The Hearst Castle in San Simeon, Calif., is a sprawling estate comprised of multiple historic structures featuring 165 rooms on 250,000 acres. The estate structures were built over many years starting nearly 100 years ago, and the buildings have undergone many changes during this time. To this day, Hearst Castle remains an unfinished project. While the original construction of the Neptune Pool spanned from 1924 to 1936, it has evolved over time. The pool visible today is the third iteration of the original, which grew in size to keep pace with other building construction on the property. The unique pool, with its custom Vermont marble tile, iconic Italian statues, and one-of-a-kind gravity sand filtration and recirculation system, created an unusual

**RESTORING AN ICON**

Renovating the Historic Hearst Castle Neptune Pool

*Terracon's Matt Reynolds, P.E., assists clients with the unique challenges of aquatic design and engineering including pool structural, electrical, and waterproofing solutions.*
restoration challenge for the geotechnical and facilities professionals at Terracon.

The renovation project was sparked by the discovery of leaks in the pool shell, piping, and filtration system, coupled with a statewide drought. Converted to a museum and now owned by California State Parks, renowned historical restoration architect Page and Turnbull and aquatics engineer Bill Rowley, Ph.D., led the Neptune Pool renovation. Terracon began involvement in the project toward the end of design through the acquisition of Rowley International.

CONSTRUCTION AND NEW DISCOVERIES
The high potential for unknowns can make an aquatics renovation more complex than new construction, and the Neptune Pool was no exception. Original plans were for only the field white marble tile to be replaced in the interior of the pool shell, while the dark green accent tile was going to be reused as much as possible. However, during pre-demolition testing, natural asbestos was discovered in the existing marble tiles. If the marble tiles could remain fully intact during demolition, then no health hazard would exist. After a test demolition revealed the tiles would break during removal, a full hazardous materials removal of the existing tile was initiated. Total replacement of the tile followed, increasing the construction schedule and budget considerably. The project scope required removing all tile, repairing the concrete shell, installing waterproofing throughout the pool interior, and reinstalling the marble tile finish.

Another renovation complication occurred during replacement of existing cast iron pool piping in a tunnel. Several unknown pipes and conduits were discovered and needed to be identified and properly capped. An abandoned electrical conduit penetrating the tunnel ceiling was not capped off and provided an avenue for water intrusion during storms. In the filter area, the project scope included removing all embedded iron pipe fittings, repairing the concrete structure, installing waterproofing on the interior surfaces, and replacing all filter media. When coring out the ferrous piping fittings, the contractor discovered the existing concrete structure was much thicker than originally anticipated. Terracon developed new repair details to match the existing condition and provided waterproof piping penetrations through the multiple filter vessels.

CREATING SOLUTIONS
The Neptune Pool project is an evolving project requiring aquatic design and engineering including pool structural, electrical, and waterproofing solutions. There were no past projects to review exactly like any of the scenarios we encountered. The project geotechnical and facilities team depended on their previous experience, review of existing conditions, and collaboration with industry experts to provide viable repair solutions to meet the restoration design intent and existing area conditions.

Expected to reopen in 2018, the Neptune Pool’s restoration will enable future generations to experience its beauty. In addition to restoration services, Terracon’s design team can assist facilities facing common restoration and design issues including maximizing efficiency, conserving energy, and improper design and installation.

Find out more about the historic Hearst Castle at hearstcastle.org

Matt Reynolds, P.E.
Matt is a department manager in Terracon’s Concord, Calif., office and oversees Terracon’s aquatics services. Matt has more than 11 years of professional engineering and design experience specializing in commercial swimming pool design, repair, and operation.
When you plan to construct a 35-story high-rise in Downtown Seattle, you must also plan to go very deep into the ground. Structures of this type commonly require temporary excavations 50 to 75 feet below grade. The challenge in construction is in the design of the temporary retaining system. The excavation retention must be designed to perform amid the existing infrastructure and adjacent buildings without causing damage. In fact, the City of Seattle requires documentation that the designs will not inflict deflections in excess of one inch in the adjacent structures.

**ACCOMMODATING SITE–SPECIFIC CHALLENGES**

As part of the Tower 12 Building project, a 60-foot-deep excavation was required to construct five levels of below-grade parking and the foundation system for the new high-rise building. Excavation was facilitated by soldier piles with lagging, along with ground anchors providing additional lateral restraint. Along the west side of the excavation, the temporary retaining wall was required to maintain support of the adjacent infrastructure which included an existing 20-story tower with three levels of below-grade parking separated from the project by an 18-foot wide alley. The below-grade parking did not permit continuation of the soil nail system used at the other excavation faces, and a site-specific approach was required to accommodate the physical obstructions.

**COMBINING EXCAVATION SUPPORT SYSTEMS**

The solution combined two temporary excavation support systems, soil nailing, and anchored soldier piles, to work within the site constraints. The adjacent building basement limited the horizontal distance available for placement of anchors in the upper half of the excavation. Densely-arranged, short-length soil nailing was used to support the top 30 feet of the excavation, while the bottom 30 feet of the excavation was supported with soldier piles combined with steeply-inclined, high-capacity (200,000 pound) ground anchors which extended below the adjacent 20-story high-rise building foundation. The solution is shown on the west wall section illustration (right). Notice how the geometry of the existing basement and underground utilities were accommodated with the combination retaining wall system. This system also eliminated the need for internal bracing, which would have increased the project’s construction cost and lengthened the schedule.

The performance of the temporary retaining wall was monitored with an inclinometer to measure ground displacement from surface down to rock as well as optical survey monitoring of the top of the excavation, adjacent roadways, and buildings. The monitoring program demonstrated the performance of the unique design, limiting the movement of the wall.

**CREATING INNOVATION**

Other services Terracon professionals provided for the 35-story high-rise building included geotechnical design recommendations for foundation support, site specific seismic design criteria, geotechnical special inspection, and environmental observation to determine if impacted soils were present during excavation. Through a collaborative approach, the team was able to bring our client an innovative and cost-effective design while meeting the project budget and schedule.

**RICHARD LUARK, P.E.**

Richard is a senior engineer in Terracon’s Mountlake Terrace (Seattle) office with more than 30 years of experience in geotechnical engineering, micropile, and retaining wall design.
RELIABLE MATERIALS VERIFICATION CRUCIAL TO PUBLIC PROJECTS
Alaska, land of extremes... extreme landscapes, extreme natural beauty, extreme wildlife, extreme topography, and some of the most extreme transportation infrastructure construction conditions in the nation. Infrastructure projects undertaken in the state of Alaska are faced with many challenges not typically encountered in the lower 48 states.

SUCCESS OF ALASKA DOT PROJECTS DEPENDS ON QUALITY ASSURANCE

UNDERSTANDING THE COMPLEXITY OF MATERIAL LOGISTICS
Design, engineering, logistics, and construction challenges for infrastructure projects include temperatures that can reach 60 degrees below zero Fahrenheit, hurricane force winds, and glaciers releasing river tsunamis. Local wildlife comes to call with grizzly bears “playing” on project sites, sea lions taking residence on the construction barges, and moose populations seeing nothing wrong with rearranging carefully-placed traffic control devices.

Steel components bound for projects in Alaska undergo lengthy transit times. They are often milled and manufactured in one state, fabricated and assembled in another, galvanized or painted in any number of states; then transported by truck or railcar to ports on the West Coast; and finally barged to ports or docks in Alaska. Once the structures or components have arrived in Alaska, after thousands of miles of transport, some of them are then moved to some of the most remote and desolate locations on the planet, including the small islands along the Aleutian chain, high mountain passes, the barren tundra of the North Slope, and the coastal fjords of the South Alaskan Coast.

The difficult and expensive transport of materials to Alaska makes it especially important the materials are correct when they arrive. If a replacement or modification to a structure or component is needed, it may prove catastrophic to a project in terms of funding, time, and loss of service. In these circumstances, materials verification is critical.

VERIFYING QUALITY IN EXTREME ENVIRONMENTS
Since 1999, Mayes Testing Engineers, A Terracon Company, has provided quality assurance services to the Alaska Department of Transportation & Public Facilities through multi-year term agreements for more than 350 infrastructure projects. Essentially, the Mayes team functions as the state inspector for all fabrication that occurs in the lower 48 states. Services cover a range of disciplines such as fabrication shop auditing/inspection, submittal review, structural/material analysis, complex coatings inspection, non-destructive testing procedures, and other specialized consulting activities as requested.

With numerous active Alaska DOT projects and 32 projects completed there in 2017, the Mayes team’s experience in managing the many project challenges and unique requirements helps verify construction materials and ensure proper fabrication. Be it a massive steel box-girder bridge, runway lighting for a remote airstrip, a ferry terminal for an isolated village, or on-site bridge analysis and non-destructive testing, the quality assurance services provided to the Alaska Department of Transportation & Public Facilities are an integral part of the infrastructure quality assurance program for projects in the wild Northwest.

BRAD GROSS, CWI, NDT LEVEL II
Brad is a senior project manager with Mayes Testing Engineers, A Terracon Company, in Lynnwood, Wash. With more than 22 years of experience, Brad is the project manager and lead quality assurance representative for State of Alaska Department of Transportation & Public Facilities projects.
Pickens, a small rural town in upstate South Carolina, had big dreams of revitalization. Dreams that may never have been realized without an abandoned railroad, support from Terracon’s Greenville, S.C. office, and an EPA Brownfield Cleanup Grant. Revitalization and small towns don’t always go hand in hand. Funding can be hard to come by to make dreams a reality. Luckily for the City of Pickens, one brownfield grant award set in motion a project consisting of 10 local, state, and federal grants totaling $1.5 million in awards and matching funds to create the Pickens Doodle Park.

THE IMPETUS FOR REVITALIZATION
The Brownfield funding acted as the catalyst for redevelopment. With the help of Terracon’s Becky Horace, a former city project manager, the city was able to leverage funds from multiple agencies. A South Carolina Department of Commerce Community Development Block Grant was used to demolish the building. A grant from the South Carolina Recreational Trails Program allowed for the extension of the trail through the future park site to Highway 8 to allow safe passage to the historic downtown. The Appalachian Regional Commission awarded $500,000 to create Pickens Doodle Park, which will boast an open-air farmers market created in the style of the historic train depot, ADA accessible playground, outdoor exercise equipment, and a sensory rain garden for children with sensory processing disorders. Additional local and state grant awards will allow for additional amenities including solar lights, a mural, art sculptures, a mobile app, and kiosks.

In addition to environmental services, Terracon is currently providing special inspections and construction materials testing for the Pickens Doodle Park project and any other environmental work needed for other city projects. “This has been a once in a lifetime project that will have a tremendous impact on this community that spans many generations,” Tice Welborn said. “I am honored to have been a part of this undertaking and proud to represent Terracon who was instrumental to the success of this project.”

STARTING WITH AN IDEA
The cities of Pickens and Easley came together to create a “rails to trails” project along the abandoned Doodle Rail Line, and an 8-mile asphalt multi-use trail was born. With the popularity of trail projects sweeping the nation, it seemed only logical to follow suit with the success of the neighboring Swamp Rabbit Trail located throughout Greenville County. There was only one problem: the blighted rail depot which sat at the trailhead in Pickens.

Although most residents saw the dilapidated structure as a roadblock to success, Tice Welborn, P.G., senior geologist, and Jeff Gurrie, senior industrial hygienist, of Terracon’s Greenville office, saw opportunity. After coordinating with the local city administrator, Bruce Evilsizor, Terracon set out to identify the issues which needed to be addressed. Upon completion of the site assessment activities, it was determined the best route would be for the City to apply for an Environmental Protection Agency (EPA) Brownfield Cleanup Grant to fund asbestos abatement from the structure. Once the city council approved, work started on the cleanup grant application. In the fall of 2015, the City of Pickens was awarded $153,000 to remove the hazardous materials from the building.

BECKY HORACE
Becky is Terracon’s Brownfield grants coordinator in the Greenville, S.C. office. She is responsible for coordination of the brownfield Assessment, Clean Up, and Revolving Loan Fund Grant applications. Her experience in local municipal government and writing provides a unique perspective and insight to our client’s needs.

TICE WELBORN, P.G.
Tice is a senior geologist in Terracon’s Greenville, S.C. office. He has more than 10 years of environmental consulting experience and has largely focused on state and federal Brownfield projects.
Be That Engineer!

Partnering with the Society of Women Engineers (SWE), and their SWENext Program, the Terracon Foundation has helped develop “A Day In the Life” video series aimed at showcasing careers in the sciences to female students.

Help us engage the next generation of engineers and scientists by addressing the enclosed postage-paid postcard to a young woman you know, encouraging her to consider a career in the sciences!

PACKER NAMED NEW PRESIDENT

We are pleased to announce Gayle Packer is now president of Terracon Consultants, Inc. and a succession framework is commencing for her appointment to chief executive officer. While most-recently serving as executive vice president, chief administrative officer, and a member of the board of directors, Gayle coordinated the acquisition and integration of 50 companies, leading Terracon’s rise to number 24 on Engineering-News Record’s Top 500 Design Firms list.

For more information, visit terracon.com
Explore “A Day In The Life”

Check out SWENext’s “A Day in the Life” video series. These videos are for students like you, who may be participating in a STEM curriculum or have an interest in learning about engineering from young women already in the field. You’ll see four Terracon women share what interested them in pursuing engineering as a career and what interests them outside of work. Learn how you can shape the future!

Watch now terracon.com/swe
#BeThatEngineer

Meet SWE
SWE has nearly 40,000 members, 100 professional sections, 300 student sections, and global affiliates throughout the United States and around the world. societyofwomenengineers.swe.org
BE THAT ENGINEER!
You can help shape the future.

As the world changes, we face big challenges that will demand the kinds of creative solutions only engineers and scientists can provide. As someone thinking about great opportunities for your future, I want to introduce you to the Society of Women Engineers (SWE)’s SWENext program that encourages girls to learn more about these careers.

Learn more: terracon.com/swe
#BeThatEngineer
societyofwomenengineers.swe.org/swenext