NAFE Winter Meeting Technical Program – Saturday, January 14, 2017 – New Orleans – Expected Presentations:

MORNING TRACK 1: GENERAL TOPICS

Author: Laura Liptai, PhD (NAFE 887 Associate Member) and Mark Ezra, PE (NAFE 641 Fellow)

Title: Forensic Engineering Analysis of Trauma in a Motorcycle Accident Utilizing Physical Evidence-Based Methodologies **(9-9:40 am)**

Abstract: The forensic biomedical investigation of trauma due to motorcycle incidents requires both a biomedical engineering analysis of the physical evidence in the form of trauma and a physics-based classical accident reconstruction of the motorcycle's and rider's likely paths of travel after the motorcycle hits the ground and rider separation occurs. This research focuses on the forensic engineering investigation of motorcycle trip accidents on highways; however, the methodology applies to motorcycle incidents broadly. Such trip accidents by motorcycles often lead to secondary impact of the rider by following traffic after the motorcycle trip. Issues of visibility of the lane height difference and angle of attack of the motorcycle toward the obstacle are evaluated. In the example discussed, the physical evidence of the trauma, including fracture mechanics, methodologically determined the principal direction of force was consistent with axial loading at the time of impact (i.e., the rider was vertically oriented with his/her body weight on the lower extremities when impacted). This fracture signature, combined with a dynamics-based motion analysis of motorcycle and rider masses, provided insight into the causal factors of the rider's injuries.

Author bio: Dr. Liptai (BioMedical Engineering, PhD, MS; Mechanical Engineering, BS) specializes in biomedical engineering analysis of human trauma and accident reconstruction. Dr. Liptai has testified in more than 100 trials in the United States as well as military assignments on the North American continent, Europe, and South America. She serves on five boards (AAFS, IBFES, LEADR, UCDBME and SFES as President) and had the privilege of reviewing the engineering chapter in the Reference Manual on Scientific Evidence, 2nd Edition for the Judicial Research Center in Washington, DC.

Author bio: Mr. Ezra is a NAFE Fellow and holds a PE license in the state of Missouri. He is a charter engineer in the United Kingdom and holds a BSc. Mech Eng (Hons) from the University of Manchester, Manchester, England. As a mechanical engineer, he has been investigating motorcycle accidents and design defects since 1981, specializing in the analysis and rebuttal of computer simulations of motorcycle, car, and truck accidents. He has been actively involved in the analysis of machine design defects since 1981, and has more than 250,000 miles riding experience on motorcycles.

Author: Richard Ziernicki, PhD, PE (NAFE 308 Fellow) and Angelos G. Leiloglou

Title: Forensic Engineering Reconstruction of Police Shooting Accident with Assistance of Newest Technologies **(9:40-10:20 am)**

Abstract: A case analysis utilized many of the latest forensic technologies to reconstruct the events that occurred during a shooting incident in which a police officer fatally shot a fellow police officer. Accident reconstruction utilized 3-D high-definition laser scanning, matchmoving police video footage from infrared radar camera mounted on a police helicopter, motion capture, photogrammetry, 3-D interactive virtual environment and Virtual Reality display systems. This paper also outlines how the trajectory of bullets and sequence of bullets were reconstructed, and how position and posture of

the shooting officer and victim officer were determined. Finally, federal judge rulings on various Daubert motions (e.g. 509 U.S. 579 [1993]) to exclude or limit testimony of expert witnesses are presented.

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. Leiloglou, M. Arch., is the Director of Visualization at Knott Laboratory. He 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, Angelos was a contract forensic animator and freelance graphic artist, and an assistant lecturer in the Department of Architecture at Texas A&M.

Author: Mark Svare, PE (NAFE 851 Member)

Title: Application of Computed Tomography (CT) to Increase Arc Mapping Reliability **(10:20-11 am)**

Abstract: Forensic engineers and fire investigators working together are tasked with determining both the area of fire origin and its cause. According to NFPA 921, the cause of a fire is determined after the fire origin has been determined by utilizing fact data collected from eyewitness information, fire patterns, fire dynamics and arc mapping. Proper application of arc mapping as a fire origin tool is dependent, in part, on the investigators' ability to analyze and distinguish between post-fire damage patterns observed on electrical wiring. Current radiograph and CT research results holds promise of utilizing these non-destructive testing (NDT) tools to more reliably analyze electrical wiring damage patterns and better perform the arc mapping methodology.

Author bio: Mr. Svare is a licensed master electrician and professional electrical engineer who has been involved in forensic engineering since 1990. He has a bachelor of electrical engineering degree from the University of Minnesota. He is also a veteran of the United States Navy, where he served as an Electronic Warfare Specialist on board the U.S.S. Briscoe DD977. While in the Navy, he has served in regions such as South America, Europe, and Mediterranean Countries. He has taught numerous electrical courses for international, U.S. federal, state, local, and private organizations, including the Bureau of Alcohol, Tobacco and Firearms Advanced Fire Investigation program located at the Federal Law Enforcement Training Center – Brunswick, GA. His practical experience and hands-on approach to investigations has qualified him as an electrical expert in both U.S. federal and state courts.

Author: Robert Peruzzi, PhD, PE (NAFE 954 Associate Member)

Title: Forensic Engineering Analysis of Quadcopter Drone Personal Injury **(11-11:40 am)**

Abstract: An owner was using a remote control model quadcopter for the first time. It descended and collided with a bystander. The owner believed that there was a malfunction. A review of the owner's manual and user guide, photos and diagrams of the scene, communications, police report, and a forensic investigation of the quadcopter (to determine if there was a malfunction) were requested. This paper introduces unmanned aircraft systems (UAS) for hobbyists, describes the specific UAS involved in this incident, the planned investigation steps, and describes the sequence of events of the incident as well as the timeline and resolution of the investigation.

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.

MORNING TRACK 2: CIVIL / STRUCTURAL

Author: Derek Hodgin, PE (NAFE 733 Senior Member)

Title: Forensic Engineering Comparison of Two Masonry Cladding Systems **(9-9:40 am)**

Abstract: In a recent construction litigation case, there was disagreement between two qualified engineering experts regarding the technical requirements of a masonry veneer cladding system that was installed on the exterior walls of a residential structure. The disagreement among the experts was related to the classification and function of the veneer cladding system. Specifically, the classification of the cladding system as cast stone or adhered masonry veneer directly impacted the functional requirements set forth by applicable codes and standards. Depending on this classification, the veneer system may or may not be subjected to various aspects of the building code, industry standards and code evaluation reports. The primary areas of concern included the attachment of the panels (i.e., anchored vs. adhered) to the masonry substrate, the extent of water intrusion and the need for water management details (i.e., flashing and weepholes). Both expert witnesses relied on applicable building codes, industry standards and manufacturer literature to form their opinions to a "reasonable degree of engineering certainty," yet these technical differences remained. This paper will present the technical highlights of this case study and identify the issues where the building codes and applicable standards require further clarification.

Author bio: Mr. Hodgin is the President of Construction Science & Engineering, Inc. Derek 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: Norman Cooper, PE (NAFE 418 Fellow)

Title: Rule of Law on International Building Code Grandfathering **(9:40-10:20 am)**

Abstract: The Code of Ethics of the National Academy of Forensic Engineers and National Society of Professional Engineers, etc., require safety to be "paramount." In Texas (and many other states), state law requires engineers to focus on safety by applying engineering knowledge/judgment in compliance with law, not by applying precedent or opinion that is in violation of law. Texas law (and many other state and local laws) requires cities to adopt into law the International Building Code (IBC) and International Residential Code (IRC) published by the International Code Council (ICC). In Texas, cities can amend ICC codes before they adopt them into law. Compared with common (usually unlawful) practice to grandfather all to construction date code, compliance with said rule of law usually makes safety "paramount" by reducing injury, death, and economic loss. Of the author's 1,000+ expert witness cases, the following pages summarize some of the author's grandfathering cases, collectively covering four lawful grandfathering possibilities: (1) No grandfathering because IBC'15 (which deleted grandfathering) governed; (2) The more restrictive injury date code governed; (3) The more restrictive construction date code governed; or (4) Local governments had not adopted or had amended relevant grandfathering in ICC codes.

Author bio: Mr. Cooper, a civil/structural engineer, has served the justice system as an expert witness in 1,000+ cases, 100+ depositions, and 50+ trials.

Author: James Drebelbis, AIA, PE (NAFE 938 Senior Member)

Title: Dissecting Complex Forensic Engineering Challenges: Two Roofing System Case Studies **(10:20-11 am)**

Abstract: As experts, our obligation is to observe and analyze technical complexity in a neutral and comprehensive manner and then present those findings clearly. While, in theory, this seems straightforward, in practice, we often confront a competing opinion based on a simplistic, less comprehensive approach. Two case studies illustrate how a complex and scientifically valid analysis of a building failure competes with a less comprehensive and inaccurate explanation. Case 1: During a storm with 80 mph winds and only ¼ inch rainfall, the southeast bay of a one-million-square-foot warehouse collapsed. The straightforward explanation blamed wind loading. But the failure pattern of the top chords indicated that water collected on the roof and precipitated the failure. Case 2: A steel roof deck of a large warehouse corroded after water soaked the insulation. The steel deck corroded because the water in the roof system absorbed acetic acid from the wood fiber insulation, then drained onto and corroded the steel deck. The straightforward explanation stated that the insulation shrank, tore the roof membrane, and then admitted water into the roof system. But a more comprehensive approach considered the surrounding terrain and climate conditions, which directed warm, moist air from the south through the open doors of the warehouse.

Author bio: Mr. Drebelbis has more than 40 years of expertise in structural engineering, architectural technology and professional practice. He has a BS ArchEng from the University of Kansas (1968) and an MBA from Western Michigan University in 1978. He is a member of Tau Beta Pi and Tau Sigma Delta honor societies. Drebelbis Engineering provides forensic engineering services since 1996 to the insurance and legal industry regarding construction and project defects. He received the AIA Dallas President's Medal for extraordinary service in 1993 and initiated legislation to modify a Texas state statute affecting the practice of engineering and architecture in 2009.

Author: Michael Stall, PE (NAFE 955 Member)

Title: Forensic Engineering Analysis of Alleged Construction Defects **(11-11:40 am)**

Abstract: Information from visual forensic inspections is often used to summarily conclude that building performance failures are caused by construction deficiencies because visual observations are limited to current conditions that seem to indicate that construction is the only cause. Design issues, constructability, product failures, adverse or abnormal weather conditions, post-construction changes, code and ordinance contradictions, lack of maintenance, abuse or neglect and construction deficiencies contribute to building performance failures. Detailed investigation coupled with visual observation are required to understand and fairly proportion liability for failures to those responsible — not just to those who seem responsible based only on visual observations.

Author bio: Mr. Stall has more than 40 years of construction and engineering experience. He earned a BS of Architectural Engineering at the University of Texas and his MS of Civil Engineering at Stanford University. He is a registered professional engineer in Texas and is a licensed general contractor in several states. Mr. Stall has more than 20 years of forensic engineering experience evaluating buildings damaged by defects and disasters.

AFTERNOON TRACK 1: VEHICLES & TRAFFIC

Author: Daniel Couture, PE (NAFE 951 Member)

Title: Forensic Engineering Analysis of Traffic Signal Timing and Speeds Prior to Collision by Rule-Based Triage of Indirect Video **(2-2:40 pm)**

Abstract: In our independent roles as expert witnesses, forensic engineers often need to go well beyond typical efforts to get closer to the truth about the circumstances of an incident, in particular when faced with multiple conflicting eyewitness accounts. A tractor/trailer - passenger vehicle collision that occurred in daylight at a major rural intersection was observed either directly or indirectly by 16 nearby persons. These witnesses stated that the tractor/trailer was traveling at high speed at the moment it engaged the left-turning passenger vehicle but offered conflicting accounts about the signal color. This paper covers development of a rule-based triage method of estimating the color of the traffic signals derived from the known signal phase sequence and the patterns of vehicle activity on the visible sections of the two roadways. The method was employed to independently deduce the moment of the tractor/trailer entry into the intersection and the probable color of the signal facing the driver at that time. Standard collision reconstruction tools demonstrated that the most likely tractor/trailer speed value was much less than the lowest speed in witness statements.

Author bio: Mr. Couture, a graduate of University of Western Ontario, was conferred an M.Sc. in metallurgical engineering by Queen's University at Kingston in 1985. He holds a P.Eng. in both Ontario and Quebec and is designated as a consulting engineer in Ontario. After serving with Dupont Canada and Alcan Wire and Cable, he briefly chased dwarf hamsters in Siberia before joining ASA Alloys as its technical director. Since 2003, he has been a principal in mechanical and metallurgical disciplines and vehicle collision reconstruction with Arcon Forensic Engineers in Toronto. He serves with ASTM E58 and recently became a full member of NAFE. As a tenth-generation Canadian, he enjoys winter and hockey in all its forms.

Author: John Leffler, PE (NAFE 709 Senior Member)

Title: Forensic Engineering Analysis of Design & Manufacturing Practices for an Automotive Spring **(2:40-3:20 pm)**

Abstract: Two child fatality cases focused on the failures of springs in an automotive control system switch. In the forensic analysis, the actions of the spring manufacturer, switch manufacturer, control system manufacturer, and vehicle manufacturer were of interest. Relevant details included the spring manufacturing drawing, the spring design itself, the Design Failure Modes & Effects Analysis (DFMEA) conducted by the switch manufacturer, the design validation and quality assurance testing performed by different entities, warranty return failure descriptions, and the actions taken by the various entities upon notice of spring failures.

Author bio: Mr. Leffler is a mechanical engineer with Forcon International in Atlanta. He earned his bachelor's degree from Georgia Tech, where he also lectures (part-time) in industrial design. He designed consumer products for Motorola, Herman Miller, Sears, and other companies for 10 years before beginning forensic work. Prior to college, he was a race car mechanic, machinist, and fabricator for eight years (including on an Indy 500-winning team). His main areas of expertise are vehicle, machine, and consumer product design/manufacturing, as well as pedestrian safety. He was lead author of two ASTM standards, and remains active in the ASTM F13 and E58 committees. Mr. Leffler is also the lead engineering consultant for Slip-Test Walkway Tribometers. As to NAFE activities, he is the NAFE Journal Technical Review Committee Chair as well as the 2016 President of the Academy.

Author: Christopher Stewart, PE (NAFE 783 Senior Member)

Title: Forensic Engineering Analysis of Vehicle Accidents Using Beam Theory **(3:20-4 pm)**

Abstract: This paper will present the use of beam theory in two different case studies and demonstrate the application of the methodology. In the first case study, the use of beam theory to determine the impact speed of a motorcycle into a passenger bus will be discussed. Onboard video footage and physical evidence will also be used to calculate an impact speed for the motorcycle. The results of the two methods will be compared, and the merits of the dual solution method will be discussed. Beam theory will be used to determine the change in velocity of a tractor trailer due to a rear impact. The buckling analysis and bending analysis will be evaluated from a geometry and kinematic point of view to discuss each method's applicability to the problem.

Author bio: Mr. Stewart is a mechanical engineer with Forensic Engineering Technologies, LLC. He received a bachelor of aerospace engineering from Auburn University in 1994 and is a registered professional engineer in the states of Florida and Georgia. Mr. Stewart has more than 20 years of experience in engineering consulting and traffic accident reconstruction.

Author: Stephen Batzer, PhD, PE (NAFE 677 Member)

Title: Forensic Analysis of a Fatal Trailer Wheel-Off Failure **(4-4:40 pm)**

Abstract: A forensic analysis of a fatal trailer wheel-off failure is presented. In this case, an older three-axle trailer was being driven at highway speed during winter time in Michigan while carrying snowmobiles. The left front wheel detached due to the catastrophic failure of all six lug studs. The wheel traveled into the oncoming traffic lane and struck

the roof of a sedan that was being driven by a local student. The oncoming driver was instantly killed due to passenger compartment intrusion. One possibility was that the lug nuts were improperly tightened, and that this looseness led to cantilever bending of the studs and fatigue fracture. A complete analysis of the failure was performed to include metallurgical testing and an analysis of the defendant's narrative that the possibility that the lug nuts were loosened during a theft attempt of the new wheel and tire during a brief stop at a fast food restaurant.

Author bio: Dr. Batzer is a mechanical engineer who does both forensic engineering and patent cases. He has military, industrial and academic experience. He has taught at five universities, including Calvin College, where he is now an adjunct. He is a single practitioner and lives in the forest in Northern Michigan.

AFTERNOON TRACK 2: FIRE & EXPLOSION INVESTIGATION

Author: Curtis Falany, PE (NAFE 746 Member) and Brad Shepherd, PE (NAFE 640 Fellow)

Title: Forensic Investigation of Wild Land Fires of Suspected Electrical Origin **(2-2:40 pm)**

Abstract: Overhead electrical power lines are installed on almost all major roadways and many other public and private rights-of-way, including forested land. They are not insulated from contact (with few exceptions). When installed and maintained in accordance with the National Electrical Safety Code (NESC), they are safe as long as they are properly designed, installed, and maintained, are not approached (within certain limits), touched by unskilled hands, or allowed to contact surrounding structures or vegetation. However, anomalies and contacts do occur, and the result is almost always property damage, serious injury, or death. These incidents usually result in litigation. The determination of why and how the incident occurred and its preventability are the purview of the forensic electrical engineer. This paper will discuss the common methods and investigative techniques employed by forensic engineers.

Author bio: Mr. Falany received a B.S. in engineering science degree from Florida State University in 1969. After graduation, he worked as an R&D engineer with Honeywell Information Systems, Inc., then returned to the College of Engineering, University of South Florida, as an adjust professor. After obtaining his P.E. 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: Jahan Rasty, PhD, PE (NAFE 768 Senior Member)

Title: Forensic Engineering Investigation into Factors Contributing to Explosion of a Common Table Top Torch **(2:40-3:20 pm)**

Abstract: In early 2014, approximately 3,500 common table-top torches designed for use with citronella oil to ward off insects were sold by a national retailer. Within six months of its debut, 22 of these products experienced violent explosions, resulting in one fatality and 21 severe burn injuries to consumers. The author was the plaintiff's expert in this case and was retained to determine the root cause(s) that led to these explosions. This paper/presentation will describe the detailed experimental-based investigation that was carried out on behalf of the fatally injured plaintiff to prove design, manufacturing and marketing defects against three defendants, namely, the designer of the torch, the

manufacturer of the fuel, as well as the retailer of the final product. It was determined that the explosions at issue happened as a result of a "perfect storm" scenario involving a defective product, inappropriate choice of fuel, as well as marketing errors by the retailer. In addition, a professionally developed forensic animation will be presented that fully describes how the combination of the defective design of the torch, in conjunction with the manufacturing defect in the fuel, resulted in the explosions and the ensuing consumer injuries / fatality.

Author bio: Dr. Rasty serves as tenured full professor of mechanical engineering at Texas Tech University where he also serves as the founding director of the graduate program in applied forensic engineering. His main areas of expertise are design, metallurgy, warning/safety, manufacturing, damage mechanics, failure analysis, and forensic engineering. He is also the founding president of Real-World Forensic Engineering, LLC, (RWFE), which is a boutique-style engineering consulting firm specializing in forensic engineering issues related to products/premises liability and intellectual property litigation matters as well as engineering consulting for industrial and government entities.

Author: David Icove PhD, PE (NAFE 899 Fellow) and Gerald Haynes, PE (NAFE 927 Member)

Title: Conducting Peer Reviews of Fire and Explosion Investigations **(3:20-4pm)**

Abstract: The proper application of fire science and engineering principles and practice is paramount when conducting comprehensive and complex fire investigations. This is particularly true when these investigations determine the fire's origin and cause, ignition, growth, sequences of timeline events, potential code violations, and assignment of responsibility. In the right circumstances, the peer review process can be a valuable litigation tool. The paper recommends a comprehensive set of uniform guidelines for the initiation, scope, conduct, and reporting of such a peer review in complex fire investigations. These recommended guidelines evaluate not only the conceptual and technical soundness of the approach, but also address the thoroughness of the overall investigative process. These guidelines also address when to conduct a peer review, choice of reviewers, scope, and proper documentation.

Author bio: The Underwriters Laboratories (UL) Professor of Practice at the University of Tennessee - Knoxville, Dr. Icove is an internationally recognized forensic fire engineering expert with more than 40 years of experience. He is the co-author of *Combating Arson-for-Profit*, the leading textbook on the crime of economic arson, *Forensic Fire Scene Reconstruction*, a popular reference for fire investigators, and the 7th Edition of *Kirk's Fire Investigation*. He has also served as a principal member of the NFPA 921 Technical Committee on Fire Investigations since 1992. 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. He is a certified fire and explosion investigator (CFEI) and holds the rank of fellow in the Society of Fire Protection Engineers as well as a board-certified fellow and diplomate in the National Academy of Forensic Engineers.

Author: William Keefe, PE (NAFE 481 Member)

Title: Forensic Engineering Investigations of Residential Clothes Dryer Fires **(4-4:40 pm)**

Abstract: Residential clothes dryers are common in the United States, and a large number of residential fires involving clothes dryers occur each year. Forensic engineers are called upon to conduct scientific analyses of the causative factors in these fires. Forensic engineering investigations of clothes dryer fires consider design, installation, use and maintenance of clothes dryers as well as evaluating ignition sources, first fuel ignited, fire containment and fire spread. A forensic engineering methodology for investigation of clothes dryers will be presented, drawing on experience from hundreds of residential clothes dryer fire investigations.

Author bio: Mr. Keefe is a mechanical engineer with more than 30 years of experience in forensic engineering. He has been a member of NAFE since 1993. He has investigated hundreds of fires involving machines, mechanical systems and appliances.

SUNDAY TECHNICAL SESSION

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

Title: Spare Tire Exposed Underbody Mounting — A Proximate Cause of Serious Road Hazards: A Case Study **(11:30 am - 12 pm)**

Abstract: The detachment of a wheel from a vehicle traveling at highway speeds can create serious hazards to other vehicles and pedestrians in the vicinity. This hazard is often referred to as wheel-off, wheel separation, wheel detachment, or wheel runoff failure. Serious injury caused by moving vehicle wheel-offs can result from the detached wheel rolling down the highway, striking pedestrians or other vehicles; loss of control or even rollover of the subject vehicle; or other vehicles on the highway maneuvering erratically to avoid the moving projectile tire/wheel as it rolls on the highway at high speeds. There are multiple root causes of wheel-off failures; however, the specific cause that will be addressed is a wheel-off failure caused by a loss of clamp load to the lug/lug nut joint while the vehicle is traveling at highway speeds. In this case study, the loss of wheel clamp load can be attributed to the spare wheel mounting design wherein a full-sized unprotected spare wheel/tire is mounted to the vehicle exterior underbody, permitting road debris and rust to accumulate on the spare wheel surfaces. Any attempt to mount a debris or rust encrusted wheel can lead to a wheel-off situation, resulting from insufficient lug/lug-nut joint clamp load remaining to secure the wheel.

Author bio: Dr. Josephs is a Professor Emeritus at Lawrence Technological University. Dr. Josephs 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.