IABSE CONGRESS

GHENT 2021

Structural Engineering for Future Societal Needs

International Associating for Bridge and Structural Engineering IABSE

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Please refer to this report as follows:

IABSE Congress Ghent 2021, Structural Engineering for Future Societal Needs, Congress Proceedings, Eds. H.H. Snijder, B. De Pauw, S.C./. van Alphen & P. Mengeot, IABSE, Zurich, 2021

https://doi.org/10.2749/ghent.2021

Proceedings

IABSE Congress Ghent 2021
Online event

IABSE Belgian Group
IABSE Dutch Group
GHENT UNIVERSITY

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Message from the President


Yaojun Ge

The International Association for Bridge and Structural Engineering (IABSE) is a scientific/technical Association comprising members of almost 100 countries and counting 58 National Groups. The aim of the Association is to exchange knowledge and to advance the practice of structural engineering worldwide in the service of the profession and society. Founded in 1929, IABSE hosted a series of Congresses every four years from 1932 to 2016 and every year from 2019 onwards. The IABSE Congress 2021 was planned to be held in Ghent, Belgium, but due the pandemic, it is now an online event taking place on the originally planned days from 22 to 24 September 2021.

The theme of the Congress is "Structural Engineering for Future Societal Needs", comprising building and maintaining safe and reliable buildings and infrastructures under the effects of climate change in a world with scarcer resources and the ambition to reduce mankind's CO_2 footprint. Future Societal Needs can be divided into three parts, Structural Safety and Reliability with Respect to Climate Change, Circularity, Re-use and Sustainability of Structures and Emission Free Building of Structures.

This IABSE Congress is organised by the Belgian and Dutch Groups of IABSE in co-operation with Ghent University. Both National Groups are among the earliest IABSE Groups and are very active and productive. This Congress is, respectively, the first and eighth international IABSE event hosted in the BENELUX since the successful IABSE Conference 2013 in Rotterdam and the third IABSE Congress 1948 in Liege. I wish to express my special thanks and compliment the Organising Committee and the Scientific Committee, for excellently mastering the preparations of this promising event under the difficult circumstances of the past year and months.

I look forward to meeting you online and to exchange the latest knowledge in structural engineering.

Yaojun Ge, President of IABSE

Message from the Organising Committee


Hans De Backer


Bert Hesselink

The Organising Committee is pleased that the IABSE Congress Ghent 2021 can be held from 22 to 24 September 2021. Originally planned as a hybrid Congress, partly on site and partly online, the Organising Committee had to take the difficult decision end of May 2021 to change the Congress into an online event, due to the uncertainty associated with the Covid-19 pandemic. The Congress is organised by the Belgian and Dutch Groups of IABSE in co-operation with Ghent University.

Due to the unpredictable situation of the Covid-19 pandemic, travel bans, and the fear to travel factor, the Organising Committee of the IABSE Congress Ghent 2021, on recommendation of the Administrative Committee of IABSE, decided to change the format of the Congress into an entirely online event for the safety of IABSE members and Congress participants.

This has been a very difficult decision, since we have tried our best to become the first “normal” IABSE event after the Covid- 19 pandemic. However, it was not meant to be. But the good news is that the quality of the technical programme did not suffer from this, that the authors of many interesting papers remained very supportive, that our sponsors showed their understanding, so that we can have a fantastic online Congress, simulating the actual conference experience as much as possible.

This entire trajectory has been a very difficult experience for all of us. Still, as organisers, we feel strengthened by the number and quality of contributions we have received and by the reactions of everybody involved in the organisation. We look forward to interacting with all participants during the Congress and hope that there will be new opportunities to really meet in person, once Covid-19 is truly behind us.

Hans De Backer, Organising Committee Chair, Belgium
Bert Hesselink, Organising Committee Vice-Chair, The Netherlands

Organising Committee

The Organising Committee is chaired by Prof. H. De Backer, Ghent University, Belgium. The full committee consists of following members:

Hans De Backer (Chair), Ghent University, Ghent, Belgium
Ane de Boer, formerly at Rijkswaterstaat, The Netherlands
Alain Dumortier, Bureau Greisch, Liege, Belgium
Bernard Espion, Université Libre de Bruxelles, Brussels, Belgium
Bert Hesselink (Vice-Chair), Royal HaskoningDHV, Amersfoort, The Netherlands
Aad van der Horst, BAM Infraconsult, Gouda,The Netherlands
Pierre Mengeot, Besix, Brussels, Belgium
Bart De Pauw, TUC Rail, Brussels, Belgium and Ghent University, Ghent, Belgium
Rudi Roijakkers, ABT, Velp, The Netherlands
Bert Snijder, Eindhoven University of Technology, Eindhoven, The Netherlands
Sven Somers, Lantis, Antwerp, Belgium
Gilles Van Staen (Secretary), Ghent University, Ghent, Belgium

Message from the Scientific Committee

The Scientific Committee of the IABSE Congress Ghent 2021 is pleased to offer the structural engineering community an interesting technical programme to discuss and contribute to the theme 'Structural Engineering for Future Societal Needs'. Future societal needs comprise building and maintaining safe and reliable buildings and infrastructures while coping with the effects of climate change in a world with scarcer resources and satisfying the ambition to reduce mankind's CO2 footprint.
Sub-themes are therefore amongst others:

- Structural safety and reliability with respect to climate change
- Circularity, re-use and sustainability of structures
- Emission free building of structures

Our call for sub-themes resulted in four interesting special sub-themes connected to the main Congress theme:

- Enhancing resilience of civil infrastructure to hurricane and thunderstorm hazards under changing climate
- Structural bearings and anti-seismic devices: innovation, standards and testing requirements
- Towards extending the service life of existing concrete infrastructure through advanced assessment methods
- Concepts and methods for the performance assessment of existing structures


Bert Sniider


Bart De Pauw

Besides these sub-themes, also the following ones are part of the programme: All types of bridges, Large span structures, Light-weight structures, High-rise buildings, All structural materials, Structural health monitoring, Design for earthquakes, Case studies, Failures and forensic engineering, Strengthening and retrofitting, Dynamics of structures, Innovative structures, Fatigue and fracture, Structural analysis and optimisation, Parametric design, Structural behaviour under fire conditions, Soil-structure Interaction, Exceptional loads on structures, Safety, reliability and risk, Architecture of structures, Additive manufacturing.

The Congress takes place online and all papers are presented orally, either pre-recorded or live, with discussion afterwards. All written papers submitted were peer-reviewed by the Scientific Committee. Apart from the opening session containing one keynote presentation, a keynote session containing two keynote presentations and the closing session containing one keynote presentation, there are normal parallel sessions and a Pecha Kucha session. To accommodate all sessions and speakers, parallel sessions run online in 8 breakout rooms on the three main Congress days. Keynote Speakers introduce relevant topics to the Congress theme and/or give a state-of-the-art overview on these topics. We are pleased that four esteemed Keynote Speakers have confirmed to contribute to our Congress (See page 23).

The technical programme has attracted all those involved and interested in the state of the art and the future of bridge and structural engineering. We received just over 400 abstracts which resulted in about 270 papers to be presented. We can present an interesting technical programme and invite you to contribute to this IABSE Congress and join us online.

Bert H.H. Snijder, Scientific Committee Chair, The Netherlands
Bart De Pauw, Scientific Committee Vice-Chair, Belgium

Scientific Committee

The Scientific Committee (SC) is chaired by Prof. H.H. (Bert) Snijder, Vice President of IABSE, Eindhoven University of Technology, The Netherlands. The Vice-Chair is Prof. Bart De Pauw, Ghent University and TUC Rail, Belgium. The SC consists of more than 90 expert members from all over the world and was elected by the Technical Committee of IABSE.

Bert Snijder, *Netherlands* (Chair)
Bart De Pauw, *Belgium* (Vice-Chair)
Sander van Alphen, *NL* (Secretary)
Pierre Mengeot, *Belgium* (Secretary)
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About IABSE

The International Association for Bridge and Structural Engineering (IABSE) is a scientific / technical Association comprising members in 100 countries and counting 58 National Groups worldwide. Founded in 1929 it has its seat in Zurich, Switzerland. The President of IABSE (2019-2022) is Yaojun Ge, China.

IABSE deals with all aspects of structural engineering: the science and art of planning, design, construction, operation, monitoring and inspection, maintenance, rehabilitation and preservation, demolition and dismantling of structures, taking into consideration technical, economic, environmental, aesthetic and social aspects. The term 'Structures' includes bridges, buildings and all types of civil engineering structures, composed of any structural material.

Mission

The aim of the Association is to exchange knowledge and to advance the practice of structural engineering worldwide in the service of the profession and society.

IABSE has the following objectives:

- to promote cooperation and understanding among all those concerned with structural engineering and related fields by worldwide exchange of knowledge and experience
- to encourage awareness and responsibility of structural engineers towards the needs of society
- to encourage actions necessary for progress in structural engineering
- to improve and foster cooperation and understanding between organisations having similar objectives.

For this purpose, the Association:

- organises conferences worldwide
- publishes the high-quality journal SEI
- publishes books reflecting the work of its Technical Groups
- creates technical groups, as required by new needs and technological progress
- offers the possibility to join activities within National Groups of IABSE
- offers a programme for young engineers
- presents Annual Awards

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Keynote speakers

Jacqueline Cramer, Utrecht University (NL)
Title: The transition to sustainable concrete in the Netherlands through network governance


Jacqueline Cramer

Jacqueline Cramer is professor of sustainable innovation at Utrecht University and member of the Amsterdam Economic Board, particularly in charge of the circular economy. Before she was Minister of Housing, Spatial Planning and the Environment in The Netherlands (2007–2010). Her background is primarily related to industry, working for many years with more than 200 companies on the implementation of corporate social responsibility and circular economy. She was and still is member of numerous international and national non-executive boards of the government, industry and non-profit organisations, among which Chair of the Dutch Concrete Agreement and chairman of the Supervisory Board of the Plastic Soup Foundation.

Michael J. Cook, Buro Happold (UK) and Imperial College (UK)
Title: Urgent Steps to Achieve a Net-Zero Carbon Construction Industry: Lessons from the IABSE (UK) Henderson Colloquium 2020


Michael J. Cook

Michael Cook was a Partner of Buro Happold from 1994 to 2020 and the Chairman from 2011 to 2017. Having retired from the partnership in 2020 he is now employed as a consultant. He is also Professor of Creative Design in the Department of Civil Engineering at Imperial College, London. He is well known for his contribution to designing innovative and award-winning buildings around the world. In 2019 he initiated the Engineers Declaration of Climate Emergency in the UK and he leads the Institution of Structural Engineer's Climate Emergency Task Group which is setting out the skills required by future generations of engineers. In recognition of his contribution to sustainable engineering design over the past 20 years, he was awarded the IABSE Milne Medal in 2009, Fellowship of the Academy of Engineering in 2010, an honorary Doctorate of Engineering from the University of Bath in 2017 and the Gold Medal of the Institution of Structural Engineers in 2020.

Junho Song, Seoul National University (S. Korea)
Title: Risk intelligence of structural systems: concepts and recent developments


Junho Song

Junho Song received his BSc. and MSc. in Civil Engineering from Seoul National University, Korea and his PhD in Civil & Environmental Engineering from the University of California at Berkeley, USA in 2004. After working as a postdoctoral researcher at UC Berkeley (2004-2005) and a senior vulnerability engineer at Risk Management Solutions, Inc. (2005), he joined the University of Illinois at Urbana-Champaign, USA. In 2014, Dr. Song joined the Department of Civil & Environmental Engineering at Seoul National University (SNU) as a Young Scholar for the Next Generation. At SNU, Dr. Song is currently serving as Professor, and Associate Director of Education and Research Program of InfraSPHERE. Dr. Song has research interests in structural & system reliability analysis, reliability-based design/topology optimization and decision-making, risk, reliability and resilience analysis of urban communities and networks, earthquake engineering & random vibrations, and statistical/machine learning for urban infrastructure systems under uncertainties. Dr. Song has presented his research outcomes through 89 papers published in peer-reviewed scientific journals. His technological innovations in the area of System Reliability and Optimization were recognized by awards including the IASSAR Research Prize (the 10th ICOSSAR conference, 2009). Prof. Song has been serving as a member of the Probabilistic Methods Committee of the ASCE Engineering Mechanics Division, five editorial boards of international journals (including Structural Safety, and Reliability Engineering & System Safety), SC3 subcommittee of the International Association for Structural Safety and Reliability, Joint Committee on Structural Safety (JCSS), and the Board of Directors of the International Civil Engineering Risk and Reliability Association (CERRA). Dr. Song is currently the President of CERRA and the Chairman of the IFIP Working Group 7.5 on Reliability and Optimization of Structural Systems.

Luc Hellemans, Lantis (BE)
Title: Oosterweel – from an underground and even underwater road infrastructure plan to an urban transformation project


Luc Hellemans

With over 25 years of professional experience in engineering, Luc Hellemans has spent more than half of it at Arcadis. He held several functions and was the CEO of Arcadis Belgium (2012-2015) and also of Italy, France and Spain as CEO of Europe South (2015-2017). Yet three distinguished threads run through his career and come together in his role as CEO of Lantis: public infrastructure, large, complex projects, and his hometown area Antwerp (Belgium). With the Oosterweel project, Luc is facing Belgium's biggest and most challenging infrastructure project of the century, matching industrial and economic needs with enhanced quality of life, spatial planning, and environmental benefits.

bridge is above 5 Hz. As the footbridge described in this work is lightweight and flexible, higher harmonics of the human actions seemed to excite the simply supported structure.

To achieve a certain degree of comfort at VSLS and complete the adopted motion-based design approach, inertial devices (passive, semi-active or active) should be installed in the future to reduce the undesired vibrations of the footbridge.

Finally, the performed experimental campaign is an initial approach to assess the dynamic behavior of the FRP structure. Since changes in the dynamic properties of the structure are expected due to human-structure interaction phenomenon, more and better tests will be carried out varying the numbers of pedestrians and the frequencies of the human actions.

7 Acknowledgements

The authors acknowledge the financial support provided by the Ministry of Science, Innovation and Universities of Spain through the project SEED-SD RTI2018-099639-B-I00. Christian Gallegos-Calderón thanks the Secretariat of Higher Education, Science, Technology and Innovation of Ecuador (SENESCYT) for the PhD scholarship CZ02-000167-2018.

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