



# INNOVATIVE BRIDGE DESIGN HANDBOOK

Construction, Rehabilitation  
and Maintenance

Edited by  
Alessio Pipinato



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# Dedication

To Laura, Francesca, Annamaria and Francesco

# Contributor details

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Sigrid Adriaenssens is a structural engineer and assistant professor at the Department of Civil and Environmental Engineering at Princeton University in Princeton, New Jersey, where she directs the Form Finding Lab. She has a PhD in lightweight structures from the University of Bath (UK). She worked as a project engineer for Jane Wernick Associates, (London) and Ney+Partners (Brussels), where she was responsible for a series of award-winning bridge projects. Her current research interests include numerical form-finding techniques and lightweight structures. She has coauthored two books, *Shaping Forces: Laurent Ney* (2010) and *Shell Structures for Architecture: Form Finding and Optimization* (2014), and has published over 30 journal papers. She is the recipient of the Alfred Rheinstein '11 Award 2015.

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Anil Kumar Agrawal is Professor of Structural Engineering at the City College University of New York. He is currently involved in structural control systems research, such as passive dampers, tuned mass dampers, active/hybrid and semi-active control systems, have been widely accepted as effective means for protection of civil engineering structures against earthquakes and wind loads. He is also Editor of the Journal of Bridge Engineering, the most world-renowned international scientific journal on bridge engineering, edited by ASCE. He is ASCE and IABSE member. He is involved in international technical committee, as ASCE Committee on Engineering Mechanics Member, ASCE Committee on Structural Control Member, ASCE Sub-Committee on Performance of Structures.

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Mohsen Amjadian is a Research Assistant with Department of Civil and Environmental Engineering at the City College of the City University of New York, United States. He received his B.S. in Civil Engineering from Razi University in 2006, M.S. in Earthquake Engineering from International Institute of Earthquake Engineering and Seismology (IIEES) in 2010, both in Iran. He worked as a professional engineer in construction and consulting companies in Iran from 2010 till 2013. His research interests are Nonlinear Analysis of Structural Systems, Structural Control and Health Monitoring, Structural Risk, Reliability and Safety, Performance-Based Seismic Design, Soil-Structure Interaction, and Seismic Pounding.

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Hans De Backer, born in 1978, received his civil engineering degree from Ghent University in 2002, and obtained his doctorate, about the fatigue behavior of orthotropic steel decks, in 2006. He is currently an assistant professor in the Department of Civil Engineering of Ghent University and heads the Bridge Research Group. His research focuses on fatigue effects, orthotropic steel decks, tubular structures, and nondestructive in situ testing of bridge construction.

**Balázs G.L.**

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György L. Balázs is a professor at the Budapest University of Technology and Economics in Hungary. His main fields of activity are concrete, reinforced concrete, and prestressed concrete structures; fiber-reinforced concrete (FRC), fiber-reinforced polymers (FRPs) as internally bonded reinforcements; externally bonded reinforcements or near surface mounted reinforcements; durability; service life; fire behavior and design; bond and cracking; high-performance concrete (HPC); and sustainability. He serves as chairman of the Fédération de l'Industrie du Béton (FIB) Commission on Dissemination of Knowledge, including FIB courses and FIB Textbook on Advanced design of concrete structures. He has been a member of the FIB Presidium since 2002 and was elected president of the organization in 2011 and 2012. He served as the immediate past president of FIB for 2013 and 2014 and has continued thereafter as honorary president.

**Bharil R.K.**

*URS Corporation, United States of America*

Rajneesh K. "Raj" Bharil is a licensed professional civil and structural engineer and a practicing principal bridge engineer with URS Corporation, Santa Ana, California. He obtained his masters in structural engineering from the University of Michigan in Ann Arbor, and completed his bachelor's degree in civil engineering from Maulana Azad National Institute of Technology in Bhopal, India. His 30-year engineering career encompasses cofounding his own bridge engineering specialty consulting firm, CES, Inc. Engineering, and serving as the president, vice president, director, principal, project manager, and lead engineer in both the private and public sectors. During his practice, he also served as an adjunct professor, teaching university courses in bridge engineering. He is a member of the American Society of Civil Engineers (ASCE), recipient of the AASHTO Value Engineering Award, author of numerous technical papers on bridges, and the lead designer of numerous bridges in the western United States.

**Bhattacharya B.**

*Indian Institute of Technology, India*

Baidurya Bhattacharya obtained his BTech in civil engineering from the Indian Institute of Technology (IIT) Kharagpur in 1991 and his MS (1994) and PhD (1997) in civil engineering from Johns Hopkins University, Baltimore, Maryland. He was an assistant professor at the University of Delaware, Newark (2001–2006) before returning to

IIT Kharagpur in 2006, where he became a professor in 2011. He has been a member of visiting faculty at Stanford (2005) and Johns Hopkins (2012). He works in probabilistic mechanics and explores how random atomic scale structural defects and fluctuations affect material properties at the microscale and how that randomness, coupled with uncertainties in the environment, affect the performance and safety of structural components and systems. He works on probability-based design and reliability analyses of civil infrastructure systems in structures such as nuclear power plants, ships and offshore structures, buildings, and bridges. He was a speaker at the Indo-American Frontiers of Engineering Symposium of the National Academy of Engineering, Washington, DC, in 2012 and has been an associate editor of the *ASCE Journal of Bridge Engineering* since 2010.

**Boegle A.**

*HafenCity Universität Hamburg, Germany*

Annette Boegle is Full Professor for Design & Analysis of Structures at the HafenCity University of Hamburg, Germany. She studied structural and civil engineering at the University of Stuttgart, where she also received her PhD (Dr.-Ing.). She works and teach in the fields of: construction history, conceptual design, design methods in engineering, parametric design, biomimetic structures, analysis of lightweight structures. Actually she is initiator of an Erasmus+ Strategic Partnership around the Baltic Sea Region on "Intersections in Build Environment". She also has been curator of several exhibitions e.g. "Leicht Weit – Light Structures" at the DAM Frankfurt, Germany. As a member of several scientific boards she is active participating in the scientific community, e.g. she is member of the scientific board of the "Bautechnik" (Journal for Civil and Structural Engineering), Vice Chair of the IABSE working Commission WC5 "Design Methods and Processes" and Vice Chair of the "IngenieurBaukunst e.V." (Association of Structural Art).

**Brühwiler E.**

*École Polytechnique Fédérale de Lausanne, Switzerland*

Eugen Brühwiler's activities as a professor of structural engineering at the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland, are motivated by the following principle: "Methods for the examination of existing structures ("Examining") must be developed with the ultimate goal to limit construction intervention to a strict minimum. If interventions are necessary, their objective is to improve the structure." His activities as researcher, teacher, and consultant include existing civil structures, particularly bridges of great cultural value, the fatigue, dynamic and structural behaviour of bridges, and the use of ultra-high-performance fiber-reinforced cement-based composites for the improvement of structures.

**Caetano E.**

*University of Porto, Portugal*

Born in 1965 in Porto, Portugal, Elsa Caetano received her civil engineering degree from the Faculty of Engineering of the University of Porto (FEUP) in 1988. In 1989, she joined FEUP herself, where she is presently an associate professor. She has been



involved in the creation and development of the Laboratory of Vibrations and Monitoring of FEUP. In the context of the activities of this laboratory, she has conducted research and consultancy work in bridges and special structures. Some relevant studies include the dynamic testing of the Vasco da Gama, Millau (in collaboration with the Centre Scientifique et Technique du Bâtiment) and Humber (in collaboration with the University of Sheffield in the UK), the dynamic design studies for the new stadium of Braga's cable roof for the Euro 2004 Football Championship, the vibration assessment, design, and instrumentation of tuned mass dampers (TMDs) at the new Coimbra footbridge, and the measurement of cable forces on the London 2012 Olympic Stadium roof.

**Chouw N.**

*University of Auckland, New Zealand*

Dr. Nawawi Chouw is associate professor and director of the University of Auckland Centre for Earthquake Engineering Research. Prior to joining the University of Auckland, he worked at universities in Europe, Japan, and Australia. He earned his diploma in civil engineering from Ruhr University-Bochum, Germany. After working in a group of consulting engineers in Germany, he returned to the Research Centre for Structural Dynamics at the Ruhr University-Bochum, and in 1993, he was awarded his doctorate. He has been awarded the Gledden Fellowship of the University of Western Australia twice, the Fritz-Peter-Mueller Prize of the Technical University of Karlsruhe, Germany, the Best Research Award of Chugoku Denryoku Research Foundation, Japan, and twice received recognition for excellence in research supervision from the China Scholarship Council. He has been invited to teach at several universities and is an editorial board member of a number of international journals.

**Cooling T.**

*AECOM, United States of America*

Thomas Cooling is a licensed professional civil engineer and geotechnical engineer with over 40 years of experience. He is recognized as a Diplomate of Geotechnical Engineering by the ASCE Academy of Geo-Professionals and is vice president of geotechnical services at AECOM, in St. Louis, Missouri. He holds a BS in civil engineering from the University of Illinois and an MS in civil engineering from the University of California, Berkeley. His bridge engineering experience includes major river crossings of the Mississippi, Ohio, Potomac, and Hudson rivers in the United States, as well as numerous other smaller bridge projects.

**Dicleli M.**

*Middle East Technical University at Ankara, Turkey*

Murat Dicleli is currently a professor and department head at the Department of Engineering Sciences, Middle East Technical University (METU). Dr. Dicleli received his PhD in structural engineering from the University of Ottawa, Canada, in 1993, and his M.Sc. and B.Sc. degrees from the civil engineering department of METU in 1987 and 1989, respectively. Dr. Dicleli's academic experience include employment both in



Illinois, at Bradley University, and in Ankara, Turkey, at METU. His research interests include seismic behavior and retrofitting of buildings and bridges, passive control systems, behavior of integral bridges under thermal and gravity loading, and behavior of steel and reinforced concrete structures under monotonic and cyclic loads. He has considerable industrial experience. He has worked as a structural and head design engineer at MNG Inc. in Ankara, Turkey, as the director of the design and planning division at MITAŞ in Ankara, Turkey, as a structural design consultant at Morrison Hershfield Ltd., in Toronto, Canada, and as senior design engineer and project manager at the Ontario Ministry of Transportation, Toronto-St. Catharines, Canada. He has been involved in the design and rehabilitation of residential and commercial buildings, industrial structures, grain storage silos, power transmission lines, and communication structures, as well as highway and railway bridges. Dr. Dicleli is also the inventor and patent holder of a recently developed torsional hysteretic damper. He serves as an associate editor for the *ASCE Journal of Bridge Engineering* and is an editorial board member of *Earthquake and Structures*, *American Journal of Civil Engineering*, *Journal of Civil Engineering and Architecture*, *ISRN Civil Engineering*, *International Journal of Engineering and Applied Sciences*, and *The Open Construction & Building Technology Journal*. He is the author of more than 160 technical publications and is also the recipient of the 2006 outstanding paper award from the Earthquake Engineering Research Institute (EERI) and 2012 thesis of the year award from the M. Parlar Foundation of METU.

**Farkas G.**

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Graduated in 1971 from the Faculty of Civil Engineering at the Budapest University of Technology and Economics (BME), he earned his Dr. Tech. in 1976, his PhD in 1994, and his Dr. Habil. in 1999 at the BME. Since 1971, he has worked at the Faculty of Civil Engineering of BME. Now a full professor, he also was head of the Department of Structural Engineering from 1995–2010, and dean of the Faculty of Civil Engineering between 1997 and 2005. In addition, he is a member of the Hungarian group of Fédération de l'Industrie du Béton (FIB) and a member of the Hungarian Academy of Engineers. He is the author of more than 200 publications in the field of reinforced concrete structures.

**Fidler P.R.A.**

*Cambridge University, United Kingdom*

P.R.A. Fidler joined the Department of Engineering at the Cambridge Centre for Smart Infrastructure and Construction in 1995, where he has worked with Professor Campbell Middleton on software for yield-line analysis of concrete slab bridges. In 2007, he began working at the department on a project funded by the Engineering and Physical Science Research Council (EPSRC) called "Smart Infrastructure—Wireless Sensor Networks for Condition Monitoring and Appraisal. This project studied potential benefits and challenges of using wireless sensor networks (WSNs) to monitor key aspects of civil infrastructure, including bridges, tunnels, and water pipes. He was involved in developing much of the embedded software for these wireless

devices. He was part of a team awarded the Telford Gold Medal (2010) from the Institution of Civil Engineers for this work. His work on WSNs continued with a trial deployment on a bridge in Wuxi, China, in 2010, and then with deployments for the Cambridge Centre for Smart Infrastructure and Construction.

### **Gastineau A.J.**

*KPFF, United States of America*

Andrew Gastineau is currently a design engineer at KPFF Consulting Engineers in Seattle, Washington, where he designs waterfront and bridge structures. He earned his BA in mathematics and physics in 2007 from St. Olaf College in Northfield, Minnesota, and subsequently his MS and PhD in civil engineering from the University of Minnesota in Minneapolis in 2013. He has been published in the *Journal of Bridge Engineering* and the *Journal of Engineering Mechanics* and has written a variety of conference publications and technical reports relating to the response modification and service life extension of existing bridge structures. He also has written about bridge health monitoring.

### **Ramos O.R.**

*University of Cantabria, Spain*

Óscar Ramón Ramos Gutiérrez is a MSc. civil engineer with sixteenth years of experience as head of the Bridges Division at Louis Berger's International Design Center (formerly APIA XXI). He has acted as the lead bridge engineer in most of the major projects developed by the company, including the hundreds of viaducts that the International Design Center has designed. Since 2006, he combines his professional duties with his work as a professor at the Department for Mechanical and Structural Engineering in the University of Cantabria (Spain). In 2011, he was given the FIB Achievement Award for Young Engineers.

### **Hegemier G.**

*University of California at San Diego, United States of America*

After witnessing the devastation caused by the 1971 San Fernando Valley earthquake and the 1972 Nicaragua earthquake, Gilbert Hegemier, then an aerospace engineer, decided to focus his research on developing systems to retrofit bridges, roadways, and buildings. He helped assemble a team of experts at the University of California, San Diego (UCSD). He and his colleagues have succeeded in creating and testing full-scale models of bridge column retrofit systems, which have been applied by the California Department of Transportation. These systems stood the ultimate test in the 1994 earthquake that hit Los Angeles, when 114 retrofitted bridges received only minor damage from the quake while several bridges scheduled for retrofit failed. Today, he is working with industry partners to develop and use lightweight fiber-reinforced composites (FRCs) to prevent earthquake damage and restore components of the nation's aging infrastructure. He is also working on blast mitigation techniques using FRCs to protect critical structures such as embassies from terrorist attacks.

**Humpf K.**

*Leonhardt, Andrä, und Partner, Germany*

Karl Humpf graduated as Dipl.-Ing. Structural Engineering from the University of Aachen, Germany, in 1975. He started his career as a project engineer for Ibering S.A. in Spain. In 1976, he went to Leonhardt, Andrä, und Partner, and he was appointed as director of international projects in 1993. He has extensive experience in bridge engineering from numerous bridge projects, including some of the firm's largest cable stayed, concrete, and composite bridges worldwide, particularly in Spain and Latin America. He is a registered Professional Engineer in Germany and in the U.S. states of Arizona, Georgia, Kentucky, and Massachusetts; he is also a member of the International Association of Bridge and Structural Engineers (IABSE) and the American Society of Civil Engineers (ASCE). He is the author or coauthor of numerous publications on long-span bridge problems in various German and international technical journals.

**Kimura K.**

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Kichiro Kimura is professor of structural engineering at the Department of Civil Engineering, Faculty of Science and Technology, Tokyo University of Science, Japan. He earned his PhD at Ottawa University, and his ME in Civil engineering at Tokyo University in 1987. He was a visiting researcher at the Boundary Layer Wind Tunnel Laboratory, Faculty of Engineering Science, University of Western Ontario, Canada, in 1991–1992. For his work on wind engineering, he has been given awards by the Japan Association for Wind Engineering in the outstanding publication category in 2012, the research paper category in 2008, and the research potential category in 1994. He is a member of the Japan Association for Wind Engineering.

**Kovács T.**

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Tamás Kovács earned his PhD in 2010 at the Budapest University of Technology and Economics, while being an assistant professor in the Department of Structural Engineering at the same university; in 2013, he became an associate professor. His research interests include dynamic-based damage assessment of concrete structures, life-cycle analysis of structures, reliability of structures, high-performance concrete (HPC) for bridges, modeling of prestressed structures, strengthening of bridges, and concrete pavements. He has been honored to receive the Scholarship of the Scientia et Conscientia Found, 1997; the Tierney Clark Award 2010 for the development of the FI-150 bridge girder family, 2011; and the Innovation Award 2010 of the Hungarian Intellectual Property Office for the development of the FI-150 type bridge girder family, 2011.

**Malo K.A.**

*Norwegian University of Science and Technology, Norway*

Kjell A. Malo got his PhD from the Norwegian Institute of Technology in Trondheim. His professional background is in steel-aluminium and timber structures. His current

research topics and fields of interest are material models for wood, strength and stiffness of connections for timber structures, vibrations and comfort issues in multistory timber buildings, and design of timber bridges. Since 2002, he has taught university courses on timber engineering and basic mechanics and is supervisor for MSc and PhD students in timber engineering. He is the author of more than 40 professional publications in the field of timber engineering, and he is a national delegate to the European standardization committee on timber structures. In addition, he is the convenor for the committee responsible for the new Eurocode EN 1995-2 Timber Bridges, and he is the coordinator of the European ERA-NET Woodwisdom project DuraTB – Durable Timber Bridges.

### **Martin B.T.**

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Barney T. Martin received his undergraduate degree in civil engineering in 1974 from Louisiana State University, Baton Rouge, Louisiana, and his master's and PhD degrees from Tulane University in New Orleans, Louisiana, in 1981 and 1992, respectively. Dr. Martin is active on the Transportation Research Board, having recently served as chairman of the Concrete Bridge Committee and the Steel Bridge Committee. He has had extensive highway bridge design experience, having been the managing engineer on bridge design projects ranging from simple girder spans to projects involving major suspension bridges. He has significant experience in the evaluation and design of long-span bridges, particularly the inspection and evaluation of parallel wire main cables of suspension bridges. In addition, he has significant experience in the design, structural evaluation, load rating, repair, and construction support of bridges of all types, both fixed and movable. President and CEO of Modjeski and Masters.

### **Middleton C.R.**

*Cambridge University, United Kingdom*

Campbell Middleton is the Laing O'Rourke Professor of Construction Engineering and director of the Laing O'Rourke Centre for Construction Engineering and Technology at Cambridge University, Cambridge, UK. He joined the staff at Cambridge in 1989, having previously worked for nearly 10 years in bridge and highway construction and design in Australia and with Arup in London. He is chairman of the UK Bridge Owners Forum, established in 2000 by representatives of the major bridge-owning organizations in the UK to identify research needs and priorities for bridge infrastructure. He has been awarded the Diploma of the Henry Adams Award of the Institution of Structural Engineers twice (in 1999 and 2014) and the Telford Premium Award (1999) and Telford Gold Medal (2010) from the Institution of Civil Engineers. He was elected a fellow of the Transport Research Foundation in 2005, has been involved in the development of bridge codes of practice, and acts as a specialist bridge consultant to clients in the UK and abroad.

### **De Miranda M.**

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Mario de Miranda obtained his civil engineering degree from the Politecnico di Milano, Italy, in 1979. His work, experience, and research are mainly related to the design and

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Victor is a Senior Geotechnical Program Manager for AECOM in St. Louis, Missouri. He has 38 years of geotechnical experience mainly in the US, but also in Europe and the Middle East. He is a PE and has been awarded certification by the ASCE as a Diplomate in Geotechnical Engineering (D.GE). He has a Master of Science Degree with emphasis in geotechnical engineering from Purdue University and a Bachelor of Science in Civil Engineering from Louisiana State University. He is a US Navy Civil Engineer Corps veteran. Victor served as a Committee Chairman for the Transportation Research Board Committee on Earthworks and served on the Bridge Foundation committee. He served as Co-Chairman of the Illinois Joint Research and Technology Center. He has managed geotechnical foundation investigation, design and construction projects for cable stayed, long span deep girder and truss bridges. He has also designed cofferdams for bridge foundation construction including evaluation of support for a floating cofferdam system in the Mississippi River. Victor has performed seismic analyses of new and existing bridge foundations for effects from liquefaction and lateral loads. He has published peer reviewed papers including "Foundation Selection and Construction Performance - Clark Bridge Replacement" that is cable stayed.

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Andrzej Nowak is a professor of structural engineering and chair of the Samuel Ginn College of Engineering at Auburn University, in Auburn, Alabama. In addition, he is vice-chair of the Transportation Research Board-Task Group for LTBP Bridge Traffic and Truck Weight and a member of two American Concrete Institute (ACI) committees: the ACI 343 Committee on Concrete Bridges and ACI 348 Committee on Concrete Bridges. He is the author of more than 100 papers in renowned scientific journals. His research interests include the analysis and design of structures; code calibration procedures for load and resistance factor design (LRFD); the ultimate, serviceability, and fatigue limit states; load models for bridges, including extreme events and their combinations; resistance models for materials and structural components; evaluation of existing structure diagnostics, field testing, and proof loading for bridges; weigh-in-motion procedures for bridges; and mechanical properties and design criteria for lightweight concrete structures.

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Alessio Pipinato obtained a bachelor's degree in building and structural engineering from the University of Padua, and a bachelor's degree in architecture from the University of Venice-IUAV. He earned his PhD at the University of Trento in structural design. He served as an adjunct professor, teaching university courses in bridge engineering and structural design, and has been a research collaborator at the University of Padua for more than ten years in the structural engineering sector (ICAR09-08B3). His twelve years of engineering career encompasses founding his own engineering consulting firm, AP&P, serving as the CEO, scientific and technical director; and providing bridge, structural engineering, research and development (R&D) services. He is/has been a member of the American Society of Civil Engineers (ASCE), Structural Engineering Institute (SEI), International Association for Bridge and Structural Engineering (IABSE), Associazione Italiana Calcestruzzo Armato e Precompresso (AICAP), International Association of Railway Operations Research (IAROR), Collegio Tecnici dell'Acciaio (CTA), International Association for Life Cycle Civil Engineering (IALCCE), International Association for Bridge Maintenance and Safety (IABMAS), Collegio Ingegneri Ferroviari Italiani (CIFI), European Convention for Constructional Steelwork (ECCS), and American Institute of Architects (AIA). He is also the author of more than 200 scientific and technical papers on structures and bridges, the chair of international conference sessions (including IABMAS 2010, Philadelphia; and IABMAS 2012, Milan). In addition, he is peer revisor of many international structural engineering journals, including the *ASCE Journal of Bridge Engineering*, *Engineering Structures*, *Structure and Infrastructure Engineering*, *International Journal of Fatigue*, and *Journal of Structural Engineering*. He has participated in a number of international research projects. His research interests includes the design, analysis, and assessment of bridges; structural analysis and design; fatigue and fracture of steel bridges; reliability analysis; life cycle assessment; probabilistic analysis; design of innovative structure and application of new materials in structures; construction control design, and fast bridge construction. He has won many international and national awards during his professional and academic career, and he served as a volunteer in the evaluation of structures during seismic emergencies for the National Service of the Civil Protection (L'Aquila 2009, Emilia Romagna 2012).

**Reiner S.**

*Leonhardt, Andrä, und Partner, Germany*

Saul Reiner was born at Lünen, Westphalia, Germany in 1938 and graduated as Dipl.-Ing. in structural engineering from the Technical University of Hannover in 1963. He



started his career with steel contractor Hein Lehmann AG Düsseldorf. In 1968, he went to Leonhardt, Andrä, und Partner, where he was appointed managing director in 1992. After his retirement in 2003, he became a consultant. From 1993 to 2006, he was licensed as a Legally Authorized Checking Engineer in Germany. In 1994, he was appointed a lecturer on steel bridges at the University of Stuttgart; in 2003, he received an honorary doctorate in structural engineering from the Technical University Carolo-Wilhelmina Braunschweig. In 2005, he became an honorary member of the Argentine Society for Structural Engineering (AIE). During his professional career, he has been involved in the design, site direction, or checking of about 40 cable stayed and suspension bridges and numerous other bridges, mainly with steel or steel composite girders. He is the author of numerous papers, mainly on steel, steel composite, and cable stayed bridges and related problems like cables and protection against ship impact.

**Rosignoli M.**

*Dr. Ing., PE, United States of America*

Marco Rosignoli has 32 years of experience in the design and construction engineering of complex bridges, the industrialization of large-scale bridge projects, and the design review and forensic engineering of bridge construction machines. Working with bridge contractors, designers, and owners in 21 countries on four continents, he has served as designer, reviewer, or technical leader for the construction of five cable stayed bridges, nine incrementally launched bridges, multiple balanced-cantilever bridges, and well over 50 km of light-rail and high-speed railway bridges. An international authority on mechanized bridge construction, he is the author of four books published worldwide, four book chapters, and over 80 publications and presentations, and he holds 32 patents on bridge construction methods.

**Schanack F.**

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Frank Schanack studied civil engineering at TU-Dresden, Germany, in 2003, and received his doctorate at Universidad Cantabria in Spain in 2008. Since then, he has been a professor on bridges and structures at Universidad Austral de Chile, where he is currently the director of the Institute of Civil Engineering. His research has an integrated focus on all aspects of bridge engineering, including conceptual design, analysis details and erection methods, and inspection and maintenance. He has worked as a consultant for the design, construction, and maintenance of over 100 bridge projects in Germany, Spain, Argentina, and Chile.

**Schultz A.E.**

*University of Minnesota, United States of America*

Arturo Ernest Schultz is a structural engineering researcher and educator. He holds a bachelor's degree in civil engineering from Southern Methodist University in Dallas, Texas, as well as master's and doctoral degrees in civil engineering from the University of Illinois at Urbana-Champaign. He is a fellow of The Masonry Society (TMS)



and member of the Precast/Prestressed Concrete Institute (PCI), the American Concrete Institute (ACI), and the American Society of Civil Engineers (ASCE). He is past recipient of the John B. Scalzi Award (TMS), the C.T. Grimm Award (Canada Masonry Design Centre), and the Charles C. Zollman and Martin P. Korn awards (PCI).

### **Stewart L.**

*Georgia Institute of Technology, United States of America*

Dr. Lauren K. Stewart, a renowned expert in blast research, came to the School of Civil and Environmental Engineering (CEE), in Atlanta, Georgia, from the University of California, San Diego (UCSD). She earned her bachelor's and doctoral degrees in structural engineering from UCSD, where she was a postdoctoral scholar and lecturer. She is also a National Defense Science and Engineering Graduate Fellow and holds a P.E. license. She has been involved with many blast and earthquake experimental projects, including the blast testing of steel structural columns, steel stud wall systems, and high performance concrete (HPC) panels using the UCSD blast simulator. She has also conducted advanced finite element analysis for the World Trade Center 7, AFRL Munitions Directorate small munitions program, and programs supported by the Technical Support Working Group. She is considered by many to be among the top blast researchers in the US, and has served as a senior blast engineering consultant to a number of organizations since 2007.

### **Ferretti Torricelli L.**

*SPEA Ingegneria Europea, Italy*

Lucio Torricelli received the master degree in civil structural engineering at the Politecnico di Milano in 1991. In 1992 he joined the design office of the construction company of Italstrade S.p.a. focusing on prestressed concrete bridges realized with various construction methods (frontal launching, movable scaffolding, balanced cantilever). Then expanded the field of expertise with the involvement as senior engineer and team leader, in the design of other transportation infrastructures, such as tunnels, and underground stations. In early 2000, joined the company SPEA Ingegneria Europea, engineering company partner of Autostrade per l'Italia-Atlantia Group, focusing the interest on highway infrastructures, as senior bridge engineer. He has been leading structural engineer charged of the design of some of the major bridges structures of the "Variante di Valico" project (A1 Highway); other noticeable works includes the preparation of the conceptual guidelines for "widening and seismic retrofitting of existing structures of A14, A9 and A1 highways"; participated in the implementation of the new structural Eurocodes, with special reference to packages 2, 3 and 4, developing a set of comparative studies in order to best fit the new design requirements; team member of the "Gronda di Genova" project, in charge of the structural design of the new Genova cable stayed viaduct; since July 2011 is the Head of Structural Engineering Department of SPEA Ingegneria Europea.

**Vardanega P.J.***University of Bristol, United Kingdom*

Paul J. Vardanega studied at the Queensland University of Technology in Brisbane, Australia, and earned a bachelor's degree in engineering with First Class Honours and a University Medal and a Master of Engineering Science in 2007 and 2008, respectively. He is a member of Engineers Australia and a member of the American Society of Civil Engineers (ASCE). He holds a PhD from Cambridge University in geotechnical engineering, completed under the supervision of Professor Malcolm Bolton, Fellow of the Royal Academy of Engineering (FREng). From April 2012 to September 2013, he worked as a research associate at the Laing O'Rourke Centre for Construction Engineering and Technology at Cambridge (under the direction of Professor Campbell Middleton, FICE) working on the project: "Best Practice Guide for Structural Monitoring over the Whole Life of Assets,". In September 2013, he took up the position of lecturer on civil engineering at the University of Bristol.

**Webb G.T.***Parsons Brinckerhoff, United Kingdom*

G.T. Webb recently completed his PhD on structural health monitoring (SHM) at Cambridge University, UK. His research focused on ways in which data can be interpreted to provide useful information, an area in which surprisingly little work has yet been published. He has developed a new classification system to aid users of SHM systems to clearly understand how data is used and what information can realistically be obtained. These new findings will help to better target investments in SHM so that results with a genuine impact can be delivered. Now working for Parsons Brinckerhoff in London, he is part of a team developing a long-term SHM strategy for the Hammersmith Flyover in London. Findings from his research are being used to ensure that a useful and beneficial system is delivered.