When a window is too high to reach, a building is difficult to access by scaffolding, or a facility is too large to survey—call in the drones! The introduction of small Unmanned Aircraft Systems (sUAS), or drones, has added exciting new options for providing building investigation services with greater accuracy and increased efficiency.

Traditionally, assisting owners, architects, and contractors tackle building enclosure issues, performance deficiencies, and maintenance investigations of their properties has meant setting up staging equipment or acquiring the largest boom lift available and hoping for safe access. This access can be time consuming, expensive, and inadequate for the task at hand. Drones can provide a safer and quicker option for examining the components of a curtain wall, accessing a recessed ledge on an architecturally-challenging building, performing construction monitoring, or inspecting large roofs and structures in substantially less time.

Drone flights for commercial use have increased significantly over the past year. In August 2016, the FAA loosened the requirements for the certification of sUAS pilots, opening the facilities industry to new applications and options taking building enclosure investigations to new heights.

**REVOLUTIONARY SERVICE OPTIONS**

Access improvements and increased safety are attractive and easily recognized benefits of sUAS for due diligence services. The lesser known, more exciting, features are what drones are doing to revolutionize services and options for building investigations. Services such as photogrammetric mapping and thermographic imaging are quickly expanding in both application and effectiveness.

Photogrammetric mapping is the use of photography for surveying and measuring distances between objects. Industry applications include mapping of architectural features for historic preservation, measuring existing structures’ elevations to be converted into CAD drawings and...
repair documents, and measuring spoil piles in geological and environmental earth moving projects. Photogrammetry allows a sUAS pilot to preprogram flight patterns over a desired location, and record the photos sequentially. The sequence of photos can later be “stitched” together to generate real-time overhead location maps, footprints of existing facilities, up-to-date elevation drawings for as-built documentation, and design and retrofit documentation.

Thermography, a process utilized by building enclosure consultants for decades, is simplified through the use of sUAS. The value of a thermographic image allows technicians to identify temperature changes caused by possible moisture within a system, voids, or installation deficiencies not visible to the eye. Thermography equipment is most effective during a small window of time in the early evening; when the sun has yet to set, but is low in the sky. Temperature differences between the roof assembly and the conditioned interior space are greatest during this time frame and allow for optimal imaging from thermographic cameras. Naturally expedient thermographic surveying of the roof area is critical for large facilities, but walking a large roof can be time consuming. Now, a thermographic camera can be mounted to a drone, allowing the operator to cover more of the roof area. The GPS coordinates for all photos and drone footage are recorded when the image is captured, which allows for quick and accurate location and documentation.

PIOLTING THE INDUSTRY

These new commercial capabilities require new licensing, permitting, safety considerations, and government oversight. The Federal Aviation Administration (FAA), state, and local authorities have several operation regulations of drones, with most states differing from federal requirements, and from one another. Private organizations, hobbyists, and businesses collaborate with the FAA to provide feedback for this dynamic industry, in an attempt to make sUAS effective and safe for the public. A remote pilot in command must be well aware of airspace, when communication with air traffic control towers is required, where restricted and prohibited flight areas are designated, and of national airspace rules.

This technology is rapidly accelerating the execution of building enclosure investigations. Terracon’s facilities professionals are using drones to help clients with large scale projects and routine maintenance inspections, making building inspections easier and safer than ever before.
CRITICAL ROADWORK

Design for Crucial Florida Road Project

At one point, the north/south corridor of Interstate 75 (I-75) in Florida’s Broward and Miami-Dade counties was a road with relatively light traffic allowing motorists to cruise along at highway speeds most of the time. This changed after Hurricane Andrew blew through in 1992. Andrew leveled thousands of homes and businesses, causing a mass migration to the newer, available homes along the I-75 corridor. With this shift, new traffic patterns developed along I-75 and other major roadways, creating significant areas of congestion in some cases.

The Florida Department of Transportation (FDOT) responded to the challenges with plans to alleviate traffic congestion and improve connectivity. The plans included additional lanes and enhancements to existing roadways and reversible, dedicated open-road toll lanes. Early in 2014, construction began on the $485 million road project, which was scheduled in four segments.

Having provided geotechnical and materials testing services for a number of South Florida projects, Terracon served as an instrumental part of the Segment E improvements. As with most area projects, the geotechnical design was complicated by existing marshy terrain and unknown subsurface conditions. Terracon’s subsurface exploration team worked quickly to collect all the necessary data from the field, enabling our geotechnical engineers to collaborate with the project’s lead designer, WSP USA, to understand the conditions.

In order to test and confirm pile depths and capacities, Terracon’s pile-driving analyzer and operating engineers were deployed together during construction to work with the team. This data-gathering phase was complicated by the need to keep traffic moving. Key challenges for the maintenance of traffic included reducing traffic shifts, limiting lane closures, and reducing weaving and merging.

As the project progressed into construction, Terracon went on to perform all the contractor quality control (CQC) testing of the materials on behalf of Dragados USA, the design-build contractor. CQC services included laboratory testing of soils and concrete, and other key components including bridge inspection, to ensure contractor compliance with FDOT plans and specifications.

In addition to working closely with WSP USA and DUSA, the Terracon team needed to coordinate with the construction engineering consultant firm (CEI), Target Engineering, and FDOT. Tasks included communication about data, scheduling, testing, and reporting results. A unique challenge for data reporting on this project was moving data entry from the Laboratory Information Management System to the Materials Acceptance Certification system at the midpoint of the project.

Terracon provided reliable data using properly trained, certified, and experienced staff to confirm the integrity of the materials used met the project specifications. The Terracon team included technicians who had completed FDOT’s Construction Training Qualification Program (CTQP).

They observed and tested more than 600,000 cubic yards of excavation and embankment material; 700,000 square yards of base material; more than 35,000 tons of asphalt materials; and more than 50,000 cubic yards of concrete.

With the project nearing completion and soon to be fully open to traffic, South Florida residents and commuters will greatly benefit from these unique, reversible toll lanes. The project provided an opportunity for Terracon to further demonstrate our transportation support capabilities and capacity utilizing multiple team members from three of our nearby offices. As a go-to consultant for critical transportation projects like I-75, Segment E, Terracon is committed to the transportation industry and proud to help our design and construction clients solve challenging issues through creative solutions.

RICH MINICHELLO

Rich is a regional manager in our Fort Lauderdale office. Rich leads a diversified practice including geotechnical, environmental engineering services, construction materials testing, laboratory services, and facilities engineering services for the transportation, education, commercial, water, federal, state, and local market sectors.
You wouldn’t consider driving your car 20,000 miles without changing the oil, rotating the tires, or having it inspected. Similarly, it is not a good idea to ignore needed maintenance of your pavements. Postponing timely pavement maintenance may buy more time, but that time will be expensive. Escalated costs for more extensive repairs are the likely result. Exposure to sunlight, rain, freeze/thaw cycles, traffic, and time, all have damaging effects on pavement. Pavement deterioration begins immediately after construction and without maintenance, environmental and structural stresses can accelerate the process.

LIFE-CYCLE UNDERSTANDING AIDS IN MANAGEMENT
Pavement quality deterioration follows a typical life cycle (see graph above). The initial 40 percent reduction in pavement quality occurs over the first three quarters of the pavement’s lifespan. At this point, the pavement has reached a critical level of wear. Beyond that point, the pavement quality rapidly declines. The next 40 percent of quality reduction occurs over the next 12 percent of the pavement life. What may cost $1.00 per square foot to maintain pavements prior to the critical point rapidly increases to about $5.00 per square foot for repair if the pavement is left to further deteriorate.

Keeping pavements at certain levels of quality involves timely inspections, application of fundamental engineering decisions, and expenditure of funds. But if critical decisions about how and when to engage preventive maintenance strategies are appropriately made, the life-cycle costs of pavements can be lowered by 400 percent, even when the time value of the money to perform preventive maintenance is considered. Traditional approaches have left these maintenance decisions up to facilities personnel, who may engage a local contractor to select treatments based on reactionary, limited or biased information.

PLANNING HELPS TO ESTABLISH ENGINEERING BUDGETS
Pavement management brings applied science and engineering into the process of identifying requirements needed to maintain pavements. An engineered pavement management program should consist of three major components:
- A regular, scheduled pavement inspection program
- A database to inventory collected data and consistently rate pavement quality
- Engineering and economic analyses to evaluate strategies to increase return on investment and provide the engineer’s cost estimate associated with each strategy

This management approach is used to plan annual repair and preservation programs and is an integral part of developing maintenance budgets. The management of pavements generally takes place at two levels—network and project.

Network Level Management
In network level management, a relatively small percentage of the pavement is inspected to obtain a snapshot of the current condition. The data is also used to project the future condition of the pavement. Projections provide the information needed to identify and schedule potential project-level areas requiring maintenance and rehabilitation in current and future years.

The forecasted maintenance requirements can also be compared with the actual costs which can be allocated for pavement maintenance and rehabilitation. Using this comparison, coupled with projected pavement condition, priorities can be established for the entire network.

Project Level Management
At the project level, a detailed condition survey is undertaken to develop actual quantities for maintenance and repair. The results of project level pavement inspection are combined with budget and/or management constraints or both to produce the final maintenance and rehabilitation project list for any particular program year. Final plans and specifications are developed and used in the bidding process.

Terraccon’s engineers can help clients with any of these pavement management services for city and county roadways, as well as parking lots and drive lanes associated with commercial developments, educational facilities, hospitals, and airports. In addition to evaluation and engineering services, we can provide construction support to include construction administration management, assist with the bidding process, and construction materials testing and observation. Our teams provide start to finish solutions for your pavement needs.

JENNIFER TRAN, P.E.
Jennifer has been with Terraccon for more than 10 years, and is currently a project manager in the geotechnical department of our Phoenix office. She works with multiple national pavement clients.

RON LECH, P.E.
Ron is the geotechnical department manager for our Cincinnati office. Ron joined the Cincinnati office in 1994 and is the chairman for Terraccon’s Pavement Practice Resource Group.
COMPLEX DEMOLITIONS

Do You Have the Right Team to Succeed?

RAZING THE RIVIERA
It’s not every day a Las Vegas icon needs to be demolished, but when it does, special expertise is required.

Terracon was selected in the summer of 2015 by the Las Vegas Convention and Visitors Authority to be a team member for a project to demolish all buildings on the 28-acre site of the iconic Riviera Hotel and Casino, located between the existing Convention Center and The Strip. Space was needed to attract larger conventions, and the Riviera site provided both the land for growth and direct access to the popular tourist area.

WORKING TOGETHER
The project team met multiple times over several months to discuss the project and work out responsibilities, schedules, and budgets. Other entities invited for input included the city, county, fire department, utilities (water, electric, and gas), regulatory authorities, and client stakeholders. The group was advised about possible environmental issues, including a Phase I site investigation.

Our team’s initial responsibilities included site exploration and reconnaissance to determine the impact, location, and quantity of asbestos, lead paint, hazardous materials, past leaking underground storage tanks, and associated contaminated soil at the site. After exploration and sampling, Terracon presented the results and provided budget estimates for complete removal of identified environmental concerns from the site. The collected data was then used to perform additional in-depth investigations and write remediation specifications for the removal and disposal of all asbestos and other hazardous materials, along with removal of the underground tanks and associated contaminated soil.

See the demolition work: http://ow.ly/bhfH30dKV2J

SAFETY IS KING IN DEMOLITION
After the bidding process and selection of a demolition and remediation contractor, the remediation and demolition began concurrently in April 2016. This meant safety considerations and procedures became even more important on this very busy and complex demolition site. The work was complicated by the intense summer heat (up to 115 degrees), which created a risk of dehydration to those working onsite. During the remediation phase, our team provided oversight and hazardous material removal verification. This work occurred while demolition was ongoing in areas with no environmental concerns and after other buildings were remediated.

Most of the buildings were mechanically demolished as the demolition contractor worked from east to west across the site. In the early summer, one building was imploded while remediation work continued on the older buildings on the west side. By mid-August, the remediation work was completed in the remaining buildings. In the early morning on August 16, the final three buildings were imploded and only rubble was left of the historic property. The remediation phase and the overall project was completed on time, meeting a very ambitious schedule within budget parameters and in a safe manner.

MITCH REIBER, P.G., C.I.H.
Mitch is a national manager for Terracon’s Environmental Service Line at our corporate office in Olathe, Kan. With more than 20 years experience, Mitch is responsible for asbestos and disaster response services, and oversees and manages environmental services.
EXPANDING CAPABILITIES WITH RECENT ACQUISITIONS

Earth Exploration Inc. and Dente Engineering Join Terracon

Terracon has increased its regional presence through the recent acquisitions of Earth Exploration Inc. (EEI) and Dente Engineering (Dente), expanding our offerings and resources to clients in the Upper Midwest and Northeast.

The addition of EEI establishes Terracon offices in the states of Indiana and Michigan. EEI offers geotechnical, materials, construction, laboratory, and associated capabilities from Indianapolis and Niles, Mich. With a staff of engineers and scientists with unique expertise in site exploration and engineering, EEI has contributed to countless industrial, commercial, educational, and governmental projects. The company and its 60 employees continue to serve clients locally as Earth Exploration Inc., A Terracon Company.

Dente’s team of 21 employees offers geotechnical, geohydrologic, and materials engineering and testing services, including special inspection and drilling capabilities from offices outside Albany, N.Y. Dente engineers, geologists, and technical experts have completed more than 4,000 projects throughout the Northeast including the Hudson Valley, southern and western New York, southern Vermont, and western Massachusetts. The company and its affiliates are known as Dente Group, A Terracon Company.

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