of the coastal engineering profession, largely due to a combination of increase in research by other countries with a healthy and stable research funding stream and tightening of the U.S. federal budget with national defense costs increasing.[3] The percentage of first authors from the United States publishing in the world's premiere coastal engineering conference, the International Conference on Coastal Engineering (ICCE), declined from 56% in 1957 to 29% in 2006.[3] Academic courses, laboratory research facilities, and field studies have also declined in the UnitedStates.[3]

In summer 2011, the American Shore and Beach Preservation Association (ASBPA) presented an assessment of U.S. coastal engineering and science to the CERB[*]. ASBPA highlighted the Corps aging coastal engineering population, with nearly half the coastal engineering staff eligible for retirement over the next decade, and summarized results of a National Research Council study that pointed to coastal engineering as being one of the smallest engineering disciplines in

[*] http://chl.erdc.usace.army.mil/dirs/events/405/23%20Simmons%2088CERB2011.pdf

U.S. academia.[2] ASBPA discussed the decline in research funding for coastal engineering in the United States and the trends to integrate discipline areas (e.g., engineering, geology, oceanography) to leverage funding at universities. The influence of academic integration of discipline areas has been observed in the Corps, with employees having science or policy backgrounds involved in coastal engineering projects.

Although coastal engineering research and education funding has remained the same or decreased through time, the need for knowledge of coastal engineering has increased with the population and infrastructure that resides in the coastal zone and from coastal damages from recent severe storms. Coastal infrastructure is aging, and with constrained budgets, there is a need for focus on life-cycle management, innovative rehabilitation, and maintenance of these coastal structures rather than traditional designs. Ice melt in the northern latitudes has caused thawing of permafrost and erosion of formerly stable coastal regions.

The coastal zone supports ports and harbors, recreation, and tourism and generates one-third of the Gross National Product.[2] World-wide, tourism represents the largest economic investment, with coastal tourism increasing exponentially in recent years.[1] Well-engineered beaches support tourism as well as prevent damages from storms and the long-term impacts of relative sea level rise. Other countries (e.g., Spain, The Netherlands, Japan, and Denmark) have invested in coastal engineering and have become world leaders in various advanced technologies such as dredging, numerical modeling, and port infrastructure.[2]

In response to ASBPA's discussions with the CERB, ERDC's Coastal and Hydraulics Laboratory (CHL, which merged CERC with ERDC's Hydraulics Laboratory in 1998) began working with the Graduate Institute to develop professional development for coastal engineering. A survey of District coastal engineering projects indicated that District employees involved with coastal projects had received degrees in disciplines related to coastal engineering, such as environmental or hydraulic engineering, but had limited exposure to coastal engineering curriculum. The need for opportunities to professionally advance Corps staff in coastal engineering, both from Districts and from noncoastal laboratories at ERDC, was of keen interest. Corps staff indicated that the professional development would be of greatest interest if offered as remote online training that could be viewed live or recorded and viewed later as the employee's schedule permitted.

The Coastal Engineering Certificate Program (CECECP)

With interest from Corps staff and universities in the ERDC-WES Graduate Institute, the CECECP began to be formulated in the spring of 2012. The CECECP was designed to provide a means for Corps engineers and scientists to obtain Basic and Advanced Certification in coastal engineering through accredited university programs. The program is intended for Corps employees that have a previous quantitative background in scientific or engineering fields and are new to coastal engineering or for coastal engineers that are interested in extending their knowledge and experience. The CECECP will provide fundamental training in coastal engineering for the specific purpose of professional advancement. The CECECP was established with two phases as follows:

Basic:

- Four courses from ERDC-WES Graduate Institute universities from the following categories; one course must be a general *context* course providing a broad overview of coastal engineering or coastal processes
    - Coastal Hydrodynamics
    - Coastal Processes
    - Coastal Structures
    - Elective

Advanced:

- Successful completion of Basic CECECP
- Successful completion of software training course provided by CHL
- Successful completion of a project with mentoring from a CHL researcher and presentation of results to a CHL panel.

For the Basic Certification in Coastal Engineering, the CECECP student is not required to be physically located on-site to take the courses, but will view lectures online and complete testing with oversight of a proxy administrator. The student may take the courses from any university in the CECECP. For Advanced Certification, the software training module is designed to provide hands-on training on Corps software products, with potential application to the applied study. The applied study is intended to demonstrate knowledge gained through the academic coursework as well as the student's proficiency in the Corps software and has the key learning component of mentorship by an experienced CHL researcher. The CHL mentor will guide the student through the applied study and be available to address questions and concerns throughout the professional development process. The final step in completion of the Advanced CECECP is presentation of the applied study to a CHL panel, which will then award the Certificate of Advanced Professional Development in Coastal Engineering.

As the CECECP was formulated, Old Dominion University (ODU) was identified as an accredited university with existing online courses that met the requirements of the CECECP, and ODU agreed to participate in the program. Table 2 lists the courses available and their categorization.

Table 2. CECECP courses by participating university.*

Course Name	Cate-gory**	2014			2015			2016			2017			2018		
		Sp	Su	F	Sp	Su	F	Sp	Su	F	Sp	Su	F	Sp	Su	F
Old Dominion University																
Intro to Coastal Engineering	CP#				X						X					
Design of Coastal Structures	CS			X						X						X
Dredging and Beach Engineering	CP						X						X			
Coastal Hydro-dynamics	CH	X						X						X		
Mississippi State University																
Sedimentation Engineering	CP			X						X						X
Hydromechanics	CH						X						X			
Tidal Hydraulics	CH				X						X					

Rivers, Estuaries & Coasts	CH		X						X						X	
Coastal Processes	CP#	X									X					
Texas A&M University																
Coastal Engineering	CP#	X			X			X			X			X		
Ocean Wave Mechanics	CH			X			X			X			X			X
Fluid Mech for Ocean and Env. Engineering	CH			X						X			X			
Nonlinear Waves	CH						X						X			
Marine Dredging	E	X						X						X		
Ports and Harbors	CS						X						X			
Coastal Sed Processes	CP#				X						X					
Estuary Hydro-dynamics	CH	X						X						X		
Env Fluid Mechanics	E	X			X			X			X			X		
Computational Fluid Dynamics	E			X			X			X			X			X
Experimental Fluid Mechanics	E			X						X						X
Louisiana State University																
Coastal Engineering	CP#			X			X			X			X			X
Coastal Hydro-dynamics	CH	X			X			X			X			X		
Sediment Transport Mechanics	CP	X			X			X			X			X		
* Anticipated; schedules may change. ** CP=Coastal Processes, CH=Coastal Hydrodynamics, CS = Coastal Structures, E= Elective, # = Context Class.																

Courses that are considered to fulfill the context course requirement are also indicated. Note that the schedule in Table 2 may change for out-years. To enroll in the CECECP Basic Certification, students must first complete an application* and resume′, and apply to the university that will provide the first course in the individual course series. The application includes information about the student's interests in the project to be conducted as part of the CECECP. Once admitted to the university, the student will enroll in the first course. For Advanced Certification, a CHL researcher will be identified to mentor the student through training on a software module and project. The CECECP will be initiated in the fall of 2015. It is envisioned that the CECECP Basic and Advanced Certifications will increase understanding and implementation of coastal engineering in Corps projects and may lead to advanced master's or doctoral degrees in the Corps.

Support for the CECECP

Colleagues in the coastal engineering profession have been supportive of both phases of the CECECP. Academic and consulting coastal engineers applaud the initiative to increase coastal engineering expertise in the United States with a relatively low-cost, flexible, and efficient approach. The program is designed to be very accommodating, allowing students to take classes and courses at their own pace within the semester's academic calendar and choose research topics of interest that synchronize with ongoing projects. Costs will be low, as there is little travel required, and the student can take classes during nonwork hours. Benefits will be great to

* http://cirp.usace.army.mil/CECEC/index.php

the student, USACE Districts, and to ERDC-CHL as researchers mentor future colleagues and learn about District projects, as well as transfer Corps software technology.

Professional engineering (PE) licensure is awarded based on passing a rigorous test in civil engineering (closest discipline to coastal engineering); there is presently no PE exam for coastal engineering. Therefore, an engineer with a civil engineering PE license may be a technical expert in some subdiscipline of civil engineering such as structural design or traffic engineering but still not have exposure to coastal engineering. Both Basic and Advanced CECECP will provide this much-needed technical background and will serve to supplement the PE licensure.

Considerations for future advancement of the coastal engineering profession

As reviewed by Whalin and Pang, the need for coastal engineering expertise extends nation-wide, including other Federal agencies, academia and consulting firms.[3] Once the CECECP has been vetted by Corps employees, if there is interest in non-Corps participation, it will be opened to others interested in advancing their professional expertise. Non-Corps students would simply follow the same procedures as Corps students to apply to the CECECP, apply to the university, and register for the initial class in the coursework series. The same requirements would include four courses for Basic Certification; Advanced Certification would include software module and an applied project to demonstrate proficiency and presentation to CHL.

Other universities, including the University of Puerto Rico–Mayaguez (UPRM) and the University of Hawaii–Mānoa (UH-Mānoa), have expressed interest in providing courses for the CECECP, with the potential to develop joint institutes of higher learning. The only requirements for participation in the CECECP are accredited coastal engineering courses that meet the course categories as defined herein, online courses that can be viewed in real-time or at the student's convenience, acceptance of remote testing with oversight from a proxy administrator, and honoring of coursework from other universities in the CECECP.

The UPRM has proposed a coastal engineering certificate program, which is presently being vetted through their approval board. The UH-Mānoa is in the process of developing a Coastal Infrastructure and Sustainability Certificate Program, and most likely will utilize ERDC expertise to teach some of the courses required for the certificate program. Thus, there is potential for joining educational opportunities with other universities and expanding the certificate program into other subdisciplines of coastal engineering. For example, coursework and software modules in dredging and navigation engineering are potential candidates for future certifications.

In conclusion, the CECECP will provide a means for professional advancement in the Corps coastal engineering expertise and most likely will be extended to include non-Corps participants, once successfully implemented and tested by initial Corps students. The CECECP is designed to provide fundamental training in the coastal field with essential mentoring from an experienced coastal researcher and will supplement licensures such as the PE. Potential to expand the CECECP is great, both to include other universities offering coastal courses and to develop subdiscipline certifications. The CECECP serves as a model not only for other universities but also internationally, providing flexible, low-cost, readily accessible professional development in the coastal engineering discipline.

References

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