Planning for stormwater management as part of construction management is among the most proactive ways to prevent environmental impacts and unexpected project costs. Even a small storm event can cause excess concrete, mud, and sediment to collect in washout areas, damaging property and delaying construction. Many owners and contractors have faced the consequences of not having a stormwater management plan in place, ranging from complaints to a visit from a local inspector—even significant fines.

Terracon’s Eric Dubcak (left) and Kyle Bennet (right), local stormwater professionals, assist clients in meeting area regulations by recommending the right solutions.

**PLANNING FOR STORMWATER PERMITTING AND COMPLIANCE**

Well in advance of breaking ground, it should be determined who is responsible for planning and managing stormwater permitting and compliance. Frequently, this responsibility occurs at the beginning of the rainy season when the general contractor notifies the owner or stormwater permit holder.

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someone should manage the stormwater to prevent scheduling delays. Since this responsibility is often specifically excluded in bids, it can become a last-minute scramble to resolve. While early partnership offers owners the greatest value, Terracon is available to collaborate with a project team after the project has begun with a focus on quickly bringing the site into compliance, and can even help after a violation has occurred.

With proper planning, stormwater design challenges can be addressed, corrected with a licensed contractor, and monitored with weekly inspections. Common recommendations may include catch basin inlet protections or other best management practices. The associated costs can affect project budgets and profit if post-violation recommendations need to include operation of a chemical treatment system to manage the stormwater.

READY TO RESPOND
When a client in the Northwest received a permitting violation letter following a recent inspection citing the lack of stormwater management, the Terracon team was quick to respond. The project setting included the demolition of a multilevel structure to be redeveloped with an even larger structure. The violations included the lack of best management practices, including “track out” of mud and failure to sweep daily; excess concrete on the ground not contained in a designated washout area; and cleaning or missing catch basin inlet protection. It also required the permit holder to have weekly inspections completed by a certified erosion and sedimentation control lead. Other administrative record-keeping violations included failure to report discharge monitoring reports from the permit start date and failure to maintain stormwater records/inspection sheets onsite and have them readily available upon request. Terracon’s team worked closely with the agency and inspector to bring the site into compliance by implementing the necessary best management practices and maintaining all required records.

Stormwater permitting and management requirements vary widely among states, making it important for contractors to maintain good working relationships with their state and local agencies. Understanding local stormwater management requirements can help prevent significant potential fines and project delays.

With offices in more than 140 locations nationwide, Terracon can provide you with local, trusted stormwater professionals familiar with your area regulations and recommend the right solutions for your stormwater issues.

Did You Know?
Stormwater permitting and management requirements vary widely among states, making it important for contractors to maintain good working relationships with their state and local agencies. Understanding local stormwater management requirements can help prevent significant fines and project delays.

Excess concrete, mud, and construction sediment often collect in washout areas.

ERIC DUBCAK, CESCL
Eric is a project manager at Terracon’s Seattle office specializing in environmental project work for a wide variety of clients throughout the Northwest.
WINDOW FEATURES IMPACT PERFORMANCE
When working with a client, Terracon’s facilities professionals consider window location, window-to-wall ratio, solar heat gain coefficient (SHGC), orientation, placement, and type (single clear, double clear, and double clear low-energy, double low-energy with shade and more). Exterior features such as an overhang or fins also have an impact on energy usage. Local code requirements mandating specific materials are another key variable. Once all relevant data is compiled, advanced performance modeling software is used to simulate the feature’s impact on building façade performance.

Impacts of Window Selection
- Visual comfort
- Thermal comfort
- Building energy consumption
- Building aesthetic
- Condensation resistance

Implementation of an energy-efficient glazing design strategy on high-performance façade is one of the key factors to impact mechanical systems. Selection and integration of the appropriate energy efficient windows is key to maximizing the performance of a building’s façade.

Taking a holistic approach to window selection can identify risk, enhance performance, optimize comfort, and provide savings.

As an example, a building located in a northern climate may be designed with larger windows when facing south allowing more light, and thus heat, ultimately saving on heating costs. Conversely, a building in a warmer environment typically achieves better energy performance with smaller windows when facing east and west, different orientation, and more tinting and shading. These assessments make sense, but modeling provides the details and confirmations to validate these assumptions while outlining expected performance criteria and forecasting results of design and product selections. The resultant scenarios greatly enhance the owner’s ability to make confident decisions for their building plan.

Building façade performance can be significantly impacted by the presence of exterior building shades or awnings.

Joe is a senior facilities architect with Terracon in Houston. He specializes in sustainable design practices, simulation modeling, and building enclosure assessment for K-12 schools, government buildings, institutions, medical facilities, office buildings, and aviation projects.
BUILDING A STRONG FOUNDATION

Laying the Groundwork for a Successful Hospital Project

Excellent healthcare facilities are essential to vibrant communities. The recently constructed Florida Hospital for Women is a great addition to the healthcare system in Orlando. The 12-story patient tower features 322 beds, 14 labor and delivery suites, and 13 operating rooms, some specially designed to accommodate the DaVinci Surgical System for robotic minimally invasive surgery. The way the geotechnical engineer collaborated with the design team to expedite its construction demonstrates how collaboration between key design partners can produce significant dividends in the budget-driven and time-sensitive healthcare industry, ultimately benefitting an entire community.

“This project is a prime example of the power of collaboration among the design and construction team members paying big dividends,” said Amr Sallam, Ph.D., P.E., Terracon’s principal geotechnical engineer. The partnership led to a final project design that saved the client more than $1 million and allowed the facility to open two months earlier to begin serving the community.

FACING SETTLEMENT CHALLENGES

The new facility would subject columns to loads of up to 2,000 tons. Such loads are routinely founded on deep foundations, extending 75 feet or more into the ground. Conventional shallow foundations may create excessive settlements under such heavy loads. In addition to the challenge of high column loads, the constricted urban site was connected to existing buildings on the main campus and was adjacent to a heavily-used rail line. Each of these features added complexity to design and construction.

Terracon believed alternatives to deep foundations could save time and money, but it took collaboration with the design and construction team to consider its suitability for the project. Understanding both the geotechnical and structural aspects of the design, Terracon progressed beyond a typical geotechnical engineering study to an interactive design with the structural engineer, Kevin Casey, P.E., (Paul J. Ford), all in collaboration with the contractor (Brasfield and Gorrie), and the owner’s representative, Mohammed Alai, AIA (Florida Hospital).

MAT FOUNDATION SAVES CONSTRUCTION TIME

After considering several options at the preliminary stage, Terracon proposed the use of a mat foundation. The design of a mat for such heavy and variable loading conditions required an iterative process between the structural engineer running the SAFE model, the structural engineer’s finite element software program, and the geotechnical engineer utilizing PLAXIS model, a finite element software. The structural model generated a preliminary contact pressure distribution. Terracon used the PLAXIS model to estimate settlement, redefining the contact pressure estimates using aspects of slab rigidity and subgrade support. The revised contact pressures were input into the structural model. This iterative approach was repeated until estimated settlements became congruent.

The iteration produced a final mat design with predicted maximum settlements of 2.5 inches at the interior core to about 1.5 inches along two adjacent buildings.

After considering several options at the preliminary stage, Terracon proposed the use of a mat foundation.

The contractor determined the cost of the mat foundation would be slightly lower than deep foundations. A more substantial benefit associated with the mat alternative was reduced construction time. The client and design team determined together the expected settlements were acceptable, and the estimates allowed the design of appropriate connection points to existing structures. The design achieved a reduction in the construction schedule by two months. Settlement monitoring confirmed settlements were well within the maximum values predicted.

Since opening in April 2016, the Florida Hospital for Women has provided enhanced medical care to the Orlando community, providing additional labor and delivery suites, operating rooms, postpartum bed space and an area for equipment offering minimally invasive surgery options for patients.

AMR SALLAM, PH.D., P.E.

Amr, a senior engineering consultant in Terracon’s Winter Park office, has been practicing geotechnical engineering for 22 years specializing in shallow and deep foundations for high-rises, heavily loaded structures, bridges, wind turbines, deep and staged excavations, and more.
MODERNIZING AN AIRPORT TERMINAL

Expanding to Improve Customer Experience

As one of Arizona’s main transportation hubs, Phoenix Sky Harbor International Airport has experienced significant growth and expansion in the last five years. To meet the needs of its nearly 40 million passengers annually, the airport is working to improve services for both airlines and travelers alike. To help in the expansion, Terracon’s experienced aviation and materials professionals provided quality assurance consulting and non-destructive testing services on building components to verify future travelers would be safe during seismic events and the quality of construction would meet the intended life-cycle costs.

Serving more than 40 million passengers annually, Phoenix Sky Harbor International Airport is meeting growth and expansion by expanding Terminal 3.

The original terminal was built in 1979 and needed improvements to keep the airport competitive. Recent work involves a $590 million design-build expansion to the existing Terminal 3, which consists of a new customer processing terminal, South Concourse, and enhancements to the North Concourse. The existing South Concourse of Terminal 3 was razed, and a 15-gate concourse was constructed to replace the structure. The makeover included adding windows throughout the facility and even a new garden and dog park—all to bring a more open and modern experience to visitors. The new structures were constructed of reinforced concrete, structural masonry, structural steel moment frames, and metal decking.

DEPTH OF SERVICES DIFFERENTIATES

For this signature project, Terracon initially conducted materials testing to supplement the City of Phoenix Aviation Department as part of the quality assurance team during construction. Terracon provided a full-time, experienced aviation technician to perform compaction verification, concrete and grout sampling, and construction observation. Having on-site knowledge and expertise with respect to Federal Aviation Administration specifications, materials, and typical construction practices occurring during airport construction was an immediate value to the owner and contractor. As an added benefit, our local staff was also well versed with City of Phoenix requirements which enhanced communication, and kept the project moving forward without unnecessary delays.

Terracon’s experienced welding inspectors observed and tested 100 percent of the moment connections in the project’s South Concourse.

During scope development, the airport team noted the project also required visual welding inspection and ultrasonic testing of the moment connections for the structural steel welding construction. Based on those notes, Terracon provided two experienced, local certified welding inspectors with non-destructive testing expertise to the project to observe and test 100 percent of the moment connections as well as provide standard welding inspection services for the welded connections for the South Concourse. High-strength bolting special inspection, structural steel erection observation, and fabrication inspection of steel were also conducted.

REPORTING ADDS VALUE

During construction, Terracon provided daily reports and test data including location descriptions and photos which were rapidly turned around to the project team—most within 24 hours after performing the service. This allowed the team to quickly confirm the information met project specifications and allowed the contractor to perform minor rework as necessary without losing time. Terracon tracked all non-conformances separately on a deviation log, keeping outstanding non-conformities at a high attention level to all concerned parties.

As airports throughout the United States prepare for update and expansion, Terracon continues to offer comprehensive services and solutions for facilities of all sizes. With a national footprint, we serve many large and regional airports from our local offices. Our aviation team is well-versed with FAA specifications, specific reporting requirements, and special inspection, and is ready to assist with any facility needs.

TRACY GROVER

Tracy is a principal and senior project manager in Terracon’s Phoenix office. Tracy is the current Chair of the American Concrete Institute Committee 311, Inspection of Concrete, and has extensive experience in airport construction, materials testing, and quality assurance. He has consulted on airports and airfields in Washington, Idaho, Utah, Colorado, Arizona, New Mexico, and Guam.
TERRACON ANNOUNCES
HEALTHCARE SERVICES LAUNCH

To better meet the needs of thousands of clients nationwide, Terracon is announcing the formal launch of our multidiscipline healthcare services. The nationwide group tailors services to help clients respond to the ever-evolving healthcare landscape.

“Healthcare is a local business. Terracon is rooted in the communities where we live and work, but we also have a national footprint that positions us to assist our clients wherever and whenever they need us,” said Laura Reinbold, P.E., Terracon national director of healthcare. “Our clients serve the most vulnerable populations, and they can rely on us to be an experienced, nimble partner.”

To learn more about our capabilities, visit:
terracon.com/healthcare