SMAR 2017

SMAR 2017 Zurich Program

Fourth Conference on Smart Monitoring, Assessment and Rehabilitation of Civil Structures

SMAR 2017, Zurich/Switzerland

13 – 15 September 2017

ETH Zurich

Edited by
Masoud Motavalli, Alper Ilki, Bernadette Havranek and Pinar Inci

İTÜ

Empa
Materials Science and Technology

Zurich

Zurich has a unique position in Switzerland. It is the country's largest city and home to an internationally reputed financial centre as well as being the focus of an economic region which acts as the motor of Switzerland, and along with Geneva is the most important gateway to the country. The wide variety of cultural activities and educational institutions define Zurich's character as a diverse, open city with a passion for life. Zurich is the capital of the canton of the same name and the centre of a number of regions which together have some 1.9 million inhabitants. It is famous for its lakeside location and green, densely wooded chain of hills which run through the city from north to south.

Welcome to SMAR 2017 at ETH Zurich Campus Hönggerberg Switzerland

SMAR 2017 is the fourth Conference on Smart Monitoring, Assessment and Rehabilitation of Civil Structures to be held at ETH Zurich, Hönggerberg, Switzerland, from 13 to 15 September 2017 co-organized by Empa, the Swiss Federal Laboratories for Materials Science and Technology and ITU, Istanbul Technical University. It is a follow-up of the biannual successful SMAR conference series starting 2011 in Dubai, 2013 in Istanbul and 2015 in Antalya. SMAR 2017 proceeds with presenting innovative materials and technologies for structural health monitoring as well as rehabilitation, such as application of Smart Fiber Optic Sensors, Fibre Reinforced Polymers, Shape Memory Alloys, and much more.

As an interdisciplinary research institute of the ETH Domain, Empa, the Swiss Federal Laboratories for Materials Science and Technology, conducts cutting-edge materials and technology research. Empa's R&D activities focus on meeting the requirements of industry and the needs of society, and thus link applications-oriented research to the practical implementation of new ideas.

ITU, the Istanbul Technical University, is a reputable institution known for its history, science, technology, art and sport achievements over the period of 244 years. ITU is the cradle of science, industry and technology conducting over 200 R&D projects in the scope of ARI Techno City. With the priority for continuous development, innovative perspective and strong international contacts ITU proves to be the university of the past, present and future.

The modern ETH Zurich Hönggerberg campus is the conference venue, which is located on the outskirts of the city of Zurich. It is a perfect example of the links between science, industry and the general public. That is why it won the European Cultural Award for Science in 2010. The Hönggerberg campus offers plenty of room for further development. Not only are new buildings for research and education being built on the campus but also apartment blocks for students.

The proceedings contain a total of 200 papers written by authors from around countries worldwide. The contributions include five interesting Keynote Papers on dynamic modeling of retrofitted structures, resilient reinforced concrete building structures in Japan, hybrid experimental/numerical strategies, seismic retrofit of cultural heritage buildings and performance-based assessment and retrofit strategies. Furthermore, there is a healthy balance between papers of theoretical nature concerned with various aspects of computational issues and those of a more practical nature.

We would like to thank all authors for preparing their work towards this compilation, which will undoubtedly serve as a useful reference to practitioners, researchers, students and academics and allied disciplines. Special thanks are due to Members of the International Scientific Committee, who reviewed the papers carefully. The support of the Sponsoring Organizations and Companies is gratefully acknowledged. We are indebted to our colleagues in the Organization Committee. Thanks to the Empa and ITU conference team, Bernadette Havranek and Pinar Inci the conference secretaries, for their tireless efforts and quick responses to many demands of the conference.

We wish you a successful conference and a good stay in Zurich.

Masoud Motavalli (Empa) and Alper Ilki (ITU)
Co-Chairs, SMAR 2017
September 2017

Organization

Chairs

Masoud Motavalli
Empa, Switzerland
Swiss Federal Laboratories for Materials Science and Technology, Duebendorf / CH
Alper Ilki
Istanbul Technical University
Maslak, Istanbul / Turkey

Organizing Committee

Eleni Chatzi
ETHZ, Switzerland
Bernadette Havranek
Empa, Switzerland
Daniele Inaudi
Smartec, Switzerland
Robert Widmann
Empa, Switzerland
Mustafa Cömert
Istanbul Technical University, ITU, Turkey
Cem Demir
Istanbul Technical University, ITU, Turkey
Ugur Demir
Istanbul Technical University, ITU, Turkey
Caglar Goksu
Istanbul Technical University, ITU, Turkey

Conference Secretaries

Bernadette Havranek
Empa, Switzerland
Pinar Inci
Istanbul Technical University, ITU, Turkey

International Scientific Committee, Council members of ISHMII, IIFC and others

Bülent Akbas, Turkey
Ahmet Emin Aktan, USA
Screenivas Alampalli, USA
Sergio Alcocer, USA
Tahmeed M. Al-Hussaini, Bangladesh
Riadh Al-Mahaidi, Australia
Farhad Ansari, USA
Yu Bai, Australia
Baidar Bakht, Canada
Mohammed Baluch, Saudi Arabia
Larry C. Bank, USA
Joaquim Barros, Portugal
Luke A. Bisby, UK
James Brownjohn, UK
Andreas Brunner, Switzerland
Ozden Caglayan, Turkey
Erdem Canbay, Turkey
F. Necati Catbas, USA
Zekai Celep, Turkey
Oguz Cem Celik, Turkey
Eleni Chatzi, Switzerland
Jian-fei Chen, N. Ireland
Alvaro Cunha, Portugal
Christoph Czaderski, Switzerland
Laura De Lorenzis, Italy
Raafat El-Hacha, Canada
Tamer El-Maaddawy, UAE
Michael Fardis, Greece
Glauco Feltrin, Switzerland
Peng Feng, China
Elyas Ghafoori, Switzerland
Hamid Ghasemi, USA
Amir K. Ghorbani-Tanha, Iran
Caglar Goksu, Turkey
Burcu Gunes, Turkey
Issam E. Harik, USA
Kent Harries, USA
Rosemarie Helmerich, Germany
Alper Ilki, Turkey
Daniele Inaudi, Switzerland
Thomas Keller, Switzerland
Renata Kotynia, Poland
Koichi Kusunoki, Japan
Arkadiusz Kwiecien, Poland
Pierre Labossiere, Canada
Werner Lienhart, Austria
Taha Mahmoud, USA
Enzo Martinelli, Italy
Urs Meier, Switzerland
Julien Michels, Switzerland
Ayaho Miyamoto, Japan
Soheil Mohammadi, Iran
Khalid Mosalam, USA
Masoud Motavalli, Switzerland
Antonio Nanni, USA
John Newhook, Canada
M. Ahmadabadi Nili, Iran
Alain Nussbaumer, Switzerland
Piotr Omenzetter, UK
Kutay Orakcal, Turkey
Baki Ozturk, Turkey
Azadeh Parvin, USA
M. Dolores G. Pulido, Spain
Muhammad K. Rahman, Saudi Arabia
Werner Rücker, Germany
Erdal Safak, Turkey
M. Saiid Saiidi, USA
Halem M. Seliem, Egypt
Rudolf Seracino, USA
Halil Sezen, USA
Behrouz Shafei, USA
Moslem Shahverdi, Switzerland
M. Shekarchizadeh, Iran
Ian F.C. Smith, Switzerland
Scott Smith, Australia
Kong Fah Tee, UK
Jin-Guang Teng, Hong Kong
Giovanni Terrasi, Switzerland
Thanasis Triantafillou, Greece
Tamon Ueda, Japan
Radu Vacareanu, Romania
Humberto Varum, Portugal
Y.F. Wu , Hong Kong
You-Lin Xu, Hong Kong
Ufuk Yazgan, Turkey
Xiao Ling Zhao, Australia
Manoochehr Zoghi, USA
Daia Zwicky, Switzerland

Organization

Institutional Sponsors

Empa

Materials and technologies for a sustainable future
As an interdisciplinary research institute of the ETH Domain, Empa, the Swiss Federal Laboratories for Materials Science and Technology, conducts cutting-edge materials and technology research. Empa's research and development activities focus on meeting the requirements of industry and the needs of society, and thus link applications-oriented research to the practical implementation of new ideas in the areas of nanostructured, "smart" materials and surfaces, environmental, energy and sustainable building technologies as well as biotechnology and medical technology.

The place where innovation starts
Through an efficient technology transfer Empa is turning research results into marketable innovations. As a result, Empa is capable of providing its partners with customized solutions that not only enhance their innovative edge and competitiveness, but also help to improve the quality of life for the public at large. Safety, reliability and sustainability of materials and systems are keys to all Empa activities. The Empa Portal is the central contact point for partners and customers who wish to start research projects in cooperation with Empa or who are seeking innovative solutions to specific problems. As part of the ETH Domain, Empa is committed to excellence in all its activities.

ITÜ

ITU is a reputable institution known for its history, science, technology, art and sport achievements over the period of 244 years. ITU, that has presented numerous scientific and technological developments, was the first to introduce novelties and unique achievements, provides academic learning being one of the oldest and most prominent technical universities in the world.

With 23 engineering programs accredited by ABET Accreditation, ITU is the world's leader among universities. Students participating in International Exchange Graduate Programs complete a part of their education at one of the partner universities in the USA and receive a dual diploma.

ITU is the cradle of science, industry and technology conducting over 200 R&D projects in the scope of ARI Techno City. In cooperation with the entrepreneurship ecosystem ITU Seed, the university provides support to students-entrepreneurs.

Long history, intelligent minds and outstanding academic environment of ITU form a strong bridge connecting the past to the future. With the priority for continuous development, innovative perspective and strong international contacts ITU proves to be the university of the past, present and future.

ISHMII

ISHMII advances our understanding and the application of SHM methodologies for the condition assessment and management of civil infrastructure systems. ISHMII shares the knowledge and experience in technologies impacting Civil Structural Health Monitoring (CSHM); including sensors, instrumentation, monitoring strategies, data mining, management, and interpretation for decision-making processes, case studies, and more. It promotes international collaboration, encourages building intelligent structures, demonstrates the benefits of SHM methodologies for maintenance of structures, and advances the state-of-practice.

ISHMII is in a unique position to address the challenges facing the infrastructure of the 21st century where each system or structure, functioning as complimentary industries, is critical to economic development.

ISHMII is an international society with a truly global perspective. It is only through SHM that it will be possible to safely extend the service lives of the mature infrastructures of industrial nations or construct more daring futuristic larger span bridges, rail links and modern infrastructure systems in developing countries. That is why ISHMII needs you as highly respected expert to bring your competence and ideas to ISHMII.

As the President of ISHMII, I am pleased to welcome you, and look forward to working with you to accomplish our objectives and further this important work.

IIFC

The aim of the International Institute for FRP in Construction (IIFC) is to advance the understanding and the application of fibre-reinforced polymer (FRP) composites in the civil engineering infrastructure, in the service of the engineering profession and society. The objectives of the Institute are to:
(a) provide a focal point for international sharing of knowledge and experience;
(b) promote collaboration to maximise the benefit of the international research and development effort;
(c) foster international harmonization of design and application standards;
(d) further the acceptance of FRP composites by the engineering community and beyond as a major construction material;
(e) advocate further innovations, particularly through the interfacing of FRP composites with other technologies such as intelligent sensing.

The Institute organises various activities in order to achieve its aim and objectives, including giving a series of awards such the IIFC Medal and the Distinguished Young Researcher Awards, various Best Paper Prizes, Best Thesis Award. It will also lunch a Best Application Award soon. More details of the IIFC can be found at its website www.iifc.org, where all IIFC conference proceedings can be downloaded for free.

One of the important activities of the IIFC is the organisation and sponsorship of international conferences, symposiums, workshops, short courses and seminars, including a biennial official conference (the CICE conferences). The IIFC has sponsored all the SMAR conferences starting from the inaugural conference in 2011 in Dubai and now the fourth one in Zurich.

On behalf of the IIFC, I would like to congratulate all the past and present organisers of this series of conferences for their professional organisation, and wish all delegates have a fruitful conference and enjoyable time in Zurich!

RILEM

The mission of RILEM is to advance scientific knowledge related to construction materials, systems and structures and to encourage transfer and application of this knowledge world-wide. This mission is achieved through collaboration of leading experts in construction practice and science including academics, researchers, industrialists, testing laboratories and authorities.

In 1956, the first RILEM Technical Committee was created, on the topic of 'Winter Concreting'. Since then almost 300 Technical Committees have been active, producing State-of-the-art reports and/or Test Recommendations.

RILEM has been organizing symposia and workshops since its foundation. Through its subsidiary company RILEM Publications Sarl, RILEM has published more than 100 proceedings since 1997. A quick glance at http://www.rilem.net shows the diversity, the importance, and the international scope of the topics.

To broaden the education of both PhD students and the professional community, RILEM sponsors interesting and informative PhD courses and seminars on subjects of relevance to researchers working in specific areas.

RILEM has about 1300 individual members worldwide, and over 100 corporate members.

Gold sponsor/Exhibitor

NEUBREX

Neubrex Co. was founded in 2002 in Kobe, Japan. It is one of the leading companies, providing the state-of-the-art Distributed Fiber Optic Sensing (DFOS) systems along with Smart Structure Solutions to the world.

With the research and development in key technologies of Brillouin and Rayleigh backscattering, as well as acoustic/phase sensing, Neubrex technologies and solutions include distributed sensing interrogators, fiber sensing cables, analyzing software, and tailor-made sensing cables to particular customer's requirements.

Since the first cm-order distributed fiberoptic strain-temperature sensing interrogator manufactured back in 2005, Neubrex continuously expands, improves and enhances its portfolio of products, which include among others:

- NBX-5100 BOTDR instrument can measure 100 km distance range
- The hybrid NBX-7020 has resolution as fine as 2 cm.
- It uses both Brillouin and Rayleigh backscattering to obtain separated temperature and strain in same, single mode fiber
- The measurement speed of NBX-SR7000 is just 10 second, keeping 20 cm resolution and 5 cm sampling interval. Its accuracy is 0.01°C for entire 10 km measurement range.
- The NBX-S3000 is Distributed Acoustic Sensing interrogator is a real-time "Phase Detectable" interrogator with its superior data compression achieving capability of 132 hours of data stored as less than 1 GB disk space.

Neubrex provided system for the tunnel displacement monitoring which had been applied to a tunnel in Switzerland since 2013. The status of the displacement and temperature of the tunnel can be displayed with the Neubrex Fiber Optic Sensing System.

From its very beginning, Neubrex always strives to be a solution provider. It starts from the understanding of customer requirements, designing the optimal solution and deploying the system.

Neubrex focuses its research and development on the displacement sensing, using higher precision interrogators, multi-function fiber optic sensors, and better data analyzing systems.

Silver sponsors/Exhibitors

DOWAKSA

DowAksa is a joint venture founded in 2012 by Dow Chemical Company and Aksa Akrilik to develop and globally market a broad range of products and technical services to support the growing carbon-fiber based composites industry. It provides carbon fiber solutions for industrial applications in today's transportation, infrastructure, aerospace and energy markets. Solutions that improve performance while reducing overall costs.

The joint venture combines the strengths of two-world class companies: Dow has the formulation expertise, proven composite technologies, global reach and materials science. Aksa is the world's largest producer of acrylic fibers. As a fully integrated solution provider for carbon fiber industry, DowAksa has both the capacity and commitment to reliably meet the unique demands of carbon fiber customers globally.

Very strong and lightweight, carbon-fiber-based materials are used in a variety of applications where weight savings, emissions reduction, durability and energy efficiency are key performance factors.

Infrastructure Solutions:
Across the globe, aging infrastructure is a growing concern – threatening public safety, causing major disruptions and draining economies. Finding long-lasting and efficient ways to repair buildings, pipelines, roads and bridges is a challenge.

The DowAksa CarbonWrap™ system is a cost-effective and innovative solution for restoring the world's infrastructure. It doesn't just repair degraded structures; it actually makes buildings safer, pipelines last longer, and roads and bridges stronger. It can also mitigate the harmful effects of seismic activity, such as found in earthquake-prone regions of Turkey.

In 2016, a team of structural experts from industry and universities in Turkey took this challenge and demonstrated in a side-by-side test how a building retrofitted with carbon fiber composites can successfully survive a simulated earthquake. DowAksa, joined with Istanbul Technical University to conduct a simultaneous full-scale earthquake simulation using carbon fiber reinforced polymer (CFRP) technology. Using the same foundation and materials, two full-scale buildings were constructed using practices that were common for several decades in Turkish construction. The first building was retrofitted with CFRP, a high-strength, lightweight and affordable technology developed by experts at DowAksa. The second building was not changed. The experiment's goal was to demonstrate how a conventional building can be retrofitted to withstand strong seismic forces. The test was completed under the supervision of ITU using a system of hydraulic actuators to simulate a seismic shock. This is the first test in the world of its type to simulate seismic forces on two 3-story substandard reinforced concrete structures simultaneously.

CRFP composites have tensile strength higher than steel, are lightweight and do not corrode. DowAksa's CarbonWrap™ is designed to offer this critical technology that can be quickly and efficiently applied by properly trained construction professionals, without interrupting the daily functions of the structures. It minimizes disruption during repair and saves significantly on installation time and costs. Applied in the form of a flexible fabric during installation, it is then saturated with a resin matrix, allowing it to harden to a strong, unyielding material with a strength-to-weight ratio that exceeds fifty times that of steel.

With these advantages of CarbonWrap™, there was no strength loss or significant damage observation on the retrofitted building. After the collapse of the reference building the push over loading continued until ten times higher lateral drift of the reference building collapse drift (to 15% drift ratio). However, even under this extremely high lateral displacement, the retrofitted building managed to stand upright.

SMARTEC

SMARTEC SA was founded in 1996, resulting from the development of the Fiber Optic SOFO monitoring system at Swiss Federal Institute of Technology, Lausanne (EPFL).

In 2000, the company integrated the DiTeSt system (Brillouin) and the DiTemp system (Raman) in its solutions. In 2005, the MuST product line, based on fiber Bragg gratings, was introduced.

In 2006, SMARTEC joined Roctest, a world leading manufacturer of instrumentation used in civil engineering, geotechnical and industrial applications. In 2010, Roctest became part of Nova Metrix.

SMARTEC has over 100 years of combined experience in Fiber Optic. SMARTEC experience and expertise are reflected by more than 1000 monitoring projects in 30 countries throughout the world. SMARTEC is committed to provide the best solution with the highest quality products, services, support and competence.

Fiber Optic Sensing

SMARTEC product range and expertise cover all major fiber optic sensing technologies. SMARTEC has been pioneers in the use of optical fiber sensors for Structural Health Monitoring and process control.

Technologies

SMARTEC offers Fiber Optic measurement systems based on the following sensing technologies:

Fabry-Perot Interferometer (FISO brand):
These point sensors measure local strain, temperature, pressure and displacement. These quantities are encoded in a change of length of an optical cavity within the sensors that can be measured accurately and with excellent long-term stability. Fabry-Perot sensors are the ideal one-to-one optical replacement of conventional geotechnical sensors.

Low-coherence Interferometers (SOFO brand):
These long-gauge sensors measure displacement or average strain over measurement bases that can extend up to several meters. They are ideal transducers for monitoring concrete and geotechnical structures. Deformations are measured by observing the length changes of an optical fiber attached to the structure under observation, compared to a loose reference fiber. This measurement principle allows accurate and stable measurements and insensitivity to temperature variations.

Fiber Bragg Grating (MuST brand):
FBG sensors are written in the optical fiber core and act as optical filters, reflecting the wavelength that matches the grating pitch. The reflected wavelength depends on the strain and temperature of the grating, enabling measurement of those two parameters and others that can be transformed to strain (deformation, tilt and acceleration). It is possible to combine multiple gratings with different reflective wavelength on the same fiber (multiplexing).

Distributed Raman Scattering (DiTemp brand):
These sensors use an intrinsic property of optical fibers to measure the local average temperature of each meter of fiber for lengths up to several tens of kilometers. This enables the measurement of thousands of temperatures along a single cable. This technology is particularly suitable for detecting and localizing hot or cold spots associated with leaks or other defects.

Distributed Brillouin Scattering (DiTeSt brand):
This technology is similar to Raman scattering, but offers the additional ability to measure distributed strain. This enables the detection of local events such as settlements, deformations, cracks and movements.

Sponsor

SCHÖCK

Schöck Bauteile AG in Aarau is a member of the Schöck Group which operates 14 sales companies operating around the globe and has over 800 employees in total. The German parent company in Baden-Baden was founded in 1962 by the building engineer Eberhard Schöck and continues to stand for innovative construction solutions relating to thermal and acoustic insulation as well as reinforcement technology.

The core focus is on development and production of construction products that make a substantial contribution to building physics.

Reliable construction quality

The main product is the Schöck Isokorb®, which is used as a load-bearing thermal insulation element for projecting components, such as balconies, access balconies or canopies. It is used in new buildings as well as modernisation projects, and even in passive houses. With standard types for use in concrete, steel and wood, Schöck is the leading specialist in this sector both for new construction and for renovation.

As a completely ready-to-install soundproofing system for staircases, Schöck Tronsole® ensures that residents in apartments are not disturbed by annoying sounds on staircases.

As a pioneer in the construction industry, Schöck has developed an entirely new form of reinforcement technology. Schöck Combar® is tested according to building physics principles. The glass fibre reinforcement is easy to machine, is neither electrically conductive nor magnetisable and cannot be affected by rust. The product is therefore ideally suited for industrial structures, tunnel construction, bridge construction, infrastructure construction, in marine areas or the construction of energy generation systems. Owing to its low thermal conductivity at almost zero and its high tensile strength, Combar® is also used as a tension rod in the Schöck Isokorb® thermal insulation element.

Sponsors/Exhibitors

Gold Sponsor/Exhibitor

NEUBREX

Silver Sponsors/Exhibitors

DOWAKSA

SMARTEC

Sponsors

Baertschi | Partner Consulting

Schöck Innovative Building Solutions

Sponsors/Exhibitors

BARTEC SYSCOM

fibrisTerre

mageba

re-Fer

RISE

SEMEX ENGCON VIBRATION MONITORING SOLUTIONS

Institutional Sponsors

ETH zürich

Kanton Zürich

FC

ISHMII

rilem

General Information: ETH Zurich Campus Hönggerberg

Venue of the Conference SMAR 2017

The campus is located on the outskirts of the city of Zurich. Zürich is home to globally-renowned universities, successful research facilities and innovative think-tanks. It also has a broad selection of accommodations, a pleasant climate and an excellent transport network making it an attractive location for SMAR2017.

ETH Zurich Campus Hönggerberg,
www.ethz.ch/en

Transportation

The most convenient way to get around in Zurich is to use the public transportation. The most important connections are given below, however for other destinations the “SBB Mobile” app can be downloaded free of charge.

From Zurich Airport to ETH Hönggerberg

The quickest way from the airport to the Hönggerberg campus would be by taking a train (S-Bahn) from the airport until Oerlikon, and then taking Bus 80 until the stop ETH Hönggerberg. Alternatively, Tram 10 can also be used to arrive to Oerlikon from the airport.

Conference rooms

The conference will take place in the ETH Hönggerberg campus, HIL building E floor. Sessions will be held in the rooms HIL E3, HIL E7, HIL E8 and HIL E9. Upon entering the building, you have to go up one floor (elevators are available) and follow the signs.

Food Market

Lunch at cafeteria “Food Market” at ETH Hönggerberg
The cafeteria “Food Market” is situated in the HPH building. It is approximately 2 minutes on foot within the campus.

Conference SMAR'17

Tuesday 12 September 2017	Wednesday 13 September 2017	Thursday 14 September 2017	Friday 15 September 2017
07.45 Preconference Scientific tour	08.00–17.30 Registration Desk open and upload of presentations	08.00–18.00 Registration Desk open and upload of presentations	08.00–18.00 Registration Desk open and upload of presentations
07.45 Meeting point Bus / Car station at Zurich main station	08.30–10.00 Room 1 Welcome address by Prof. Dr. M. Motavalli and Prof. Dr. A. Ilki Conference Chairs Lecture by Dr. Peter Richner, Deputy Director of Empa	08.30–10.00 Room 1 Keynote sessions 08.30–09.10 Keynote Prof. S. Kono 09.10–09.50 Keynote Prof. O. Rabinovitch 09.50–10.00 Information ISHMII by W. Habel	08.30–09.30 Room 1 Keynote session 08.30–09.20 Keynote Prof. S. Pampanin 09.20–09.30 Information IIFC by R. El-Hacha
	10.00–10.30 Coffee break	10.00–10.30 Coffee break	09.30–10.00 Coffee break
	Keynote sessions 10.30–11.10 Keynote Prof. R. Al-Mahaidi 11.10–11.50 Keynote Prof. K. Beyer 11.50–12.00 Pres by Gold sponsor	Sessions à 8 papers Room 1 10.30–12.30 Session 9 Room 2 10.30–12.30 Session 10 Room 3 10.30–12.30 Session 11 Room 4 10.30–12.30 Session 12	Sessions à 8 papers Room 1 10.00–12.00 Session 21 Room 2 10.00–12.00 Session 22 Room 3 10.00–12.00 Session 23 Room 4 10.00–12.00 Session 24
	12.00–13.30 Lunch	12.30–14.00 Lunch	12.00–13.30 Lunch
	Sessions à 6 Papers Room 1 13.30–15.00 Session 1 Room 2 13.30–15.00 Session 2 Room 3 13.30–15.00 Session 3 Room 4 13.30–15.00 Session 4	Sessions à 6 papers Room 1 14.00–15.30 Session 13 Room 2 14.00–15.30 Session 14 Room 3 14.00–15.30 Session 15 Room 4 14.00–15.30 Session 16	Sessions à 8 papers Room 1 13.30–15.30 Session 25 Room 2 13.30–15.30 Session 26 Room 3 13.30–15.30 Session 27 Room 4 13.30–15.30 Session 28
	15.00–15.30 Coffee break	15.30–16.00 Coffee break	15.30–16.00 Coffee break
	Sessions à 6 Papers Room 1 15.30–17.00 Session 5 Room 2 15.30–17.00 Session 6 Room 3 15.30–17.00 Session 7 Room 4 15.30–17.00 Session 8	Sessions à 6 papers Room 1 16.00–17.30 Session 17 Room 2 16.00–17.30 Session 18 Room 3 16.00–17.30 Session 19 Room 4 16.00–17.30 Session 20	Sessions à 6 papers Room 1 Room 2 16.00–17.30 Session 30 Room 3 16.00–17.30 Session 31 Room 4
Preconference scientific tour	18.30 After conference sessions Get Together Party and Welcome reception at Empa and NEST	19.00 Apéro and Conference Dinner at Restaurant Lake-Side Zurich	17.30 Closing Ceremony and the awards for the best papers

Keynote Speakers

Riadh Saleh Al-Mahaidi

Professor of Structural Engineeing; Academic Vice President (Research Engagement, Middle East); Director, Smart Structures Laboratory, Swinburne University of Technology, Victoria, Australia

Keynote lecture:
Advanced hybrid experimental numerical strategies for safer structures

Dr Riadh Saleh Al-Mahaidi is a Professor of Structural Engineering and Director of the Smart Structures Laboratory at Swinburne University of Technology in Melbourne, Australia. He also holds the position Academic Vice President (Research Engagement) at Swinburne. Over the past 20 years, he focused his research and practice on life time integrity of bridges, particularly in the area of structural strength assessment and retrofitting using advanced composite materials. He currently leads a number of research projects on strengthening of bridges using fibre reinforced polymers combined cement-based bonding agents, fatigue life improvement of metallic and concrete structures using advanced composite systems and shape memory alloys. He recently started some projects on hybrid testing of structures. He received a BSc (Hon 1) degree in civil engineering from the University of Baghdad and MSc and PhD degrees in structural engineering from Cornell University in the United States. To date, Riadh published over 180 journal and 250 conference papers. He was awarded the 2012 Vice Chancellor‘s Internationalization Award, the RW Chapman Medals in 2005 and 2010 for best journal publication in Engineers Australia Structural Journal, best paper awards at ACUN-4 (2002) and ACUN-6 (2012) Composites conferences. Prof Al-Mahaidi and his research group won the 2016 Engineers Australia Excellence Award for Innovation, Research and Development (High Commendation) for the Multi-Axis Substructure Testing (MAST) System they built at Swinburne and the 2017 WH Warren Medal by the Board of the College of Civil Engineers of Engineers Australia.

Katrin Beyer

Assistant Professor at the Earthquake Engineering and Structural Dynamics Laboratory EESD, Ecole polytechnique fédérale de Lausanne EPFL, Switzerland

Keynote lecture:
Seismic retrofit of cultural heritage buildings – when less is more

Katrin Beyer joined EPFL in 2010 and leads the Earthquake Engineering and Structural Dynamics Laboratory (EESD, http://eesd.epfl.ch/). She became the first female faculty member in civil engineering at EPFL and was nominated Associated Professor in Structural Engineering in 2017. Her research interest comprise the seismic response of reinforced concrete walls and of unreinforced masonry structures. Research on the latter focuses on the strength and deformation capacity of unreinforced masonry structural members. Her research group developed the first strength capacity models for unreinforced masonry spandrels and the first mechanical models for predicting the deformation capacity of unreinforced masonry walls developing a shear failure mode. These successes have earned Katrin to deliver invited lectures at the 2nd European Conference on Earthquake Engineering and Seismology, Istanbul, Turkey in 2014 and at the 16th World Conference on Earthquake Engineering, Santiago, Chile in 2017. In 2015 she became the youngest appointed member of the editorial board of the Bulletin of Earthquake Engineering, which is the journal with the second highest impact factor in her field.

Susumu Kono

Professor at the Urban Disaster Prevention Research Core, Laboratory for Future Interdisciplinary Research of Science and Technology, Institute of Innovative Research, Tokyo Institute of Technology, Tokyo, Japan

Keynote lecture:

Efforts to develop resilient reinforced concrete building structures in Japan

Professor S. Kono received his M.S. in Structural Engineering from Kyoto University in 1989. He received his Ph.D. in Civil Engineering from the University of Illinois in 1995. After working as a bridge engineer in California for a year, he became an Assistant Professor of the Dept. of Civil Engineering at Toyohashi University of Technology in 1996. In 1998, he moved as an Assistant Professor of Structural Engineering at Kyoto University and became an associate professor in 2002. He has been serving as a professor in Tokyo Institute of Technology since 2012.

Professor Kono's primary research areas involve the experimental investigation of reinforced and prestressed/precast concrete structural systems subjected to earthquake loadings. His interests include performance based design of reinforced concrete, damage control or zero damage design using prestressed/precast concrete. His current research topics include the following; (1) Damage evaluation/control of RC structures to improve the performance based design, (2) Development of damage controling system using precast/prestressed concrete technology, and (3) Study on shear tranfer mechanisim of reinforced concrete members.

Stefano Pampanin

Professor of Structural Design & Earthquake Engineering, Department of Civil and Natural Resources Engineering, University of Canterbury, Christchurch, New Zealand

Keynote lecture:

Towards the practical implementation of performance-based assessment and retrofit strategies for RC buildings: challenges and solutions

Stefano Pampanin is Professor of Structural and Earthquake Engineering at the University of Canterbury, Christchurch, New Zealand, where he joined in 2002 and at La Sapienza University of Rome since 2015. He is a Past President of the New Zealand Society for Earthquake Engineering, NZSEE, (2012-2014), Fellow of the Institution of Professional Engineers in NZ (IPENZ) since 2015 and Fellow of NZSEE since 2017.

In the past 20 years, he has dedicated a significant effort in the research and development, codification, practical implementation, teaching and dissemination of innovative solutions for the seismic design of low-damage structural systems in concrete and timber, as well as for the seismic assessment and retrofit of existing RC structures. He is author of more than 400 scientific publications in the field of earthquake engineering and received several awards for his research activities. He has been the Task Leader and Main Author of the Concrete Section in the new NZSEE2017 Guidelines on "Seismic assessment of Existing Buildings".

Oded Rabinovitch

Dean and Professor at the Faculty of Civil and Environmental Engineering, Technion, Israel Institute of Technology, Haifa, Israel

Keynote lecture:

Dynamic modeling challenges in strengthening existing structures with advanced composites

Dr. Oded Rabinovitch is a Professor at the Faculty of Civil and Environmental Engineering at the Technion – Israel Institute of Technology and the holder of the Abel Wolman Chair in Civil Engineering. Since January 2014 he is the Dean of the Faculty of Civil and Environmental Engineering at the Technion. In 2012 he was awarded the Yanai Prize for Excellence in Academic Education. He received a B.Sc. degree In Civil Engineering in 1997 and a Ph.D. in 2001, both from the Technion, Israel Institute of Technology. After graduation, he was a post – doctoral fellow in the Center for Composite Materials at the University of Delaware and in 2002 he joined the Faculty of Civil and Environmental Engineering at the Technion.

Prof. Rabinovitch teaches and leads research in the field of structural engineering. His main fields of interests are strengthening of structures with composite materials and, more generally, the structural behavior of other layered, composite, laminated, adhesively bonded, and sandwich structures. In particular, he focuses of the analytical, numerical, and experimental characterization of the unique static and dynamic failure mechanisms that are typical to such structural forms. He is also active in the fields of nonlinear smart, piezoelectric, and ferroelectric active structures, masonry structures, as well as in the development of new sensory structural systems. Prof. Rabinovitch guided and is guiding 18 graduate students (5 PhD and 6 MSc completed, 6 PhD and 1 MSc in progress), raised about 3.2M NIS research funding, mostly from competitive grants, and published 89 peer reviewed journal papers, 51 conference papers/ presentations, and 1 patent.

Program, Wednesday, 13/9/17

08.00–18.00	**Registration Desk open and upload of presentations at conference presentation rooms**	**Room 1**
08.30–10.00	**Welcome address by Prof. Dr. M. Motavalli and Prof. Dr. A. Ilki, Conference Chairs** **Lecture by Deputy Director of Empa, Dr. Peter Richner**	
10.00–10.30	**Coffee break**	
10.30–11.10	**Keynote by Prof. R. Al-Mahaidi** **Advanced hybrid experimental/numerical strategies for safer structures**	
11.10–11.50	**Keynote by Prof. K. Beyer** **Seismic retrofit of cultural heritage buildings – when less is more**	
11.50–12.00	**Presentation by Gold sponsor**	
12.00–13.30	**Lunch**	

13.30–15.00

Session 1 Room 1

Co-chairs:
Al-Mahaidi, R. and Ghafoori, E.

Session Metallic Structures

120 **Development, testing, and FEA of a SMA/CFRP patch for repair of cracked metallic structures**
Dawood, M., Zheng, B., El-Tahan, M.

82 **Intermediate debonding on cracked steel beams reinforced with CFRP plates under fatigue**
Bocciarelli, M., Colombi, P., Fava, G., D'Antino, T.

177 **Crack-reinforcement of old steel structures using adhesively bonded composite**
Lepretre, E., Chataigner, S., Dieng, L., Gaillet, L.

68 **An experimental investigation into bond behavior of prestressed CFRP to steel substrate**
Hosseini, A., Wellauer, M., Ghafoori, E., Sadeghi Marzaleh, A., Motavalli, M.

260 **Feasibility of iron-based shape memory alloy strips for prestressed strengthening of steel plates**
Izadi, M., Ghafoori, E., Hosseini, A., Motavalli, M., Maalek, S., Czaderski, C., Shahverdi, M.

Session 2 Room 2

Co-chairs:
Comert, M. and Sena-Cruz, J.

Session Durability issues

168 **Durability of HC-FCS cylinders subjected to hybrid environmental and mechanical loads**
Wang, S., ElGawady, M.

172 **Characterization of thermomechanical properties of a textile reinforced concrete (TRC) under high temperature**
Tlaiji, T., Vu, H.X., Ferrier, E., Larbi, A.S., Michel, M.

200 **Automated Detection of Areas of Deterioration in GPR Images for Bridge Condition Assessment**
Shakibabarough, A., Bagchi, A., Zayad, T.

232 **Bond strength of fly ash geopolymer with CFRP fabric after exposure to high temperature**
Sarker, P.K., Borak, A., Mukherjee, A., Rangan, V.R.

354 **Structures and buildings rehabilitated with FRP: durability issues and challenges for materials advancements**
Frigione, M.

292 **Durability monitoring of reinforced concrete**
Seguí Femenias, Y., Angst, U., Elsener, B.

Session 3 Room 3

Co-chairs:
Shahverdi, M. and Saiidi, S.

Session SMA

39 **Analysis, Design, and Construction of SMA-Reinforced FRP-Confined Concrete Columns**
Tazarv, M., Saiidi, S.M.

77 **Active shear strengthening of RC beams using shape memory alloys**
Rius, J., Cladera, A., Ribas, C., Mas, B.

118 **Iron-based shape memory alloy strips, Part 1: characterization and material behavior**
Shahverdi, M., Michels, J., Czaderski, C., Arabi-Hashemi, A., Motavalli, M.

116 **Iron-based shape memory alloy strips, Part 2: flexural strengthening of RC beams**
Michels, J., Shahverdi, M., Czaderski, C., Schranz, B., Motavalli, M.

239 **Functional properties of Fe-based shape memory alloys containing finely dispersed precipitates**
Krooß, P., Vollmer, M., Chumlyakov, Y., Niendorf, T., Somson, C.

242 **Stress recovery behavior of an Fe - Mn - Si - Cr - Ni - VC shape memory alloy subjected to cyclic fatigue loading**
Ghafoori, E., Hosseini, E., Michels, J.

Session 4 Room 4

Co-chairs:
Nussbaumer, A. and Ilki, A.

Session Damage control, strengthening

11 **Strengthening of short span steel jetty exposed to abnormal loads**
Oukaili, N.K.

27 **Standardization approach for a new class of retrofitting systems**
Walendy, B., Sedlmair, R., Stempniewski, L.

33 **A New Concept for Sustainable Refurbishment of Existing Bridges Using FRP Materials**
Yang, J., Haghani, R., Ricci, F., Valvo, P.S., Veltkamp, M.

35 **Internal and external transversal reinforcement interaction in RC beams strengthened in shear with externally bonded composites**
Gonzalez-Libreros, J., D'Antino, T., Sneed, L.H., Pellegrino, C., Giacomin, G.

41 **Strengthening an existing industrial building by optimally designed passive dampers under seismic and service loads**
Khansefid, A., Bakhshi, A.

49 **Emergency retrofitting of a shear-damaged RC column using fiber belt prestressing**
Nakada, K., Castro, J.J.

15.00–15.30 Coffee break

Program, Wednesday, 13/9/17

15.30–17.00

Session 5 Room 1

Co-chairs:
Ghafoori, E. and Dawood, M.

Session Metallic Structures

22 **Tools for efficient and accurate strain cycles monitoring of metallic railway bridges with wireless sensor networks**
Feltrin, G., Popovic, N., Jalsan K.-E.

259 **Development of anchorage systems for strengthening of steel plates with iron - based shape memory alloy strips**
Izadi, M., Ghafoori, E., Hosseini, A., Motavalli, M., Maalek, S.

66 **Fatigue strengthening of cracked steel plates using prestressed unbonded CFRP reinforcements**
Hosseini, A., Ghafoori, E., Motavalli, M., Nussbaumer, A., Zhao, X.-L., Koller, R.

342 **Recent developments of strengthening techniques for metallic structures**
Ghafoori, E., Dawood, M., Hosseini, A.

245 **CFRP strengthening of cast and wrought iron structures**
Moy, S.S.J.

Session 6 Room 2

Co-chairs:
Helmerich, R. and Nöther, N.

Session SHM

15 **Damage detection method based on state representation methodology (SRM)**
Miyamoto, A., Brühwiler, E.

26 **Quantitative estimation method of rebar corrosion degree of RC structures**
Oshita, H., Kanemoto, K.

36 **Evaluating the stresses in a supertall structure: Field monitoring and numerical analysis**
Osman, A., Malak, C.

38 **Predicting Freeze-Thaw Damage using Tipping Point Analysis of Strain Data**
McAlorum, J., McKeeman, I., Perry, M., Niewczas, P.

45 **Optical and Acoustic Techniques for Crack Monitoring in RC Building Structures**
Watanabe, T., Yanase, T., Takahashi, N., Ogata, Y., Sakurai, M., Kobayashi, J.

51 **Laboratory experiment for damage assessment using the DAD-method**
Erdenebat, D., Waldmann, D., Teferle, F.N.

Session 7 Room 3

Co-chairs:
Czaderski, C. and Cladera, A.

Session SMA

355 **New anchorage mechanism for smooth Fe-SMA bar used for flexural strengthening of RC beams using NSM technique**
Rojob, H., El-Hacha, R.

318 **SMA Bar Dampers using Bending Behavior Combined with Tension or Compression**
Choi, E., Park, S., Woo, D., Chae, S., Lee, S.-Y., Kwon, E., Park, H., Hoan, N.D.

347 **Deflection of SE-SMA reinforced concrete Beams-Column joints**
Kaduskar, S., Bajoria, K.M.

350 **Evaluation of mechanical behavior of NiTi/NiTiCu bi-layer composites aided by analytical modelling and FEM validation**
Taghizadeh, M., Nili-Ahmadabadi, M., Malekoshoaraei, M.H.

351 **On the pseudoelastic behaviour in a lath martensitic steel under two discrete processes consist of cold rolling and heat treatment**
Koohdar, H.R., Nili-Ahmadabadi, M., Habibi-Parsa, M., Jafarian, H.R.

Session 8 Room 4

Co-chair:
El-Badry, M. and Selcuk, B.

Session Damage control, strengthening

54 **Rapid repairing mortar material for corroded reinforced concrete structure**
Siu, K.M.C., Leung, C.K.Y., Wu, C., Lu, C., Lam, J.Y.K.

94 **Punching shear in reinforced concrete bubbled slabs: experimental investigation**
Oukaili, N.K., Husain, L.F.

128 **A soft-computing approach to seismic retrofitting of existing RC structure**
Falcone, R., Lima, C., Faella, C., Martinelli, E.

129 **Design, Construction, and Performance of an Elevated Slab Reinforced with GFRP Bars**
Plemic, P., Andrews, B.

194 **Interfacial cohesive material law for SRP strips bonded to concrete**
Carloni, C., Santandrea, M., Imohamed, I.A.O.

205 **Out-of-plane behaviour of TRM strengthened masonry walls**
Kariou, F.A., Trantafyllou, S.P., Bournas, D.A., Koutas, L.M.

18.30 Start Visit to Empa and Welcome reception at Empa and NEST

Program, Thursday, 14/9/17

08.00–18.00	**Registration Desk open and upload of presentations at conference presentation rooms**	**Room 1**
08.30–10.00	**Keynote sessions**	
08.30–09.10	**Keynote Prof. S. Kono** **Efforts to develop resilient reinforced concrete building structures in Japan**	
09.10–09.50	**Keynote Prof. O. Rabinovitch** **Dynamic modeling challenges in strengthening existing structures with advanced composites**	
09.50–10.00	**ISHMII information by W. Habel**	
10.00–10.30	**Coffee break**	

10.30–12.30

Session 9 Room 1

Co-chair:
Czaderski, C. and Keller, T.

Session 25 years of CFRP in construction

19 **20 Years of CFRP in Kentucky's Bridges**
Harik, I., Peiris, A.

201 **Long-term applications of CFRP prestressing in Canada**
Green, M.F.

17 **Long term behavior of epoxy adhesives and FRP's for strengthening of concrete**
Czaderski, C., Meier, U.

275 **Impact of Professor Urs Meier in application of CFRP composites in structural strengthening in Iran**
Najafi, J.

28 **Fatigue and durability of laminated carbon fibre reinforced polymer straps for bridge suspenders**
Terrasi, G.P., Baschnagel, F., Gao, J., Meier, U., Widmann, R.

83 **Post-tensioned CFRP strap elements for civil engineering applications**
Keller, T.

139 **Experimental investigation of time – dependent shear deformation in RC beams strengthened with CFRP straps**
Jin, F., Lees, J.M.

110 **Behaviour of Prestressed CFRP Anchorages under Freeze-Thaw Cycle Exposure**
Harmanci, Y.E., Michels, J., Chatzi, E.

Session 10 Room 2

Co-chairs:
Feltrin, G. and Nöther, N.

Session SHM

42 **Optimisation of structural health monitoring system topology based on the value of information concept**
Omenzetter, P.

64 **Smart Bridge – Way into practice**
Dabringhaus, S., Hindersmann, I.

76 **Bridge pier and embankment foundation real time scour monitoring system development**
Lin, Y.-B., Chang, K.-C., Gu, M.-H., Lin, X., Lai, J.-S.

79 **Development of FBGS-systems for Monitoring Purposes of large Timber Structures**
Franke, S., Schiere, M., Müller, A.

102 **The use of drilling tests to assess the strength of building materials: Review of existing methods and a proposed new technique**
Alyamac, K.E., Olek, J.

103 **Estimation of concrete strength combining rebound hammer and Windsor probe test methods**
Alyamac, K.E., Ulucan, Z.C., Ulas, M.A., Tas, Y.

115 **Monitoring the flow of asphalt mixtures compacted on two different rough surfaces**
Ghafoori Roozbahany, E., Partl, M.N., Guarin, A.

101 **Non-Contact Laser Ultrasonics based Monitoring of Civil Infrastructure**
Majhi, S., Mukherjee, A., Karaganov, V., Uy, B.

Session 11 Room 3

Co-chairs: Harmanci, Y.E., Chatzi, E. and Dertimanis, V.K.

Session Vibration based SHM

114 **Monitoring of bridge vibrations with image-assisted total stations**
Ehrhart, M., Kalenjuk, S., Lienhart, W.

117 **High Spatial Density Vibrational Measurements via 3D-Particle Tracking Velocimetry**
Harmanci, Y.E., Gülan, U., Zimmermann, M., Chatzi, E., Holzner, M.

121 **A basic research for track maintenance with track facility daily monitoring data**
Uno, T., Okada, K., Aoki, K., Saito, Y.

143 **Anomaly detection of bridges under vehicle induced vibration by means of Bayesian inference**
Goi, Y., Kim C.-W.

145 **Energy harvesting from earthquake for vibration-powered wireless sensors**
Quaranta, G., Trentadue, F., Maruccio, C., Marano, G.C.

149 **Monitoring of cable stayed bridges and its integration from the design stage – Case studies**
Meng, N., Islami, K., O'Suilleabhain, C.

162 **Usefulness of ambient-vibration measurements for seismic assessment of existing structures**
Reuland, Y., Abi Radi Abou Jaoude, A., Lestuzzi, P., Smith, I.F.C.

257 **Improved Structural Health Monitoring of the DLR Warton Road Bridge using Digital Image Correlation**
Winkler, J., Hendy, C.

Session 12 Room 4

Co-chairs:
Ilki, A. and Kono, S.

Session Damage control, strengthening

60 **Nonlinear Modeling of Bar Buckling and Rupture in RC Columns Under Cyclic Loads**
Girgin, S.C., Moharrami, M., Koutromanos, I.

104 **Seismic Behavior of Precast Hollow-Core FRP-Concrete-Steel Column having Socket Connection**
Abdulazeez, M.M., ElGawady, M.A.

151 **SCF in FRP strengthened tubular T-joints under brace axial loading, in-plane bending and out-of-plane bending moments**
Hosseini, A.S., Bahaari, M.R., Lesani, M.

160 **Review of Methods for Reinforced Concrete Column Retrofit**
Sichko, A., Sezen, H.

161 **Evaluation of Retrofit Methods for Reinforced Concrete Beams**
Sichko, A., Sezen, H.

170 **Cyclic response of FRP-to-concrete adhesive joints: effect of the shape of bond-slip model**
Martinelli, E., Zhou, H., Fernando, D.

178 **Experimental evaluation of the developed reinforcement system in FASSTbridge project**
Chataigner, S., Benzarti, K., Gemignani, G., Calderon, I., Birtel, V., Lehmann, F., Brugiolo, M., Pinero, I.

179 **Use of polymer flexible joint between RC frames and masonry infills for improved seismic performance**
Kwiecien, A., Kisiel, P., Gams, M., Korelc, J., Viskovic, A., Rousakis, T.

12.30–14.00 Lunch

Program, Thursday, 14/9/17

14.00–15.30

Session 13 Room 1

Co-chairs:
Czaderski, C. and Keller, T.

Session 25 years of CFRP in construction

307 **Recent contributions from UMinho and Empa on durability issues of flexural strengthening of RC slab with EB CFRP laminates**
Sena-Cruz, J., Michels, J., Correia, L., Silva, P., Fernandes, P., Fança, P.M., Czaderski, C., Harmanci, Y., Gallego, J.M.

34 **Flexural strengthening of reinforced concrete beams using externally bonded FRP laminates prestressed with a new method**
Yang, J., Haghani, R., Al-Emrani, M.

89 **Design of CFRP pre-stressed double-tee girders and experimental behavior under service load**
Spadea, S., Rossini, M., Nanni, A.

225 **Torsional behavior of hollow - core FRP - concrete - steel bridge columns**
Anumolu, S., Abdelkarim, O.I., Abdulazeez, M.M., Gheni, A., ElGawady, M.A.

278 **Effects of loading rate on the behaviour of CFRP strengthened steel members**
Kadhim, M.M.A., Wu, Z., Cunningham, L.S.

93 **Experimental and numerical study on the bond slip laws of adhesively bonded FRPs**
Sedlmair, R., Stempniewski, L., Walendy, B.

Session 14 Room 2

Co-chairs: Ghorbani-Tanha, A.K. and Feltrin, G.

Session SHM

84 **Capabilities and challenges of distributed Brillouin sensing in geotechnical applications**
Nöther, N., von der Mark, S.

85 **Miniature Fiber Optic Sensors: from Human to Structural Health Monitoring**
Inaudi, D., Blin, R.

86 **Distributed Sensors for Underground Deformation Monitoring**
Belli, R., Inaudi, D.

119 **An Innovative Deformation-Based System for Monitoring the Structural Safety of Stay-Cables**
Bimschas, M., Kaufmann, W.

123 **Study on monitoring technology focused on reinforcement cable for a fail-safe system**
Toyota, Y., Hirose, T., Ono, S., Shidara, K.

132 **Dynamic identification-model updating-seismic performance assessment of stone arch bridges**
Soyoz, S., Karcioglu, E., Aytulun, E., Kaynardag, K., Pelvan, S.C., Karadeniz, A.

Session 15 Room 3

Co-chairs: Harmanci, Y.E., Chatzi, E. and Dertimanis, V.K.

Session Vibration based SHM

261 **Vibration-based structural performance assessment via output only sub-Nyquist/compressive wireless sensor data**
Gkoktsi, K., Dertimanis, V., Chatzi, E.N., Giaralis, A., Klis, R.P.

183 **Potential of detecting dynamic motion by analysing SNR of GPS satellite signals**
Peppa, I., Psimoulis, P., Meng, X.

193 **Vibration-based damage identification in railway concrete sleepers**
Janeliukstis, R., Kaewnruen, S., Clark, A., Rucevskis, S.

166 **Remote vibration monitoring for scour detection of a railway bridge**
Kim, C.-W., Kawabe, D., Kitagawa, S., Shinoda, M., Nakamura, T., Yao, H.

211 **Structural Damage Diagnosis with Time-Varying Loads Using Convolutional Neural Network**
Gulgec, N.S., Takac, M., Pakzad, S.N.

233 **Utilization of wavelet-based damage-sensitive features for structural damage assessment of steel braced frames**
Hwang, S.-O., Lignos D.G.

Session 16 Room 4

Co-chairs:
Michels, J. and Kotynia, R.

Session Damage control, strengthening

263 **Experimental behavior of a severely damaged RC beam-column joint repaired with FRCM composites**
Faleschini, F., Gonzales-Libreros, J., Hofer, L., Snned, L.H., Pellegrino, C.

181 **Experimental Study on the Bond-Slip Behaviour of CFRP Laminates Bonded on RC Tension Members**
Bischof, P., Gomer, A., Lötscher, D., Mata Falcón, J., Kaufmann, W.

190 **Performance of RC Slabs Strengthened with Mechanically Fastened Composites**
Ibrahim, W.

191 **Construction case and development for the upper surface strengthen method of bridge RC slab**
Komori, W., Kobayashi, A., Abe, T.

240 **Assessment of axial behavior of HPFRCC members externally confined with FRP sheets**
Demir, U., Sahinkaya, Y., Ispir, M., Ilki, A.

230 **Flexural Response of RC Beams Strengthened using UHPFRC Panels Epoxied to the Sides**
Al-Osta, M.A., Rahman, M.K., Isa, M.N., Baluch, M.H.

15.30–16.00 Coffee break

Program, Thursday, 14/9/17

16.00–17.30

Session 17 Room 1

Co-chairs: Kinzo Kishida, K., Osman, A. and Shahverdi, M.

Session Performance and damage assessment

32 **An edge cracked frame finite element for analysis of cracked structures and inverse crack detection**
Rezaiee-Pajand, M., Gharaei-Moghaddam, N., Arabshahi, A.

96 **Numerical simulation of micro-crack identification in pipes with nonlinear guided waves**
Guan, R., Lu, Y., Duan, W., Wang, X.

105 **Nonlinear Analysis of Hollow-Core Composite Building Columns**
Abdulazeez, M.M., ElGawady, M.A.

301 **Cement composites with graphite, graphite oxide and graphite - like for applications in sensors**
Santos Mendonça, M.G., Borin Barin, G., de Almeida, T.S., Barreto, L.S.

124 **Probability based comparison of retrofit methods for existing nonductile concrete frames**
Miano, A., Sezen, H., Jalayer, F., Prota, A.

125 **Punching Shear and Critical Shear Crack Theory in existing Column-Supported RC Slabs**
Arslantürkoglu, S., Bärtschi, R.

Session 18 Room 2

Co-chairs: Omenzetter, P. and Helmerich,R.

Session SHM

133 **Structural health monitoring of airfield pavements using distributed fiber-optics sensing**
Rabaiotti, C., Hauswirth, D., Fischli, F., Facchini, M., Puzrin, A.

134 **Exploring the solution space in error-domain model falsification using classification algorithms**
Pai, S.G.S., Smith, I.F.C.

148 **Elastic-wave-based Imaging System for Detecting Voids in Concrete Structures**
Tong, J.-H.

150 **Structural health monitoring of a "Stary most" bridge in Bratislava with novel FBG technology**
Salat, T., Lowy, P., Patassy, G.

159 **Application of distributed optical measurements to structural concrete experiments**
Haefliger, S., Mata-Falcon, J., Kaufmann, W.

169 **Pre and Post Retrofit behaviour of an existing Railway Open web Steel Girder bridge**
Singh, S.K., Dhang, N.

Session 19 Room 3

Co-chairs: Harmanci, Y.E., Chatzi, E. and Dertimanis, V.K.

Session Vibration based SHM

16 **Identification of Structural Damage in Hybrid Bridge Truss Girders Using Relative Wavelet Entropy**
Moravvej, M., El-Badry, M.

56 **Non-contact vibration measurement of cables in a cable - stayed bridge by consumer - grade camera**
Xu, Y., Brownjohn, J.

65 **Dynamic effects of cable rupture in a tensegrity structure**
Sychterz, A.C., Smith, I.F.C.

74 **Comparative Study of Damage Detection in Symmetric and Asymmetric Buildings**
Wang, Y., Thambiratnam, D.T., Chan, T.H.T., Nguyen, A.

100 **Detecting damage in concrete beams using Bi-coherence of vibration data**
Ahmed, F., Ahsan, R.

108 **Deterioration Sensitive Feature using Enhanced AR Model Residuals**
Monavari, B., Chan, T.H.T., Nguyen, A., Thambiratnam, D.P.

Session 20 Room 4

Co-chairs: Frigione, M. and El-Hacha, R.

Session Damage control, strengthening

62 **Bond behaviour of NSM CFRP strips with innovative high-strength self-compacting cementitious adhesive (IHSSC-CA) made with graphene oxide**
Al-Saadi, N.T.K., Mohammed, A., Al-Mahaidi, R.

63 **Assessing the effectiveness of cementitious adhesive made with graphene oxide used in NSM CFRP applications**
Mohammed, A., Al-Saadi, N.T.K., Al-Mahaidi, R.

206 **Stress - strain Response of Steel - FRP Confined Concrete Columns Determined by DIC**
Carloni, C., Santandrea, M., Ravazdezh, F., Sneed, L.

212 **Effect of FRCM properties on masonry out of plane strengthening**
Ramaglia, G., Lignola, G.P., Prota, A., Fabbrocino, F.

214 **Retrofit of corroded reinforced concrete buildings to improve their seismic capacity**
Bossio, A., Lignola, G.P., Prota, A., Mandredi, G., Fabbrocino, F.

283 **An Experimental Study on Effects of Lap-Spliced Joint on Structural Behavior of RC Columns**
Pul, S., Senturk, M.

19.00 Apéro and Conference Dinner at Restaurant Lake-Side Zurich

Program, Friday, 15/9/17

08.00–18.00	**Registration Desk open and upload of presentations at conference presentation rooms**	**Room 1**
08.30–09.20	**Keynote Prof. S. Pampanin** **Towards the practical implementation of performance-based assessment and retrofit strategies for RC buildings: challenges and solutions**	
09.20–09.30	**IIFC information by R. El-Hacha**	
09.30–10.00	**Coffee break**	

10.00–12.00

Session 21 Room 1

Co-chairs:
Meier, U. and Ilki, A.

Session Practical applications/ case studies

14 **Performance of a Hybrid FRP-Reinforced Bridge Truss Girder System – Experimental Assessment**
El-Badry, M., Moravvej, M., Joulani, P.

48 **Monitoring the structural response of historical Islamic minarets to environmental conditions**
Hamed, A., Osman, A., Malek, C.

55 **Preliminary estimates of the viability of UAV - based bridge inspections in Switzerland**
Kielhauser, C., Romer, F.P., Adey, B.T.

81 **Strengthening & water-proofing of concrete structures with Ductal® UHPFRC**
Boiron, L., Wassmann, K., Brühwiler, E.

88 **Behavior of composite concrete-cellular steel beams under combined flexure and torsion**
Oukaili, N.K., Adbullaah, S.S.

272 **Structural Performance of Innovative Precast Hollow Concrete Walls for Buildings**
Ibrahim, M., Rahman, M.K., AlHems, L.M., Maslehuddin, M.

266 **Structural response of full-scale concrete bridges subjected to high load magnitudes**
Halding, P.S., Schmidt, J.W., Jensen, T.W., Henrikson, A.H.

357 **Architectural Approach and Design of the Restoration Project of the Seyh Süleyman Masjid**
Berlucci, N., Aydemir, O., Simsek, M., Kuran, F.

Session 22 Room 2

Co-chairs:
Miyamoto, A. and Harik I.S.

Session SHM

173 **Duffing-like model for the hysteresis modelling of MR damper**
Tu, J.-Y., Ke, J.-C., Lin, Y.-B.

196 **Study of SPM monitoring improvement**
Castelli, P., Rizzo, M., Spadaccini, O., Vignoli, A.

197 **Managing Structural Health Monitoring Data Using Building Information Modelling**
Valinejadshoubi, M., Bagchi, A., Moselhi, O.

203 **Earthquake laboratory tests on balconies with thermal break elements (Schöck Isokorb)**
Standeker, J., Bärtschi, R.

204 **Stiffness degradation under flexural loading using MEMS inclinometers sensors**
Lahuerta, F., de Ruiter, M.J.

250 **Evaluation of strains and stresses of prestressed girders for Bridge A7957, MO, USA (Field study)**
Alghazali, H.H., Myers, J.J.

251 **Dynamic Load Allowance of a Prestressed Concrete Bridge through Field Load Tests**
Hernandez, E.S., Myers, J.J. Chen, G.

182 **Analysis of Structural Health Monitoring Data for cable-stayed bridge with ruptured cables**
Gil, H., Park, J.

Session 23 Room 3

Co-chairs:
Martinelli, E. and Sezen, H.

Session Performance, damage assessment

70 **Numerical simulations of medium and high frequency elastic waves for damage detection in composite wind turbine blades**
Szlaszynski, F., Omenzetter, P.

131 **Prediction of mechanical properties of engineered cementitious composites using artificial neural network**
Shi, L., Lin, S., Lu, Y., Bai, Y.

136 **Seismic performance assessment of FPS isolated liquid storage tanks at various intensity levels**
Bagheri, S., Hayati Raad, H.

254 **Modeling the bond of GFRP and concrete based on a damage evolution approach**
Rezazadeh, M., Carvelli, V., Veljkovic, A.

343 **Quantification of initial defects in concrete caused by low temperature curing before 28d**
Li, S., Hao, W., Ji, T., Chen, G., Dou, T.

321 **Wind Analysis of the Bosphorus Suspension Bridge: Numerical and Experimental Investigation**
Bas, S., Apaydin, N.M., Ilki, A., Catbas, F.N.

294 **Effect of vehicle-induced impact on hanger of a half-through tied steel arch bridge**
Gao, J., Zheng, Y., Zhao, B.

286 **Toughened 2K-Epoxy Adhesives: From Automotive and Wind towards Construction**
Mayer, C., Meier, T., Hofstter, D., Bosshard, B.

Session 24 Room 4

Co-chairs:
Voigt, G. and Rabinovitch, O.

Session Damage control, strengthening

236 **Fatigue life prediction of RC beams strengthened with FRP through MLE method**
Meneghetti, L.C., Garcez, M.R., Teixeira, R.M., Pinto da Silva Filho, L.C.

221 **Cyclic Compression Behavior of Concrete-Filled Hybrid Large Rupture Strain FRP Tubes** *Nain, M., Abdulazeez, M.M., ElGawady, M.A.*

271 **Evaluation of Performance of RC Beam – Column Joint Externally Strengthened with Steel Strips**
Al-Naghi, A., Al-Osta, M., Rahman, M.K., Al-Gadhib, A.

276 **Behavior of Concrete Confined by Jute Natural Fiber Reinforced Polymer with Heat Treatment**
Voravutvityaruk, T., Jirawattanasomkul, T., Ueda, T., Wuttiwannasak, N., Poonswat, T.

280 **Ductility improvement of existing RC columns strengthened with CFRP**
Del Zoppo, M., Di Ludovico, M., Balsamo, A., Prota, A.

284 **Finite Element Analysis for Obtaining Structural Performance of Bridge Pier Interacting with Soil**
Sentürk, M., Pul, S.

287 **Effects of soil - structure interaction on design of reinforced concrete structures for various earthquake zones structures**
Kilicer, S., Ozgan, K., Daloglu, A.T.

288 **Time-dependent bond behavior between NSM CFRP strips and concrete**
Emara, M., Baena, M., Barris, C., Torres, L., Moawad, M., Perera, R.

12.00–13.30 Lunch

Program, Friday, 15/9/17

13.30–15.30

Session 25 Room 1

Co-chairs:
Ghafoori, E. and Dawood, M.

Session Metallic Structures

332 **Fatigue strengthening of tubular X joint using un-bonded CFRP laminates**
Khayatazad, M., Shariatmadar, De Backer, H.

67 **A novel mechanical clamp for strengthening of steel members using prestressed CFRP plates**
Hosseini, A., Ghafoori, E., Motavalli, M., Nussbaumer, A., Al-Mahaidi, R., Terrasi, G.

267 **Retrofitting of Ayala Bridge, an Historic Steel bridge in Manilla (Philippines)**
Buchin-Roulie, V., Kaczkowski, N., Gros, A., Tesson, F.

171 **Stiffness prediction of CFRP/steel double strap joints**
Lu, Y., Li, W., Liang, H., Liu, Z.

353 **Performance assessment of Shape Memory Alloy plates for recovery of deflection in steel frame**
Bajoria, K.M., Jadhav, R.

112 **Strengthening of steel plate by carbon fiber sheet under axial compression force**
Hidekuma, Y., Ohgaki, K., Okuyama, Y., Miyashita, T., Kobayashi, A.

157 **Behavior of Retrofitted Concrete Members Using Iron-Based Shape Memory Alloys**
Zerbe, L., Reda, M., Dawood, M., Belarbi A., Michels, J., Senouci, A., Genctruk, B., Al-Ansari, M.

Session 26 Room 2

Co-chairs:
Miyamoto, A. and Inaudi, D.

Session SHM

279 **Clarifying distinctive acoustic emission signal features of a steel fiber reinforced concrete beam by parameter analysis**
Tayfur, S., Alver, N., Saatci, S.

199 **A Three-dimensional Structural Health Monitoring System Using Multi-Scale Sample Entropy**
Lin, T.K., Tzeng, T.-C., Lin Y.

282 **UQ and FE model updating of large scale steam turbine rotor**
Giagopoulos, D., Arailopoulos, A.

285 **Millimeter Wave Imaging of Notches in Metal Specimens under Dielectric Coating Using Image Processing**
Hoshyar, A.N., Kharkovsky, S., Samali, B., Zoughi, R.

293 **Infrastructure management integrating SHM and BIM procedures**
Del Grosso, A., Basso, P., Ruffini, L., Figini, F., Cademartori, M.

320 **Smart reinforcement steel bars embedded with low-cost MEMS sensors for strain monitoring**
Tondolo, F., Cesetti, A., Matta, E., Quattrone, A., Sabia, D.

281 **Measuring vertical strains and temperature with fiber optics in diaphragm walls**
Goeminne, E., Couck, J., Brutin, M., Benoot, J., De Vos, L.

185 **GNSS and Earth Observation for Structural Health Monitoring (GeoSHM) of the Forth Road Bridge**
Psimoulis, P., Meng, X., Owen, J., Xie, Y., Nguyen D.T., Ye, J.

Session 27 Room 3

Co-chairs:
Czaderski, C. and Beyer, K.

Session Durability issues

12 **Long-term behavior of RC slabs strengthened with EB CFRP strips subjected to sustained load and exposed to solar radiation**
Gallego, J.M., Czaderski, C., Michels, J.

109 **Behaviour of Carbon Fiber Reinforced Polymer (CFRP), with and without fire protection material, under combined elevated temperature and mechanical loading condition**
Nguyen, P.L., Vu, X.H., Ferrier, E.

144 **A study on fatigue durability of the top surface repair method using two types of adhesives for damaged RC slabs**
Ito, K., Abe, T., Fuchigami, M., Kozakai, N. Kodama, T.

152 **Determining Moisture in Materials and IoT**
Voigt, G., Helmerich, R., Adao, F., Rückschloss, M.

153 **Humidity monitoring in concrete using Bluetooth Low Energy sensors**
Adao, F.J.F.S., Helmerich, R., Voigt, G., Modenhauer, L., Neumann, P.P.

324 **A method to inspect the risk of fire spalling of existing concrete members**
Lu, F., Bärtschi, R., Fontana, M.

255 **The Effects of Engineering Properties of Waste Tires into Self Compacting Concretes**
Öztürk, H., Bideci, A., Salli Bideci, Ö.

97 **Performance Evaluation of Concrete Structures Reinforced by Corrosion Free FRP and SMA Materials**
Parvin, A., Raad, J.

Session 28 Room 4

Co-chairs:
Shahverdi, M. and Gao, J. Ms

Session Damage control, strengthening

180 **DIC and numerical analysis of polymer flexible adhesive in composite-to-brick strengthening**
Kwiecień, A., Tekieli, M., Słoński, M., Hojdys, L., Krajewski, P.

290 **Assessment of an existing masonry structure using linear and nonlinear material models**
Gunes, B., Mangir, A., Okumus V.

296 **Different application methods on CFRP- and GFRP- confined concrete: experimental results**
Moretti, M.L., Arvanitopoulos, E.

326 **Use of the disipador SL-B in the rehabilitation of health facilities in Cuba**
Valdés Jiménez, V.M., Pupo Ordono, D., Fenandez Pérez, R.M., Martinez Almagnuer, R.

340 **Research Progress on Low Temperature Anti-crack Design of Hydraulic Epoxy Mortar Protective Material**
Huang, H., Hao, J., Dou, T., Li, S.

349 **Parametric investigation on the behaviour of CFRP wrapped concrete columns**
Fareed, S., ur Rehman Khan, A.

299 **Preloading effect on strengthening efficiency of RC beams strengthened with NSM strips**
Kotynia, R., Pryzigocka, M.

98 **Collapse Analysis of Concrete Frame Structures Subjected to Extreme Loading**
Parvin, A., Khandel, O., Crozier, D., Raad, J.

15.30–16.00 Coffee break

Program, Friday, 15/9/17

16.00–17.30

Session 30 Room 2

Co-chairs:
Helmerich, R. and Amiri, M.M.

Session SHM

338 **Monitoring of tunnel shape using distributed optical fiber sensing techniques**
Kishida, K., Yamauchi, Y., Nishiguchi, K., Guzik, A.

246 **Carbon nanoparticles to monitor moisture damage propagation in GFRP**
Taha, E.O., Kandil, U., Emiroglu, M., Reda Taha, M.M.

341 **Monitoring of subway intersection tunnels during TBM excavation in urban distressed areas**
Amiri, M.M., Kouhsankini, A.

73 **Natural stone floors monitoring – inference on persistence of humidity spots**
Donadini, F., Rück, P., Portmann, B.

176 **Acoustic monitoring of a prestressed concrete beam reinforced by adhesively bonded composite**
Chataigner, S., Gaillet, L., Falaise, Y., David, J.-F., Michel, R., Aubagnac, C., Houel, A., Germain, D., Maherault, J.-P.

253 **Sensitive Smart Concrete Loaded with Carbon Black Nanoparticles for Traffic Monitoring**
Monteiro, A., Cachim, P., Costa, P.M.F., Oeser, M.

Session 31 Room 3

Co-chairs:
Michels, J. and Myers, J.

Session Performance, damage assessment

339 **Evaluating Compactness of CSGR by Falling-Ball Test**
Feng, W., Zhang, Y., Lu, X., Liu, Z.

344 **Study and Application of Epoxy Coating in Freshwater mussels Prevention in Hydraulic Tunnels**
Xia, S., Dou, T., Li, J., Zhao, B., Yao, G., Zhou, J.

323 **Decision support for bridge condition assessment**
Honfi, D., Leander, J., Björnsson, I.

106 **Reliability analysis of available relations and suggestion of a new formula for effective moment of inertia in concret e beams with FRP bars reinforcement**
Arabshahi, A., Gharaei-Moghaddam, N., Tavakkolizadeh, M., Arashani, A.

154 **Output-Only System Identification on 199+325 Steel Railway Bridge**
Ozcelik, O., Yormaz, D., Girgin, O., Yucel, U., Durmazgezer, E., Amaddeo, C., Kahraman, S.

209 **Numerical Study on Seismic Isolation for Medium - rise Buildings Using Rubber - Sand Mixtures**
Edinçliler, A., Yildiz, O.

17.30 Closing Ceremony and the awards for the best papers

Social Program

Preconference Scientific Tour to Tamina Bridge

Tuesday, 12 September 2017

07.45 Meeting point at Bus Station north of Zurich Main Station
08.00 Bus departure to Versuchsstollen Hagerbach near Sargans
09.30 Coffee break at Cafeteria Hagerbach and first information on Tamina Bridge
10.00 Hagerbachstollen – Tour and demonstration in Hagerbachstollen
12.30 Lunchbreak in Bad Ragaz
14.00 Visit of Tamina Bridge – Photostop
16.00 Teabreak in Bad Ragaz at the Grand Resort
17.00 Bus departure – return to Bus station at Zurich Main Station (approx. 1.5 h depending on the traffic load)

Conference reception and Scientific evening tour

Wednesday, 13 September 2017, 18.30

After the conference sessions we commute to Empa in Dübendorf, transportation by bus and train. Scientific tours will guide you through the NEST – Exploring the Future of Buildings and the large Testing Hall at Empa. Followed by the get-together welcome Apéro of SMAR 2017 conference at NEST, *www.empa.ch/nest*

From ETH to Empa

To arrive to Empa from ETH Hönggerberg campus, the easiest way is to take Bus 80 until Oerlikon and then taking a train S14 (S-Bahn) departure 17.16, 17.46, 18.16 until Dübendorf. From Dübendorf, it is 12 minutes on foot or 3 minutes with Bus 760 until the stop Empa.

Conference Dinner at Restaurant Lake-Side Zurich

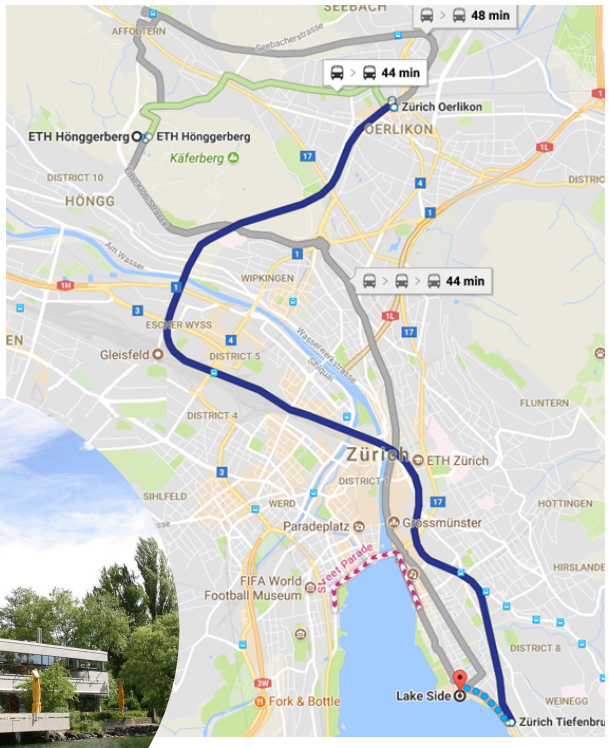
Thursday, 14 September 2017, starting 19.00 with Apéro

From ETH Hönggerberg:

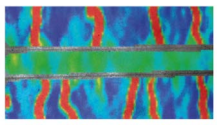
Please use either Bus 80 until Oerlikon and then change to an appropriate train S 6 Plattform 7, or S 16 Plattform 6 (S-Bahn) until Bahnhof Tiefenbrunnen. From there it is a 5-10 minute walk along the lake.

From Bellevue:

tram 2 or 4 to Stop „Fröhlichstrasse“, then a short walk towards the lake or by bus 912 or 916 to stop „Chinagarten“, then a short walk along the sea towards the restaurant.



Notes



SMAR 2017

SMAR 2017 Conference

Empa
Structural Engineering Research Laboratory
8600 Dübendorf
Switzerland

smar2017@empa.ch
www.smar2017.org

ISBN: 978-3-905594-66-9