NAFE Summer Meeting Technical Program – Saturday, July 28, 2018 – Buffalo – Expected Presentations:

MORNING TRACK: GENERAL TOPICS

Author: Stephen Jenkins, CEng

Title: Forensic Investigation of the Failure of a Large Marine Propeller Shaft **(9-9:40 am)**

Abstract: The starboard propeller shaft of a twin-screw diesel electric rail ferry in New Zealand failed just after the ferry left port. Weather was not a factor. The ship was a on a regular schedule of three sailings a day; a government agency operated the ferry, and it completed the trip on one shaft. The starboard propeller was found in 120 meters of water approximately two nautical miles from the channel and some distance from the point where power was observed to reduce to zero on the shaft. The fracture surface of the shaft showed a classic fatigue failure pattern. However, there were questions to be answered, including what initiated the failure, and why a tension failure occurred in a shaft that was primarily under compression from the reaction forces of the propeller. The author was appointed as lead technical investigator to determine the cause of the failure and to provide technical reports to the company and the government investigators. The job involved the coordination of a number of experts, including metallurgists, specialists in shaft vibration, marine inspectors, manufacturers, digital image experts and practical tradespersons. This presentation/paper will look at some interesting factors in the investigation, the techniques used to limit the investigation to relevant areas, a few of the false trails that were followed, and the processes eventually used that were the most convincing.

Author bio: Mr. Jenkins graduated with a degree in mechanical engineering from the University of Canterbury in 1971, and completed a master's degree at the Tepper Graduate School of Industrial Administration (GSIA) at Carnegie Mellon University in Pittsburgh. His professional qualifications include Eur. Ing., CEng (UK), and CPEng (NZ). He specializes in failure analysis and risk, and was the first person to be elected to the National Academy of Forensic Engineering of the USA as an International Affiliate. His current work includes technical due diligence for large transactions and assistance with the resolution of insurance claims and technical litigation.

Author: Daniel Couture, PEng

Title: Forensic Engineering Analysis of an Apartment Freezing Sequence Using Heat Flow Equations **(9:40-10:20 am)**

Abstract: Four students left their electrically heated third floor shared residence apartment to head home for the winter holiday break. They were responsible for electricity costs in their separate bedrooms. Two pipe bursts and a frozen toilet were discovered a week after the last resident had left. The investigation revealed that some electric heaters had been turned off, and some bedroom and living room windows were open. A forensic engineering analysis was conducted to determine the effects of heater disengagement and open window positions on the apartment temperature drop and to estimate the likely start date of sub-zero Celsius conditions. Heat flow and balance equations for different sets of factors were used to assess whether certain students carried more potential liability. The analysis revealed that the open windows were the dominant factor for the freeze-up condition development leading to the bursts.

Author bio: Mr. Couture, a materials science graduate of University of Western Ontario, holds an M.Sc. in metallurgical engineering from Queen's University at Kingston. He is licensed as a PEng in both Ontario and Quebec and is designated as a consulting engineer in Ontario. Since 2003, he has been a principal in the mechanical and metallurgical disciplines

and vehicle collision reconstruction with Arcon Forensic Engineers in Toronto. He became the first full Canadian member of NAFE in 2016, and serves with ASTM E58. He remembers when the NHL's Flames were based in Atlanta, and has the "flaming A" fridge magnet to prove it.

Author: David Icove PhD, PE and Thomas May, JD

Title: Computer Fire Modeling and the Law: Application to Forensic Fire Engineering Investigations **(10:20-11 am)**

Abstract: Computer fire modeling can be a two-edged tool in forensic fire engineering investigations. Professional standards of care recommend that fire modeling's primary use is in examining multiple hypotheses for a fire and not determining its origin. This paper covers current uses of computer fire models, historical and pending legal case law, and methods to get the results of modeling into expert reports and testimony. Particular issues reviewed are the use of animations versus simulations, evidentiary guidelines, and authentication using verification and validation studies.

Author bio: The Underwriters Laboratories (UL) Professor of Practice, Dr. Icove is an internationally recognized forensic fire engineering expert with more than 40 years of experience. As a retired federal law enforcement agent, Dr. Icove served over his career as a criminal investigator on the federal, state, and local levels. Dr. Icove holds B.S. and M.S. degrees in electrical engineering and a Ph.D. in engineering science and mechanics from The University of Tennessee. He also holds a B.S. degree in fire protection engineering from the University of Maryland-College Park. He is presently a professor in the department of electrical and computer engineering at The University of Tennessee, Knoxville; an adjunct faculty member at the department of fire protection engineering, University of Maryland; and is a registered professional engineer.

Author bio: Mr. May has extensive experience in all facets of the fire service industry with more than 31 years of involvement in fire/investigations related fields. He is a licensed attorney who specializes in cold case forensic fire/explosion investigations, litigation, and representation of expert witnesses facing Daubert or similar challenges. Mr. May also provides expert witness testimony and performs NFPA 921- and NFPA 1033-based peer and file reviews for insurance companies and attorneys. He is a frequent lecturer, an active author and researcher in the area of forensic fire science and law, and teaches fire-related subject areas as an adjunct professor. Mr. May routinely advise Innocence Projects worldwide in matters involving fire-related forensics. In 2008-09, he served in Iraq as a Forensic Fire Investigator for the U.S. Army Corp of Engineers and Task Force SAFE.

Author: Robert Peruzzi, PhD, PE

Title: FE Analysis of Video Screens for a Business Dispute Over Requirements and Specifications **(11-11:40 am)**

Abstract: This case involves LCD video screens intended to be components of medical equipment requiring an ultra-wide viewing angle. The seller was a wholesaler of various types of video screens from multiple manufacturers. The buyer was a distributer of various electrical equipment for various industries. The end consumer, not involved in the case, was a manufacturer of medical instruments and equipment. The end consumer refused a shipment of 1,000 LCD video screens, claiming that multiple units did not meet the requirements specified in the purchase agreement. The buyer had already paid the seller. When the seller refused to take back the shipment and issue a refund or credit, the buyer sued the seller. The author was retained through an expert witness agency to examine samples of the video screens, read the published data sheets and submit an expert opinion answering the following questions: Did each sample have substantially the same performance or different performance? Did each sample meet data sheet specification for

viewing angle? Was each sample adequate for its intended application as advertised in the data sheet? (That is, for industrial settings requiring ultra-wide viewing angle.) The case went to trial before a judge. With advance permission from the judge, the author assembled a test setup in the well and presented a demonstration where the difference in viewing angles was discernable. The judge decided the case in favor of the buyer and directed the seller to pay all damages, attorney's fees and costs. This report will discuss the details of the technical investigation and the rationale for presenting a demonstration beyond providing measurement data.

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 1: MECHANICAL/VEHICLES

Author: Richard Ziernicki, PhD, PE and William Pierce, PE

Title: FE Analysis of Right-Turning Trucks Impacting Bicyclists or Pedestrians (2-2:40 pm)

Abstract: Right-turning trucks present a serious hazard to bicyclists and pedestrians. When a collision between a right-turning truck and a bicyclist or pedestrian occurs, the truck driver often does not realize an impact occurred, and the bicyclist or pedestrian is pushed down and dragged by the truck. As a result of such collisions, pedestrians or bicyclists can sustain serious injury or death. Forensic engineers are retained to investigate and reconstruct such complex collisions. There can be disputes between forensic engineers as to the impact location, visibility, and reaction processes of both the driver and pedestrian or bicyclist. For example, physical evidence related to impact is usually faint and is often the subject of debate between forensic engineers, who may disagree to the direct line-of-sight. Further, reactions or lack thereof are subject to debate. This paper presents the application of various techniques and methodologies to effectively reconstruct collisions between right-turning trucks and pedestrians or bicyclists. Such techniques and methodologies include the identification and verification of faint physical evidence regarding impact location through the use of computer simulation and/or testing, the usage of high-definition laser scans and virtual scenes to replicate mirror line-of-sight or obstruction line-of-sight, evaluation of driver and pedestrian/bicyclist reaction processes, and the use of scientific visualizations to effectively communicate complex issues of a case.

Author bio: Dr. Ziernicki is a Registered Professional Engineer in the States of Alabama, California, Colorado, Kansas, Texas and Wyoming. Dr. Ziernicki is certified by the National Council of Examiners for Engineering and Surveying; Dr. Ziernicki is Board Certified Diplomate in Forensic Engineering by the National Academy of Forensic Engineers.

Dr. Ziernicki has evaluated several thousand industrial and vehicular accidents. Dr. Ziernicki has presented papers and lectured at over one hundred technical conferences in the United States, Europe and South America. He is the author of over 70 publications, primarily in the fields of mechanical engineering, and vehicle accident reconstruction. Dr. Ziernicki's accident reconstruction expertise has been featured over thirty times on local and national television including the Discovery Channel, Dateline NBC, MSNBC, FOX News Channel and National Geographic Channel

Dr. Ziernicki has investigated several high-profile cases such as:

- an explosion that destroyed Hawthorn boiler of a coal-and-gas fired power plant in Kansas City Mo, a $600 million lawsuit.
- the Princess Dianna accident in Paris, France.
- the collapse of the "Big Blue" crane during construction of Brewers baseball stadium in Miller Park, Milwaukee.
- the motor vehicle accident involving Stanley Cup MVP, hockey player Dany Heatly.
- A motor vehicle accident in Germany on behalf of the United States Department of Defense.
- the NASCAR case involving Kevin Ward, Jr. vs. Tony Stewart.

Dr. Ziernicki is past President and past board member for the National Academy of Forensic Engineers.

As a result of his investigations, Dr. Ziernicki has testified in court as an expert witness in a few hundred cases and was deposed over 500 times. He works as an expert witness for clients such as US Department of Justice, US Department of Defense, State of Colorado Attorney General's Office, attorneys and an Insurance companies.

Author bio: Mr. Pierce is a forensic engineer employed by Knott Laboratory, LLC, a forensic engineering and animation company founded in 1982. Pierce has a bachelor's of science degree in mechanical engineering from Purdue University (West Lafayette, IN) and is a licensed professional engineer. He gained interest in forensic engineering while interning with Rimkus Consulting Group, Inc. After graduating in 2009, Pierce began working full-time for Rimkus Consulting Group, Inc., where he gained experience developing and testing tribometers and investigating motor vehicle accidents and product failures. In 2012, he began working at Knott Laboratory, LLC where he has investigated a variety of motor vehicle accidents involving pedestrians, motorcycles, cars, and heavy commercial vehicles.

Author: Stephen Jenkins, CEng

Title: Forensic Issues that Arise from Recirculating Hot Water Systems **(2:40-3:20 pm)**

Abstract: There has been a significant increase in the failure of pipes used for recirculating hot water systems installed in hospitals and hotels in recent years. The rise has occurred as these systems have increased in popularity, and thermostatic mixing valves have made the higher operating temperatures safe. A common theme tends to be the continuous flow of water above 65°C (150°F) at velocities that have been found acceptable for non-continuous flow. The problem has been experienced in both copper and random polypropylene pipes. Corrosion has been typically pinhole or wall thinning through erosion corrosion in copper pipes and cracking developing from the inside surface of polypropylene piping. Explanations have been slow to emerge; however, standards are being implemented to minimize or prevent the problem. This paper will cover the history of corrosion in copper pipes, cold water and hot water pinhole processes, erosion, and some of the background history, myths and current thinking — some fairly speculative — on the causes of the problem in both copper and polypropylene from the point of view of a forensic engineer trying to make sense of uncertain science.

Author bio: Mr. Jenkins graduated with a degree in mechanical engineering from the University of Canterbury in 1971, and completed a master's degree at the Tepper Graduate School of Industrial Administration (GSIA) at Carnegie Mellon University in Pittsburgh. His professional qualifications include Eur. Ing., CEng (UK), and CPEng (NZ). He specializes in failure analysis and risk, and was the first person to be elected to the National Academy of Forensic Engineering of the USA as an international affiliate. His current work includes technical due diligence for large transactions and assistance with the resolution of insurance claims and technical litigation.

Author: David Komm, PE

Title: Forensic Engineering Analysis of the Energetic Failure of Plastic Pool Chlorinators **(3:20-4 pm)**

Abstract: Mechanical equipment used to circulate water in swimming pools may include a reservoir of chlorine with mechanisms to add the chemical at some prescribed rate. Known as chlorinators, these vessels are typically made of polypropylene or polyvinyl carbonate, and can hold up to two dozen cakes of chlorine at a time. While the vessel materials are typically thought of as resistant to chlorine attack, the high chlorine concentration together with the transient dynamics of pool mechanicals can lead to high energy failures of the caps and bodies, shrapnel and resulting propensity for human injury.

Author bio: Mr. Komm is the president of Augspurger Komm Engineering, Inc., a company providing forensic engineering services and expert witness testimony. His specialties include origin and cause analysis of fire and explosions, component failures and human dynamics. With 35 years of experience in engineering, including industrial experience in gas turbine design, test and end user integration, Mr. Komm has testified over 100 times in jurisdictions including federal and state courts. He is licensed in a number of states and Canada and previously served as a member of the Arizona Board of Technical Registration.

Author: Nicholas A. Petrucci, PE

Title: Machine Safeguarding: Theory, Practice and Case Studies **(4-4:30 pm)**

Abstract: A machine is a device that uses mechanical or electrical energy to perform some type of useful mechanical work. A machine must therefore have at least one, and more often many, moving parts. A safeguard is a measure taken to protect someone from physical harm. The sources of harm from a machine typically stem from moving parts and/or electric current. Proper machine safeguarding will substantially reduce personnel exposure to these hazards, and, as a result, help to optimize productivity. Different types of machine safeguards will be discussed in this paper. The safeguarding hierarchy will be presented, which is a guide to help determine what safeguarding method(s) should be used. The safeguarding hierarchy, however, must be supplemented with expertise of machine hazards, safeguarding methods, personnel tendencies, OSHA regulations and the operation and maintenance of the machine in question in order to develop an effective safeguard. Case studies of injuries that were caused, at least in part, by various machine safeguarding deficiencies, will be presented. Relevant matters that arose during an OSHA National Emphasis Program on Amputations audit at a manufacturing facility where the author served as the primary contact will be discussed. These topics will hopefully help to provide an insight on how to develop and employ more effective machine safeguards.

Author bio: Mr. Petrucci teaches mechanical engineering courses in the electro-mechanical engineering technology program at Penn State's New Kensington campus. He earned a master's degree in mechanical engineering from Penn State and a bachelor's degree in marine engineering systems from the U.S. Merchant Marine Academy. Mr. Petrucci has more than 25 years of engineering experience. He is a licensed professional engineer, a board-certified Diplomate Forensic Engineer and a board-certified safety professional. He specializes in analyzing equipment and machinery failures, and conducting safety assessments related to personal injuries.

AFTERNOON TRACK 2: CIVIL/STRUCTURAL

Author: Edward Fronapfel, PE

Title: Interdisciplinary Forensics as a Result of Substantial Completion Request **(2-2:40 pm)**

Abstract: Typically, an owner relies on the design professional to provide a review of the work to determine substantial completion. The potential for conduct arises when the designer may have errantly designed, observed, approved or omitted work during the construction process. As a third-party observer who comes on the property late finds substantial visible deviation from code, plans, manufacturers' installation, and contract deviations, the owner must determine how to handle the need for correction based on contractual provisions and legal recourse. The cost to cure the work can be substantially greater than the cost of the work defined in the contract. This paper will reveal the work from the inspection through the arbitration process and the discovery necessitated by the findings.

Author bio: Mr. Fronapfel is owner of SBSA, Inc., in Golden, CO. A registered engineer in 33 states, he has been a practicing forensic engineer nationally for more than 20 years. His background is comprised of geohydrology, hydraulics, hydrology, site design, civil and structural engineering. This experience includes new design, repairs and rehabilitation and quality assurance for industrial, commercial and residential properties. His experience also includes more than 500 deposition testimonies, more than 65 trial testimonies, and hundreds of mediations/arbitrations. He is a Fellow Member of the NAFE and ASCE as well as a Board-Certified Building Inspection Engineer with NABIE.

Author: Paul Carr, PhD, PE, Wayne Thompson, PE, and William Walker

Title: FE Evaluation of Failed Adhered Masonry Veneer: Investigation, Testing and Resolution **(2:40-3:20 pm)**

Abstract: The difficulty often facing the forensic engineer is the integration of an in-situ field testing protocol with a Code-mandated testing regime, which typically involves laboratory testing. That laboratory testing would yield theoretical results for typical material installations, while leaving unanswered the in-field application results. The challenge of the field testing is to computationally compare the laboratory testing with the field testing methods to validate results. The case study presented is a failure of an adhered masonry veneer natural stone for the exterior finish of a new facility. The veneer panels delaminated from the substrate. A testing regime was established to recreate the installation of the veneer in accordance with the manufacturer's instructions, with in-situ tests for compliance, while the Code only dictates a laboratory test method. The paper presents the forensic investigation, the testing processes, findings and conclusions.

Author bio: Dr. Carr was the founder, CEO and Chairman of the Board of an architectural and engineering practice that provided the planning, design and construction management of educational facilities, municipal water and sewage treatment plants, bridges, municipal buildings, public housing projects, hospitals and libraries. As a diplomate of the National Academy of Forensic Engineers, Dr. Carr focuses his current forensic engineering consulting practice on failure assessment and prevention in public building projects and infrastructure capital programs. His experience encompasses architect and engineer errors and omissions claims, design and construction review, construction delay claims and disputes as well as code compliance matters.

Author bio: Mr. Thompson graduated from McGill University (Montreal, QC), where he studied civil engineering. He worked as a licensed general contractor for 25 years, gathering a wealth of knowledge and experience as to the manner

in which buildings of all types are designed, scheduled, and constructed. Mr. Thompson has practiced structural engineering in New York for the last 15 years, designing structures, conducting field investigations, and performing structural condition assessments. In addition to his current consulting engineering duties, he works on various forensic engineering assignments within the consulting practice of Paul G. Carr and Associates, LLC.

Author bio: Mr. Walker practices as a forensic consultant with a focus on economic recovery claims; specifically related to labor productivity, change orders and their cumulative impact, contractual issues including delays and time extensions, and building code review for compliance of various building components. His application of contractor experience, architecture & engineering firm experience, and on-site construction management experience brings a comprehensive perspective to construction claims evaluation, as well as all associated phases of construction projects.

Author: Chad Williams, PE

Title: FE Analysis of Damage Attributed to Earthquakes in Residential and Light Commercial Buildings **(3:20-4 pm)**

Abstract: Since approximately 2009, there has been an increase in the occurrence of low-magnitude earthquakes (M 3.0 to M 5.0) within the State of Oklahoma. Additional earthquakes ranging from M 5.0 to M 5.8 have also occurred. The seismic activity has resulted in an increase in the observation of damage and other conditions attributed to earthquakes in residential and light commercial buildings. To determine scopes and methods of repairs, it is necessary to first determine what damage is attributable to earthquake and/or other causes. This paper will include the discussion of the methods and processes utilized in that process.

Author bio: Mr. Williams is a senior engineer with 15 years of engineering experience, including forensic evaluations of residential, commercial, industrial, and institutional facilities, and operations engineering in support of military, aviation, and industrial facilities. He earned his bachelor's of science in civil engineering from the University of Oklahoma (July 2001). His forensic experience includes the assessment of damage and/or conditions related to construction defects, design errors, earthquakes, fires, floods, foundation movement and failures, hail storms, surface and subgrade plumbing systems, surface and overland flooding, soils and ground movements, tornados, vehicle impacts to buildings, water intrusions, and wind.

Author: Geoffrey E. Clarkson, PEng, and Daniel Couture, PEng

Title: Using Novel Ultrasonic Technique to Determine Fitness for Service of FRP Equipment with Case Studies **(4-4:40 pm)**

Abstract: Fiberglass-reinforced plastic materials are well suited to a wide variety of equipment where strength, resistance to corrosion is required. FRP and other composites are being used in a variety of applications: tanks, pipes, wind turbine blades, train cabs, water slides, etc. A significant impediment to adoption of these materials for many suitable applications lies with the inability to do a fitness for service determination after the equipment has been in service. This is largely due to the lack of effective non-destructive and non-intrusive techniques for plastic materials. This paper presents two case studies of equipment that was evaluated with a new ultrasonic technique: scrubber used to neutralize gas with sodium hydroxide solution and a wind turbine blade. The results compared destructive and non-

destructive applications and indicated a good correlation. Although the FRP equipment was already discarded, this study indicated that significant life had still remained.

Author bio: Mr. Clarkson is the chief engineer and founder of UTComp, Inc. He has a degree in systems design engineering and has more than 30 years of global industrial experience with mineral processing, pulp and paper, nuclear and chemical processing. Since 2000, he has developed UltraAnalytix, a reliable technology for ultrasonic testing of FRP composites. He is a licensed professional engineer in a number of jurisdictions and Member of the Order of Honour of Professional Engineers Ontario and a Fellow of Engineers Canada.

Author bio: Mr. Couture, a materials science graduate of University of Western Ontario, holds an M.Sc. in metallurgical engineering from Queen's University at Kingston. He is licensed as a PEng in both Ontario and Quebec and is designated as a consulting engineer in Ontario. Since 2003, he has been a principal in mechanical and metallurgical disciplines and vehicle collision reconstruction with Arcon Forensic Engineers in Toronto. He became the first full Canadian member of NAFE in 2016, and serves with ASTM E58. He remembers when the NHL's Flames were based in Atlanta, and has the "flaming A" fridge magnet to prove it.
