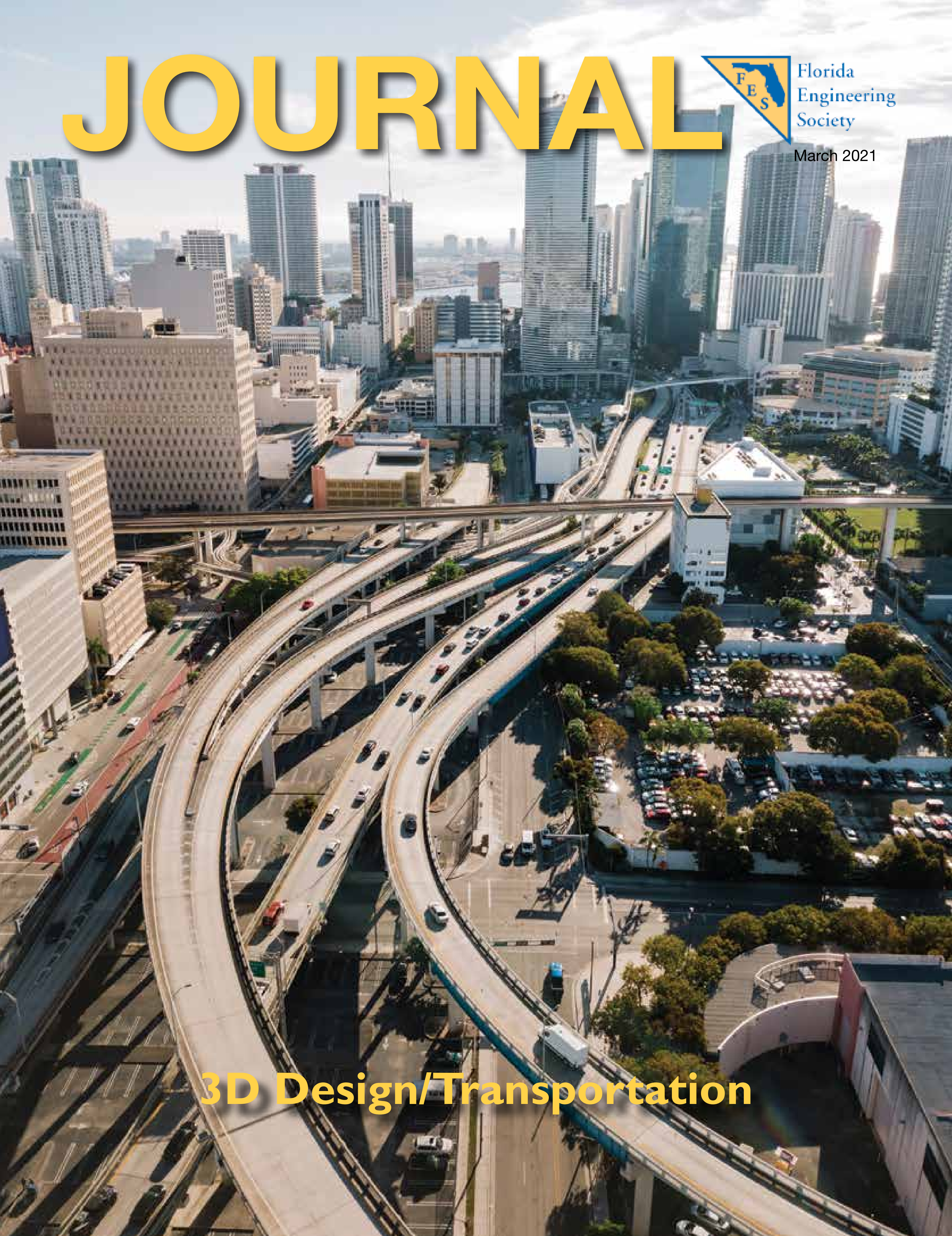
JOURNAL

Florida Engineering Society

March 2021



3D Design/Transportation

Florida Engineering Society presents

Award for Chapter Excellence (ACE Award)

Deadline for submission:
April 30, 2021

The ACE Award competition emphasizes individual chapter activities. The ACE Award is presented to the winning chapters at the FES/ACEC-FL Annual Conference in August. The emphasis on individual activities should allow for even competition between all chapters — small, medium or large.

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MARCH 2021 (ISSN 0015-4032) VOLUME 75, NUMBER 6

About the Champion:

Ann Schiola, CPSM, CIP has over 20 years' experience in marketing professional services in the A/E/C industry. This experience includes working for ENR Top 500 firms creating competitive value to better manage risks and anticipate new market opportunities. She has an MBA from the University of Dallas, a Master of Competitive Intelligence from the Fuld-Gilad-Herring Academy of Competitive Intelligence and is a Certified Professional Services Marketer by the Society for Marketing Professional Services. Ann is Senior Market Analysis and Growth Leader at RS&H. Reach her at 727-403-3171 or ann.schiola@rsandh.com.

ALSO IN THIS ISSUE

March 2021, Volume 75 Number 6. ISSN 0015-4032 is published monthly as the official publication of the Florida Engineering Society. FES is fortunate to have a number of active committees composed of dedicated, enthusiastic members. The FES Communications Advisory Committee (CAC) has true leaders and volunteers who serve as a "champion." Champions diligently find authors based on an editorial calendar created by the CAC. Opinions expressed by authors herein are not necessarily those of the Society. As a matter of policy, FES does not endorse any items, products, or services appearing in advertisements. FES members receive the *Journal FES* as part of their membership benefits. Non-member subscriptions-$50 for 11 issues (Jan-Nov). December issue is available only to FES members. Editorial matters,, change of address, and correspondence regarding advertising should be mailed to PO Box 750, Tallahassee, FL 32302 or emailed to fes@fleng.org. Advertising rate card sent upon request and available online at fleng.org. Periodicals postage paid at Tallahassee, FL and at additional mailing offices. POSTMASTER: Send address changes to: *Journal FES*, Florida Engineering Society, 125 S Gadsden St, Tallahassee, FL 32301 or PO Box 750, Tallahassee, FL 32302. Phone: 850-224-7121

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PRESIDENT'S MESSAGE

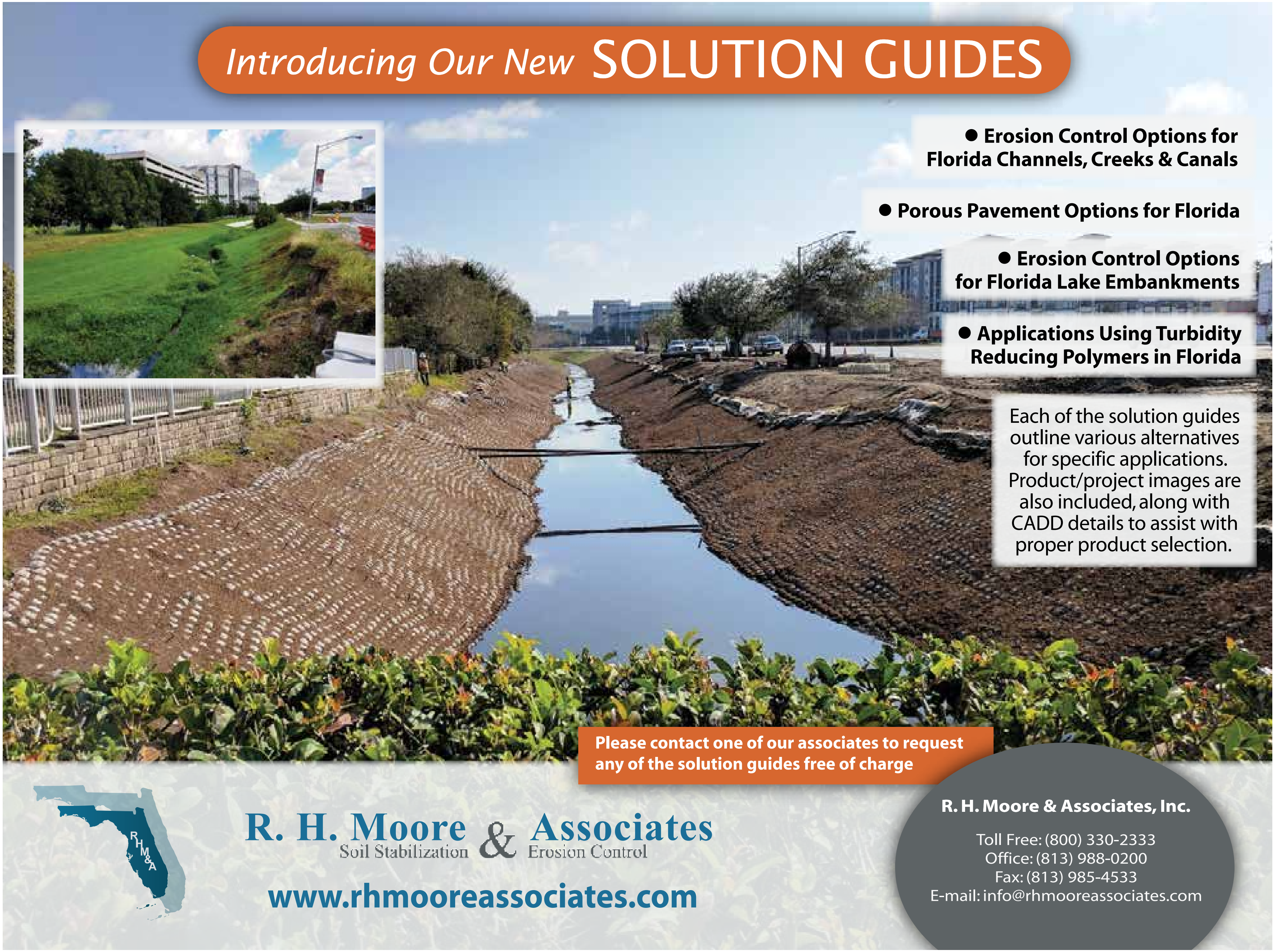
Adam Schildmeier, PE
WGI

As we wrap up Engineers Week, March signals the beginning of the spring season for most of the country and the start of the new year as most of the country recovers from a deep freeze. At FES, we are trying something new as well. After years of trying and largely continuing the same issues, FES will have a Public Relations firm to assist in getting our message to the public. At our spring board meeting we voted to hire Ms. Edie Ousley and Yellow Finch Strategies to be an amplifier of our activities and advocacy efforts. At the end of 2020, Yellow Finch was hired to amplify an Op-Ed that echoed some recent sentiments by our state legislators concerning stormwater treatment. The resulting exposure generated buzz for our industry and really got the community talking. It is our sincere hope that FES can capitalize on some of that energy with Ms. Ousley's continued assistance and FES can "spring" ahead this year as well.

The Florida Engineering Society is made up of an amazing group of volunteers. Engineers like to solve problems but aren't great at self-promotion. Your chapter's fundraisers and FELI class projects have an amazing impact to our local communities that few people ever get to hear about. We represent the various practice sections we are employed by: Engineers in Education (FEE), Engineers in Construction (FECON), Engineers in Government (FPEG), and Engineers in Industry (FPEI), and Private Engineering Practice (ACEC-FL/PEPP). These areas cover all aspects of the Florida professional industry. Its our goal to be on the leading edge of issues impacting each of these areas to do what we do best, to solve those problems. We need each of us to help contribute to that effort. Get involved in your practice sections board, communicate your chapter activities to the state level, and sign up to contribute to the next topic discourse.

March also signals the start of this year's Legislative session in Tallahassee; it's a more traditional start time. With several bills filed already in Committee Weeks last month, FES is monitoring several with potential impacts to the profession. This includes another year of attempts to deregulate professional licenses, so please reach out to your local legislator to let them know you do not support eliminating engineering licensure in SB 344/HB471. In addition, we are in support of additional liability protections for search and rescue engineers during states of emergency (HB 891/SB 1060). Please head to our Legislative Advocacy section on our website for more bills to follow and discuss with your local representatives.

At the end of the month, the MATHCOUNTS® State Competition is continuing to provide our local middle schoolers with a chance to head to nationals and compete for state bragging rights, scholarships, and materials for their school's programs. Please continue to support those team leaders and MATHCOUNTS® chairs and see what you can do to assist.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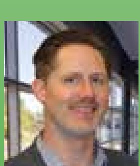
Crash Evaluation and Reduction Plan



Matt O'Connell, GISP

Kyle Roberts, PE, PTEO

The FDOT Zero Fatalities program, Florida's response to the International Vision Zero initiative, aims to eliminate all traffic-related deaths. Supporting the Zero Fatalities initiative is the Florida Transportation Plan (FTP), which prioritizes safety as one of the key elements in Florida's transportation vision for the future. The FTP outlines FDOT's strategy for improving road safety for drivers, passengers, bicyclists, and pedestrians. This strategy includes reporting on key safety indicators including total crashes, fatalities and serious injuries among drivers and passengers, and non-motorized fatalities and serious injuries. While these key indicators are good measures of Florida's work towards Zero Fatalities, crash data analysis is necessary to identify problem areas and develop engineering solutions to move closer to the goal of eliminating traffic-related fatalities.

Understanding where the crashes are occurring tells agencies where to focus attention; while understanding the contributing crash factors illustrates how to mitigate dangerous areas. For many large jurisdictions, it is not practical to evaluate every crash. Therefore, a ranking system is useful to identify the most dangerous roadways and intersections. Through use of a crash ranking system and analysis of contributing factors, it is possible to prioritize road improvements and implement safety mitigation strategies.

Understanding where the crashes are occurring tells agencies where to focus attention; while understanding the contributing crash factors illustrates how to mitigate dangerous areas.

An example of a Crash Evaluation and Reduction Plan illustrates how the City of Baltimore addressed the issue. The City of Baltimore typically experiences approximately 18,000 police-reported crashes per year. Identifying crash hot spots will help the City target safety improvements, education, and enforcement efforts for locations that have the highest crash densities. This effort will help the City make the most of limited resources and aid in implementation of the correct countermeasures at hot spot locations. Additionally, by identifying the roadway geometric and traffic operational characteristics of the hot spot locations, other proactive measures can be implemented at similar locations throughout the City.

Mapping and Ranking Crash Hot Spots

Baltimore needed to identify and rank high crash locations, and evaluate crash type and roadway characteristics. This would allow the City to address immediate safety needs and create a framework for future crash analysis and crash mitigation. The analysis was based on GIS data, which contained XY coordinate information and crash attribute data. The data covered all the crashes recorded over a three-year period (2017-2019). Key data attributes included crash type, injury severity/fatality, bicycle and pedestrian-related crashes, weather and light conditions, date and time, and other crash characteristics. This data was mapped to determine the crash hot spots—the highest crash road segments and intersections. The hot spot locations were determined by identifying intersections and segments with the highest crash frequency on the map. Intersection hot spots were determined by creating a buffer distance from the intersection and then including all crashes that are reported in the attribute table as intersection-related. Segment hot spots were identified by locating the segments with the most crashes. The crash hot spot locations were identified and ranked using a weighting system that accounted for crash frequency, severity, and crash rate. Frequency was defined as the total crashes; severity ranking was calculated using weighting factors by severity type. Crash rates were calculated for road segments and intersections based on vehicular exposure. For road segments, crashes per million vehicle miles traveled (MVMT) was used; for intersections, crashes per million entering vehicles (MEV) was used. In addition, a composite crash index (CCI) ranking was created that assigned a 25% weight to frequency and crash rate and a

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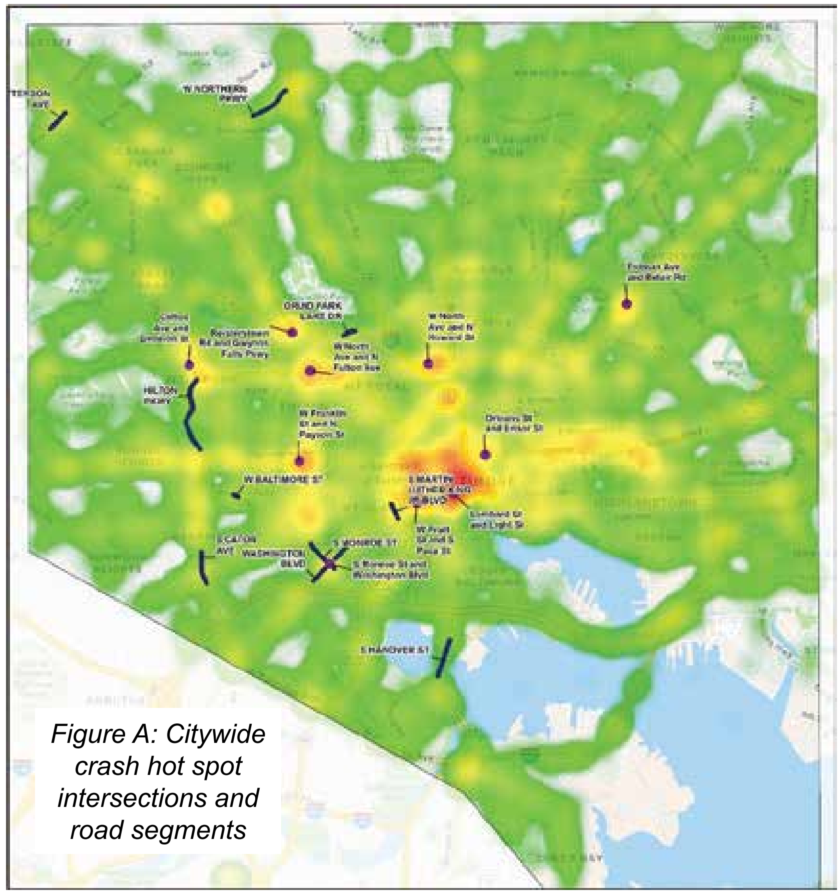

Figure A: Citywide crash hot spot intersections and road segments

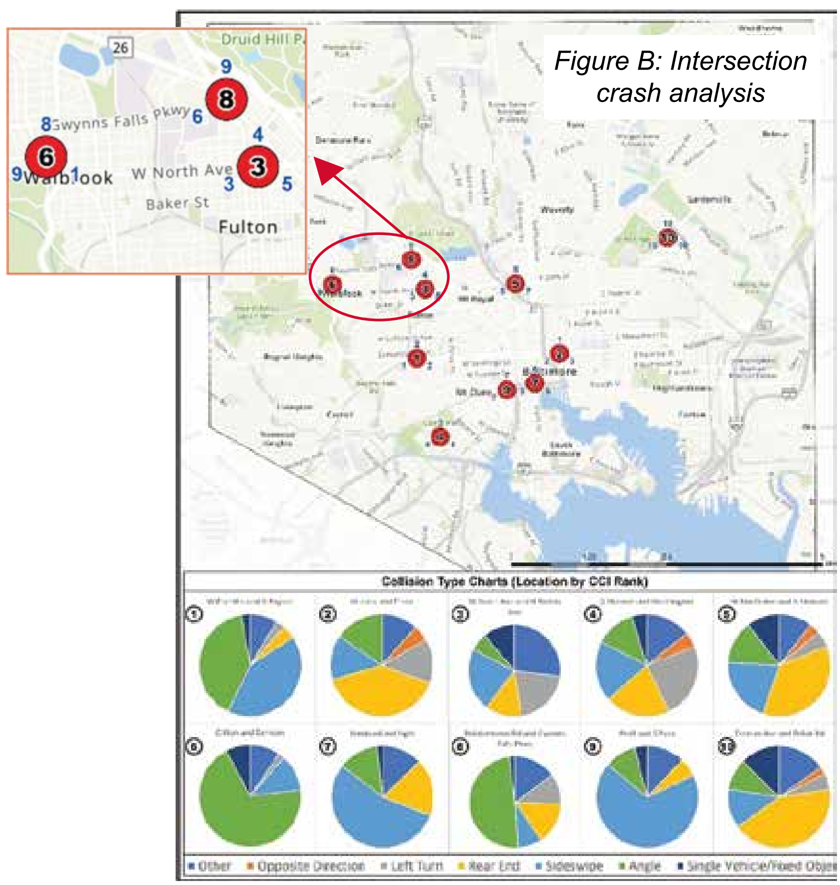

Figure B: Intersection crash analysis

 continued from page 7

An additional consideration in the crash analysis was investigating how the hot spot locations align with low-equity areas in the City.

50% weight to severity. Once the rankings were established for the hot spots, analysis was performed to determine trends and any contributing issues/ factors at these locations, including roadway characteristics such as lane configuration, typical section, lighting, and intersection controls.

Through the analysis, the top 10 hot spot intersections and the top 10 hot spot road segments were ranked. Each hot spot had four rankings. The CCI ranking was used as the primary ranking metric, while the rankings for frequency, severity, and rate were also given. ***Figure B*** shows the top 10 ranked intersections, with the CCI ranking shown in red in the middle. The charts at the bottom of the map show the breakdown of crash type for each intersection. The predominant crash types at intersections were sideswipes (27%), angle crashes (23%), and rear end (20%). For road segments, rear end (31%), single vehicle/ fixed object (21%), and sideswipes (16%) were most common. We repeated the same crash analysis for crashes involving bicyclists and pedestrians. At intersections, 30% of bike/ped crashes were sideswipes, 25% were "other," and 16% were rear end. On road segments, the most common bike-pedestrian crashes were rear end (22%), sideswipe (22%), single vehicle/ fixed object, (22%), and "other" (20%).

Evaluating Crash Hot Spots

After the crash hot spots were identified and ranked, the roadway characteristics of the intersections and road segments were analyzed. Identifying common characteristics of high crash locations not only informs mitigation strategies for current hot spots, but it can also be used as a predictive model for potential high crash locations. Hot spot road segments were evaluated for the following:

AADT	Functional class	Segment length	Typical lane width
Road width	# of lanes	Pavement condition	Pavement markings
Posted speed	Curbside parking	Sidewalks / ped facilities	Bike lanes
Crossings	Crossing spacings	Signals	Signal spacing
Cycle length	Roadway curvature	Grades	Adjacent land use
Pedestrian generators	Roadway lighting	Median type	Travel lanes to median
Traversable median			

For intersections, the characteristics for all entering streets (N/E/S/W) were evaluated, as well as at the intersection itself. Intersection hot spots were evaluated for the following:

Control type	Functional class	AADT	Posted speed
# of lanes	Grades %	Left turn lanes	Opposing thru lanes
Left turn offset	Right turn lanes	Phasing	Cycle length
Crosswalk type	Crosswalk width	Intersection lighting	Pavement condition
RTOR	ADA ramps	Ped button/walk signals	Bike facilities
Curbside use	Signal spacing	Direction to nearest signal	Adjacent land use
Pedestrian generators	Median type	Road width	Pavement markings

The crash data and roadway and intersection characteristic data is currently being developed into an ArcGIS Online (AGOL) application. The application is an interactive web mapping platform that enables mapping and analysis functionality such as queries, zooming, panning, toggling map layers on and off, and viewing the crash data attributes and roadway characteristics. The application is intended to help the City understand the similarities in the roadway characteristics among high crash road segments and intersections. By understanding the similarities, the City will be better informed to implement mitigation strategies as well as predict potential problem areas. FDOT also utilizes the AGOL platform and has developed applications to support various transportation initiatives throughout the state.

Equity Analysis

An additional consideration in the crash analysis was investigating how the hot spot locations align with low-equity areas in the City. Focusing on safety analysis in low-equity areas is an important factor in working towards social and environmental justice. Such analysis can help in advancing Florida's commitment to *Reduce disparities in transportation safety and other public health outcomes among socioeconomic groups*.[1] To analyze social inequities relating to crashes in Baltimore, the City provided an equity score polygon shapefile which was overlaid with the crash hot spots. The map (***Figure D***) demonstrates that some of the low equity areas (dark purple) are also high crash areas. This information can be used to help the City address traffic safety issues and better allocate resources related to social justice. Implementing Vision Zero initiatives while being sensitive to environmental and social justice is a strategy that will improve the lives of citizens in Baltimore, Florida, and in state and local DOTs across the country.

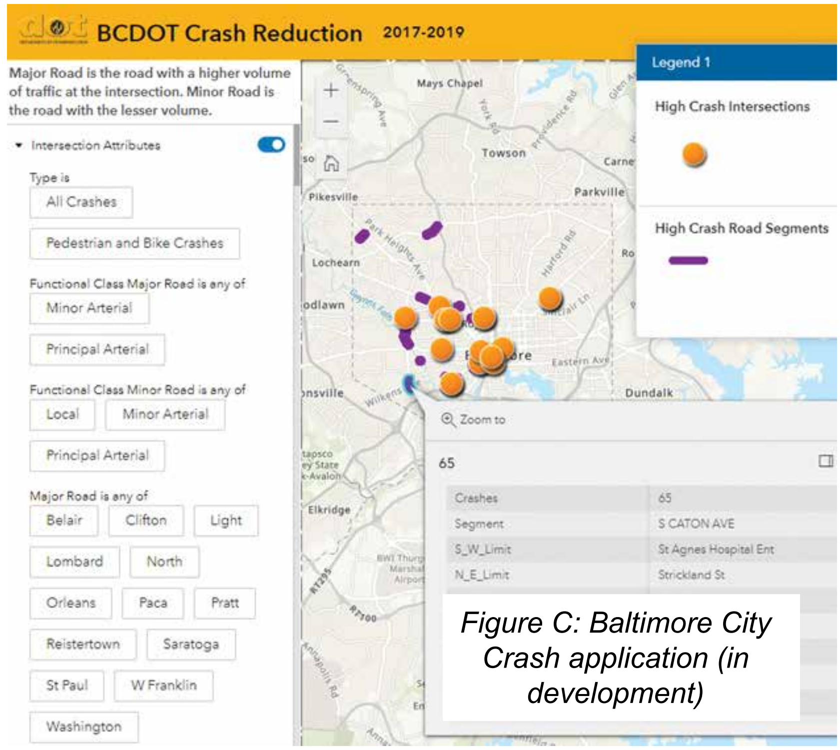

Figure C: Baltimore City Crash application (in development)

About the Authors:

Matt O'Connell, GISP is a Geographic Information Systems Professional (GISP) with over 12 years of experience in the public and private sector. Matt serves as a GIS Supervisor in the Transportation Planning practice at Mead & Hunt, overseeing GIS work for planning projects across the country. Matt has done extensive mapping, quality control, data analysis, and database and application development for traffic safety studies, Vision Zero initiatives, and safety audits.

Kyle Roberts, PE, PTOE, has been active in the transportation planning and traffic engineering field for 10 years. Kyle is a Project Manager in the Transportation Planning practice at Mead & Hunt and has managed numerous on-call planning and engineering tasks for municipal, county, MPO and state transportation agencies. He has worked on multi-modal corridor studies, traffic safety, Vision Zero and safety audits, traffic and transit operations analysis and streetscape concepts to develop more complete streets for all modes of travel.

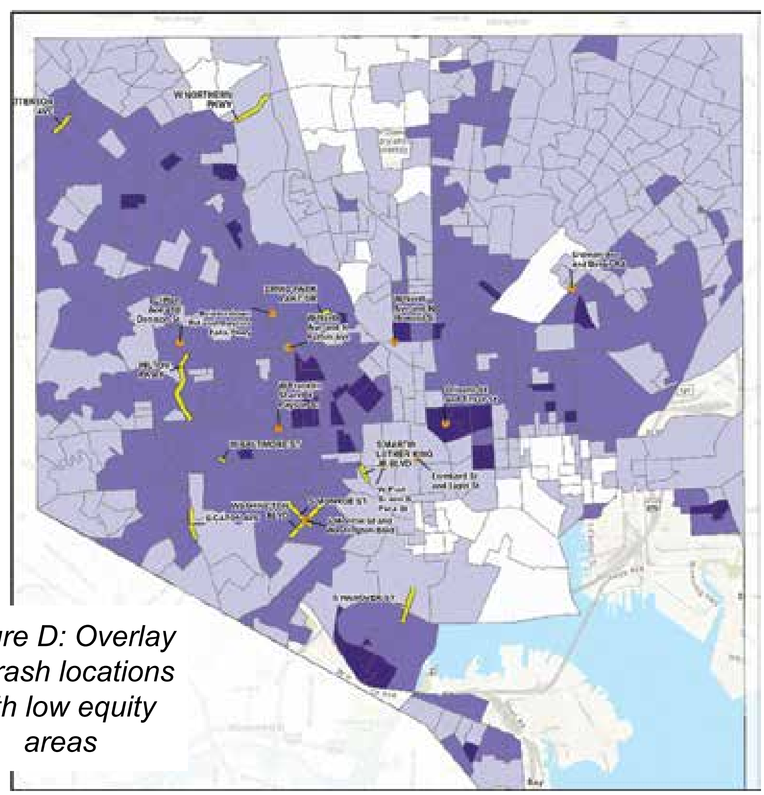
Figure D: Overlay of crash locations with low equity areas

[1] performanceelement2020.pdf (floridatransportationplan.com) p 6
[1] policyelement2020.pdf (floridatransportationplan.com) p 32
[1] policyelement2020.pdf (floridatransportationplan.com) p 22

Safer, More Equitable Mobility:
Advisory Bike Lanes in West Palm Beach

Inspired by Dutch CROW, innovative lane-sharing with motorists and cyclists has been a goal as community improvement in the City of West Palm Beach.

by Scott Edgar, PE
and
Lina Camacho, PE

When the City of West Palm Beach sought to make improvements to Spruce Avenue, a residential street in the Old Northwood and Northboro Park historic districts, it set goals beyond replacing aged infrastructure.

One of the city's goals was to improve the community. At the heart of the city's vision was to create safer mobility for all modes of travel by leveraging the existing bicycle infrastructure.The final design, inspired by the Dutch CROW, known as the Netherlands' design manual for bicycle traffic, brought an innovative lane-sharing concept to motorists and bicyclists alike.

This project was the first use of Advisory Bike Lanes (ABL) in the city's bicycle infrastructure.

Choosing Spruce Avenue

Several elements contributed to choosing Spruce Avenue for the unique enhancements that would accommodate automobile, bicycle, and pedestrian traffic while also preserving the neighborhood's scenic qualities.

Low traffic volume, low speed, and existing on-street parking providing the necessary width to repurpose for bike lanes all made Spruce Avenue an ideal candidate for the ABL concept. Additionally, community support for the project was high, and many desirable destinations are accessible from the corridor.

The nearly mile-long segment between 25th Street and 40th Street serves as frontage to many historic homes, and it provides passage to parks, places of worship, shopping, dining, and an elementary school, all in downtown West Palm Beach. The area is a natural complement to the city's bicycle infrastructure, which is further connected through 36th Street to North Flagler Drive to the east and through North Australian Avenue to the west.

Dutch CROW and Bicycle Travel

The Dutch CROW is famous for its cycling infrastructure and has one of the highest rates of bicycle use in the world. In the U.S., there is growing interest in shared-road concepts, whereas 47% of adults have stated that they want to ride bicycles more often.[1]

Key to the ABL concept is supportive traffic-calming designs. The elements work together to provide motorists with guidance for yielding to bicyclists, and to provide bicyclists with a safer means for traveling along roadways.

Calming Traffic

Since safety was at the Spruce Avenue design improvements' forefront, roundabouts were reconstructed at selected intersections to enhance traffic-calming elements, further supporting Vision Zero West Palm Beach, a citywide initiative to create safer streets for people using any form of transportation.[2] The improvements accommodate pedestrians using the new crosswalks, bicyclists, and vehicles, including those of emergency responders.

Throughout the segment, the asphalt pavement was milled, resurfaced, and restriped with a two-way 16-foot travel lane and 5.5-foot shared bike lanes on either side. Sidewalks were replaced with 5-foot concrete sidewalks to facilitate pedestrian mobility. Adding community-minded signage, pavement markings, and ADA-compliant curb ramps helped emphasize the traffic-calming elements.

Other improvements included the addition of speed humps to reduce traffic speed and support the new advisory bike lanes.

Quality-of-Life Enhancements

Landscaping was another important element in the design. The use of native trees, shrubs, and plants enhances the aesthetics and gives the community a sense of place and charm. Residents appreciate the neighborhood's scenic route while traveling to downtown attractions, whether they are behind a steering wheel or enjoying the view from a bicycle seat.

The project also improved stormwater-drainage flow, providing benefit to residents.

A Vision for the Community

The city was inspired by a vision and then seizing an opportunity for greater community enhancement by transforming a roadway into one that encourages interconnectivity among the community's attractions.

The result of the city's investment in an innovative solution that benefits users of all ages, abilities, and modes of transportation, making the City of West Palm Beach an attractive place to live, work, and do business.

About the Authors:

Lina Camacho, PE is a Senior Project Engineer for the City of West Palm Beach, with over 10 years of experience in civil engineering in the private and public sector. She graduated from Florida Atlantic University.

Scott Edgar, PE is the Southeast Regional Manager/Project Manager at Erdman Anthony's West Palm Beach office. He has a Bachelor of Science degree in civil engineering from the University of Florida and is a Florida professional engineer. He also is a Boynton Beach resident who has over 22 years of design and management experience in transportation, including urban and rural highway design.

[1] PeopleForBikes.org
[2] www.wpb.org/our-city/mayor-s-office/vision-zero

Beyond Deliverables:
A New Take on 3D Design

Transportation project requirements are constantly evolving as technology enables us to see our designs in greater detail than ever before.

by Andrew Poszich, PE

Designers and industry professionals are in a constant succession to stay ahead of advancing standards. Though many see these requirements as the driving force behind change, there are endless benefits that can be realized by going beyond the minimum. Whether it's the addition of modeled conflict envelopes for MSE straps and unsuitable soil for design, or the inclusion of utility trenches for constructability and phasing, there is plenty to consider for your next project.

Traditional Deliverable

Traditionally, the catalyst for 3D deliverables has been the efficiency of Automated Machine Guidance (AMG) or machine-controlled field equipment. Florida Department of Transportation (FDOT) requirements have been established to provide the level of detail necessary to execute earthwork grading and final surface analysis. This, in combination with existing grade and alignment files, provide the contractor a suitable reference for their understanding of the project. However, today's contractual requirements still revolve around a set of 2D plans, so these models often must be recreated by the contractor. Fortunately, these alignment and surface files serve as a critical back-checking tool for the CEI utilizing them to confirm construction accuracy.

Full 3D models are often submitted alongside these Land XML files, but we are missing an opportunity when they are not used to their full potential. Much of the issue is file incompatibility between the software used by the designers and the software and equipment being used by the contractor, but this will change as FDOT transitions to NexGen plans, pushing the 3D model towards the center of the design process.

As we progress into the next generation of project delivery requirements, we can begin examining new ways to leverage 3D tools today to improve the always-exacting design and construction process.

Beyond Design

It's no secret that 3D design in transportation is here to stay. The last several years have seen a major shift from 3D modeling being an afterthought to being a critical component in any design workflow. With the industry seeing a major push for 3D components such as drainage, structures, geotechnical, and utilities, in addition to building information modeling (BIM) becoming more mainstream, it is critical to look beyond standard requirements and begin identifying tools to optimize the design process.

Water Table:

While some regions must design around underground rock layers, Florida's challenge is often the water table. With base clearance being a concern on most projects, the simple act of converting a series of boring elevations to a 3D surface can save several hours digging through design documents. While it doesn't fully replace engineering judgment, a clear visual estimation for the water table in all profile and cross section views will undoubtedly make the process more efficient.

Strap Fields:

Much of the justification for additional 3D modeling efforts stems from clash detection, or the ability to automatically identify overlapping design elements. Strap fields are a prime example. This can be used as a conflict region modeled behind various wall types, which indicate an area for other components to avoid. Since these limits often vary with the height of a wall, seeing this limit represented dynamically in both plan view and 3D gives others working on the project a much better understanding of the area.

Vertical Clearance:

In a similar spirit to wall strap field regions, the same can be applied to roadway vertical clearances. By proving a physical representation of this vertical limit in the 3D model, any designer working on overhead components (from bridges to utilities)

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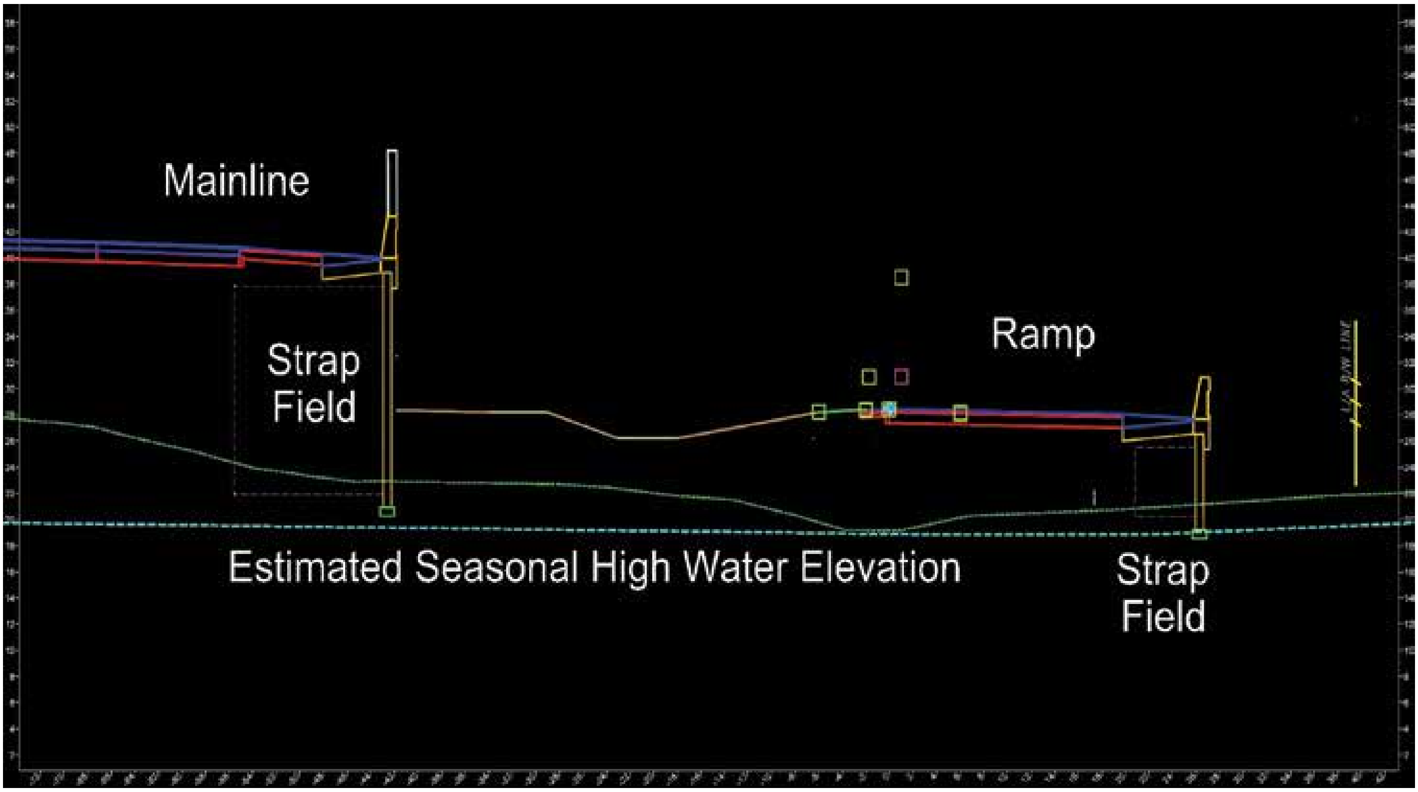
The concept that the model is only as powerful as its weakest component is an impactful ideology.



will have immediate indication of any clearance issues. Furthermore, automated clash detection tools can be used to check clearance along the entire corridor.

Project Completeness:

The concept that the model is only as powerful as its weakest component is an impactful ideology. This suggests that missing components can create a greater expense to the project than the effort it would take to bring these elements into the 3D design. Imagine a comprehensive clash analysis without the inclusion of bridge foundations and underground utilities, or perhaps setting guide sign foundations without being able to visualize offsite grading. For many, this is business as usual, but for those who have invested the time into mastering 3D capabilities, these are invaluable processes that are a must on any future project.

Visualization:

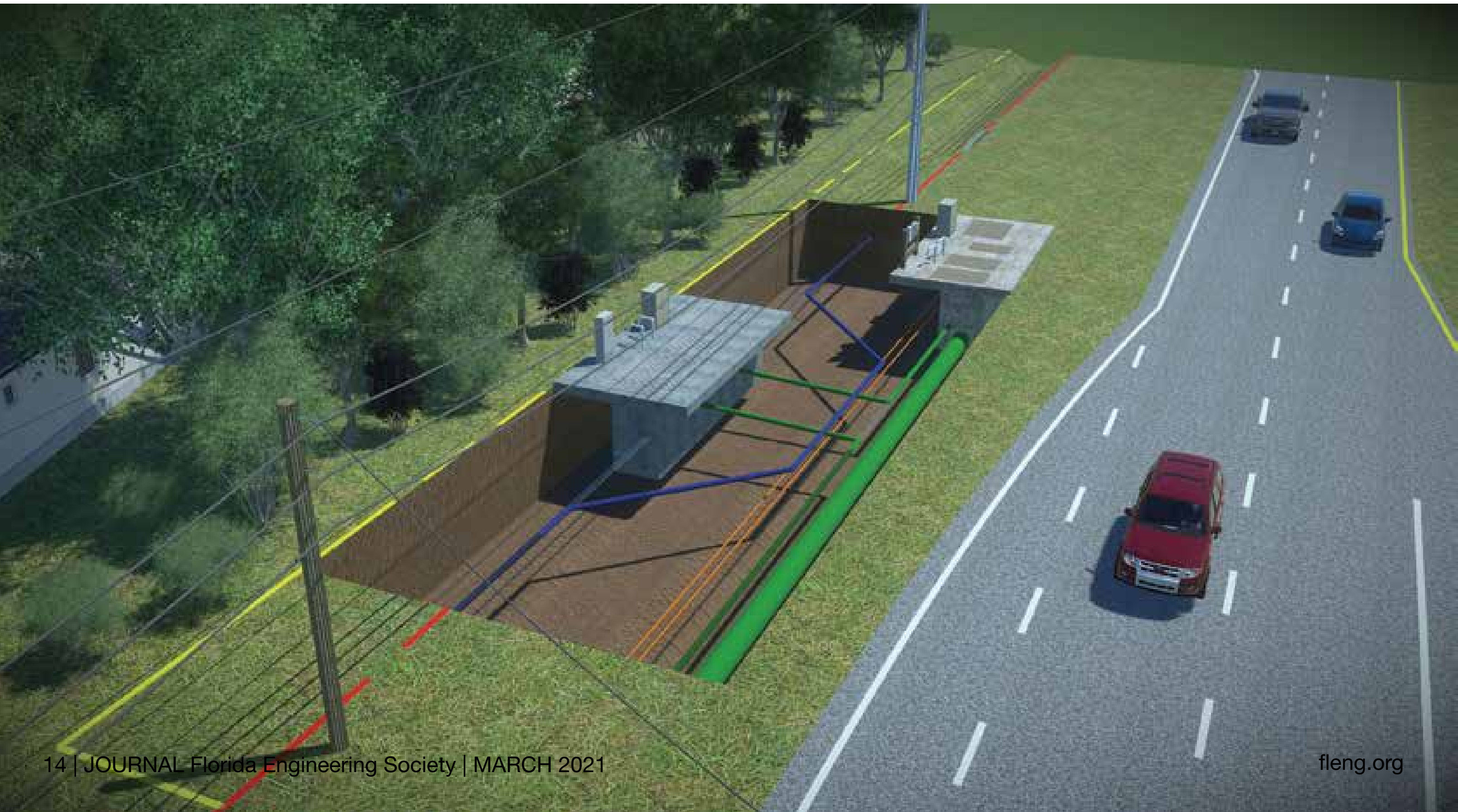
Once a team agrees on developing a complete 3D model, the door is opened to further leverage the model as a communication tool. With all components properly represented, engineered visualization can easily be introduced to bring greater context into meetings, measure performance more easily, and to expedite decision-making. This ability to provide clients and business partners with a clearer understanding of the project will quickly become an integral part of any team's workflow.

Beyond Construction

While LandXML final grade and earthwork surfaces are today's standard delivery, the future will incorporate even more elements into the design model to expand its use and potential. FDOT's NexGen plans certainly bring much of this to the forefront, but below are some items that can be combined into today's ongoing projects.

Additional Layers:

While a proposed final surface is great for review and coordination, it typically isn't the most practical for automated machine control. To properly run the equipment,



break line surfaces need to be extracted for each pavement and earthwork layer. This is especially useful on projects with complex pavement designs where depths are varying. Additional consideration may need to be taken in regards to file deliver and how the surfaces are divided, it's important to keep in mind that what's best for the designer is not always what's best for those in the field. Here, communication is key.

Subsoil Excavation:

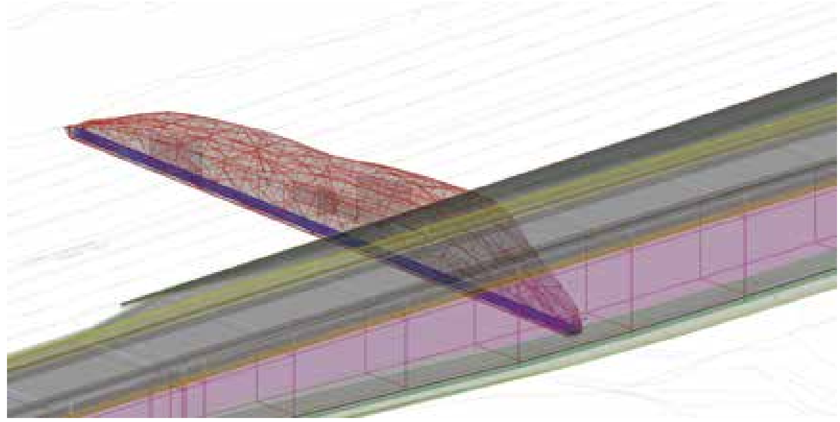
The excavation of unsuitable materials can lead to major constructability concerns. It's true that some level of onsite exploration will always be needed, but a modeled 3D volume will give teams a better understanding of what needs to be taken out underground as well as the impacts of excavation. Traditional cross-section representation can be misleading, with critical areas potentially being missed altogether. Because temporary shoring may not always be feasible, identifying this type of issue as early as possible will allow for an optimal solution to be developed.

Utilities Trenches and Foundations:

Another challenge contractors often face is the order in which underground features are constructed. It's not always obvious which utility should be constructed first, or whether a foundation can be installed without impacting neighboring components. Having a separate deliverable dedicated to trenching and excavation limits can save significant time in establishing the project schedule.

4D/5D Modeling:

While not yet in widespread use, the process of integrating both schedule and cost into a 3D model is being used more regularly on major construction projects across the world. As technology improves and more complete models are delivered, this valuable additional data will be more practical to implement on the average transportation project. While this may still be down the road for most, deliverables can still be established with these extra dimensions in mind to provide a more seamless transition from design to construction.



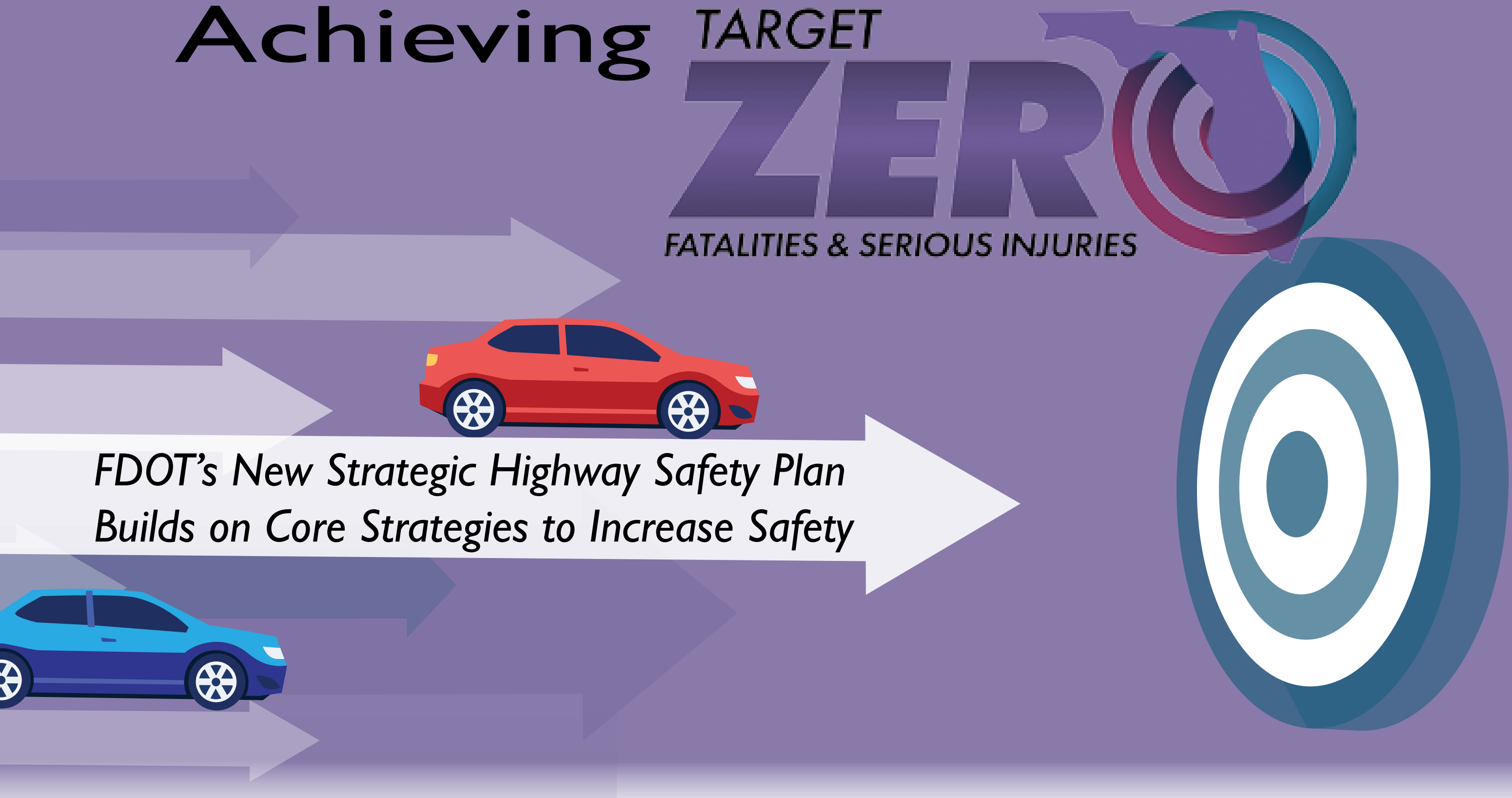
Beyond, Together

Regarding technology, it is imperative that we not just keep up, but look ahead. As industry professionals, we are charged with making the most out of the investment in our infrastructure. The approaches discussed herein promise to streamline workflows, improve communication, and help the industry deliver much-needed safety and mobility projects more efficiently.

About the Author:

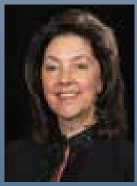
Andrew Poszich, PE has been a valued member of RS&H's highway design team for more than seven years. He brings an in-depth understanding of OpenRoads modeling and overall three-dimensional workflow within the Bentley MicroStation environment as it relates to core engineering geometry and interdisciplinary collaboration. Most recently, his focus has been on bringing 3D design to life through engineered visualization and exploring the next generation of project delivery methods.

Achieving TARGET ZERO FATALITIES & SERIOUS INJURIES



FDOT's New Strategic Highway Safety Plan Builds on Core Strategies to Increase Safety

Strategic Highway Safety Plan introduces new strategies that look at roadways, road users, user behavior, and priorities; it aligns partnerships, and commits us better to use our time, talent, and resources.



Lora Hollingsworth, PE
Chief Safety Officer, FDOT

Eight people die and 49 people are seriously injured on Florida's roadways every day. Changing these heartbreaking statistics and eliminating fatalities and serious injuries in preventable traffic crashes—the only acceptable goal—is the reason the Florida Department of Transportation recently created its new Strategic Highway Safety Plan (SHSP).

The plan acknowledges that achieving "Target Zero"—zero deaths and serious injuries on Florida's roadways—will not be easy. It will require energy, stakeholder involvement, and an unwavering focus on the goal.

"We've talked about roadway safety for a long time—and we've made good progress during the past few decades," said FDOT Secretary Kevin J. Thibault, PE. "We are focused on high-priority issues like lane departure crashes, intersection crashes, and pedestrian and bicyclist crashes, and we have implemented a long list of proven countermeasures from safety belt use to rumble strips to driver education. The SHSP calls on us to continue and expand or enhance many of these activities—but it also challenges us to do more."

To that end, while the state's new safety plan includes the traditional embrace of the four Es—engineering, education, enforcement, and emergency response—that have been included in FDOT's previous safety plans, this SHSP deepens and broadens FDOT's aggressive approach to reduce crashes, serious injuries and fatalities. It introduces new strategies that look at roadways, road users, user behavior, and priorities; it aligns partnerships, and commits us better to use our time, talent, and resources.

Crashes are complex, with multiple contributing factors that are highly variable and, in many cases, preventable. Our previous plan, developed in 2016, was a good starting point in reducing Florida's roadways' preventable crashes. In creating the 2021 plan, we have identified opportunities to elevate our approaches by seeking additional stakeholders and bringing them to the table. SHSP development was guided by the Florida Transportation Planning steering committee and its Safety sub-committee, including safety partners from federal and state agencies, metropolitan planning organizations, regional planning councils, local governments, and law enforcement. But many other transportation and safety organizations also contributed, including the state's safety coalitions and more than 100 other key safety partners and advocates.

The Plan's Foundation

The four **E**s underpin the SHSP in these ways:

- Engineering – Transportation connects where we live to where we learn, work and play. Our reliance on transportation creates expectations for a safe and accessible system. FDOT's engineering strategies speak to the need to plan and provide transportation solutions that use best practices for safe mobility, such as reducing points of conflict; improving signs, markings, and lighting; and managing speed.

- Education – A safe transportation system is effective only if its users understand how the system works and use it as intended. FDOT conducts extensive outreach to help Florida residents and visitors understand the risks of unsafe road user behaviors, such as speeding, unrestrained driving, distracted and impaired driving, and improper roadway crossings.

  An example is our work with the Occupant Protection Coalition, with whom FDOT partners to conduct child safety seat installation training. We also seek to help our customers understand how to use innovative and proven infrastructure solutions, such as roundabouts, diverging diamonds, and bike lanes, as well as vehicle-based solutions like occupant protection and lane departure warning systems. These and other actions represent the proactive opportunities we are taking to interact with people regarding their personal involvement in achieving Target Zero.

- Enforcement – Even when road users are well-informed, some take risks. When that happens, they should be held accountable, because the lives of everyone on the road are at stake. Our law enforcement officers ensure we adhere to the traffic laws meant to keep us safe. FDOT has further committed to bringing law enforcement to the table when we are designing roads.

  As a means of taking safety to the next level, enforcement relies on local communities. Local experts must together identify high-risk intersections and corridors and develop solutions, and coalitions from every level of government must engage in problem-solving with one another.

- Emergency Response – Quick and efficient emergency response to crashes can mean the difference between life and death or minor and serious injuries. Timely emergency response also is critical to ensure rapid crash clearance to avoid secondary crashes.

  FDOT's efforts as part of the SHSP include implementing proven and innovative techniques and best practices that reduce emergency response time and improve the efficiency, effectiveness, and quality of care to crash victims. FDOT carries out this strategy in part by supporting appropriate training so that emergency responders know, for example, how to correctly remove the helmet of a motorcycle crash victim to prevent more serious injury. This intensive training has saved and will continue to save lives.

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New vehicles offer improvements in safety features, like airbags and impact designs, and automation, such as lane departure warnings, adaptive cruise control, automatic braking, and other driver assistance.

FDOT's priority is to create a safe, efficient transportation system for all road users in Florida.

Increased Effectiveness

While the four Es continue to be key approaches to safety, FDOT's new plan addresses four additional approaches, which we refer to as the four Is: intelligence, innovation, insight into communities, and investments and policies. Layering this thinking into the SHSP acknowledges that hitting "Target Zero" demands more than just enhancing traditional approaches.

The four **I**s comprise:

- Intelligence – Quality and timely data are the basis for identifying and applying the strategies and countermeasures most likely to reduce fatalities and serious injuries. Data on crashes, roadway conditions, user characteristics and behaviors help us understand safety trends, high-crash areas, and risk factors. Data also informs us about how well we address safety challenges, which countermeasures are effective, and whether we are making progress toward our zero target.

  FDOT will work collaboratively to improve the quality of traffic records and other safety data, integrate that data with other related information such as land use and community data, improve data sharing among partners, explore new measures and data sources and strengthen the tools and methods for turning data into usable information.

- Innovation – Advancements in traffic management, monitoring, and systems operations can connect data from the roadway, signs, or traffic signals to vehicles, improve traffic management and flow, improve system connectivity for trips, and enhance roadway incidents' clearance. New vehicles offer improvements in safety features, like airbags and impact designs, and automation, such as lane departure warnings, adaptive cruise control, automatic braking, and other driver assistance.

  Emerging and new technologies, such as connected and automated vehicles, offer the potential for dramatic traffic safety improvements by heightening driver awareness and reducing human error, which is the underlying reason for more

than 90 percent of traffic crashes. FDOT will implement existing best practices and technologies to achieve immediate gains and will develop, test and deploy emerging automated and connected vehicle technology.

- Insight into Communities – Achieving zero fatalities and serious injuries requires more than addressing specific hazards and influencing individual decisions and behaviors. It also involves systemic approaches to reshape our transportation systems and communities to create a safer environment and greater emphasis on more equitable access for people and all modes of travel.

  A proven way to reduce traffic fatalities and injuries is to adjust vehicle speeds to match users' mix on a roadway. In Flagler County, for example, SR 430 (Oakridge Boulevard) is being redesigned to convert the existing three-lane facility to a two-lane roadway with a designated bicycle lane. This redesign provides for multiple road users, including drivers, bicyclists, and pedestrians, and encourages reduced speed for motor vehicles.

  The SHSP's Insights to Communities also supports community-based actions —among them Safe Routes to School, a statewide, FDOT-funded program designed to ensure children can safely walk or bike to school. In this instance, we would like to see more schools, neighborhoods, planning communities, and local law enforcement work together to identify and address gaps in local design, school zone ticketing, speed, and monitoring to prevent children from being struck on their way to and from school.

- Investments and Policies – Transportation investment needs to continue to grow as Florida's population and economy expand. How FDOT invests its limited resources must be linked to our vision of zero traffic fatalities and serious injuries. In the future, we will invest wisely, using data-driven decision-making to support creative and proven funding strategies and prioritize projects that provide a demonstrated reduction in fatalities and serious injuries. Additionally, we will pursue legislation and policies that best support the safest transportation system.

FDOT's priority is to create a safe, efficient transportation system for all road users in Florida. Our new safety plan builds on our previous foundation of experience, affirms that we will leverage new technologies and data, and relies on the added insights of communities and safety partners to move toward the vision of a fatality-free transportation system during the next five years.

We acknowledge that some policies, procedures, and practices must change. In some cases, systematic changes are required to make meaningful progress, and that is our commitment, underscored by the establishment of the Vital Few Safety Team. The team was established to critically evaluate FDOT's existing safety-related activities and determine which are working well while also identifying innovations that can continue moving the needle toward zero —because even one life lost is too many.

A proven way to reduce traffic fatalities and injuries is to adjust vehicle speeds to match users' mix on a roadway.

About the Author:

Lora Hollingsworth is Chief Safety Officer for the Florida Department of Transportation (FDOT). She is a registered professional engineer with over 30 years of experience in the public and private sectors. Ms. Hollingsworth led the effort to update Florida's Strategic Highway Safety Plan (SHSP) in 2012, 2016, and again in 2021, working with traffic safety partners across the state. She is a longtime safety advocate.

Revisiting Concrete Pile Damage Evaluation Using High Strain Dynamic Testing

The paper highlights that the upward and downward travelling force waves, from which the Beta is derived, contain an unknown soil interaction component and therefore the true value of Beta cannot be calculated, irrespective of the equations published.

Gerald Verbeek, MSc

Aneesh Goly, PhD, PE

The March 2020 issue of the Florida Engineering Society *Journal*, the previous issue that dealt specifically with geotechnical issues, included an article written by Thai Nguyen, Dave Rancman and Stanley Delmas on "Concrete Pile Damage Evaluation Using High Strain Dynamic Testing." The article discussed concrete pile damage evaluation using the High Strain Dynamic Testing (HSDT) Method in accordance with ASTM D4945. The test method itself can be performed with internal (embedded) gauges or external gauges, and the authors concluded that the external gauge system, whereby the pile integrity is evaluated by the so-called Beta Method "is best in detecting pile tension damage, but [that] it can be unconservative in estimating toe damage." This conclusion implies that the Beta Method, though not perfect, is still a useful tool. This contradicts what George Goble, one of the originators of the method, concluded more than eight years ago.

In a paper cowritten by George Goble and Gerald Verbeek in 2012, titled "Reevaluation of the method to determine pile damage using the Beta Method" [2], it was concluded that that the Beta method should not be used to protect against pile toe damage. Based on the March 2020 article we felt it may be time to revisit this topic to evaluate what, if anything, had changed to validate the conclusions of Nguyen, Rancman and Delmas.

The Beta Method, which uses the change of pile impedance, if any, to assess pile damage, was first introduced in 1979 in a paper published by Rausche and Goble [1]. Over the years this method became the standard for pile damage assessment in many parts of the world, often without an understanding of that method by those who apply it. Instead, the numerical outcome is seen as a reliable indicator of damage in driven piles, and a Beta value of more than 80% is generally accepted as solid evidence that there is no pile damage. In 2011, Verbeek and Middendorp published a paper in the *DFI Journal*

[3], where they discussed the initial findings of their review of the Beta Method. The paper was based on data from more than 400 concrete piles driven in Florida with both internal and external gauges. It raised serious questions regarding the reliability of any damage assessment method based solely on the change of pile impedance (such as the Beta Method), especially to detect damage near the pile toe. The paper also suggested the need to re-assess the damage classification used for the Beta Method, as they reiterated the point made by Rausche and Goble in their original paper that "there is no experimental proof available justifying the (…) classification."

Verbeek and Goble took this suggestion to heart and together reviewed the method in detail (covering both the theoretical and practical aspects of the method); the findings of which were presented during the 9th International Conference on Testing and Design Methods of Deep Foundations in Japan in 2012. The theoretical review of the method revealed flaws in the original paper and demonstrated that the basic equation of the Beta Method was incorrect for any part of the pile where there was interaction between the soil and the pile.[1] While the theoretical review of the method showed clearly that the Beta Method cannot be a reliable indicator of pile damage (simply because the equation for the Beta value is flawed), the practical review reinforced this. Using the more than 400 data sets for piles driven in Florida with both internal and external gauges (the same data used by Verbeek and Middendorp), the review focused on piles with toe damage and showed that the Beta Method is not a reliable indicator for such damage. On that basis Verbeek and Goble concluded that the Beta Method, derived by Rausche and Goble himself some 30 years earlier, should not be used any longer to protect against pile toe damage.

Whereas the practical review performed by Verbeek and Goble focused on pile toe damage, the conclusion that the Beta Method should not be used is not just applicable for that type of damage. Since the sensors are generally embedded in the top and toe of the pile, there were no readily available data sets that allowed a review of potential damage in other parts of the pile. But it should be noted that the theoretical review clearly showed that the method is flawed for any part of the pile that is buried (i.e., for the parts of the pile where there is interaction between the pile and the soil) and for parts that are not buried no analysis method is required to assess pile damage, as visual inspection will suffice.

In the article by Nguyen, Rancman and Delmas, it is stated that, while the Beta Method is not ideal to identify pile toe damage, it can still be used, since "in the pile crush scenario (...) it is likely that the remaining toe capacity is still quite significant" because "it is typical that the rock at the pile toe causing the crushing is of very high strength." There are multiple issues with this or any suggestion to use the Beta Method, whether for pile toe damage or damage to any other buried part of the pile:

- To assess damage using a method that is flawed (as was highlighted in a peer-reviewed technical paper published in 2012) without clearly disclosing that, is misleading at best. This is especially the case when a specific Beta value (e.g., 0.8) is used to determine whether a pile is damaged or not, as it completely ignores the fact that Rausche and Goble clearly stated that deriving any conclusions from the Beta value is not founded on experimental proof.

- By using this flawed damage assessment method, the owner (in case a damaged pile viewed is seen as undamaged) or the piling contractor (in case an undamaged pile is seen as damaged) may be exposed.

- While it may be true that even for a damaged pile the remaining toe capacity is still quite significant, it is irrelevant when it comes to the validity of the Beta Method. After all, using this justification,

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Whereas the practical review performed by Verbeek and Goble focused on pile toe damage, the conclusion that the Beta Method should not be used is not just applicable for that type of damage.

[1] The paper highlights that the upward and downward traveling force waves, from which the Beta is derived, contain an unknown soil interaction component and therefore the true value of Beta cannot be calculated, irrespective of the equations published.

there would be no reason whatsoever to be concerned with pile toe damage, since the remaining toe capacity is still significant.

- In most geologic formations, high strength rock layers are likely inclined or pinnacled, causing the crushing to begin in a significantly reduced area of the concrete. This further complicates the analysis of pile tip damage, as the crushing is usually non uniform. In addition, in numerous geologic formations throughout Florida, these hard rock lenses can be adjacent to or above soft lens of material, which offer no pile tip capacity.

Apart from the above there is another, more general aspect that must be highlighted, something that Nguyen, Rancman and Delmas also point to: all aspects of analyzing data obtained with gauges at the pile top is complex. As the authors noted in their article, as they "increased the skin friction (...) and updated the quake and damping parameters" they could easily mask any reflections caused by pile damage. Analyzing these reflections is not simple, because there is no unique solution, which means that the outcome depends on the person analyzing the data (begging the question which outcome to trust). But recognizing that should automatically point to the fallacy of the Beta Method, because any equation to calculate the Beta value implies that there is a unique solution, and that is simply not the case.

Based on the above it should be clear that the Beta Method should not be used, as was suggested by Verbeek and Goble in 2012; but that does not mean that the results of the High Strain Dynamic Test cannot be used at all to identify pile damage. Assuming the pile is not damaged at the beginning of pile driving, any reflections in the upward wave are due to either the pile itself (e.g., the pile toe) or the soil profile. If the pile gets damaged as it is driven into the ground, changes in the reflection pattern will occur that can be identified by carefully comparing the results of subsequent blows. This is obviously a much more tedious process than simply looking at the Beta value derived for a single blow when the pile has been driven into the ground, but really the only way to identify concrete pile damage using HSDT with external gauges.

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About the Authors:

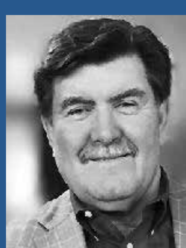
Aneesh Goly, PhD, PE is a registered Florida Professional Engineer with over a decade of experience. His areas of expertise include geotechnical engineering, deep foundation testing, lifecycle monitoring and artificial intelligence. He is currently serving as President of Smart Structures and is responsible for driving innovative products/solutions. Dr. Goly has designed and/or developed several state-of-the-art solutions including SmartPile Inspector, SmartPile Analysis and SmartField Sheet. Dr. Goly has been honored for his engineering achievements including Outstanding Engineering Achievement Award by the National Engineers Council. While continuing to advance the innovative products and solutions for smarter infrastructure as a professional, Dr. Goly remains committed to giving back to academia in various capacities. He currently serves as an Adjunct Faculty and as a member of Department Advisory Board at Florida Atlantic University.

Gerald Verbeek received his BSc in Civil Engineering from Delft University of Technology in 1981 and his MSc in Structural Engineering from the same university in 1983. After spending about 20 years in the Oil and Gas industry, Verbeek started a management consulting business, Verbeek Management Services (VMS), in 2004. One of the activities of his firm is helping European companies with their business in North America, and as part of that he has been active in promoting soil and foundation testing philosophies and equipment. In the area of foundation testing this is done through Allnamics USA, which provides a wide range of foundation testing equipment and services. Apart of his involvement with DFI (where he previously served as the chair of the Testing & Evaluation Committee, Verbeek is active in various organizations: TRB (as a member of AKG20 and AKG70), PDCA (where he serves on the Technical and the Education Committee) and ASTM (where he is a member of D18, the committee on soil and rock and the chair of D18.01, the committee for surface and subsurface characterization).

In Memoriam
Herbert R. Oatman

Herbert R. "Bert" Oatman died on April 20, 2020 at the age of 90. He was a native and life-long resident of Jacksonville, except during military service and college. He graduated from Landon High School, Jacksonville University, University of Florida and University of North Florida, earning degrees of Bachelor of Civil Engineering and Master of Business Administration. Bert served in the U. S. Army in 1947-48. He had a long career as a Professional Engineer with Reynolds, Smith and Hills, Flood Engineers, Florida Junior College and the City of Jacksonville, from which he retired in 1995 after 28 years and serving as Chief of the Building and Zoning Inspection Division and Deputy Director of Public Works. He was a life member of the Florida Engineering Society, National Society of Professional Engineers, and several other professional groups, and was honored as "Engineer of the Year" by the local chapter of FES in 1991. He served as a volunteer for 10 years in the American Red Cross Life Saving Corps and was an avid swimmer throughout his life.

In Memoriam
Gregory Baxter Clary



Gregory Baxter Clary (Greg) passed away at home on November 12, 2018 at the age of 67. He was born on October 7, 1951 and grew up in Savannah, Georgia but lived and worked almost half a century in Florida.

Greg worked as a professional land surveyor and was an avid bow hunter and sportsman. He founded the firm Clary and Associates Surveying & Mapping in 1983. He served on many local and state boards. He will be remembered as a pillar of his community, respected professionally and looked to as a godly man with wise counsel. He was known for his selfless gift of time and generous giving. He was loved by too many to count.

In Memoriam
Donald Farshing, Jr.

Captain Donald David Farshing Jr. USN (Ret) was born in Salisbury, NC on July 4, 1925. He was predeceased by his wife, Sharon Farshing, and by his parents, Margaret Ramsay Farshing and Donald D. Farshing. Don died of natural causes at his home in Jacksonville, FL, on September 22, 2020. He was 95 years old. Don managed Hydro-Mechanical Engineering for Eastern Airlines from 1969 to 1974, taught engineering subjects at Florida Community College at Jacksonville from 1974 to 1984, during which time he earned a PhD from Florida State University. Don concluded the last 24 years of his teaching career at the University of North Florida in the College of Computing, Engineering and Construction, retiring at age 82.

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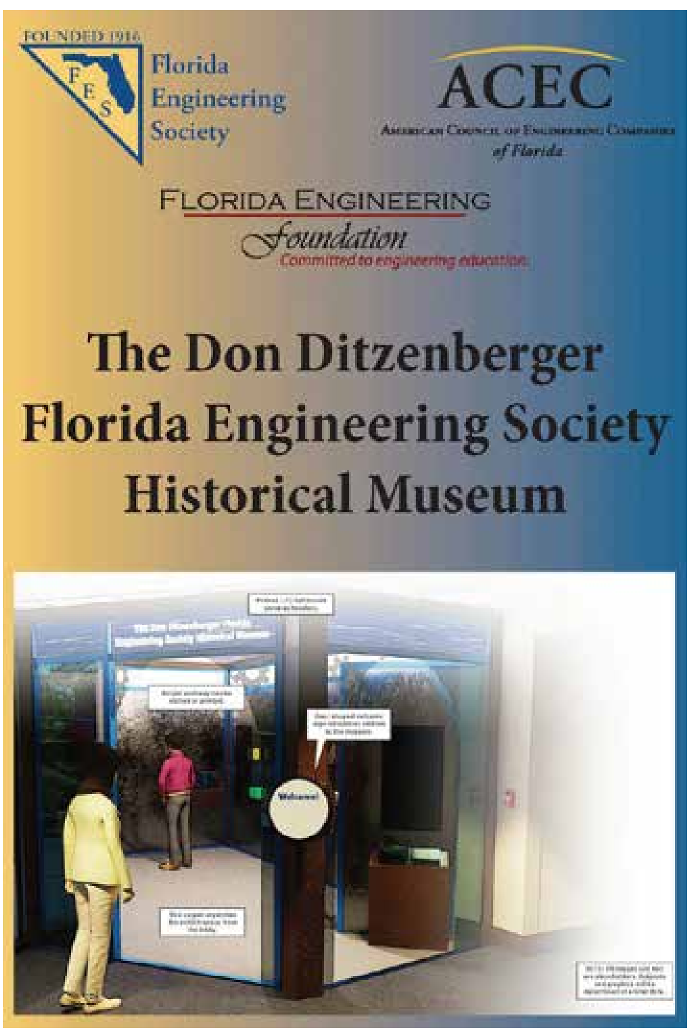

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