Engineering the First Coast

Promoting Engineering to Future Generations

2020 Engineers Week

February 16 – 22

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Advertisements

Chairperson's Message

by Joe Champion, PE, ECS Florida, LLC

Welcome to Engineers Week 2020! This is our time to celebrate our great profession. A profession of colleagues, partnerships, and teamwork rather than individualism. The greatest accomplishments of engineering and society progress are achieved through team success. The Apollo Space Program always comes to mind for me… check out the podcast "13 minutes to the Moon" if you're a space nerd like me. I believe the most crucial aspects of team success are respect, competitiveness and diversity. Varying perspectives, opinions, experiences, attitudes, strengths and passions combined with shared vision, mutual respect, planning, and implementation is how any team success is achieved. This year we chose to recognize the importance of diversity in our profession during our period of celebration, and recognize the importance and influence from women in our engineering community.

If you read my message last year, I rely heavy on search engines and this year in researching statistical facts on women in engineering the data is a bit overwhelming to process, so I'll refrain from summarizing my Bing searches like last year. I recommend visiting the Society of Women Engineers (SWE) for some very interesting and detailed reports, but my impression is that women account for only 15% - 20% of STEM professions. More young women are engaging in STEM professions, but not at a significantly different rate than the overall growth of STEM interest. Our hope this E-week is to engage and promote the many efforts on further engaging women in engineering. We are fortunate here in Northeast Florida to have many active and impactful women in our profession.

Ok, if you miss my presentation of sharing my internet searches, I will share a few interesting search facts I found searching for women in engineering:

- Henrietta Edwards, Eli Whitney's wife, actually invented the cotton gin, as a convenience tool around the house, but women couldn't patent, so her husband got all the credit.

Chairperson's Message (Cont.)

- Emily Roebling was the Chief Engineer during the construction of the Brooklyn Bridge, completed in 1883, when her husband became sick, and so she lead the construction by carrying out her own studies of technical issues, materials, stress analysis, construction and calculations.
- Kate Gleason is the only woman in the US to have a college of engineering named in her honor ~ RIT's Kate Gleason College of Engineering.
- Marie Curie was the first person to win two Nobel Prizes for Science.

In writing this introduction message, I must admit I feel a decent bit of pressure to write something entertaining, relevant and inspiring, so after much effort and thought I've come up with the following very original-ish and inspirational message:

"Great weeks are born from great opportunity, and that's what you have here this week, engineers. That's what you've earned here this week. One week, if we engineered ten times, we might fail nine. But not this week, not today. Today, we design with our team. Today, we innovate with our team, and we keep utilities running because we can. Today, we are the greatest engineers in the world. You were born to be engineers – every one of you, and you were meant to be here today. This is your time. The time for the illogical is done. It's over. I'm sick and tired of hearing personal injury attorney commercials. Screw'em. This is STEM time. Now go out there and take it." (-Joe Champion, 2020 (-Herb Brooks, 1980))

I hope you are pumped up as I am! This just came to me while working at the house with the TV on in the background, I think there was a hockey movie on.

In all seriousness, while I write this the State of the Union is on in the background (almost a hockey match). Unlike many of our politicians, we as engineers succeed by striving to unify our community and serving the wellbeing of the public through our team success. So, thank you and your teams for your service.

A final big thank you again to the small and diverse group of volunteers to help bring E-Week together. It's been a Miracle, so let our week begin…

PROCLAMATION

ONE CITY. ONE JACKSONVILLE.

WHEREAS: The National Society of Professional Engineers first recognized National Engineers Week (EWeek) in 1951. The February timeframe was selected to coincide with George Washington's birthday, in acknowledgment of our first president, the nation's first notable engineer, and surveyor; and

WHEREAS: Today, EWeek is a formal coalition of more than 70 engineering, education, and cultural societies, and more than 50 corporations and government agencies. The observance raises public awareness of engineers' positive contributions to communities' quality of life, while promoting the importance of a technical education and high levels of math, science, and technology literacy that motivate youth to pursue engineering careers; and

WHEREAS: The diverse engineering professions provide citizens with a number of necessities, including the design and construction of industrial facilities, delicate medical instruments, computer software, mechanical systems, water systems, and electrical transmission and distribution systems; and

WHEREAS: Engineers lead and address the technological challenges of our times by researching sustainable energy sources and studying new methods to improve safety and grow the nation's global communication abilities; and

WHEREAS: Jacksonville supports and relies on engineers to leverage their knowledge and skills to meet the demands of our future in Northeast Florida and throughout the world.

NOW, THEREFORE, I, LENNY CURRY, by virtue of the authority vested in me as mayor of Jacksonville, Florida, do hereby proclaim February 16-22, 2020 as

ENGINEER'S WEEK

in Jacksonville and encourage all citizens to recognize the important and far-reaching contributions engineers make to our community and future.

IN WITNESS THEREOF, this 23rd day of January in the year Two Thousand Twenty

Lenny Curry

MAYOR

CITY OF JACKSONVILLE, FLORIDA

Supporting Societies

American Concrete Institute (ACI)

American Public Works Association (APWA)

American Society of Civil Engineers (ASCE)

American Society of Highway Engineers (ASHE)

American Society of Mechanical Engineers (ASME)

American Society of Plumbing Engineers (ASPE)

American Water Works Association (AWWA)

Design Build Institute of America (DBIA)

Florida Association of County Engineers and Road Superintendents (FACERS)

First Coast Manufacturers Association (FCMA)

Florida Engineering Society (FES)

Florida Structural Engineers Association (FSEA)

Florida Transportation Builders Association (FTBA)

Florida Society of Surveyors and Mappers (CROWN FSMS)

Institute of Electrical and Electronics Engineers (IEEE)

Institute of Transportation Engineers (ITE)

North East Florida Builders Association (NEFBA)

National Utility Contractors Association (NUCA)

Society of Military Engineers (SAME)

Society of Marketing Professionals (SMPS)

Society of Women Engineers (SWE)

UNF – The College of Computing, Engineering & Construction (CCEC)

US Green Building Council, North Florida (USGBC NF)

Women's Transportation Seminar (WTS)

Supporting Societies (Cont.)

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JACKSONVILLE BRANCH

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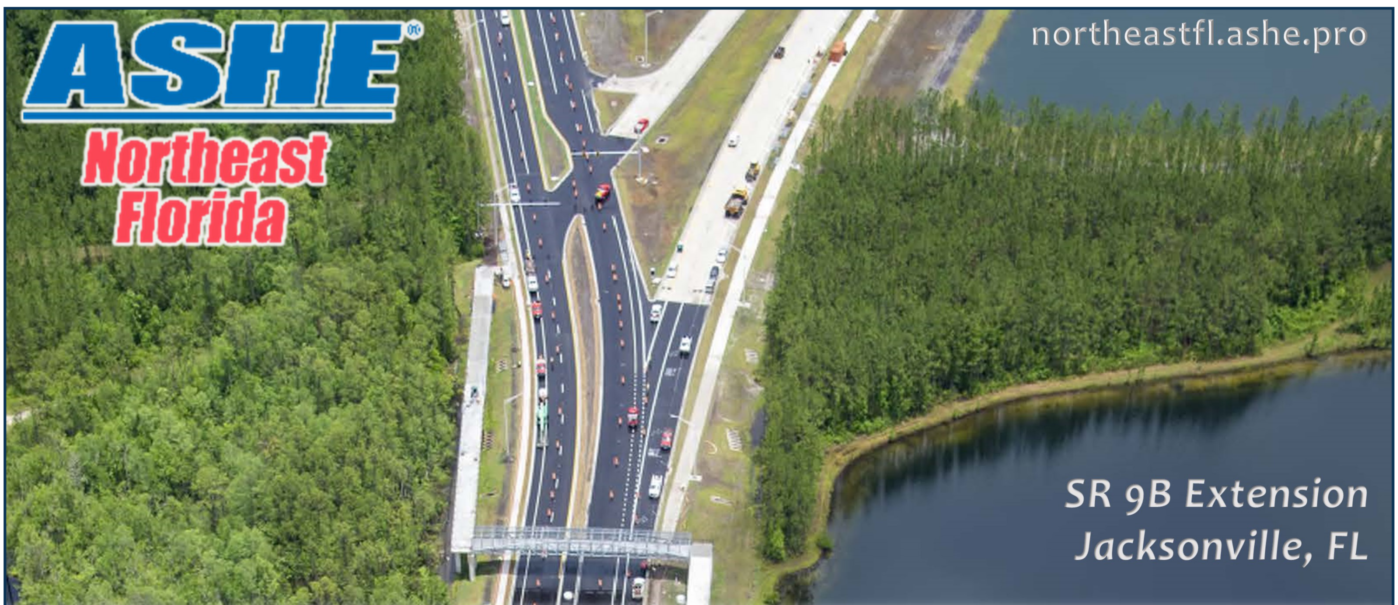

We would like to thank our sponsors for another successful year:

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Supporting Societies (Cont.)

Florida Engineering Society
Northeast Florida Chapter

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As an FES member you are part of a community of over 3,300 engineers in Florida.

Community Outreach

FES gives you a great opportunity to give back or to "pay it forward" through great programs including K-12 programs, MATHCOUNTS, fundraisers to benefit Scholarship programs, and involvement with Student Chapters.

Leadership Opportunities

Become a student in our world renowned Florida Leadership Institute (FELI) or becoming involved in a FES Committee or become a Chapter Officer.

Continuing Education

FES offers a number of affordable programs and products that allow you to grow your technical expertise, improve your leadership skills, and help keep your career on track.

Career Resources

FES offers job listings, opportunities to market yourself, forward.

ASCE's Pivotal Role in Concrete Pipe History Plus RCP's Link to Epcot

by Douglas J. Holdener, P.E.
Director, Florida Concrete Pipe Association

The American Society of Civil Engineers (ASCE) was founded in 1852.[1] Ten years prior to the formation of ASCE, in 1842, concrete pipe was installed for the first time in the United States in Mohawk, New York. The 1842 Mohawk concrete pipe was cast in place for a sanitary sewer application and remained in use and in excellent condition for over 140 years. In 1867, Joseph Monier, a French commercial gardener, patented wire reinforcement.[2] Monier showcased wire reinforcing at the Paris Exposition, and subsequently established more patents including production of reinforced concrete pipes in 1868.[3] Precast reinforced concrete pipe (RCP) was first commercially produced in France in 1896 and was introduced in the U.S. in 1905.[4] Since the early 1900s, reinforced concrete pipe (RCP) design, installation, and specifications have evolved, and the ASCE was significant in the development of modern RCP standards.

When the precast RCP market was initially developing in the early 1900s, there was no quantifiable design method for buried pipe. In 1910, Iowa State researchers began to formally study rigid pipe installations. In 1913 and 1917, Anson Marston (Iowa State), a former Director of ASCE [5] , published the first formal practices for calculating loads on buried pipe.[6,7] Among the findings in 1913 was that a properly supported and backfilled rigid pipe was almost impossible to collapse.

Continued research in the 1920s led to the Indirect Design method, which correlated estimated trench loads to the estimated supporting strength of the pipe. In the Indirect Design method, the required supporting strength of the pipe is a function of the estimated installed load on the pipe divided by a bedding factor. The bedding factor is a numerical value that represents the level of load distribution for a given installation type. The Indirect Design method is one of two design methods for concrete pipe in AASHTO LRFD Bridge Design Specifications, and it is the basis for the Three-Edge Bearing (3EB) test that is used today for certification of RCP strength class (e.g., III, IV, or V).

Three-Edge Bearing (3EB) Testing 18-inch Diameter Reinforced Concrete Pipe at County Materials in Astatula, Florida

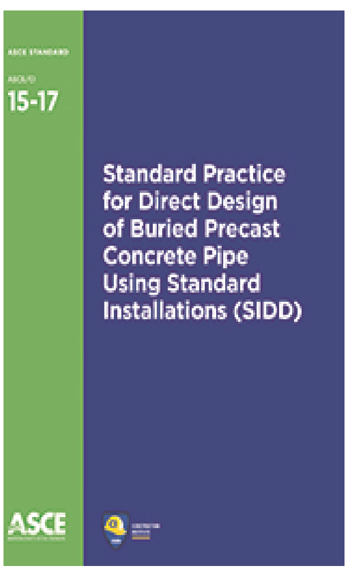
The concept of "installation type" originated in the early 1900s. For much of the 20th century, standard installation types for concrete pipe consisted of: (a) concrete cradle (Bedding Factor of 2.8 to 4.8); (b) shaped subgrades (Bedding Factor of 1.5 to 1.9; and (c) flat subgrade (Bedding Factor of 1.1). These early installation types were not the most practical nor economical for construction, however, these older installation details are occasionally still referenced in specifications that have not been updated to modern standards.

In the 1960s, Massachusetts Institute of Technology (MIT) researcher Frank Heger adapted reinforced concrete beam theory to the circular pipe wall profile. **Incidentally, Dr. Frank Heger was the chief structural engineer for Spaceship Earth at Walt Disney World's Epcot.**[8] In the 1970s through 1980s, the American Concrete Pipe Association (ACPA) conducted research that incorporated the evolving design theory of reinforced concrete pipe in addition to geotechnical expertise and pipe-soil interaction models. This research studied the interaction between buried pipe, embedment materials and the native soils using finite element analysis.

In 1988, Dr. Heger published "New Installation Designs for Buried Concrete Pipe" in the Proceedings of the 1988 ASCE Pipeline Infrastructure Conference. Dr. Heger recognized that the traditional installation types using concrete cradles and shaped subgrades were not practical construction methods. ASCE's 1988 ASCE document was the result of over one hundred finite element analyses of installation variables to develop new standard installation types that provide practical and efficient criteria for designing and installing buried concrete pipe systems.

In 1993, ASCE published Standard 15 - Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD). ASCE Standard 15, republished in 2017, [9] established the Direct Design methodology and four Standard Installations for concrete pipe. The Direct Design method and the Standard Installation types were incorporated in AASHTO LRFD Bridge Design and Construction Standards and in ASTM C1479. The four Standard Installation types (1 – 4) allow the Engineer to design for a range of construction parameters, ranging from the most intensive compaction limits and stiffest embedment materials (i.e., Type 1) to the least intensive compaction limits and lesser stiffness embedment materials (i.e., Type 4).

ASCE's contribution to modern concrete pipe design and installation resulted in the modern standard of practice in AASHTO and ASTM C1479, and it was used in the Florida Department of Transportation (FDOT) Drainage Manual Cover Heights. The value of ASTM C1479 and the Standard Installations to the Engineer is that the concrete pipe installation specifications for any given project can be established based on the economics, in-situ soils, and expected construction practices. For instance, FDOT requirements of a Type 1 Standard Installation may not be practical, or even necessary, for some municipal and private projects, particularly for pipe installed outside of the right-of-way. These modern standards also can provide an engineering basis for Cost Savings Initiatives (CSIs) to gain efficiencies from an agency's standard specifications, such as reduced density testing frequency, use of more plastic in-situ materials, or alternative embedment specifications.



ASCE Standard 15

ASCE played a pivotal role in the evolution and development of modern reinforced concrete pipe standards. In addition to ASCE Standard 15, the ASCE has also published ASCE Standard 27 – Standard Practice for Direct Design of Precast Concrete Pipe for Jacking in Trenchless Construction. In Florida, the Florida Concrete Pipe Association (FCPA) is highly supportive of ASCE. Since 2018, through the paid registrations by the civil engineering community to FCPA seminars, the FCPA has generated over $8,200 in contributions to ASCE Student Chapters and local Branches.

[1] "About ASCE," American Society of Civil Engineers, 2020, http://www.asce.org/about_asce/.

[2] "Joseph Monier", Encyclopedia Britannica, January 1, 2020, https://www.britannica.com/biography/Joseph-Monier.

[3] "Freytag Acquires the Monier Patent," Wayss & Freytag Ingenieurbau AG, December 16, 2019, https://www.wf-ib.de/en/about-us/history/from-1875/1884/freytag-acquires-the-monier-patent/.

[4] "A Brief History of Rigid Pipe Design," A Presentation at Pipe School, American Concrete Pipe Association, by Chris Macey, P.Eng., AECOM, January 2020.

[5] "Marston," History of Iowa State: People of Distinction, Iowa State University, 2007, http://historicexhibits.lib.iastate.edu/150/template/marston.html.

[6] Stoops, Ken, "Loads on Buried Pipe: A 100-Year Old Formula Still Holds Water," Becht Engineering Company, 2020, https://becht.com/becht-blog/entry/loads-on-buried-pipe-a-100-year-old-empirical-formula-still-holds-water

[7] "Reinforced Concrete Pipe – How to Assess the Transition from Indirect to Direct Design Methods in Deep Cover Installations," A Presentation at Pipe School, American Concrete Pipe Association, by Adam Braun, P.Eng., AECOM, 2018, http://www.concretepipe.org/secure/tracks/2018/Engineering:Technical%20Marketing:Sales/IndirectDirectDesign_Braun. pdf.

[8] Coppa, Clare, People: Frank Heger's Sphere, Standards News, American Society for Testing and Materials, February 2000, https://www.astm.org/SNEWS/FEBRUARY_2000/people.html.

[9] ASCE Publications, https://sp360.asce.org/PersonifyEbusiness/Merchandise/Product-Details/productId/233078662.

Table 1: Standard Installation Soils and Minimum Compaction Requirements

Installation Type	Bedding Thickness	Haunch and Outer Bedding	Lower Side
Type 1	D_o/24 minimum, not less than 3" (75 mm) If rock foundation, use D_o/12 minimum, not less than 6" (150 mm)	95% Category I	90% Category I, 95% Category II, or 100% Category III
Type 2	D_o/24 minimum, not less than 3" (75 mm) If rock foundation, use D_o/12 minimum, not less than 6" (150 mm)	90% Category I or 95% Category II	85% Category I, 90% Category II, or 95% Category III
Type 3	D_o/24 minimum, not less than 3" (75 mm) If rock foundation, use D_o/12 minimum, not less than 6" (150 mm)	85% Category I, 90% Category II, or 95% Category III	85% Category I, 90% Category II, or 95% Category III
Type 4	No bedding required except if rock foundation, use D_o/12 minimum, not less than 6" (150 mm)	No compaction required, except if Category III, use 85%	No compaction required, except if Category III, use 85%

Standard Installations and Respective Bedding, Soil Embedment Types, and Compaction Limits
Source: American Concrete Pipe Association

Federal and Elected Officials, JAXPORT, and SSA Marine Break Ground on $238.7 Million Terminal

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SSA Jacksonville Container Terminal Groundbreaking

U.S. Department of Transportation Maritime Administrator Rear Adm. Mark Buzby joined elected officials and leadership from JAXPORT and SSA Marine on Nov. 22 to break ground on a new state-of-the-art international container terminal at JAXPORT's Blount Island Marine Terminal.

The SSA Jacksonville Container Terminal is an expansion of SSA's current leasehold at Blount Island and includes $238.7 million in infrastructure and equipment upgrades. Operations will continue throughout the redevelopment, which is expected to be complete in 2023—coinciding with the completion of the federal project to deepen the Jacksonville shipping channel to 47 feet. Harbor Deepening is ahead of its original schedule and anticipated to be finished later that year, based on continued funding.

Phased yard improvements are underway at the terminal that will allow the facility to accommodate up to 700,000 TEUs (twenty foot equivalent units) annually. Berth upgrades are expected to be complete in 2021 and will allow the terminal to simultaneously work two post-Panamax vessels. The Jacksonville Harbor Deepening Project includes construction of a vessel turning basin that will allow larger vessels calling on the terminal to turn at Blount Island.

The SSA Jacksonville Container Terminal offers 80 acres of terminal operating space, with the option to grow up to 120 acres as space becomes available. The facility features three post-Panamax electric container cranes and terminal plans include the addition of three more state-of-the-art container cranes.

The facility is expected to create or protect 3,500 jobs, in addition to attracting new businesses and jobs resulting from the terminal's increased efficiency and capacity.

During the groundbreaking, Admiral Buzby formally presented JAXPORT with a previously awarded $20 million grant from the U.S. Department of Transportation. The grant will fund terminal enhancements that will allow the facility to accommodate more containers on an expanded footprint.

"An investment in the Port of Jacksonville delivers benefits for the local economy and for American workers. It is a central part of President Trump and Secretary Chao's belief of investing in infrastructure to grow our economy and create jobs," said Admiral Buzby. "This grant will also indirectly help support the jobs of the American civilian mariners who crew military sealift vessels that help us carry the fight wherever we must go."

"Jacksonville's port is a critical economic engine for our city, state, region and nation," said Jacksonville Mayor Lenny Curry. "The cargo that moves through these docks every year generates jobs and economic opportunities that empower families throughout our community. The enhancements we're breaking ground on today will help companies meet the growing demand and further enhance Jacksonville's growing reputation as a logistics hub for the southeastern United States."

"This facility represents a milestone in the evolution of our port," said JAXPORT Vice Chairman Jamie Shelton. "Together, with the support of Secretary Elaine Chao,

SSA Jacksonville Terminal MARAD Check Presentation our federal, state and local partners, and SSA Marine—we are investing in our region's future and ensuring JAXPORT can continue to create more jobs and economic opportunity for the people of Northeast Florida."

"There is no doubt about it, Jacksonville's port is on the rise," said SSA Marine Vice President of Project Engineering and Implementation Ari Steinberg. "This public-private partnership enables SSA to provide a world-class facility for our customers while investing in Northeast Florida—a community in which we have proudly served for more than four decades."

The SSA Jacksonville Container Terminal is a public-private partnership between JAXPORT and SSA Marine, with more than 65 percent of the landside improvements being funded by SSA.

The facility is a 4-mile dray from JAXPORT's Dames Point Intermodal Container Transfer Facility, offering direct service to and from Atlanta and Chicago, with additional service from Detroit.

A recent economic impact study found that cargo activity at Jacksonville's seaport generates more than 26,000 jobs in Northeast Florida and supports nearly $31.1 billion in annual economic output for the region and state.

SSA Jacksonville Container Terminal Groundbreaking (Left, Above, and Below)

Beach Renourishment in Jacksonville Florida

by Steven C. Howard, P.E., D.CE and Kevin R. Bodge, Ph.D., P.E., D.CPE
Olsen Associates, Inc.

2010 Aerial Photograph of Duval County, Florida

The beaches of Duval County, along Florida's "First Coast", enjoy a long and rich history that has been heavily influenced by coastal construction. There are about 16 miles of ocean beaches in Duval County, divided by the St. Johns River Entrance. The six miles of beach north of the river are part of a large expanse of public parks and remain mostly undeveloped. In contrast, the ten miles of beach south of the river are mostly developed and urban in nature. These include the 1.0- and 1.5-mile shorelines of the Mayport Naval Station and City of Jacksonville's Hanna Park, closest to the river entrance, and 7.5-miles of urban shoreline referred to collectively as "The Beaches". From north to south, this includes the Cities of Atlantic Beach, Neptune Beach, and Jacksonville Beach. These three local governments maintain separate budgets and governance but each share common services with the City of Jacksonville via an intra-local agreement. For more than 100 years, the beach cities have been an important and heavily utilized recreational amenity for the citizens of Duval County.

The Duval County coastline has been profoundly changed by navigation improvements built at the St. Johns River Entrance. These include construction of two rock jetties by the U.S. Army Corps of Engineers beginning in 1879 which were subsequently sand-tightened in the early twentieth century. Dredging and removal of sand deepened the river entrance from 15 feet to over 47 feet. The length of the north and south jetties is about 3 miles and 2.5 miles, respectively. As a result of sand impounded against the north jetty, the natural inlets north of the River Entrance have shifted north and one has nearly closed, and new islands have formed and overlapped old ocean shorelines. On the other hand, the jetties -- combined with persistently deeper channel dredging and the resulting changes to the ebb tidal shoal -- act as a littoral barrier that deprive the southern beaches of their natural sediment supply and have caused The Beaches to erode. This erosion, probably combined with imprudent development upon the natural dunes, prompted coastal residents and businesses to construct timber bulkheads as early as the 1910's and 1920's during the Florida land-boom.

After storms in 1925 and 1932, most of these bulkheads were replaced by concrete seawalls. Widespread coastal armoring combined with a chronic sediment deficit resulted in a gradual deflation and narrowing of the beach profiles throughout southern Duval County, from the 1920's through the 60's and 70's . The nor'easter of 1962 -- followed by the passage of Hurricane Dora in 1964 -- extensively damaged the beaches and coastal communities. The Corps began placement of sand dredged from the River Entrance to the 1-mile shoreline of Mayport Naval Station, just south of the inlet, in 1963. But the coastal damage was severe enough to warrant congressional authorization of the Federal Shore Protection Project (SPP) along the entire southern 10 miles of the Duval shoreline, south of the St. Johns River Entrance. The authorized project consists of a 60-foot wide construction berm at an elevation of +11 ft, MLW. The original 1965 authorization included federal fiscal participation for 10 years, which was later extended to 50 years. The Corps' authorizing design document was adopted in 1975. Initial project construction placed about 3.7 million cubic yards (cy) of sand on the beaches between 1978 and 1980, including sand from maintenance dredging. During the following 35 years, there were five principal renourishment events along portions of the southern, urban shoreline (in 1985-87, 1991, 1995, 2005, and 2011) along with periodic placement of maintenance dredged sand along the northern project shorelines of Mayport Naval Station and Hanna Park, just south of the inlet (about every 3 to 5 years). These efforts combined with a dune fencing & vegetation program initiated by the City of Jacksonville resulted in a remarkable recovery of Duval's beaches.

In September 2016, construction of the 6th scheduled renourishment of the SPP began. On October 7, Hurricane Matthew impacted Duval County with devastating effects to the local beaches. Hurricane Matthew caused substantial erosion to both the beach berm and approximately 8 miles of non-federal sand dunes. Despite loss of the seaward half, the existing dunes mostly held and prevented otherwise certain widespread flooding and additional damage to the Jacksonville Beaches . Areas without dunes experienced a much higher incidence of storm surge inundation into the upland relative to those areas where dunes were present or constructed prior to the storm. Further, areas where the ongoing federal project had been completed prior to Matthew experienced far less dune and beach erosion than areas yet to be renourished. By late summer 2017, the Corps and City had completed the post-Matthew beach renourishment including fast-track re-construction of 5.5+ miles of the non-federal dunes. This included direct sand placement of about 1,069,000 cubic yards of beach and dune sand, and installation of over 600,000 dune plants. Of the total sand volume, about 874,000 cubic yards was placed to the beach berm template and the remaining 195,000 cubic yards was placed as dune repair. About 3 miles of dune could not be fully repaired.

In September 2017, within one week of the last sea-oat's planting, the project was hit by Hurricane Irma, a storm which was similar in intensity to Hurricane Matthew. The prior dune reparations held up fairly well – particularly where the recently renourished berm took the majority of the storm's erosional force. Thanks to last minute sand closure of the few breaches left in the re-built dune, there was no flooding to the Jacksonville Beaches as was experienced during Hurricane Matthew. The 3 miles of dunes that were not rebuilt after Matthew suffered further damage, including localized breaching and upland inundation. About 1/3'rd of the new dune vegetation was destroyed – some by erosion, but much by wind .

Beach Erosion and Storm Damage from Hurricane Irma, North Atlantic Beach

The 7th principal renourishment of the project began in November 2018 along 8.5 miles of Duval shoreline including the City of Jacksonville (Hanna Park), Cities of Atlantic Beach, Neptune Beach, and Jacksonville Beach. The activity restored sand eroded from the project by Hurricane Irma. Dredging and beach fill placement of about 868,000 cubic yards of sand were placed to the project for berm and dune construction. Of this volume, approximately 777,850 cy was placed to the beach berm template, and the remaining 90,150 cy was placed as dune repair. Sand for the initial construction of the project and all subsequent renourishments was dredged from the project's offshore sand borrow area which is located about 8 miles east of the coastline in water depths of about 55 feet. Following fill placement, approximately 340,000 dune plants were installed to mitigate storm damages and plant newly constructed dunes. All work was completed by late summer 2019.

The total cost to renourish the federal project and mitigate of damages related to Hurricanes Matthew and Irma was about $39 million. For typical beach renourishment projects, costs are shared between the Federal Government (61.6%), State of Florida (18%), and the City of Jacksonville (20.4%). However, damages resulting from Hurricane Matthew and Irma were eligible for Federal Flood Control and Coastal Emergencies (FCCE) funds resulting in a Federal cost share of about 66.8% (~$26.1 million). Included in the total project expenses is $7.5 million paid by the City of Jacksonville in order to repair the non-federal dunes, constructed at 100% City cost. Because the engineered dune repairs were completed in response to a declared disaster, the City is anticipating State and Federal reimbursements which will bring the City's ultimate net expenditure to about $4.7 million, which is equivalent to a 12% share of the total project costs.

With nearly four decades of successful periodic renourishment, the Duval SPP is one of the three oldest federal beach nourishment projects in the state of Florida. A natural byproduct of highly successful long-term beach projects can be waning of public awareness regarding the original (and continued) need for beach nourishment. In Duval County, for example, one might be hard pressed to find an average beachgoer who is aware that the remnants of a rip-rap armored seawall are buried underfoot by the overwhelmingly healthy dune system. With continued renourishment of the federal project and maintenance of the non-federal dune system, hopefully a history lesson is the only education they'll receive on the subject.

Dune and Beach Repair from the 2018/19 Renourishment, Prior to Dune Vegetation Planting

Guajataca Dam Spillway Failure and Emergency Response

by John Kendall, P.E. and Dennis Zeveney, P.E.
United States Army Corps of Engineers South Atlantic Division, Jacksonville District

Guajataca Dam is owned and operated by the Puerto Rico Electric Power Authority (PREPA) and is located in northwestern Puerto Rico. In the days following Hurricane Maria, spillway releases from the dam destroyed the spillway chute and threatened the stability of the dam. This article describes the damage that initiated after Hurricane Maria, investigates the causes of the damage, describes the emergency response that followed, and some of the unique engineering challenges associated with Guajataca Dam. More detailed descriptions of these events are being published in United States Society on Dams (USSD) conference publication in April 2020.

Hurricane Maria made landfall in Puerto Rico on September 20, 2017 as a strong category 4 hurricane. The storm caused over $100B in damages, island-wide power loss, and reported life loss of about 3,000. The storm followed a previously active hurricane season that included Hurricanes Harvey, Irma and several smaller magnitude storms that devastated parts of Texas and Florida and which used up much of the available resources for power restoration in the southeast United States. Additionally, Hurricane Irma likely contributed to the spillway failure at Guajataca in that it produced significant rainfall across the island and used up much of the stormwater storage capacity and saturated the landscape prior to Maria.

Construction of Guajataca Dam was completed in 1928. The 121 foot (37 m) high, 1,036.8 feet (316 m) long embankment dam was constructed with roller compacted fill for the outer shells and hydraulic fill ("puddled core") methods to construct the core (where fines are placed as a water jetted slurry). The outlet works consist of a 20.5 foot (6.26 m) diameter concrete lined tunnel, excavated through the right abutment limestone with an intake and gated tower located upstream in the reservoir and outlet portal at the right downstream embankment toe. Water discharges form the outlet portal either through the river outlet to the Guajataca River or through the water supply pipe, which siphons under the spillway and into a distribution canal. Figure 1 shows the major features of the dam.

The spillway is constructed in a natural saddle in left abutment. The spillway has an approximately 500 ft long approach channel with a curved left side training wall to direct flows to an uncontrolled, ogee weir. The spillway is a 750 foot (228.6 m) long concrete trapezoidal chute that discharged orthogonally into the Guajataca River.

Figure 1. Post-Hurricane Maria Site Conditions

Settlement and transverse cracking of the embankment and significant cracking and distress of the original concrete spillway prompted PREPA to engage the U.S. Bureau of Reclamation (USBR) to remediate the dam in the 1980s. During site geotechnical characterization, USBR identified a number of weak, slickensided, clayey shears and scarp features across the project as well as confirming widespread presence of a CH/CL basal landslide shear surface on the east and south (i.e.; left) side of the Guajataca river channel and which underlies the majority of the dam and spillway foundation. 1980's remediation included rebuilding the upper 10 feet (3 m) of the embankment crest to restore the design elevations and repair cracking, the addition of a sand filter and stability berm to the downstream face of the dam, placement of buttressing fill downstream of the dam to increase effective stress on the landslide contact. Also at this time, the upper half of the spillway was reconstructed using overlapping slabs on a membrane to allow the concrete to move differentially and telescope out as the landslide mass continued to creep. Since this remediation in the 1980s, inclinometers have confirmed that the landslide continues to creep at rates of a few millimeters per year.

The following Figure 2 shows a sample of the basil shear surface collected from excavation during post hurricane Maria repairs. The sample shows 2 distinct directions of shear. The broad and deeper slickensides align more cross valley at 6 degrees and better align with current movement of the spillway. The more recent top set of slickensides that cross at 311 degrees better align with the current movements of the dam. It is postulated that construction of the dam itself, which buttress the slide cross valley, changed the dynamics of the slide and altered the resultant force acting on the slide causing the dam to now creep in a more downstream direction.

Figure 2. Sample of Basil Shear Surface Showing Multiple Orientations of Slickensides. The Red Arrows Show the General Trend of Creep

Figure 3. Red Lines Indicate Pre-hurricane Outline of the Spillway Chute Invert

Vehicular access was not possible in many areas after the storm due to flooding of local roads, down trees/ power lines, landslides, etc. PREPA wasn't able to inspect the dam until 2 days after the storm. The first known post-hurricane photographs of the dam were taken by a local news organization on September 22; one of these photographs is shown in Figure 3. This photograph clearly shows massive erosion of the spillway. The red lines on this photograph indicate the approximate pre-hurricane limits of the spillway chute. About half of the concrete spillway chute (about 100 meters) was completely destroyed and the water supply siphon under the spillway was destroyed, cutting off water supply to this part of the island.

USACE first arrived on site 4 days after the storm. By the time, spillway flows had receded in magnitude to about 0.3 m above spillway crest. After inspecting the site and reviewing as-builts, it became apparent that the river outlet had become blocked with debris from the spillway, limiting discharge capacity of the outlet works and exacerbating the problem. The outlet was immediately cleared; however, the capacity of the circa 1920's outlet gates was not sufficient to draw water below the spillway crest and spillway flow continued for a total of 23 days. Based on the potential for continued erosion, and considering that much of the material that had eroded from the end of the spillway chute was buttressing the left abutment landslide, the decision was made to initiate emergency intervention measures. At this time, military support was engaged to aid in placement of armoring materials. Jersey barriers were identified as an asset with sufficient size and quantity available on the island to reinforce the end of the spillway and dissipate the energy of the plunging water. Figure 4 shows a CH 53 helicopter dropping a concrete Jersey barrier. USACE also installed ten-45 cm pumps (capacity of 2.4 cubic meters per second or 85 cubic feet per second) connected to HDPE pipes that were routed from the reservoir and discharged into the water supply canal and river. This temporarily restored water supply and allowed greater control of the reservoir.

Figure 4. CH 53 Helicopter Dropping a Concrete Jersey Barrier

Large sand bags were also air dropped from helicopters to quickly construct an end sill for a temporary stilling basin. Figure 5 is a photograph taken of the progress of Jersey barrier and sand bag placement. Final placement of these materials included 502 Jersey barriers and 1,338 large sand bags.

Comparison of the first available images from September 22 to the final images after spillway flow stopped show that the majority of the spillway damage and erosion occurred within the first 48 hours of spillway flow. It is estimated that 85%

Guajataca Dam Spillway Failure and Emergency Response (Cont.)

Figure 5. Jersey Barriers and Large Sand Bags Forming a Stilling Basin

of the total spillway damage had already occurred by September 22 following an estimated maximum reservoir head over the spillway crest of 2 m and 227 cubic meters per second (about 43 percent of the spillway capacity). Even though spillway flow continued for an additional 21 days at depths of 0.3 meter or less, little additional loss of the spillway occurred. During this additional 21 days, the scour hole continued to slowly widen laterally and deepen. Although progression was slow, the material that was eroding was buttressing the landslide on which the project is founded. Loss of the buttressing fill and reactivation of the slide would have had catastrophic consequences. An estimated total of 50,000 to 60,000 cubic meters of material were eroded by the spillway flow during the entire event.

The damaged spillway washed most of the forensic evidence downstream that could be used to evaluate the failure mechanisms that initiated during Maria. Creep of the left abutment landslide had resulted in severe cracking and displacements of the spillway monoliths, which were replaced by USBR in the 1990s but continued to crack and were again in poor condition at the time of Hurricane Maria. The first idea theorized for the initiation of the spillway failure was uplift or failure of one of the slabs due to cracking. However, review of historical imagery showed that erosion had previously occurred off the northwest end of the spillway during previous spillway releases. Figure 6 from 2016 shows how erosion had previously occurred due to the misalignment of the spillway to the river.

It is theorized that erosion likely initiated in the same location during Hurricane Maria; however, spillway flows were of such magnitude and duration that the erosion undermined the west side of the spillway concrete, causing it to collapse. Although there was a shallow turndown cutoff wall at the end of the spillway chute, such a feature would provide little protection if erosion progressed from the side of the chute as suggested in the image above.

Figure 6. Aerial View of Erosion of the Northwest (left) Side of the Spillway Near the Discharge End Following Spillway Releases in November 2015 and March 2016

In the 2+ years that has elapsed since Hurricane Maria, USACE and FEMA have completed interim repairs of the spillway, including construction of a stilling basin at the downstream end of the chute and a realignment to align flows to the degree possible with the alignment of the river. These are considered interim repairs given that seismic stability and static overtopping of the spillway and embankment were not evaluated or remediated as part of the post Maria emergency response. Figure 7 below shows the repaired spillway.

Conclusions

Unique emergency actions, which included air dropping concrete Jersey barriers and large sand bags, provided erosion protection and landslide stabilization that helped prevent the failure of the entire spillway and potentially failure of the dam.

Review of historic imagery of the dam shows that erosion previously occurred off the left side of the spillway chute, most likely due to the spillway's misalignment with the river that allowed water to flow out of the sides of the spillway rather than off the end. This likely was the initiation point of the spillway failure during Hurricane Maria.

Comparison of the first available images taken two days after the storm to the final images taken after 23 days of spillway flow show that the majority of the spillway damage and erosion occurred rapidly within the first 48 hours of flow.

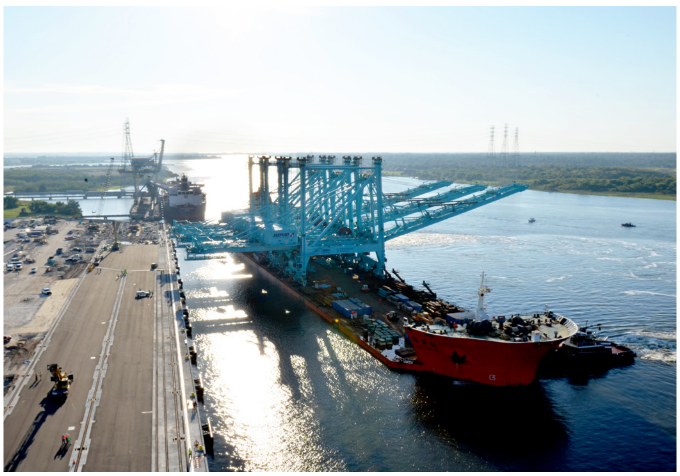
Although the spillway has been repaired and water supply restored, future studies are planned by PREPA to address static overtopping, seismic stability concerns, and long term mitigation of the left abutment landslide.

Figure 7. Aerial of Repaired Spillway

Blount Island Marine Terminal Reconstruction

by Frank Proctor
Ports Section Manager, HDR Engineering, Inc.

The Jacksonville Port Authority (JAXPORT) is working to upgrade their facilities to accommodate the next generation of cargo ships spurred by the expansion of the Panama Canal and the industry trend toward larger vessels. These larger ships require deeper water and more robust infrastructure. While the USACE has been working on deepening the federal navigation channel, JAXPORT has been upgrading their wharves and ship-to-shore (STS) gantry cranes to maximize the benefits of the industry changes and continue to grow the Port's business.



Blount Island Marine Terminal Crane Arrival

HDR provided JAXPORT with planning and engineering design services to reconstruct the wharf at their primary container handling facility, Blount Island Marine Terminal (BIMT). The existing wharf and inefficient cargo handling equipment could no longer support the larger vessels being utilized by their customers and were in dire need of replacement. The existing terminal was limited to servicing Panamax-sized vessels (950 feet long, 106 feet wide, and a draft of 40 feet) with a fleet of 50-foot gage rail-mounted, diesel-powered ship-to-shore (STS) gantry cranes. As part of the modernization of the container operations and facilities at BIMT, as well as to substantially increase the throughput capacity, the new wharf is designed to support New Panamax vessels (1,200 feet long, 168 feet wide, and a draft of 50 feet) and 100-foot gage electrified STS cranes. The project, in excess of $100M in new construction by completion, will provide the Port with a new container and mixed cargo wharf that will service their needs well into the latter half of the century.

The first phase of construction (Berth 35) included complete removal and replacement of 1,285 linear feet of pile-supported wharf. The replacement structure was designed to accommodate 100-ft gage New Panamax STS cranes, three (3) of which were recently delivered from China. Because JAXPORT handles multiple cargo types and BIMT is not solely a container terminal, the wharf deck was designed for a 1,000 psf uniform live load and has a dedicated Heavy Load Zone. This load zone has been designed for a 2,000 psf uniform live load to handle special cargoes and also provide a location for delivery of the new STS cranes. The second phase of the wharf replacement, currently under construction, includes removal and replacement of approximately 1,385 linear feet of wharf and continuation of the 100-ft gage landside crane beam.

As this was the first facility at JAXPORT's Blount Island terminal that can accommodate electrified STS cranes, the first phase of the project included construction of all necessary electrical infrastructure to support up to eight (8) cranes, including a new 20 MVA substation that transforms incoming 26.4 kV high-voltage current to 13.2 kV medium-voltage current, a switchgear building that houses the 13.2 kV medium-voltage electrical switchgear, and all associated underground distribution.

Blount Island Marine Terminal Phase I Complete

HDR's planning and design addressed challenges specific to construction in a working cargo terminal, which included the implementation of a construction approach and phasing plan to accommodate construction with minimal disruption to ongoing tenant operations while maintaining access for the existing container cranes to necessary heavy weather tie-down points.

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2020 E-WEEK CALENDAR OF EVENTS

Feb. 11 (Tueday)
ITE First Coast Chapter Meeting - North Florida TPO

Feb. 13 (Thursday)
ASHE Luncheon - UNF University Center

Feb. 14 (Friday)
ASCE Kick-Off Luncheon - UNF University Center

Feb. 16 (Sunday)
ASCE Community Outreach - McCoys Creek

Feb. 17 (Monday)
AWWA Sporting Clay Shoot - St. Augustine

Feb. 20 (Thursday)
Engineers Week/ASHE/ASCE/ FES/FEST Happy Hour

Feb. 22 (Saturday)
Annual Awards Banquet & Casino Night - San Jose Country Club

Feb.25 (Tuesday)
SMPS North Florida Transportation Breakfast & JRTC Tour - 927 Events

Feb.25-27 (Tue.-Thurs.)
Northeast Florida Construction Career Days - Equestrian Center

Feb. 28 (Friday)
Mathcounts - UNF University Center

March 10 (Wednesday)
Project S.A.F.E. - Jacksonville Transportation Authority Headquarters

Reminiscing on 2019 E-Week
















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ECS Florida, LLC

Joe Champion, PE
ECS Florida, LLC

Annual Awards
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Joe Champion, PE
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