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TECHNOLOGY in the AEC Industry
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I'm not a millennial, but thanks to a dad with an interest in computers I've had (or shared) a personal computer since early elementary school (Commodore 64, anyone?). Below our computer room, however, was our kitchen, which lacked a microwave, dishwasher and garbage disposal. This juxtaposition shaped my relationship to technology. While I enjoy technology and think it can be an amazing tool, I also value doing things in more “analog” ways.

In structural engineering this balance is incredibly important. As young engineers we quickly become intimate with the latest software and want to rely on it to do everything for us. We use programs with sophisticated capabilities, but often many of their features are not really necessary for every project or problem that we encounter. With the help of good managers, young engineers learn how to simplify their models in order to take advantage of the software without creating complex solutions to simple problems.

As managers the challenge is reversed – technology develops that we've never used before, but it is our job to manage others who are using it and we must take ownership for their results. It is possible to do this, but only if we constantly balance very basic hand checks based on first principles with an understanding of new software based on known pitfalls of familiar software. When I sit down with an engineer to review a model in an unfamiliar program, I question results that don't make sense, but also get the engineer to explain how the program works. I push back when I think their model is too complex, but try to be open to using the software to save time in our analysis and design process.

As technology continues to change at a rapid pace this balance between older, simpler methods and the latest, fastest analysis software will continue to be crucial for us all to practice and to pass down to new engineers.

Sara Steele
CODES & STANDARDS
The Codes and Standards Committee has continued our efforts to gain a greater understanding of current building and material codes and reflect that back to provide our technical expertise to the engineering community. As such we have been working to gather information and provide recommendations to the New York City Department of Buildings. We have recently provided a draft of our recommendation for an Existing Building Code. This included an outline of code provisions, triggers for code compliance and material sections. Our work on this topic is not complete and we are continuing to gather additional information and will be providing more refined recommendations in the future.

In addition to providing comments regarding an Existing Building Code, the Codes and Standards Committee is in the process of reviewing the IBC in order to provide our recommendations for code changes. This work is just underway and our deadline is to send our recommendations by mid-January of 2018. Our goal is to try to have the IBC incorporate some of the enhancements that the New York City Code and other jurisdictions have adopted.

DIVERSITY COMMITTEE
The SEAoNY Diversity Committee held their inaugural event on 30th October entitled “Networking Strategies for the AEC Industry.” Our speaker, Judy Nitsch provided a captivating and candid presentation full of useful tips and anecdotes for networking and business development. A PDF of the presentation slides can be downloaded at www.seaony.org. Congratulations to Guillermo Díaz-Fañas, Aíne Brazil, and Jessica Mandrick for placing top in the SEAoNY Networking BINGO game! We look forward to continuing to provide successful events for the membership. Attendees received a short post-event survey. If you attended and have not received the survey, please contact seaonydiversity@gmail.com

We are currently planning our next event which will be held on February 27th at the CFA from 6-8PM. Details to follow soon at www.seaony.org/events. We look forward to seeing you there!

EDUCATION COMMITTEE
The Education Committee began the year with the goal of expanding SEAoNY’s presence at the various NYC Metro universities. By increasing the number of events and engaging the students earlier in the process, we aimed to host more attended, impactful events, catered specifically to each university’s needs. Further promoting structural engineering as a profession, we also planned to begin the process of starting official student chapters at each of the schools, hoping that our events would showcase the benefits of being engaged in SEAoNY as a student. So far, we’re off to a great start. In a bit of a changeup from our normal routine, we’ve hosted three resume workshops throughout the early fall months. The events were hosted at Cooper Union, Columbia University, and Manhattan College and were very well received, both because of their key timing and profound insights. Columbia was so impressed they invited us back as panelists to participate in a Civil Engineering showcase discussion.

Immediately following in early November, our committee hosted the annual Structure Quest. This year was very successful with a total of sixty-five students attending from seven different universities. We would like to extend a big thanks to the many volunteers who made the event possible, especially the professionals and day-of volunteers from the Young Members Group!

As we continue to strive for more progress, we will be working in the coming months on technical presentations, interview workshops, and further preparation for establishing student chapters.

SE LICENSURE COMMITTEE
Last year, the committee received approval from the SEAoNY Board on our proposed SE Licensure Requirements and Project Thresholds. This year we are focused on further promoting the idea of SE Licensure and drafting the actual legislation. We believe that SE Licensure enhances the safety of the public – especially in times of extreme events, but not everyone has come to this conclusion. We are preparing both online and printed marketing materials for distribution to structural engineers, the design and construction industry, and the general public. We are also preparing articles, form emails, and form letters that are ready to distribute as part of a push for the legislation. Relationships are important along the path to the legislation; so we are making contacts with the New York State Licensing board and legislators. In addition to this marketing, we are preparing the actual draft language of the legislation; so we can provide it to the legislators as we search for sponsors in the state house.

PROGRAMS COMMITTEE
The Programs Committee continues to provide SEAoNY members with quality programs that are relevant to the NYC structural engineering community. Following the Annual Meeting in September; we hosted the October monthly evening seminar in collaboration with the ASCE Met Section Forensic Group. The lecture, presented by Ali Ashrafizadeh, Ph.D., P.E., LEED AP of Thornton Tomasetti, focused on the application of performance based fire engineering in forensic investigations and evaluation of existing structures.
Through SEAoNY’s continued partnership with AISC, we held the T.R. Higgins lecture in November. Todd Helwig, PhD from the University of Texas at Austin is the 2017 award lecturer. His lecture titled “Effective Bracing for Flexural Members and Systems in Steel Buildings and Bridges,” dealt with the stability of flexural systems in steel buildings and bridges with particular focus on bracing requirements.

Mass timber construction has become a popular subject within recent times. With our efforts to stay on top of structural engineering innovations, we hosted a lecture on the tallest contemporary mass timber building in the world. The presentation was done by Tanya Lufti, PE of Fast + Epp. The talk introduced the design approaches considered, the unique design challenges as well as the construction methods and coordination involved in building Brock Commons.

Our programs in 2018 will feature monthly lectures focusing on topics such as seismic and wind performance of tall buildings and construction tolerances in concrete construction. We will also put on the ATC Training and a hands-on Welding seminar. Our featured seminar, the SEAoNY All Day Seminar, will focus on renovations and alterations and will held in February. We will begin accepting entries for the Excellence in Structural Engineering Awards, which recognizes achievements by New York Structural Engineering firms, in February. The winners will be announced on our Annual Boat Cruise to be held in June.

The Programs Committee continues to meet on the last Wednesday of each month unless otherwise noted.

**WEBSITE COMMITTEE**

The Website Committee in conjunction with SEAoNY staff is “Spring Cleaning” seaony.org. We have reviewed all portions of the website and are ready to update and refresh content. As part of the extensive review of the site, we identified areas where a consultant may be brought on to improve graphics and functionality for both SEAoNY membership and SEAoNY staff. After spring cleaning of the website is complete, the Website Committee will begin creating a new online home for the SEAoNY Excellence in Structural Engineering Awards Program.

**YOUNG MEMBERS GROUP**

The Young Members Group hosted their second annual Trivia Night on Thursday, September 28th. Over 50 young engineers participated in the event and all attendees received free tickets to the “Never Built NYC” exhibit at the Queens Museum. The committee also debuted their new “Truss me, I’m an engineer” t-shirts as a prize to the winning team.

Young Members also hosted a ‘Recap & Rewind’ session after the TR Higgins lecture on November 21st. The post-lecture networking series was a great opportunity to continue conversations from the lecture while expanding their professional network. The series is open to all lecture attendees and YMs plan to host another session after one of the spring lectures.

Congratulations to our new Young Members Board: Sam Brummell, Maya Stuhlbarg, Anthony Piderit, Paige Sieffert, Frankie Nagel and Olivia Parker. A special thanks to Paige for creating our new YMG Facebook page which includes more information about our board, as well as past and upcoming events.

And finally, please join us for our second annual Holiday Party on Thursday, December 7th at 7:00pm at District Social. Pre-registration is encouraged. See the SEAoNY website for more information.

Interested in YMG? Contact the cochairs at seaonyMG@gmail.com or visit our Facebook page at https://www.facebook.com/SEAoNYYMG/
Kurt Vonnegut, whose father and grandfather were architects, imagined a computer program called “Palladio” in his novel *Timequake* (1997). Palladio, the story went, could perform a complete building design according to basic user input such as the use, size, location, architectural style, and even the aesthetic of surrounding buildings. The program would spit out full working drawings, down to “plans for the wiring and plumbing” (presumably structural as well), in less than half an hour. An architect hears of the program from a friend’s teenage daughter, and he goes to his local computer store to see for himself, bringing a wild test for Palladio: to design “a three-story parking garage in the manner of Thomas Jefferson”. True enough, Palladio quickly and successfully designs the building, and additionally offers “alternative plans in the manner of Michael Graves or I.M. Pei”. The architect subsequently commits suicide, at the “blow to his self-respect”.

Palladio is not here yet, but there are signs of its approach through increasing computer prowess, plus other ways that technology may dramatically change the profession of structural engineering in the next 5, 10, or 30 years. A few topics specifically are very exciting (or worrying), and some readers may already be seeing these trends in their own firms.

**SITE VISIT DRONES**

A huge emerging tool for anyone who inspects or observes construction in progress, or documents the conditions of existing structures and sites, is the use of camera-mounted drones (or UAVs – unmanned aerial vehicles). Drones are already providing visual access on projects for locations too high, far, deep, or hazardous for humans to view themselves. Examples include facades, tower spires, inside partially collapsed structures, across debris-strewn fields, and down shafts. Drones can be especially useful when the other access options would involve a challenging scaffold, person-lift, or rope drop. Photo and video are already available; sample-taking and resistance-testing (e.g. hammer sounding) may not be far off. Drones controlled from a remote office would also save travel time to and from the site, and provide views that can be overlaid directly with the design drawings for comparison. Perhaps someday an engineer would go to the site only a half or a tenth as frequently as today, with the other 50% or 90% of visits conducted by the engineer’s “avatar” drone, controlled from the office desk.
3D COORDINATION
While “seamless coordination” and “clash detection” still often feel more dream than reality, it is clear that Revit and other BIM programs have made great strides in the last decade, and we should expect ever more useful, rapid, and clever tools for coordination among the design team collaborators. Virtual reality (VR) and augmented reality (AR) will enhance and speed up communication between architect, structural engineer, MEP engineer; and other disciplines. Information about architectural finishes and MEP infrastructure will live in the team’s model with embedded structural loading properties. Structural modeling programs and analysis programs will get better at talking to each other; with the cutting edge perhaps moving completely toward single model platforms.

AUTOMATED TASKS
Much as a good design spreadsheet permits unlimited calculation iterations to be run rapidly, we will continue to outsource many automatable tasks to computers, whose processing speeds will continue to increase. Ideally, the hope goes, this will free up the engineer for more big picture or deeply critical thinking. Many standard and custom programs already do iterations and optimization for structural member design, and load derivations based on project location and governing code, when enough input has been given by the engineer. But perhaps soon the computer will be able to gather and interpret more of the input itself automatically, e.g. deriving dead and live loads directly from the architect and MEP drawings. Comparing old and new versions of drawings, contracts, and reports could also be automated so that only important changes are highlighted for the human user; as well as some of the steps in comparing construction submittals to design drawings.

MACHINE LEARNING
The tech industry is developing ever more powerful and sophisticated programs for pattern recognition and translation, which – when you think about it – is basically what humans do as “service work”, including much of design. Tech people sometimes call this machine learning, or deep learning as, not just rote repetitive tasks, but distilling vast amounts of data in recursive learning loops so that the program is advancing its own insights and capabilities. As of the writing of this article, computers are competing with (or already “superior” to) humans at: driving cars, diagnosing cancer from X-rays, identifying faces, and translating foreign languages. Is the day far off when the computer could not just size the beams and rebar; but lay out the framing plan, choose the structural system, and negotiate the project contract?

PREFABRICATION
Balfour Beatty, one of the most well-known construction companies in the UK and US, published a thought-provoking manifesto earlier this year called “Innovation 2050 - A Digital Future for the Infrastructure Industry”. One of its visions for coming revolutions in construction is the expanded use, on a very large scale, of prefabrication and preassembly. This they see as necessary to reconcile humanity’s mass urbanization with the shortage of skilled labor; and to put tighter control on the often-messy construction process. As the tech and finance industries run away with profits on “scalable” technologies, mass prefab could be a similar opportunity for the construction industry. Or, even on the small and custom level, prefab can limit time and risk on the construction site, and facilitate the increased use of robot “workers” both in the shop and on site.

3D PRINTING
A previous SEaNY Cross Sections article (2016 Volume 20 No. 4) explored several aspects of various “3D Printing” methods. In short, 3D printing takes advantage of technology either in material science (weld deposits, laser-zapped powders, etc.) or computer guidance of conventional materials (e.g. the CNC-cut plywood creations of Wikihouse); but it also reduces the need for skilled human labor on site, sometimes down to zero. As these types of construction methods gain traction and their associated architectures become more ambitious, structural engineers will need to train themselves (and their computer programs) in these materials and design methods.

Are you seeing these trends as well, or other ones? Let’s discuss, in the short time we have before robots replace us.

Further reading:
APPLICATION OF ACOUSTIC TESTING METHODS TO MEASURE THE ARRANGEMENT, CONDITION AND COMPRESSION STRENGTH OF CONCRETE STRUCTURES.

EDWARD SEWELL & GEORGE BALLARD, GB Geotechnics USA Inc.

Using non-destructive techniques to evaluate the arrangement and condition of existing buildings has become common practice in the construction industry over the last 50 years, largely a result of improvements in instrumentation electronics and the portability of electronic recording systems. The primary usage of these techniques is the discovery and diagnosis of building and construction material defects, ranging from the location of insect infestation in timber to the assessment of micro-cracking in fatigued concrete.

Recently, two acoustic testing methods of Ultrasonic Pulse Velocity (UPV) and Impact Echo (IE) were used to help quantify the extent of a known construction defect within a concrete framed structure and, under controlled conditions with calibration from limited concrete core samples, provide accurate in situ strength assessments at hundreds of locations across the building both quickly and non-intrusively.

The first structure considered was, at the time of inspection, a partially constructed 32-story reinforced concrete framed building, where the reinforced concrete frame had reached the 11th floor. Normal cube/cylinder compression tests were carried out across the concrete structure in a grid of orthogonal points, resulting in the collection of several thousand individual data points. At each point, tuned hammers were used to pass pulses of acoustic energy into the material of an element, causing it to resonate as a standing wave within the material. This response was recorded in both the time and frequency domain to analyze the dimensions, arrangement, and mechanical properties of the various elements. Any variations found may be attributed to variations in concrete condition and strength – information of this nature inevitably carries with it some ‘noise’ and other extraneous signals of no engineering value, all of which can be identified and rejected.

Core sampling locations were then selected based on that analysis: once extracted, logged and inspected for visual defects, UPV was used to measure the acoustic velocity of the core sample at a series of depths into the structure before the sample was crushed to determine its compressive strength. Once the UPV test results strengths were known, the IE data was revisited and the correlation between strength and acoustic velocity was examined. From this data set, the condition and strength of the insitu concrete can be extrapolated (within certain limitations, explored below) to each IE test location across the structure.

Impact Echo can thus be used more extensively than as described in ASTM C 1398-98, which covers its usage for measurement of concrete ‘plate’ thickness, assuming that the plate (or slab, or other concrete element) in question is a continuous homogenous elastic medium, i.e. concrete of constant strength and density (see analysis below). Note that the Standard references work by Sansalone and Street at Cornell, which states that short-duration mechanical impact, produced by tapping a small steel sphere against a concrete or masonry surface, is used to generate low mean strength of 9000 psi. When the formwork was struck, voidage against the forms was observed at several locations, concentrated around the base of the columns/walls where some voids were observed to extend across the full section width. Concern arose that further voidage might exist within the concrete which could not be detected by visual inspection alone. As a result, a concrete condition assessment on the 7th floor of the structure at specified wall and column locations was designed, utilizing both IE and UPV together with Ground-Penetrating Radar (GPR). The investigation was designed to inspect for areas of defect within the body of the concrete across the 7th floor walls and columns, primarily to identify any poor compaction/honeycombing or voiding, and to assess potential variations in concrete strength. Again, limited targeted coring and compressive strength testing was provided for calibration.

For both of these cases, the principle of the investigation methodology was the same. A suite of IE tests were carried out across the concrete structure in a grid of orthogonal points, resulting in the collection of several thousand individual data points. At each point, tuned hammers were used to pass pulses of acoustic energy into the material of an element, causing it to resonate as a standing wave within the material. This response was recorded in both the time and frequency domain to analyze the dimensions, arrangement, and mechanical properties of the various elements. Any variations found may be attributed to variations in concrete condition and strength – information of this nature inevitably carries with it some ‘noise’ and other extraneous signals of no engineering value, all of which can be identified and rejected.
frequency stress waves that propagate into the structure and are reflected by flaws and/or external surfaces.1

**Analysis**

Where Impact Echo data is collected, the transmitted energy propagates through the object as a mechanical wave causing it to vibrate, with lowest impedance found at the natural frequency of a standing wave between the two surfaces. This frequency is fixed by the thickness of the element and acoustic velocity within the material, which is a function of its elastic modulus and density. In a simple homogenous elastic medium, a single frequency resonance occurs; where elastic and mechanical discontinuities occur they may create additional resonances within the spectrum of the impacting hammer below.

When defects lie approximately in the path of the wave front generated by the impact, which spreads hemispherically from the point of impact, the compacted, uncompromised concrete is distinguishable from compromised concrete through analysis of the range of frequency responses, and the location within the time-domain data stream.

Analysis takes the form of a series of measurements of the wave behavior after impact, in response to the impact spectra, and then analyzing in the frequency domain within the operating bandwidths.

In sound concrete, a resonance will be achieved for a compressive wave travelling through the full depth of concrete and returning as a tension wave to form a fundamental standing wave: the frequency response here is therefore a wavelength proportional to the full thickness.

The relationship between acoustic velocity and strength, for any given material is proportional to its modulus of elasticity and its density (which both increase as compressive strength increases). Both UPV and IE can be used in determining acoustic velocities through concrete elements by direct measurement of the thickness, and density can be determined by assessment of cores. These base measurements and analyses can be correlated with other known parameters of the concrete, such as the mix design, target strength, age of the concrete, and compression strength values (cylinder strength/cylinder strength).

The absolute determination of equivalent compressive strength of concrete from its acoustic velocity is complicated by the nature of the concrete itself, which is not a homogenous elastic medium, but composed of reasonably but not necessarily evenly distributed aggregate set in a cement paste, which as it cures and dries, will shrink and tend to crack. For example, during the process of curing, stress is generated within the micro-structure and may introduce micro cracks on the aggregate boundary, which may be the subject of autogenous healing processes over time. Any variation in homogeneity or discontinuities will alter the acoustic performance. Cracks of any sort will reduce the acoustic velocity compared to the velocity (and the strength) within a well-compacted, sound, un-cracked section. In addition, a significant proportion of concrete is aggregate, which itself varies in density and elasticity depending on the parent material from which it is manufactured.

There are, however, limits to the range of velocities and strengths in practical concrete: the graph (below) gives a view of the typical range of strength versus velocity based on a number of calibrated tests. The lowest values are controlled by the velocity of un-cemented aggregate, at around 2 km/sec and above 4 km/sec the concrete strength goes beyond the range which can be reasonably assessed by the method. In the band of interest between 2 and 4 km/sec the response is quasi-linear and includes the range from good structural concrete to weak and friable concrete which would be rejected for all uses except perhaps general blinding.

This assessment has application and use in any one design of concrete provided the variations between batches are small to negligible, not forgetting that a single batch within a particular pour could show a significant difference indicative of a poorly controlled batch – which is of course the purpose of this test procedure.

The range values of acoustic velocity are therefore not an uncertainty or error, as is often cited, but a reliable indicator which can be used both as a relative assessment within a single batch of concrete, or an absolute assessment where adequate calibrator cores are available.

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Imagine arriving on site for an inspection of a high-rise office building. You take your drone out of a backpack, power it up, and set it on the sidewalk. Back in the office, you programmed the flight path as well as camera positions for still photographs and video. Now, you simply tap an icon in your smartphone’s drone app and the drone takes off, flies its mission, and returns to land itself at the takeoff point.

Kristen Olson, Vertical Access LLC

VA DRONE PILOTS ON SITE DURING A RECENT PROJECT

HIGH HOPES: DRONE INSPECTIONS FOR BUILDINGS AND STRUCTURES

There has been great interest in the engineering and construction applications of unmanned aerial vehicles (UAVs), also known as unmanned aerial systems (UAS), small unmanned aircraft (sUA), or simply drones. UAVs have already gained widespread acceptance, if not widespread implementation, for agriculture, site surveys, energy infrastructure inspection, and construction monitoring, not to mention real estate and film production. But what role will they play in inspecting and diagnosing buildings and structures, especially in dense urban areas? Will engineers and consultants soon be spending more time behind the controls of a drone (or behind the screen of a smartphone’s drone flight app) than on scaffolds and swing stages?

PROMISING TECHNOLOGIES

In 2016, Gartner Inc. placed commercial UAVs close to the “peak of inflated expectations” position on its annual Hype Cycle for Emerging Technologies. In reality, commercial applications are wide-ranging, with some uses already proven (monitoring crop health), and others still years away from implementation (drone deliveries).

A UAV by itself is ultimately just an operating platform, and it’s important to remember that many of the anticipated applications of drones will depend upon the advancement of software innovations and other technologies that are themselves in various stages of development, such as automated crack detection, 3D photogrammetry, and virtual reality, to name just a few.

There are some tasks drones won’t be taking over just yet, like conducting nondestructive evaluation or opening probes in a façade. Still, there are several useful drone applications for the inspection of buildings and structures. Where pinnacles, finials, and cupolas are impossible to access without building a frame scaffold, drones can provide a quick and relatively inexpensive yet hands-off inspection. In municipalities with façade inspection ordinances, drones may provide a “first pass” to help identify areas for a more thorough, hands-on investigation using suspended scaffolding or other means. For projects where rope access presents the fastest, least intrusive, or most economical option, a reconnaissance flight by a drone can be a first step in developing a rigging plan, or it can
be a physical rigging aid, flying a lightweight line up and over a building element, in order to help install heavier rigging for personnel. Drones are also an obvious match for infrared investigations of tall structures, where the angle of view is crucial in obtaining usable data. And, drone-based photogrammetry presents opportunities to model buildings and structures accurately and at a fraction of the cost of ground-based laser scanning.

But before engineers, architects, and consultants can get their drone services off the ground, they have to figure out how to fly legally.

THE CURRENT STATE OF DRONE REGULATIONS

In August 2016, 14 CFR Part 107 went into effect, providing a framework for the legal use of drones for commercial purposes. Prior to 107, companies had to undergo a lengthy and cumbersome process of obtaining a “Section 333” exemption, and even then, the rules were so restrictive as to effectively prohibit drone flights in all but the most remote locations.

Now commercial operators can fly in unrestricted airspace up to 400 feet above ground level (higher if the UAV remains within 400 feet laterally of a building or other structure) and in populated areas, as long as they comply with a host of rules, including a prohibition against flying over people. All drone operations must be under the direction of Remote Pilots who must pass a written test and a TSA background check.

Exemptions can be requested for several of the Part 107 rules, many of which are likely not of concern for engineers (no operating your drone from a moving vehicle or at more than 100 miles per hour, for instance). However, consultants wishing to conduct infrared investigations outside of daylight hours will need to apply for an exemption to the daytime operation rule.

While Part 107 represents a big step in the right direction, a significant hurdle for building and structure consultants remains, in that many urban areas are within restricted airspace, generally around airports, where commercial drone flights require special permission from the FAA. For example, the snowman-shaped Class B airspace of LaGuardia and JFK airports covers all of Manhattan north of midtown, nearly all of Queens and the Bronx, and about half of Brooklyn. Most of the Buffalo, Rochester, Syracuse, and Albany metro areas are in Class C restricted airspace; Ithaca, Rome, Newburgh, and White Plains are largely in Class D airspace; and about half of Long Island is in either Class C or Class D airspace (Class B airspace surrounds the nation’s busiest airports, while Class C and D airspace typically extends two or more miles from smaller and regional airports).

To fly in restricted airspace, remote pilots must request an airspace authorization or airspace waiver from the FAA at least 90 days in advance. As of November 2017, according to the FAA, “there is a backlog of Airspace Authorizations of 3 months and Airspace Waivers for 6 to 9 months.” This timeframe places a significant burden on operators whose project schedules don’t accommodate a 3-month wait, and the uncertainty of whether a request will be granted dampens the marketability of drone services.

The authorization process is expected to become much more streamlined within the year as the FAA rolls out a platform for “real time” airspace authorizations based on maps of pre-authorized areas, called the Low Altitude Authorization and Notification Capability (LAANC). This is expected to be a temporary bridge to a system that NASA is developing called the Unmanned Aerial Vehicle Traffic Management System (UTM), which has a target date of 2019. This next-generation system will be necessary for businesses to realize the types of drone services that are grabbing headlines, such as package delivery.

If the status of FAA regulations isn’t complicated enough, states, municipalities, and government entities such as the National Park Service are making their own rules, which may be more restrictive than the FAA’s rules. The legality of these “patchwork” regulations has not yet been tested in court, and in fact there is legal precedent for a single set of rules under the sole authority of the FAA. Also contributing to uncertainty about commercial operations is the fact that the readiness of local law enforcement to handle issues related to commercial drones is largely untested.
CASE STUDY: INVESTIGATING A DECOMMISSIONED POWER PLANT

Our firm recently conducted a drone inspection of areas of the Glenwood Power Plant on the Hudson River in Yonkers, New York, working for the Lela Goren Group as part of a project team including Easton Architects and Silman. The plant is located in Class G (unrestricted) airspace, so no burdensome authorization process was required, allowing our team to mobilize in a timely manner. The drone inspection complemented a hands-on investigation of the structure performed by Vertical Access as well as other members of the project team, providing video footage of areas of the structure that were unsafe for personnel access. VA conducted the drone inspection in advance of the hands-on investigation, in order to determine which areas of the structure would be safe for personnel access.

The plant was constructed between 1904 and 1906 and was designed by Charles Reed and Allen Stem as one of two plants to serve the New York Central Railroad electrification. The steel-framed, skylit brick building is partially supported over the Hudson by timber piles. The complex consists of a three-story switch house, turbine hall and boiler room, pump house, and coal bunkers. Two raised chimney stacks extend through the roof of the boiler room. The plant closed in 1963, and in 2008 it was listed on the Preservation League of New York State’s annual “Seven to Save” list of endangered properties. It is scheduled to undergo rehabilitation into a mixed-use arts and events center.

Vertical Access was tasked with performing a drone survey of the chimney exteriors and portions of the south and west facades, in addition to hands-on investigation and access to other areas of the structure. VA used a DJI Phantom 4 Pro quadcopter to record video of both smokestacks, saving hours of rigging and climbing while providing a much safer means of access for observing the condition of the brick masonry. The UAV survey also provided views of the power plant facades that are visible only from the river. Combined with hands-on survey of other areas of the building, including measurements of structural steel framing, the data gathered by the drone will help the project team with the assessment of conditions and preparation of construction documents as part of the larger rehabilitation effort.

CONCLUSIONS

While drones present great opportunities for engineers and other building consultants, implementation has been hampered by uncertainty about regulations and local ordinances, airspace restrictions that disproportionately affect urban areas, and the limitations of current technologies. As of this writing, there is not yet an out-of-the-box solution to bring to life the scenario described in the opening paragraph of this article. Today’s drones still require skill and practice to fly safely, but features such as sense-and-avoid capabilities are inching drones closer to full autonomy. As demonstrated in the case study, successful operations will combine clear benefits to the project team, the ability to gather quality data, and a cost or time savings over other means of access. Most importantly, drone inspections will be in addition to, not in place of, hands-on investigation and other evaluation methods.

Kristen Olson is an architectural historian with Vertical Access and a SPRAT-certified Level II industrial rope access lead technician. Kristen has worked on investigation and documentation projects including McKim Mead and White’s Manhattan Municipal Building, the Chapel at the United States Naval Academy and the historic campus of Harvard Medical School. She is actively involved in the continued development of the TPAS direct-to-digital documentation system and the production of drawings from video captured using unmanned aerial systems. Kristen has a Bachelor of Arts degree in Art from Colby College and a Master of Arts in Historic Preservation from Cornell University.
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The architecture, engineering and construction (AEC) industry relies heavily on technology to function. New technologies are constantly being developed and refined. The sales pitch is always that technology will allow you to operate more efficiently and save you money in the long run. If you don’t sign on to this technology, you risk being left behind and will be at a competitive disadvantage to your peers.

Think back to the widespread adoption of email over 20 years ago. New graduates entering the workforce were used using email from college, however at this point only large private corporations, technology companies and some government agencies had adopted its use for every day communication. Email was amazing. It was much more convenient than sending or receiving a fax and one could include document as attachments. Fast forward to today. Email is now everywhere and we are not tethered to our desks. The fax is all but dead. On the rare occasion when a fax is sent, its delivery is generally by email and one could include document as attachments. Fast forward to today. Email is now everywhere and we are not tethered to our desks. The fax is all but dead. On the rare occasion when a fax is sent, its delivery is generally by email and one could include document as attachments. Fast forward to today. Email is now everywhere and we are not tethered to our desks. The fax is all but dead. On the rare occasion when a fax is sent, its delivery is generally by email and one could include document as attachments. Fast forward to today. Email is now everywhere and we are not tethered to our desks. The fax is all but dead. On the rare occasion when a fax is sent, its delivery is generally by email and one could include document as attachments. Fast forward to today. Email is now everywhere and we are not tethered to our desks. The fax is all but dead. On the rare occasion when a fax is sent, its delivery is generally by email and one could include document as attachments.

The efficient use of new technologies requires adequate training. Technology companies sometimes bury that fact. Sometimes the need for training is obvious. For example, non-destructive evaluation often utilizes specialized equipment and the data that this equipment outputs must be processed and interpreted to have significant meaning and be applied appropriately. I believe most people would agree that people operating the equipment and interpreting the data should be trained. Let’s take another example of video or web conferencing. This is so easy; just click a few buttons; anyone can do it! But how many times have you been on a web or video call that was delayed due to an issue with the technology? Sure, sometimes the technology fails, but how much of it is due to user error or lack of user training? How many times is a new feature added, or an old feature moved so that the end user can not readily locate it? Technology is constantly evolving, but how many of us are keeping up with the changes?

Historically the adoption of new technology has also been hampered by cost. The personal computer revolution of the 1980’s made computers accessible to most, both at home and in the workplace. However, costs are still significant.
Think of the combined cost of servers, workstations, tablets and phones; it adds up. Software can also be cost prohibitive. In the past one purchased a perpetual software license with a large upfront one-time cost. Some vendors also sold service contracts that gave access to technical support, bug fixes and minor upgrades. The high initial cost was sometimes a barrier for smaller companies. Smaller companies would make do with less sophisticated software that was more affordable.

In the past, pooling of licenses or lax enforcement of license restrictions helped bring down the effective cost. Companies could also choose when to upgrade. One could delay upgrading for a few years until there were enough new features to justify the expense. If the software is functioning on a legacy version, why should I upgrade? The software industry is moving away from this business model. The subscription model is gaining popularity and will be the only option in a few years. There are some benefits here. The initial high capital outlay for new software titles or versions will go away. Smaller companies will no longer have a high barrier to entry. The flip side is that once you stop paying, access to the software goes away. Over time, the software company will gain more revenue. Sure, you will still own your data files (for now). However, how useful are they without the software that they run on? Speaking of data files, the rise of cloud computing is amazing. Microsoft, Google, Amazon and a host of smaller companies offer some version of cloud computing. The cloud can be public or private, can be solely for data storage or can run applications. The end user no longer must worry about hard drive crashes because the information is backed up to the cloud. System administrators will no longer need to worry about backup media failing because files are backed up to the cloud, which are inherently redundant systems. However, not all clouds are created equal. What happens when your service provider has a system outage? This has happened to all the major providers at some point. What happens if your service provider goes out of business or is acquired by another company? Most of us won’t own our own data centers and must rely on these service providers. As the technology matures these will be questions that we will all face. There is also another cost to cloud computing: bandwidth. We are transferring more and more data every day. Today it’s impossible to have too much bandwidth, and internet service providers are happy to provide the bandwidth you want at a cost. Your accessibility to your choice of provider or final cost can often be limited by your local infrastructure. Which telecommunications providers have wired your office building and who owns the “last mile” of fiber?

Technology evolution means that hardware changes and software file formats change. Backward compatibility of systems is a constant issue. If you have an old tape backup from 15 years ago, do you have the hardware to read that data? Is the tape media still good? Compatibility of various software platforms is also an issue. Security of computer systems and the data they contain is a huge issue today. Software operating system providers, such as Microsoft, frequently push out updates to address vulnerabilities or new threats. It’s great that we can set our computers to auto update so that we are as secure as possible. However, what happens when the update breaks other software? Do you hold off on the operating system software update so that you can use your technical software? Your business can operate, but you are now more exposed to hackers while you wait for the technical software vendor to make the necessary updates to their software.

New technologies are constantly being developed. We are in exciting times as we figure out how to best apply these technologies to better our lives and work. However, let’s take a holistic approach, so that we avoid or manage the downsides that come with any new technology.
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