



**World
Construction
Forum
2019**

BUILDINGS AND INFRASTRUCTURE RESILIENCE

WCF2019 Book of Abstracts with Programme



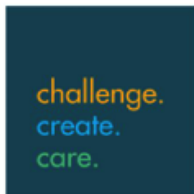
LJUBLJANA, SLOVENIA, APRIL 8 – 11, 2019

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Slovenian Chamber of Engineers (IZS)

University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG)

World Federation of Engineering Organisations (WFEO)



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European Council of Civil Engineers

Fédération Européenne d'Associations Nationales d'Ingénieurs

Federation of African Engineering Organizations

Engineering Association of the Mediterranean Countries

Federation of Arab Engineers

Pan American Federation of Engineering Societies

World Council of Civil Engineers

Slovenian Academy of Engineering

Slovenian Engineering Association

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Slovenian Association for Information Modeling in Construction

Slovenian Association of Earthquake Engineering

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UNESCO Chair on Water-related Disaster Risk Reduction

Slovenian National Committee on Large Dams

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Željko Vukelić, Naravoslovnotehniška fakulteta, University of Ljubljana
Roko Žarnić, Faculty of Civil and Geodetic Engineering, University of Ljubljana

Key-note speakers at the WCF 2019 Opening Ceremony

Peter Fajfar, Professor at the Faculty of Civil and Geodetic Engineering, University of Ljubljana & Slovenian Academy of Engineering, Slovenia
Antonia Moropoulou, President of the General Assembly of the Technical Chamber of Greece, Professor at the National Technical University of Athens, Greece
Jinxu Yan, Vice President of the International Tunneling and Underground Space Association (ITA) & Vice President of the Chinese Tunneling and Underground Works Society of CCES, Professor and Deputy General Manager, China Railway Academy Co., Ltd., China
Mark Coleman, Senior CAD Manager at Crossrail, United Kingdom

Opening Addresses

It is my great pleasure to welcome you at the *World Construction Forum 2019 (WCF2019)* in Ljubljana. The theme of the resilient construction of buildings and infrastructure addresses several sustainable development goals of *UNESCO*, which also acts as a patron of the forum. In addition to our respected partner, the *Faculty of Civil Engineering and Geodesy of the University of Ljubljana*, the co-organizer of this forum is also the *World Federation of Engineering Organizations*, which represents millions of engineers from all five continents.

The main theme of the *WCF2019 Buildings and Infrastructure Resilience* is resilient construction – from climate changes to disaster risk and facility management. Civil engineering is for sure the most traditional industry, but in the recent period, there have been many changes regarding new technologies and management (BIM etc.). Given the expected growth of the world's population, it will be necessary to significantly change the construction standards. As we are faced with an increased risk of threatening natural disasters, it will be necessary to reduce the consumption of building materials, and energy, otherwise it will not be possible to provide enough resources. Each of the topics dis-



Slovenian Chamber of Engineers (IZS)

Mag. Črtomir Remec,
President of the Slovenian Chamber of Engineers

cussed on the forum touches at least one sustainable development goal, opens up dilemmas and brings solutions in the direction of resilient construction.

This year, however, we celebrate also the 100th anniversary of the establishment of the *Chamber of Engineers and the Technical Faculty of the University of Ljubljana*, which are important foundations of Slovene statehood. The Austro-Hungarian *Chamber of Engineers Act* was adopted in 1913, but due to disagreements over the representation of Slovenes in the *Chamber of Engineers of Trieste* and the beginning of the First World War, the *Chamber of Engineers of Ljubljana* was established only in 1919. The great economic crisis and the Second World War displaced many excellent Slovene engineers to various parts of the world, where some achieved enviable successes. The exhibition in the lobby of *Can-karjev dom* speaks also about them.

World Construction Forum 2019 with its theme of the resilient construction of buildings and infrastructure continues our efforts started at the *World Engineering Forum 2012* on sustainable construction and, in cooperation with many Slovene and international engineering organizations, sets the basis for a permanent

internet platform for construction, where all lectures and speeches will be accessible to millions of engineers and other interested public. In addition to a few hundred active participants of the *WCF2019*, we will provide free access to current information and new knowledge also to those who cannot afford expensive travels or do not want to increase the carbon footprint in the care for future generations.

In a wish for a successful *World Construction Forum 2019* under the auspices of UNESCO, I would like to thank the honorary patron, President of the *Republic of Slovenia*, His Excellency Mr Borut Pahor, for his trust and excellent cooperation, the President of *WFEO*, Dr. Marlene Kanga, and the Dean of the *Faculty of Civil Engineering and Geodesy of the University of Ljubljana*, Prof. Dr. Matjaž Mikoš. My great thanks also go to all partners, co-organizers, key-note speakers and lecturers, participants and especially sponsors who made it possible the perfect implementation of the first *World Construction Forum*. ■



University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG)

Professor Matjaž Mikoš, dr. sc. tech.

ETH, Eurling, M ASCE, M NYAS, IAS Vice President, Dean of UL FGG

As the host organisation and since we are celebrating the 100th Anniversary of University of Ljubljana this year, the Faculty of Civil and Geodetic Engineering of the University of Ljubljana is proud to co-organize this World Construction Forum 2019 in Ljubljana, Slovenia.

Successfully organizing the 4th World Landslide Forum in 2017 here in Ljubljana with 600 participants, we are determined to have another successful meeting – may I greet you all at the World Construction Forum 2019 in the name of the University of Ljubljana.

The support of two international organisations in the Forum preparations is of paramount importance. We may thank World Federation of Engineering Organisations, as well as the United Nations Educational, Scientific and Cultural Organization for their firm support and personal involvement.

We are aware about the importance of construction sector for supporting economy and for increased national competitiveness on one hand, but on the other hand also for social well-being and quality of life in changing environment and under the impacts of fast globalization. Therefore, the focus of WCF

2019 was intentionally selected to be on buildings and infrastructure resilience as a part of societal resilience – this is also the Forum motto. We believe that for achieving many of 17 Sustainable Development Goals (SDGs), adequate resilience of existing as well as planned buildings and infrastructure including cultural heritage, is very important.

University as an academic institution supports continuous engineering capacity building, starting with engineering education in primary and secondary schools being vital for successful higher education in the field of engineering and technical sciences in general, and paramount to boost creative and breakthrough thinking and innovation in the young generation. This educational system should be upgraded by a life-long capacity building of general population and specifically of professionals and experts in the field of built environment.

That is why I am looking forward to an exchange of expertise and knowledge among different Forum participants, with different backgrounds and competences, coming from more than 40 countries around the world – especially allow me as the Faculty Dean to welcome warmly all university stu-

dents and young engineers who are attending WCF2019. The forum oral presentations and discussions will be made freely available on the web after the event as a clear contribution to Open Educational Ressources, Open Learning and Open Science.

I hope that the 2019 Ljubljana Declaration on Buildings and Infrastructure Resilience with its short and clear recommendations, to be discussed and accepted during this Forum will be a small yet clear contribution of the world construction sector towards achieving Sustainable Development Goals and clearly supporting Sendai Framework for Disaster Risk Reduction, as well as Paris Agreement on Climate Change. Steps towards and Active reaction on challenges ahead of us in years and decades to come, must combine with determined steps towards adaptation strategies, based on new technologies and social discourse.

I wish you all a pleasant and memorable stay in Ljubljana, and a fruitful and successful Forum! ■



World Federation of Engineering Organisations (WFEO)

Dr. Marlene Kanga AM Hon.
FIEAust Hon. FIChemE FTSE, WFEO President

The World Federation of Engineering Organisations (WFEO) is pleased to welcome delegates to the World Construction Forum 2019 on the occasion of the celebration of the 100th Anniversary of the Ljubljana Engineers Chamber, predecessor of the Slovenian Chamber of Engineers, and of the 100th Anniversary of the University of Ljubljana. I am proud that this important event is co-organised by the Slovenia Chamber of Engineers (IZS), an important national member of the Federation. My warmest congratulations on this important occasion and I look forward to our organisations working together for the next century.

The World Federation of Engineering Organisations is the peak body for engineering, representing nearly 100 nations and 30 million engineers. It is the voice of engineering at an international level and promotes the important role of engineers in key issues that the world is now facing, especially to advance the goals of sustainable development. The Federation is recognised in this role by the United Nations and its agencies including UNESCO.

The implementation of the United Nations Sustainable Development Goals is a key ob-

jective of the World Federation of Engineering Organisations. These goals take an integrated approach for future development, combining progress in economic prosperity, social inclusion and environmental sustainability. This focus recognises that engineers are at the heart of sustainable development, using their ingenuity to develop and implement the solutions that the world needs to manage its resources, protect our planet and provide basic amenities, water and energy, to so many around the world.

I am therefore delighted that this the World Construction Forum will focus on six Sustainable Development Goals (SDG) related to water, energy, innovation, sustainable cities and infrastructure and action against climate change.

It is pleasing that diverse topics will be discussed at the Forum. Experts from every region of the world will discuss the latest technologies and advanced engineering for the design and development of infrastructure such as roads and tunnels and for the operation and maintenance of facilities, buildings and heritage structures. Importantly, the use of energy efficient technologies, is on the agenda, critical for sustainable living in in-

creasingly urban populations around the world. The preservation of our cultural heritage and infrastructure that is resilient against natural disasters such as earthquakes and the increasing impact of climate change, is also essential. An important theme is capacity building in engineering especially in developing countries and the need for quality education in engineering so that the world has the engineers that it needs to advance the goals of sustainable development.

I look forward to the presentations and discussions and the many unique opportunities to develop solutions to the challenges we face. The collaborative, approach among the international experts that will be attending the Forum will be a powerful catalyst to develop the best solutions that the world needs for sustainable development.

My very best wishes to everyone involved in this Forum and my sincere thanks to the Slovenia Chamber of Engineers (IZS), the University of Ljubljana, the Organising Committees and staff, for hosting the World Federation of Engineering Organisations and the engineers from around the world. The Forum is an opportunity to celebrate the past 100 years and also to look ahead, to plan for a

sustainable future and to create a better world. ■



United Nations Educational, Scientific and Cultural Organization (UNESCO)

Dr. Peggy Oti-Boateng,
Director, Division of Science Policy and Capacity Building,
Natural Sciences Sector, UNESCO Headquarter, Paris, France

It gives me great pleasure to welcome delegates to the World Construction Forum 2019 being held in Ljubljana from 8-11 April 2019. This Forum is a great celebration of two significant anniversaries of engineering in Slovenia: the centenary of the Ljubljana Engineers Chamber, predecessor of the Slovenian Chamber of Engineers, and of the centenary of the University of Ljubljana. My sincere congratulations to both these illustrious institutions and the leadership that they have provided to Ljubljana and to Slovenia over the past 100 years.

The Division of Science Policy and Capacity Building at UNESCO works closely with the World Federation of Engineering Organisations (WFEO) as strategic partners in pursuing our mandate in Engineering for Sustainable Development and we are pleased that the Slovenia Chamber of Engineers, a national member of the Federation, is one of the key organisers of this important Forum.

Importantly, UNESCO is delighted that the Forum will focus on some of the UN Sustainable Development Goals relating to water, energy, sustainable infrastructure, innovation and climate change. All these Goals will require engineers and engineering to devel-

op, implement and provide solutions to these numerous challenges of our time.

The Forum will be an opportunity to reflect on the achievements of engineers and the contribution that engineering has made over the past 100 years to the economy, environment and society of Slovenia and to consider the opportunities of the next 100 years. It is fitting that these discussions will bring together experts from around the world, discussing contemporary issues and the solutions that are possible.

My very best wishes for a successful Forum. UNESCO Division for Science Policy and Capacity Building in the Natural Sciences Sector looks forward to the outcomes of the Forum and the solutions that will lead to the advancement of the UN Sustainable Development Goals. ■

Key-note Speakers at the Forum Opening



Peter Fajfar



**Antonia
Moropoulou**

Peter Fajfar is Professor at the University of Ljubljana. His main research interest is seismic analysis and design of structures. He was a visiting professor at several prestigious universities, including Stanford University. In the period 2003-2015 he was one of three Editors of the journal Earthquake Engineering and Structural Dynamics. He served on the Board of Directors of the International Association of Earthquake Engineering and was a member of the Executive Committee of the European Association of Earthquake Engineering, where he is now an Honorary Member. He has been involved in the development of the European standard Eurocode 8 and leads the implementation of this standard in Slovenia, which was the first country where Eurocode 8 became compulsory. As a designer, consultant and/or reviewer, he has participated in a large number of projects for industry. He received several awards, among them the highest award for the scientific work in Slovenia and Prof. Nicholas Ambraseys Distinguished Lecture Award. P. Fajfar is a member of the Slovenian Academy of Sciences and Arts, of the Slovenian Academy of Engineering, of the European Academy of Sciences (Belgium), and of the National Academy of Engineering (USA). ■

Prof. Antonia Moropoulou, is Professor at the National Technical University of Athens, Greece and President of the General Assembly of the Technical Chamber of Greece. She is a Chemical Engineer, PhD, Full Professor at the Section of Materials Science and Engineering of the School of Chemical Engineering, Director of the Materials Science and Engineering Laboratory. She was elected as Contracted Professor in IUAV University of Venice (1993), Visiting Professor at Princeton University (1995-1996) and has served as Vice Rector of Academic Affairs of NTUA (2010-2014) and Vice President of the European Society for Engineering Education – SEFI (2013-2016). She is a world class expert in building materials and the preservation of monuments that comprise the World's Cultural Heritage (Hagia Sophia in Istanbul, Medieval City of Rhodes, Holy Sepulcher in Jerusalem, et al) scientific coordinator of more than 80 National, European and International research competitive programs and author of 5 books, 22 monographies and chapters in books and editor of 15 books. She is the author of 500 scientific publications i.e. 186 original papers published in International Scientific Journals, 5 in Greek Scientific Journals, 98 papers in periodical editions, 186 papers in peer-reviewed. In 2012 she was >>>



Jinxiu Yan

awarded the 'YPATIA' Award by the 'Association of Hellenic Women Scientists'.

In 2011 she was acknowledged by the Council of Canadian Academy as an author of the top 5% most highly cited papers worldwide in the field of Cultural Heritage Protection. In 2012 she was awarded the 'YPATIA' Award by the 'Association of Hellenic Women Scientists'. In 2015 she was conferred by His Beatitude, Patriarch of Jerusalem and All Palestine, Theophilos III, of the honorary title of the Supreme Taxiarch of the Equestrian Order of the Holy Sepulcher. In 2017 she was honored by the European Society for Engineering Education with the SEFI Fellowship Award. She has received honorary international Association Memberships: New York Academy of Sciences, American Association for the Advancement of Science, International Who's Who of Professionals, Academia NDT International, American Ceramic Society, et als. She is member of numerous Hellenic Academic Associations in her scientific field. ■

Professor Jinxiu (Jenny) YAN is currently the Vice President of the International Tunnelling and Underground Space Association (ITA); Vice President of the Chinese Tunnelling and Underground Works Society of CCES and Deputy General Manager of China Railway Academy Co., Ltd.

Prof. YAN has been working as consulting engineer or researcher for many major tunnel projects for more than 30 years. In the past 5 years, she has delivered 26 international keynotes or lectures in Asia, Europe, America and Middle East. As research team leaders or experts appointed by the governments or the project owners, she has been involved in the construction of many major railway, highway tunnels and metro projects as well as long subsea tunnels in China, such as the longest 32km long Guanjiao Railway Tunnel; the 18km long Qinling Railway Tunnel on Xikang Railway; the 13km long Yesahnguan Tunnel in Karstic geology on Yiwang Railway; the longest 18km Qining Zhongnanshan Highway Tunnel; the longest subsea highway tunnels in China (Qingdao Jiaozhou Bay Subsea Highway Tunnel and 8.6km long Xiamen Xiang'an Subsea Highway Tunnel) etc.. Prof Yan has been awarded such honors as the winner for Tip-Top Talent by the Ministry of



Mark Coleman

Railways, P.R. China in 2000; the winner for the 5th Talent Prize of China Zhantianyou Development Foundation for Railway Science and Technology in 2008; the Expert for enjoyment of China State Council Special Allowance for Outstanding Contribution to Engineering in 2011; the winner of 2012 China Economic Female Entrepreneur Figures; 2017 China Women's Example Award; 2018 China's Top Ten Brand Women. ■

Mark Coleman is "Senior Cad Manager" for Crossrail in London where he manages the CAD and Information Applications teams, administering the production of intelligent output from 3D models for construction documentation and asset information.

Prior to Crossrail, Mark has worked in Hong Kong, Australia and the UK across a broad range of industries, from telecommunications to building services. His recent work in the rail industry has focused on using digital technologies and information drivers for better decision making and management of projects through design and construction. ■

General Information

Location and forum address

Cankarjev dom, Cultural and Congress Centre
Prešernova 10, SI-1000 Ljubljana, Slovenia
Phone: +386 1 241 7100, Fax: +386 1 241 7296

Forum Secretariat

Ms. Alenka Kregar
Prešernova 10, SI-1000 Ljubljana, Slovenia
Phone: +386 1 24 17 133, Fax: +386 1 24 17 296, E-mail: alenka.kregar@cd-cc.si

Official language

The official language of the World Construction Forum 2019 is English.

Internet

Wireless internet connection is available in all halls of Cankarjev dom.
The name of the network is **CD_GUEST**. No login or password is needed.

Coffee break and lunch

Coffee breaks are scheduled from 10:00 to 10:30 and 15:30 to 16:00 (in Foyer II).
Lunch breaks are scheduled from 12:00 to 13:00 (in Foyer II).

Registration and Information Desk

The Registration and Information Desk for the WCF2019 will be located in Foyer II of Cankarjev dom as follows:

Monday, April 8	16:00 – 20:00
Tuesday, April 9	08:00 – 17:00
Wednesday, April 10	08:00 – 17:00

Exhibition

Exhibition will be held in Foyer II (Drugo preddverje).

Conference Identification Badge

A conference identification badge will be included in the conference material provided upon registration. There will be no admittance to the Scientific Sessions without the conference badge. Invitations to social events will be collected at the entrance.

Guidelines

ORALS

Authors should upload their presentation online before the event (instructions were sent to contact authors). In case that you have not uploaded your presentation to the provided link until 1st of April you are kindly asked to upload your presentation in the Speaker Centre located in the Foyer II next to the registration desk within 60 minutes before the actual time block of the session. Please use the WCF2019 template that is available on the WCF web-page. Technical staff will make sure that your presentation will be downloaded on the computer in your specific session room. Please make sure that your computer presentation is fully operational before your talk. Only Power Point presentations, CDROM, USB Memory cards will be accepted. Version MS PowerPoint 2013 is recommended.

In-session presentations should be 12 minutes talk followed by 3 minutes discussion. Keynote presentations should be 25 minutes talk followed by 5 minutes discussion.

Social Programme

Monday, April 8, 2019

18:00 – 20:00 Welcome Reception with Exhibition Opening / Cankarjev dom – Foyer II

Wednesday, April 10, 2019

19:30 – 22:30 Gala Dinner / Grand Hotel Union (not included in the forum registration fee)

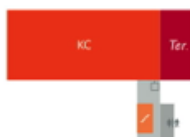
Venue Floor Plan

cankarjev dom
Cultural and Congress Centre
Prešernova 10, 1000 Ljubljana
Slovenia



CONGRESS
AND EVENTS
MANAGEMENT

6 | CD Club



6 | CD Club

KC CD Club from Erjavčeva St.,
Entrance 5
Ter. Terrace

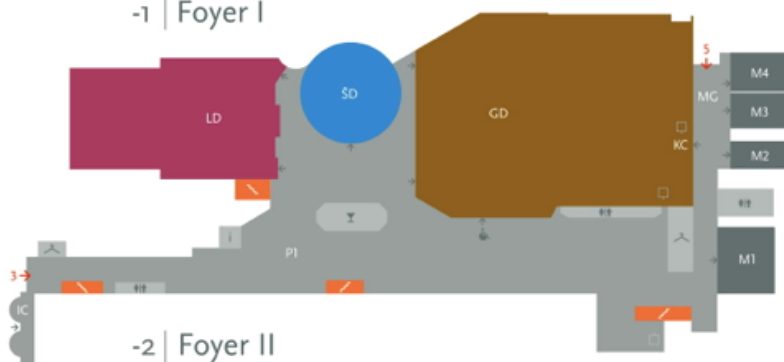
o | Grand Reception Hall



o | Ground Floor

1 Entrance 1 Prešernova St.
2 Entrance 2 Republic Sq.
4 Entrance 4 Stage Ent.
6 Entrance 6 Employee Ent.
VS Grand Reception Hall
GD Gallus Hall
Circle and Balcony
GC CD Gallery
LN Lili Novy Club from 1st Fl.
DP Duša Počkaj Hall
Rec. Reception
Bar »Idealist«

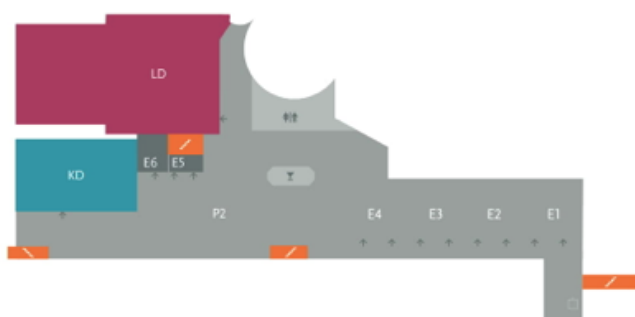
-1 | Foyer I



-1 | Foyer I

3 Entrance 3 from Maxi
Passageway
5 Entrance 5 from Erjavčeva St.
P1 Foyer I
GD Gallus Hall Stalls
LD Linhart Hall Balcony
ŠD Štih Hall
MG Small Gallery
IC Info Centre & Box Office
KC Klub CD from 6th Fl.
M Conference Rooms 1-4

-2 | Foyer II



-2 | Foyer II

LD Linhart Hall Stalls
KD Kosovel Hall
P2 Drugo preddverje
E Conference Rooms 1-6

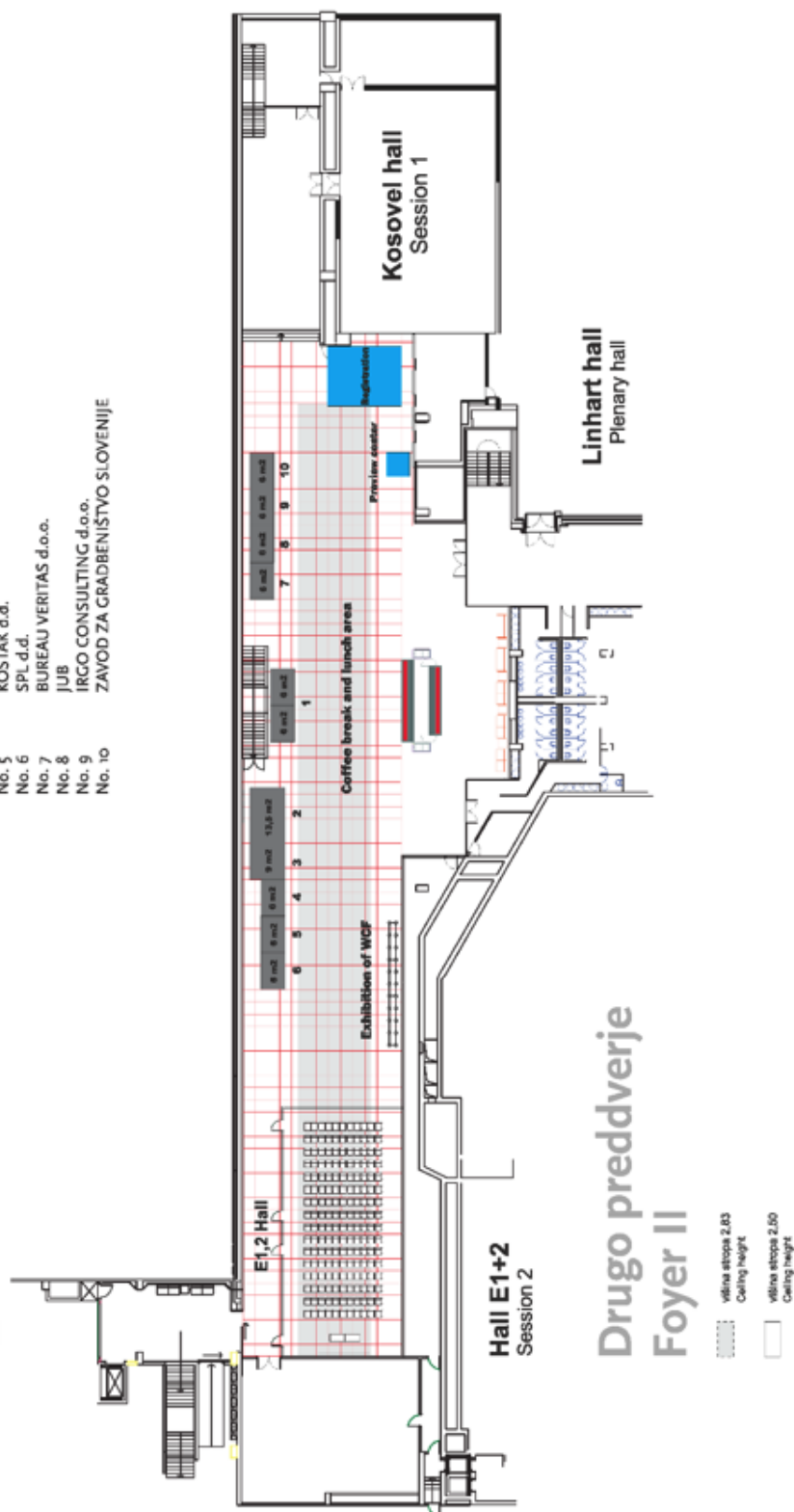
Toilette
Cloakroom
Lift
Bar
CD Entrance
Hall Entrance
Stairway

Forum Exhibitors

1. UNIVERZA V LJUBLJANI - FAKULTETA ZA GRADBENIŠTVO IN GEODEZIJO
2. DARS d.d.
3. KNAUF INSULATION
4. ŠPICA INTERNATIONAL - eOBLAK
5. KOSTAK d.d.
6. SPL LJUBLJANA d.d.
7. BUREAU VERITAS d.o.o.
8. JUB d.o.o.
9. IRGO CONSULTING d.o.o.
10. ZAVOD ZA GRADBENIŠTVO SLOVENIJE

List of exhibitors

- | | |
|--------|---------------------------------|
| No. 1 | ULFGG |
| No. 2 | DARS d.d. |
| No. 3 | KNAUF INSULATION |
| No. 4 | SPICA |
| No. 5 | KOSTAK d.d. |
| No. 6 | SPL d.d. |
| No. 7 | BUREAU VERITAS d.o.o. |
| No. 8 | JUB |
| No. 9 | IRGO CONSULTING d.o.o. |
| No. 10 | ZAVOD ZA GRADNENIŠTVO SLOVENIJE |



WCF2019 Programme at a Glance

Saturday, April 6, 2019

- WFEO Meetings (09:00-17:00) (at invitation only, separate programme available)

Sunday, April 7, 2019

- WFEO Meetings (09:00-17:00) (at invitation only, separate programme available)

Monday, April 8, 2019

- WFEO Meetings, reception at the University of Ljubljana, (09:00-15:00) (at invitation only, separate programme available)
- Forum registration at Cankarjev dom (Prešernova cesta 10) (16:00-20:00)
- Welcome Reception with Exhibition Opening at Cankarjev dom for WCF2019 participants (18:00-20:00)

Tuesday, April 9, 2019

- Forum registration at Cankarjev dom (Prešernova cesta 10) (8:00-17:00)
- Forum Opening with Key-notes (9:00-12:00) (Linhart Hall)
- Lunch Break (12:00-13:00)
- Parallel Forum Sessions (13:00-18:30)
- Ljubljana sightseeing tour (optional-not included in the forum registration fee) (10:00-12:00; meeting point at the Registration desk in Foyer II at 09:45)

Tuesday, April 9, 2019			
9:00-12:00	Forum Openings and Keynote Lectures (Linhart Hall)		
12:00-13:00	Lunch break		
13:00-15:30	Theme 3 (E1-E2 Hall)	Theme 6 (Kosovel Hall)	Theme 5 (M1 Hall)
15:30-16:00	Coffee break		
16:00-18:30	Theme 3 (E1-E2 Hall)	Theme 6 (Kosovel Hall)	Theme 5 (M1 Hall)

Wednesday, April 10, 2019

- Forum registration at Cankarjev dom (Prešernova cesta 10) (8:00-17:00)
- Parallel Forum Sessions (08:30-17:00)
- Lunch Break (12:00-13:00)
- Ljubljana Declaration & Closing Remarks (17:15-17:45)
- Gala Dinner (not included in the forum registration fee) (19:30-22:30)

Wednesday, April 10, 2019			
8:30-10:00	Theme 4 (M1 Hall)	Theme 2 (E1-E2 Hall)	Theme 1 (Kosovel Hall)
10:00-10:30	Coffee break		
10:30-12:00	Theme 4 (M1 Hall)	Theme 2 (E1-E2 Hall)	Theme 1 (Kosovel Hall)
12:00-13:00	Lunch break		
13:00-15:30	Theme 4 (M1 Hall)	Theme 2 (E1-E2 Hall)	Theme 1 (Kosovel Hall)
15:30-16:00	Coffee break		
16:00-17:00	Theme 4 (M1 Hall)	Theme 4 (E1-E2 Hall)	Theme 1 (Kosovel Hall)
17:15-17:45	Ljubljana Declaration & Closing Ceremony (Kosovel Hall)		

Thursday, April 11, 2019

Technical Visit (8:30-16:30) Predjama castle & Škocjan caves (Slovenia)

Meeting point at the Registration desk in Foyer II at 8:15 (optional-not included in the forum registration fee)

WCF2019 Theme List

THEME 1:

Energy in 21st Century – Resources Efficiency of Built Environment

(Chair and co-chairs: Željko Vukelić, Andrej Kryžanowski, Emilio Colon)

The section is intended to give the viewpoint of lecturers and conferrers on questions related to Wind Power, Nuclear Power, Water Energy, Solar Energy, Sustainable Energy, with special emphasis on technical and economic feasibility of energy issues of significance to society. It aims at providing the engineer and decision-making officers with updated information regarding the resource potential, advantages and disadvantages of specific energy, state-of-the-art of different technologies that are being used or under consideration for the supply of energy, energy productivity & efficiency, examples of good and bad practice, commissioning and operation, maintenance, electrical system integration, infrastructure requirements, policy and regulatory framework, waste management, costs, influence on climate change, emissions, global trends, challenges.

THEME 2:

Construction 4.0 – Advanced Construction Engineering

(Chair and co-chairs: Žiga Turk, Ke Gong, Aris Chatzidakis)

Construction 4.0 is construction industry's version of Industry 4.0. Technically, industry 4.0 is about creating cyber-physical systems. In these systems the material world and the digital world merge and overlap into one – with the goal of creating not only high quality, inexpensive and sustainable, but also smart, interconnected and customized products for the end user. Construction 4.0 is achieved through internet of people and their social networks and internet of things where the material world is flooded with sensors and cameras; where machines are digitally controlled and include robots and 3D printing. Data (big data!) is collected and analysed using cognitive computing methods, artificial intelligence, high performance computing, and cloud computing for storage and processing. A key technological element is a digital twin of the real world where interaction of the digital with the real can be designed

and simulated. In construction, this is called Building Information Model. For the end user all this results in smart products, smart materials, smart buildings, smart cities, smart infrastructure.

The section is intended to give the viewpoint of lecturers and conferrers on issues related to technologies underpinning construction 4.0, the emerging new business models, as well as new management and organizational methods. It will also address social issues that include the data divide and data privacy. It will address Construction 4.0 in the fields of buildings, transportation and civil infrastructures, as well as education and research policies.

THEME 3:

Cultural Heritage in Digital World

(Chair and co-chairs: Roko Žarnić, Marinos Ioannides, Roberto Di Giulio)

The section is intended to give the viewpoint of lecturers and conferrers on questions related to importance of digital technology in the integrated approach to cultural heritage. The key themes addressed in this theme are: development of methods and tools for data collection and processing needed to support policy development, inclusive heritage site management, intervention decision-making and decision impact analysis, furthermore increasing of heritage asset resilience based on application of digital technology, innovations in 3D modelling of cultural heritage through an inclusive approach for time-dynamic reconstruction of artefacts, built and social environments applying the Historic building information modelling (HBIM) and last but not least development of sustainable use of cultural heritage based on digital technology in order to increase economy development in cultural heritage areas.

THEME 4:

Disaster Risk Management & Governance for Resilient Communities

(Chair and co-chair: Villas Mujumdar, Matjaž Dolšek)

The quality of life of citizens and functionality of communities are primarily dependent on the service provided by the built environment which cannot be absolutely guaranteed due to geophysical, hydrological, metrological, climatological and technological hazards. These hazards threaten every day service of built environment in a form of earthquakes, tsunamis, floods, landslides, cyclones, extreme temperatures, droughts, frost, wildfires, chemical releases, nuclear accidents, NaTech events and by a series of such events. Each of these events can cause severe disasters and, as a consequence, huge economic losses and extremely long recovery time due to the complexity of built environment. In order to optimize the functionality of built environment and enhance community resilience by developing smart buildings, smart infrastructure and smart cities, it is necessary to understand disaster risk, adequately communicate the risk among all stakeholders and managing disaster risk by establishing effective partnership between national authorities, professional organizations, code-writing bodies, civil defence units, construction industry, insurance and reinsurance companies, owners and other stakeholders exposed to risk.

The objective of this section is to exchange the viewpoint of lecturers and conferrers on questions related to disaster risk management and governance aimed at enhancing community resilience by discussing on hazard identification, risk and resilience assessment of existing and

new constructions including systems of built environment, risk reduction, prevention, preparedness and response procedures as well as strategies of recovery and reconstruction of the affected built environment caused by extreme events. The emphasis will be given on understanding the risks, developing and demonstrating cyber-physical systems for different stakeholders, addressing the role of construction industry and engineering practitioners, monitoring and reporting on emerging policies, strategies and practices at national and international levels and promoting high standards for engineering practitioners, research and higher education units.

THEME 5: Engineering Capacity Building

(Chair and co-chairs: Yashin Brijmohan, Goran Turk, Martin Manuhwa)

The section is intended to give the viewpoint of lecturers and conferrers on questions related to a key role that engineering professionals play in the global economy of the 21st Century, in the overall economic development activities of countries and regions, but only when the role of the engineering professional is well understood and utilized. Special focus will be given to strengthening of economies, governments, institutions and individuals through education, training, mentoring, orientation and the mobilization of resources by developing secure, stable, appropriate, affordable and sustainable structures, systems and organizations, with a particular emphasis on improving the quality of life. Improving the capacity and skills of engineering professionals to carry out effective action in the face of disasters is also a part of this topic.

THEME 6: Digitally engineered built environment: BIM lifecycle and Facility & Asset – Management

(Chair and co-chairs: Tomo Cerovšek, Vladimír Benko, Samo Peter Medved)

This theme is focusing on project information management for efficient collaborative digital workflows supported by BIM lifecycle – from advanced development of project information model for Design for Construction – to reality capturing/checking integration into asset information model for innovative Facility Management (FM) and Asset Management (AM).

Digital Design for Construction shall focus on parametric models and special functions of BIM in modern supply chains, which lead to efficient design, planning, construction and operation of resilient built environment. We seek digital workflows that create and sustain safe built environment, and consider sustainability aspects (economic, social, environmental).

Facility and Asset Management shall focus on smart (digital) business process (reengineering) addressing strategic, tactical and operational management with computational analytics over the lifetime of facility. FM encompasses the access, egress, use, wellbeing, security, safety, energy, water services, heating, ventilation, air conditioning (HVAC) – all systems. AM shall target methods that minimise risks, costs, and maximise capacity, value of assets and ensure sustainable development of the infrastructure, which define a new generation of cyber-physical asset management systems.

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Saturday, April 6, 2019

- WFEO Meetings (09:00-17:00) (at invitation only, separate programme available)

Sunday, April 7, 2019

- WFEO Meetings (09:00-17:00) (at invitation only, separate programme available)

Monday, April 8, 2019

- WFEO Meetings, reception at the University of Ljubljana (09:00-15:00) (at invitation only, separate programme available)
- Forum registration at Cankarjev dom (Prešernova cesta 10) (16:00-20:00)
- Welcome Reception with Exhibition Opening at Cankarjev dom for WCF2019 participants (18:00-20:00)

Tuesday, April 9, 2019

09:00-12:00

Room Linhart Hall: Opening Addresses

	<i>Črtomir Remec</i> , President of the Slovenian Chamber of Engineers
	<i>Matjaž Mikoš</i> , Dean of the Faculty of Civil and Geodetic Engineering University of Ljubljana
	<i>Zoran Jankovič</i> , Mayor of Ljubljana City
	<i>Simon Zajc</i> , Minister of the Environment and Spatial Planning
	<i>Marlene Kanga</i> , President of the World Federation of Engineering Organizations
	<i>Ana Luiza Massot Thompson-Flores</i> , Director of the UNESCO Regional Bureau for Science and Culture in Europe

Room Linhart Hall: WCF2019 Plenary Keynote Lectures

	<i>Peter Fajfar</i> : Earthquake resistant structures – The key element of seismic resilience
	<i>Antonia Moropoulou</i> : Novel, Sustainable Preservation of Modern and Historic Buildings and Infrastructure. The paradigm of the Holy Aedicule's Rehabilitation
	<i>Jinxu Yan</i> : Development of Tunneling Technology in China over the Past 40 years
	<i>Mark Coleman</i> : Crossrail – A Case Study in BIM and Asset Management

12:00-13:00

Lunch Break

13:00-15:30

Theme 3, E1-E2 Hall,

Convener(s): Roko Žarnić, Marinos Ioannides, Roberto Di Giulio

13:00-13:30	ICTs for accessing, understanding and safeguarding cultural heritage (THEME KEYNOTE) Roberto DI GIULIO
13:30-13:45	Holistic Documentation of the Past: A key Challenge in the 21st century Marinos IOANNIDES, Robert S. DAVIES, Diofantos HADJIMITSIS, Kyriakos THEMISTOKLEOUS
13:45-14:00	The elements of identification of cultural heritage services Roko ŽARNIĆ, Barbara VODOPICEC
14:00-14:15	Geodetic Methods for Modeling and Documenting Cultural Heritage Objects Dušan PETROVIČ, Dejan GRIGILLO, Mojca KOSMATIN FRAS, Tilen URBANČIČ, Klemen KOZMUS TRAJKOVSKI

14:15-14:30	Using owl-time ontology to define time in h-BIM models Anna Elisabetta ZIRI, Peter BONSMMA, Ernesto IADANZA, Federica MAIETTI, Marco MEDICI, Federico FERRARI
14:30-14:45	BIM-based Cultural Heritage Asset Management Tool. Innovative solution to orient the preservation and valorization of historic buildings Emanuele PIAIA, Federica MAIETTI, Roberto DI GIULIO, Oana SCHIPPERS-TRIFAN, Andre VAN DELFT, Sander BRUINENBERG, Rosamaria OLIVADESE
14:45-15:00	Cultural heritage BIM: challenges and opportunities Vlatka RAJČIĆ, Jelena BLEIZIFFER
15:00-15:15	Accessing and understanding heritage buildings through ICT. The INCEPTION methodology applied to the Istituto degli Innocenti Federica MAIETTI, Roberto DI GIULIO, Marco MEDICI, Federico FERRARI, Emanuele PIAIA, Silvia BRUNORO
15:15-15:30	Discussion
Theme 6, Kosovel Hall, Convener(s): Tomo Cerovšek, Vladimír Benko, Samo Peter Medved	
13:00-13:30	Digitally engineered built environment: monitoring from space (THEME KEYNOTE) Sivasakthy SELVAKUMARAN
13:30-13:45	Digital Built Environment Maturity Model (dbEMM) in smart infrastructure asset management Dejan PAPIČ, Tomo CEROVŠEK
13:45-14:00	New bridge management system for Slovenian road network Matej KUŠAR, Jana ŠELIH
14:00-14:15	Maintenance Of Special Equipment At Bridge Constructions Marko LUTMAN
14:15-14:30	Infrastructure and facilities asset management best practices Gianclaudio OLIVA
14:30-15:00	BIM in the lifecycle of concrete structures: applications and training challenges (THEME KEYNOTE) Miguel AZENHA, José GRANJA
15:00-15:15	Impact of using BIM on project management (Design for obtaining a construction permit and Detailed design) for section of main railroad between Maribor and Šentilj Iztok ZABREZNIK
15:15-15:30	Integrated BIM Project Management Approach and Asset Management on large scale projects Veljko JANJIĆ

Theme 5, M1 Hall,**Convener(s): Yashin Brijmohan, Goran Turk, Martin Manuhwa**

13:00-13:30	Riccardo Morandi's bridge in Genova from a tragedy to a new renaissance (THEME KEYNOTE) Enzo SIVIERO, Alessandro STOCO, Michele CULATTI
13:30-13:45	Engineers in sustainable development societies Lidija Kegljevič ZAGORC
13:45-14:15	i-Bribery Standards, Systems and Strategies for Optimising Engineering Projects Delivery (THEME KEYNOTE) Martin MANUHW
14:15-14:30	From zero to heaven: first five years of siBIM Andrej TIBAUT, Klara MIHALIČ
14:30-14:45	Issues and Challenges in Engineering Capacity Building in Nigeria Aliyu MUHAMMED
14:45-15:30	Discussion

15:30-16:00**Coffee Break****16:00-18:30****Theme 3, E1-E2 Hall,****Convener(s): Roko Žarnić, Marinos Ioannides, Roberto Di Giulio**

16:00-16:30	The role of digital tools in the preventive conservation of cultural heritage: the experience of HeritageCare project (THEME KEYNOTE) Daniel V. OLIVEIRA, M. Giovanna MASCIOTTA
16:30-16:45	Accessible cultural heritage: developing digital user experiences Giuseppe MINCOLELLI, Gian Andrea GIACOBONE, Michele MARCH
16:45-17:00	Medieval geometries identified by digital analysis – creating capacity to knowledge, cultural value and technical maintenance: The case of the 13 th cent. S. Francis church in Assisi, Italy André De MAEYER
17:00-17:15	Advanced monitoring of the church of St. Benedict in Kančevci (Slovenia) Tilen URBANČIČ, Vlatko BOSILJKOV, Violeta BOKAN BOSILJKOV, Petra ŠTUKOVNIK, Božo KOLER
17:15-17:30	Simplified seismic assessment of monument applying the 3D time evolution presentation Meta KRŽAN, Roko ŽARNIĆ
17:30-17:45	Digital data platforms for heritage-led urban regeneration and historical sites enhancement Amir DJALALI, Jacopo GASPARI, Ernesto IADANZA, Giovanni LEONI, Martina MASSARI, Beatrice TURILLAZZI

17:45-18:00	New approach and tools for the governance of historic urban landscapes. The role of resilient communities Andrea BOERI, Danila LONGO, Valentina GIANFRATE, Saveria O.M. BUOLANGER, Chiara MARIOTTI
18:00-18:15	Protection versus Developement: Cultural Heritage in Functionally Derelict Areas Gašper MRAK, Mojca FOŠKI, Barbara LAMPIČ, Alma ZAVODNIK LAMOVŠEK
18:15-18:30	Digital tools for documentation and analysis of heritage city centres in India Luca ROSSATO, Pietro MASSAI, Federica MAIETTI, Marcello BALZAN

Theme 6, Kosovel Hall,

Convener(s): Tomo Cerovšek, Vladimír Benko, Samo Peter Medved

16:00-16:15	BIM – Bridge Infrastructure over Digital Twin chasm Tone STANOVNIK
16:15-16:30	Setting competitive smart goals with BIM Ozlem GEYLANI, Attila DIKBAS, Alev YALCINKAYA
16:30-16:45	Progressive Use of BIM for Holistic Energy Renovation of Office Buildings Gašper STEGNAR, Tomo CEROVŠEK
16:45-17:00	Physical Protection of Data Centers Using WiFi Channel State Information and Building Information Modeling Tools Chih-Hsiung CHANG, Ru-Guan WANG, Chien-Cheng CHOU
17:00-17:15	BIM-enabled condition assessment tool for asset maintenance with integrated Dutch inspection standard Oana SCHIPPERS-TRIFAN, Sander BRUINENBERG
17:15-17:30	Slovenian Real Estate Market: maintenance of multi-dwelling buildings and management challenges Klemen PAHULJE
17:30-17:45	Implementation and use of BIM technology in multidwelling facilities for management and maintenance of buildings Borut HAFNER, Branka TREBUŠAK
17:45-18:00	Indoor Environment and ventilation in sustainable building Peter NOVAK, Franci PLIBERŠEK
18:00-18:30	Discussion

Theme 5, M1 Hall,

Convener(s): Yashin Brijmohan, Goran Turk, Martin Manuhwa

16:00-16:30	Impacts of Bologna declaration on the higher education of civil engineering in Slovenia (THEME KEYNOTE) Goran TURK
16:30-16:45	Terms of Reference for Civil Engineering Competences – TUNING Approach Alfredo SOEIRO

16:45-17:00	A bridge between Europe and Africa Enzo SIVIERO, Michele CULATTI , Viviana MARTINI, Alessandro STOCCO, Nicola MONDA
17:00-17:15	Water Education Games for Better Decision-making and Resilient Communities Marta VAHTAR
17:15-17:30	Construction industry and technical associations: mutually beneficial cooperation Petro KULIKOV, Ivan NAZARENKO, Petro SHILYUK, Mykola KIRYUKHIN
	International doctoral summer school natural disasters: opportunity for improvement of understanding of natural disasters and their prevention (presented as poster) Mojca ŠRAJ, Mitja BRILLY, Klaudija SAPAČ, Johannes HÜBL, Roberto RANZI, Andreja ŽGAJNAR GOTVAJN, Franc LOBNIK, Matjaž LOBNIK
	Flood Risk Management Master Programme – Success Story (presented as poster) Mitja BRILLY, Biswa BHATTACHARYA, Dimitri P. SOLOMATINE, Christian BERNHOFER, Allen BATEMAN
17:30-18:30	Discussion

Wednesday, April 10, 2019

8:30-10:00

Theme 1, Kosovel Hall,

Convener(s): Željko Vukelić, Andrej Kryžanowski, Emilio Colon

8:30-9:00	Challenges of energy decarbonization: Issues for energy systems in 21st Century (THEME KEYNOTE) Tomaž ŽAGAR
9:00-9:15	Power Transmission Method for Building Yiqing YUAN, Yicheng YUAN
9:15-9:30	Hydro Powerplants Chain on the Lower Sava River Silvester JERŠIČ
9:30-9:45	The role of shallow geothermal energy in transition to low carbon energy systems in Slovenia Gašper STEGNAR
9:45-10:00	Future needs for energy storage in Alpine region Lovrenc NOVAK, Gašper RAK, Marko HOČEVAR

Theme 2, E1-E2 Hall,

Convener(s): Žiga Turk, Ke Gong, Aris Chatzidakis

8:30-9:00	From Industrie 4.0 to Construcion 4.0 (THEME KEYNOTE) Raimar SCHERER
9:00-9:15	Perspectives for Industry 4.0 in Construction Žiga TURK, Robert KLINC
9:15-9:30	Building smart and safe construction sites with dependable decentralised artificial intelligence applications Janez BREŽNIK, Uroš PAŠČINSKI, Vlado STANKOVSKI
9:30-9:45	Public & free(?) access to spatial data Marko KOMAC, Matjaž MIKOŠ
9:45-10:00	New aspects of interdisciplinary cooperation based on OPEN BIM platform Hermann OOGING

Theme 4, M1 Hall,

Convener(s): Villas Mujumdar, Matjaž Dolšek

8:30-9:00	Issues and strategies for earthquake resilience in Italy (THEME KEYNOTE) Iunio IERVOLINO
9:00-9:15	Recent advancements in the seismic protection of rc precast industrial buildings Tatjana ISAKOVIĆ, Blaž ZOUBEK, Matej FISCHINGER
9:15-9:30	LIQUEFACT: assessment and mitigation of liquefaction potential across europe Janko LOGAR, Keith JONES

9:30-9:45	Slovenia Earthquake Event Rapid Response Toolbox - POTROG Darko BUT, Primož BANOVEC
9:45-10:00	Summary: Research Using Large-Scale Shaking Table Jae-Do KANG, Koichi KAJIWARA

10:00-10:30

Coffee Break

10:30-12:00

Theme 1, Kosovel Hall,

Convener(s): Željko Vukelić, Andrej Kryžanowski, Emilio Colon

10:30-11:00	Analysis of the development of the energy market (THEME KEYNOTE) Igor MESHERIN
11:00-11:15	Energy Efficiency of CLT Frame with Laminated Glass Infill Vlatka RAJČIĆ, Nikola PERKOVĆ, Roko ŽARNIĆ, Jure BARBALIĆ
11:15-11:30	The optimization involves the resources allocation in the power industry Yiqing YUAN, Yicheng YUAN
11:30-11:45	Issues related to efficient and safe design of refurbished and upgraded large hydropower infrastructures in Slovenia Jernej MAZIJ, Anton BERGANT
11:45-12:00	Challenges for Better Acceptance of NZEBs in Slovenia Marjana ŠIJANEC ZAVRL, Damjana VARŠEK, Marko JAČIMOVIĆ, Mojca ŠTRITOF BRUS

Theme 2, E1-E2 Hall,

Convener(s): Žiga Turk, Ke Gong, Aris Chatzidakis

10:30-11:00	Digitization of the Construction Industry. Engineering Organizations in Support of European Initiatives, BIM Standardization and Accelerating BIM Adoption (THEME KEYNOTE) Maria STEFANOVA, Dimitar NATCHEV
11:00-11:15	Consistent and standard model content – a way towards utilization of advanced BIM use cases Jure ČESNIK, Anjo ŽIGON, Martin LAH
11:15-11:30	Supporting measures of BIM from the perspective of professional institutions Vladimír BENKO, Tomáš FUNTIK
11:30-11:45	Using bridge-wim to measure bridge performance indicators Aleš ŽNIDARIČ, Maja KRESLIN, Jan KALIN, Andrej ANŽLIN
11:45-12:00	GeoGuard: an innovative service to monitor the displacements of structures and ground, based on cost-effective GNSS sensors (presented by A. GATTI) Eugenio REALINI, Stefano CALDERA, Daniele MOLINARI, Lapo PASQU

**Theme 4, M1 Hall,
Convener(s): Villas Mujumdar, Matjaž Dolšek**

10:30-10:45	Enhancing resilience – a means of disaster risk management Ashok BASA
10:45-11:00	Structural Sustainability for existing Infrastructure and buildings Aris CHATZIDAKIS
11:00-11:15	A risk-based grading system incorporating tolerance against short-term and long-term risk posed by natural hazards Anže BABIČ, Matjaž DOLŠEK
11:15-11:30	A ground motion selection approach based on multiobjective optimization tailored to provide region specific record sets Konstantinos T. TSALOUCHIDIS, Lukas MOSCHEN, Ricardo A. MEDINA, Christoph ADAM
11:30-12:00	Discussion

12:00-13:00

Lunch Break

13:00-15:30

**Theme 1, Kosovel Hall,
Convener(s): Željko Vukelić, Andrej Kryžanowski, Emilio Colon**

13:00-13:15	The Slovenian approach to sustainability indicators for buildings Marjana ŠIJANEC ZAVRL, Miha TOMŠIČ, Friderik KNEZ, Sabina JORDAN
13:15-13:30	Enhancing deployment of integrated solar combined cycle projects in MENA region Maher SAAB SALAMAH
13:30-13:45	Comprehensive Design Strategies for Sustainable Timber-Glass Buildings Vesna ŽEGARAC LESKOVAR, Miroslav PREMROV
13:45-14:00	The use of timber in high-rise building structures Boris AZINOVIC, Iztok ŠUŠTERŠIČ
14:00-14:15	Permeability Of High Volume Fly Ash Concrete Chung-Hao WU, Qi-Bao ZHAO, Yu-Feng LIN, Ming-Yuan CHEN
14:15-14:30	New Nuclear Power Plant as Part of Long Term Energy Sustainable Development in Slovenia Robert BERGANT, Samo FÜRST
14:30-14:45	Biomass district heating in Italy. Case study Ania LOPEZ
14:45-15:00	Efficient use of energy in the light of optimal public passenger transport Janez BLAŽ, Samo ZUPAN, Miha AMBROŽ
15:00-15:15	Potential of shallow geothermal energy in Slovenia Željko VUKELIĆ
15:15-15:30	Discussion

Theme 2, E1-E2 Hall,**Convener(s): Žiga Turk, Ke Gong, Aris Chatzidakis**

13:00-13:30	Analysis of Combined Pile Raft Foundation based on a static load test (THEME KEYNOTE) Zygmunt MEYER, Piotr CICHOCKI
13:30-13:45	Analysis of Frame Constructions of Morefloors Buildings with the Aspect on Distribution of Internal Forces Predrag SAVIĆ
13:45-14:00	Optimization test study of connections and joints between elements of the hybrid timber-structural glass panel Vlatka RAJČIĆ, Roko ZARNIĆ, Nikola PERKOVIĆ, Jure BARBALIĆ
14:00-14:15	Numerical models for verification of bearing capacity of the hybrid timber- structural glass panel Vlatka RAJČIĆ, Roko ZARNIĆ, Nikola PERKOVIĆ, Jure BARBALIĆ
14:15-14:30	Project of railway Tunnel connecting three main stations Łódź Stanisław STADNICZENKO
14:30-14:45	Standardisation in construction cost control; the beginning Charles MITCHELL
14:45-15:00	GIMS: an innovative cost-effective system to monitor ground deformations, based on GNSS, InSAR and inertial measurement units Eugenio REALINI, Ismael COLOMINA, Michele CROSETTO, Angelo CONSOLI, Mateja JEMEC AUFLIČ, Sara LUCCA
15:00-15:30	Discussion

Theme 4, M1 Hall, Convener(s): Villas Mujumdar, Matjaž Dolšek

13:00-13:30	New standardization of technical torrent control structures in Austria (THEME KEYNOTE) Johannes HÜBL, Georg NAGL
13:30-13:45	Debris flow hazard assessment – from regional to basin scale Jošt SODNIK, Matjaž MIKOŠ
13:45-14:00	Novel monitoring barrier to investigate the interaction of debris flows and mitigation structures Georg NAGL, Johannes HÜBL
14:00-14:15	Implementation of multidisciplinary approach for determination of landslide hazard Tina PETERNEL, Jernej JEŽ, Blaž MILANIČ, Anže MARKELJ, Jošt SODNIK, Matej MAČEK, Mateja JEMEC AUFLIČ
14:15-14:30	Optimization of HPPs chain operation during flood waves Gašper RAK, Franci STEINMAN, Daša GORŠAK, Matija BRENČIČ
14:30-14:45	Impact of the structural flood protection measures on the activities of protection, rescue and relief forces Janja KRAMER STAJNKO, Franci PETEK

14:45-15:00	Flood and Drought Management: Challenges for Civil Engineering Teodoro ESTRELA, Tomás SANCHO
15:00-15:15	The design rainfall issue: impact on the results of the hydraulic modelling Nejc BEZAK, Mojca ŠRAJ, Simon RUSJAN, Matjaž MIKOŠ
15:15-15:30	Discussion

15:30-16:00

Coffee Break

16:00-17:00

Theme 1, Kosovel Hall,

Convener(s): Željko Vukelić, Andrej Kryžanowski, Emilio Colon

16:00-16:30	Practical experiences with design and construction of Slovenian first Platinum certified DGNB sustainable building Domen IVANŠEK
16:30-17:00	Improving energy and resource efficiency in the EU construction sector Olga MALA, Miroslava IVANOVA

Theme 4, E1-E2 Hall,

Convener(s): Villas Mujumdar, Matjaž Dolšek

16:00-16:15	Application of Earth observation and 3D geospatial data in disaster monitoring Krištof OŠTIR, Urška DREŠČEK, Matjaž IVAČIČ, Žiga KOKALJ, Anka LISEC, Jernej TEKAVEC
16:15-16:30	More Room for Water Mitja BRILLY, Mojca ŠRAJ Andrej VIDMAR, Simon RUSJAN
16:30-16:45	Role of pollutant mass balances in environmental modelling Dušan ŽAGAR
16:45-17:00	Discussion

Theme 4, M1 Hall,

Convener(s): Villas Mujumdar, Matjaž Dolšek

16:00-16:15	Detention basin „Krems-Au“ as an example for flood protection in densely populated areas of Austrian mountainous regions Norbert MAYR
16:15-16:30	JUBIZOL thermal insulation systems with an integrated risk management system in case of natural disasters Iztok KAMENSKI
16:30-16:45	UNESCO Chair on Water-related Disaster Risk Reduction (WRDRR) Matjaž MIKOŠ, Mitja BRILLY

16:45-17:00	The concept of a competent person in disaster risk management & governance for resilient communities Marko KOMAC, Vitor CORREA
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17:15-17:45

Ljubljana Declaration & Closing Remarks, Kosovel Hall

19:30-22:30

**Gala Dinner at Grand Hotel Union for WCF2019 participants
(not included in the forum registration fee)**

WCF2019 Abstracts Proceedings

Theme 1: Energy in 21st Century – Resources Efficiency of Built Environment

CHALLENGES OF ENERGY DECARBONISATION: ISSUES FOR ENERGY SYSTEMS IN 21ST CENTURY

Authors: doc. dr. Tomaž ŽAGAR^{1,2}

¹ GEN energija d.o.o. tomaz.zagar@gen-energija.si, ² Faculty for Energy technology, University of Maribor

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	The current development of greenhouse gas (GHG) emission are increasing the risks for serious climate instability in the future. The series of the warmest years on record is continuing. The Intergovernmental Panel on Climate Change (IPCC) issued in October 2018 its Special Report. Based on scientific evidence, it demonstrates human-induced global warming has already reached 1°C above preindustrial levels and is increasing at approximately 0.2°C per decade. Without an immediate action and move towards less carbon intensive economy as soon as possible, global average temperature increase will surpass 2°C soon after 2060. The world needs to act immediately with a goal to decarbonize energy, industry and economy as whole. To reach the goals set in Paris Agreement EU countries need to decarbonize its economies before 2050. This requirement generates a series of challenges which need to be resolved if we are serious about achieving our climate goals.
Solutions - Methods / Results - Findings	<p>One of the key conclusions of the report is that the EU needs to fully decarbonize its energy system. Currently fossil fuels represent more than 70 % of all energy supplies in Europe and a huge change in energy system is needed. Several ways on how world and EU can reach deep decarbonization are presented in the recently released "Clean Planet for All" EU document. In terms of electricity production, nuclear, hydro and renewables will play a key role, as they will help in an increased EU electrification process, particularly in the mobility and industrial sectors.</p> <p>At international level, the also IPCC report made it clear that nuclear power is essential if the world is to reduce the rate of climate changes. The International Energy Agency (IEA) and Organization for Economic Cooperation and Development (OECD) also repeated the message that nuclear is important low-carbon source of baseload electricity and that nuclear will form the backbone of a carbon-free European power system, together with hydro and renewables in the future. Some key findings of the World Energy Outlook (WEO) report as the flagship report of the IEA will highlight and underline this conclusions and their relation with the future of global nuclear power.</p>
Novelty - Value / Relevance to ...	<p>Although power production currently contributes less than half of all GHG emissions at the level of both the world and OECD countries, it is expected to bear the brunt of the effort to reduce carbon emissions. Electrification of other sectors like transport and heating will increase power requirements. It is obvious that the coming challenge for decarbonizing electricity systems is gigantic. The solution lies in a harmonized and simultaneous development of all low-carbon sources including nuclear, hydro and renewables.</p> <p>A goal will be presented; to provide 25 % of the world's electricity with nuclear by 2050, which means building about 1000 GW of new nuclear capacity by then.</p>
Forum statement	Harmonized development of reliable, clean, low-carbon and affordable energy system (nuclear, hydro and renewable) is needed.

Keywords: Decarbonisation; Energy system

Power Transmission Mode for Building

Authors: Yiqing YUAN¹, Yicheng YUAN²

¹ 1 Huachang Operating Team of Dalian Power Supply Company Operation Work Area, Dalian, China,

yyqing627@163.com

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	The abundant space resources at 50-150 meters from ground surface shall be utilized for power transmission, high-rise building can still be constructed below the transmission corridor and transmission line, and it is safer. Urban land can be saved for constructing compact city, and it is energy-saving for reasonable planning of city and town.
Solutions - Methods / Results - Findings	<p>The pole tower of high-voltage distribution line, high-voltage transmission line, extra high voltage transmission line and ultra high voltage transmission line (except AC 1000kV pylon tower and angle tower of double-circuit transmission line on the same tower) in city and town can be selectively fixed onto the top of high-rise building which is about 50-150 meters high. The strength of transmission facilities and high-rise building shall both be appropriately strengthened.</p> <p>Violating the regulations in force, but is scientific and feasible. Since:</p> <ul style="list-style-type: none"> ● Reliable and safer. The 1150 kV ultra high voltage of former Soviet Union operated for six years with a total length of 11112 km, and the transmission was interrupted for four times (accounting for 80%) because of the line trip off caused by lightning. Therefore, the probability of trouble at transmission line that might threaten the safety of personnel below the transmission line is $\leq 0.045 \times (1-80\%) = 0.009$ time/(hundred km²year), and that is acceptable; in addition, closed management is performed to the top of high-rise building, equipotential bonding is integrally implemented to building, and it is well grounded, once the transmission line is broken, it would firstly contact the high-rise building, since the pace voltage and touch voltage are zero, the personnel inside the high-rise building is absolutely safe, i.e., having high-rise building below the transmission line is safer than vacant land; the building of civil structure and brick-timber structure is unsafe. ● Environmental protection. The environmental protection indexes in high-rise building, such as electric field, magnetic field and sound, etc., are all lower than the standard in force of each country in the world, and non-work personnel are prohibited from going up to top of high-rise building; there is no radiation. ● For the transverse load (which seldom exceed 1500 tons, most being less than 500 tons) produced by most transmission towers, so long as it is taken into consideration at the time of design, high-rise building can easily bear, and the increased cost is very low. ● Radio interference can be overcome and solved by wired means. ● Existing operation, maintenance, galloping prevention, lightning protection, shock-proof and flame-proof techniques (etc.) are mature. ● Conductor with carbon fiber composite core is adopted. ● The electric substation with voltage grade of 330kV and below can be constructed inside high-rise building, and power supply can be led in through cable from top of high-rise building, and it seems more economical to adopt 22-25kV as the rated voltage for medium voltage power distribution. ● It had better avoid famous scenic area; ● The economic benefit will be at least 3-5 times of investment, and very great benefit can be brought about to city, town and even countryside, the benefit is far greater than the disadvantage. ● Fear and worry more come from the subjective aspect (psychological factor) of populace. For the 66kV and above overhead transmission line, objective probability of personal danger occurrence is far less than the probability of traffic accident, it is estimated to be less than 0.01% of probability of traffic accident, but we have not abandoned automobile for the probability of traffic accident.
Novelty - Value / Relevance to ...	Saving urban land, improving urban efficiency, constructing compact city, reducing investment on urban infrastructure, it is safer below the transmission corridor, the selection of transmission route is relatively easy, energy-saving and low carbon. Med-term, long-term and even ultra long-term planning of city and power transmission and transformation engineering needs to be strengthened, and it needs support from government and relevant laws and regulations. Shortcoming: impacting landscape, initial investment is relatively great, misunderstanding by populace. This thesis belongs to the domain of building and city planning.
Forum statement	Saving urban land, improving urban efficiency, constructing compact city, reducing investment on urban infrastructure, it is safer below the transmission corridor, the selection of transmission route is relatively easy, energy-saving and low carbon. Med-term, long-term and even ultra long-term planning of city and power transmission and transformation engineering needs to be strengthened, and it needs support from government and relevant laws and regulations.

Keywords:

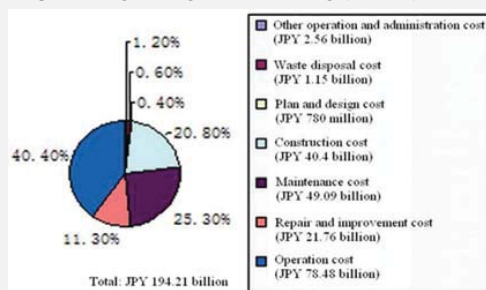
developing power transmission line corridor; high-rise building; urban efficiency; conductor with carbon fiber composite core; optimizing resource configuration;

Graphics:

Table 1 Former Soviet 500, 750kV and 1150kV lines failure rate data

Voltage Class (kV)	500	750	1150
Total length of each line (km)	57314	15519	11112
Average break rate of each line (including successful reclosing)	0.574	0.206	0.144
Average interruption rate of each line	0.201	0.097	0.045

Chart 1 LCC Comparison of high and large-scale office buildings (Reference)



HYDRO POWERPLANTS CHAIN ON THE LOWER SAVA RIVER

Authors: Silvester Jeršič, Master's degree in business engineering

HESS, d.o.o. Brežice, silvester.jersic@he-ss.si

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

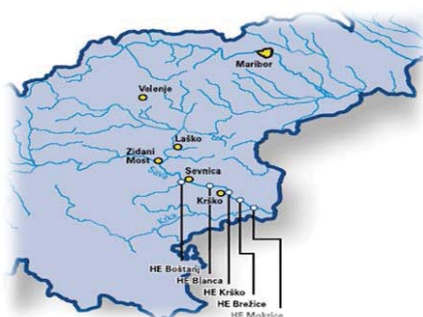
Abstract:

Problems - Issues / Challenges-Needs	<p>Growing electricity consumption:</p> <ul style="list-style-type: none"> Electricity consumption in Slovenia is and will be growing, so new renewable electricity production units are and will be needed to cover electricity demand and assure stable electrical grid and system operation <p>Flood protection:</p> <ul style="list-style-type: none"> Posavje region was and still is exposed to the floods, so flood protection is necessary to provide appropriate conditions for living and society development <p>Climate changes</p> <ul style="list-style-type: none"> Actions to reduce impacts on the environment are needed and must take place, if not already taken, immediately or climate change causes, such as floods, will cause even greater damages and negative consequences
Solutions - Methods / Results - Findings	<p>Multipurpose project:</p> <ul style="list-style-type: none"> To address current huge problems/issues with foreseen growing trends in case of not taken any serious actions, adequate actions had to take place already and have to take place immediately The multipurpose project on the Lower Sava river in Posavje was launched in 2002 to address at the time present and foreseen problems/issues in following sectors: energy/electricity, flood protection, environment protection, economy, agriculture, local society, etc. Unites interests and provide benefits for different interest communities; Republic of Slovenia, power/electricity producers, local communities, different companies in fields of production, building, tourism, agriculture, sport associations, nature protection associations, etc.
Novelty - Value / Relevance to ...	<p>Multipurpose project:</p> <ul style="list-style-type: none"> Addresses: <ul style="list-style-type: none"> Requirements and expectations of different interest communities Climate change needed actions Improves current living and economy conditions and provides a new solid sustainable platform for future society and economy development
Forum statement	Hydro powerplants as a part of renewable energy sources are the answer and the need in relation to the climate changes

Keywords:

HPP - Hydro powerplants, RES – Renewable energy sources, CC – Climate change, Multipurpose

Graphics:



5 new HPPs on the Lower Sava river:

- New green electricity production
- Competitive electricity price
- Multipurpose benefits
- Climate change answer

The role of shallow geothermal energy in transition to low carbon energy systems in Slovenia

Authors: Gašper STEGNAR¹

¹ Jožef Stefan Institute – Energy Efficiency Centre, Ljubljana, Slovenia; gasper.stegnar@ijs.si

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

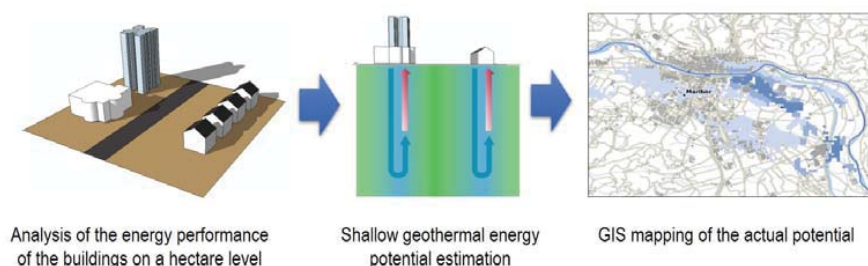
Abstract:

Problems - Issues / Challenges-Needs	The deployment of geothermal energy systems can contribute significantly to climate change mitigation and play part in transition to low carbon society based on renewable energy by 2050. The challenge is not only to identify the amount of technical potential of possible exploitation, but to determine the amount of economically viable potential as an individual heating system, new district heating systems or as support to existing ones.
Solutions - Methods / Results - Findings	<p>The framework for role outline must consist of:</p> <ul style="list-style-type: none"> • heat density map, • approach to determine shallow geothermal energy potential for water to water and brine to water systems, • approach to identify new areas for DH networks and • methods for determination of economic potential for DH system and for individual systems. <p>Results of the analysis can:</p> <ul style="list-style-type: none"> • establish a role of shallow geothermal energy systems in scenarios leading to low carbon society, • support local and national energy plans by using GIS mapping for steering decision-making processes.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Determination of economically viable shallow geothermal energy potential on a hectare level. • Development of cost effective area model for district heating. • Outline the role of shallow geothermal energy for the transition to low carbon society.
Forum statement	Shallow geothermal energy in Slovenia can in economical way play a pivotal role for individual heating systems and supply base load power in district heating systems.

Keywords:

district heating, geothermal energy, spatial constraints, heat density, GIS

Graphics:



Future needs for energy storage in Alpine region

Authors: Lovrenc NOVAK¹, Gašper RAK², Marko HOČEVAR¹

¹ University of Ljubljana, Faculty of mechanical engineering, Lovrenc.Novak@fs.uni-lj.si; ² University of Ljubljana, Faculty of civil and geodetic engineering

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

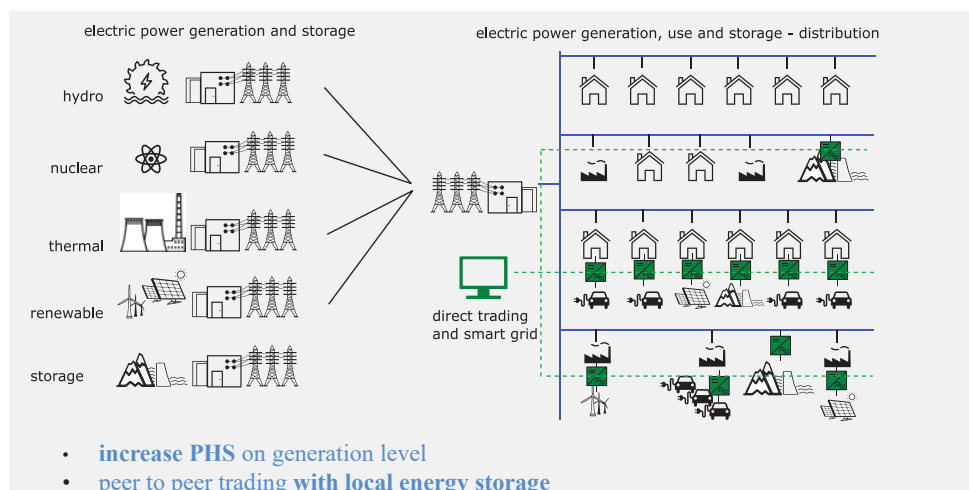
Abstract:

Problems - Issues / Challenges-Needs	With Renewable energy directive the EU has committed itself to a significant reduction in greenhouse gas emissions which will be achieved mainly by increasing energy efficiency and share of renewable energy sources at European level. Electricity systems need to be flexible to guarantee the equilibrium between generation and consumption. <ul style="list-style-type: none"> Conventional energy sources provide stable frequency and voltage of the electric grid Energy production from the renewable sources is highly unpredictable and intermittent With reduction of electric energy production from conventional sources, facilities for coping with huge production variation are needed
Solutions - Methods / Results - Findings	Methodologies for estimation of currently available hydro pumped storage and assessment of short- and long-term future needs: <ul style="list-style-type: none"> Assessment of storage capacity in Alpine space based on available data and HPP database (available volume in reservoir of impoundment and diversion HE facility, reservoirs of PSHP) SWOT analysis of PSHP for alpine region and comparison with other storage options New-developed model for estimation of future need for energy storage capacity based on analysis of past consumption and future trends in share of renewable electric energy sources and reduction of conventional energy sources, evolution of electric energy market, electromobility, climate conditions, etc.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> Comparison and evaluation of different possibilities for energy storage (HPSP, batteries, hydrogen technologies, etc.) Determination of the most promising energy storage strategies for the alpine region Assessment of the need for PHS due to large share of RES and electromobility Recommendation for peer to peer trading with local PHS, modification of legislation, etc.
Forum statement	<ul style="list-style-type: none"> Energy storage capabilities must be in the future very much increased

Keywords:

Energy storage; Sustainable development; Alpine Region; Renewable electric energy generation

Graphics:



Analysis of the development of the energy market

Authors: Igor MESHERIN, Ph.D. (Eng.)

¹ National Chamber of Engineers, Info@npirf.ru;

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> Why did it become clear at the beginning of the 21st century that any single energy forecast made in the 20th century was justified?
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> Convergence of living standards of the population of various countries and continents as factor of the global energy market development paradigm change. "French" and "German" ways of development of energy balances of the European Union countries and continents. The energy market of Anglo-Saxon and Japanese models: pro et contra.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> Abnormal profit of main hydrocarbon producers as a guarantee for renewables progress and success.
Forum statement	Analysis of the development of the energy market in the 21st century. Ways to solve.

Keywords:

Energy; balance; forecast; hydrocarbons; RES.

Energy efficiency of CLT frame with laminated glass infill

Authors: Vlatka RAJČIĆ¹, Nikola Perković², Roko Žarnić³, Jure Barbalić⁴

¹ University of Zagreb, Faculty of Civil Engineering, Zagreb, Croatia vrajcic@grad.hr

² University of Zagreb, Faculty of Civil Engineering, Zagreb, Croatia nperkovic@grad.hr

³ University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia, roko.zarnic@fgg.uni-lj.si

⁴ University of Zagreb, Faculty of Civil Engineering, Zagreb, Croatia jbarbalic@grad.hr

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century- Resources Efficiency of Built Environment	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0- Advanced Construction Engineering	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

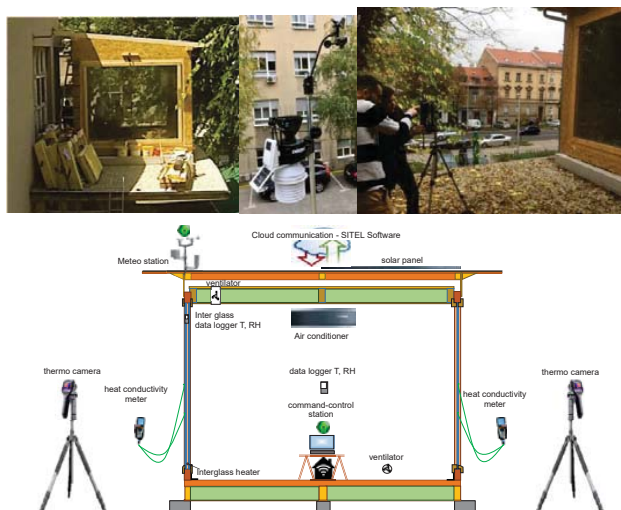
Abstract:

Problems - Issues / Challenges-Needs	<p>When developing the thermal and physical properties of the composite CLT - glass panel and designing the connectivity details that directly affect it, the study is accompanied by the following issues:</p> <ul style="list-style-type: none"> Optimizing its insulation characteristics Bringing it into compliance with the requirements of regulations at national and European level <p>Researching and improving this unique system brings challenges both in the scientific and in the practical aspect of engineering. The key goal is:</p> <ul style="list-style-type: none"> Acquainting the thermal characteristics of the panel and obtaining parameters for construction design in accordance with the applicable Technical Regulations
Solutions - Methods / Results - Findings	<p>Experimental and analytical research of the properties that determine the energy efficiency of the panel is divided into 2 phases:</p> <ul style="list-style-type: none"> Phase 1: Mockup (live laboratory) is examined with double and laminated glass panels. At that stage, the east facade is covered by a wooden sandwich panel in order to measure the influence of the object's orientation on thermal losses on the west side Phase 2: The mockup with single glass panels with elements of equal thickness and properties as in the previous stage is examined <p>The results and measurements that determine the success of the research and future research activities are as follows:</p> <ul style="list-style-type: none"> Local climate, amount of energy from the solar panel, heating between the two glass elements, temperature and relative humidity of the inner area, values of thermal conductivity coefficient, identification of thermal bridges
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> By examining the amount of energy supplied and consumed, the data for the energy balance calculation of the building is obtained Measurement of internal temperature and humidity allows control and achievement of the required internal conditions Based on the measurement results analysis, the thermal properties of the composite panel will be improved and thus contribute significantly to raising the level of its technological readiness
Forum statement	Energy efficiency is the most (cost) effective way to achieve sustainable development goals and combat climate change

Keywords:

Mockup, CLT frame, laminated glass, energy efficiency, long-term monitoring

Graphics:



The optimization involves the resources allocation in the power industry

Authors: Yiqing YUAN¹, Yicheng YUAN²

¹ 1 Huachang Operating Team of Dalian Power Supply Company Operation Work Area, Dalian, China,

yyqing627@163.com

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	The abundant space resources at 50-150 meters from ground surface shall be utilized for power transmission, high-rise building can still be constructed below the transmission corridor and transmission line, and it is safer. Urban land can be saved for constructing compact city, and it is energy-saving for reasonable planning of city and town.
Solutions - Methods / Results - Findings	<p>The pole tower of high-voltage distribution line, high-voltage transmission line, extra high voltage transmission line and ultra high voltage transmission line in city and town can be selectively fixed onto the top of high-rise building which is about 50-150 meters high. The strength of transmission facilities and high-rise building shall both be appropriately strengthened. Violating the regulations in force, but is scientific and feasible</p> <p>Since:</p> <ol style="list-style-type: none"> 1) Reliable and safer. The 1150 kV ultra high voltage of former Soviet Union operated for six years with a total length of 11112 km, and the transmission was interrupted for four times (accounting for 80%) because of the line trip off caused by lightning. Therefore, the probability of trouble at transmission line that might threaten the safety of personnel below the transmission line is $\leq 0.045 \times (1-80\%) = 0.009$ time/(hundred km*year), and that is acceptable; in addition, closed management is performed to the top of high-rise building, equipotential bonding is integrally implemented to building, and it is well grounded, once the transmission line is broken, it would firstly contact the high-rise building, since the pace voltage and touch voltage are zero, the personnel inside the high-rise building is absolutely safe, i.e., having high-rise building below the transmission line is safer than vacant land; the building of civil structure and brick-timber structure is unsafe. 2) Environmental protection. The environmental protection indexes in high-rise building, such as electric field, magnetic field and sound, etc., are all lower than the standard in force of each country in the world, and non-work personnel are prohibited from going up to top of high-rise building; there is no radiation. 3) For the transverse load produced by most transmission towers, so long as it is taken into consideration at the time of design, high-rise building can easily bear, and the increased cost is very low. 4) Other environmental protection indexes like radio interference, etc. constitute no problem. 5) Existing operation, maintenance, galloping prevention, lightning protection, shock-proof and flame-proof techniques (etc.) are mature. 6) Conductor with carbon fiber composite core is adopted. 7) The electric substation with voltage grade of 330kV and below can be constructed inside high-rise building, and power supply can be led in through cable from top of high-rise building, and it seems more economical to adopt 22-25kV as the rated voltage for medium voltage power distribution. 8) It had better avoid famous scenic area; 9) The economic benefit will be at least 3-5 times of investment, and very great benefit can be brought about to city, town and even countryside, the benefit is far greater than the disadvantage. 10) Fear and worry more come from the subjective aspect (psychological factor) of populace. For the 66kV and above overhead transmission line objective probability of personal danger occurrence is far less than the probability of traffic accident, it is estimated to be less than 0.01% of probability of traffic accident, but we have not abandoned automobile for the probability of traffic accident.
Novelty - Value / Relevance to ...	Saving urban land, improving urban efficiency, constructing compact city, reducing investment on urban infrastructure, it is safer below the transmission corridor, the selection of transmission route is relatively easy, energy-saving and low carbon. Med-term, long-term and even ultra long-term planning of city and urban and power transmission and transformation engineering needs to be strengthened, and it needs support from government and relevant laws and regulations. Shortcoming: impacting landscape, initial investment is relatively great, misunderstanding by populace. This thesis belongs to the domain of building and city planning.
Forum statement	The optimization involves the resources allocation in the power industry.

Keywords:

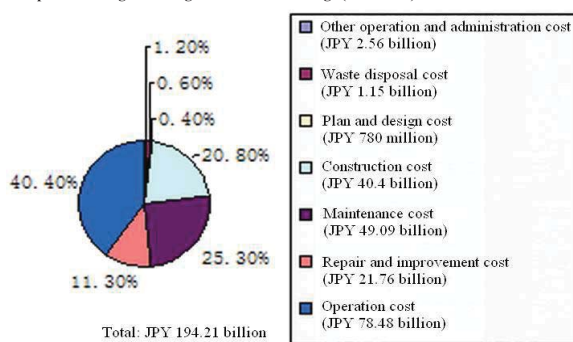
developing power transmission line corridor; high-rise building; urban efficiency; conductor with carbon fiber composite core;
optimizing resource configuration;

Graphics:

Table 1 Former Soviet 500, 750kV and 1150kV lines failure rate data

Voltage Class (kV)	500	750	1150
Total length of each line (km)	57314	15519	11112
Average break rate of each line (including successful reclosing)	0.574	0.206	0.144
Average interruption rate of each line	0.201	0.097	0.045

Chart 1 LCC Comparison of high and large-scale office buildings (Reference)



Issues related to efficient and safe design of refurbished and upgraded large hydropower infrastructures in Slovenia

Authors: Jernej MAZIJ¹, Anton BERGANT²

¹ Litostroj Power d.o.o., Ljubljana, jernej.mazij@litostrojpower.eu; ² Litostroj Power d.o.o., Ljubljana, anton.bergant@litostrojpower.eu;

Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input checked="" type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Refurbishment and upgrading of aging hydropower plants presents a growing area in hydro business. But increase of overall output can result in higher dynamic and structural loads on the existing structure. The main objective is to identify critical elements and operational scenarios which may cause unacceptable structural loads in hydropower plants with complex water-conveyance systems. This is viewed and analysed in terms of transient analysis and broad interdisciplinary knowledge needed.
Solutions - Methods / Results - Findings	Basic overview regarding hydrology and related hydropower plant development in Slovenia will be presented followed by design approaches to upgrading and transient control. A brief outline on theoretical transient models and solutions will also be presented. Theoretical transient models and solutions will be presented and discussed in light of their capability, availability and uncertainty Practical case studies of recent executed projects using combined results of numerical methods and measurements will show effective implementation of transient control devices coupled with expanded analysis of the existing structure.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Presentation of interdisciplinary knowledge and field of transient analysis. • Presentation of transient models, software and on-site measurements techniques. • Overview of hydropower plant development in Slovenia. • Presentation is relevant to all engineers involved in the field of hydropower development.
Forum statement	...

Keywords:

hydropower; water turbines; transient regimes, computational models, field tests

Graphics:

	When to Use	Protection		Reliability	Special Demands	Problems in Restarting	Frequency of Application	Cost
		High pressure	Low pressure					
Surge tank	High head, long tunnel/penstock	Yes	Yes	Very good	None	None	Very often	Very high
Air Vessel	High head, long tunnel/penstock	Yes	Yes	Good	Air compressor	Routine control	Rarely	Moderate
Inertia	All types	Yes	Yes	Excellent	None	None	Often	Moderate
Regulation	All types	Yes	Yes	Good	High-pressure oil installation	Routine control	Very often	Low
One-Way Reservoir	Very long tunnel/penstock	No	Yes	Poor	Frequent maintenance and control	Routine control	Rarely	Moderate
Air Valves	Protection of penstocks	No	Yes	Good	Frequent maintenance and control	Routine control	Very often	Low
Aeration Pipes	Protection tunnel/penstock	No	Yes	Good	None	None	Often	Low
Rupture Membrane	As a last measure	Yes	No	Good	Outlet for water discharge	Replace membrane	Rarely	Very low

CHALLENGES FOR BETTER ACCEPTANCE OF NZEBs IN SLOVENIA

Authors: Marjana ŠIJANEC ZAVRL¹, Damjana VARŠEK², Marko JAČIMOVIČ¹, Mojca ŠTRITOF BRUS²

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>By the year 2020 Nearly Zero Energy Buildings (NZEBs) will become obligatory for all new projects. Slovenia encouraged the construction of "early" NZEBs in order to make the construction sector, developers and end-users ready for advanced energy efficient technologies and for on-site production of energy from renewable energy sources.</p> <p>In spite of good experiences with single family NZEBs in Slovenian real-estate market, the construction of large apartment buildings in NZEB standard revealed many new challenges, like:</p> <ul style="list-style-type: none">-the need for experienced designers, skilled construction teams and specialized control;-to integrate NZEB quality assurance in construction process and in all stages of the building life cycle;-to reduce NZEB investment costs in order to make NZEBs cost effective and even cost optimal energy concept;-to increase the end-users' acceptance of (large) NZEBs by explaining them the benefits of living in such buildings, by offering them appropriate trainings, by providing them simplified and focused information on technologies in NZEBs and by understanding the tenants' and owners' prejudices;-to provide feed-back to policy makers regarding user-friendly NZEB building regulation.
Solutions - Methods / Results - Findings	<p>In the paper the analysis of recent NZEB investments of Housing Fund of The Republic of Slovenia will be presented and the main characteristics of Slovenian early NZEB apartment buildings will be compared with main findings from other countries of H2020 CONZEBS projects consortium (Denmark, Germany, Italy). Thus the national NZEB minimum requirements, typical energy efficiency and RES technologies used and the corresponding costs of NZEBs will be presented and Slovenian national options to reduce investment costs in NZEBs by eventual simplification of the building energy concept will be discussed.</p> <p>Moreover, a survey of current (7) and future (90) NZEB end-users opinion on living in NZEB was done in order to reveal the expectations and eventual fears of tenants and building owners regarding living in NZEBs. Slovenian end-users. Respondents in Slovenia seem well informed about NZEBs. They value good thermal comfort, fresh air in the apartments and good access to daylight. However, they exposed some concerns, especially regarding technical buildings systems in NZEBs and the reliability of their performance.</p>
Novelty - Value / Relevance to ...	<p>The Project CoNZEBs (Solution sets for the cost reduction of new Nearly Zero-Energy Buildings) (2017 - 2019) is funded by the European Commission in the framework of the Horizon 2020 Program under the Grant Agreement No. 754046.</p>
Forum statement	<p>Early NZEBs allowed the study of life cycle costs and technological solutions to reduce the construction costs of new multi-family houses and thus to increase the acceptance of NZEBs.</p>

Keywords:

NZEB, life-cycle costs; reduction of investment costs, end-users' acceptance

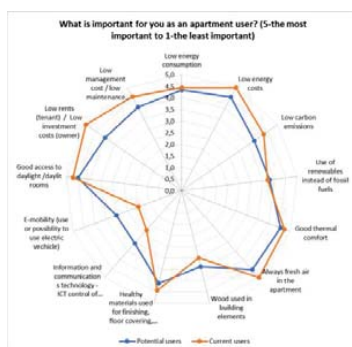


Figure 1: Importance of topics related to living in NZEBs for current and potential future NZEB users in Slovenia)

THE SLOVENIAN APPROACH TO SUSTAINABILITY INDICATORS FOR BUILDINGS

Authors: Marjana ŠIJANEC ZAVRL, PhD¹, Miha TOMŠIČ, MSc¹, Friderik KNEZ, BSc (Phys.)², Sabina JORDAN, PhD²,

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

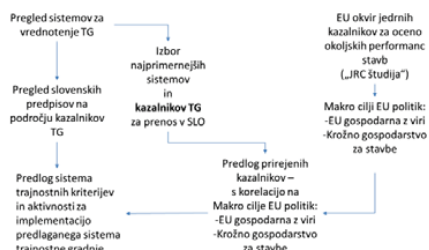
Abstract:

Problems - Issues / Challenges-Needs	Consideration of sustainability in construction of new buildings and in building renovation has been recognized as an important principle in climate and energy strategic documents in Slovenia and in EU. In practice, the increasing of energy efficiency and the integration of RES in new buildings and in renovation often lack of consideration of complementary fields that together influence the core priorities of sustainable building: like GHG emission along the buildings life cycle, resource efficiency and circular materials life cycles (LCA), efficient use of water resources, safety (mitigation of risks due to earthquake), healthy and comfortable spaces, resilience to climate change, optimization of life cycle costs (LCC) and retention of a building value. Currently, there is no methodology defining sustainable construction available in Slovenia, neither in terms of recommendations, nor guidelines or legislation. Moreover, Slovenian market seems to be too small for the national adaptation of international sustainability certification schemes, while on the other hand a generalized (EU wide or international) assessment method is too rough due to neglecting local context.
Solutions - Methods / Results - Findings	The paper presents results of the study commissioned by the Ministry of the Environment and Spatial Planning about various international sustainability criteria with a proposal for possible transfer onto the national level. The research was based on a comparison of international commercial schemes for assessment (and certification) of building sustainability and on evaluation of their applicability in Slovenian construction sector. A consultation with stakeholders was an important step of development process. The research investigated the compliance of national understanding of building sustainability with EU experiences and trends (LEVEL(s)), where a special focus was put on an overview of the Slovenian regulatory framework and the comparison of national of minimum requirements, available benchmarks, adequate assessment methods and tools, as well as knowledge in the fields that are subject to building sustainability assessment. As a result, a set of 8 sustainable indicators with a number of sub-indicators is proposed and for each indicator the implementation gap is evaluated as well as the action plan is prepared to facilitate the implementation of Slovenian approach for assessment of building sustainability in practice.
Novelty - Value / Relevance to ...	The novelty of this research is the tailored approach for assessment of building sustainability comprising a set of indicators that correspond to the priorities of EU resource efficiency & climate and energy policies. Although a building may be evaluated according to many other criteria, important for end-user and developer, this study imposed a distinction between the building sustainability indicators of public and private interest. Thus a set of sustainable indicators will primarily support the state as a guardian of public interest in the Republic of Slovenia in implementation of the "resource-efficient Europe", and the policy of the "circular economy" well as "climate and energy" targets.
Forum statement	"Small real-estate markets like Slovenia also need tailored Sustainable Buildings Indicators (SBI) as well as a country specific SBI system instead of just an international assessment system in order to meet national targets regarding sustainability in building sector."

Keywords:

Sustainable Building; Indicators; assessment system, resource efficiency, LEVEL(s)

Graphics:



Enhancing deployment of integrated solar combined cycle projects in MENA region

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges- Needs	<p>The problems which are related to deployment the integrated solar combined cycle (ISCC) technology may be characterized in the two following items:</p> <ul style="list-style-type: none"> •Infancy ISCC: Although the feasibility of ISCC Technology in MENA region, yet the ISCC projects have been slow to take off in MENA region. •Achievements ISCC Deployment: Efficient use of fuel and solar energy, improvement the performance, increase the out power, meet the growing need energy, to provide a larger share of clean electricity and maximize reductions of CO₂ emission, competitive in energy market and create economic opportunities. <p>Challenges that relate to the need to deployment ISCC technology:</p> <ul style="list-style-type: none"> •Enhance more technical improvements, thermal storage, investment courage and remove the economic and non-economic barriers
Solutions - Methods / Results - Findings	<p>Some methods and strategies for enhance deployment of ISCC in MENA region:</p> <ul style="list-style-type: none"> •Research, development and demonstration support, Develop Incentives for deployment ISCC, Addressing economic and none economic barriers. •Governments in MENA region ensure increased and sustained funding for public and private researches development and deployment (RD&D) of ISCC •Governments to develop ground and satellite measurement/modelling of solar resources. •Seek new heat transfer fluid and storage media for concentrated solar plant (CSP) with through collectors. •Avoid arbitrary limitation on ISCC plant size and hybridization or integration; develop procedures to maximize solar share. •Consider offering suitable land and access to grid or water resources, and waiving land property and other taxes for quick-start deployment. •Provide certainty to investors with long-term power purchase agreements or bidding procedures. •Facilitate grid access for ISCC developers and reward ISCC plants that have firm capacities. •Establish an equitable environment for CSP development through feed-in tariffs or binding renewable energy standards. •Expand international mechanisms to foster the development of CSP plants for local consumption in developing countries. •Financial community should gain the confidence in ISCC. <p>Sustainable and interoperable solutions leading to deployment of ISCC projects in MENA region shall support</p> <ul style="list-style-type: none"> •Integrate more potential gas- combined power plant with solar field. •Meet growing energy demand with reliability and sustainable energy by increasing solar share •Maximizing reduction of CO₂ emission towards the considerations about climate change •Create economic perspective, it offers considerable long-term benefits because of minimum fuel costs for backup, hybridization or integration. •The initial investment costs are likely to fall steadily as plants get bigger, <ul style="list-style-type: none"> •Achieve competitiveness for peak and intermediate loads competition
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> •Crucial Evaluating and provide addressing the challenges and barriers that which should overcome for deployment ISCC projects in MENA region. •The enhancing widespread application of ISCC projects will contribute to reach the aforementioned goals of sustainable development, especially SDG7. •National governments, ISCC industry and developer, Nongovernmental organization and stakeholders in MENA region that plan, implement and take advantage of the ISCC projects.
Forum statement	Integrated solar combined cycle (ISCC) projects are efficient resources among of renewable energies technologies that can contribute in built the sustainable environment

Keywords:

Integrated solar combined cycle; ISCC projects; concentrated sola power; MENA region; and enhancing method.

Graphics:

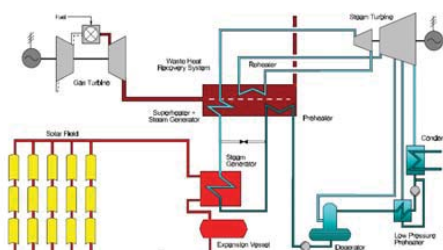
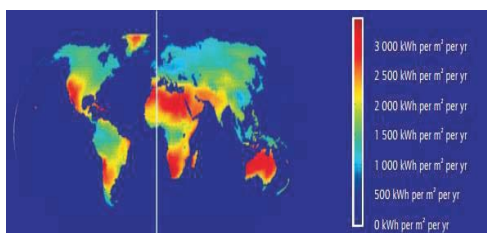
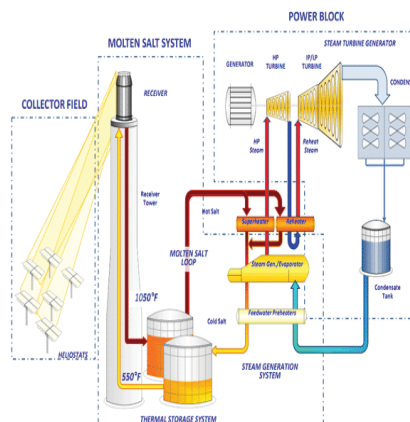


Diagram of Integrated Solar Combined Cycle(ISCC) Power plant



Source: Breyer & Knies, 2009 based on DNI data from DLR-ISIS (Lohmann, et al. 2006).



Typical molten salt storage diagram

Table 1: Current ISCC projects in MENA region

Project	Applicatio n	country	Status	Developer	Capacity (Solar share)	Technology	Owner
Ain-Beni-Mathar	BSCC	Morocco	Operation	Abener	20 MW	Parabolic Trough	ONE
Hassi-R'mel	BSCC	Algeria	Operation	Abener, Abengoa/Mew Algeria	25 MW	Parabolic Trough	Sonatrach
Kuraymat BSCC	BSCC	Egypt	Operation	Renew and renewable energy authority	20 MW	Parabolic Trough	NREA
Duba 1 BSCC	BSCC	Saudi Arabia	Under construction	Saudi Electricity Company	50 MW	Parabolic Trough	Saudi Electricity Company
Waad Al shamal Power plant (BSCC)	BSCC	Saudi Arabia	Under construction	Saudi Electricity Company	50 MW	Parabolic Trough	Saudi Electricity Company
Derwah CSP plant (IRC)	BSCC	Turkey	Development	Esdar/GE-Matco	50 MW	Tower	Metcap Energy Investment
Al Abdullayyah BSCC	BSCC	Kuwait	Development	Ministry of electricity and water	50 MW	Parabolic Trough	Ministry of electricity and water
Yazd BSCC	BSCC	Iran	Development	MAPHA Group	17 MW	Parabolic Trough	
El Borma BSCC	BSCC	Ukraine	Announced	STEG	5 MW	Parabolic Trough	STEG-STEG

ISCC IN MENA

Plant	Country	Operator	Design capacity	Notes
Hamdaniyah-Quana	Algeria	Énergie Production de l'Algérie	400,000	already operating in 2016
Ugha	Algeria	Énergie Production de l'Algérie	400,000	already operating in 2016
Armen East	Jordan	Jord Energy Production Company	1,100,000	already operating in 2016
Armen East	Jordan	NEPCO	500,000	already operating in 2016
Palma	Jordan	NEPCO	100,000	already operating in 2016
Lagouira	Morocco	ENR	100,000	already operating in 2016
Tou-Tou	Morocco	ENR	100,000	already operating in 2016
Al Masud	Algeria	Al Masud Power	230,000	already operating in 2016
Alor	Saudi Arabia	SIC	310,000	already operating in 2016
Shiba	Saudi Arabia	SIC	384,000	already operating in 2016
Jahil	Saudi Arabia	SIC	130,000	already operating in 2016
Qaf	Saudi Arabia	SIC	140,000	already operating in 2016
Al-Jawf	Saudi Arabia	SIC	160,000	already operating in 2016
Chumail	Saudi Arabia	SIC	160,000	already operating in 2016
Chumail	Saudi Arabia	SIC	160,000	already operating in 2016
Palma	Saudi Arabia	SIC	100,000	already operating in 2016
Al-Fayha	Saudi Arabia	SIC	60,000	already operating in 2016
Al-Fayha PWR-C	Saudi Arabia	SIC	1,100,000	already operating in 2016
Tabuk	Saudi Arabia	SIC	444,000	already operating in 2016

Source: IGC Policy.

COMPREHENSIVE DESIGN STRATEGIES FOR SUSTAINABLE TIMBER-GLASS BUILDINGS

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	In view of reducing the negative environmental impacts and increasing the quality of built environment the development of design strategies linking various aspects of sustainability became crucial in architectural and structural planning. Considering alternative and eco-friendly solutions in residential and public building construction requires the use of integrative and interdisciplinary design approach, where buildings are treated as comprehensive system fulfilling multiple demands, such as functional, aesthetic, structural, safety, environmental and energy efficiency.
Solutions - Methods / Results - Findings	Contemporary buildings are mostly subject to attractive modern design characterized by large glass areas enabling adequate daylighting and use of solar gains, which on the other hand opens several problems regarding structural demands. In this manner, the role of responsible and sustainable design has to be oriented towards consideration of various design aspects, into an understanding of various disciplines and not preferring only individual design criteria which have been shown in the past as low quality and partial solutions. The current paper presents a comprehensive overview of the research considering the design of timber-glass buildings. Firstly, it explains the needs for such a building design and secondly, it shows the role and importance of integration of architectural, energy, environmental and structural design. Various researches on building structural stability, energy efficiency, indoor environmental quality and environmental assessment are briefly presented forming an integrated, holistic design strategy for sustainable timber-glass buildings. The integration of individual researches shows the existence of a strong correlation between the building shape, design of glazing areas, selection of building materials, structural design and building quality in terms of sustainability indicators such as environmental and energy performance, structural safety, indoor environment quality and functionality.
Novelty - Value / Relevance to ...	The contribution presents a comprehensive approach to the design of timber-glass buildings considering the issues of energy efficiency, environmental performance and structural design. The conclusions can be used by designers for new built design or the development of renovation strategies for existing buildings.
Forum statement	Reaching the sustainability of buildings is possible only through integrative and interdisciplinary design approach.

Keywords:

timber-glass buildings; energy-efficiency; environmental impact, structural design

THE USE OF TIMBER IN HIGH-RISE BUILDING STRUCTURES

Authors: Boris AZINOVIĆ¹, Iztok ŠUŠTERŠIČ²

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

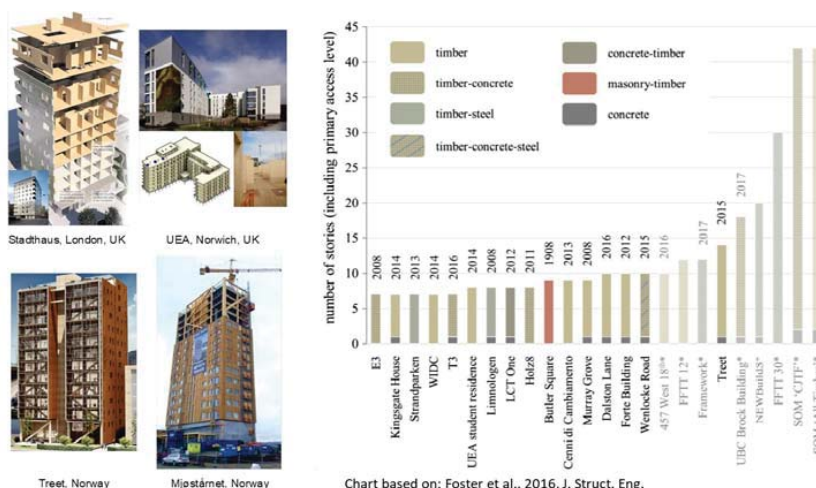
Abstract:

Problems - Issues / Challenges-Needs	Due to the expected increase of population in urban communities the development of new construction technologies using timber is essential in order to achieve more environmentally friendly and sustainable cities. The growing interest in including timber in high-rise buildings has consequently demanded an evolution of new timber and hybrid structural systems. These have not yet been comprehensively researched or used in practice to a greater extent. This issue is even more profound in Slovenia, where the development and construction of such buildings is not as rapid as in some other countries. This may be due to several reasons, such as the limitations of building regulations, technological (un)development, inadequate qualification of building contractors, support of local communities etc. Several new policies have already been or are still being implemented in Slovenia in order to encourage the use of timber in building construction and this could lead to a revolutionary change in the housing industry
Solutions - Methods / Results - Findings	In the presentation, the advantages / disadvantages and feasibility of using timber and timber-based materials as an alternative solution in the construction of mid and high-rise buildings in Slovenia will be presented. Various structural systems will be considered, where a review of already existing timber and hybrid buildings in Slovenia and worldwide will be shown. Descriptive methods will be used in order to recognize the qualities of already constructed timber and hybrid buildings that are essential for their design. The research will try to identify the potential of high-rise timber/hybrid buildings in Slovenia.
Novelty - Value / Relevance to ...	The research will contribute to new knowledge about sustainable design of high-rise timber and hybrid buildings by considering a comprehensive review of such structural systems and by discussing how these buildings fit in the Slovenian local environment and how they perform in terms of their sustainability.
Forum statement	Considering wood as a structural material for the primary structural elements would increase the use of renewable resources in high-rise buildings.

Keywords:

high-rise timber and hybrid buildings; sustainability; environmental impact, economic impact, social impact

Graphics:



PERMEABILITY OF HIGH VOLUME FLY ASH CONCRETE

Authors: Chung-Hao WU¹, Qi-Bao ZHAO², Yu-Feng LIN³, Ming-Yuan CHEN⁴

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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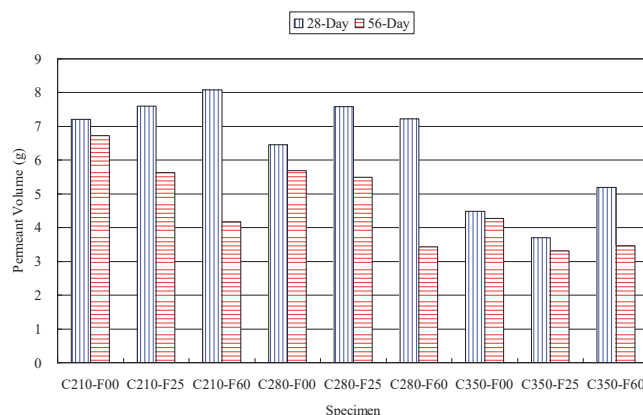
Abstract:

Problems - Issues / Challenges-Needs	In Taiwan, Taiwan Power Company's coal-fired power plants produce 2 million tons coal ash every year, the output of fly ash is about 1.6 million tons, and the bottom ash is about 400,000 tons. All of them are good concrete mineral admixtures, and the utilization value is quite high. It is a well-recognized approach to reduce CO ₂ emissions by substituting fly ash to cement, especially taking high volume fly ash. Therefore, the study aims to discuss the permeability of high volume fly ash concrete.
Solutions - Methods / Results - Findings	In presence of water, fly ash can react with calcium hydroxide at ordinary temperatures to produce cementitious compounds, improving the pore structure of concrete. Hence, high volume fly ash concrete (HVFAC) should be more durable than the ordinary portland concrete (OPC). The test variables in this study include three compressive strengths of concrete (21MPa, 28MPa and 35MPa), three contents of fly ash (0%, 25% and 60%) and two testing ages (28-day and 56-day). The permeability test used 0.3 MPa of water pressure upon the top surface of saturated surface dried specimens ($\phi 150 \times 50$ mm) for 3 hours. Test result shows that water permeation of HVFAC is obviously small than that of OPC, especially at the later age (56-day). However, the phenomenon at the age of 28-day is not obvious. It may be the portland reaction not entirely at this age.
Novelty - Value / Relevance to ...	This study obtains a ideal permeability of HVFAC incorporating Taiwan Power Company's fly ash, it shows that HVFAC is more durable than the OPC. HVFAC is a kind of green building materials, it is low cost and friendly to our environment.
Forum statement	It aims at providing the engineer and decision-making officers with updated information regarding the waste management, costs, influence on climate change, emissions, global trends, challenges.

Keywords:

High volume fly ash concrete; compressive strength; durability; permeability

Graphics:



NEW NUCLEAR POWER PLANT AS PART OF LONG TERM ENERGY SUSTAINABLE DEVELOPMENT IN SLOVENIA

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>There is a long debate in Slovenia about a new energy concept for the next couple of decades. The previous energy plan was valid until 2009 and since then we still do not have any long term energy strategy.</p> <ul style="list-style-type: none"> - There are clear strategic goals set by the European Commission on greenhouse gas emissions on EU level, i.e. -20% by 2020, -40% in 2030 and -80 to 95% by 2050 compared to the level in 1990. The -20% goal was adopted by 2020 climate and energy package, while -40% reduction is part of 2030 climate and energy framework adopted by EU leaders. The goal for 2050 is part of the roadmap to low-carbon economy, which is still in debate regarding the level of required CO2 reduction. But there is solely on the Members how the strategy of cutting greenhouse gas emissions will be implemented in individual countries. In reaching those strategic goals it is essential to follow the sustainable development criteria, i.e. environmental impact, economic competitiveness and safety & security of supply. - The European Commission also set the goals for renewable share and improvement of energy efficiency, i.e. 20% by 2020 and 27% by 2030. - Increasing share of renewables, especially variable renewables (solar and wind), introduces intermittency into the grid system, therefore increasing the system costs
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> - Energy balance analysis are needed to determine the consumption and production of electrical energy in Slovenia for next 40 years. Two very important factors have to be considered, the first one is to determine the growth rate of electricity consumption during the time, and the second one is to carry out how old units will be replaced. - Possible solutions have to be analyzed in term of energy sustainability – energy security, energy equity and environmental sustainability (energy trilemma)
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> - Renewables and nuclear are the only sources in the long term that can contribute to the "fully" decarbonizing of electricity systems. - Nuclear energy is low carbon source, with very reliable baseload production and it can be also very flexible (load following capabilities), if needed. - Renewables and nuclear can be very complementary to each other.
Forum statement	Construction of new NPP in Slovenia is part of the sustainable solution and it would significantly contribute to the sustainable development goals up to 2050 and beyond.

Keywords:

Sustainable development; Nuclear energy; New NPP; JEK 2



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ABSTRACT WCF2019
THEME_1 ENERGY

Keywords: Biomass, District heating, forest, impact analysis, energy performance.

- **PROBLEMS-ISSUES** to be considered when producing a feasibility study:
 - This system is only suitable for areas with forests.
 - Infrastructure costs
 - Obtaining permission and approval for the project
- **CHALLENGES** for domestic use
 - Continuous process of Reforestation necessary
 - Reduce CO2 emissions
 - Introduce a new system of domestic heating
- **RESULTS /FINDINGS** sources : **FIPER** (Federazione Italiana Produttori di Energia da Fonti Rinnovabili). **Politecnico di Milano** (Dipartimento ABC Architettura, Ingegneria delle Costruzioni e Ambiente costruito)
 - Analysis of 13 biomass TLR plants, distributed in four distinct and heterogeneous climatic regions for adopted technology, conformation, population density and climatic zone from South Tyrol to Tuscany.
 - Assessment of the economic and employment impact at different levels: direct, Indirect and Induced.
 - The performance of Biomass District Heating
 - The substitution of traditional oil heating systems

NOVELTY VALUE: The particular case of Italian district heating in mountain areas and the forest-energy supply chain. The use of wood as a primary source for the production of heat.

FORUM STATEMENT: Biomass district heating is an efficient alternative to other more traditional sources of sustainable energy, in particular due to the relative energy advantages and the potential role in the containment of fine dust emissions in the atmosphere.

Efficient use of energy in the light of optimal public passenger transport

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>Solving problems related to the effective use of Public Passenger Transport (PPT) are opportunities, among other things, for:</p> <ul style="list-style-type: none"> - energy savings, - reduction of greenhouse gas emissions, - reducing congestion, etc. <p>These positive effects can be further enhanced by the following measures:</p> <ul style="list-style-type: none"> - by adapting public passenger transport to the needs of the population, - by selecting such PPT vehicles that use alternative propulsion technologies according to the terrain configuration.
Solutions - Methods / Results - Findings	<p>The basis for the implementation of Public Passenger Transport (PPT) is represented by:</p> <ul style="list-style-type: none"> - the static infrastructure part consisting of station points, stops, line sections, lines, itineraries, ... - the dynamic traffic part, which represents timetables together with the departures of individual journeys and traffic implementation modes. <p>Efficient public passenger transport is achieved through the optimization procedures of the static and of the dynamic part.</p> <p>In addition, by choosing the most advanced vehicle propulsion technologies in the PPT system, we aim to achieve additional energy savings and reduction of greenhouse gas emissions.</p> <p>The article presents research in the field of selection of vehicle propulsion technologies in the PPT system focusing on optimization procedures taking into account the configuration of the terrain and the characteristics of the infrastructure base.</p>
Novelty - Value / Relevance to ...	<p>The described model of establishing efficient public passenger transport is an important tool for the efficient management of this PPT, which is under the responsibility of the Ministry of Infrastructure in the Republic of Slovenia.</p> <p>It is proposed that such research be continued and be included in the tendering procedures for awarding concessions in the PPT area in the Republic of Slovenia. This kind of research would also have the greatest effects on efficient use of energy for achieving optimal PPT implementation.</p>
Forum statement	...

Keywords:

Public Passenger Transport, Energy savings, Alternative propulsion technologies

POTENTIAL OF SHALLOW GEOTHERMAL ENERGY IN SLOVENIA

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Forum topics	<input checked="" type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

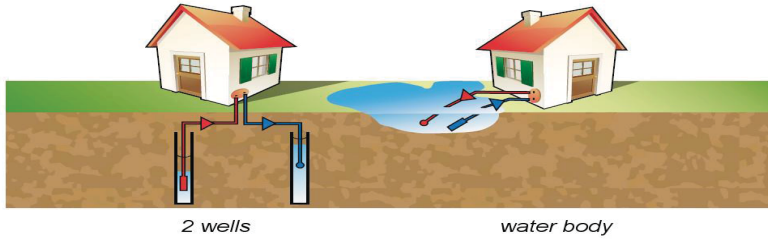
Problems - Issues / Challenges-Needs	Geothermal energy is a renewable source of energy. One of many options is the use of shallow geothermal energy. This energy is stored in the form of warmth under the Earth's surface to 300 or 400 meters of depth. We exploit it with the help of geothermal heat pumps. Those strip the warmth out of the underground water in the case of water-water, or it strips the warmth in the case of earth-water and exploits it to the object where it warms the places. For the deprivation of water open-loop and closed-loop systems are needed. In the case of underground water pumping a well is used that works like an open system, in which the main parts are two holes. One is used to pump water and other for returning of the used water back into the source. In case of dispossession of the heat out of the rocks earth panels are built-in borehole collectors or horizontal collectors. By the deciding for the manner of gathering it is important to consider the situation in the nature (are there any wells, aquifers, lakes or streams), is there enough space to do an excavation, is there access for excavating a hole, is the earth moderate enough for the excavation and so on. The course of the transition of the heat is happening in the heat pump through its component parts. The refrigerant, that took the heat, travels through the evaporator, compressor and condenser, where its state of matter is changed, it ends in an expansion valve, where it cools down so it can begin to start stripping the heat again. The process repeats itself. The produced energy is used for heating, cooling, ventilation and air-conditioning of rooms, also in production processes. In the article we show the potential of using shallow geothermal energy in Slovenia
Solutions - Methods / Results - Findings	Shallow geothermal energy is present everywhere and constantly. There is no possibility that, due to weather or political conditions, there will be a break in its delivery. There is also no need for fuel and waste transportation. There are also no air discharges. We do not need storage and storage for energy products. In general application, that for 1 kW of electric power input we receive additional 3 kW of thermal power from the ground and we heat with total heating power of 4 kW. This efficiency is increasing with the development of technologies. Following the trend of current growth, the pumps installed in 2020 will already achieve the seasonal efficiency factor SPF = 5. Shallow geothermal energy comes from the building and its own grounds, and the payment that we pay for the part of the energy invested, remains at home. Shallow geothermal energy is suitable for new buildings as well as renovation of new and older buildings. The setting in the building requires very small space, the operation is quiet, and the technology of the operation of geothermal heat pumps is comfortable, reliable and enables long operation, for 30 years and even more.
Novelty - Value / Relevance to ...	Shallow geothermal energy in renovations and new constructions always appears as an example of advanced renewable energy sources. In the article we present concrete solutions for the exploitation of shallow geothermal energy, while at the same time we present the good practices and potential that Slovenia has in the exploitation of shallow geothermal energy. Good practices in the use of geothermal energy from individual countries have a wider social significance in the efficient use of renewable energy sources.
Forum statement	...

Keywords:

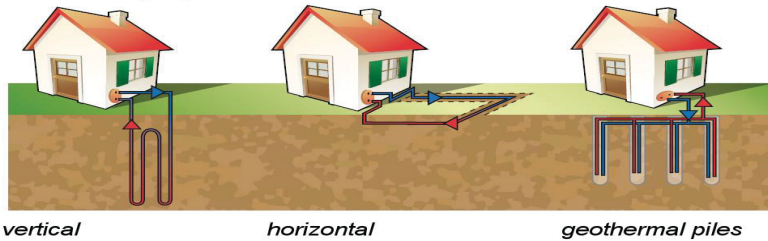
Shallow geothermal energy; Geothermal heat pump; Well; borehole collector; Groundwater

Graphics:

open loop system



closed loop system



IMPROVING ENERGY AND RESOURCE EFFICIENCY IN THE EU CONSTRUCTION SECTOR

Authors: Olga MALA¹, Miroslava IVANOVA²

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Abstract:

Problems - Issues / Challenges-Needs	The EU building stock is aging and becoming increasingly outdated in terms of energy efficiency standard. In fact, buildings currently account for approximately 40% of the EU's energy consumption and 36% of its CO2 emissions. In addition, the current replacement and renovation rates are not high enough to ensure that the full potential energy savings is achieved.
Solutions - Methods / Results - Findings	In this challenging context, EU and EU Member states policy-makers have developed different responses to these issues, ranging from national strategies, to policies, regulations, instruments (fiscal and financing measures). However, these responses also face several obstacles – whether they are shaped by the national institutional and regulatory framework, or by a lack of economic incentives and capacities. This is reflected in the European Construction Sector Observatory policy fact sheet and analytical reports, which look into more depth in the energy and resource efficiency of the construction sector in the EU and EU Member States. On this basis, the presentation will aim to provide recommendations about how national policies can improve energy and resource efficiency of the construction sector.
Novelty - Value / Relevance to ...	This presentation will help providing an EU-wide overview of the energy and resource efficiency of the construction sector, and highlight some of the areas where especially policy-makers can have a major impact. These include energy performance improvements and renovation initiatives; financing measures; information and awareness raising activities; research initiatives; skills and training provision and resource efficiency improvements.
Forum statement	-

Keywords:

Energy Efficiency, Resource Efficiency, Energy Policy, Construction Demolition Waste, European Construction Sector Observatory

Graphics:



Practical experiences with design and construction of Slovenian first Platinum certified DGNB sustainable building

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	<input checked="" type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	There are many sustainable buildings, materials and solutions on the construction market. Some are truly sustainable and some are self-proclaimed. How can we differentiate or compare such solutions and buildings and find out how well sustainability aspects are really fulfilled? There is a lack of such benchmarks, good praxis cases and practical know-how in Slovenian construction industry. On the other hand there are several sustainability aspects already incorporated in national policies regarding construction and there is an European voluntary sustainability reporting framework (LEVEL(s)) in preparation. Do we really know how to face them?
Solutions - Methods / Results - Findings	In Knauf Insulation we planned to build a new conference and workshop building in Škofja Loka, Slovenia. For a long time ago we passed energy efficiency mantra and went beyond that – thinking construction industry as a whole, including sustainability aspects. We wanted to prove to ourselves first and to others second that our materials, solutions and know-how can provide modern, truly sustainable buildings. That is why we decided to use internationally used DGNB sustainability certification scheme for independent assessment. There were some specialties and novelties compared to traditional construction processes, since it was the first new built building in Slovenia to be assessed, but we learnt a lot throughout the project. And we achieved excellent result – highest Platinum DGNB certificate. Additionally we are in the process of assessment also according to LEVEL(s) framework. The results, findings and practical experiences from this pioneering project will be the main focus of the presentation.
Novelty - Value / Relevance to ...	Knauf Insulation Experience center (KIEXC) is a demonstration and education centre where activities about sustainable construction and materials for the professional and laic public are actively organized. KIEXC is an important exemplary building – it is the first certified sustainable new-built building in Slovenia, certified according to DGNB and Open house scheme and pilot project for LEVEL(s). It is also pilot project for Slovenian Ministry of Environment for gaining practical experience in quality certified sustainable construction on Slovenian market and preparation of national sustainability construction guidelines.
Forum statement	...

Keywords:

Insulation; sustainability; DGNB, LEVEL(s);

Graphics:



Theme 2: Construction 4.0 – Advanced Construction Engineering

Development of Tunnelling Technology in China over the Past 40 Years

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Vice President, Tunnel & Underground Works Branch of China Civil Engineering Society(CCES)
Professor and Deputy General Manager, China Railway Academy Co., Ltd., yanjinxou01@crecg.com

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	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Since the adoption of the reform and opening-up policy 40 years ago, China's achievements are remarkable and its tunnelling sector also witnesses significant development. Over the past four decades, the length of only traffic tunnels (railway, road and metro tunnels, not including hydropower tunnels, hydraulic tunnels and utility corridors, etc.) built in China has reached 33,000km, 15.8 times the total length of tunnels built before reform and opening-up. Meanwhile, the tunnelling technology in China has undergone a rapid development, characterized by the technological innovations in investigation, design, construction and equipment, and the breakthroughs in the construction of mega and complex tunnel projects. The presentation will cover the technical challenges and achievements in the construction of super long tunnels, great-depth tunnels, super-large tunnels and high-altitude tunnels. In addition, it will show the major technical challenges facing the Major Tunnel Projects to be built in the near future, and the development trends of tunnelling technology in China. It is generally acknowledged that the tunnel engineering achievements in China over the past 40 years would not have been possible without the benefits gained from the development of international tunnelling technology, while reciprocally, the development of tunnelling technology in China also contributes to the international tunnel engineering development.
Solutions - Methods / Results - Findings	
Novelty - Value / Relevance to
Forum statement	...

Keywords:

Long tunnels; Great-depth tunnels; Large tunnels; High-altitude tunnel; China

Perspectives for Industry 4.0 in Construction

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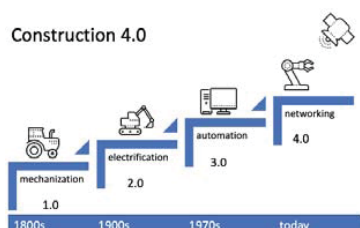
Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	In the early 2010s the German industry started their revival under the umbrella term "Industrie 4.0". European industry's strategies recapitulated most of the ideas and the European architecture, engineering and construction (AEC) industry is following. This contribution will elaborate on how to understand in structure the Industry 4.0 ideas in the context of construction. Special attention will be given to the relation to the building information modelling technology which is seen as the main driver of this new technological approach in the AEC industry, however, within the industry 4.0 it becomes an important building block.
Solutions - Methods / Results - Findings	<p>We are exploring the concept using the structure-function-behavior paradigm.</p> <p>Structurally what explore technologies are involved, such as:</p> <ul style="list-style-type: none"> • internet of (people and) things, • cloud, digital twins, robotics and • cognitive computing. <p>We structure the technologies into five levels as per literature and give examples from the domain of construction. Five levels of complexity of cyber-physical systems are presented.</p> <p>Functionally, we explore aspects of what the Industry 4.0 provides for the customer, for the company and for the industry.</p> <p>Based on these criteria, an analysis was carried out asking where the elements of construction 4.0 can already be found, what is still missing and what is the direction that research and work of the builders should focus on to retain the leading role in the design of the built environment. As such environment will inevitably become a cybernetic-physical system, building and construction professionals will have to compete against professions providing a cybernetic part. This contributes to the behavioral part of the concept.</p>
Novelty - Value / Relevance to ...	It's increasingly hard to find an industry in the 21st century that is more physical and less digitized than AEC. That is why cyber-physical systems are among the major challenges for the construction industry. They are closely related to the shift of the AEC industry from business models, where the product is of a material nature, to information and digital products, data and intellectual business models. The competition for networking the built environment is large and comes from different sides, so it is necessary to take initiative. We are presenting and evaluating strategies and directions derived from Industry 4.0 that could enable us to achieve that.
Forum statement	Unless construction industry does not adopt and develop industry 4.0 concepts it is exposing itself to danger that it would be a subcontractor of those who will be developing intelligent built environment.

Keywords: industrial policy, construction 4.0, information modelling, cyber-physical systems

Graphics:



BUILDING SMART AND SAFE CONSTRUCTION SITES WITH DEPENDABLE DECENTRALISED ARTIFICIAL INTELLIGENCE APPLICATIONS

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Abstract:

Problems - Issues / Challenges-Needs	Every building project is unique; it is designed for a specific site, and usually requires the collaboration of several companies with different project roles. In the course of every building project, it is necessary to address a number of problems and issues falling under the broad categories of safety at work, construction site management, management of resources, waste and assets, construction progress monitoring and early (disaster) warning. The goal of the present work is to analyse various use cases where smart operation and safety can be achieved at construction sites with the use of advanced information and communication technologies, particularly, the Internet of Things, Artificial Intelligence, Cloud, Fog, Edge, Blockchain and Smart Contracts technologies.
Solutions - Methods / Results - Findings	<p>Various use cases for smart and safe construction sites are analysed. These include the design of applications for safety, such as the identification, if all persons on a construction site wear helmets, intruder detection, real-time equipment (assets) positioning, access routes control, warning systems for collision detection, waste mapping, construction progress monitoring use cases, and alignment of the collected information with a Building Information Model (BIM).</p> <p>In order to achieve information integration, a methodology and a distributed system is presented that can be used to turn a specific construction site into a smart and safe construction site by including a specific number of cameras and sensors on the ground, on the actors (such as construction workers, visitors) and objects (such as building equipment, waste, materials etc.), so that data and information can be collected and information, signalisation and notifications can be provided through the use of innovative means, such as smartphones, digital signalisation and actuators.</p> <p>Smart applications have been designed that involve the use of sensors and video-cameras that stream data towards Fog and Cloud computing resources. A Big Data pipeline is designed in which various Artificial Intelligence (AI) algorithms are used, such as, for example, Tensor Flow based deep learning. The presented applications' design optimises the operation of a construction site by issuing notifications and at the same time provides the construction workers an improved safety based on information on working hazards, while reducing physical stress. Alerts and notifications are made automatically via mobile IT devices.</p>
Novelty - Value / Relevance to ...	The novelty of this work is the use of latest Artificial Intelligence and Fog computing approaches that are applied in the domain of smart construction management. This work is aligned with several initiatives and projects world Wide.
Forum statement	With the use of advanced information and communication technologies, particularly the Internet of Things, Artificial Intelligence, Cloud, Fog, Edge, Blockchain and Smart Contracts technologies towards the Smart and safe construction

Keywords:

Safety at work; construction site management; management of resources, waste and assets; construction progress monitoring; early (disaster) warning.

Acknowledgment:

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 815141 (Decenter project: Decentralised technologies for orchestrated cloud-to-edge intelligence).

Graphics:



New aspects of interdisciplinary cooperation based on OPEN BIM platform

Authors: Hermann Ooging¹

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	<input checked="" type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	BIM is advancing the AEC industry, enabling project teams to work more efficiently through digitalization of design and build workflows. The increase in BIM design and construction technology tools is demanding more from the engineering workflow making collaboration amongst all project partners more complicated and difficult to manage efficiently. Multi-disciplinary project teams now organize the design and build process by bringing together their respective models for coordination, issue tracking, and clash detection; however, this primarily has benefitted architectural design and construction workflows. Structural engineering design and build workflows are more complicated, and as project teams modify their respective models, structural engineers must maintain not only the structural model but also the analysis model. Existing engineering exchange formats are difficult to edit, incomplete, and most importantly do not meet the needs of customers. Structural designers, modelers, and detailers spend a significant amount of time and resources maintaining their analytical and structural models as projects progress from conceptual design to the construction site.
Solutions - Methods / Results - Findings	At the center of Digital Structures is Allplan's Bimplus, a cloud based model server with object-oriented data storage, where multiple structural and analysis models can be stored semantically. Through this central place, a common data environment, both the structural modeling and analysis applications can be connected with no loss of data or clumsy file transfers needed during the design process. Unlike most collaboration platforms where data is only stored and visualized as an aggregated model, Bimplus uses intelligent linking of the applications to connect different model information. Nemetschek embraces OpenBIM and the common data environment is made available to 3th party applications through IFC and an Open API. In an effort to improve the structural design and analysis industry the digital structures team is developing a new Structural Analysis Format (SAF) that makes the improved workflow process open to all applications. Our thorough investigation has shown that there is not a real standard in this domain. Although we support IFC for structural analysis modeling, it is limited in functionality and doesn't meet the requirements of engineer's daily workflows. Engineers need something convenient, editable, and user-friendly, that's why we chose to create the SAF format in the spreadsheet format. Almost every engineer uses spreadsheets in their daily workflows and we find it a natural format for their needs. We hope it will be adopted by the industry.
Novelty - Value / Relevance to ...	We understand that structural engineering workflows are complicated, and engineers need something to help them streamline their BIM processes. We aim to bring real BIM for engineers to the AEC industry and enable project teams to work more efficiently through digitalization.
Forum statement	...

Keywords:

OpenBIM; Support of digitization; Digital Structures

Graphics:



Digitization of the Construction Industry. Engineering Organizations in Support of European Initiatives, BIM Standardization and Accelerating BIM Adoption.

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Abstract:

Problems - Issues / Challenges-Needs	<p>Construction 4.0 - "branch" of Industry 4.0. Digitization of construction industry.</p> <p>The European Commission has confirmed further support for a harmonized and aligned European approach to digitization in the construction sector:</p> <ul style="list-style-type: none"> Digitizing European Industry initiative (DEI) - The European Platform of national initiatives as the core part of the overall coordination framework. European digital industrial platform for construction sector. European Construction Industry Manifesto for Digitalization in support of Europe-wide digital platform. CWA Smart CE marking for construction products. BIM - at the heart of Construction 4.0 but not the only element. What else is Construction 4.0? <p>International and European Standardization in support of Construction 4.0.</p> <p>Standardization challenges are partially responsible for the construction industry lagging behind in the digitalization trend. Standardization issues is perceived as the most important barrier for digitalization, including both the lack of standards, and the use of too many different standards.</p> <ul style="list-style-type: none"> BIM Standardization Platform. International BIM standardization as a complex process involving ISO and CEN technical committees, buildingSMART, geospatial and industrial entities. The role of CEN Technical Committee 442 on BIM - fundamental to put together national efforts to define standards contributing to the creation of a common framework for the digitisation of the construction sector. <p>The challenges:</p> <ul style="list-style-type: none"> "Digitizing European Industry" Initiative requires ambitious collective effort involving public and private stakeholders across Europe at regional, national and EU level. Creating a unified approach to BIM implementation is hugely important -the role of EU BIM Task Group. The CEN technical committee 442 in charge of the standardization work regarding all information in the built environment. <p>The needs:</p> <ul style="list-style-type: none"> Engineering organizations need to be proactive in the process of digital transformation of the construction industry – preparing Europeans engineers for the digital future.
Solutions - Methods / Results - Findings	<p>The adoption of open BIM standards is an essential first step to industry digitalization providing a common interoperability.</p> <p>Governors of the World Economic Forum (WEF) Initiative on the 'Future of Construction' have prioritized BIM adoption as a critical step toward transforming the industry and recommended actions that companies, industry organizations and governments are advised to implement to accelerate BIM adoption - An Action Plan to Accelerate BIM Adoption.</p> <p>Engineering organizations in support of Accelerating BIM Adoption, providing greater communication and awareness raising. A strong network facilitating transfer of knowledge, expertise and capabilities needs to be put in place at the European level.</p> <p>Engineering organizations will contribute for transferring lessons across national and regional boundaries and creating a more balanced understanding of digital transition across the construction sector in Europe.</p>
Novelty - Value / Relevance to ...	<p>There is a need to be changed behaviour and processes, not just technology.</p> <p>Engineering organizations need to work more collaboratively towards a new level of collaborative engineering knowledge management and to be committed to cooperate constructively towards achieving the engineering challenges of construction digitization and sustainable development, providing a continuous EU-wide dialogue.</p>
Forum statement	Joint European approach is needed to develop a world-class digital construction sector.

Keywords: Construction 4.0, digital transformation, BIM standardization, BIM Adoption, Engineering organizations

Consistent and standard model content – a way towards utilization of advanced BIM use cases

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Abstract:

Problems - Issues / Challenges-Needs	All the efforts of engineers involved in a BIM project must strive towards consistency of deliverables. Consistent model file names, element names, classification and property names with consistent values are the key to successful implementation of advanced BIM use cases, like e.g. 4D-, 5D- and 6D-modelling. By respecting existing national BIM standards and guidelines we have a good input when planning the implementation, but far more detailed guidelines need to be developed in planning documents (Employer information requirements – EIR and BIM execution plan – BEP).
Solutions - Methods / Results - Findings	One of the most important BIM execution planning activities is exact definition of consistent content of the future models. The following concerns need to be addressed at the project initiation: <ul style="list-style-type: none"> • Optimal segmentation of project to partial models, • selection of appropriate classification system (on the element level), • definition of required properties (names and values) and property sets for different types of elements and different BIM use cases, • level of development (geometry and alpha-numerical information) for each element type, • quality control of the content during design development.
Novelty - Value / Relevance to ...	Efficient way for defining these requirements is to establish a database that is capable of transferring the data to modeling software. In example, BIM management defines the property names and possible values for a specific element in a database and after synchronization with modelling software, same properties and list of values are assigned to this element. This is limiting the possibility of forming inconsistent content during design development. This approach enabled us to implement advanced BIM use cases on several complex infrastructure and high rise projects.
Forum statement	Consistent and standard model content brings real value to optimization of processes in the AEC industry.

Keywords: BIM implementation planning; Level of Information; Quality control; BIM use cases; Experiences from complex projects



Supporting measures of BIM from the perspective of professional institutions

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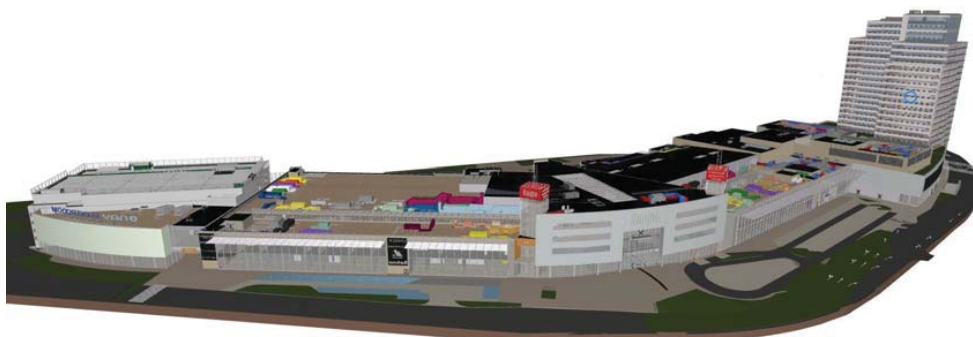
Abstract:

Problems - Issues / Challenges-Needs	Creating and modifying BIM models and objects in 3D parametric BIM environment is a highly professional activity that requires not only special knowledge in the field of construction but also the skills to use specialized software allowing BIM utilization. Properly created object is important prerequisite for further use of information derived from BIM model and to fully explore the potential of BIM.
Solutions - Methods / Results - Findings	Specialized courses are aimed at acquiring and acquiring basic knowledge and skills for teamwork within virtual projects. The course is intended for individuals from all participants in the building process and throughout the life cycle of the building. A prerequisite for successfully completing training courses is the ability to adopt a new concept of work focused on object collaboration and effective exchange of information.
Novelty - Value / Relevance to ...	The role of Chartered Engineers is to support the innovation in the construction sector and to provide Civil engineers with the skills and technical knowledge requested by investors when using Building Information Modeling (BIM).
Forum statement	...

Keywords:

BIM; ECEC; Support of digitization; Better project delivery

Graphics:



USING BRIDGE-WIM TO MEASURE BRIDGE PERFORMANCE INDICATORS

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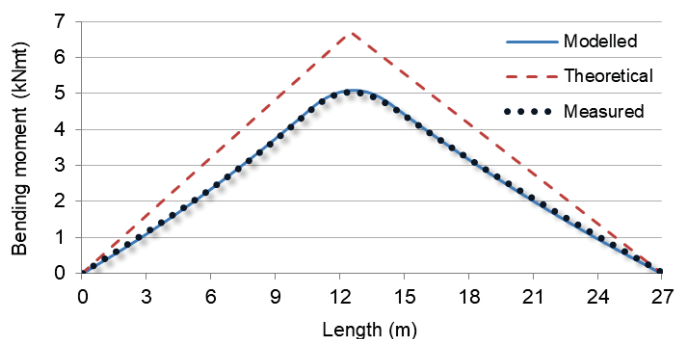
Abstract:

Problems - Issues / Challenges-Needs	Bridge management requires accurate information on the status of the bridge in order to achieve optimal balancing between maintenance costs, potential risks and overall bridge performance. One of the key performance indicators is structural safety of the bridge, which not only requires knowledge about how bridge condition affects its resistance, but also in-depth information about the actual traffic loads. Assessment is primarily needed for ageing bridges that are deteriorated and close to the end of their life cycle. Safety of such bridges is often difficult to prove when using only the traditional analytical methods. To avoid unnecessary remedial actions, such as strengthening or even replacement of a bridge, it is therefore beneficial to use load, structural and material testing.
Solutions - Methods / Results - Findings	This paper will discuss the latest developments in bridge weigh-in-motion technology, which not only provides axle loads, axle spacings and accurate timestamps of all heavy vehicles that cross a bridge, but can also efficiently measures structural parameters that are critical for optimal bridge assessment: influence lines, girder distribution factors (GDF) and dynamic amplification factors (DAF). Knowing the statistical values of these performance indicators significantly reduces uncertainties associated with the load effects, which decisively affects the results of structural safety assessment. In addition, applying measured, not assumed data allows to reduce the safety levels (selected partial safety factors or risks of failure) used in the analyses. This all contributes to more optimal spending of infrastructure maintenance funds.
Novelty - Value / Relevance to ...	Collecting structural information and true traffic loading is slowly penetrating to bridge assessment practice, with the goal to optimize the rehabilitation decisions. The topic is relevant for infrastructure owners and managers who want to spend their resources for maintenance of transport infrastructure in the optimum manner.
Forum statement	...

Keywords:

Structural safety; bridge; weigh-in-motion, traffic loading, resistance

Graphics:



Theoretical, bridge-WIM measured and calibrated analytical influence line of an in theory simply-supported bridge

GeoGuard: an innovative service to monitor the displacements of structures and ground, based on cost-effective GNSS sensors

Authors: Eugenio REALINI¹, Stefano CALDERA¹, Daniele MOLINARI², Lapo PASQUI²

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	<input type="checkbox"/> Engineering Capacity Building	<input checked="" type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Precise and timely measurements of displacements for structure health monitoring and natural hazard monitoring and prediction are highly valuable data for engineers, infrastructure and civil protection managers. Aging and ground motion affect the health of structures such as bridges, dams, pipelines. GNSS technology allows for continuous and precise monitoring of structures and ground movements, but it is not widely adopted due to the high cost of the instrumentation based on geodetic-class GNSS products.
Solutions - Methods / Results - Findings	The GeoGuard monitoring service provides continuous monitoring with millimeter-level accuracy for daily/hourly solutions, by using cost-effective GNSS hardware. The whole system is designed, developed, produced and operated by GReD and Softeco. The GeoGuard weather-resistant units are deployed, operated and maintained by Softeco. GNSS data sensed by the GeoGuard units are continuously processed by means of positioning software and station network management software developed by GReD. Customers visualize the results by connecting to an online portal, showing the measured displacement data for each station.
Novelty - Value / Relevance to ...	The recent introduction on the market of cost-effective GNSS equipment allow to reduce the hardware cost by a factor of ten. Unlike traditional GNSS hardware vendors, GeoGuard provides an end-to-end service that includes all the activities and tools needed to effectively provide a continuous monitoring of the movements and deformations undergone by structures and/or the ground. As an additional service, GeoGuard can also provide time series of atmospheric water vapor estimated along the zenith direction from each GNSS antenna, which can be used to improve the forecast of local convective rain events, which in turn could trigger movements of the ground.
Forum statement	GeoGuard: an innovative service for the continuous monitoring of displacements of structures and ground by means of cost-effective GNSS sensors

Keywords:

Monitoring; GNSS; structures; landslides; sensors

Graphics:



Analysis of Combined Pile Raft Foundation based on a static load test

Authors: Zygmunt MEYER, Prof. Ph.D. (Eng)¹; Piotr CICHOCKI, Ph.D. (Eng)²

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input checked="" type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

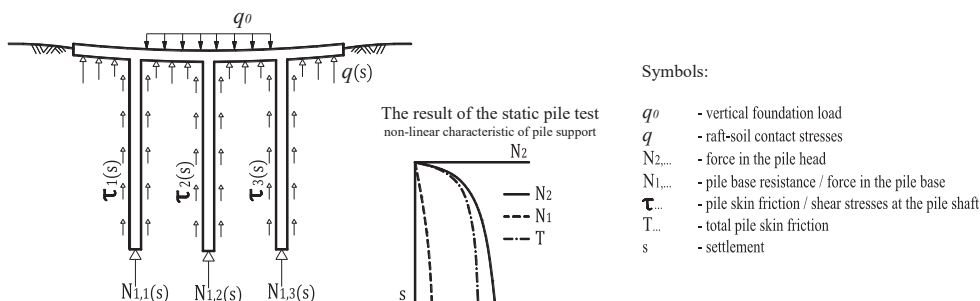
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> It is common practice to verify the correctness of the assumptions made for the calculation of a given pile foundation, by performing a static load test of piles. The test piles also enable the correction of the basic piling design assumptions in order to optimize the costs and time of its execution. When analysing the settlement of a construction object, it should be taken into account that the results of measurements of the single pile behaviour obtained during the static test do not correspond to the behaviour of the pile occurring in the group of piles under the raft. This is mainly due to the formation of stresses zones in the soil from the individual piles forming the foundation. In connection with the above, a method was developed that uses the results of a static pile test to analyse the load-settlement curve of a pile occurring in the pile group under raft. An additional advantage was the use of a curve extrapolating the results of the test to the limit load corresponding to the vertical asymptote on the load-settlement curve. This makes it possible to determine the safety factors of the foundation and, if necessary, to optimize the plan of piling or thickness and reinforcement of the raft.
Solutions - Methods / Results - Findings	<p>The proposed method of calculating piled raft foundations take into account the interaction of the raft, piles and soil. The mathematical model used research on the range of active stress zones in the determination of foundation settlements and a curve approximating the results of static tests of piles. They enable taking into account the actual load-settlement relations of the raft and piles, which makes the discussed model closer to the physical description.</p> <p>The developed mathematical model allows to determine the contact stresses under the foundation raft and the reaction of piles in the form of skin friction and base resistance.</p>
Novelty - Value / Relevance to ...	<p>Numerous methods used to analyse piled raft foundations have not taken into account the pile reaction under the raft in accordance with the curve approximating the results of the test static pile load and extrapolating them to the limit load capacity. The proposed mathematical model gains significant practical significance, in combination with the method of designing piles included in Eurocode 7 on the basis of results of static load tests and the observation method recommended during the realization of piled raft foundations.</p>
Forum statement	<p>It is possible to use the load-settlement curve from the static load test of the pile in the full range for practical purposes, to analyse the load-settlement curve of the pile occurring in the group of piles under the raft.</p>

Keywords:

piled raft foundation, settlement, numerical model

Graphics:



Analysis of Frame Constructions of Morefloors Buildings with the Aspect on Distribution of Internal Forces

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Simple calculation of the frame constructions, due to the effect of horizontal seismic forces, which is possible by using approximate methods and procedures, respecting analogy and similarity of the console and multi-floors buildings. The accuracy of the procedures depends on the starting assumptions and the input parameters. Control of the balance state of the frame constructions of the whole building or individual floors is also important, as a security in accuracy of the results.
Solutions - Methods / Results - Findings	<p>Starting basics for calculation and analysis of calculation models:</p> <ul style="list-style-type: none"> - Using computers and appropriate software packages, - The symmetrical framework structures of multi-faceted buildings on the effect of horizontal seismic forces were analysed, - Using an analogy with the equivalent static load method, - Modelling ranges for beams or gaps in pillars, - Modelling floor level, - Modelling stiffness of columns and beams, - Modelling structural assemblies of frame structures, <p>Analysis of the results of the diagram of the moment bending of frame structures of multi-storey or multi-floor buildings it showed that:</p> <p>There is a complete analogy of frame structures with a console carrier in the redistribution of the bending moment.</p> <p>The sum of the bending moment in the vertical columns or the nodal connections of the frame structure with a direction opposite to the effect of the horizontal seismic force is equal to the value of the clamping moment in the replacement console carrier.</p>
Novelty - Value / Relevance to ...	<p>The value of the bending moment in the pillars of the ground floor is equal to the value of the product of the total seismic force applied at the level of the first ceiling and the height of the first floor it is possible to quickly and easily control the balance situation at any stage or the whole construction.</p> <p>This analysis method indicates the existence of legality regarding the redistribution of the bending moment in the frame construction due to the effect of horizontal seismic forces, which results in the value of the clamping moment at an equivalent console carrier with a precise value without any deviation.</p>
Forum statement	...

Keywords:

frame constructions; console; seismic forces; system balance; bending moment

OPTIMIZATION TEST STUDY OF CONNECTIONS AND JOINTS BETWEEN ELEMENTS OF THE HYBRID TIMBER-STRUCTURAL GLASS PANEL

Authors: Vlatka RAJCIC¹, Roko ZARNIC², Nikola PERKOVIC³, Jure BARBALIC⁴

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>The hybrid timber-structural glass panel, which authors are Zarnic and Rajcic, is innovative building element suitable for adaptive façade or as load bearing element. This multifunctional system is merging and overlapping transparent building envelope and constructive element purpose into one – with the goal of creating not only architectural quality, sustainable and inexpensive, but also smart, interconnected and customized product. In development of the panel, two main problems have been imposed:</p> <ul style="list-style-type: none"> • unknown effect of friction between timber and glass, which proved to be a significant factor in energy consumption due to lateral loads • unknown behavior and bearing capacity of laterally loaded joint in corner of timber frame made with glued-in rod <p>Challenges that relate to the need to investigate these unknowns and at the same time to find optimized panel characteristics.</p>
Solutions - Methods / Results - Findings	<p>As there is no European standard for direct friction test, alternative solution is provided. Glass panel was placed between two timber beams, whereby slats offset from glass prevented displacement out of plane. Sample was compressed by two springs of known stiffness and glass was sliding on beams by a controlled shift. Various types (IZO glass and sheet glass), thicknesses (12 or 20 mm) and number (1 or 2 pcs) of glass panels were varied as well as three force values (from 1 to 3 kN). The results proved to be expected and gave a friction factor value of 0.4. The bearing capacity of joint with glued-in rod which connected column and girder made of cross laminated timber was tested according to the European standard EN 383:2007. The sample size was defined by dimensions of the cross section of timber frame elements which is an integral part of the hybrid panel. Three different rod diameter were used (M10, M14 and M20), all with nominal strength of 8.8. Position of the rod was also varied, parallel or perpendicular to the fibers. The results showed a bearing capacity which could be corresponded to one calculated according to the European design code EN 1995 for joints with steel bolts.</p>
Novelty - Value / Relevance to ...	<p>This research provides instructions for testing of friction between glass and timber, whereby the highest contribution is nominal value of coefficient of friction which is not dependent on the thickness and type of structural glass panel. Significant contribution was also made to examine the bearing capacity of joint with glued-in rod, which has not been sufficiently processed in the literature so far. This investigation has given the conclusion that laterally loaded joint with glued-in rod can be considered as any other joint in timber construction made with steel bolts. Such research is not only directed to the scientific public, it is also the precondition for introduction of this type of bearing element into real constructions as well as the basis for development of further standards which should be used in practice.</p>
Forum statement	<p>Effect of friction between timber frame and structural glass in hybrid panel is same for all type of structural glass. Laterally loaded joint in corner of timber frame made with glued-in rod should be considered as end grain connection with laterally loaded steel bolts.</p>

Keywords:

laboratory tests; timber; structural glass; friction; glued-in rods joint

Graphics:



NUMERICAL MODELS FOR VERIFICATION OF BEARING CAPACITY OF THE
HYBRID TIMBER-STRUCTURAL GLASS PANEL**Authors:** Vlatka RAJCIC¹, Roko ZARNIC², Nikola PERKOVIC³, Jure BARBALIC⁴¹ University of Zagreb, Faculty of Civil Engineering, vracic@grad.hr; ² University of Ljubljana, Faculty of Civil and Geodetic Engineering, roko.zarnic@gmail.com; ³ University of Zagreb, Faculty of Civil Engineering, nperkovic@grad.hr, ⁴ University of Zagreb, Faculty of Civil Engineering, jbarbalic@grad.hr

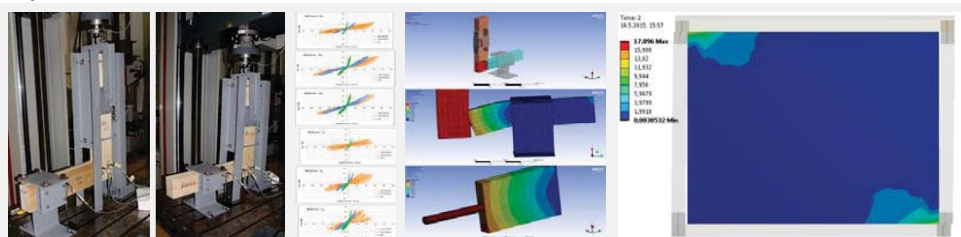
Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>The hybrid timber-structural glass panel, which authors are Zarnic and Rajcic, is innovative building element suitable for adaptive façade or as load bearing element. Due to complex behavior of this multifunctional and potentially smart hybrid panel, there is need for computing methods analysis and cloud processing. A key technological element is a digital twin of the real panel where interaction of the digital with the real can be designed and simulated through high performance computing. In order to develop a unique numerical model for design of panel as a building element, it is necessary to consider separately:</p> <ul style="list-style-type: none"> numerical model of joint in panel corner under cyclic lateral load, which proved to be a most significant share of panel bearing capacity numerical model of panel under lateral cyclic and constant vertical load <p>Optimization of model size and precision in order to reduce processing time, versus the correct model settings, represent challenges to generate these models.</p>
Solutions - Methods / Results - Findings	<p>Experimental tests of joint in the corner of the hybrid panel were accompanied by numerical analyzes. The bearing capacity was tested according to the European standard EN 12512. The sample size was defined by dimensions of the cross section of timber frame elements which is an integral part of the hybrid panel. Three different rod diameter were used (M10, M14 and M20), all with nominal strength of 8.8. Simulations were performed in the ANSYS 15.0 software which has a CAE computer support interface where different geometric model simulations are solved by using finite element method (SOLID elements were used). In the preliminary phase of the design, it was decided to use the 3D model due to the complex stress condition. The 3D model is made up of the actual dimensions and material characteristics of the tested samples, with separately defined elements: steel rod (without threads in order to obtain the better quality of finite element mesh), adhesive layer, central lamella of beam and column in area of significant stresses (with Tsai-Wu criterion of failure), outer and central lamellas in the area of minor stresses (with Hill criterion of failure) and steel bearings and rails. The complex criteria for the failure of timber elements was not contained in the basic software package algorithms, so, it was necessary to create a USERMAT problem descriptor subroutine. Particular attention was paid to nature and accurate definition of contact between elements. The models showed good match with experiments.</p>
Novelty - Value / Relevance to ...	<p>Development of these models give significant contribution to better understanding of complex behavior of joint with glued-in rod in the corner of timber frame. With this approach, the model is not only connected with hybrid panel, it also could be applied on similar joints in any timber construction. Implementation of this model into the model of whole element, significantly simplified the analysis and verification of hybrid panel behavior. Due to the complexity and high cost of real scale panel tests, design and verification of the whole panel model is of great importance. This computational research is not only directed to the scientific public, it is also the precondition for introduction of this type of bearing element into software for statics as well as the tool for detailed parametrical analysis in developing of analytical models for practical design.</p>
Forum statement	<p>Numerical models of hybrid timber-structural glass panel, as well as numerical model of joint in corner of timber frame made with glued-in rod, proved to be sufficiently accurate and as such can be used in development of software or calculations due to design code.</p>

Keywords:

numerical model; timber; structural glass; glued-in rods connection; seismic

Graphics:

Project of railway Tunnel connecting three main stations Łódź

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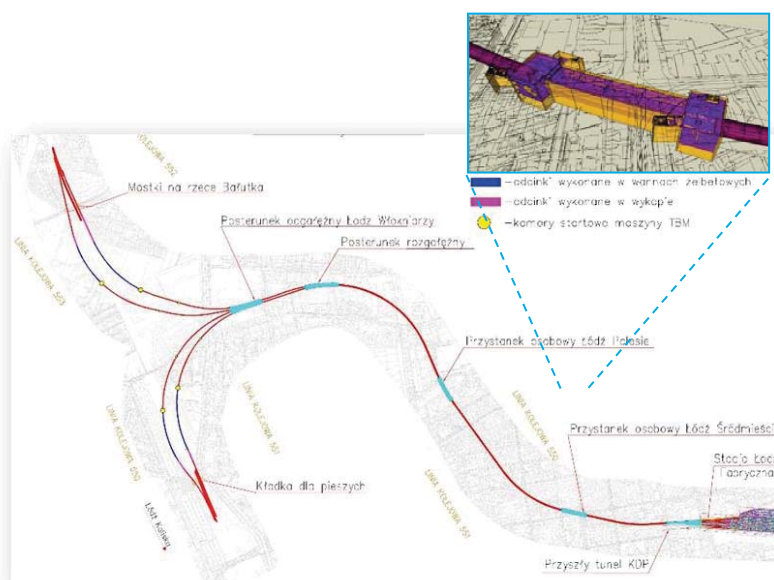
Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> Facility & Asset Management, BIM Lifecycle

Abstract:

Problems - Issues / Challenges-Needs	As the 3rd largest city in central Poland Łódź is supposed to be transformed a modern center for trade and economy, business services, culture and fashion. A main item to achieve this is the establishment of an efficient infrastructure with modern means of transport. The Design & Build – Project of Tunnel connecting three main stations Łódź Fabryczna, Łódź Kaliska and Łódź Żabieniec has been awarded to a Joint Venture composed of Energopol Szczecin S.A. (leader) and PDBiM Sp. z o.o. in December 2017. It contains the "ready to use" construction of the underground tunnel with a total length of 1 x fi 12,7 x 2,6 km and 1 fi 8,5 x 3,6 km tunneling, 2 intermediate stations, switching areas as well as cross passengers and emergency exit shafts. Driven by the need to have a working public transportation system in place with future adjustment of the line for construction High Speed Railway in 2022, the time frame for the project was – and still is – very tight.
Solutions - Methods / Results - Findings	The 6,2 km of tunneling in center of City of Łódź will be realized with 2 EPB machines simultaneously and will be completed in only 18 months. In additions 10 cross passages/exits will be build as well as all the shafts and intermediate stations. In this contribution the overcoming of some of the many changes delivering a world class urban tunneling project is described emphasizing topics such as design issues (dense historic city buildings, low overburden, difficult ground & water conditions, connection with brand new railway Station Łódź Fabryczna) , TBM selection and performance (big 13,0 m diameter of the shield), logistic concepts (narrow streets, city center), interface management and health & safety.
Novelty - Value / Relevance to ...	The project is the biggest investment of Polish National Railways in history and at the same time the first tunneling project with usage of TBM EPB machine for conventional railway in Poland. Project is key project for fast railway connection of the most important cities in Poland – Łódź and Warsaw. Simultaneously the tunnel will play very important role in agglomeration and public transport.
Forum statement	...

Keywords: tunnel, railway, geotechnics, TBM,

Graphics:



Standardisation in construction cost control; the beginning.

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>The sharing of construction cost information across the global economy has always led to the production of questionable cost data. Given the interdependency of the various economies and their dependence on stable construction markets it has become more important to standardise the information and its resulting data for the purposes of:</p> <ul style="list-style-type: none"> • International construction cost comparison for projects of similar nature. • Construction output as a measure of economic growth and stability. <p>The challenge is to see if such an international standard already exists or if an existing standard can be incorporated as the standard. In the event that such a standard does not exist then how does the global construction industry produce and introduce such a standard.</p>
Solutions - Methods / Results - Findings	<p>The method and strategy employed to investigate the need for such standardisation are:</p> <ul style="list-style-type: none"> • Working groups incorporating action research and public consultation. • Investigation of existing standards and various international approaches. • Review of the requirement of non-construction organisations such as the UN, EU and IMF to monitor construction growth. <p>The standardisation of construction cost management has impact on other areas of cost management such as the management of costs in Life Cycle Costing (LCC) and the use of Building Information Modelling (BIM) in the compilation of construction cost data.</p>
Novelty - Value / Relevance to ...	<p>The introduction of international construction cost management standards allows for the production of relevant construction cost data which can be utilised in the:</p> <ul style="list-style-type: none"> • Evaluation of project viability on both national and global scales. • Monitoring of existing and developing economies on an economic basis.
Forum statement	Construction is seen as a key indicator of economic growth and as such a standardised approach to measuring it is required.

Keywords:

project cost management, construction cost standard, Economic growth.

GIMS: an innovative cost-effective system to monitor ground deformations, based on GNSS, InSAR and inertial measurement units

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Abstract:

Problems - Issues / Challenges-Needs	Geological, hydrological, geotechnical, and environmental phenomena causing deformation of the Earth surface (subsidence, landslides, floods, sinking) are happening at an increasing rate, also due to extreme events likely to be driven by climate change, as well as rarer geophysical phenomena (earthquakes and volcanic eruptions). These phenomena govern negative and sometimes destructive impacts on land, structures (dams, bridges, buildings), infrastructures (roads, railways, channels, pipelines, energy infrastructures); in addition, structures and infrastructures can undergo an obsolescence process, eventually leading to a collapse.
Solutions - Methods / Results - Findings	The main objective of the GIMS project is to build and commercialize an advanced low-cost system based on GNSS (including Galileo), Copernicus SAR and other in-situ sensors, like inertial measurement units, for the purpose of monitoring ground deformations with a focus on landslides and subsidence. The system will recover displacements with millimetric level accuracies and daily acquisition rate. Moreover, the integration of in-situ accelerometers will give real-time alerts in case of sudden movements. The observations of these three different monitoring techniques, namely GNSS, SAR and accelerometers, are complementary in time and space and can be integrated to obtain a better understanding of the monitored processes and a more complete knowledge of the deformation phenomenon.
Novelty - Value / Relevance to ...	The main novelty lies in the design, development and testing in operational environment of an integrated cost-effective monitoring system based on GNSS, SAR and IMU equipment, including a new active compact reflector for SAR. The project involves researchers and industrial developers from different fields: radiofrequency analysis and related hardware design, telecommunications, SAR and GNSS data analysis, accelerometers signal processing, geostatistics, geology. Pilot tests will be conducted in the two selected sites in Slovenia where landslides could pose serious hazard to local inhabitants and infrastructure.
Forum statement	A project to design, develop and test in operational environment a cost-effective displacement monitoring system based on GNSS, SAR and IMU sensors.

Keywords:

GNSS; SAR; IMU; monitoring; landslide

Theme 3: **Cultural Heritage in Digital World**

NOVEL, SUSTAINABLE PRESERVATION OF MODERN AND HISTORIC BUILDINGS AND INFRASTRUCTURE. THE PARADIGM OF THE HOLY AEDICULE'S REHABILITATION

Authors: Antonia MOROPOULOU¹

¹ NTUA Professor, President of the General Assembly of the Technical Chamber of Greece, amoropul@central.ntua.gr

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input checked="" type="checkbox"/> Cultural Heritage in Digital World
	<input checked="" type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input checked="" type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Today's Built-Environment is to a great extent the result of intense construction activity which was initiated in the inter-war period and intensified with the urban, industrial and technological transformation of the modern Society. Today, more than 70 years later, a great percentage of the Built-Environment, especially reinforced concrete built – assets, has exceeded its life expectancy. The threat from the end of the lifetime of the built-environment, including historical and contemporary buildings and infrastructure, is of significant socio-economic impact for Europe. The fact that, more than 40 % of construction works in Europe, are related to retrofitting of existing buildings is indicative of their importance. The weathering and aging of existing structures triggered by environmental stresses, influences their durability, their bearing capacity and serviceability.
Solutions - Methods / Results - Findings	The need for reliable assessment and the capacity to redesign and implement durable interventions to existing works aiming towards Sustainability (regarding both buildings and civil infrastructures), demand Research and Innovation and are matters of high priority and great importance and impact on national, regional and international level. The challenge for an integrated methodology of diagnosis, monitoring and control towards protection and preventive conservation of existing buildings and infrastructures, pre-requires an interdisciplinary approach, the use of multi-dimensional and hyper-spectral data, parameterization of the results deriving from various on-site (NDTs) and in-lab investigations and modeling, after an interoperable way and management in a georeferenced three-dimensional environment. Innovative scientific methodologies and challenging projects making future trends in the protection of built environment and infrastructure, have initiated a universal conversation within a holistic approach, merging capabilities and know-how from the scientific fields of architecture, civil engineering, surveying engineering, materials science and engineering, information technology and archaeology, as well as construction engineering professionals and companies, stakeholders of buildings and infrastructure.
Novelty - Value / Relevance to ...	The advanced digital documentation permits the data fusion of interdisciplinary innovative modeling, analytical and non-destructive techniques, supporting the emergence of the trans-disciplinary field of multispectral sustainable preservation and management of build environment. The project of the rehabilitation of Holy Sepulchres' Holy Aedicule is of multispectral, multidimensional, novel methodology, transferable for resilient construction.
Forum statement	...

Keywords:

Preventive conservation and maintenance; Integrated Digital Environment; Non-Destructive Testing; Diagnosis; Monitoring and Control; Holy Aedicule Rehabilitation

ICTs FOR ACCESSING, UNDERSTANDING AND SAFEGUARDING CULTURAL HERITAGE

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input checked="" type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
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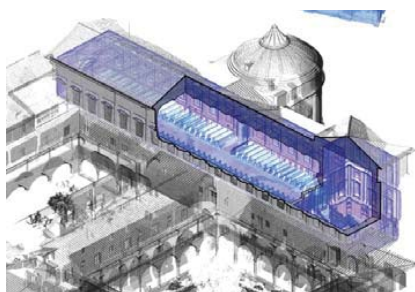
Abstract:

Problems - Issues / Challenges-Needs	<p>The Cultural Heritage plays a crucial role in making sustainable the impact of the social changes that Europe is facing. Cultural heritage is a driver of societal cohesion if we consider it as an expression of identity and a common resource. Preserving the Cultural Heritage and making it more accessible and understandable, may strengthen the cultural identity and consequently the societal cohesion and the solidarity.</p> <p>On the other hand, increasing the accessibility to the CH sites make them more vulnerable and the risks to which they are subjected increase due to natural hazards and human activities.</p> <p>Therefore, the challenge is preserving CH without reducing the possibility to a larger number of people to know and learn about them through strategies and solutions for a sustainable and inclusive access to the historical sites.</p>
Solutions - Methods / Results - Findings	<p>ICTs can play a strategic role for:</p> <ul style="list-style-type: none"> - ensuring the sustainability of a larger and inclusive access to the CH sites, - optimizing and enhancing their safeguard, monitoring and maintenance and - making them more resilient. <p>Application of 3D integrated laser scanner procedures allow to survey very rapidly historical buildings and sites by collecting millions of spatial coordinates to be used for creating 3D models certificate with a high degree of accuracy and precision.</p> <p>Availability of innovative tools, based on 3D models, Virtual Reality (VR) and Augmented Reality (AR), opens innovative scenarios in the CH.</p> <p>3D models can be used not only for documentation and monitoring purposes but also for digital application (such as virtual tours, virtual tourism, digital reconstructions, etc.) and to create integrated 3D database for preservation, diagnostics, restoration, and management procedures.</p>
Novelty - Value / Relevance to ...	<p>Enriching semantically the 3D models and improving the applications of VR and AR, the understanding of the European cultural heritage can be more accurate and can go beyond the virtual tours.</p> <p>Historic areas' resilience to climate change is a complex challenge due to many uncertainties, especially as single-hazard climate uncertainty translates into multi-hazard climate risks. Implementation of predictive tools based in 3D semantic models and focused on the interconnection of environmental, economic and social factors can enhance the CH resilience creating more reliable vulnerability analysis based on the intensity and frequency of climate change related events and natural hazards.</p>
Forum statement	...

Keywords:

Cultural Heritage; Accessibility; Understanding; Safeguard; ICT

Graphics:



Holistic Documentation of the Past: A key Challenge in the 21st century

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input checked="" type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>Holistic approach for the e-documentation of the Past: to capture, reconstruct, model, archive, preserve, protect, use/reuse and disseminate CH content, including the latest advances in technology combined with novel experimental Apps.</p> <p>Here we could name the following challenges:</p> <ul style="list-style-type: none"> • Unique High quality dense matching photogrammetry • Exceptional Reverse engineering processes from created point clouds • Morphological and holistic Reconstruction of Monuments • Single Image 3D reconstructions (camera alignments) • 3D Real-time Implementation to mobile devices using AR and IVR (immersive VR) <p>VR implementation to mobile devices showcasing 4D sceneries of city scapes...</p>
Solutions - Methods / Results - Findings	<p>We are presenting different solutions:</p> <p>A) An Application for the city of CALW in the southern part of Germany (State of Baden Wurttemberg):</p> <ul style="list-style-type: none"> • 4D reconstruction using novel methods of data fusion between terrestrial laser scans, photogrammetry and single image reconstructions through camera alignments. • 4D Real-time implementation of large cityscapes for walkthroughs and turntable viewing → Tourism <p>B) The UNESCO WHL Monument of Asinou in Cyprus:</p> <ul style="list-style-type: none"> • Bringing 1000 Years of history to the school, • A Monument and an e-Book , • iVR application for UNESCO WHL monument. <p>C) The digitalisation of tangible and intangible content and the enrichment of their metadata for the EU digital Library Europeana</p>
Novelty - Value / Relevance to ...	<p><i>We can showcase the best practise examples for Students, Cultural Heritage, Experts/Professionals, Guides, Tourists, general public:</i></p> <ol style="list-style-type: none"> 1) <i>The holistic documentation of the UNESCO WHL Asinou Monument in Cyprus</i> 2) <i>Archaeological Site of Carnuntum in Austria: The VR & MV experience</i> 3) <i>The German city of Calw: The city in 4D: A VR / AR Mobile App, VR App for Headsets, Documentation and Visualisations</i>
Forum statement	...

Keywords:

Digital Cultural Heritage, Holistic Documentation, Reverse Engineering, Virtual Reality and Augmented Reality in Cultural Heritage



Graphics:

The elements of identification of cultural heritage services

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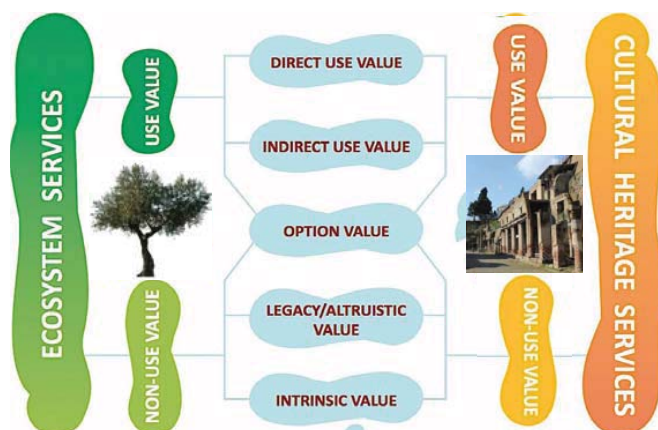
Abstract:

Problems - Issues / Challenges-Needs	Introduction of the new term "Cultural Heritage Services" opens the possibilities for better understanding of values and larger sustainable exploitation of cultural heritage assets in order to support the development of European economy and generating the large variety of job opportunities from simple to highly professional ones. The beneficial influence of services has been proved in case of Eco-system Services. Eco-system Services and Cultural Heritage Services are linked through comparable values and uses that are offered both by natural environment and by human built environment. Both environments are equally exposed to long-term environmental impacts due to climatic changes and sudden events (natural disasters). But even more dangerous are anthropogenic influences among which the wrong decisions are the most serious. Therefore, the profound knowledge about heritage is needed to enable its long-term resilience avoiding and managing of negative impact consequences and preserve the services and their economic values.
Solutions - Methods / Results - Findings	The system for identification and study of cultural heritage services is yet to be developed although there are present elements that can be well used in future development. Some of them has resulted from the research within Ph.D. studies at University of Ljubljana or delivered by EU financed research projects as EU FP7 EU-CHIC (www.euchic.eu) and EU H2020 INCEPTION (www.inception-project.eu). The quality and quantity of reliable documentation is crucial for identification of cultural heritage services. Important part of documentation is visualization of asset and its parts, but even more important are well-organized meta-data and semantic, descriptive data on heritage significances that encompass the potential basis for sustainable use of heritage assets without endangering its character and quality. The wide range of significances and their potential for identification of heritage services will be described and illustrated with possibilities of application in one of Slovenian regions rich with eco and heritage potentials.
Novelty - Value / Relevance to ...	The idea of identification and application of "Cultural Heritage Services" is new and not yet enough developed and understood. The intention of the proposed paper is to contribute to development of idea by proposing of elements that may be the basis for future establishing of system for introducing of well elaborated approach to practice of economic development of areas with rich environmental and heritage content.
Forum statement	"The potential of cultural heritage services for economic development of areas with rich environmental and heritage content should be studied with support of IT tools"

Keywords:

Cultural heritage services, significances, IT support, local community, economic growth

Graphics:



Geodetic Methods for Modeling and Documenting Cultural Heritage Objects

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Abstract:

Problems - Issues / Challenges-Needs	<p>Creating digital models of important cultural heritage objects for documentation or reconstruction:</p> <ul style="list-style-type: none"> • Complex buildings, in different conditions • Sometimes difficult to access, on remote places • Need for adequate geometrical accuracy and completeness
Solutions - Methods / Results - Findings	<p>Technologies and methods that can be used:</p> <ul style="list-style-type: none"> • Establishment of basic geodetic network • Terrestrial laser scanning • Terrestrial photogrammetric capturing • Use of Unmanned aerial vehicles • Point clouds and object modelling • Estimation of quality of 3D models for inspection, documentation, maintenance and restoration • Attractive presentations: 3D prints, AR views • Results in three cases: Chapel on Kravec, Castle Smlednik and Castle Brestanica
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Combination of different technologies and methods • Accuracy estimation of each methodology and quality estimation of final product (model) • Correct models for authorities, maintainers and investors; attractive presentations for public
Forum statement	Geometrically correct and detailed models of cultural heritage object are the only guarantee for long time preservation and documentation.

Keywords:

Cultural heritage objects; photogrammetry; laser scanning; UAV

Graphics:



USING OWL-TIME ONTOLOGY TO DEFINE TIME IN H-BIM MODELS

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Abstract:

Problems - Issues / Challenges-Needs	<p>BIM representations of heritage buildings present several challenges since historical buildings evolution is inherently different from recent ones. One of the main issues is the visualization of the history of the site and the related changes over time, from the construction to the architectural evolution, taking into account tangible and intangible significances.</p> <p>Actually, CH buildings holistic documentation refers to different time frames and should be correctly related to the different features of the model and be available considering specific historical periods. So, a way to trace and define "time" to be related both to different parts of the BIM model and to integrated information is essential in 3D modelling of heritage buildings.</p> <p>Although Semantic Web standards are a huge reference model in Cultural Heritage digital applications, finding an Open Standard to represent time, phases and time spans in a BIM environment is not trivial, and modelling time has been a challenge in many Semantic Web domain applications.</p>
Solutions - Methods / Results - Findings	<p>In the framework of the EU funded project INCEPTION – <i>Inclusive Cultural Heritage in Europe through 3D semantic modelling</i>, an HBIM ontology to model CH sites reconciling BIM and Semantic Web Standards into the INCEPTION Platform was developed. The HBIM ontology allows identifying each building part through semantic concepts, allowing to relate them to other Semantic Web entities and opening the building model to holistic enrichments. Using ontologies allows: 1) layering other ontologies, which means adding levels of machine-readable knowledge, 2) linking each component to external media files and 3) managing time-related properties.</p> <p>The construction of a Time-Machine which allows visualizing the evolution over time of the building was though to use the same ontology and standards of BIM representation. To achieve this goal the new OWL-time ontology released by the W3C in October 2017, the state of the art in the field of ontology time modelling, was used to define phases and time frames, bringing together a complete HBIM ontology that follows the building and its enrichment through its historical evolution.</p>
Novelty - Value / Relevance to...	<p>Representing time and phases on a BIM model through Semantic Web standards is a new achievement of the Horizon2020 INCEPTION project and allows to link together a whole Semantic Web digital description of CH buildings using the main ontology at the core of the INCEPTION platform.</p>
Forum statement	<p>BIM models of Cultural Heritage buildings are represented with Semantic Web technologies on Inception platform, integrating the OWL-Time ontology to represent phases</p>

Keywords:

Cultural Heritage, H-BIM; Semantic Web; OWL-Time

Graphics:



BIM-based Cultural Heritage Asset Management Tool. Innovative solution to orient the preservation and valorization of historic buildings

Authors: Emanuele PIAIA¹, Federica MAIETTI², Roberto DI GIULIO³, Oana SCHIPPERS-TRIFAN², Andre VAN DELFT², Sander BRUINENBERG², Rosamaria OLIVADESE²

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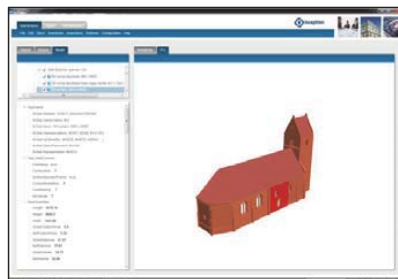
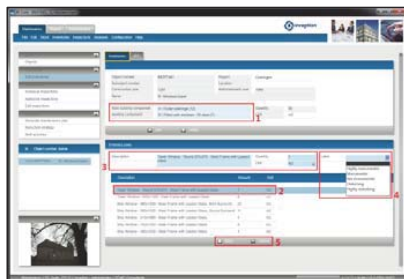
Abstract:

Problems - Issues / Challenges-Needs	Digital technologies are more and more needed to give access to Cultural Heritage (CH) and to allow for their curation and re-use. For this reason it is necessary to increase the knowledge on the CH building stock to support sustainable maintenance, preservation and revitalization strategies through the development of user-friendly asset management tools to support decision making on the interventions needed during the lifetime of the building.
Solutions - Methods / Results - Findings	The H2020 INCEPTION project creates an inclusive understanding of European built CH across different disciplines (ICT, architecture, history, and law), using a set of relevant IT technologies and serving various business sectors and different stakeholders within the CH sector such as technicians, asset managers or owners and local authorities. This paper presents a desktop (off-site) and mobile (on-site) application that equips the stakeholders involved in CH preservation with cost-effective instruments for condition assessment, asset management, rehabilitation and maintenance planning of heritage assets, as well as decision-support on how to maintain the CH stock within constraints on monumentality and resources.
Novelty - Value / Relevance to ...	Within INCEPTION, Asset Management (AM) is regarded mainly within the framework of decision-making for restoration, conservation and maintenance of historic buildings. As such, AM deals with collecting, structuring, analysing and disclosing data related to historic buildings. The CH AM is a Building Information Modelling (BIM) user application for preventive conservation of CH buildings. It supports the required on-site and technical assessment and off-site analysis to determine the actual condition of the historic buildings. As a result, it will enhance the understanding of possible and necessary preventive measures for the historic buildings, including the implications of these measures in relation to technical risks, monument protection regulations, cost management, and socio-functional building performance. Together with the IT technologies developed within INCEPTION, the CH AM tool will facilitate streamlining the conservation and management process of heritage assets.
Forum statement	Preserving Cultural Heritage through to BIM based Asset Management tools.

Keywords:

Cultural-Heritage; BIM; Condition assessment; Sustainable maintenance; Asset Management

Graphics:



CH AM Tool pictures

CULTURAL HERITAGE BIM: CHALLENGES AND OPPORTUNITIES

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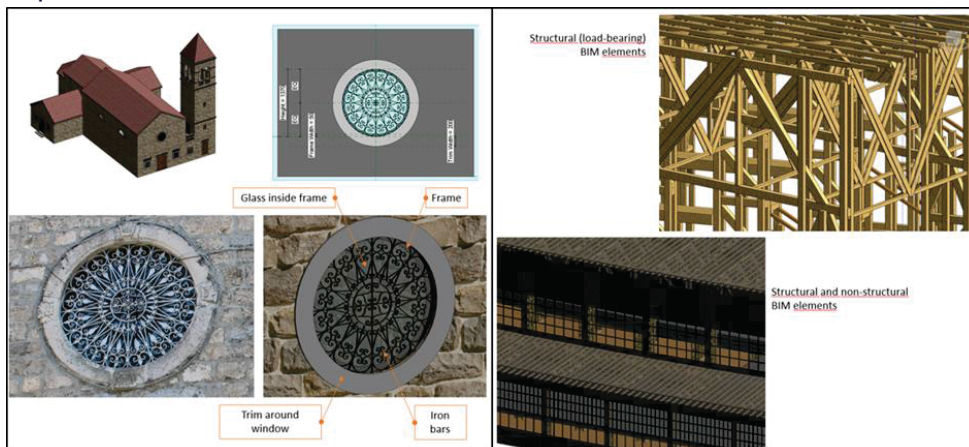
Abstract:

Problems - Issues / Challenges-Needs	Building information modeling (BIM) is considered the true digital revolution within the quite conservative Architecture, Engineering and Construction industry. It heavily changes the way the new projects are designed and executed by offering tools to ease the collaboration of different project participants in design and also construction stages while subsequently providing a structured input for managing various following activities throughout the building life-cycle. Working with cultural heritage implies working with existing buildings, for which the work flow and parameters that need to be included are somewhat different. While in new BIM projects one differentiates between Levels of Development of the model, this might not be appropriate to modeling existing structures as they are fully developed on site, but the amount of data available for modeling might vary, thus the Level of Accuracy (LoA) and Level of Confidence (LoC) are modeling issues to be considered. Development of any BIM model should be guided by its purpose. A single BIM model of a cultural heritage may serve many purposes – from 3D visualizations only (for instance as to support tourism) to more refined data required for inspection, assessment and structural analysis as well as facility management. It is very convenient that a model once developed may be subsequently enriched with additional data required, so a staged development is possible, but still, the initial model should take into account as much as possible the many subtleties of an existing building in question – dealing with the building transformation throughout the history, focus on the cultural heritage properties, and if possible to the properties important for future conservation and structural analyses purposes which are then correlated in LoA and LoC employed.
Solutions - Methods / Results - Findings	The paper discusses the development of BIM of two cultural heritage sites in Croatia – Technical Museum Nikola Tesla in Zagreb, the capital, and the Church of the Assumption of St. Mary in Mirlovic Zagora in Dalmatia hinterland. The latter is a part of the larger complex of the sites at the Unesco municipality. Both are listed as tangible cultural heritage, so even in the case of the museum, the building is of prime concern. Development of BIM for those two cases, even though they are both cultural heritage buildings, required quite a different approach. Mirlovic Church (originating in 1688) is quite a small building. In that sense, it is remarkable that there are several academic papers providing some fragments of its past and present. Even though some of those papers deliver plan views and sections of the building, those were assessed as not detailed enough to build a BIM model. Thus, laser scan of external surfaces of the church was carried out, and served as a base for BIM development providing an outline of the structure. With trees hindering some parts of the building, the scan execution proved difficult by itself. The model was built generally using the standard BIM elements, such as walls, floors, roofs, stairs, windows and doors, but for windows and doors specific element types were made, including the rose window above the main entrance. Since there was no scan of interior, the depth/ width of elements such as walls/ roofs was generally given a generic value unless an on-site measurement value was available. Thus, there was a difference of LoC within the elements of the same structure. The model of existing structure is made by vertical and horizontal sectioning the laser scan, and snapping to points of the cloud from scan. This particular model was made primarily for tourist purposes, and all BIM elements were thus positioned horizontally/ vertically, disregarding the sag of the roof and inclination of the bell tower. Still, this information is relevant for structural analysis. The building history was introduced in the phasing of the BIM model, but with the somewhat low level of confidence as only the parts of the building could be associated to a period, and there was not enough data to reconstruct all the elements of phases. The Technical Museum Nikola Tesla is much more recent structure. It is a rare existing example of European engineering concept of expo-halls timber structures with large span (85 x 40 m) from the early 20 th century, so the focus was on modelling timber structure of the main hall. One of the benefits of BIM model is that it comprises not only geometry, but also an analytical model that may be exported to a number of structural analysis software. However, development of such model requires understanding of how structures work, and for this particular building a comprehensive knowledge of performance of various members of timber structures is required to build an appropriate model. Since a timber structure of this scale employs a composition of a very large number of structural members, especially if there is an additional effort in joint modelling, this results in very heavy file for 3D viewing. In this case the model was built from available documents, adjusted to measurements on-site where available, as the laser scan would be insufficient to document the cultural heritage since the cultural heritage structure is concealed with cladding and surfaces.
The Novelty - Value / Relevance to ...	The cases presented are examined within H2020 INCEPTION research project. BIM surely provides an efficient tool to build 3D models, and for various purposes. Depending on the features of cultural heritage and its BIM purpose, high specific experience might be essential to truly exploit the benefits BIM provides, which is far beyond the 3D visualization. The cases presented were used to build, test and improve H-BIM INCEPTION platform, both for the model size (Technical Museum) and phasing (Mirlovic Church).
Forum statement	BIM is a great cultural heritage tool if handled with great care for cultural heritage

Keywords:

BIM; cultural heritage; modeling; time machine (phasing); timber structure

Graphics:



Accessing and understanding heritage buildings through ICT. The INCEPTION methodology applied to the Istituto degli Innocenti

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¹ University of Ferrara, Department of Architecture, (mttfr; dgr; mdcmr; frfr; piann; brnslv)@unife.it

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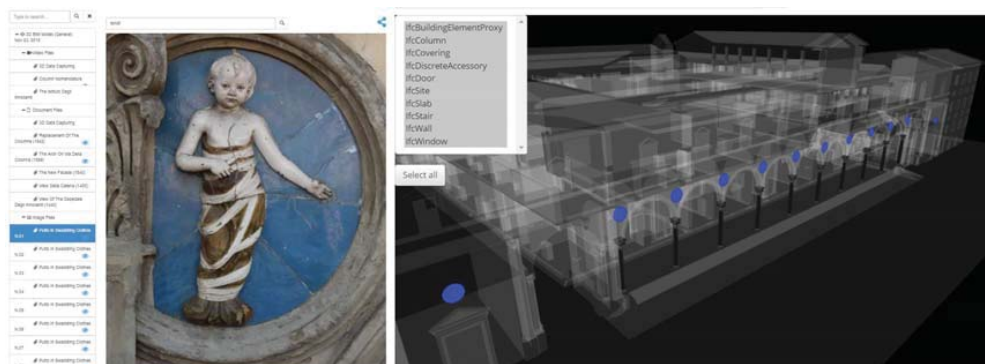
Abstract:

Problems - Issues / Challenges-Needs	The enhancement of digital cultural heritage accessibility is the ability to access cultural contents and resources for as many people as possible by using ICT functionalities and applications, overcoming cultural, environmental and management barriers for an easy and spread fruition. Beyond the application of ICT for management, research, diagnosis, conservation and restoration procedures, education and enhancement, new technologies allow the communication and dissemination of cultural assets that become more and more accessible for new knowledge and experiences; through digital technologies broad categories of users have access to European tangible and intangible cultural assets. In this framework, the main challenges is:
Solutions - Methods / Results - Findings	Starting from new innovative approaches to digital documentation, the EU funded INCEPTION project develops an open-standard Semantic Web platform for accessing, processing and sharing interoperable digital models resulting from 3D data capturing and holistic documentation. An outstanding example of the overall INCEPTION process is the digital documentation of the Istituto degli Innocenti in Florence, Italy, by Brunelleschi, an extraordinary example of Italian Renaissance architecture. The optimized 3D survey, modelling and model semantic enrichment led to the upload of a set of data on the INCEPTION platform to be browsed by several users, expert and non-expert in the field of digital heritage.
Novelty - Value / Relevance to ...	The INCEPTION platform is a unique device to collect, link and enrich 3D models of heritage sites and buildings, allowing several researches and applications. The project is based on the close connection between state-of-the-art architectural modeling technologies (BIM, Building Information Modeling) and the latest web technologies. The platform is grounded on semantic web technologies in order to enrich heritage 3D models by using Semantic Web standards.
Forum statement	ICT and digital heritage play an essential role in accessing and understanding Europe's cultural basis and history

Keywords:

Heritage digital documentation; 3D survey and modelling; Platform

Graphics:



The role of digital tools in the preventive conservation of cultural heritage: the experience of HeritageCare project

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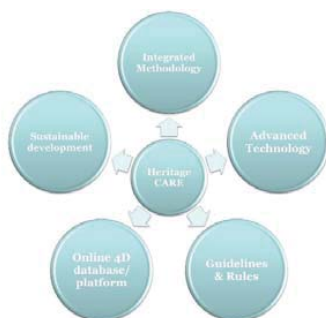
Abstract:

Problems - Issues / Challenges-Needs	The implementation of a preventive conservation approach for cultural heritage buildings entails several challenges. Points of concern are not just the physical objects per se, but also the multiple layered heritage values existing beyond them. Preventive conservation approaches are gaining attention as opposed to traditional strategies of curative conservation, in the attempt to systematize inspections and monitoring routines to address directly the causes of damage and minimize deterioration processes, thereby avoiding curative actions that often do not result in the removal of causative factors but lead to a reactive pattern of treatments and overpriced interventions. In order to facilitate monitoring activities and keep track of the conservation status of the cultural heritage, accessibility and longevity of the information may become crucial requirements for preventive conservation purposes. The new opportunities brought by digital tools can be of great help in this regard. Indeed, one of the major benefits of the digital revolution is that information can be stored, manipulated, shared and transferred almost instantaneously from virtually anywhere in the world. Although an increasing number of countries are supporting open cultural heritage data and promoting its reuse, systematic digital workflows for preventive conservation and management of cultural heritage are still lacking.
Solutions - Methods / Results - Findings	To meet challenge above, the European project "HeritageCare: Monitoring and preventive conservation of the historic and cultural heritage" has developed specific digital tools to allow for the real-time digitization and storage of the entire inspection process of built cultural heritage, with tremendous advantages in terms of condition survey, data reporting time as well as accessibility and longevity of the acquired information. This work describes the HeritageCare experience towards the implementation of a multi-level system of services for the preventive conservation of built cultural heritage rooted in the digitization of all heritage-related information and aimed at providing enhanced tools and services to make cultural heritage buildings widely accessible to people regardless of their location and financial status to actually visit heritage sites.
Novelty - Value / Relevance to ...	Dedicated web-based and mobile applications combining flexibility and easy access have been designed in accordance with the protocol of inspection defined during the project, enabling to keep track of the conservation status of the inspected buildings over time and to notify interested parties in case of alarming symptoms. Besides, advanced geomatic techniques are being leveraged to generate high-resolution virtual replicas of historic buildings for the accurate mapping and diagnosis of existing damage so as to obtain value-added data sources for the identification of affected areas and for the extraction of reference information for post-event analysis. Lastly, 3D models carrying meaningful attributes about the inspected buildings are created into the HBIM environment and interactively visualised through HoloLens applications, providing easy access to the stored information and offering a streamlined management of the heritage conservation process.
Forum statement	Historic and Cultural Heritage: Prevention is better than cure

Keywords:

cultural heritage; preventive conservation; digital tools

Graphics:



Accessible cultural heritage: developing digital user experiences

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Abstract:

Problems - Issues / Challenges-Needs	Europe is blessed with an immense cultural and historical heritage but sometime its huge worth is not completely known or discoverable. This difficulty is affected by both objective aspects (such as the lack of technical and comprehensive tools to disseminate historical information) and subjective aspects (such as the struggle to fly and visit the monuments in first person). The challenge of this project is to make the European cultural heritage more accessible and to spread its knowledge through an open-access tool, which enables people to have an accessible and inclusive fruition of it. The project is developed for a wide and heterogeneous group of users, characterized by three macro categories: citizens (visitors or tourists); technicians or experts; decision makers.
Solutions - Methods / Results - Findings	This contribution reports INCEPTION project, a multiple-screen web platform, designed to make all knowledge of European cultural heritage more open and accessible for everyone. The methodology – utilized throughout the research – has applied both some approaches (Human Centred Design, Design for All, Co-Design) and techniques (UX user experience maps, card sorting, storytelling and so on) related to Design principles, even including the main users into an iterative and interactive design process. The method has firstly gathered several needs from all categories of user (differentiated by age, skills and knowhow) and then it has transformed their exigencies into technical attributes, in order to develop a consistent experience of INCEPTION. The web platform has to be inclusive and constituted by a high level of readability, navigation accessibility, writing and content usability, which are able to provide great amount of technical information, texts, images or videos of every single historical monument, in a comfortable and easy way.
Novelty - Value / Relevance to ...	The primary value of INCEPTION, specifically for its inclusive web platform, is to improve human knowledge on cultural heritage through a virtual interface, which is able to extend the target of users and to customize the web contents – subsequently personalizing the user experience – based on a specific profile of a single person.
Forum statement	Enable people to freely access to European cultural heritage and to explore its historical knowledge, designing an inclusive networked platform through Human Centred Design and participative Co-Design techniques.

Keywords:

Digital Cultural Heritage, Accessibility, Human Centred Design, Co-Design, User Experience

Graphics:



Medieval geometries identified through digital analysis and capacity building for cultural values and technical maintenance - The case of the 13th cent. S. Francis Church in Assisi (Italy)

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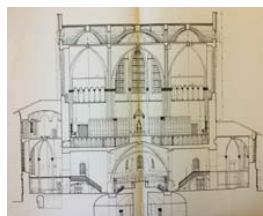
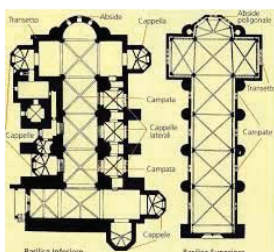
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> • understanding architectural and construction design criteria in medieval church buildings • full collection of measured documentation to ensure best practice in repair and maintenance • * detection of historic construction systems based on graphic and numerical procedures regarding reciprocal building assets; ancient theories for dimensioning structural components.
Solutions - Methods / Results - Findings	<p>Methods:</p> <ul style="list-style-type: none"> • CASE STUDY of the 13th cent. S.F rancis church in Assisi, Italy • identification (by confrontation) of applied (anthropomorphically) metric standards and previous buildings of reference which may have influenced the design process. • digital analysis of photogrammetric measured drawings • comparative study with similar buildings from same period and region within their cultural context • technical and archeological analysis of used materials & definition of reciprocal chronology <p>Findings:</p> <ul style="list-style-type: none"> • presence of simple geometric design patterns (square, circle, polygons) based on arithmetic proportions and numeric symbology. • partly imitation of the biblical temple of Salomon and parallel geometries with S. Peter 's- Rome • hierarchical sequences and arithmetic series
Novelty - Value / Relevance to ...	<p>Value - Relevance to:</p> <ul style="list-style-type: none"> • Historic and artistic valuation of the architectural and structural monument • Potential base for best practice model in repair and maintenance of historic buildings with respect to authenticity and cultural values – Maintenance capacity building • Creation of a scientific catalogue on historic building typologies based on their design and structural characteristics.
Forum statement	...

Keywords:

medieval geometries, digital analysis, Italy, architecture, maintenance capacity

Graphics:



Advanced monitoring of the church of St. Benedict in Kančevci (Slovenia)

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input checked="" type="checkbox"/> Cultural Heritage in Digital World
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	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

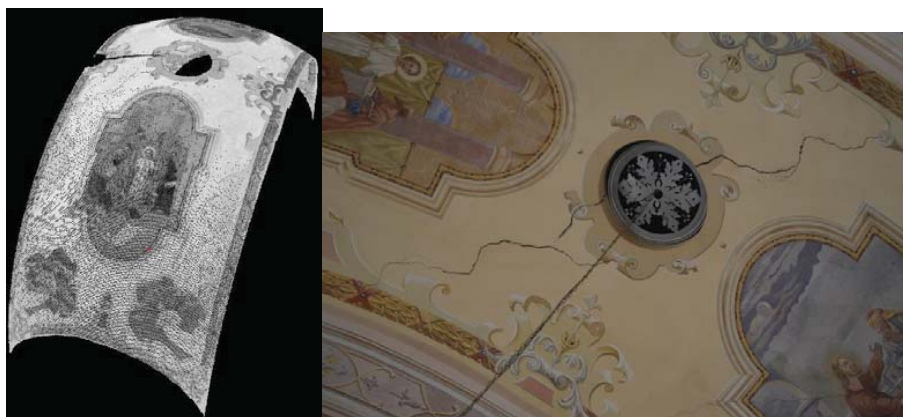
Abstract:

Problems - Issues / Challenges-Needs	<p>A number of false steps have been made in the process of the recent church renovation works. During archaeological excavation in the main nave of the church at numerous positions foundations have been undermined that may cause severe cracking of side walls, separating of the nave from the bell tower and consequently damage on both artistic and structural elements on the ceiling of the church. However high trees in the vicinity of the church and SSF interaction may be also additional causes for structural degradation of the church.</p> <p>The challenges are:</p> <ul style="list-style-type: none"> - determine the current condition of the building with combination of different advanced geodetic and mainly non-destructive and minor destructive civil engineering testing techniques, - set-up of effective advanced monitoring protocol for the future assessment of both material and structural degradation, - identify main causes for structural degradation.
Solutions - Methods / Results - Findings	<p>Solutions – Methods:</p> <ul style="list-style-type: none"> - Crack-pattern investigation with set-up of monitoring positions measuring main deformations on church walls, main vaults of the nave and bell tower. - Monitoring of both exterior and interior of the church by means of 3D laser scanning and comparison with the results from crack-pattern monitoring. - Profiling of moisture conditions along the walls and bell towers together with taking material samples for further laboratory investigations. <p>Results - Findings:</p> <ul style="list-style-type: none"> - Church has severe structural cracks. At some positions remedial actions were already introduced. - Monitoring started in November 2017, thus we cannot effectively exclude the influence of different seasons on obtained results yet. - Geometric changes of the object were determined from levelling and terrestrial laser scanning data and they match well with the results of crack pattern investigation.
Novelty - Value / Relevance to ...	<p>Assessment of the interior and exterior of the church by means of advanced methodology approach considering interdisciplinary work.</p> <p>Results of monitoring will be used for easy determination of progress of structural and artistic deterioration as well as for the optimal planning for effective strengthening measures on the church.</p>
Forum statement	<p>Advanced monitoring of cultural heritage buildings demands interdisciplinary work and effective combination of geodetic and civil engineering measurement methods enables quick and efficient assessment of artistic and structural deterioration of cultural heritage assets.</p>

Keywords:

Advanced monitoring; church; laser scanning; levelling; degradation

Graphics:



Simplified seismic assessment of monument applying the 3D time evolution presentation

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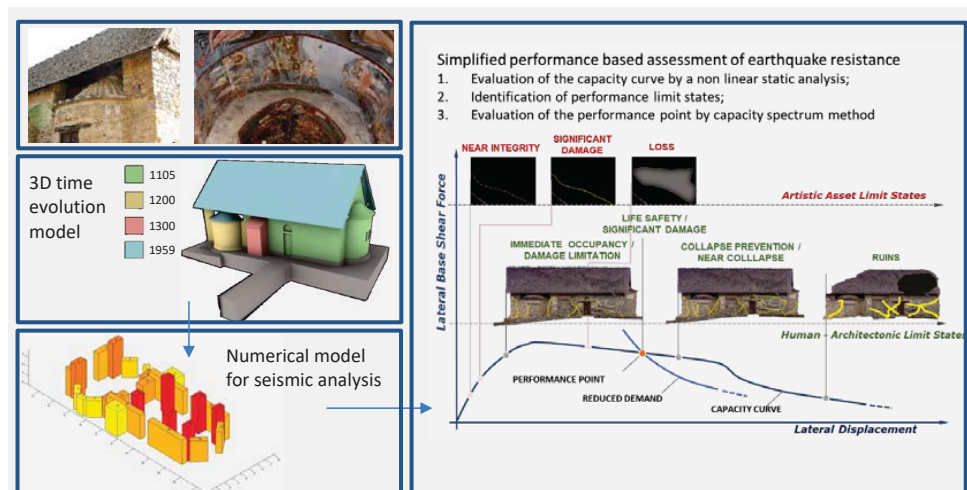
Abstract:

Problems - Issues / Challenges-Needs	In order to perform numerical seismic analyses, which predict the behavior of structures during earthquake with adequate accuracy, many data needs to be considered to build a sufficient model. For monuments, this task is even more difficult, since there might be very limited information (if any) on the structural system, built in materials, details etc. available. Furthermore, monuments have often been constructed in more phases in different periods and subjected to structural changes through time. Due to its age and exposure to different environmental influences and events, monuments may already possess different types of damage. All this information is essential to determine the proper geometric and material characteristics of the monument for evaluation of the seismic resistance of the structure and of its assets (valuable non-structural elements) and furthermore to design (appropriate) intervention measures.
Solutions - Methods / Results - Findings	In the paper, application of seismic assessment approach using the case of stone masonry Asinou Church in Cyprus will be presented. The structure of the church has developed since 1105 in several steps until today and has valuable wall paintings. In the paper it will be demonstrated how the seismic resistance of church considering structural parts from different periods can be assessed by simplified performance-based approach introduced by EU FP7 project PERPETUATE (2010-2012, http://www.perpetuate.eu). For the input parameters, the recently introduced multimodal capturing of geometry and monument surface appearance with indoor and outdoor 3D laser scanner combined with high resolution digital and infrared camera provides improved accuracy and quality of data needed for monument assessment. Special attention will be paid to explanation of application of 3D information captured by integrated instrument.
Novelty - Value / Relevance to ...	The presented case is one of the case studies carried out within the on-going project EU H2020 INCEPTION (http://www.inception-project.eu). Project realizes innovation in 3D modelling of cultural heritage through an inclusive approach for time-dynamic 3D reconstruction of artefacts, built and social environments. It enriches the European identity through understanding of how European cultural heritage continuously evolves over long periods of time.
Forum statement	"The nondestructive data collection can in combination with data obtained by digital tools be very useful for the definition of the input parameters for numerical models used for seismic assessment of cultural monuments."

Keywords:

Cultural monument, assessment, earthquake resistance, time evolution, 3D model.

Graphics:



Digital data platforms for heritage-led urban regeneration and historical sites enhancement

Authors:

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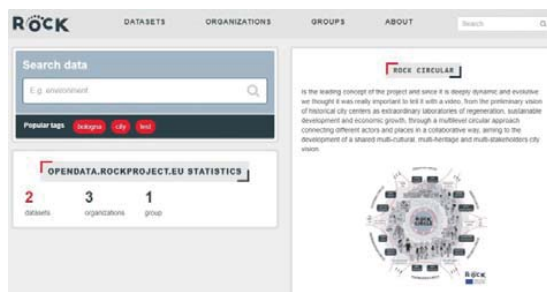
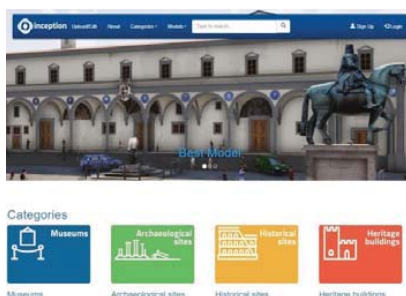
Abstract:

Problems - Issues / Challenges-Needs	Despite the effort spent to boost the fruition and dissemination of Cultural heritage, in all its multidisciplinary forms, accessibility in a wide meaning is still a priority challenge to overcome the existing barriers. In this perspective, technologies and new digital media are increasingly adopted for promoting and managing cultural heritage, collecting local material and immaterial data and gathering trans-national knowledge. These new tools let users to approach non-specialized information and visualize data locally in different ways. However specific knowledge is still embedded and aggregated in exclusive digital environments with very limited chance of dialogue. Therefore, there is still a lack of interaction between site-specific knowledge and practices with trans-national policies intertwining different tools and data entries.
Solutions - Methods / Results - Findings	Two ongoing EU funded projects, namely INCEPTION (Inclusive Cultural Heritage in Europe through 3D semantic modelling) and ROCK (Regeneration and Optimisation of Cultural heritage in creative and Knowledge cities), share the common aim to develop interoperable semantic platforms to enlarge access, fruition, understanding of CH in different ways. The INCEPTION platform deals with semantically enriched heritage 3D BIM models. Based on semantic web technologies, it makes extensive use of RESTful APIs to query and enrich 3D models leveraging on semantic web standards. The ROCK platform deals with local and trans-national data related to historic city centres; it manages and compares static and dynamic information collected in dedicated Atlases used to make data understandable at a glance. Both of them are social digital tools for interchanging information and sharing practices to address CH policies and widen citizenship of CH knowledge.
Novelty - Value / Relevance to ...	The innovative aspect deals with the chance to acquire a deeper understanding of Cultural Heritage by organizing and cross-referencing data through advanced data analysis algorithms, as well as human-readable data visualization tools. CH data platforms connect stakeholders coming from different technical and cultural backgrounds (policy makers, private businesses, cultural producers, innovators, tourists, etc.) to boost and support the process of transformation and "consumption" of cultural heritage in cities. This follows a cross-disciplinary approach at all level: from cultural heritage production, including policy making, to valorization of cultural assets, education, business matching, integrated management, etc.
Forum statement	...

Keywords:

Semantic platforms; Cultural Heritage integrated management, Sustainable development, City regeneration, Resilience in built environment.

Graphics:



New approach and tools for the governance of historic urban landscapes. The role of resilient communities

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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Abstract:

Problems - Issues / Challenges-Needs	Today the historical urban landscape (HUL) can be seen as a patchwork of environmental, climatic and social vulnerabilities, but also as a valuable treasure chest of tangible and intangible cultural inheritance. This makes it a privileged experimental lab where testing new community-based strategies with the aim of increase city resilience. Several recent resolutions are strongly committed with the implementation of community engagement approaches, empowering "local communities" (UNESCO 2011), promoting "heritage communities" (Faro Convention 2005) and fostering sustainable cities and communities (SDGs 2015). Therefore, the challenge is to deal with the social dimension of resilience, in line with the creation of resilient communities as " <i>robust and fully functioning communities able to withstand the shock of disaster, caused by nature or human intervention</i> " (Nichols, 2012).
Solutions - Methods / Results - Findings	Into this context, new governance methodologies are needed in order to understand place-based resilience necessities and to correctly address them into a multi-stakeholders and multi-layered approach. In fact, the complexity linked with built environment resilience applied to HUL needs the direct involvement of different layers of actors public and private in order to co-develop and co-design new solutions and approaches, thus creating more resilient communities. In the framework of the EU funded project (H2020, n.730280) <i>ROCK – Regeneration and Optimization of Cultural heritage in creative and Knowledge cities</i> – the University of Bologna is developing and implementing a methodology to support the transition towards a sustainable HUL betting on resilient communities. Thus, the paper will describe ROCK methodology and actions by focusing on Bologna case. All the experimental actions are managed through an innovative integrated management plan (IMP), based on the involvement of a local ecosystem of stakeholders. The IMP constitutes a fundamental governance tools to strengthen and support with un-conventional financial schemes the social infrastructure, the sense of belonging, the civic commitment and the improvement of historic urban resilience through its own communities.
Novelty - Value / Relevance to ...	The major innovation of ROCK approach deals with the innovative methodology of building new strips of governance where community is part of an experimental multi-stakeholder management team, to co-produce new governance models, fostering the transition of HUL into resilient and sustainable districts, with an approach relevant for urban agencies, public bodies and urban planners.
Forum statement	Disaster Risk Management & Governance for Resilient Communities.

Keywords:

Resilience; historic urban landscape; community-based approach; ROCK; Bologna.

Protection versus Development: Cultural Heritage in Functionally Derelict Areas

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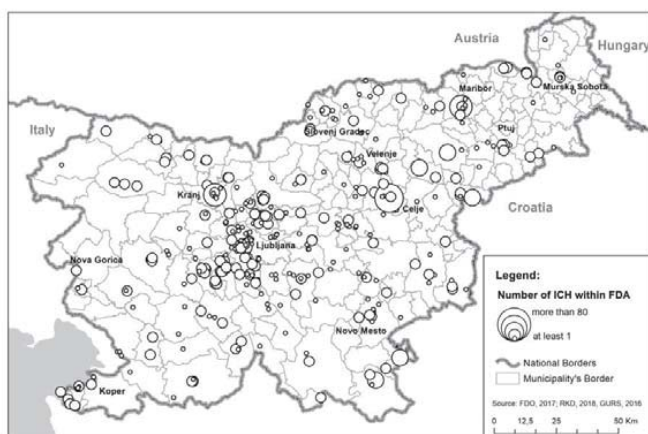
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Abstract:

Problems - Issues / Challenges-Needs	Within the project of identification and recording of the Functionally derelict areas (FDAs – abandoned or not fully utilised land with the impact of its previous use and of lower utility value) in Slovenia a major issue regarding the presence of immovable cultural heritage (ICH) arose during the interviews with the professionals on local level. Presence of different types of the ICH in the FDA were revealed as an important obstacle in the redevelopment of the FDA. In the eyes of the local stakeholders cultural heritage were presented as key constraint or obstacle for the redevelopment initiatives either from private or even from the municipal side.
Solutions - Methods / Results - Findings	The research was carried out in GIS software using two databases: the complete dataset of the FDA in Slovenia, total number was 1081, (Lampič et al. 2017) and the dataset of the Cultural Heritage Register, total number was 32.408 of ICH (MoC, 2018). Presence of ICH in FDA was detected in almost 38% of all FDA in Slovenia. Although the FDAs with ICH are dispersed throughout Slovenia, higher numbers are present in major urban areas. Urban municipalities and urban centres have higher economic development potential for the reactivating FDAs with ICH. All FDAs with the presence of ICH were classified into three groups (A, B, and C - depending on the intensity of the ICH phenomenon in the FDAs) which are basis for proposing various instruments for their reactivation.
Novelty - Value / Relevance to ...	The reactivation of the FDA should not depend on FDA types, but rather on the ownership structure, the alignment of the restoration programme with the envisaged use of space, legal regimes, spatial restrictions, available financial resources, etc. The presence of ICH in FDAs should be promoted as an opportunity for the creation of high quality and culturally diverse spaces for future use.
Forum statement	Cultural heritage should be considered as an opportunity for the reactivation and (re)development of the functionally derelict areas.

Keywords: derelict areas, cultural heritage, brownfields, reactivation, Slovenia

Graphics:



DIGITAL TOOLS FOR DOCUMENTATION AND ANALYSIS OF HERITAGE CITY CENTRES IN INDIA

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¹ University of Ferrara, Department of Architecture (rsslcu; mssptr; mttfrc; bzm)@unife.it

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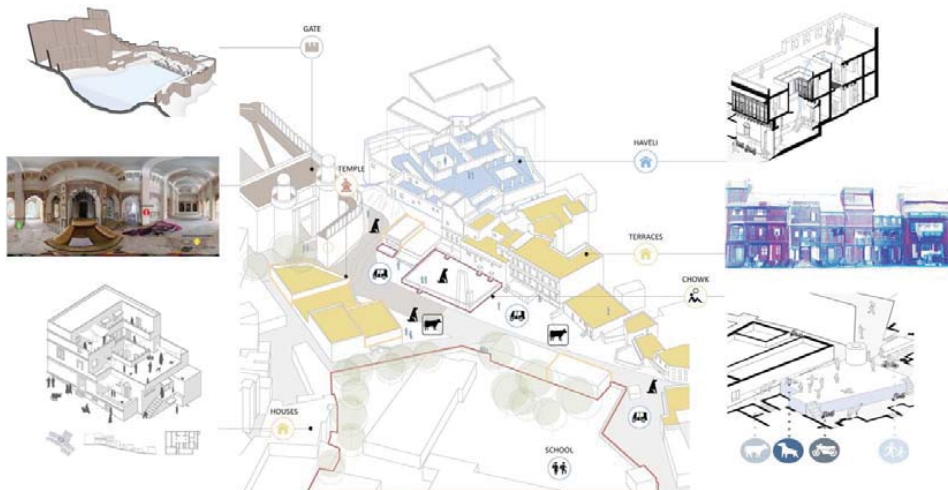
Abstract:

Problems - Issues / Challenges-Needs	In emerging countries, technologies are very often economically uncompetitive if transposed to cultural heritage preservation field without the right methodology and a proper use. This study would like to highlight the possibility to apply digital technologies for the documentation of historic city centres in fragile contexts such as global south countries by a deep case studies analysis of the Indian old cities of Ahmedabad and Jodhpur. The main aim of the research is to evaluate accuracy requirement and assess digital tools for heritage preservation. Several challenges faced by this research are related to the development of documentation methods and tools for data collection and processing aimed at supporting Indian policy development. By means of affordable use of digital technologies, the research stresses the relevance of sustainable economy development linked to cultural heritage.
Solutions - Methods / Results - Findings	The research is settled on a wide range of digital documentation tools, examining procedures of identification of heritage elements to be preserved and enhanced. In order to reach this goal, the applied methodologies were focused on the identification of an interpretation method of the urban fabric based on the integration of investigations on both intangible and tangible features. The methodology led to affordable and feasible methods for all the actors involved in the preservation actions (NGOs and Trusts) and based on social and physical analysis.
Novelty - Value / Relevance to ...	The applied methodologies have been particularly relevant and novel in the Indian context thanks to the integration of several technologies such as Photogrammetry, Laser Scanner Surveys, 3D reconstructions, 360 degrees photos, virtual tour applications. The result consists in a low cost and feasible methodology of documentation, which is historically and morphologically consistent, that allow assessing the average variation - within different time frames - of heritage features according to a set of selected indicators. Thanks to these collected data, municipalities, NGOs and Trust, would be able to identify target-areas to be enhanced and preserved in old city centres.
Forum statement	Digital Heritage supports policy developments, conservation strategies and economic development in emerging countries.

Keywords:

Digital tools, Indian Cultural Heritage, Integrated documentation, Technology transfer

Graphics:



Theme 4: Disaster Risk Management & Governance for Resilient Communities

ISSUES AND STRATEGIES FOR EARTHQUAKE RESILIENCE IN ITALY

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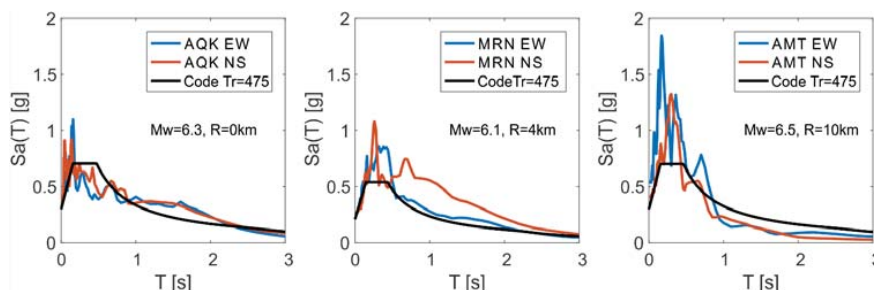
Abstract:

Problems - Issues / Challenges-Needs	Earthquakes with magnitude equal or larger than six occur, on average, every eight years in Italy. Given the dense urbanization of the country, these earthquakes typically determine significant damage and lifeline disruption in the affected areas. This is mainly because the vast majority of the building stock is designed with obsolete codes if any. Nevertheless, it has been recently demonstrated that this kind of earthquakes, which are relatively frequent, can possibly pose a threat also to constructions conforming to the state-of-the-art performance-based seismic design if they are located near to the earthquake source. Furthermore, it has also been observed that modern seismic design does not ensure uniform failure risk across the country.
Solutions - Methods / Results - Findings	The country is becoming increasingly aware of the situation and it is developing some policies to manage and reduce the seismic risk at a national scale. As it regards the existing building stock, the Italian government in the last two years has launched an initiative to promote seismic real-estate structural upgrading related to tax-deductible cost. The technically relevant part of the so-called <i>sisma-bonus</i> initiative is that it is based on a quantitative risk assessment (in terms of the annual expected loss) for the building before and after the seismic upgrading. Nevertheless, the impact of <i>sisma-bonus</i> is still relatively limited as some administrative issues impair its diffusion. As it regards new constructions, research has found that despite the uniform risk principle for citizens, code-conforming design does not warrant the same structural failure risk, which increases as the seismic hazard of the construction sites increases. Such a variation of the failure rate can be as large as a few orders of magnitude. Moreover, it has also been demonstrated that earthquakes of magnitude around six or more, around their source, are expected to systematically expose the structures to performance demands beyond what considered in design. These issues can call for some thoughtful discussion toward the next generation of European seismic codes.
Novelty - Value / Relevance to ...	The value of the presentation stays in the risk management issues and policies in Italy, which could be a paradigm for other European countries exposed to relevant seismic hazard. The relevance is for engineers, policy makers and emergency managers.
Forum statement	...

Keywords:

Risk; Earthquake; Resilience; Policy-making.

Graphics:



Comparison of recorded and design spectra during: L'Aquila (2009) earthquake (left), Emilia (2012) earthquake (center), the central Italy (2016) earthquake (right).

RECENT ADVANCEMENTS IN THE SEISMIC PROTECTION OF RC PRECAST INDUSTRIAL BUILDINGS

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Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> Reinforced concrete (RC) precast buildings represent a considerable part of the industrial and commercial infrastructure in Europe. The potential losses in the case of strong earthquakes are therefore large. This was explicitly demonstrated by recent earthquakes in Italy (in Emilia-Romagna, 2012). The economic losses due to the damaged industrial infrastructure and due to production interruption were amounted to more than 13 billion euros. In spite of the broad use of RC precast buildings, the knowledge about their very complex seismic response is still limited and the design practice and the design codes need to be improved.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> The seismic response and seismic safety of RC precast buildings clearly depends on the performance of the specific connections between different structural and nonstructural elements. So far, knowledge about the highly complex inelastic seismic behaviour of such connections has been very limited. It was, intensively investigated within two European projects SAFECAST and SAFECLADDING where full-scale experiments were performed on specific connections as well as on prototype structures, and the behaviour of different types of precast structures was studied. University of Ljubljana was actively involved in these projects with the main goal to obtain a better insight into the seismic response of existing systems of RC precast structures, which are broadly used all over the Europe. The extensive and detailed experimental and analytical studies of dowel connections, which are crucial for the stability of these buildings, were performed. The seismic response of the façade cladding panels and their role to the overall response of precast buildings was systematically evaluated for the first time. These studies, performed within the SAFECLADDING project, have been recently completed with unique full-scale shake table experiments, performed within the project funded by Slovenian National Research Agency.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> The complete insight into the main mechanisms of the dowel connections was obtained for the first time. The important parameters of the cladding panels' response were identified, and the improvements of the design practice have been proposed. The innovative system for the seismic protection of the existing cladding panels was developed. These research activities had important impact to the improvements of the design codes. Considering the UL research results, several new requirements were included into the recently proposed draft of the new version of Eurocode 8 standard. The new design procedure that has been proposed by UL, is included into this standard as the normative procedure for the design of dowel connections.
Forum statement	...

Keywords: RC precast buildings; Seismic response; Dowel connections, Cladding panels, Eurocodes

Graphics:



LIQUEFACT: ASSESSMENT AND MITIGATION OF LIQUEFACTION POTENTIAL ACROSS EUROPE

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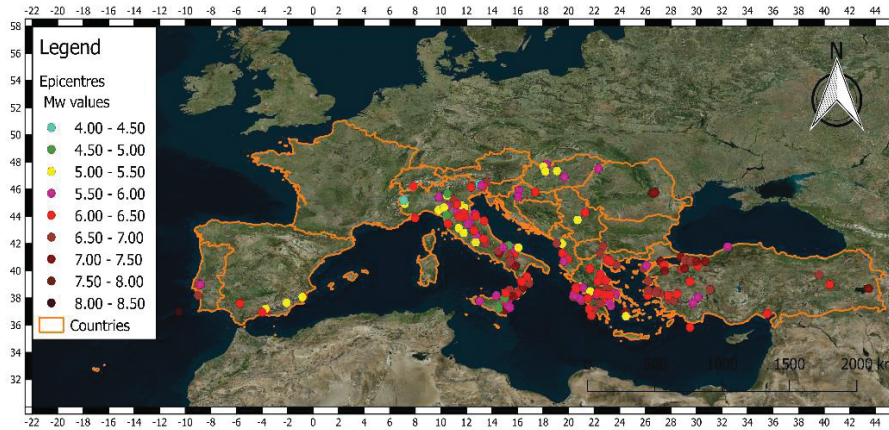
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> Recent events (Christchurch 2010-2011, Emilia Romagna 2012, Indonesia 2018, Hokkaido 2018 and others) have demonstrated that Earthquake Induced Liquefaction Disasters (EILDs) are responsible for tremendous structural damages and fatalities causing in some cases half of the economic loss caused by earthquakes. Novel liquefaction mitigation strategies are needed, especially beneath existing buildings. A tool for liquefaction hazard and risk assessment is required for the analyses of community resilience in cases of EILD.
Solutions - Methods / Results - Findings	<p>Liquefact project (H2020) addresses the challenge of EILD in a holistic way. It does not cover only the study of liquefaction hazard to individual structure but also the resilience of the collective urban community in relation to its quick recovery from and EILD occurrence. The EILD events are treated in systematic way by:</p> <ul style="list-style-type: none"> assessing the liquefaction occurrences in Europe, by studying 4 sites in different European countries, developing analytical tools for analyzing the behavior of different structures during EILD, proposing and testing of novel ground improvement options (in laboratory, in geotechnical centrifuge and on site), developing a liquefaction specific Risk Assessment and Improvement Framework (RAIF), assembling all the above developments in a software tool to support liquefaction mitigation planning.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> European liquefaction hazard map was produced. New approaches for the analysis of liquefaction resilience and vulnerability assessment of structures, lifelines and traffic in infrastructure. New liquefaction mitigation techniques were tested in centrifuge and in-situ: desaturation of liquefiable soil and installation of horizontal drains. The RAIF was proposed that allows facility managers responsible for critical infrastructure to identify the most appropriate mitigation actions, to reduce vulnerability and improve resilience to EILD events. The liquefaction mitigation planning software is currently being developed and tested.
Forum statement	The results of Liquefact project will enable to enhance the resilience of collective urban community to EILD events in Europe and worldwide.

Keywords:

liquefaction; earthquake; community resilience, ground improvement

Graphics:



Slovenia Earthquake Event Rapid Response Toolbox - POTROG

Authors: Darko BUT¹, Primož Banovec²,

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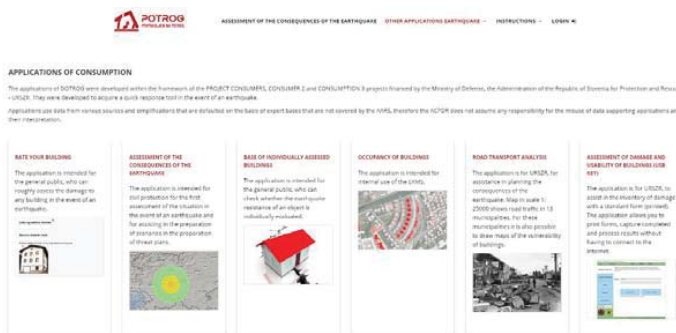
Abstract:

Problems - Issues / Challenges-Needs	Earthquake event is an outstanding risk event. Its occurrence is very sporadic, but it might impose significant damage to buildings (infrastructure?), human life and activities. This is requesting efficient and effective activities in all phases of the disaster management cycle with necessary support to first responders, thus supporting the overall coping capacity.
Solutions - Methods / Results - Findings	<p>Recognizing that the earthquake events pose, beside the flood events, the most outstanding risk in Slovenia, the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief has in 2011 initiated a POTROG project with an aim to develop a rapid response tool supporting different activities in the case of an earthquake?. The web-based tool was developed based upon the existing public registers and a parametric model of seismic risk of real buildings. This seismic risk model was developed on the basis of individual seismic assessment of more than 1.500 existing buildings in Slovenia assessed in the last 30 years.</p> <p>Within the project several modules were developed, forming one comprehensive toolbox composed of:</p> <ul style="list-style-type: none"> - Rapid assessment toolbox – assessment of damage grades (EMS-98 scale) and usability of buildings modelling each building in Slovenia individually with any location and magnitude of earthquake. - Rate your own building – modelling tool for citizens; - Assessment of seismic risk of critical infrastructure. - "Did you feel it?" module; - Assessment of necessary response capacity; - Daytime occupancy model, seismic risk of population and human life loss models; <p>Different components of the POTROG toolbox are regularly used. Most often, the "did you feel it?" module is used for the development of seismic maps in the case of earthquakes with lower magnitude. Other modules of the POTROG toolbox are mostly used for the earthquake preparedness stage – development of municipal, regional and national disaster management plans, and as simulation tool for earthquake response exercises. POTROG toolbox has also a significant impact on general population as central national earthquake preparedness rising platform. In the presentation the features of the POTROG toolbox and ongoing developments will be discussed.</p>
Novelty - Value / Relevance to ...	The operational POTROG platform is already proving to be essential multipurpose tool enabling more efficient preparedness and response to earthquake events in Slovenia. Beside that, by addressing with some features like "Rate your own building", the tool is enabling also outreach to general public increasing awareness.
Forum statement	Integrated tools that efficiently support all steps of disaster management cycle should be developed and made available for a wide array of users.

Keywords:

earthquake resilience, DSS, did you feel it, coping capacity, response

Graphics:



SUMMARY: RESEARCH USING LARGE-SCALE SHAKING TABLE

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	The Hyogoken Nanbu (Kobe) earthquake (January 17, 1995) took lives of about 6,500 citizens and destroyed over thousands of houses in Kobe and surrounding cities. Its direct economic loss was expected to be about 10 trillion JPY (approximately 100 billion USD) that was the largest loss in Japan. To investigate the realizable collapse mechanism, a three-dimensional and full-scale earthquake testing facility commonly referred to as "E-Defense" was constructed.
Solutions - Methods / Results - Findings	E-Defense, Japanese National Research Institute for Earth Science and Disaster Resilience (NIED), is an internationally well-known earthquake testing facility that has the world largest three-dimensional shaking table (size: 20 m × 15 m and maximum loading capacity: 12,000 kN). E-Defense has been nationally and internationally contributing to earthquake and structural engineering via execution of over ninety experiments since its commencement in 2005. In this paper, we introduce about E-Defense and summarize the following experiment activities: 1) highly earthquake-resistant Japanese wooden house (2005), 2) three-storey RC school building (2006), 3) Complete collapse test of a four storey steel frame (2007), 4) Lower parts of a high-rise building (2008-2009), 5) Four types of dampers in a steel structure (2009), 6) Four-Story Reinforced Concrete and Post-Tensioned Concrete Buildings (2010), and 7) Large-space structure with suspended ceiling (2013)
Novelty - Value / Relevance to ...	E-Defense has accumulated experience and special techniques by operating large-scale shaking table tests and various types of experiments. By using E-Defense, the following issues were confirmed: 1) collapse mechanism from complete collapse tests, 2) seismic behavior of non-structural components from tests of non-structural components, and 3) seismic behavior of high-rise buildings from substructure shaking table tests of high-rise buildings.
Forum statement	To prevent the future disasters, researchers of E-Defense are currently investigating about new testing methodologies and efficient sensing techniques for experiments targeting on more complicated systems such as soil-foundation-structure.

Keywords:

Large-scale shaking table; E-Defense; Collapse test

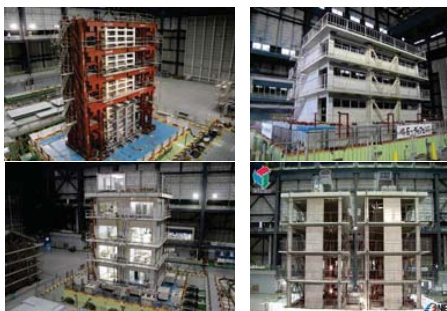
Graphics:

Large-Scale Shaking Table (E-Defense) Test

Timber Structures



Reinforced concrete Structures



Steel Structures



Enhancing Resilience – A means of Disaster Risk Management

Authors: Ashok Basa

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Abstract:

Problems - Issues / Challenges-Needs	"Resilience, in the context of disaster risk, is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transfer and recover from the effects of a hazard in a timely and efficient manner including, the preservation and restoration of its essential basic structures & functions through risk management" (UNISDR Terminology 2017). In accordance with UNISDR-2015 – "Resilience is about anticipating, planning, and reducing disaster risk to effectively protect persons, communities and countries, their livelihoods, health, cultural heritage, socio-economic assets and ecosystem." Resilience can be enhanced by increasing technological capacity, infrastructure development, skills & education levels, knowledge & information etc, and emphasizing on innovation.
Solutions - Methods / Results - Findings	Disasters, natural disaster in particular, cannot be prevented. But its effect can be reduced by enhancing resilience. It is seen that the effects of disaster is less in developed countries in comparison to developing or under developed countries. Let us take the example of effect of earthquake. The developed countries like USA, Japan, New Zealand etc have witnessed very high intensity of earthquake quite frequently. Thanks to the efforts of the engineers in those countries, because of their updated codes & strict adherence to the codes during construction practice, the community is more resilient to earthquake. Contrary to this in case of developing and poor nations, even a moderate earthquake causes a huge human causality. For instance, in case of 1995 Kobe (Japan) earthquake measuring 7.2 in Richter scale about 6,425 people died, where as in case of 2010 Haiti earthquake measuring 7.0 in Richter scale more than 316,000 people died. Thus, when we talk of resilience as a means of Disaster Risk Management, it involves not only psychological resilience of the community after the disaster, technical knowledge also plays a vital role. A country backed by adequate technical knowhow & infrastructural development will always lead to be more resilient.
Novelty - Value / Relevance to ...	The topic will be dealt with certain case studies from India involving earthquake & cyclone. After the 1999 Odisha Super cyclone & 2001 Gujarat Earthquake, lot of developments have taken place both in the technological & social sectors in India impairing resilience of the community. This yielded exemplary result & leading to drastic reduction of human causality from more than 10,000 in 1999 Odisha Super Cyclone to 43 in 2013 Phalane (another similar cyclone).
Forum statement	...

Keywords:

Resilience; Disaster; Disaster Risk Management;

Structural Sustainability for existing Infrastructure and buildings

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Abstract:

Problems - Issues / Challenges-Needs	<p>The presentation will focus to a rather forgotten aspect of Sustainability which is structural safety and integrity. Although safety is an "essential requirement" according to Eurocodes it is rather out of the current "literature" about sustainability.</p> <p>Sustainable Structural Design for new buildings means incorporation of environmental parameters and life cycle approach from the early stage of design. New generation of Eurocodes will enlarge our understanding for sustainability.</p> <p>Europe's basic road infrastructure was created mainly between the years 1960-1980. It counts already 40-50 years of life. When designed and constructed technical knowledge was quite different as far as it concerns, durability matters, earthquake risk and seismic loads, analysis methods and modeling facilities, pollution impact on ageing of structures and most of all poor quality of concrete and completely different, less heavy, traffic loads. The decade-long policy of austerity imposed across Europe has in general been accompanied by a generalized cut in public investment in infrastructure and, above all, in the budget allocated to maintenance and upgrading of the existing infrastructure.</p>
Solutions - Methods / Results - Findings	<p>Buildings:</p> <p>For existing buildings, Sustainability means that when renovation projects of a certain scale are undertaken, structural upgrade should be considered and funded jointly with functional and energy efficiency upgrade. While new buildings can be constructed with high performance levels, the older buildings typically need renovation measures, because of their low energy performance and seismic vulnerability.</p> <p>It is reasonable to argue if it makes sense in countries with high seismicity to invest heavily in the improvement of the building envelope, regardless of the state of the structure of these buildings. It is statistically certain that many of the surface interventions and coatings will sink down to the next earthquake.</p> <p>So we would like to stress and emphasize on the need of considering the energy and structural efficiency upgrade, jointly.</p> <p>Infrastructure:</p> <p>As the state of transport infrastructure, after many years of insufficient maintenance seems to become critical, and as the Genoa collapse showed, sometimes even dangerous, we have to undertake a new positive development in investing with innovative way in maintenance, upgrade and renovation.</p> <p>It is obvious that regular maintenance and upgrade of the existing infrastructure, mainly of bridges, is vital for safety and functional reasons if Europe has to maintain its productive and human respect standards.</p> <p>In each European country there are of course a lot of actions undertaken concerning the assessment maintenance and upgrade of existing infrastructure, but there is not a common European approach on methods and efforts.</p> <p>Obviously, the scale of needs requires a much more organized approach and we think that we must come to a European roadmap of maintenance and upgrade of the existing European network to keep it functional and safe.</p> <p>In addition to the necessary organizational and managerial effort, the unified administrative structure, the modernization of monitoring methods and the assessment of infrastructures, it is clear that significant resources will have to be mobilized either from Community resources or from national or other mixed funding methods.</p>
Novelty - Value / Relevance to ...	<p>We need to develop a policy for seismic upgrading of Europe's structural wealth alongside wider sustainable environmental upgrading, approaching holistically the problem of improving the performance of the built environment. This policy requires a collective effort and a cross-sectoral approach.</p>
Forum statement	<p>There is a need to develop a policy for seismic upgrading of Europe's structural wealth alongside wider sustainable environmental upgrading, approaching holistically the problem of improving the performance of the built environment.</p>

Keywords:

Structural Sustainability; Building and Infrastructure Maintenance; Sustainable Structural Design

A risk-based grading system incorporating tolerance against short-term and long-term risk posed by natural hazards

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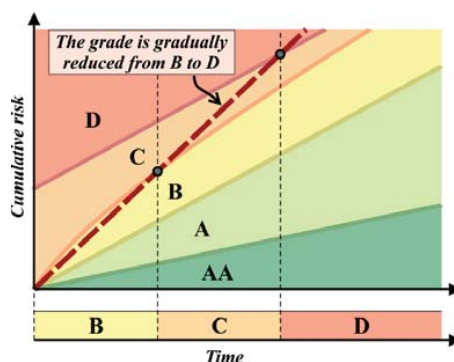
Abstract:

Problems - Issues / Challenges-Needs	Although several methods for the estimation of risk of facilities against natural hazards have been developed in recent decades, they are not yet harmonized and are rarely used in practice. One of the reasons for this is the public's unawareness of natural hazards risks, which decreases the role of rational risk-based decision making.
Solutions - Methods / Results - Findings	In the study, a recently developed tool for the evaluation and communication of risk posed by natural hazards is used to evaluate seismic risk. The tool is formulated as a grading system, which considers both the long-term and short-term risk tolerance. Grades AA and A indicate that the facility is exposed to the long-term tolerable risk, grades B and C correspond to the risk which is acceptable only for a certain period of time, whereas grade D implies that the risk is not tolerable even in the short-term. The grading process is performed in two steps. First, the initial grade is determined based on the so-called risk criterion. In this step, only grades AA, A, B and C can be obtained. If the initial grade is AA or A, the grading process is concluded. However, if the initial grade is B or C, the second step is performed, in which the initial grade is gradually reduced to grade D based on the so-called cumulative risk criterion. In this way, the stakeholders are given some time to design and implement appropriate risk mitigation strategies before obtaining the lowest grade. The grading system is applied to three precast reinforced concrete buildings with the same structure, but different type of non-structural elements. The influence of non-structural elements on the grades, which are assigned to the buildings, is investigated. It is shown that, although the seismic risk of all three investigated buildings is long-term intolerable, the time of obtaining the lowest grade differs due to the type of non-structural elements.
Novelty - Value / Relevance to ...	The recently proposed grading system, which combines together the concepts of long-term and short-term risk tolerance, is applied to a case study, in which three precast reinforced concrete buildings are analysed. The sensitivity of the grades to the difference in risk, which results from the selection of non-structural elements, is explored. The grading system allows the decision maker to prioritize which building to retrofit first and to determine the retrofitting schedule.
Forum statement	In order to enhance the role of risk-based decision making, the concepts of long-term and short-term risk tolerance should be distinguished and combined into a common system for the evaluation and communication of risk.

Keywords:

Grading system; risk evaluation; risk communication; cumulative risk; precast buildings

Graphics:



A GROUND MOTION SELECTION APPROACH BASED ON MULTIOBJECTIVE OPTIMIZATION TAILORED TO PROVIDE REGION SPECIFIC RECORD SETS

Authors: Konstantinos T. Tsalouchidis¹, Lukas Moschen², Ricardo A. Medina³, Christoph Adam¹,

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² VCE Vienna Consulting Engineers ZT GmbH, Vienna, Austria, moschen@fcp.at ;

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Abstract:

Problems - Issues / Challenges-Needs	For seismic building assessment the application of nonlinear time history analysis in engineering practice seems to gain ground, creating a necessity for a robust ground motion selection scheme. The recently proposed "Ground Motion Record Selection Approach Based on Multiobjective Optimization (L Moschen, RA Medina, C Adam: Journal of Earthquake Engineering; 2017) successfully meets the following objectives for the creation of ground motion sets: <ul style="list-style-type: none"> • Properly represents the region where the analysis is targeted, both in terms of geotechnical and seismological characteristics. • Matches a predefined target spectrum over a period range in terms of first and second order statistics (median and standard deviation).
Solutions - Methods / Results - Findings	The applied multiobjective optimization procedure creates a number of Pareto-optimal solutions. From these solutions the most appropriate one for the specific regional requirements must be selected. This is achieved through a procedure that takes into account the regional data concerning the built environment (types of buildings, height etc.) or more specifically, data concerning the analyzed target area (for instance, mid-rise RC buildings located in the city of Vienna, Austria). As application examples, one record set for the city of Vienna and one set for the city of Innsbruck (Austria) are derived.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • The proposed method aims to be a useful tool for engineer practitioners by simplifying the procedure of ground motion selection. • Once a ground motion record set for a specific city/region has been extracted, it is ready for multiple application without further analysis. • In this way, defining the input (excitation) of nonlinear time history analysis for seismic assessment of buildings becomes a more straightforward procedure, facilitating the whole task.
Forum statement	A robust methodology for ground motion record selection suitable for creating record sets for regions and large cities.

Keywords:

Ground motion selection; Multiobjective optimization; Regional ground motion record sets

New standardization of technical torrent control structures in Austria.

Authors: Johannes Hübl^{1*}, Georg Nagl¹

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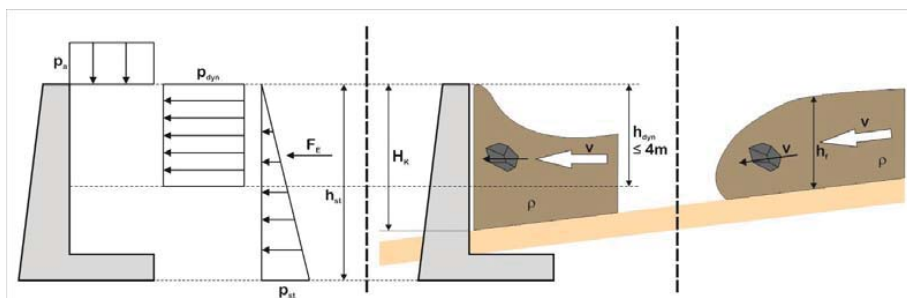
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Abstract:

Problems - Issues / Challenges-Needs	Due to a long tradition in the torrent control works, different approaches for designing and numerous types of protection structures on different condition levels existing in Austria. To harmonize the different approaches, an interdisciplinary working group (ON-K-256) was launched for a standardization of the design of technical structures founded on the Eurocode, encompassing torrential processes, snow avalanches and rock fall.
Solutions - Methods / Results - Findings	New standardization of the design of technical structures founded on the Eurocode <ul style="list-style-type: none"> • scenario-oriented protection concepts • including variable disposition of a torrent catchment • including transition of the predominant displacement process New harmonized stress model and the load distribution <ul style="list-style-type: none"> • For debris flows, for example, a standardized stress model in ONR 24801 combines the static and dynamic load by debris flow impact on the structure.
Novelty - Value / Relevance to ...	The new standardization for torrential processes in Austria <ul style="list-style-type: none"> • Definition and classification (ONR 24800) • Action on structures (ONR24801) • Design of structures (ONR24802) • Operation, monitoring and maintenance (ONR 24803)
Forum statement	New standardization of technical torrent control structures in Austria to enable practitioners to properly design debris flow countermeasures.

Keywords:

Torrent control; debris flow; standard; Austria



DEBRIS FLOW HAZARD ASSESSMENT - FROM REGIONAL TO BASIN SCALE

Authors: Jošt Sodnik, Ph.D.^{1,2}, prof. Matjaž Mikoš, Ph.D.²

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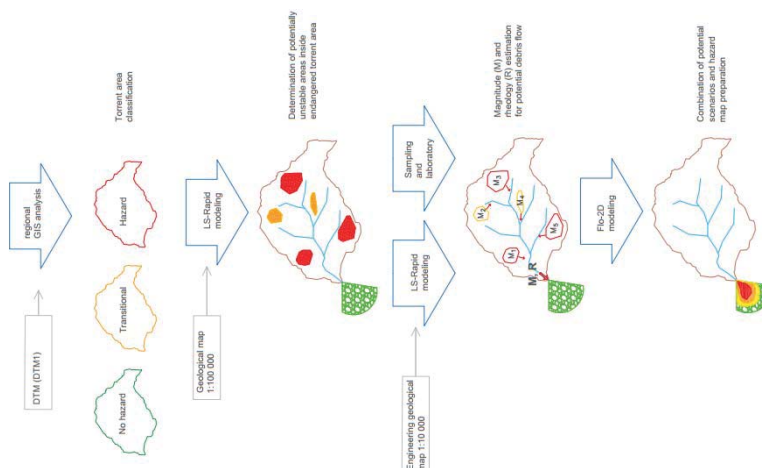
Abstract:

Problems - Issues / Challenges-Needs	In Slovenia, floods hazard assessment has been introduced by the national legislation and special regulations; it does not cover debris flows. Several large debris flows in the last few decades ask for special legislation and thus debris-flow hazard should be implemented in spatial planning process. Debris flow research in the past mainly focused on post-event analysis. When predicting potential events, several questions should be addressed: Where can it occur? What magnitude can we expect? What are its rheological characteristics?
Solutions - Methods / Results - Findings	Various morphological methods and susceptibility models were analyzed to classify torrential catchments into three groups: prone to debris flows, transitional catchments and catchments with no debris flow hazard. The main difference between floods and debris flows, when assessing magnitude of an event, is that a debris-flow magnitude is much harder to estimate than for torrential floods. Debris-flow magnitudes can be estimated using a landslide triggering model LS-Rapid. Main model input data are LiDAR digital terrain models (DTM1) and the geological map of Slovenia (scale 1:100 000). This approach can only determine the upper and lower limits for potential debris-flow magnitudes. Rheological parameters in the 2D numerical transport model Flo-2D can be calibrated for past events, but not for potential future events. Sensitivity analysis of the Flo-2D model has shown that volume concentration is the most relevant parameter for modeling results and that changing values of dynamic viscosity and shear resistance in a debris-flow has only small effects on the modeling results. The proposed methodology can be tested in other debris-flow prone areas in Slovenia.
Novelty - Value / Relevance to ...	A methodology for debris-flow hazard assessment on torrential fans was proposed covering phases from preliminary classification of torrential fans to a final preparation of debris-flow hazard maps. Such maps should avoid to apply sharp border lines between hazard classes, the transition between them should be smooth and the consequences of this novelty in hazard assessment for spatial planning procedures should be discussed and optimized.
Forum statement	In debris-prone areas, debris-flow hazard and risk should be assessed and furthermore used in spatial planning process to increase their resilience.

Keywords:

debris flows, hazard assessment, mathematical modeling, risk management, spatial planning

Graphics:



Novel monitoring barrier to investigate the interaction of debris flows and mitigation structures

Authors: Georg Nagl¹, Johannes Hübl¹,

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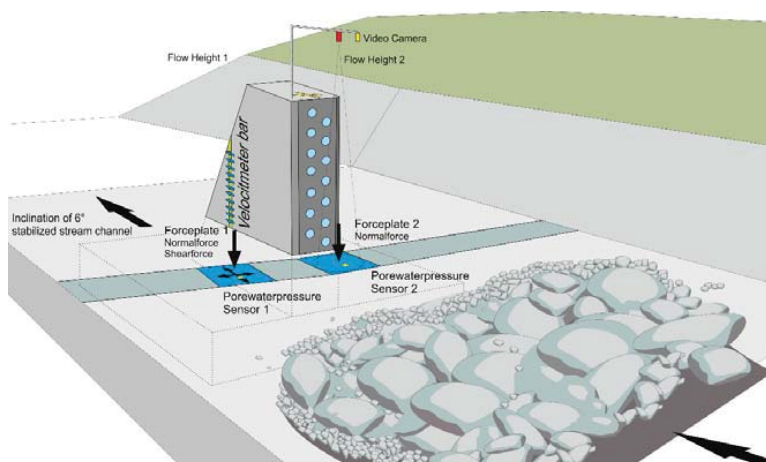
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Abstract:

Problems - Issues / Challenges-Needs	<p>Knowledge of design values is of particular importance for the design of structural mitigation measures.</p> <ul style="list-style-type: none"> • Challenging task to measure extreme destructive forces of debris flows • Essential parameter like impact force, density and velocity are necessary provide high quality information for designing
Solutions - Methods / Results - Findings	<p>A new monitoring barrier with more than 50 sensors was built for measuring flow properties like and to investigate the interaction of debris flows with mitigation measures</p> <ul style="list-style-type: none"> • flow depth, • normal stress, • shear stress, • pore fluid pressure • internal velocity profile • impact pressure • earth pressure
Novelty - Value / Relevance to ...	<p>Three events were measured during two years of observation, with densities from 2500 to 1500 kg/m³ Velocities of 1-4 m/s ...and impact pressures up to 40 kPa and higher</p>
Forum statement	In-situ real time measurements of three debris flow events to provide high quality information for the design of structural mitigation measures.

Keywords:

Torrent control; debris flow; Monitoring; Impact force



IMPLEMENTATION OF MULTIDISCIPLINARY APPROACH FOR DETERMINATION OF LANDSLIDE HAZARD

Authors: Tina PETERNEL¹, Jernej JEŽ¹, Blaž MILANIČ¹, Anže MARKELJ¹, Jošt Sodnik^{2,3}, Matej MAČEK³, Mateja JEMEC AUFLIČ¹

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Abstract:

Problems - Issues / Challenges-Needs	The aim of this paper is to present investigations and modelling of slope mass movements in the hinterland area of the Koroška Bela settlement (Bela torrent watershed) that is located on torrential fan in the Karavanke mountain ridge in north-western Slovenia. The hinterland of Koroška Bela settlement has complex geological and tectonic conditions. The active landslides are mainly related to soft fine-grained and tectonically deformed clastic rocks, most of which are covered with large quantities of carbonate scree material. Based on the investigation and field observation, the most active landslides of the Bela stream hinterland are considered to be the Urbas and Čikla landslides. Based on investigations herein, previous research and historical evidence have showed that the area of interest could present source areas of potential debris flow that could be triggered by extreme events (such as extreme precipitation events, earthquake or combination of both). A debris flows present a direct hazard for underlying settlement with 2,200 inhabitants and developed infrastructure (international railway) and industry (steel industry). With this potential risk in mind, monitoring the sliding mass, assessing the volume of active landslides and the potential hazard is crucial for effective disaster risk management.
Solutions - Methods / Results - Findings	In order to assess the hazard for underlying village, a multidisciplinary approach using engineering geological and geophysics investigation, hydrogeological and geotechnical monitoring was applied. Firstly, an engineering-geological mapping was applied in order to identify areas prone to slope mass movements and to determine location and type of investigation (geomechanical boreholes, geophysical investigations). The entire hinterland of the Koroška Bela settlement was geologically mapped at scale 1:5,000, while selected important landslides were mapped at scale 1:1,000 (the Urbas and Čikla landslide). Secondly, the core drilling and core logging of 7 boreholes and excavation of 2 trenches were applied at the Urbas and Čikla landslides. Based on core logging we identify the main lithological units and sliding surfaces of both landslides. Furthermore, the thickness of lithological layers was determined using geophysical surveys. The 4 boreholes were equipped with inclinometers or piezometers which were beneficial to interpreted subsurface conditions, absolute displacement rates and measurements of ground water levels were interpreted based on 4 boreholes equipped with inclinometers or piezometers. Additionally, geomechanical properties were determined using laboratory tests such as soil suctions, grain size analysis, edometer test, direct shear test and permeability based on samples collected from the boreholes and trenches. Based on geological survey, results in geotechnical lab and hydrological model of the area, potential debris flow scenarios (magnitude, rheological characteristics) from Čikla and Urbas were determined. Mathematical model Flo-2D was applied to simulate these potential debris flow events. Modeling results show that potential debris flows with previously mentioned magnitudes would have catastrophic consequences on Koroška Bela torrential fan. Simulated depths of potential debris flow exceed 5m in some densely populated parts of the Koroška Bela fan. Therefore, application of mitigation measures is inevitable.
Novelty - Value / Relevance to ...	Investigation of landslide kinematics from their origin to the deposition areas is becoming crucial to reduce human loss from landslides and to assess landslide hazard. In doing so, the following questions are pursued: where can landslides occur (place of origin), when (rheological properties of material, rainfall), how extensive can they be (magnitude), and where can landslides act (place of action)? When searching for the answers to these questions, a comprehensive interdisciplinary approach is one of the most reasonable solutions on which experts and the science of landslide dynamics should focus more attention both in Slovenia and internationally. In such complex mountain morphological, geological, hydrological and urbanistic setting interdisciplinary approach is crucial for the efficient disaster risk management. Detail spatial basis serves as the most important input for planning and design of needed mitigation or protective construction measures.
Forum statement	Acknowledgments: The surveys within this study were conducted in the frame of a project financed by the Ministry of the Environment and Spatial Planning and the ARRS project (grant. no. J1-8153, duration: 1.5.2017–30.4.2020) financed by the Slovenian Research Agency.

Keywords:

landslide; hazard; monitoring; hinterland of Koroška Bela, NW Slovenia

Optimization of HPPs chain operation during flood waves

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¹ University of Ljubljana, Faculty of Civil and Geodetic engineering, Gasper.Rak@fgg.uni-lj.si; ² IBE, Consulting Engineers, Ljubljana, Slovenia

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Abstract:

Problems - Issues / Challenges-Needs	<p>The construction of a chain of six hydroelectric power plants on the lower course of the River Sava (Vrhovo, Boštanj, Arto - Blanca, Krško, Brežice, Mokrice) will more than double the production of base load power on the Sava, but at the same time the chain of HPPs changes run-off regime, especially during flood waves.</p> <ul style="list-style-type: none"> • Operation of HPPs that requires minimum necessary passive flood protection measures (e.g. flood embankments) • Providing a constant water volume in the storage reservoirs during increase of the flood wave discharge • Preservation of natural propagation and transformation of flood waves along the HPPs chain • Preservation of the runoff conditions in the border profile with the Republic of Croatia
Solutions - Methods / Results - Findings	<p>Methodology:</p> <ul style="list-style-type: none"> • The hybrid modelling approach – physical and numerical modelling of entire HPPs chain and its individual parts (hydro-mechanical equipment at hydraulic structures, high water spillways, etc.) • Analyzing of optimum drawdown curve for each HPP • Preservation of floodplain retention capacity, while the extend of flood hazard remains the same or mitigated
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Operation mode of run-off river HPPs, which requires the minimum passive flood protection measures • Controlled spilling of high waters onto floodplain areas with retention capacity • Optimum operation of hydro-mechanical equipment at hydro-engineering structures (coordinated gate operation on main dams of reservoirs and high water spillways) • The method can be used both on reservoirs in narrow river valleys, as well as in the case of wide river valleys with significant retention capacity.
Forum statement	Operation mode of HPPs chain could ensures a renewable energy source and preservation or even mitigation of flood hazard

Keywords:

Flood hazard; Flood waves; Chain of HPPs; Optimal operation; Hydraulic modelling

Graphics:



- Chain of the hydropower plants on Lower Sava

IMPACT OF THE STRUCTURAL FLOOD PROTECTION MEASURES ON THE ACTIVITIES OF PROTECTION, RESCUE AND RELIEF FORCES

Authors: Janja KRAMER STAJNKO, Ph.D. (Eng.)¹, Franci PETEK²

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Abstract:

Problems - Issues / Challenges-Needs	Floods are natural phenomena, which cannot be prevented and are causing many fatalities, enormous economic losses as well as environmental threats. Therefore, it is crucial to set up an efficient flood risk management policy, which would reduce likelihood and the impact of floods. The necessary elements of flood risk management according to "integrative risk management cycle" are preparedness (prevention, preparation), response (intervention, recondition) and recovery (reconstruction). Comprehensive structural flood protection measures can reduce flood risk, but cannot eliminate a potential risk of flooding; therefore, an efficient civil protection service is an indispensable element in a system of flood risk management.
Solutions - Methods / Results - Findings	Protection, rescue and relief forces are involved into a part of the response phase and are responsible for alert, rescue, damage mitigation, information etc. Furthermore, they take care for provisional repair, supply and disposal, communications etc. during the recondition phase. The most powerful force of protection, rescue and relief forces in Slovenia are voluntary fire-fighting units, which are playing also the most important role on interventions during floods. The implementation of preventive structural flood protection measures influences significantly the extent of intervention and recondition during floods. This can be observed on a case study of the Drava river where a flood event in year 2012 caused enormous damage along the surrounding areas. Especially vulnerable are areas in Dogošë and Duplek, where in year 2015 protection embankment and protective wall were finished. The occurrence of high waters on the Drava river end of October 2018 has shown that the implemented structural measures reduced the flood risk on these locations. The extent of intervention measures in view of protection, rescue and relief forces was also significantly reduced.
Novelty - Value / Relevance to ...	A flood safety in vulnerable areas cannot be achieved with implementation of structural measures only. The potential risk will remain and has to be accepted by society. The cooperation and communication with protection, rescue and relief forces which can give a feedback about the efficiency of flood protection measures is indispensable.
Forum statement	Flood risk can be reduced with structural measures but cannot be eliminated completely, therefore the efficiency of flood risk management is depending on the activities of protection, rescue and relief forces.

Keywords:

Flood risk management; Integrative risk management cycle; Structural flood protection; Protection, rescue and relief forces

Graphics:



FLOOD AND DROUGHT MANAGEMENT: CHALLENGES FOR CIVIL ENGINEERING

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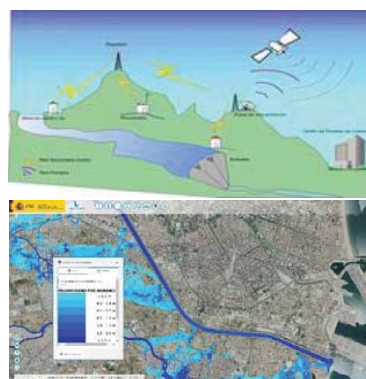
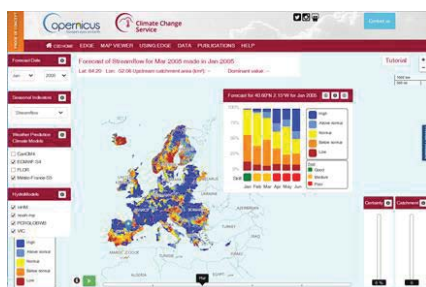
Abstract:

Problems - Issues / Challenges-Needs	Droughts and floods are extreme events that bring about great social, economic and environmental impacts, affecting numerous regions and populations all over the world. In addition, the occurrence, frequency and impacts of droughts and floods can be aggravated by the effects of climate change.
Solutions - Methods / Results - Findings	Water policies to manage droughts and floods have evolved from traditional emergency actions to risk management plans. This paper establishes a general framework for these extreme events and describes different case studies distributed all over the world, which show this evolution focusing on the contribution of civil engineers to this change and how the solutions must deal with complexity of problems and uncertainty.
Novelty - Value / Relevance to ...	Traditionally, civil engineers have designed and constructed what it are called "grey solutions", as flood defenses through dikes, dams or embankments. Currently, cost-benefit analysis is used as a basis for decision-making of this type of solutions, as required by the European Flood Directive in the Flood Risk Management Plans. New approaches based on risk management, where prevention, protection and preparedness is prioritized, are being applied all over the world. Droughts policies have moved from a crisis management approach focused on emergency works to drought risk management where the associated measures often result in comprehensive drought risk management plans with water stress area mapping, alert levels, indicator systems and warning systems. High scientific and technical level tools are being developed as part of Decision Support Systems which help in the decision making process.
Forum statement	From traditional emergency actions to risk management plans for droughts and floods

Keywords:

Floods; Droughts; Risk Management; Civil Engineering, Challenges

Graphics:



THE DESIGN RAINFALL ISSUE: IMPACT ON THE RESULTS OF THE HYDRAULIC MODELLING

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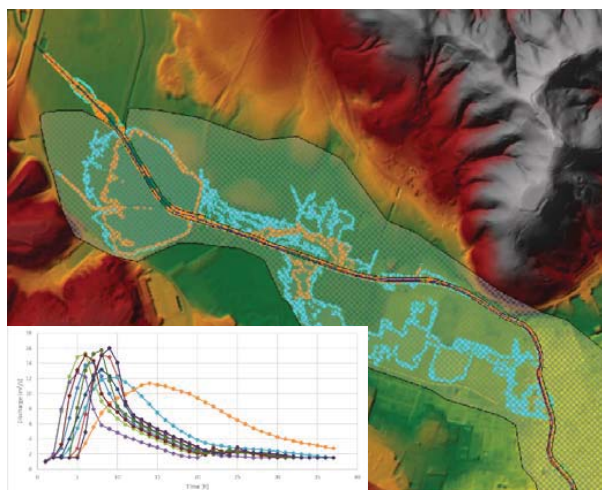
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> In the case of small, ungauged catchments different procedures can be used to derive the design hydrograph and design peak discharge. Measured input data needed for estimation of design peak discharges are often missing.
	<ul style="list-style-type: none"> The design hydrograph and the design peak discharge information are needed as crucial input data for the design of different hydraulic structures or producing the flood hazard maps.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> Different design rainfall scenarios should be considered in the hydrological models in order to consider different input hydrographs into the hydraulic models. Huff curves proved to be an efficient tool for assessing the design rainfall events (temporal rainfall distribution) based on the analysis of the measured rainfall events in the past. Selection of the design rainfall event should be regarded as an important initial step since hydraulic modelling results for different scenarios differ significantly.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> Consideration of different design rainfall events results in the different design discharges and design hydrographs. Consequently, the spatial extensions of the flooded areas in the flood hazard maps also differs. At our study case, the maximum flooded area extent was 2 times larger than the minimum one and the maximum water velocity over flooded areas was more than 10 times larger than the minimum one.
Forum statement	Rainfall characterization is crucial for credible assessment of the input data for designing of hydraulic structures on small streams.

Keywords:

design hydrographs; Huff curves, design peak discharges; flood hazard maps, hydraulic structures design

Graphics:



Detention basin „Krems-Au“ as an example for flood protection in densely populated areas of Austrian mountainous regions

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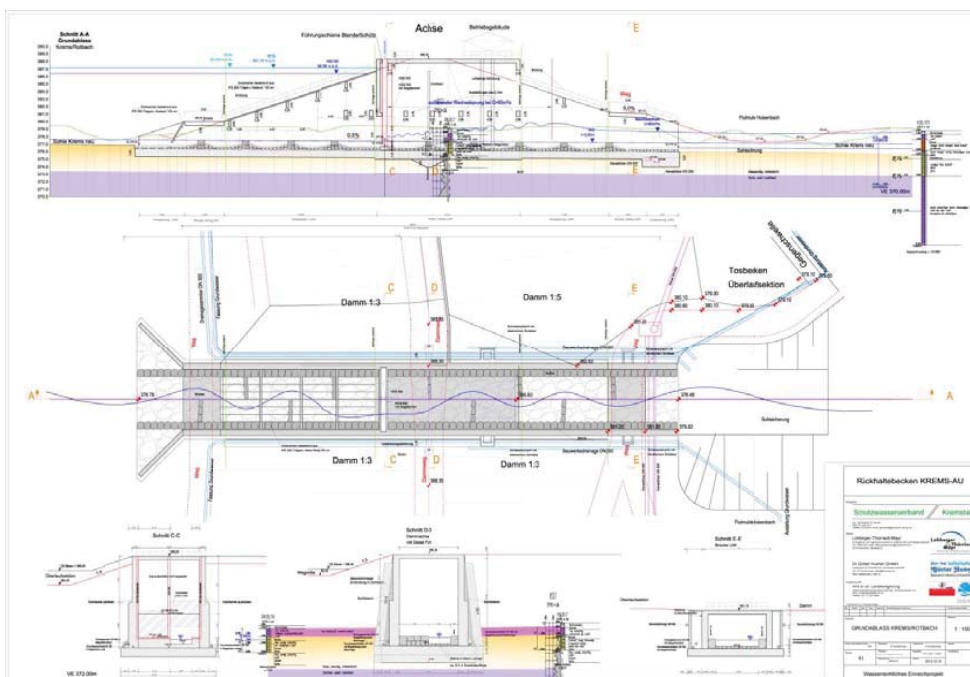
Abstract:

Problems - Issues / Challenges-Needs	Dimensioning and design of flood protection by detention basins have two main technical challenges: At first hydrographic data for calculating the necessary reservoir and on the other hand the safety of the construction
Solutions - Methods / Results - Findings	<p>At the example of Austria's largest detention basin "Krems-Au" the solution of these two challenges will be described.</p> <p>The detention basin is located at the river Krems in the foothills of the Northern Alps, Upper Austria.</p> <p>Chapters:</p> <ul style="list-style-type: none"> • Flood event in Upper Austria in August 2002 and the Krems river • Regional Conception and Hydrography in Austria • Construction and the Austrian Reservoir Commission • Building phase <p>In August 2002 two flood events within 8 days took place in regions along the Danube river but also in catchment areas from 100 to 1000 km². One of these areas was the catchment of the river Krems in Upper Austria. The catchment consists of alpine areas and foothills of the Northern Alps and measures about 400 km². The flood was due to precipitation of 24 to 48 hours and generated floods in upper Austrian catchments annuality of 30 to 300. Along the river Krems the annuality was above 100. The trough valley of the Krems is densely populated and industrialized. Residential and industrial areas are concentrated in the valley plains because of the mountainous topography beside the valleys. This is a flood problem which we find anywhere in the Alpine regions. The damage of an HQ100 along the Krems river is about EUR 70 Mio.</p> <p>After the flood of 2002 several conceptions for flood protection were ordered by governmental organisations of Upper Austria. In these conceptions it was obvious that one of the main contents of flood protection along the river Krems has to be a detention basin at the upper part of the catchment. In Austria hydrographic surveying began in a professional way in the 1890ies on the one hand because of shipping on the Danube river and on the other hand because of tremendous floods in those years (1897 and 1899). Since then an enormous number of observation features for precipitation and water level gauges were installed. In the Krems catchment there are four water gauges and four rain gauges in operation.</p> <p>So the dimensioning of flood protection facilities and the calculation of characteristic runoff could not only be made by modelling runoff on precipitation data but by statistical evaluation of measured events in up to 100 years.</p> <p>The conception of the Krems-Au detention basin resulted in an essential effective storage of 2,5 Mio m³.</p> <p>In a sparsely populated part of the valley there was found a place where the basin could be designed on an area of about 100 ha (=1 km²) of partly extensive agricultural land.</p> <p>The basin consists of an embankment dam with a length of 1,9 km, 2 bottom outlets and a dam spillway with a length of 200 m. The construction of the dam and all its safety facilities is supervised by the Austrian Reservoir Commission beginning at the construction phase to the authorization by the public administration and also in the building phase.</p>
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Calculation of detention reservoir by statistics of hydrographic surveying an N-Q-modelling • measuring of additional safety reservoir and extremely rare runoff by more than one methods • Supervision by the Austrian Reservoir Commission
Forum statement	...

Keywords:

Detention basin; Hydrology; dam

Graphics:





JUBIZOL thermal insulation systems with an integrated risk management system in case of natural disasters

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Abstract:

Problems - Issues / Challenges-Needs	The basic purpose of the thermal insulation system is to perform the function of maintaining the optimal temperature in the room, both in winter and in summer. By changing weather conditions and increasing the number of natural disasters, such as floods, hail, storms, extremely high temperatures, increased UV radiation, smog; the facade wrapper must also have properties that enable the management of such risks.
Solutions - Methods / Results - Findings	UV resistance - COOL pigments. COOL pigments contain IR reflective particles that effectively reflect sunlight and thus prevent excessive heating and expansion of the facade surface. Resistance to water absorption of finishing layers - longevity of JUBIZOL systems Resistance to floods. Flood is the most common type of natural disaster, which in case of using an inappropriate system means an increased amount of moisture in the building material JUBIZOL system in combination with HYDROSOL Superflex 2K means waterproof protection of the lower facade parts of the building and prevents ingress of water inside the building. Resistance to mold and algae occurrence as a result of natural disasters. The occurrence of damage events is often the result of mold and algae on facade or inside of the building, which are not only non-aesthetic, but also harmful to health. The only precaution against microbes on the internal and external walls is the choice of finishing layers with adequate antimicrobial protection, which optimal protection is previously determined in a specialized laboratory.
Novelty - Value / Relevance to ...	The JUBIZOL Strong thermal insulation system has an increased bending and tensile strength of the carrier layers of the system and increased resistance of the facade surface to impacts and perforations. Both are achieved by thickening and double reinforcement, and specially designed basic plaster for this purpose, with micro-reinforcement additives that influence the increased bending and tensile strength. In this way, we ensure a high level of safety of the system, especially from damage caused by extreme weather events and vandalism, from damage caused by various animals on the facade, as well as from damage due to large heat extensions and shrinkage the consequence of the installation of finishes of dark colored tones. In the future we will face natural disasters that will be more frequent and whose effects will have irreversible consequences if we do not choose a technically adapted system. The choice of the facade system should be based on the analysis of the load on the site, where we will build and on the certified characteristics, on the tests which are made on accredited institutes.

Keywords: JUB, Kamenski Iztok, JUBIZOL Strong, JUBIZOL sistemi, HYDROSOL Superflex 2K,

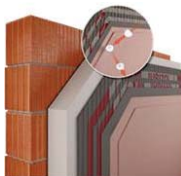
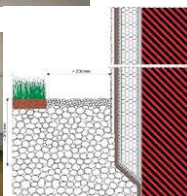
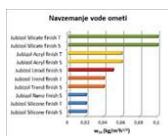


Table 2 — Categories for liquid water permeability (W)

Category		Requirement w $\text{kg}(\text{m}^2 \cdot \text{h}^{-0.5})$
W_1	High	≥ 0.5
W_2	Medium	≤ 0.5
W_3	Low	> 0.1



UNESCO Chair on Water-related Disaster Risk Reduction (WRDRR)

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Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> Water is at the heart of recent milestone agreements such as the UNESCO 2030 Agenda for Sustainable Development, the Sendai Framework for Disaster Risk Reduction 2015-2030, and the 2015 Paris Agreement. The 2030 Agenda introduced 17 Sustainable Development Goals (SDGs) – among targets: by 2030, reduce by half the loss of human life and property from water-related disasters, by improving the resilience of nations. The UN General Assembly proclaims the period 2018-2028 the International Decade for Action "Water for Sustainable Development", to further improve cooperation, partnership and capacity development in response to the ambitious 2030 Agenda. There is an urgent need to a better understanding of the hydrological cycle, of all of its components as well as its changes and variability under fast climate change in the next decades.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> The International Association of Hydrological Sciences (IAHS) Scientific Decade 2013-2022 "Panta Rhei" is a fundamental contribution to new science of integrated hydrological and societal processes. Launched in 1992, the UNITWIN/UNESCO Chairs Programme promotes international inter-university cooperation and networking to enhance institutional capacities through knowledge sharing and collaborative work. In Slovenia, there are 3 out of 736 UNESCO Chairs – also Chair of Water-related Disaster Risk Reduction (WRDRR) at the University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG). UNESCO Chair WRDRR co-organized the 4th World Landslide Forum (2017), the 3rd Regional Symposium on Landslides of the Adriatic-Balkan Region (2017), is supporting landslide research through the World Centre of Excellence in Landslide Risk Reduction at UL FGG (since 2008) and capacity building in flood risk management through contributing to the ERASMUS Master Programme on Flood Risk Management.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> UNESCO Chair WRDRR is strengthening society resilience in its field of expertise – through international research and higher education. In higher education, study programmes in civil engineering need to be international and give competencies to master & doctoral students in water & risk management for their higher competitiveness on the labor market – UNESCO Chair WRDRR is supporting that.
Forum statement	<ul style="list-style-type: none"> UNESCO UNITWIN Networks and UNESCO Chairs as part of the internationalization of higher education can effectively contribute to a higher impact of civil engineering disciplines to the joint worldwide efforts to fulfillment of the UNESCO 2030 Agenda on Sustainable Development and its 17 Sustainable Development Goals.

Keywords: Agenda 2030; Droughts; Floods; International Hydrological Programme; Landslides; Sustainable Development Goals

Graphics:



THE CONCEPT OF A COMPETENT PERSON IN DISASTER RISK MANAGEMENT & GOVERNANCE FOR RESILIENT COMMUNITIES

Authors: Marko KOMAC^{1,2}, Vitor Correa²

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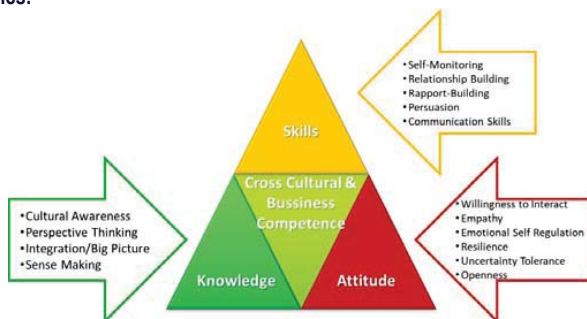
Abstract:

Problems - Issues / Challenges-Needs	Disaster Risk Management and Governance for Resilient Communities (DRM & GRC) processes are complex and as are aimed in reducing the risk for the society (people, animals, real-estate, nature etc.) and governing its resilience, demand the highest possible level of competence and ethical behavior from experts engaged in these processes. Thus, recognising competence and setting common professional standards for experts engaged in the DRM & GRC processes is paramount to public safety and effective prediction, prevention and mitigation of natural hazards.
Solutions - Methods / Results - Findings	Many professional fields where responsible decisions that could lead to devastating consequences and/or financial liability have introduced a professional title that defines the frame of the expert's competences, professional experience and ethical standards. As natural disasters are specific processes also a professional title (hereafter called a "professional title in DRM & GRC") that defines an expertise in this field is needed. A professional title in the field of DRM & GRC has to follow basic defined and agreed upon rules (standards) and procedures for a professional title granting scheme, underpinned by transparency and materiality, to ensure wide recognition among peers and to demonstrate to regulators and the general public that an individual is competent to provide geological advice. The holder of a professional title in DRM & GRC must have suitable academic qualifications, professional experience and skillsets learnt over time.
Novelty - Value / Relevance to ...	Ensuring competent and ethical practice among experts engaged in the Disaster Risk Management and Governance for Resilient Communities processes contributes to public safety and facilitates cooperation with other experts and effective communication with the public.
Forum statement	Introduction of a concept of a professional title in DRM & GRC promotes excellence in the Disaster Risk Management and Governance for Resilient Communities processes

Keywords:

Professional title; Competence; Professionalism; Ethics; Standards

Graphics:



Adapted and modified after Abbe and Halpin, 2009

graphics)

Application of Earth observation and 3D geospatial data in disaster monitoring

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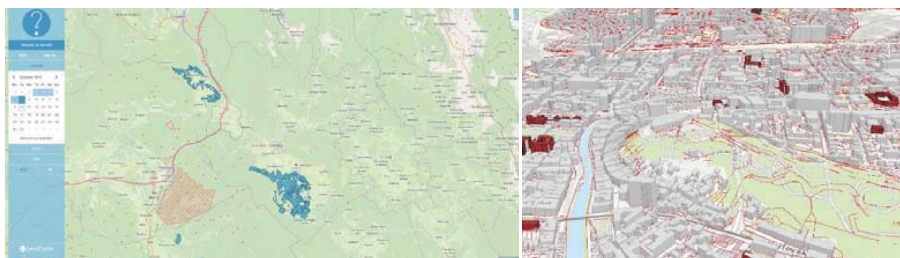
Abstract:

Problems - Issues / Challenges-Needs	Geospatial data and information are becoming a crucial support in disaster response and risk management. Besides the answer on “what happened”, the information on where it happened as well as the spatial extent of the event is of the utmost importance. Two main challenges related to geospatial information support in disaster response and risk management are addressed in this presentation: (1) the complexity and dynamics of built and natural environment require three-dimensional geospatial data models, with the additional temporal dimension to better monitor, control, and manage the dynamics; (2) technological advances have driven the evolution and reduced the costs involved in developing and processing of geospatial data and information.
Solutions - Methods / Results - Findings	Recent advancements in Earth observation and geoinformatics offer several solutions that can be applied to emergency response systems. We will demonstrate the use of a combination of 3D city and landscape models and flood detection data from satellite images. The flooded areas can be detected using free and open data from the European Union's Copernicus program. Our application uses Sentinel-1 SAR imagery and produces a spatial layer of water bodies immediately after the images are available. The advantage of using radar data compared to aerial and optical satellite imagery is the ability to provide reliable results at night and in cloudy weather conditions, usually present in case of floods. The result of processing is a vector layer delivered via a web geospatial information system (GIS) and as a service. It can be later combined with a georeferenced 3D city and landscape model produced from other data sources, e.g. laser scanning, giving the water depth information, very important for disaster response action planning and damage assessment.
Novelty - Value / Relevance to ...	The fully automatic real-time water bodies detection system, developed together with Space-SI and GeoCodis, is operational for the area of Slovenia and has been demonstrated in several European and African regions. The inclusion of 3D city models is relevant for damage assessment, disaster response planning, and damage prevention.
Forum statement	Real time EO data processing and 3D modelling are essential tools in disaster risk management in built environment.

Keywords:

Earth observation; Copernicus; Sentinel; 3D modelling; Geoinformatics

Graphics:



More Room for Water

Authors: Mitja BRILLY¹, Mojca ŠRAJ¹ Andrej VIDMAR¹ and Simon RUSJAN¹

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Abstract:

Problems - Issues / Challenges-Needs	Since ancient times, and more intensively from the mid-19th century the land belonging to water has been reduced and occupied by human activity. The surfaces 'taken' from rivers used primarily for agriculture and urban development. Such developments occurred worldwide. At the end of the 20th century, many rivers flowed in highly confined channels. This resulted in the changes reducing water resources of appropriate quality, affecting natural habitats, causing major flood damage, decreasing groundwater stock, and deteriorating water quality.
Solutions - Methods / Results - Findings	Today, developments in urban water management should allow the increase of the room for water and, moreover, give back to the river at least some of the space that it once possessed. Furthermore, we have to make room for water infrastructure with storage and waste water treatment facilities. Water attracts the attention of city authorities when problems occur, rather than during the planning of urban development. As it is, suitable land is urbanised and already occupied due to the various needs of the city, while solutions are complex and expensive. The release and creation of space for water needs is subject to strong personal and other public interests; even though these areas can also be used for other urban purposes, their primary role of supporting the water regime must be ensured. In any event, releasing more room for water pays out economically in the long-term, for which, nevertheless, long-term strategic decisions for landscape planning and real-estate policy are required. Natural based solution often could not be implemented without additional room for water. More room for water means: More room for river, More room for creeks, More Room for torrent More room for wadi More room for ground water recharge More room for water storage, More room for wetlands More water resources More security for people and ecosystem at all
Novelty - Value / Relevance to ...	To develop innovative strategies for the sustainable management of MORWater for the benefit of both humans and nature. To assess the future trends of water regime development in order to develop and test adaptation and mitigation strategies.
Forum statement	...

Keywords:

water; more room for water; water management; water land; floods

Role of pollutant mass balances in environmental modelling

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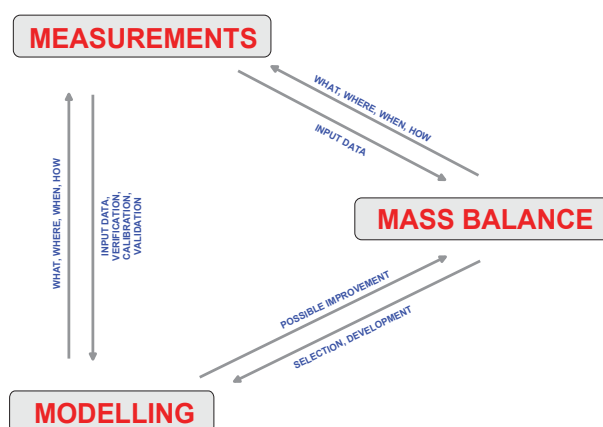
Abstract:

Problems - Issues / Challenges-Needs	Many sophisticated environmental models are used as a decision-making tool for the authorities. Pollutant transport and transformation models are being used to determine the state of pollution and future scenarios. These models are generally not capable to simultaneously simulate transport and fluxes in a macro-scale domain and, within this, the transformation processes in many micro-domains with specific parameters.
Solutions - Methods / Results - Findings	Observed domains consist of several environmental compartments where several pollutants/species are studied. Furthermore, the bio-geochemistry of pollutants can be complicated. By establishing a mass balance based on budgets, cross-boundary fluxes and transformations of a selected pollutant we can recognise the lack of measurements or knowledge on processes, and the modules of the environmental model that need to be improved with highest priority. When balanced, they confirm the relevance of the measurements and models. Such balances are either a product of calibration or a calibration tool for the models. When unbalanced, they may direct further research: they reveal missing or incorrectly evaluated fluxes and/or processes, or emphasise the need for explanation of either accumulation or depletion. The excess output is sometimes favourable, as it depicts the level of remediation and/or explains the output of the observed domain. Even the balances established without connections to models may reveal unknown facts explaining environmentally important phenomena.
Novelty - Value / Relevance to ...	An established mass balance reveals the relevance of the individual terms and/or processes, emphasises the ones obtained with lower accuracy,, and helps in development of relevant environmental models. Simultaneous and well-planned measurements, modelling and mass balance calculations are needed for an efficient support to decision-making tools for the authorities. Only in this way relevant mitigation measures can be proposed and implemented.
Forum statement	Insufficient quantity of adequate measurements and unsatisfactory accuracy of environmental models can be supplemented by mass balances since they diminish the unreliability of models.

Keywords:

mass balance; environment; modelling; flux; transformation; measurements

Graphics:



Theme 5: Engineering Capacity Building



RICCARDO MORANDI'S BRIDGE IN GENOVA FROM A TRAGEDY TO A NEW RENAISSANCE

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input checked="" type="checkbox"/> Engineering Capacity Building	<input checked="" type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	The collapse of Polcevera Morandi's bridge on August 14th 2018 left all of us astonished. The reason is even now after more than three months not yet fully understood. In the meantime the need of reconstruction is more and more stringent.
Solutions - Methods / Results - Findings	The aim of this paper is to show how that instead of demolishing all end build a new bridge "anonymous" (we are talking about more than 1200 meters long..., the reconstruction can be performed partially (240 meters only...) by refurbishing the remaining parts (1000 meters...) extending the life up to 100 years or even more, and designing a new bridge as a kind of "transition" between the approach viaduct and the two other parts that represent a landmark in the skyline of Genova.
Novelty - Value / Relevance to ...	The extradosed typology seems to be the most appropriate, from historical , technological , structural , architectural and landscape points of views.
Forum statement	...

Keywords: Morandi's Bridge, Genova.

Graphics:



ENGINEERS IN SUSTAINABLE DEVELOPMENT SOCIETIES

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

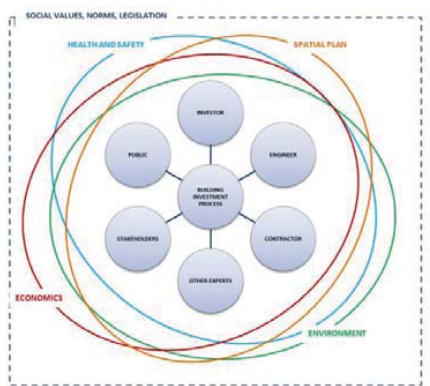
Abstract:

Problems - Issues	In national strategy documents of European countries sustainable development (SD) has been stipulated as a central development guideline and has become the starting point and a concept for shaping national development policies. By setting sustainable development as the starting point for development policies, the practices and criteria for measuring development are changing, which, in addition to technical and economic aspects, also include environmental and social aspects.
Challenges-Needs	Sustainable development in construction is mainly focused on sustainable construction, i.e. on the technical aspect of sustainable development, which is indirectly related to environmental protection, but not to other aspects of SD, which characterize the sustainable construction of structures. For this reason, the integrity of the changes brought about by sustainable development into the process of building structures has been overlooked and is thus reflected both in practice and in construction legislation.
Solutions - Methods / Results - Findings	As in other areas of society, the construction sector is also faced with multidimensional objectives of building investment, the interdisciplinarity of the profession and the specialisation of work, as well as the increasingly intensive involvement of various social groups in the process of building structures. Due to these characteristics, there are an increasing number of stakeholders, and processes and procedures are becoming increasingly complex and demanding; considerable time is dedicated to coordinating goals and interests and finding compromise (and not merely technical) solutions. The environment is becoming more and more complex and turbulent, therefore, in sustainable construction; it is no longer just about technical aspects, such as materials and technological processes, but also about the introduction of new dynamic models for the management of construction designs. In such an environment, the role of engineers is becoming increasingly important, and it is important also to provide different skills and competences in response to the interdisciplinarity of the profession.
Novelty - Value / Relevance to ...	The field is relevant for defining and evaluating the role of engineers in sustainable development societies and for determining their skills and competences. The paper will highlight the characteristics of sustainable development which are not directly related to the technical aspect of sustainable development and are therefore generally overlooked in technical disciplines. At the same time, these characteristics have a major influence on the work of engineers and determine their role in modern society.
Forum statement	Sustainable development brings interdisciplinarity to the construction profession and is changing the role of engineers.

Keywords:

Sustainable development, engineers, stakeholders

Graphics:



Anti-Bribery Standards, Systems and Strategies for Optimising Engineering Projects Delivery

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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Abstract:

Problems - Issues / Challenges-Needs	Corruption is one of the greatest obstacles to the development of safe and adequate infrastructure. Project funds are diverted to corrupt officials, funders, contractors, consultants, suppliers and agents. Corruption occurs in all nations, both developed and developing countries, in public and private sectors, as well as non-profit organisations (GIACC, 2010). The problem of corruption within or across nations is not a recent phenomenon, nor is it exclusively a Third World problem.
Solutions - Methods / Results - Findings	The total loss and impact to corruption is difficult to quantify. Corruption imposes great human, economic and project cost losses to the public. The harmful effects of corruption are most severe on the poor in the developing world like who are in most cases hardest hit by economic decline, are most reliant on the provision of public services, and are least capable of paying the extra costs associated with bribery, fraud, and the misappropriation of economic privileges. Consequently, tackling corruption in the construction sector requires the elaboration of a comprehensive strategy that involves efforts from all stakeholders, including public sector, private companies and consumers. The study was a mixed methodologies survey which balanced qualitative and quantitative methods. This was meant to triangulate data obtained from a wide range of stakeholders concerned with corruption in the construction and engineering sectors in Sub-Saharan Africa. It employed three instruments in its approach: i.e. the Infrastructure Anti-Corruption Index Survey Questionnaire, the Diagnostic and Structured Infrastructure Anti-Corruption Index Survey Questionnaire and the contextualised qualitative interview questionnaires. The first instrument was administered online to gather data regarding the identity of the respondents and their views/beliefs and perceptions of corruption. The second instrument was partly self-administered but was designed to measure effectiveness of methods in place at various stages of construction projects to avert corruption. A cognitive interview approach was used to ensure reliability, validity and integrity of the data collected.
Novelty - Value / Relevance to ...	Some of the most effective anti-corruption strategies as proposed by stakeholders were to increase political accountability, strengthen civil society participation, create a competitive private sector, improve public sector management as well as put in place institutional restraints on power. The WFEO national members are therefore, urged to support the ISO37001 as a requirements standard so as to effectively minimise corruption.
Forum statement	Anti-Bribery Standards, Systems and Strategies for Optimising Engineering Projects Delivery

Keywords: anti-bribery standards, anti-corruption strategies, infrastructure projects delivery, optimisation of policies.

Graphics:

Box 1: Thirteen features that makes infrastructure projects prone to corruption

1. Size of the project – projects vary considerably in size. Large complex projects such as hydro-electric dams create ample opportunity to hide corrupt acts.
2. Uniqueness of the project – projects are often one-offs which makes it difficult to compare costs, which in turn makes it easier to inflate costs or hide corrupt practices.
3. Government involvement – governments either own infrastructure or regulate its development. Where there are insufficient controls it can be relatively easy for officials to extract bribes.
4. The number of contractual links – these provide opportunities to offer a bribe for a contract award or for payment to be made.
5. A high number of project phases makes oversight difficult.
6. Project complexity creates uncertainty in how to manage problems. This creates opportunities to submit unjustified claims or inflate claims for payment.
7. Projects come at irregular intervals, creating pressure to win new contracts.
8. Work is concealed – many (physical) components in construction are concealed by other components. Lack of strong supervision creates the opportunity to conceal defective work or use cheaper components.
9. A culture of secrecy – there is no culture of transparency in the sector.
10. Entrenched interests – companies often have entrenched positions in the market place, often cemented by bribery.
11. No single organisation governs the industry – each of the many professions or trade have different codes of conduct and levels of enforcement of these codes.
12. Cost of integrity – corruption is an accepted norm with organisations unwilling to change the status quo as they risk losing out to less scrupulous competitors.
13. Lack of due diligence by financing bodies on the participants of an infrastructure project allows corruption to continue.

Source: Stansbury, N. (2005) Exposing the Foundations of Corruption in Construction, in Chapter 2: Corrupt Practice, Transparency International Global Corruption Report 2005.

From zero to heaven: first five years of siBIM

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	<input checked="" type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Global impact of digitalization on professional society does not guarantee its widespread use beyond the early adopters. This is very characteristic for the AECO sector. Therefore, <ul style="list-style-type: none"> • Early adopters must get organized to create a critical community of practice (a BIM Association) to "digitally evangelize" the AECO sector, • Independent nature of a BIM Association generates more power than any other vendor supported professional association can achieve, • Interdisciplinarity is the key for success of a BIM Association because it involves stakeholders from the whole built environment sector.
Solutions - Methods / Results - Findings	BIM Association Slovenia (siBIM) was founded in 2015 by thirty-two engineers and experts from the fields of civil engineering, architecture, information technology, mechanical and electrical engineering and academia from all over Slovenia. The siBIM's mission was to "become main horizontal and vertical driver for BIM in Slovenia". After five years, several achievements were accomplished by the siBIM: <ul style="list-style-type: none"> • Annual BIM conferences: siBIM 2015, 2016, 2017, 2018, (2019), • Guidelines for Elaboration of Terms of Reference for Implementation of BIM approach in Construction Projects (prepared for The Slovenian Chamber of Engineers), • Action Plan for digitalization of Built Environment in Slovenia (prepared for the Ministry of Economic Development and Technology), • Technical Committee for BIM at Slovenian Institute for Standardization (relation to CEN), • BIM Dictionary – first set of terms translated from English to Slovenian, • Steps towards buildingSMART International.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Clear (annual) actions plans related to different contexts of BIM and their successful execution, • Best professional community of practice around the theme of BIM in Slovenia (and in the region), • Continuing cooperation with SI Government, Slovenian Chamber of Engineers, Chamber of Commerce and Industry of Slovenia, Slovenian Smart Specialization Initiatives etc., • Slow but smart growth of siBIM for BIM leadership in region.
Forum statement	National BIM Association (like siBIM) can greatly contribute to overall digitalization of built environment sector in a country if it is independent, open-minded, professional and interdisciplinary.

Keywords:

BIM Association; Leadership; Community of Practice; Non-profit Organization



Impacts of Bologna declaration on the higher education of civil engineering in Slovenia

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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Abstract:

Problems - Issues / Challenges-Needs	<p>In May of 1998 four ministers of education from France, Germany, Italy and United Kingdom signed Sorbonne Joint Declaration which triggered a process usually termed as Bologna Process. In the next year 1999 the Bologna Declaration was signed by 31 ministers of education from Europe. There are six major points in this declaration: comparable grades, two main study cycles, system of credits (ECTS), promotion of mobility, promotion of quality assurance, promotion of European dimensions in higher education. During the period following the Bologna Declaration there were several ministerial conferences with the last in Yerevan (Armenia) in 2015. The establishment of a common higher-education space in Europe can be considered as one of the success stories of Europe.</p> <p>However, the inappropriate understanding of two-cycles study as proposed by the original Bologna declaration lead to a present system of engineering education in Slovenia and other parts of Europe which is less than optimal. In Slovenia the first three year bachelor cycle is followed by the second two years master cycle. It was assumed that three year study suffice for the education of a civil engineer. We now realize this is not the case. As a result most of our students continue to study at the second cycle. It is a common understanding between all stakeholders that the unified master degree study would be more appropriate system. We plan to replace the existing two-cycle system with a single unified master study program in the next two years.</p>
Solutions - Methods / Results - Findings	
Novelty - Value / Relevance to
Forum statement	...

Keywords:

Bologna declaration; two-cycle degree system; engineering study program;

Terms of Reference for Civil Engineering Competences – TUNING approach

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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Abstract:

Problems - Issues / Challenges-Needs	This work done in the subject area of Civil Engineering concern degree profiles and the tasks and societal roles graduates will take on, but also show how different degrees fit into the wider context of overarching qualifications frameworks. In other words, which are the essential elements that constitute a particular subject area in higher education? Among other aspects, the guidelines include general descriptors for the first and the second cycle, the bachelor and master, presented in easy-to-read tables, and are meant to be used as reference points for the design and delivery of individual degree programmes. According to the Tuning philosophy, each degree programme has its own unique profile, based on the mission of the institution and taking into account its social-cultural setting, its student body, and the strengths of its academic staff.
Solutions - Methods / Results - Findings	The Tuning methodology is based on student-centred and active learning approaches it has promoted since its very launch. Tuning's mission is to offer a platform for debate and reflection which leads to higher education models able to ensure that graduates are well prepared for their societal role, both in terms of employability and as citizens. Graduates need to have obtained as the outcome of their learning process the optimum set of competences required to execute their future tasks and take on their expected roles. As part of their education graduates should have developed levels of critical thinking and awareness that foster civic, social and cultural engagement. The Tuning methodology is based on student-centred and active learning approaches it has promoted since its very launch. Tuning's mission is to offer a platform for debate and reflection which leads to higher education models able to ensure that graduates are well prepared for their societal role, both in terms of employability and as citizens. Graduates need to have obtained as the outcome of their learning process the optimum set of competences required to execute their future tasks and take on their expected roles. As part of their education graduates should have developed levels of critical thinking and awareness that foster civic, social and cultural engagement.
Novelty - Value / Relevance to ...	In developing the (CALOHEE) Tuning model, it was concluded that 'dimensions' are an indispensable tool, because they make it possible to distinguish the principal aspects that constitute the subject area. Dimensions help give structure to a particular sector or subject area and also make its basic characteristics more transparent. Furthermore, the 'dimension approach' is complementary to the categories included in the EQF for LLL, which uses the categories of knowledge, skills and wider competences to structure its descriptors. Thus, in CALOHEE terms, the three columns correspond to a 'knowledge framework', a 'skills framework' and a 'wider competency framework', linked by level. The last column, the 'wider competency framework', refers to the wider world of work and society and identifies the competences required to operate successfully in the work place and as a citizen. It builds on the first two elements: knowledge and understanding and the skills necessary to develop and apply this knowledge. The use of the learning outcomes and competences approach implies changes regarding the teaching, learning and assessment methods. Tuning has identified approaches and best practices to form the key generic and subject specific competences. Finally, Tuning has drawn attention to the role of quality in the process of (re-)designing, developing and implementing study programmes. It has developed an approach for quality enhancement which involves all elements of the learning chain. It has also developed a number of tools and identified examples of good practice which can help institutions to improve the quality of their degree programmes.
Forum statement	The ultimate ambition of the CALOHEE Tuning for Civil Engineering initiative is to develop a transnational multi-dimensional competence model which allows for actual measuring and comparing of learning, taking into account the specific mission and profile of each degree programme, within its cultural and academic context. This model should offer sets of consistent test formats and items which make it possible the assessment of deep knowledge and understanding as well as high level skills.

Keywords:

Civil Engineering, Competences, Bachelor, Master, Tuning

TUNeIT: A BRIDGE BETWEEN EUROPE AND AFRICA

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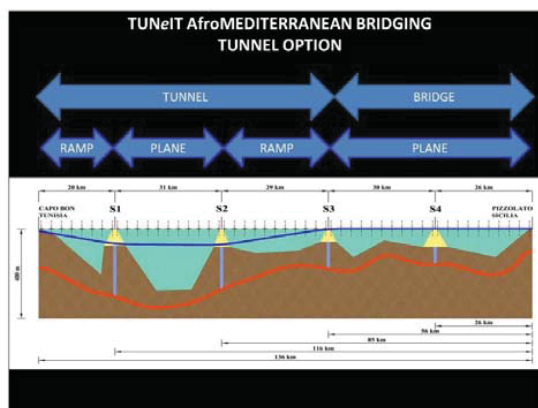
Abstract:

Problems - Issues / Challenges-Needs	The African road infrastructural system, although physically independent, in the sense that it has no permanent connections with the rest of Europe, if and when it will be completed and, therefore, to a large extent interconnected, will need to cope with the traffic of people and goods to and from Europe. If we make a leap in scale and note the European attitude towards infrastructure, we realise that the trend is to privilege the development of infrastructural corridors that are mainly structured in northern Europe. It is therefore reasonable to assume that commercial traffic overland, in the future, may exclude Italy.
Solutions - Methods / Results - Findings	Clearly, it is therefore no coincidence that new studies are now underway to explore the idea of TUNeIT, an "old" project proposed in its time by ENEA in the form of a tunnel, and now revised in a more modern key as a plan that relies on suspended bridges and artificial tunnels. This hypothesis, strongly supported by EAMC, which takes the form of a permanent connection between Sicily (Mazzara del Vallo) and Tunisia (Bon), would cover the 140 km span with a system of works designed with attention to both landscaping criteria and high-level technical and functional criteria, creating truly excellent terminals both in Italy and in Tunisia. In the eyes of much of Italy, the very idea of permanent connections between Africa and Sicily and Sicily and the Peninsula may appear scandalous, but the risk of being marginalised in the system of intercontinental exchanges should not be underestimated.
Novelty - Value / Relevance to ...	In the eyes of much of Italy, the very idea of permanent connections between Africa and Sicily and Sicily and the Peninsula may appear scandalous, but the risk of being marginalised in the system of intercontinental exchanges should not be underestimated.
Forum statement	...

Keywords:

TUNeIT; Link between Africa and Europe.

Graphics:



Water Education Games for Better Decision-making and Resilient Communities

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Abstract:

Problems - Issues / Challenges-Needs	Limited knowledge generally leads to bad choices. A general public (including architects and planners) often does not have a good understanding of basic processes related to water, especially when talking about groundwater or floods and droughts, nor has a good notion about their own environment. Therefore, bad choices are inevitable. We also know that to a large degree our cities are not at risk of disastrous floods so much as the consequence of climate change, but because of the effects of common practices of managing water in contemporary cities. So, the challenge is how to change bad practices and increase necessary notion not only among professionals, but among general public as well in as shortest time possible to spark innovation and willingness to make changes, so that people's everyday choices can become part of the solution that eventually leads to resilient cities and resilient communities.
Solutions - Methods / Results - Findings	Today, when knowledge is easily accessible to all, it is not the accumulation of knowledge that is most needed. What we really need is making use of that knowledge in our everyday life. Our knowledge is often compartmentalized. We, as an advanced society, we lost common sense and understanding of natural processes that once every farmer had in one's gut. To make things worse, the challenges that we are facing today with climate change are challenging everything that we take for granted. So it is not just the accumulation of new knowledge that will help to solve the problem, but our creativity, making sense of what we know, and willingness to change. Our education system needs to change to put creative thinking in its focus and not to kill it. Integrative approach with experiments, role-playing, games and other innovative activities is needed to make sense of what we learned and to connect that with everyday life. A deep understanding that touches our system of values is needed to bring forward our willingness to change. Our 22-year experience with running Water Detective program (an educational program for primary schools), as well as community design and planning workshops, provides some good insights into methods that can be used to tackle this problem.
Novelty - Value / Relevance to ...	Better understanding and cognition of processes connected to water dynamics helps to understand the problems and possible solutions, and eventually leads to better decisions. In water management and spatial planning, we often deal with resentment of local communities when trying to implement various flood protection or other water management related measures that do not have a direct positive impact on a particular local community, or that such a positive impact is not obvious since people are not aware of a possible threat.
Forum statement	Therefore, early integrated education on processes related to floods based on games and experiments increases the notion of risks and solutions, and leads to better decision making and eventually to resilient communities.

Keywords:

water education; awareness rising; public participation

CONSTRUCTION INDUSTRY AND TECHNICAL ASSOCIATIONS: MUTUALLY BENEFICIAL COOPERATION

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Abstract:

Problems - Issues / Challenges-Needs	Construction industry together with agricultural sector is the engine of economical growth of Ukraine. The same time, constructional SMEs, especially in rural areas, have limited access to innovative technologies. Large companies should have discussion place for exclusion unscrupulous competition. Construction business should also have joint voice for dialog with the government. Cooperation between business and technical associations gives answers on above challenges.
Solutions - Methods / Results - Findings	The large number (20+) of Pan-Ukrainian technical associations related to construction sector is Ukrainian feature. Most of them are headed by ambitious leaders, so dialog between them was the first step for fruitful cooperation. Next step was regular joint meetings of ExBs of largest associations. Representatives from the government and parliament are presenting their visions on such meetings. Friendly atmosphere helps to find better solutions. Technical associations are mobile. It gives them opportunity to provide faster and better information about world and local innovations in construction. The tools are: exhibitions, conferences, seminars, Round Tables and etc. both in the capital and in the regions. Progress in construction is impossible without permanent training of engineers and workers. Jointly with technical university our associations launched pilot project for cross-cutting learning from school till post-graduate study. Fair competition is very important for construction sector. One of the largest associations: Construction Chamber of Ukraine even has its own Lawbook of fair competition, which is mandatory for signing by each member.
Novelty - Value / Relevance to ...	Typical problem of any technical association is funding. To fix this problem our associations create for-profit subsidiaries (institutes, innovation centers, etc.) for implementation of novel technologies and to create innovations. The example of passive house, which was designed and built by experts for Academy of Construction of Ukraine, is shown on the fig.1. Other novelty is permanent dialog between Pan-Ukrainian associations and authorities (like Meyers of small cities) in the regions. Information about trends on the state level are delivered to the regions by our Round Tables, seminars, etc.
Forum statement	...

Keywords:

Construction industry; Technical associations; Innovations

Graphics:



INTERNATIONAL DOCTORAL SUMMER SCHOOL NATURAL DISASTERS: OPPORTUNITY FOR IMPROVEMENT OF UNDERSTANDING OF NATURAL DISASTERS AND THEIR PREVENTION

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Abstract:

Problems - Issues / Challenges-Needs	<p>The international doctoral summer school Natural Disasters, which was implemented in 2017 in Ljubljana in the scope of the Erasmus+ KA2-HE-14/15 project:</p> <ul style="list-style-type: none"> stemmed from the fact that natural disasters do not respect borders and they should be treated as such, brought together international experts and doctoral students from various fields (e.g., civil and environmental engineering, soil science, landscape architecture, water engineering and management, agriculture, natural resources management, spatial planning), was mainly related to floods, droughts, earthquakes, and landslides.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> Summer school was conducted: as 3 week course by blended learning method (activities of 1st week took place at a distance through the website www.let-group.com, 2nd and 3rd week as face-to-face learning in classroom) It was organized as a joint initiative of 3 universities (University of Ljubljana, University of Natural Resources and Life Sciences Vienna, University of Brescia) and 1 private company (Piktorama d.o.o.). Activities included: watching of pre-recorded lectures and consolidation of knowledge through website, active participation in 4th World Landslide Forum, excursion to various locations of past natural disasters in Slovenia, oral presentation of research work of all students; presentations were broadcast live to website, discussions on student presentations and lectures given by professors in the classroom.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> The results of the survey among students and lecturers show that for most of them this summer school was the first experience with blended learning/teaching. Based on the experience with Natural Disasters summer school 76% of the students and all lecturers would use the blended learning methodology in the future if they had opportunity. Presentation of natural disasters related research work to colleagues from different countries worldwide with a different backgrounds (look at the same problem from a different point of view) can have a positive impact on the development of more effective measures to protect against natural disasters and gives the opportunity for development and improvement of ideas for ongoing and future research work.
Forum statement	<p>"International doctoral summer school Natural Disasters is an example of good practice in exchanging experience and opinions of experts from various fields and for developing new ideas about natural disasters prevention."</p>

Keywords:

natural disasters; blended learning; doctoral summer school

Graphics:



PRESENTATION TITLE: Flood Risk Management Master Programme - Success Story

Authors: Mitja BRILLY¹, Biswa BHATTACHARYA², Dimitri P. SOLOMATINE², Christian BERNHOFER³ and Allen BATEMAN⁴

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input checked="" type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input type="checkbox"/> BIM Lifecycle, Facility & Asset Management

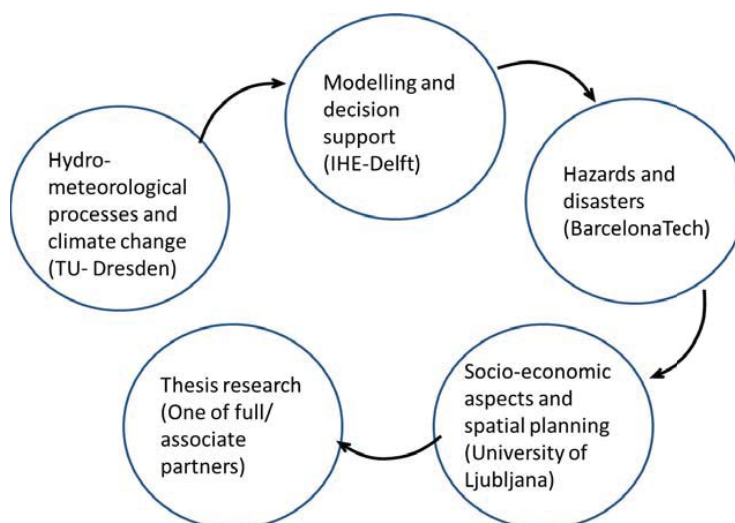
Abstract:

Problems - Issues / Challenges-Needs	Flood risk management challenged human society in 21 st century. In the last decade (1995-2015) there is 157.000 victims, 2.300.000.000 people affected and damage in \$ p.a. (2001-2011) reach 24.000.000.000. Integrated flood risk management aims to reduce the human and socio-economic losses caused by flooding while taking into account the social, economic and ecological benefits from floods and the use of flood plains or coastal zones. The need for the adoption of a holistic integrated approach to managing flood risks has been reflected in the Flood Directive of the European Parliament.
Solutions - Methods / Results - Findings	The FLOODRisk master offers a unique, multi-disciplinary course of studies equipping graduates to deal with the growing flood risks of the 21 st century. There is a lack of professionals with the interdisciplinary engineering skillset needed to tackle the environmental, social and economic aspects of the problem. The Erasmus Mundus Programme, started in 2011 and up to the year 2017 96 students from different European countries and other continents graduate, has funded the Master Programme on Flood Risk Management. Courses share between partner Universities. First semester started at TU Dresden, second semester continue on IHE and third one started at TU Barcelona and finished on University of Ljubljana. Research work for Master Thesis supported by several leading European research Institutes, figure 1. A survey carried out in 2016 has shown that 91% of the FLOODRisk11 graduates reported that they have jobs, of which 97% are in water sector. Students' employed 48% in research and 42% in consultancy. The syllabus developed with the view that students not only learn the scientific basis and the principles of flood risk management, but also trained in using computer-based modelling, forecasting, optimization and decision support tools. The syllabus upgraded with new developments, for example, in EC-funded research projects on the engagement of citizens in gathering water data and water governance that leads to participatory water management. The aim is to train students with practical tools so that students better trained to work in a real-life situation and thus will be closer to the job market.
Novelty - Value / Relevance to ...	The course based on integrated approach to flood risk management and has multi-disciplinary character. Such course single institutes cannot offer and present Ideal example of joint education. Course was recognize as Success Story and presented on the Kick-off meeting for Erasmus-Mundus the projects selected in year 2018.
Forum statement	...

Keywords:

master degree study; flood risk management; training and education; university learning; Erasmus Mundus,

Graphics:



Theme 6:

Digitally engineered built environment: BIM lifecycle and Facility & Asset – Management

Digitally engineered built environment: monitoring movements from space

Authors: Sivasakthy SELVAKUMARAN¹

¹ University of Cambridge, ss683@cam.ac.uk

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input checked="" type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

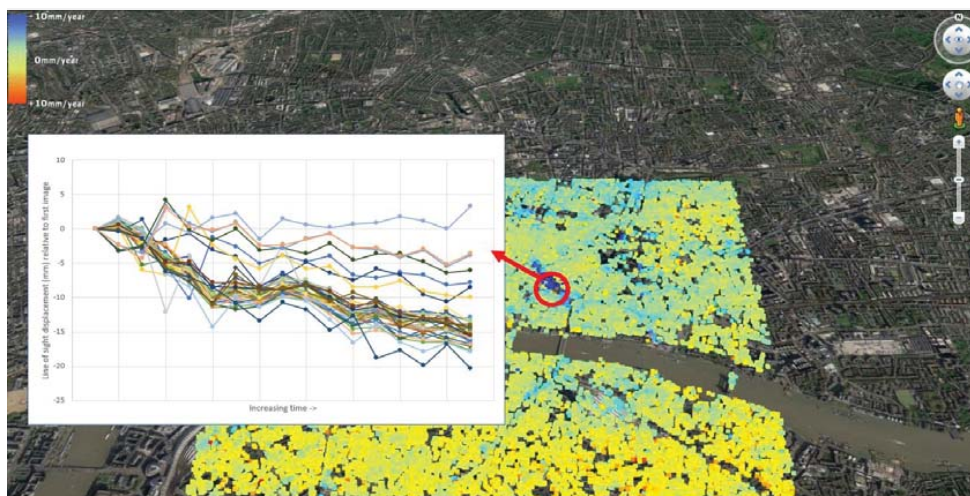
Abstract:

Problems - Issues / Challenges-Needs	Ageing infrastructure and widespread deterioration as well as recent collapses of bridges, tunnels and other key services are problems which highlight: <ul style="list-style-type: none"> The limitations of traditional monitoring of structure condition by visual inspection The importance of structural health monitoring as well as monitoring of environmental surroundings Challenges include deriving value from large quantities of data and the implementation of early warning systems.
Solutions - Methods / Results - Findings	New insights and opportunities to support resilient infrastructure can be gained by leveraging new technologies such as: <ul style="list-style-type: none"> The latest in sensors and in-situ monitoring Rapid advancements in satellite observation and measurement technologies The integration of heterogeneous data sets The development of effective digital environments Understanding the relevance, utilisation, and limitations of such systems to civil engineering applications can support civil engineers in monitoring for signs of failure, as well as support in recovery after disaster.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> Advances in satellite imagery resolution that can capture individual assets at measure millimetre-scale movement The fusion of satellite, in-situ surveying and monitoring could provide complementary systems to improve inspection Identification of possible precursors to disaster using such tools through the study of historical failures Digital models that can bring better value and understanding of 'big data' sets to aid better-informed decision making
Forum statement	Leveraging remote sensing, environmental and structural monitoring data can improve efficiency in asset management.

Keywords:

structural health monitoring; remote sensing; satellites; digital environments

Graphics:



Digital Built Environment Maturity Model (dbEMM): Advancing methods & processes in smart infrastructure asset management

Authors: Dejan PAPIC¹, Tomo CEROVSEK²

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

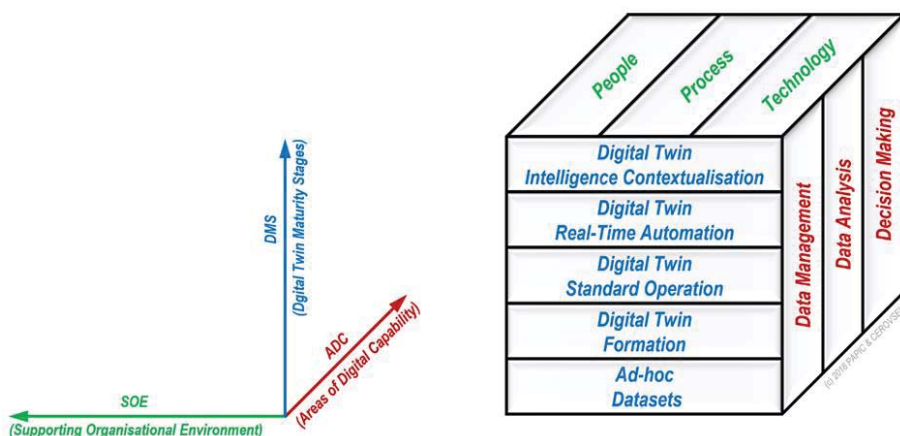
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> - Not achieving desired improvements in: utilization of existing assets, improved design, selection, and delivery of new assets, which could be enabled by digitalization, and availability and better use of data, due to the lack of comprehensive digital capability across an asset management organization - Identify digital capabilities improvements, which will facilitate better utilization of data across the organization
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> - Comprehensively develop and expand digital capabilities in a gradual way (step by step), to facilitate better awareness of assets' condition, and decision making, based on available data - The initial response to maturity model shows that it may become a valuable tool to streamline the development of smart asset management and a digital (twin) - built environment. The concept of Digital Twin Maturity might be also transferred to other application areas/industries
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> - Advanced infrastructure management enabled by better decision making, based on availability and better use of the asset data - Infrastructure and other asset management organizations who are looking to establish and improve their digital capability
Forum statement	Comprehensive improvement of digital capability enables better management of the built environment

Keywords:

smart asset management; maturity model; digital twin; reality capture; artificial intelligence

Graphics:



NOVEL BRIDGE MANAGEMENT SYSTEM FOR SLOVENIAN ROAD NETWORK

Authors: Matej KUŠAR¹, Jana ŠELIH²

¹ DRI Investment Management Ltd., matej.kusar@dri.si, ² Faculty of Civil and Geodetic Engineering, University of Ljubljana, jana.selih@fgg.uni-lj.si

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

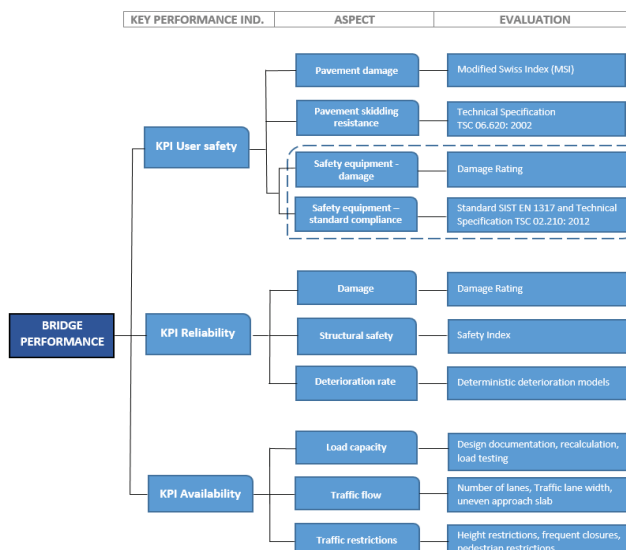
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> The trend in the developed countries road infrastructure is shifting from construction to maintenance management. Bridges are critical components of the road infrastructure as they facilitate transportation. The posting/failure of bridges lead to detours, causing increased travel times and travel distances or even casualties. Maintaining the adequate quality of bridge fund in economically efficient and socially acceptable manner is the fundamental task/challenge of road authorities. To optimize the use of financial resources a comprehensive management system is required.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> The newly developed Slovenian Bridge management system considers multiple aspects (safety, reliability, availability) to determine individual bridge performance. To optimize the use of financial resources, the maintenance costs have to be dealt on the network level where numerous maintenance strategies can be compared.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> The theme deals with Slovenian Bridge management system based on COST Action TU1406 findings and national road authority's needs. Although COST Action TU1406 "Quality specification for roadway bridges, standardization at a European level" is still in progress, its practical use is already confirmed.
Forum statement	...

Keywords:

bridges, bridge management; performance indicators; maintenance planning;

Graphics:



MAINTENANCE OF SPECIAL EQUIPMENT AT BRIDGE CONSTRUCTIONS

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Since 2015 DARS has regularly maintained the expansion joints and from this year also the bearings of bridging facilities that are equipped according to the most modern requirements of the profession.
Solutions - Methods / Results - Findings	At the same time DRI has trained quite a few engineers who are able to control, or control the installation of, spare parts according to these requirements. By participating in such events, DRI follows the development of the profession and new technologies, and upgrades specialist knowledge, thus providing the highest level of material services in the construction and maintenance of bridges. We have found that in this way it is possible to prevent major defects and mistakes, which, were before, a constant building practice in our country.
Novelty - Value / Relevance to ...	The article also focuses on technical challenges in the construction and renovation of bridges due to specific border conditions, standardization for bridges in Europe, and the content and consequences of the revision of the new standard for the bearings. In the field of expansion joints, the most talked about question is the CE marking, in particular the experience and perspectives of the new regulations.
Forum statement	Maintenance of special equipment at bridge constructions is no longer a "nightmare" for the maintainers, but a regular job like others.

Keywords:

Bridges, expansion joints, bearings, asset management, maintenance.

BIM in the lifecycle of concrete structures: applications and training challenges

Authors: Miguel AZENHA¹ José GRANJA¹

¹ ISE, University of Minho, PORTUGAL, miguel.azenha@civil.uminho.pt, granja@civil.uminho.pt

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input checked="" type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Despite of an increasing trend adoption worldwide, BIM has not yet reached a generalized application state. Challenges still exist regarding the capacity of well defining required information on the side of owners, as well as that of AEC practitioners to embody the necessary BIM requirements and uses, as to take full advantage of the inherent methodologies. This is a reality in construction in general, and in concrete structures in particular, mostly due to limited knowledge of the involved stakeholders, and also due to limitations of interoperability and off-the shelf software solutions.
Solutions - Methods / Results - Findings	Research and academic institutions have important responsibility in the exploration of the new possibilities that are offered by BIM methodologies and software, that can be implemented in the entire life-cycle of concrete structures, including design (since conceptual stages), construction management and operations/maintenance. Furthermore, the need for providing undergraduate students and practitioners with the necessary knowledge to perform proper use of BIM, further extends the role of academy in promoting suitable BIM adoption. In view of the contexts framed above, the University of Minho in Portugal has been playing an active role in both research on BIM applied to structural concrete and teaching BIM in general. This work initially reports a set of key developments of our team: <ul style="list-style-type: none"> • A proposed framework for BIM supported 'Integrated Project Delivery' at the conceptual design stage of thin concrete shells, supporting direct interaction between Architects and Engineers; • A methodology for integrated analysis of the thermal stresses occurring in concrete arch dams, associated with a cellular automation tool for quick definition of construction phasing scenarios, in direct connection to a BIM platform; • A framework for checking adequacy of design of RC structures through BIM-based virtual load testing; • A new system for BIM-based inspection and management of reinforced concrete bridges. Additionally, the key role of the University of Minho in BIM teaching at national and international levels will be discussed, with focus on: <ul style="list-style-type: none"> • Integration of a course module on BIM in the 4th year of the MSc in Civil Engineering (pioneering in Portugal); • Creation and management of the National BIM Course for practitioners (www.cursobim.com); • Leadership of the newly created European Master in Building Information Modelling – BIM A+ (EU funded), together with the University of Ljubljana and Politecnico di Milano.
Novelty - Value / Relevance to ...	The developments are considered of significant value towards the demonstration of viability of complex tasks with support in BIM in the context of reinforced concrete structures. The second part of the work regarding academic dissemination/training is considered a good practice example at several levels, that can bring inspiration to others.
Forum statement	...Integrate BIM into the lifecycle of engineering practice (concrete structures) through innovative approaches and proper training practices.

Keywords:

BIM; concrete structures; full lifecycle; training/teaching

Graphics:



Impact of using BIM on project management (Design for obtaining a construction permit and Detailed design) for section of main railroad between Maribor and Šentilj

Authors: Iztok ZABREZNIK^{1,2}

¹ Lineal d.o.o, iztok.zabreznik@lineal.si;

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> The complexity and the scope of the project (new railway line near to existing one, road connections, a new tunnel with a length of 1,530 m, a maintenance shaft and a new viaduct with a length of 897 m) has presented a challenge for the management of all information transmitted through the whole process. The whole project consisted of more than 90 different plans from more than 12 different companies, prepared by more than 40 project developers. A peculiarity and a first example of using a rigid track on a new railway line in Slovenia. The challenge was also guaranteeing the transportability of existing track throughout the construction of new one. In order to manage big working groups all the available technological solutions that enable a better control of information need to be applied.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> The contractor wished to realize the potential benefits of a digital approach to design and later construction and operation of the project by using Building Information Management (BIM) delivery processes. The BIM strategy framework centered around the information modeling and management was developed on the basis of employer information requirements (EIR). Main principles: <ul style="list-style-type: none"> An open BIM approach structure. To extend the use of BIM beyond 3D models to include wider information attributes. 4D BIM modeling and construction scheduling. A life cycle centric approach to information delivery and use (CDE). Improved cross project coordination with better quality and trustworthiness of deliverables.
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> As the project is an infrastructure project on the railway network, not even abroad there are comparable practice examples to be found. For this reason, we were obliged to develop our own practice that has been tested on the management and planning process. To encourage and support design and construction sector to use BIM tools and technology in design and construction of the railway and other infrastructure objects.
Forum statement	...

Keywords:

BIM; Railway; Design; Management; Strategy



Integrated BIM Project Management Approach and Asset Management on large scale projects

Authors: Veljko JANJIČ

CEO & Co-Founder of BEXEL Consulting, veljko.janjic@bixelconsulting.com

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

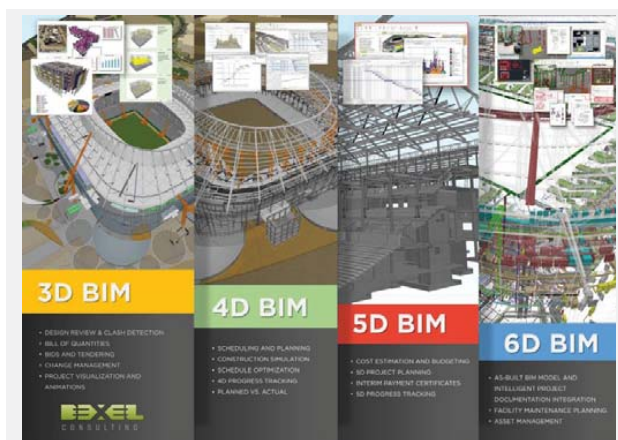
Abstract:

Problems - Issues / Challenges-Needs	<p>Today BIM is well recognized as one of the most promising technologies for managing the construction projects throughout the whole project lifecycle. However, development of an effective integrated BIM Project and Asset Management system usually is faced with various challenges, especially on large scale projects:</p> <ul style="list-style-type: none"> • Information loss between different project phases as well as between different stakeholders - rework and recreation of data • Limited reusability of BIM deliverables, interoperability issues • Lack of efficient tools for managing big data for project planning, monitoring and asset management <p>There is a need for efficient system, processes and tools for ensuring that each deliverable is structured in line with existing PM processes, with clear quality control and assurance procedures as well as workflow instructions on where it will be reused later in the lifecycle and what will be the necessary information handshake and requirements for it.</p>
Solutions - Methods / Results - Findings	<p>The main methods and principles which should be implemented for efficient BIM integrated project and asset management are:</p> <ul style="list-style-type: none"> • Information requirements management – Start with end in mind • LEAN management – fit to purpose principle • Information handshake • Information system interoperability and deliverables reusability • Continuous research and innovation <p>The defined information requirements for each of the BIM deliverables should take into account the software output interoperability between deliverables and ensure that the outputs from one procedure can be utilized as inputs and references of another – a piece of information entered once should propagate through the process and be used to the highest extent. In a way, the process of defining information requirements and information handshakes should resemble the principles of system engineering.</p>
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • BIM standards aligned with Project Management and Asset Management standards - BIM ISO 19650 • BIM multidimensional integrated software solutions – BEXEL Manager (showcased on real use case study) • Advanced use of information model for whole-lifecycle purposes – Asset Management and Facility Maintenance of large residential projects • Research and development in integration of information models with asset monitoring systems - measuring, monitoring and asset data collecting in real-time, combining with existing data and analysing together by deep learning techniques for the purpose of establishing new and innovative processes for asset maintenance to be validated in field - Assets4Rail project within Shift2Rail, the European rail initiative.
Forum statement	Integrated BIM project and asset management with information share between systems, project phases and stakeholders throughout the project lifecycle, using the advanced multidimensional integrated solutions.

Keywords:

BIM; Integrated Project and Asset Management; Lean; Information handshake; R&I

Graphics:



BIM – Bridge Infrastructure over Digital Twin chasm

Authors: Tone Stanovnik¹, Rok Kanduti², Monika Varkonji Šajn³

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Oblak, monika.varkonji@unistarpro.si

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
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Abstract: (250 to 500 words: for each heading use the bullet points or narrative - the submission including graphics should not exceed one page)

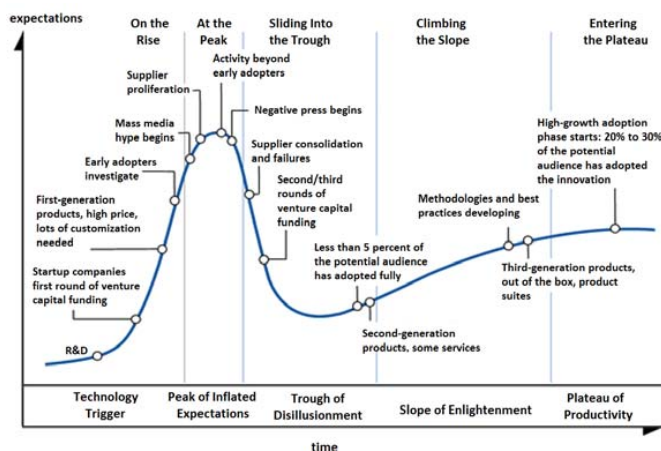
Problems - Issues / Challenges-Needs	<p>How can BIM build a resilient infrastructure bridge over the technology dead valley?</p> <p>According to the latest Gartner's Technology Hype Cycle, Digital Twins are currently on the top of inflated Key Technology Expectations. Next phase is Trough of Disillusionment. While the hype cycle has peaks and troughs, the underlying reality of the technology continues to progress. The gap between expectations and reality creates opportunities and challenges for smart entrepreneurs to manage according to the reality, while competitors chase the hype cycle.</p>
Solutions - Methods / Results - Findings	<p>BIM is already well established in AEC Industry.</p> <p>If we combine resilience of BIM tools with new emerging IoT sensors, we can build strong pillars for new innovative business models.</p> <ul style="list-style-type: none"> • With Edge Computing, which distribute power to PoC – Point of Capture and PoA – Point of Activity, we reduce information that travel to Cloud Hub and back. This strong platform needs power for agile and real time response. • With Artificial Intelligence applications, which predict future from historical data, we can build smart machines that humanity was always looking for.
Novelty - Value / Relevance to ...	<p>Slovenia as BIM Digital Twins Living Lab in Digital Europe</p> <p>Young Slovenian Architects and ICT Engineers are leaving the country, looking for better life and salary for their creative work. New distributed concept of BIM Digital Twins offers opportunity to design, build and manage assets and facilities remotely from home country. Therefore, they can stay in Slovenia, start working in Living Lab incubators like SPICA Center of Excellence and export services and knowhow into the world, what is the top economic priority for Slovenia.</p>
Forum statement	<p>If we follow the old investment advice "Buy low, sell high!" we can bridge the Digital Twin gap and with BIM turn the Threat into a huge Opportunity.</p>

Keywords: (up to 5 keywords)

Digital Twins; Edge Computing; Cloud Computing; Facility & Asset Management; Spica Living Lab

Graphics: <https://www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/>

Gartner Hype Cycle by Olga Tarkovskiy:



SETTING COMPETITIVE SMART GOALS WITH BIM

Authors: Ozlem GEYLANI¹, Attila DIKBAS², Alev YALCINKAYA³

¹ Istanbul Technical University 1, ozlemgeylani@gmail.com; ² Istanbul Medipol University 2, hadikbas@medipol.edu.tr; ³

Ronesans Holding 3, alev.yalcinkaya@ronesans.com

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
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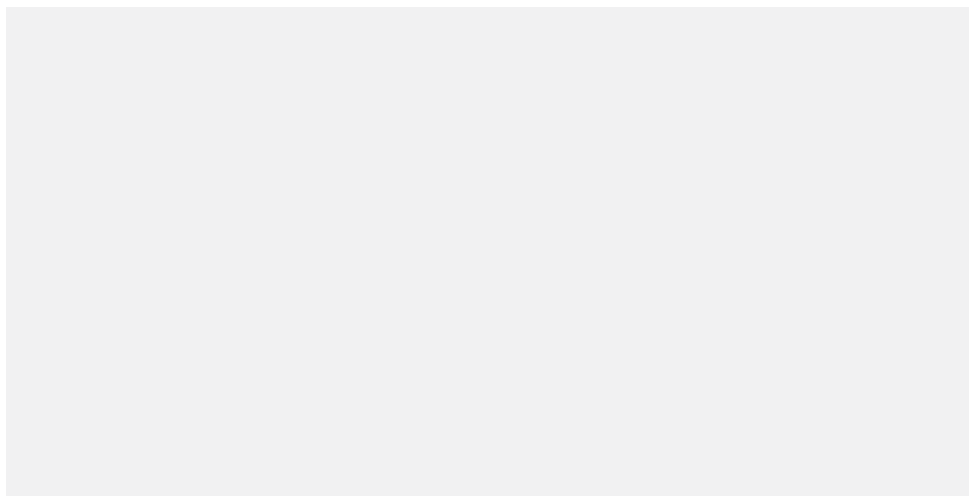
Abstract:

Problems - Issues / Challenges-Needs	Organizational objectives including competitive advantage are closely linked to firm goals. Thinking about these objectives from the S.M.A.R.T point of view may effect on firm's organizational development in order to reach competitive advantage along the route. So, this paper aims to present a case study that will be an example for other construction firms which are willing to set precise S.M.A.R.T objectives that related with a specific asset just as BIM (Building Information Modelling).
Solutions - Methods / Results - Findings	The development of organizational objectives may be thought as they have S.M.A.R.T (Specific, Measurable, Attainable, Relevant, Time-limited) parameters. Also, the settlement of organizational goals can be addressed to competitive advantage that supported by a new asset adoption which is BIM. Accordingly, the research is undertaken through Ronesans Holding which is one of the worldwide known Turkish construction brands. Hence, the BIM implementation approach of the firm is competitive advantage based and unique to its organizational strategy. More, the overall aim of this case study is to consider the implementation of a new asset that regarding specific S.M.A.R.T objectives that provides and measures the productiveness of BIM implementation itself.
Novelty - Value	This paper extends the S.M.A.R.T view of the firm to give an overview of the connections between BIM and other resources of the firm. Especially, it develops a conceptual framework explaining BIM adoption and organizational goals that incorporate the competitiveness of the firm as presenting a case study. On the basis of this framework, it shows how BIM affects the competitiveness of the construction firms.
Relevance to ...	
Forum statement	...

Keywords:

BIM; Construction; Competitive Advantage; S.M.A.R.T; Organizational Development

Graphics:



Progressive use of BIM for holistic energy renovation of office buildings

Authors: Gašper STEGNAR¹, Tomo CEROVŠEK²

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² Faculty of Civil and Geodetic Engineering, University of Ljubljana, Ljubljana, Slovenia; tomo.cerovsek@fgg.uni-lj.si

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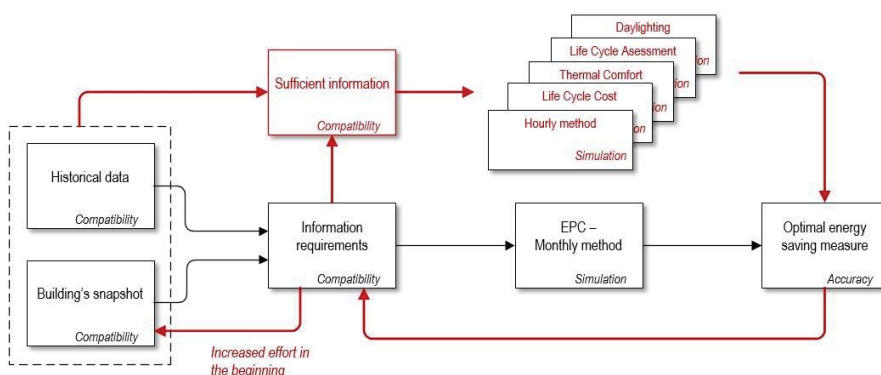
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> Building information modelling (BIM) is becoming widely used to facilitate informed decision-making of the holistic energy renovation projects. Large data collections may be gathered that do not meet the information needs in energy renovation design, performance evaluation, (re)construction and operations. Insufficiently managed information often leads to sub-standard project deliverables, re-work, errors, budget deficits, and delays.
Solutions - Methods / Results - Findings	<p>Presented progressive BIM methodology suggests the specification of adequate information which matches the purpose of an evolving renovation design process with emphasis on energy performance, while addressing multiple sustainability aspects. This approach is based on firm methodological premises and validated on the actual refurbishment of office buildings.</p> <p>Results show that progressive BIM methodology can improve design, predict more accurately the actual energy consumption after the renovation is completed and reduce investment costs, prevent design and planning errors and construction delays.</p>
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> This approach provides alignment between design efforts and project outcomes for different levels of design services enabling performance based BIM design. Progressive use of BIM aids the design process of holistic energy renovation.
Forum statement	Progressive use of BIM increases the building value, performance, and provide a healthier and more comfortable environment for occupants.

Keywords:

progressive BIM, project information management, renovation, energy performance, sustainability

Graphics:



Physical Protection of Data Centers Using WiFi Channel State Information and Building Information Modeling Tools

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

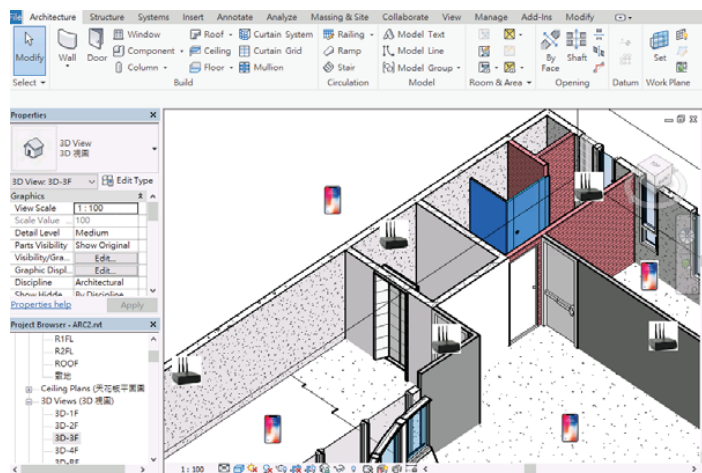
Abstract:

Problems - Issues / Challenges-Needs	<ul style="list-style-type: none"> In 2013, a data center inside a building located in Taipei experienced an accident, which had disconnected many Taiwan optical submarine cables for almost one day. Physical security for a data center refers to the protection of the facility, equipment and the data from natural or man-made disasters. This research aims at applying WiFi Channel State Information (CSI) to detection of any human activities inside a data center and displaying the results using Building Information Modeling (BIM) tools. Traditional surveillance systems cannot provide comprehensive monitoring of such IT infrastructure and are easily hacked. WiFi CSI is a promising technology for indoor positioning and does not require special devices or deployments, thus making hacking difficult by changing system configurations dynamically.
	<ul style="list-style-type: none"> By collecting CSI measurements from all WiFi access points (APs) that can hear the packet transmitted by the target, we can calculate time of flight (ToF) and angle of arrival (AoA) of all the multipath from the target to each of the APs. The location of the target can be estimated to infer any human movements. The analysis results can be displayed inside a BIM tool. Further, since each AP has its own coverage area, the best deployment plan regarding all the APs can be crafted using the geometry data from the BIM tool.
Solutions - Methods / Results - Findings	<ul style="list-style-type: none"> WiFi CSI can achieve centimeter-granularity indoor positioning. BIM geometry and topology information can assist in WiFi CSI signals processing and deployments. Data centers may coexist with offices or apartments in a building, complicating the facility protection work.
	<ul style="list-style-type: none"> Integration of WiFi CSI technology into BIM may strengthen the level of protection of a facility.
Novelty - Value / Relevance to ...	
Forum statement	

Keywords:

BIM; CSI; Physical Security; Infrastructure Protection.

Graphics:



BIM-enabled condition assessment tool for asset maintenance with integrated Dutch inspection standard

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Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	Real estate assets have become more and more vital. Thus, a proper maintenance and timely rehabilitation is required to ensure: 1) Building operation and maintenance costs are minimized and 2) Levels of service and quality standards are met. Inspection of building components is a necessary step to ensure that maintenance and rehabilitation needs are properly understood. In most cases, the assessment procedure and condition rating process depends on the personal judgment of the building inspector. And it is therefore very difficult to optimize the quality and sustainability within an available budget.
Solutions - Methods / Results - Findings	The large amounts of data that are created and required by various stakeholders through the lifecycle of a building create a daunting information management task. The use of BIM aims at simplifying this task by creating a single unified information repository that can serve various actors involved at different stages of the facility lifecycle. The Asset Management tool of DEMO Consultants is a software solution used for condition assessment on -site and management of assets with embedded Building Information Model (BIM) software. The main aim of the tool is to leverage the existing data in BIM to expedite and enhance the quality of building inspections. The solution provides the possibility to not only assess the condition in a professional way, but also to optimize the maintenance planning according to different ambition levels and needs. A well elaborated and used standard for Condition Assessment is integrated and tailored on Cultural Heritage.
Novelty - Value / Relevance to ...	The BIM-enabled building condition assessment tool ensures consistent and cost-effective inspection of building components making use of the integrated Dutch condition-based maintenance (NEN2767). The tool controls the inspection of building components where new inspection data are added such as assessment score, repair urgency, and type of component defect. Input and modification of inspection data can be done with the iPad which is synchronized with the offsite tool. Inspection results including the observed defect and its characteristics (scale, intensity, etc.) and costs incurred to remedy the defect through an activity can be reported on the BIM. The inspection reports and the generated Multi-Annual Maintenance Planning helps for proper repair decision making in terms of ambition of quality, cost and planning.
Forum statement	Maintaining assets of the past with technologies of the future.

Keywords:

BIM 1; asset management 2; condition assessment 3

Graphics:



Slovenian Real Estate Market: maintenance of multi-dwelling buildings and management challenges

Authors: Klemen Pahulje, BSc

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Forum topics	<input type="checkbox"/> Energy in the 21st Century	<input type="checkbox"/> Cultural Heritage in the Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

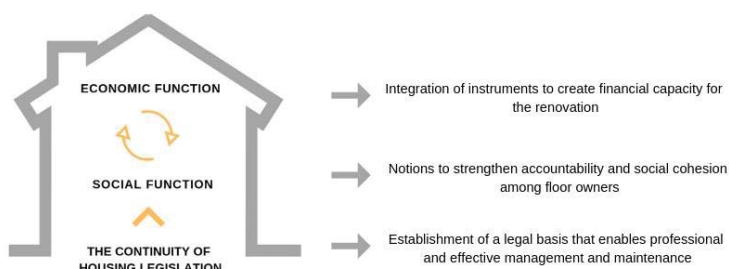
Abstract:

Problems - Issues / Challenges-Needs	<p>Socio-economic development and absence of a long-term and consistent housing policy in the management and maintenance of multi-dwelling buildings in Slovenia are caused by:</p> <ul style="list-style-type: none"> • Inadequate material condition of the housing fund (lowering the market value of multi-dwelling buildings and reducing lifetime of buildings) • Fragmented ownership of housing (atomised ownership) <p>Challenges related to the need to improve the situation in the form of overcoming the main obstacles towards housing fund reform:</p> <ul style="list-style-type: none"> • Economic function - creating conditions for the financial ability of renovation of multi-dwelling buildings • Social function - strengthening responsibility towards co-ownership and social cohesion or consciousness amongst floor owners • Legislative function - legislative regulation of management (status of a manager, relationship and competence of participants, conditions for performing activities, etc.)
Solutions - Methods / Results - Findings	<p>Methods and strategies for more efficient management and maintenance of multi-dwelling buildings:</p> <ul style="list-style-type: none"> • Analysis of the impact of indirect factors on the performance of maintenance work in multi-dwelling buildings • Exploring the basics, management, and approaches to the maintenance of multi-dwelling buildings • Comparison of the legislative framework and examples of good practice in different socio-economic systems in Europe <p>Sustainable solutions leading to progress in the management and maintenance of the housing fund:</p> <ul style="list-style-type: none"> • Integration of instruments to create the conditions for a more effective solution to the problem of renovation of multi-dwelling buildings • A targeted approach and the establishment of a consistent housing policy (elimination of the re-regulation and uncritical transfer of solutions of other European countries to Slovenian legislation)
Novelty - Value / Relevance to ...	<ul style="list-style-type: none"> • Legal basis that enables professional and effective management and maintenance of multi-dwelling buildings • Elimination of participants' passivity and leverage to strengthen mutual cooperation in the process of building management and maintenance • Maintaining or improving the state of the housing fund in Slovenia
Forum statement	The housing fund is one of the constituents of the national wealth of every country and a mirror of a housing policy.

Keywords:

Maintenance, management, multi-dwelling buildings, housing fund

Graphics:

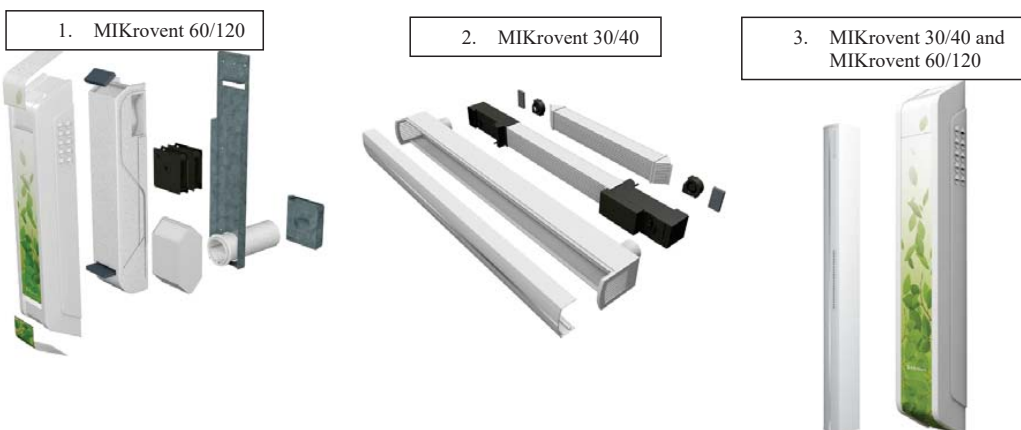


INDOOR ENVIRONMENT AND VENTILATION IN SUSTAINABLE BUILDINGS**Authors:** Prof. Peter NOVAK, PhD, Franci PLIBERŠEK, Arch.¹ Fac. Mech. Eng, UNM, peter.novak@energotech.si; ²MIK, Celje, franci.plibersek@mik-ce.si;

Forum topics	<input type="checkbox"/> Energy in 21st Century	<input type="checkbox"/> Cultural Heritage in Digital World
	<input type="checkbox"/> Engineering Capacity Building	<input type="checkbox"/> Disaster Risk Management & Governance for Resilient Communities
	<input type="checkbox"/> Construction 4.0	<input checked="" type="checkbox"/> BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	<p>Ventilation is the key issue for providing suitable Indoor Air Quality (IAQ), while it is also responsible for energy use in buildings.</p> <ul style="list-style-type: none"> Thus, improving ventilation systems, preventing sick buildings syndrome, plays an important role not only in fostering energy efficiency in buildings, but also in providing better indoor climate for the occupants and decreasing the possibility of health issues in consequence. IAQ in some new and many old thermally renovated, very tight buildings, is in many cases deteriorated, because of lacking proper ventilation systems. <p>Challenge is to find the energy efficient, low noise, modular ventilation system, appropriate for all type of buildings, integrated in smart building concept, using IIoT and IoT for easy production, installation, maintenance and use including recyclability at the end of life.</p>
	<p>There are many different solutions for high quality ventilation of sustainable and unsustainable buildings. Analyzing existing buildings block, homes and apartment buildings, which need to be in next year's thermally renovated, we find that local ventilation system give the industry, installer and user the best practical solution. For industry this means serial, IIoT supported mass production. For installer more flexibility, less impact on existing building construction and for user high quality, low costs product with extra flexibilities at use (IoT), maintenance and disposal.</p>
Solutions - Methods / Results - Findings	
Novelty - Value / Relevance to ...	<p>New units for local ventilation represent an integration of air filtration, high efficient heat recovery, indoor air humidity, VOC or CO₂ control, radon concentration, control of ventilation art (in-out, only in, only out), natural cooling in summer times. Using -in and outdoor dampers in still stand enable tightness of building, according to newest standards. Using flexible inlet nozzles, users can control the incoming air distribution diverting the incoming air flow as they wish or need. Local ventilation connectivity with other equipment in smart building, in cloud operation, local wetter information and even some security task (indoor movement) can be achieved with this type of local ventilation units.</p> <p>System is of great relevance for effective and proper low cost and energy high efficient ventilation of old and new buildings with minimum influence on the building design, construction and maintenance</p>
Forum statement	Ventilation is an important issue for sustainable buildings design and renovation and should be not neglected in future.

Keywords: IAQ, local ventilation, flexibility, efficiency**Graphics:** (please use the gray area below for *representative graphics* or *graphical summary*: select the gray area below and paste your graphics)

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