Exponent®
Engineering & Scientific Consulting


# Omar Abuodeh, Ph.D., P.E.

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## Professional Profile

Dr. Omar Abuodeh is a senior engineer specializing in structural health monitoring and finite element modeling (FEM) of bridges, buildings, and civil infrastructure. At Exponent, he has worked on forensic engineering cases, including construction defect litigation and insurance claims for residential and commercial buildings. He has performed failure analyses of structural components (e.g., girders, columns, slabs) in bridges and buildings using finite element modeling and evaluated the design compliance of concrete, steel, wood, and masonry structures per commonly adopted building codes and engineering standards. Dr. Abuodeh's technical expertise includes conducting site inspections to assess structural conditions, guiding destructive and non-destructive testing, analyzing site data, and reviewing construction documentation. His investigative work includes assessing structural damage from environmental factors such as water intrusion and hurricane and hail damage, with a focus on building envelope performance and structural member deterioration.

Prior to Exponent, Dr. Abuodeh conducted advanced research in structural engineering, including experimental testing of structural members, vehicle characterization through static and dynamic testing, and FEM-based simulations of nonlinear behavior in reinforced concrete strengthened with composite materials (e.g., fiber-reinforced polymers, aluminum alloy plates). He also developed finite element models to capture the vibration characteristics of vehicle-bridge interaction and applied machine learning techniques health monitoring through the passing vehicle signals. His work integrates data-driven methodologies, signal processing, and automation in Python to optimize structural assessment techniques.

As an NSF Graduate Research Fellow at Clemson University, Dr. Abuodeh contributed to infrastructure resilience research, collaborating with an interdisciplinary team to develop the South Carolina State Engagement Hub (SCSEH)—an initiative addressing climate change-related extreme events. In his final year, he served as an instructor of record, teaching structural mechanics to undergraduate engineering students.

His core competencies include structural health monitoring, operational modal analysis (OMA), finite element analysis (FEA), machine learning (ML) for structural applications, signal processing, and Python automation.

## Academic Credentials & Professional Honors

Ph.D., Civil Engineering, Clemson University, 2023

M.S., Civil Engineering, American University of Sharjah, UAE, 2019

B.S., Civil and Environmental Engineering, American University of Sharjah, UAE, 2016

 

## Licenses and Certifications

Professional Engineer Civil, Florida, #102945

## Academic Appointments

Instructor of Record, Clemson University, Spring 2023

## Prior Experience

Instructor of Record, Clemson University, Spring 2023

NSF Research Fellow, Clemson University, 2020-2022

Graduate Research Assistant, Clemson University, 2019-2020

Research Assistant, American University of Sharjah, 2017-2019

R&D Engineer, University of Sharjah, 2016-2017

## Professional Affiliations

American Society of Civil Engineers (ASCE)

American Institute of Steel Construction (AISC)

## Publications

Abuodeh, O. and Redmond, L. Investigation of Multiple-Vehicle Scenarios to Improve System Identification for Indirect Health Monitoring of Bridge Networks. Engineering Structures, 2023. (Under review)

Abuodeh, O. and Redmond, L. An autonomous and heuristic approach for extracting bridge frequencies from passing vehicles. Engineering Structures, Vol. 290, 2023.

Abuodeh, O., Locke, W., Redmond, L., Sreenivasulu, R.V., Schmid, M. Examining Methods for Modeling Road Surface Roughness Effects in Vehicle–Bridge Interaction Models via Physical Testing. In: Conference Proceedings of the Society for Experimental Mechanics Series Dynamics of Civil Structures, Vol. 2, 2023.

Locke, W., Mokalled, S., Abuodeh, O., Redmond, L., and McMahan, C. A Bayesian Estimation Technique for Multilevel Damage Classification in DBHM. In Leveraging Artificial Intelligence in Engineering, management, and safety of infrastructure,Taylor & Francis Ltd, 2022.

Abuodeh, O., Redmond, L. A Framework for Developing Efficient Vehicle-Bridge Interaction Models Within a Commercial Finite Element Software. In: Conference Proceedings of the Society for Experimental Mechanics Series, Springer, Vol. 2., 2023.

Mokalled, S., Locke, W., Abuodeh, O., Redmond, L., McMahan, C. Drive-by health monitoring of highway bridges using Bayesian estimation technique for damage classification. Structural Control Health Monitoring, Vol 29, 2022.

Abuodeh, O., Hawileh, R.A., and Abdalla J.A. Nonlinear finite element models of reinforced concrete beams strengthened in bending with mechanically fastened aluminum alloy plates. Computers & Structures, Vol. 253, 2021.

Abuodeh, O., Hawileh, R.A., and Abdalla J.A. Finite element modelling of aluminum alloy plated reinforced concrete beams. Computers and Concrete, Vol. 27, 2021.

Abuodeh, O., Abdalla J.A., and Hawileh, R.A. Flexural strengthening of RC beams using aluminum alloy plates with mechanically-fastened anchorage systems: An experimental investigation. Engineering Structures, Vol. 234, 2021.

Locke, W., Mokalled, S., Abuodeh, O., Redmond, L., and McMahan, C. An intelligently designed AI for structural health monitoring of a reinforced concrete bridge. The Concrete Industry in the Era of AI, 2021.

Abuodeh, O., Abdalla J.A., and Hawileh, R.A. Assessment of compressive strength of Ultra-high Performance Concrete using deep machine learning techniques. Applied Soft Computing, Vol. 95, 2020.

Abuodeh, O., Abdalla J.A., and Hawileh, R.A. Prediction of shear strength and behavior of RC beams strengthened with externally bonded FRP sheets using machine learning techniques. Composite Structures, Vol. 234, 2020.

Abuodeh, O., and Abed, F. A Finite Element Model of a UHPC Beam Reinforced with HSS Bars. In: 8th International Conference on Modeling Simulation and Applied Optimization (ICMSAO), 2019.

Abuodeh, O., AlRifai, M., Hawileh, R.A., and Abdalla J.A. Finite element modelling of aluminum alloy plated beams. In: 8th International Conference on Modeling Simulation and Applied Optimization (ICMSAO), 2019.

Abuodeh, O., Abdalla J.A., and Hawileh, R.A. Prediction of compressive strength of ultra-high performance concrete using SFS and ANN. In: 8th International Conference on Modeling Simulation and Applied Optimization (ICMSAO), 2019.

Abuodeh, O., Abdalla J.A., and Hawileh, R.A. Predicting the shear capacity of FRP in shear strengthened RC beams using ANN and NID. In: 8th International Conference on Modeling Simulation and Applied Optimization (ICMSAO), 2019.

Abuodeh, O., Abdalla J.A., and Hawileh, R.A. The flexural behavior of bolting and bonding Aluminum Alloy plates to RC beams. In: Procedia Structural Integrity, 2019.

### Presentations

William Locke, Omar Abuodeh, “Multi-Family Buildings in Coastal Communities – Avoiding Catastrophic Loss,” in NCBA 2025 Construction Law Fall Program, September 19, 2025.

Abuodeh, O. Examining Methods for Modeling Road Surface Roughness Effects in Vehicle–Bridge Interaction Models via Physical Testing. Presentation at the IMAC-XLI, Austin, TX, 2023.

Abuodeh, O. A Framework for Developing Efficient Vehicle-Bridge Interaction Models Within a Commercial Finite Element Software. Presentation at the IMAC-XLI, Orlando, FL, 2022.

Abuodeh, O. A Finite Element Model of a UHPC Beam Reinforced with HSS Bars. Presentation at 8th ICMSAO, Manama, Bahrain, 2019.

Abuodeh, O. Finite element modelling of aluminum alloy plated beams. Presentation at 8th ICMSAO, Manama, Bahrain, 2019.

Abuodeh, O. Prediction of compressive strength of ultra-high performance concrete using SFS and ANN. Presentation at 8th ICMSAO, Manama, Bahrain, 2019.

Abuodeh, O. Predicting the shear capacity of FRP in shear strengthened RC beams using ANN and NID. Presentation at 8th ICMSAO, Manama, Bahrain, 2019.

## Project Experience

**Construction Defect Disputes:**

*Residential Complex Apartments:* Investigated reported framing failures due to water intrusion from improperly waterproofed components. Performed site inspections and participated in destructive testing to document existing conditions. Engineering analyses were conducted to assess whether building elements were installed in compliance with governing codes (e.g., IBC, IRC), engineering drawings, and industry standards (e.g., NDS, ACI, ASCE 7).

*Warehouse Facilities:* Investigated cracking in concrete slabs and adjacent aprons at two warehouse facilities. Investigation involved reviewing structural and architectural drawings, construction records, and post-construction documentation. Assessed adequacy of control joint spacing and slab design parameters using the applicable ACI standards.

*Residential Complex Apartments:* Analyzed deterioration of wood sheathing and framing due to moisture intrusion in multi-family apartment buildings. Conducted multiple site inspections and reviewed construction documentation. The evaluation determined whether construction complied with building codes (e.g., IBC, IRC), contract drawings, and accepted engineering standards (e.g., NDS, TMS).

**Failure and Damage Investigation:**

*Airport Hangar:* Analyzed reported twisting, bending, and sagging of roof rafters and columns in a pre-engineered metal building (PEMB). Developed finite element models of multiple frame lines using SAP2000 based on provided engineering drawings. Performed gravity and lateral load analyses using code-required load combinations, followed by capacity checks for affected rafters and columns per applicable design standards (e.g., AISC 360). Issued a report summarizing the structural deficiencies contributing to observed performance issues.

*Storage Facility:* Investigated the collapse of a pre-engineered metal building (PEMB) roof following a snowstorm. Developed finite element models of selected frame lines in SAP2000 to compute forces and moments under snow loads, per ASCE 7, to determine the governing load case. Performed capacity checks of the purlins and their connections to roof rafters using AISI standards (e.g., AISI S100) and design procedures from MBMA guidelines. The analysis identified deficiencies in the load path and connection capacities that contributed to the roof failure.

*Bridge Collapse:* Evaluated a bridge collapse that occurred during construction staging for lane expansion. The work included the review of structural and construction drawings, followed by hand calculations using influence line methods to determine governing forces and moments under anticipated construction loads per codes and standards (e.g., AASHTO). The analysis identified the critical loading scenarios that contributed to the structure’s premature failure.

*Airport Hangar Door Failure:* Investigated hinge failure in a pre-engineered metal building (PEMB) hangar door. This involved the review of photographs, drawings, and original engineering calculations. Created a finite element model of the door and hinge assembly to evaluate imposed forces across varying operational angles. Determined the cause of hinge failure and assessed whether deficiencies were attributable to design limitations.

*Commercial Building:* Evaluated reported tile cracking following vehicular impact into a commercial structure. Developed a finite element model simulating vehicle-structure interaction using SAP2000. The

structural analysis was used to identify the probable cause-and-effect relationship between impact loads and observed cracking.

**Insurance Investigations:**

*Residential Properties:* Assessed reported hail damage to asphalt shingle roofs and residential façades. The inspection included detailed documentation of shingle and façade conditions, followed by technical evaluation of whether observed damage was consistent with hail impact.

*Commercial Properties:* Assessed reported hail damage to TPO and EPDM roofs. The inspection included detailed documentation of the TPO and EPDB conditions, followed by technical evaluation of whether observed damage was consistent with hail impact.