

Exponent®
Engineering & Scientific Consulting

Florin Marcu, Ph.D., P.E.

Managing Engineer | Mechanical Engineering
Seattle
+1-425-519-8781 | fmarcu@exponent.com

Professional Profile

Dr. Florin Marcu is a mechanical engineer and forensic investigator with expertise in mechanical failures, personal injury incidents, property damage claims, construction defects, fires and explosions, and building mechanical systems.

His investigations frequently involve root cause analysis of plumbing, HVAC, and fire suppression systems serving commercial, residential, and high-rise buildings, heavy construction and mining equipment, commercial vehicles, industrial machinery, and other safety-critical mechanical equipment.

He provides technical consulting, litigation support, expert witness services, and engineering leadership for complex investigations involving mechanical equipment and building systems.

Dr. Marcu regularly conducts site inspections, field testing, laboratory evaluations, and engineering analyses of failed equipment and mechanical systems. His work frequently involves instrumentation, data acquisition, failure analysis, and engineering reconstruction of incidents.

Dr. Marcu has more than 20 years of engineering experience, including engineering and technical leadership positions at Caterpillar and Kenworth Trucks, spanning product development, laboratory and field testing, research, and forensic investigations.

Dr. Marcu's expertise includes:

Building Mechanical Systems

- HVAC systems
- Plumbing systems
- Fire suppression systems
- Hydronic systems
- Refrigeration systems
- High-rise building mechanical systems
- Building mechanical equipment failures

Safety and Accident Reconstruction

- Personal injury investigations

- Equipment incidents
- Operator behavior and equipment interaction
- Product safety
- Machine guarding and industrial safety

Equipment and Vehicle Investigations

- Construction and mining equipment
- Commercial trucks and trailers
- Material handling equipment
- Industrial machinery
- Automotive systems
- Agricultural equipment

Mechanical Failure Analysis

- Hydraulic and pneumatic systems
- Rotating equipment
- Bearings, shafts, and power transmission systems
- Mechanical integrity and reliability
- Root cause analysis
- Fatigue
- Corrosion
- Manufacturing and installation defects
- Maintenance and operational issues

Testing and Instrumentation

- Laboratory and field testing
- Data acquisition systems
- Pressure testing
- Shake and vibration table testing for durability and performance, including human vibration testing
- Immersive, interactive vehicle simulators and motion/simulator sickness
- Strain and vibration measurement
- Custom test fixture development

Vehicle Dynamics, Vibration and Noise

- Human vibration exposure
- Vehicle ride dynamics
- Vibration and its effect on structures, occupants, and equipment performance
- Seats and seat belts

- Suspension systems (passive and active)

Data Analysis

- Noise and vibration data analysis
- Digital signal processing in both time and frequency domain
- Fatigue damage spectrum analysis

Fire and Explosion Investigations

- Mechanical-origin fires
- Fire suppression systems
- Equipment fire investigations
- Combustible and flammable liquid systems

Before joining Exponent, Dr. Marcu led Kenworth Trucks' noise and vibration engineering activities and previously spent nine years at Caterpillar developing suspension systems, conducting human vibration research, and leading advanced vehicle dynamics testing programs.

He led Caterpillar's ride simulator laboratory and conducted testing on human-rated six-degree-of-freedom motion systems, semiactive seat suspensions, and cab suspension technologies for construction and mining equipment.

Dr. Marcu's mechanical engineering experience has consistently straddled the divide between theory and hands-on application. This started during his doctoral work at Virginia Tech, where he developed a dynamic model of a semitruck from first principles which he used to design a semiactive cab suspension and its control algorithm. He then modified a semi truck, installed the new cab suspension, implemented the real-time controller, and conducted all the lab and field tuning of the system. His dissertation work culminated in the delivery of a truck with a working prototype of a novel, semiactive cab suspension.

While completing the Ph.D. work, Dr. Marcu built up a machine shop and developed the IT infrastructure in the research lab. He also performed maintenance on the facility’s lab and IT equipment.

During his undergraduate years, he was an active leader and member of the Tennessee Tech Baja SAE team (then Mini Baja). Post graduation he was involved in the organization, racecourse design, and design judging at several Baja SAE races.

Dr. Marcu served in the Swedish Air Force where he performed turnaround crew work on the Saab J-35 Draken jet fighter, facility maintenance, and fire fighter duties. As part of his military training, he received and maintained a Commercial Driver’s License in Sweden from 1998-2020.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Virginia Polytechnic Institute and State Univ, 2009

B.S., Mechanical Engineering, Tennessee Tech University, 2005

Pi Tau Sigma, Honors Society for Mechanical Engineers

Tau Beta Pi, Engineering Honors Society

Omicron Delta Kappa, National Leadership Honor Society

Licenses and Certifications

Professional Engineer Mechanical, Washington, #24004709

Six Sigma Green Belt Certification (CSSGB)

Certified Fire and Explosion Investigator (CFEI)

Academic Appointments

Graduate Research Assistant, Center for Vehicle Systems & Safety, Virginia Tech, 2005-2009

Graduate Teaching Assistant, Land Vehicle Dynamics, Virginia Tech, 2006-2009

Prior Experience

Lead NVH Engineer, Kenworth Trucks, 2018-2021

Vibration Engineering Specialist, Caterpillar, Inc., 2015-2018

Seat Suspension Sr. Engineer, Caterpillar, Inc., 2012-2015

Cab Suspension Engineer, Caterpillar, Inc., 2009-2012

Wave Soldering Line Engineer, Denso Manufacturing, 2003-2004

Turn-around mechanic (rank: staff sergeant), Saab J-35 Draken (jet fighter), Swedish Air Force, 1998

Professional Affiliations

Society of Automotive Engineers (SAE)

The American Society of Mechanical Engineers (ASME)

Languages

German

Swedish

Romanian

Patents

US Patent 8,682,528: Seat suspension system having fail-safe functionality, March, 2014 (Michael S. Contratto, John C. Spangler, JR., II Charles E. Lewis, Florin M. Marcu, Kristen A. Gerstner).

Publications

Farjoud, A., Marcu, F., and Schumann, E., "Multi-Physics Modeling of a Cab Suspension System with Fluid Filled Mounts," SAE Technical Paper 2012-01-1912, 2012

Marcu, F., Ahmadian, M., Southward, S., and Jansson, S., "A Methodology for Laboratory Testing of Truck Cab Suspensions," SAE Technical Paper 2009-01-2862, 2009

Marcu, F., Ahmadian, M., Southward, S., and Jansson, S., "A Methodology for Accounting for Uneven Ride Height in Soft Suspensions with Large Lateral Separation," SAE Technical Paper 2009-01-2920, 2009

Project Experience

Mechanical Failures

- Investigated failures involving generators, fans, pumps, industrial production equipment, conveyors, automatic door systems, utility systems, pressure vessels, piping systems, and mechanical components.
- Conducted root-cause analyses involving fatigue, corrosion, wear, manufacturing defects, installation deficiencies, maintenance practices, and operational issues.
- Evaluated equipment performance through field inspections, laboratory testing, instrumentation, data acquisition, and engineering analysis.
- Assessed mechanical integrity, reliability, and equipment suitability for intended service.

Building Systems

- Investigated commercial, residential, and high-rise building HVAC systems, plumbing systems, hydronic systems, sprinkler systems, fire suppression systems, refrigeration systems, and other building mechanical equipment.
- Evaluated construction defects involving HVAC, plumbing, and fire protection systems.
- Investigated water damage claims, freeze failures, improper installations, and equipment performance issues.
- Evaluated compliance with applicable building codes, mechanical codes, plumbing codes, manufacturer requirements, and industry standards.
- Performed hydraulic calculations, pressure testing, and mechanical system evaluations.

Injury and Safety Investigations

- Investigated incidents involving construction equipment, industrial machinery, vehicles, consumer products, roadway equipment, automatic doors, furniture, and recreational systems.
- Evaluated equipment design, operation, maintenance, warnings, and human interaction.
- Conducted root-cause analyses of personal injury incidents involving vehicles, industrial equipment, and consumer products.
- Evaluated vehicle systems in transportation-related incidents, including braking-system performance.

- Investigated mining equipment incidents, automatic door accidents, and carbon monoxide poisoning events.

Fire and Explosion Investigations

- Conducted root cause investigation of commercial and residential fire scenes.
- Investigated fires involving vehicles, generators, building systems, and industrial equipment.

Vibration and Noise

- Investigated vibration-related vehicle performance and lemon law claims.
- Developed analytical methods for evaluation of vibration exposure and fatigue damage.
- Evaluated vibration-related equipment issues in vehicle and industrial applications.
- Conducted testing and analysis of transportation-related product damage.
- Performed noise and vibration measurements in laboratory and field environments.

Projects from past employers

- Identified sound quality issues and improved digital display chime audibility through changes to the sound amplifier circuit.
- Developed corporate strategy for noise and vibration performance for OEM vehicle platforms.
- Created FEA models and conducted structural analysis of engine- and chassis-mounted components.
- Conducted field investigations for cabin noise level and interior sound quality at customer sites.
- Collected vibration data and performed Operational Deflection Shapes (ODS) and Transfer Path Analysis (TPA).
- Performed human vibration, visibility, ergonomics, and usability studies on a human-rated shake table.
- Performed air borne and structure borne noise testing both in lab and in the field.
- Collected rigid body vibration data from field equipment and converted it into 6DOF laboratory shake data.
- Developed passive and semiactive seat suspension systems for off-highway equipment.
- Developed semiactive cab suspension for on and off-highway equipment.
- Developed control algorithms for suspension systems for on and off-highway vehicles.
- Led and operated several research labs and machine shops with a perfect safety record.

Additional Education & Training

Automate the Boring Stuff with Python, Online Course, 2021

Machine Learning, Stanford University, 2020

MSHA Part 48A&B Coal/Metal/Nonmetal Surface & Underground Safety Training, 2011-2018

Advisory Appointments

ISO TC108/SC4 Human exposure to mechanical vibration and shock

ISO TC127/SC2 US TAG Earth Moving Machinery

SAE HFTC4 Operator Seating and Ride

Peer Reviews

Society of Automotive Engineers

Journal of Failure Analysis and Prevention