NAFE Summer Meeting Technical Program – Saturday, July 22, 2017 – Atlanta – Expected Presentations:

MORNING TRACK 1: GENERAL TOPICS

Author: Mamoon Alyah, PE (NAFE 758 Senior Member)

Title: A Comparative Study of Forensic Engineering Practice Around the World

(9-9:40 am)

Abstract: Globalization has allowed manufacturers and contractors from around the world to sell their products and construct projects in other countries. Regardless of where a loss occurs, parties are looking to forensic engineers to determine the root cause of the failure. Though all parties, regardless of their nationality, are looking to determine the root cause and responsible party, the investigative process varies greatly, based on the location where the loss occurs. This paper presents a comparative analysis between investigative processes applied in different parts of the world. A review of the steps taken by forensic engineers, public authorities, manufacturers, and contractors to determine the cause of an incident is presented in this paper. Comparison between acceptable and unacceptable procedures in different countries is made based on real-life investigations that were carried out in four continents over a number of years. Evidence spoliation, burden of proof, documentation of opinions, application of standards, interaction with attorneys, and testimony at court are among the different topics that will be discussed. The analysis looks at court rulings related to forensic investigations and concludes with lessons learned from each of them.

Author bio: Mr. Alyah has more than 30 years of experience performing forensic investigations of various types of incidents and extent of damage resulting from fires, breakdown, electrical faults, electrocutions and other similar incidents. He was instructed by clients as a forensic expert to investigate incidents in more than 48 countries on matters involving heavy machinery, hi-tech equipment and complex engineering systems. He has acted as an expert witness in different jurisdictions in the United States, UK, UAE and other countries, testifying on multiple engineering disputes. He has also authored a number of articles and has been a frequent presenter to leading insurance, risk and engineering organizations in the United States, Europe, and the Middle East.

Author: Drew Peake, PE (NAFE 460 Fellow)

Title: Engineering Analysis of Cost to Protect Workers from Diacetyl Exposure and the Economic Benefit of Noncompliance

(9:40-10:20 am)

Abstract: A large commercial bakery used artificial butter flavor (containing diacetyl) in its recipes for 40 years. In 2012, a health-based exposure threshold was published by the American Conference of Governmental Industrial Hygienists. Bakery management knew what was necessary to protect workers from exposure but did nothing. Instead, they invested the funds for worker safety into production. This study develops the costs that would have been necessary to protect workers, and uses the U.S. EPA model (BEN) to calculate the economic benefit of noncompliance. This offers a characterization of the profit incentive to place workers at risk.

Author bio: Mr. Peake is a Fellow Diplomate of NAFE. He went into private practice as Peake Engineering in 1988, after 12 years as a project engineer and enforcement officer for US EPA. He is a Diplomate Environmental Engineer, Certified Industrial Hygienist and Certified Safety Engineer, with BS and M.Eng., in Environmental Engineering and MBA degrees. Captain Peake retired from the Navy after 41 years active and reserve service.

Author: Robert Peruzzi, PhD, PE (NAFE 967 Associate Member)

Title: Forensic Engineering Analysis Regarding a Business Sale/Purchase Dispute over Semiconductor Test Equipment Manufacturing Capability

(10:20-11 am)

Abstract: A privately-owned semiconductor test hardware company was sold by its owners to a buyer. The sale was to take place in several stages. Unknown to the buyer at the time of the agreement, the seller's latest flagship product was being rejected by customers for not meeting specifications. When this came to light, the buyer refused to continue with the second and subsequent stages of purchase. The seller then sued the buyer for not complying with the agreement, and the buyer counter-sued for fraudulent deception. The author was retained by the buyer to review specification documents regarding the product, the due diligence reports, e-mail chains regarding product quality, field returns and repairs. Several interesting aspects of this case are presented: 1) a general overview of integrated circuit, design, fabrication, testing and packaging; 2) explanation of the product in question its role – a probe-card which electro-mechanically connects computer-controlled test instruments to a chip before that chip is separated from its wafer, for pass/fail testing; and 3) the timeline of the case: company history, investigative and analytical steps, events of the legal proceedings, and case results.

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.

Author: Rune Storesund, PhD, PE (NAFE 474 Correspondent)

Title: Forensic Engineer Expert Communications: Lessons Learned from the March 2014 Oso Landslide Litigation

(11-11:40 am)

Abstract: This paper presents an examination of issues arising in connection with expert communication discovery protocols for the March 2014 Oso Landslide litigation in Washington state. Discussion, with a focus on discovery-related issues, includes an overview of the landslide and its devastating effects, the formulation of an expert team to evaluate allegations, challenges associated with developing expert opinions, and a chronology of expert communications. The expert discovery process and the court's interpretation and response are outlined. Finally, specific lessons learned are presented to inform future litigation requiring expert teams to analyze and evaluate evidence in order to render expert opinions.

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 over $1 billion in litigation claims. He is the Executive Director of UC Berkeley's Center for Catastrophic Risk Management.

MORNING TRACK 2: FIRE INVESTIGATION

Author: Maurice Cueva-Eguiguren, PE (NAFE 776 Senior Member)

Title: Forensic Engineering Analysis of an Electrical Substation Fire in a Manufacturing Plant in Brazil

(9-9:40 am)

Abstract: This paper discusses the investigation of a cable splice failure that resulted in a fire in an 88 – 4.16 kV electrical substation at a manufacturing plant in Brazil. The fire was caused by a cable splice failure in one of the 4.16 kV cables that provided power to a 6 MVAR capacitor bank. The cable splice failure caused an electrical short circuit in the 4.16 kV distribution system in the substation lasting for approximately 120 seconds. The short circuit in the cable splice ignited the cable insulation in the adjacent cables located in the cable tray, and damaged sections of the 4.16 kV substation overhead cables, three disconnect switches, and four 88 – 4.16 kV transformers that provide electrical power to the plant. As a result of the fire in the 88 – 4.16 kV electrical substation, the electrical power to the plant was lost, causing the loss of production with an estimated value of three-quarters of a million dollars per day for 29 days. The temporary repairs to the electrical substation allowed the plant to operate until a new gas insulated (SF6) substation was installed the following year.

Author bio: Mr. Cueva-Eguiguren, president of Acticon Engineering, P.C. has more than 38 years of electrical engineering experience, including managing and overseeing multi-discipline engineering and design services for projects related to the electric utilities, industrial, commercial, residential and government markets. Utility projects include fossil and nuclear fueled power plants and substations up to 765kV. He also provides forensic engineering services for various investigations related to electrical engineering systems and equipment.

Author: Roger Owens, PE (NAFE 412 Fellow)

Title: Forensic Engineering Analysis of Arc Flash Fires

(9:40-10:20 am)

Abstract: One of the most difficult types of electrical failures to analyze is a medium-voltage failure that results in an extended arc flash occurrence. Medium voltage can be defined anywhere between 600 V and 69 kV; however, in the IEEE Standard Dictionary the upper limit for medium voltage is 15 kV in power generation systems. An arc flash produces light and heat at levels sufficient to cause substantial equipment damage, fire, and personal injury. One of the characteristics of an uncontrolled arc flash is that the resistance in air decreases due to ionized particles in the vapor cloud. The current increases rapidly, and the energy dispersion increases until the installed protective devices operate or the conductors burn free such as to de-energize the system. This paper discusses uncontrolled arc flash occurrences, provides some rules of thumb for arc flash fault analysis, and provides some references to assist in a more detailed analysis for the reader. Additional references that discuss personnel protection equipment (PPE) for qualified workers are also provided.

Author bio: Mr. Owens is a USN retired LCDR who served three chief engineer tours and two command tours on USN ships at sea. He has an MEE from NCSU 1968 and has practiced as a forensic engineer since 1986. Although partially retired, he says it would be hard to turn down a really challenging case.

Author: Raymond Thompson, PhD, PE (NAFE 763 Fellow)

Title: Forensic Engineering Metallurgical Analysis of PTO Air Compressor Rupture and Fire

(10:20-11 am)

Abstract: The coalescer of an air compressor mounted on a utility-truck ruptured and resulted in the expulsion of burning oil onto a nearby employee. An investigation ensued to determine the root cause of the injuries. Many potential contributing factors were examined, including system and component manufacture, design, installation, maintenance and use. Metallurgical and failure analysis procedures were used to determine root cause of the system failure and related injuries. A PTO-driven compressor operates at high temperature (200°F) and pressure (110 psig), creating opportunities for dangerous conditions. The system has a safety shutdown control to prevent the system from going over temperature and pressure limits. The exploded coalescer and fire in this case indicated the temperature and/or pressure systems were compromised as well as the control system. Compressor failures are not uncommon; however, violent failures that cause fire and injury are much less common. PTO compressors are relatively simple machines with only about 30 components. However, the proper function of most components is essential to the safe operation of the unit. In this root cause investigation, it was necessary to look at each component relative to its fitness for service and potential contribution to the system failure.

Author bio: Dr. Thompson is a Fellow of the American Welding Society, a Fellow of the American Society of Materials, and the 2013 Engineering Council of Birmingham's Engineer of the Year. He has completed more than 500 projects with companies on three continents and served plaintiff and defense lawyers for 37 years as a consultant and expert witness.

Author: Christopher Shiver, PE (NAFE 661 Senior Member)

Title: Forensic Engineering Evaluation of a Carpet Wrapping Machine — Maintenance Worker Fatality

(11-11:40 am)

Abstract: A wrapping machine was the end unit in a production process that provided final packaging for rolled carpet. To complete wrapping, pneumatic driven "paddles" pressed plugs into each roll end. An experienced maintenance worker responded to a call to troubleshoot a unit malfunction. During that process, he was trapped between one of the outward moving end paddles and the machine frame, resulting in a fatal injury. Key issues included unit design, installation and function with particular interest in the automated control processor code details, the details of operator interface controls, and machine hazards and guarding features. Also evaluated were the appropriateness of maintenance worker training, the energy control program (lockout/tagout) for this facility, and typical actions performed by maintenance workers when troubleshooting the subject unit.

Author bio: An ME/EE since 1981, Mr. Shiver worked as a generating plant engineer for a major electrical utility for seven years. He also served as principal of a design, testing, and forensic engineering consulting firm for 22 years. For the last five years, he has been a sole practitioner as a forensic engineer. Shiver has conducted approximately 3,000

engineering incident evaluations and has given sworn expert testimony in nearly 200 appearances. He has also served on eight codes and standards committees.

AFTERNOON TRACK 1: VEHICLES & MACHINES

Author: Daniel Couture, PEng (NAFE 951 Member)

Title: Forensic Engineering Investigation of a Fatal Farm Tractor Incident

(2-2:40 pm)

Abstract: A farm owner was found unresponsive with crushing head injuries on his property in rural Ontario. His small farm tractor was found 60 meters away down a small incline, with its engine running and transmission in neutral. The owner's son alleged that when the parking brake was engaged with the engine running and transmission in neutral, this tractor's parking brake would "pop out," causing it to move. Field tests were conducted on the tractor to attempt to duplicate the scenario and to determine if the sequence of events was plausible. Components of the parking brake and two exemplars were assessed with specialized metrology to determine whether they were within manufacturing specifications. A 3D CAD model of fit was created, and several variances were identified between the factory drawing and the parts. The results of the analysis concurred with the scenario.

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 P.Eng. 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.

Author: Ben T. Railsback, PE (NAFE 713 Senior Member)

Title: Forensic Investigation of a Powered Industrial Truck Accident

(2:40-3:20 pm)

Abstract: It is well known in various industries and workplaces that unintended movement of powered industrial trucks after operators have left the operating position have led to serious, and sometimes fatal, accidents. Even though operators are trained to prevent unintended movement of these powered industrial trucks, the operators can forget to shut off the power source or activate systems to prevent the unintended movement when leaving the truck. Operators are known to make mistakes, especially if they are working in a fast-paced environment and are required to frequently leave the trucks. Engineers have designed systems (or interlocks) to prevent unintended movement (i.e., an automatically applied parking brake); however, not all powered industrial trucks are equipped with them. Furthermore, some of these systems only disconnect the power source from the truck's drivetrain, and these trucks can continue traveling due to their initial momentum or by gravity if the truck was left on a slope. This paper will document the forensic investigation of a powered industrial truck accident and show that trucks equipped with systems that would automatically stop unintended movement when operators leave the operating position increase the safety of these trucks and will reduce the chances of serious and/or fatal accidents.

Author bio: Mr. Railsback, MS, PE is Director of Mechanical Engineering at Knott Laboratory in Centennial, Colo. He is a mechanical engineer that practices in the areas of accident reconstruction, product safety, and safety engineering. He began to pursue a career in mechanical engineering because of his interest in cars and machine design and continues to develop experience in vehicle dynamics, automotive engineering and manufacturing. Mr. Railsback is an avid snowboarding, cycling and running enthusiast and loves the outdoor lifestyle that Colorado can provide.

Author: William Lee, PhD, PE (NAFE 655 Senior Member)

Title: Forensic Engineering Analysis of Upper Extremity Nerve Entrapment Injury Mechanisms as Related to Low-Velocity Rear-End Collisions

(3:20-4 pm)

Abstract: Upper extremity nerve entrapments, such as carpal tunnel syndrome (CTS) and cubital tunnel syndrome (CT), are often claimed as a result of a low-velocity rear end collision. After reviewing the basics of such entrapments, the mechanisms associated with such conditions, and other causes (including risk factors), it will be shown that any biomechanical basis (e.g., blunt trauma or upper extremity traction) for a claim that CTS or CT are causally related to the collision are without basis, reflecting occupant kinematics, focusing on movements of the upper extremities, any possible occupant-interior surface contacts, and other relevant factors.

Author bio: Dr. Lee is a professor in the Department of Chemical & Biomedical Engineering at the University of South Florida since 1985 and also has research affiliations at the Tampa VA Hospital and Florida Orthopedics Institute. He is Board Certified in Forensic Engineering Sciences by the International Board of Forensic Engineering Sciences. He has been providing forensic engineering analysis with a focus on injury biomechanics for the last 24+ years. Bill has published widely in the areas of biomechanics and related subjects in forensic engineering.

Author: Richard M. Ziernicki, PhD, PE (NAFE 308 Fellow), Ben T. Railsback, PE (NAFE 713 Senior Member) and Stephen D. Knapp, PE (NAFE 891 Senior Member)

Title: Forensic Engineering Analysis of a Motorsports Racing Incident

(4-4:40 pm)

Abstract: The motorsports racing industry was built on the foundation of people wanting to engage in competition, take risks, and enjoy the capabilities of their go-fast hobbies. Risk undoubtedly accompanies such dangerous activities and as a result race participants sign a waiver giving up their right to file claims against affiliates of the racing event. Who then is liable for the failure of a component that is certified for racing and is responsible for an injury? This paper will address this question and outline important factors related to an incident involving the failure of a race certified transmission flexplate that resulted in serious injury.

Author bio: Dr. Ziernicki, chairman and CEO of Knott Laboratory, has evaluated several thousand industrial and vehicular accidents. He has presented papers and lectured at 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 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. Dr. Ziernicki has testified in court a few hundred cases and has been deposed more than 500 times. He has testified on behalf of clients such as 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. Railsback, MS, PE is Director of Mechanical Engineering at Knott Laboratory in Centennial, Colorado. He is a mechanical engineer that practices in the areas of accident reconstruction, product safety, and safety engineering. He began to pursue a career in mechanical engineering because of his interest in cars and machine design and continues to develop experience in vehicle dynamics, automotive engineering and manufacturing. Mr. Railsback is an avid snowboarding, cycling and running enthusiast and loves the outdoor lifestyle that Colorado can provide.

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.

AFTERNOON TRACK 2: MATERIALS

Author: John Certuse, PE (NAFE 708 Fellow)

Title: Forensic Engineering Analysis of Copper Pipe Solder Joint Failure

(2-2:40 pm)

Abstract: Separation of copper pipe solder joints is a common failure due to issues such as ice expansion and poor workmanship. In the event of piping system impact or over-pressurization, it is common for improperly assembled solder joints to fail first, resulting in speculation as to the initial failure being the pipe or the system event. This paper addresses the quantification of the strength of copper solder joints under varying degrees of surface area engagement. Additionally, the degenerative and corrosive effect of slightly leaking (weeping) solder joints and hardness mineral salt accumulation will be addressed. A final surface area to internal pressure (SAIPR) as well as surface area to tensile force ratio (SATFR) will be derived for common schedule 40 copper piping diameters.

Author bio: John Certuse is a licensed professional engineer and director of engineering at ISE Engineering in Attleboro, Mass. ISE Engineering performs forensic engineering examinations for the insurance industry with a large concentration based upon heating system failures.

Author: Jesse Grantham, PhD, PE (NAFE 597 Fellow)

Title: Forensic Engineering Assessments of Failed Welds in 12-Inch Diameter Inlet Pipes of a 1 Million Gallon Municipal Water Storage Tank

(2:40-3:20 pm)

Abstract: Initially, the subject water storage tank was emptied of water for routine, interior re-coating and minor improvements to water inlet collar regions. Then 18-inch-long pipe extensions were welded to each inlet collar to create a silt-barrier above the bottom of the tank. As the tank was being re-filled, water gushed from the new welds and defective butt welds at the inlet collars and the tank bottom. The effects of the rapid water exiting from the storage tank were cavernous voids in the earthen pad beneath the tank and structural unsoundness of the tank bottom. The welding contractor, welder, and their attorney were hesitant to accept responsibility for the defective welds and the damage to the tank bottom. Forensic engineering evaluations and examinations of the areas of interest lead to re-draining the tank for interior visual examinations of the inlet regions, deformed tank bottom and failed welds by all parties. Upon visual inspections of the inlet regions, it was confirmed by the owner and contractor that the new welds were flawed. As a result of the voids, the tank bottom moved downward and caused additional weld failures in the fillet welds of the collars to the bottom and the pipe extensions. The forensic engineer analyzed the alloys of the steel inlet collars and steel extension pipes by Optical Emission Spectroscopy (OES). Wall thicknesses were measured by ultrasonic thickness testing. An engineered Welding Procedure Specification (WPS) was qualified for the steel collar alloys, tank bottom, consumables and a suitable welding process.

Author bio: Dr. Grantham, PE is a NAFE Fellow. His specialties are welding and nondestructive testing. He testifies about compliance with welding codes, welding contracts and related safety regulations. He owns and operates Welding & Joining Management Group in Frederick, Colo. In his laboratory he conducts mechanical testing of welds and metals, nondestructive testing of welds and metals, and alloy analysis of welds and metals. He is renowned as a certified welding inspector, certified welding educator, certified radiographic interpreter and certified nondestructive testing expert. He writes welding procedures and certifies welders. He testifies about welds, welding safety and assesses disputed welding failures. He is a Life Member of the American Welding Society and American Society of Nondestructive Testing.

Author: Dhirendra “Sax” Saxena, PE (NAFE 586 Fellow)

Title: Forensic Engineering Evaluation of an Allegedly Deficient Steam Turbine Foundation

(3:20-4pm)

Abstract: Forensic engineering as applicable to "construction materials evaluation" was used in investigating a condition where an alleged severe deficiency occurred during placement of concrete for a Steam Turbine Generator (STG) structure in west central Florida. Structural integrity of the partially completed structure was questioned by the owner. Removal and replacement of the partially completed structure was initially demanded by the owner. A forensic investigation was conducted to determine whether the damage was superficial and repairable, or if removal and replacement of the structure was, in fact, warranted.

Author bio: Mr. Saxena obtained his M.Eng. in Civil Engineering in 1967-68 from TUNS (formerly NSTC), Halifax, Canada; B.Tech (Hons.) in Civil Engineering 1962 from I.I.T. Kharagpur, India. Sax is, or has been, a registered Professional Engineer in seven states. He is a board certified diplomate in Forensic Engineering by NAFE (D FE), in Geo-technical Engineering (D GE) by AGP, and a certified Forensic Litigation Consultant (C FLC) by FEWA. He has authored, co-authored, presented, and published more than 80 technical papers at local, state, national, and international conferences. He has also presented lectures at various national and international conferences and to various professional groups and institutions globally. He has received prestigious engineering society awards throughout his professional career.

Author: Kamran Farahmandpour, PE (NAFE 854 Fellow) and Derek Hodgin, PE (NAFE 733 Senior Member)

Title: Forensic Engineering Assessment of Fault Allocation of Involved Parties in Building Envelope Defect Cases

(4-4:40 pm)

Abstract: There are numerous industry standards that establish evaluation, investigation, and testing protocols for determination of failure causes in building envelopes. However, there is little guidance to establish standard procedures for assessment of responsibility and allocation of damages to various parties. This paper endeavors to provide a systematic approach for allocation of damages to parties involved in building envelope litigation. This process is broken down into assessment of project delivery method, which impacts contractual obligations of each party, design, code requirements, the building official's role in reviewing and issuing a permit, implementation of the design by the construction team (general constructor, construction manager, trade contractors, material suppliers and manufacturers), testing laboratories, the party responsible for overseeing the construction, and those involved in the operations and maintenance of buildings. While the authors will not be able to provide a definitive methodology for determining allocation of responsibility that applies to every case, a recommended procedure to be followed and a list of major issues that should be considered and analyzed in such an evaluation will be provided.

Author bio: Mr. Hodgin is the President of Construction Science & Engineering, Inc. He has more than 20 years of forensic engineering experience, investigating all types of construction issues. Mr. Hodgin has designed repair details to address damages identified in hundreds of buildings located in the Southeastern United States and the Caribbean.

Author bio: Mr. Farahmandpour is the Principal of Building Technology Consultants, PC. He has been involved in the evaluation, testing, and repair of construction materials and building envelope performance since 1984. Kami is a Fellow of RCI, and has served on many technical committees and Boards of Directors of various organizations. His involvement with the building envelope industry has earned him many awards, both for his contributions to the industry and for his work on several projects.

SUNDAY TECHNICAL SESSION

Author: Harold Josephs, PhD, PE (NAFE 295 Fellow)

Title: Lead-Acid Battery Explosion Due to Excessive Sulfation: A Case Study

(Time TBD)

Abstract: This case study reviews the pertinent steps that led to the explosion of a large industrial lead-acid battery that was manufactured and sold for use on electric forklift trucks. It was ultimately determined that the battery explosion resulted from excess sulfation, which was created from lengthy inactive battery storage coupled with inadequate water additions. Additionally, inadequate and ambiguous warnings and instructions had a significant impact on creating this hazardous situation resulting in the battery explosion and serious injury to the battery technician.

Author bio: Dr. Josephs is a Professor Emeritus at Lawrence Technological University. He is the author of numerous technical papers and is the co-author of two engineering texts. He has nine patents and has presented numerous seminars to industry focusing on quality, safety, fastening, and joining.