NAFE Winter Meeting Technical Program – Saturday, July 27, 2019 – Denver – Expected Presentations:

MORNING TRACK 1: CIVIL/STRUCTURAL

Author: Rune Storesund, PhD, PE

Title: Forensic Evaluation of Ground Vibrations and Noise in an Urban Drainage Project (9-9:40 am)

Abstract: This study performed a forensic evaluation of ground vibration propagation to surrounding residential and commercial structures — and noise impacting adjacent individuals — as a result of construction activities from an urban drainage project. Vibration data collected during the course of the drainage project was first evaluated for conformance with data collection specifications and quality. Attenuation relationships were used to delineate ground vibration extents and magnitudes. Construction equipment utilization logs were used to create a "time history" of daily maximum noise levels. The forensic engineer found significant deviations from the required data collection protocols and a high degree of "under-reporting" as well as a routine violation of the maximum allowable thresholds.

Author bio: Dr. Storesund has 16 years of planning, design, engineering, and construction experience in all aspects of civil, geotechnical, water resources, ecological, restoration, and sustainability projects. He has more than 10 years of forensic consultation/expert witness experience on more than $1 billion in litigation claims. He is the Executive Director of UC Berkeley's Center for Catastrophic Risk Management.

Author: Ronald Bova, PE

Title: Forensic Analysis of 1960s Steel Tower Failure (9:40-10:20 am)

Abstract: Tall slender steel structures are used for light poles (luminaires), signs, stacks, cell towers, and amusement rides, among other things. The 1964 vintage 230-foot-tall, 8-foot-diameter, hollow cylindrical tower was fabricated with 1-inch-thick A36 carbon steel plates that comprised the shell, reinforced with stiffener plates spanning vertically between steel compression rings. The tower was first observed to be "swaying" by passersby. Due to public safety concerns, the city ordered the tower to be demolished to a safe height. The author was retained to determine the cause of the swaying. This was a challenging task with only a 5-foot stub left from the original 230 feet. However, the engineering analysis utilized rudimentary engineering principles coupled with YouTube and other public domain resources. It was ultimately determined that severe scale rust corrosion of the 1960s fillet welds was the root cause of the excessive tower vibrations resulting from von Karman street vortex shedding — not from static wind forces of hurricanes and the like.

Author bio: Mr. Bova was married to Karen in 1984, has three married children, and has a fifth grandchild due! He holds a B.S. in Civil Engineering Technology from Rochester Institute of Technology, Rochester, NY, an M.B.A. from SUNY, Albany, NY, and is licensed in five states and the U.S. Virgin Islands. He is a senior member of NAFE and a diplomate of NABIE. Certified through S.E.C.B., he is the former membership chairman of the ASCE Mohawk-Hudson section. A former Advisory Board member to the Civil and Construction Technology Department of Hudson Valley CC, he is also a member of NSPE, ASCE, ASHE, ACI, AISC, American Wood Council and the NRCA. Early forensic engineering work involved assisting his college professor in 1980 with acquiring field samples and performing lab analysis for a trench failure investigation.

Author: Robert Murray, PE

Title: Condition Assessment of a Green Roof Assembly (10:20-11 am)

Abstract: This paper focuses on a condition assessment of a green roof assembly on an academic building at Cornell University. The existing building experienced persistent leaks despite frequent warranty repairs by the contractor. The paper will detail the forensic investigation to remove the green roof and subsequent destructive testing of the roof assembly. The methodical fieldwork and forensic documentation uncovered systemic workmanship issues that were key in bringing the contractor back for settlement discussions eight years after the project completion. Ultimately, the contractor agreed to replace a portion of the roof at no cost to the University. The paper will also provide lessons learned for all team members on a construction project. Specifically for design professionals, it will convey encoding proper oversight and inspection into the project as well as require the project team to provide the field documentation of these specified tasks. For owners experiencing problems related to new construction, this condition assessment provides a potential roadmap for engaging a forensic professional.

Author bio: Mr. Murray is a licensed professional engineer in the state of New York. He graduated from the University of Maryland with a bachelor's degree in Civil and Environmental Engineering and has worked in the consulting engineering field for 14 years. Since 2013, Rob has worked at Cornell University central facilities as an engineer within Facilities Engineering, an in-house enterprise unit that produces construction documents for bid. Rob also supports the Cornell Maintenance division to keep close to 16 million square feet of academic, research, and housing buildings in good repair. An Associate Member of NAFE since January 2018, he is often contacted by Cornell Maintenance to help scope water infiltration, masonry, and building envelope issues and help participate in developing the repair approach.

MORNING TRACK 1: VEHICLES

Author: David Danaher, PE

Title: FE Analysis of a Wheel Spindle Failure due to Pre-Load and Fatigue (9-9:40 am)

Abstract: Typically, most vehicles equipped with non-powered wheels utilize a spindle that not only supports the weight of the vehicle but also allows the rotation of the tire. To allow for the rotation, tapered bearings are typically used that are mounted to the spindle and connected to the hub and wheel assembly. Tapered bearings are chosen for this application because they are designed for applications where forces are generated radially (vertical) and axially (laterally) during use. Although tapered bearings are ideally suited for use in wheel and spindle assemblies, they must be installed properly to perform as designed. As part of that installation, the spindle nut must be properly torqued in order to apply a sufficient pre-load to the tapered bearings. Without the proper pre-load, the bearings can either generate too much friction or ride improperly on the spindle, generating forces that are not properly distributed. This paper will discuss the failure of a spindle and wheel assembly that experienced fatigue due to improper pre-load of the spindle nut.

Author bio: Mr. Danaher is a highly accomplished engineer with wide-ranging experience in accident reconstruction and mechanical failures. His case work involves motor vehicles, heavy equipment, and major mechanical systems. During his career, he has investigated and analyzed hundreds of vehicular accidents and applies his knowledge of vehicle dynamics, simulation, crush energy and driver response to accident reconstruction. He has also analyzed heavy equipment such as skid loaders, motor graders, oil drilling equipment, and other mechanical systems for safety and maintenance-related issues. He has been qualified as an expert witness with extensive deposition and courtroom expertise. In addition to Mr. Danaher's case work, he is a well-known contributor to the industry of forensic engineering. He has authored peer-reviewed publications related to forensic engineering, accident reconstruction, and visualization. In addition, he has presented at conferences and seminars on a range of topics throughout the United States.

Author: Richard M. Ziernicki, PhD, PE, Martin E. Gordon, PE, Steve Knapp, PE, and Angelos G. Leiloglou

Title: The Application of Matchmoving for Forensic Video Analysis of a Fatal Sprint Car Accident, Part 1 (9:40-10:20 am)

Title: The Application of Matchmoving for Forensic Video Analysis of a Fatal Sprint Car Accident, Part 2 (10:20-11 am)

Abstract: The methodology used for the reconstruction of a high-profile sprint car accident that was captured by at least three different video recording devices will be presented. Accidents captured on video are unlike most simple car collision evaluations and require expert knowledge from experienced professionals. Understanding the race car vehicle dynamics as they relate to recorded video footage allows a proper methodology to be followed in order to gather and process the evidence needed to provide meaningful data to the trier of fact. This paper discusses the currently acceptable scientific methodologies that were used to collect and interpolate the available scientific evidence.

Author bio: Dr. Ziernicki has evaluated several thousand industrial and vehicular accidents. He has presented papers and lectured at a number of technical conferences in the United States, Europe, and South America. He is the author of more than 60 publications, primarily in the fields of mechanical engineering, and vehicle accident reconstruction. His accident reconstruction expertise has been featured more than 30 times on local and national television, including the Discovery Channel, Dateline NBC, Dr. Oz Show, MSNBC, FOX News Channel and National Geographic Channel on accidents such as the Princess Diana accident, the Air France Flight 447 accident and more. Dr. Ziernicki was a member of several past SAE Standards Committees. He is Past President and current Board Member for the National Academy of Forensic Engineers and also serves on many Committees for the organization. As a result of his investigations, Dr. Ziernicki has testified in court as an expert witness in a few hundred cases and was deposed more than 500 times. He has testified and works as an expert witness for clients such as the U.S. Department of Justice, U.S. Department of Defense, State of Colorado Attorney General's Office, district attorneys, and public defenders.

Author bio: Mr. Gordon is a Professor and Director of External Academic Relations, College of Engineering Technology, at the Rochester Institute of Technology, founder and president of Gordon Engineering PC, and a past president of the National Academy of Forensic Engineers. A nationally recognized expert in the field of forensic engineering and traffic accident reconstruction, Martin is also recognized for his teaching excellence — sharing his knowledge with thousands of aspiring engineers as a professor at the Rochester Institute of Technology. During his 25-year career at RIT, Gordon has developed and taught courses in the field of mechanical engineering and crash reconstruction. He has been the RIT Baja SAE advisor since 1995 and is the only six-time Baja SAE event chief organizer. Gordon also leads his own forensic engineering firm, Gordon Engineering PC, which provides forensic engineering consulting services. Professor Gordon has been involved as a consultant in hundreds of cases involving traffic accident reconstruction, machinery accidents and product liability.

Author bio: Mr. Knapp performs investigation and reconstruction of both passenger and commercial vehicles. He has extensive experience evaluating failure events of mechanical systems. He is an experienced and certified CFEI fire investigator and has evaluated hundreds of fire incidents for the purpose of determining the origin and causation of fires. Mr. Knapp was a team member of the University of Colorado at Denver, Society of Automotive Engineers (SAE) sponsored, small-scale Baja race car programs for several years. In 1998 and 1999, Mr. Knapp was a team leader and was responsible for designing, constructing, machining, and welding of the vehicle assembly.

Author bio: Mr. Leiloglou has a bachelor of environmental design degree and a master of architecture degree from Texas A&M University, College Station, TX. Before joining Knott Lab, he was a contract forensic animator and freelance graphic artist, and an assistant lecturer in the Department of Architecture at Texas A&M.

Author: Shawn Ray, PE

Title: FE Analysis of a Crash Caused by Swingout of an Articulated Booster on a Semi-Trailer (11-11:40 am)

Abstract: The rig was traversing an exit ramp when the trailer tires lost traction and the booster axle redirected the rear of the trailer into oncoming traffic. The reconstruction used a detailed analysis of roadway geometry, truck geometry, and suspension characteristics to determine the cause of the swingout of the unloaded lowboy trailer with an articulated booster axle. A comprehensive topographical map was created from 3D laser scans. The interaction of each

tire with the pavement surface was used to determine the individual wheel loads. Dynamic analysis of the curved path quantified the speed required to cause loss of traction and subsequent swingout.

Author bio: Mr. Ray is a project manager/mechanical engineer and has been evaluating mechanical failures/accident reconstruction for 25+ years. He worked his way through school as a mechanic and has been involved in racing, which is a test bed for new technology, vehicle development, and controls. In addition to being a registered Professional Engineer, he is a triple ASE Master Certified Technician, holds an ACTAR Reconstructionist accreditation, and is a Certified Fire and Explosion Investigator and Vehicle Fire Investigator. He is active in SAE's COMVEC — the Commercial Vehicle Exhibition & Technology Connection. His involvement includes being a past organizer, moderator and Chair of the Powertrain committee. Currently, Mr. Ray is the Vice-Chair of SAE's Crash Data Collection and Analysis Steering Committee.

AFTERNOON TRACK 1: GENERAL

Author: Curtis Falany, PE

Title: Forensic Investigation of Electric Shock Drowning: Speculation vs. Reality (2-2:40 pm)

Abstract: A young man drowns in the family pool. A great deal of publicity results from the tragic loss with much speculation in the media as to what happened and who or what might have been responsible for the death. The author was present for, and participated in, the investigation. There was little disagreement among the investigators that the death was an electric shock drowning or ESD. The mystery was the defect or defects that allowed the deadly electric current to flow into the pool. The author relates the investigation, the science applied, and the conclusions reached as to the defects that allowed the current to flow.

Author bio: Mr. Falany received a B.S. in Engineering Science from Florida State University in 1969. After graduation, he worked as an R&D engineer with Honeywell Information Systems, Inc., then moved to the College of Engineering, University of South Florida as an adjunct professor. After obtaining his PE license in 1974, he went into private industry. In 1988, he retired as President of Energy Control Contractors, Inc. In 1993, he returned to engineering as a forensic engineer. At present, he is President of J. B. Shepherd & Company, Inc., a forensic electrical engineering firm located in Florida.

Author: George Samarus, PhD, PE

Title: Ergonomic Considerations in Forensic Engineering (2:40-3:20 pm)

Abstract: Forensic engineering in product liability disputes routinely examines available hardware, software, and quality engineering attributes and activities. Ergonomic aspects may be considered, but they tend to be limited or overlooked. The human factors engineering discipline spans the full breadth of human product use; in fact, human factors and ergonomics are all about fitting tools to humans (not humans to tools) to promote safe and effective products. It extends far beyond hand tools to automation, organizational management, and cultural expectations. The presentation will discuss the four major subdisciplines and their overt/covert aspects: (a) micro-ergonomics (physical ergonomics) addresses overt anthropometrics & covert biomechanical and sensory processes; (b) meso-ergonomics (information ergonomics) addresses overt verbal and nonverbal behaviors & covert affective, cognitive, and physiological behaviors; (c) macro-ergonomics (social ergonomics) addresses overt communication and coordination in groups & covert conventions and expectations; and (d) mega-ergonomics (cultural ergonomics) addresses overt tangible artifacts and language & covert beliefs, customs, ethics and morals. Each has roles in the design, construction, and deployment of products and in the known and foreseeable use/misuse of a product. Illustrative examples will be drawn from medical device and health information technology domains but are generalizable to other product domains.

Author bio: Dr. Samaras is an engineer in private practice. Trained as an electrical engineer, he holds doctorates in both physiology and industrial engineering, is licensed in both electrical and software engineering, is board-certified in both human factors and forensic engineering, and is a certified quality engineer and biomedical auditor. He is a former medical school and engineering graduate school professor, former CEO of an FDA-regulated product development firm, and a former FDA reviewer and manager. His practice is limited to medical devices and health information technology systems.

Author: Stephen Batzer, PhD, PE

Title: Forensic Engineering Analysis of Weapons Incidents (3:20-4 pm)

Abstract: The possession and use of firearms are highly regulated at the federal, state, and local levels. However, the design and manufacture of these devices are largely unregulated. Predictably, results vary. Once a mass-produced weapon is released for public sale and use, field experience quickly reveals whether its performance matches the expectations of the designers. A discussion of the performance of various weapons and their operators is presented. Themes include technological state of the art, foreseeable misuse, the efficacy of warnings, and the role of objective and subjective evidence. Case studies include user errors, design inadequacies, manufacturing defects, gunsmithing faults, and a criminal case study involving prosecutorial misconduct.

Author bio: Dr. Batzer has a PhD in mechanical engineering and a master's degree in industrial engineering. He testifies in product liability, criminal, and patent cases. He is licensed in Michigan and works nationally. He served as an active and reserve Army ordnance officer, and retired at the rank of Lieutenant Colonel. He has OEM manufacturing experience working for the automotive industry designing and manufacturing fasteners. He has taught at five universities and has given numerous public presentations on a variety of topics. He has 70 peer-reviewed papers and two patents. He shoots competitively on weekends.

Author: Robert Peruzzi, PhD, PE

Title: FE Analysis of Communication Systems for Drive-Through Restaurants in a Business Dispute over Quality Specifications and Design Process (4-4:40 pm)

Abstract: This case involves communication systems intended for use in Quick Service Restaurant (QSR) drive-through lanes. The buyer had an established reputation for reselling and repairing QSR communications and decided to manufacture them under its own brand. They outsourced the design to the designer, who claimed expertise in radio design. Expected deliverables included assembled exemplar units, schematics, software, part lists, diagrams and assembly/service instructions. The buyer and designer agreed to specifications, schedule, and cost. Both cost and schedule were overrun. The buyer demanded contract rescission and a refund. The buyer sued the designer after negotiations failed. The author was retained by the buyer's attorney to investigate and opine on measured audio quality of the system. Did it meet specifications? Did the designer follow best design practices? This report provides an overview of QSR communication system components and operation, and then introduces communication systems and channels. It provides an overview of non-linear, time-varying system design, contrasted with linear, time-invariant systems, including best design practices. It also provides the details of how audio quality was defined and measured for two competing systems.

Author bio: Dr. Peruzzi is an associate member of NAFE. He is a self-employed electrical engineering consultant at R. Peruzzi Consulting, Inc. The specialties of his expert witness practice are circuit analysis, intellectual property, patent analysis and infringement, product requirements and specifications, and product liability, involving ICs, modules, and electro-mechanical systems.

AFTERNOON TRACK 2: MECHANICAL

Author: Daniel Couture, PEng

Title: Forensic Engineering Investigation of the Catastrophic Breakdown of a Diesel Engine in an Emergency Generator Set (2-2:40 pm)

Abstract: A large-displacement 16-cylinder diesel engine was coupled with a 1750 kW-rated generator set to provide emergency power to an international airport parking facility. It had been in service for seven years, and had accumulated only 242 operating hours from a regular monthly test procedure. On the day of the incident, less than three minutes after starting up, the engine began smoking and running roughly. It then suddenly failed catastrophically. A forensic engineering investigation was undertaken to determine the cause. Two cylinders in opposite banks had been damaged. The proverbial "smoking gun" was found — an obstruction comprising a rubber gasket within the main oil gallery leading to these cylinders. The investigation explored the probable method and means that this gasket was entrained into the gallery. The results of the analysis allowed for an assessment of relative liability of the parties.

Author bio: Mr. Couture has been a Senior Metallurgical & Mechanical Engineer at Arcon in Toronto for more than 15 years and a Professional Engineer since 1982. He has been qualified as an expert witness before the Ontario Superior Court. His broad industrial experience provides the basis for effective investigation of failures of equipment components. He is a Fellow of Engineers Canada and was the first Canadian Member of NAFE. He is Vice-Chair, First Timers, and hopes to be a Director at Large of NAFE someday soon!

Author: Richard M. Ziernicki, PhD, PE and Ricky Nguyen, PE

Title: FE Analysis of a Fatal Overhead Crane Accident (2:40-3:20 pm)

Abstract: This paper outlines forensic procedures and techniques used in reconstruction and safety assessment in a fatal overhead crane accident. The decedent, a subcontractor, was working as a pipe fitter at a manufacturing plant. At the time of the accident, the decedent had climbed up onto an overhead crane rail to move existing pipework when the crane struck and killed him. This paper presents the application of various techniques/methodologies to reconstruct the complex accident, including 3D HD scanning, drone video imaging and 3D modeling and principles of photogrammetry to explain the case and provide visualizations of the construction project. Safety analysis was conducted by analyzing crane maintenance and operation as well as the duties/responsibilities of the different employers and comparing industrial standards and practices such as OSHA, ANSI and safety principles.

Author bio: Dr. Ziernicki has evaluated several thousand industrial and vehicular accidents. He has presented papers and lectured at a number of technical conferences in the United States, Europe, and South America. He is the author of more than 60 publications, primarily in the fields of mechanical engineering, and vehicle accident reconstruction. His accident reconstruction expertise has been featured more than 30 times on local and national television, including the Discovery Channel, Dateline NBC, Dr. Oz Show, MSNBC, FOX News Channel and National Geographic Channel on accidents such as the Princess Diana accident, the Air France Flight 447 accident, and more. Dr. Ziernicki was a member of several past SAE Standards Committees. He is Past President and current Board Member for the National Academy of Forensic Engineers and also serves on many committees for the organization. As a result of his investigations, Dr. Ziernicki has testified in court as an expert witness in a few hundred cases and was deposed more than 500 times. He has testified and works as an expert witness for clients such as the U.S. Department of Justice, U.S. Department of Defense, State of Colorado Attorney General's Office, district attorneys, and public defenders.

Author bio: Mr. Nguyen has performed investigations and reconstructions of high- and low-speed motor vehicle accidents involving passenger cars, motorcycles, pedestrians, bicycles, and commercial vehicles. Mr. Nguyen frequently utilizes the latest technologies available in accident reconstruction throughout all analysis stages, from gathering

evidence through accident reconstruction and accident simulation. He has been involved in extensive investigation and analysis of the safety of mechanical products, including consumer products and material handling equipment such as stand-up and sit-down forklifts and cranes.

Author: Daniel Cowley, PE

Title: Forensic Engineering Analysis of a Failed Roll-Over Protective Structure (ROPS) (3:20-4 pm)

Abstract: Agricultural, commercial and some lawn and garden tractors (tractors) have been known to tip and even roll over. Roll-Over Protective Structures (ROPSs) are designed and tested to assure seat-belted occupants can survive in a zone of clearance within the structure, during and following a roll-over event. Within the laboratory testing parameters established in the standards, energy absorption is based on tractor mass alone, apart from any other forces that may be acting on the tractor during the event. In the past, tractors were mainly employed in soil-engaging or surface-grooming exercises. The center of gravity (CG) of these attached implements was relatively low. Today, however, tractors may tow larger, taller and heavier implements with high CG on multiple axles, such as large liquid manure tank spreaders (spreaders). The heavier weight of these spreaders requires more tires on the ground to distribute the load more evenly. The geometry of the multi-axle tires in turning maneuvers tends to increase axle stresses and cause tire scrub that forms ruts or disturbs the sod. Steering the spreader allows it to follow the path of the tractor more closely. Numerous methods are employed to articulate the spreader's axles. One such standardized method senses the differential angle between the tractor's drawbar and the longitudinal plane of the trailing spreader and adjusts the lead and trailing axles' tire steering angles accordingly. The purpose of this paper is to investigate the physical issues associated with tractors towing high CG implements, such as geometrically tall, articulated steerable axle spreaders operating in sloped terrain that cause an ROPS to fail.

Author bio: Mr. Cowley is a mechanical engineer and the founder/CEO of FACET-ics LLC. He currently works as a forensic investigator and has completed more than 50 cases. He worked at John Deere for more than 30 years in the agricultural machinery and heavy equipment industry. He has received a couple of international patents. His 40+ years' experience includes specifying, designing, testing, and supporting components such as vehicle chassis and suspensions, tire equipment, ROPS, electronic sensors, GPS receivers, and more. His work in reliability analysis greatly honed his "root cause" identification skills. Raised in West Africa, he still enjoys international work and travel. He's also building a legacy of great memories with his wife, three children, and nine grandchildren.

Author: Daniel Couture, PEng, and Shawn M. Jay, PEng

Title: Forensic Engineering Investigation of a Self-Unloading Boom Collapse on a Great Lakes Freighter (4-4:40 pm)

Abstract: A 42-year-old mid-sized Great Lakes bulk freighter (a "laker") was preparing to load crushed stone at Thessalon port on Lake Huron. While luffing its self-unloading 76-meter-long boom, it collapsed suddenly near the midpoint, with the tip falling 20 meters to the deck. The laker was within three years of its expected retirement. The metallurgical analysis found that inboard and outboard lower chords had fractured by overload. The boom failed due to the compromised bottom chords where extensive corrosion had reduced the thickness of the webs between panels, greatly reducing both the compression load and lateral load-carrying capacity of the structural members. Inspections and repairs of these critical boom areas of the owner's fleet of similar lakers were recommended

Author bio: Mr. Couture has been a Senior Metallurgical & Mechanical Engineer at Arcon in Toronto for more than 15 years and a Professional Engineer since 1982. He has been qualified as an expert witness before the Ontario Superior Court. His broad industrial experience provides the basis for effective investigation of failures of equipment components. He is a Fellow of Engineers Canada and was the first Canadian Member of NAFE. He is Vice-Chair, First Timers, and hopes to be a Director at Large of NAFE someday soon!

Author bio: Mr. Jay is an established specialist in civil & structural forensic engineering with over 20 years of experience and has been qualified as an expert witness before the Ontario Superior Court. His specialization is the forensic assessment of residential, commercial and industrial building deficiencies and damages, including the investigation of structural and infrastructure design failures. Mr. Jay is the President of Arcon Forensic Engineers.