



# European Council of Civil Engineers

E - JOURNAL 16

JULY 2018

## NEWS FROM:

- Austria
- Bulgaria
- Cyprus
- Poland
- Serbia
- Spain
- Turkey
- U.K.

## INSIDE THIS ISSUE:

67 <sup>th</sup> ECCE General Meeting	3
International Conference "Civil Engineering and Cultural Heritage"	4
ECCE position paper "The infrastructure and management of water"	5
Appropriate regulation for the practice of civil engineering in Europe - Common ECCE perspective	6
Estimation of dynamic behavior of historical masonry arch bridges depending on dimensions	11
Conservation of Hagia Sophia in Instabul	17
News from ECCE Members	26
News from ECCE partners	35
News from EU	37
Upcoming events	39
68 <sup>th</sup> ECCE General Meeting	43

## 2018 European Year of Civil Engineers - An ECCE initiative to celebrate Civil Engineering

Join the European Council of Civil Engineers in 2018 for the European Year of Civil Engineers, a year when Civil Engineering will be celebrated across Europe.



### PROCLAMATION

Dear Community of Civil Engineers, Dear Colleagues,

Civil engineering belongs to the oldest domains of human activity – its history is as long as the history of civilization. The social role of civil engineering in the development of mankind has always been of fundamental importance because the standard of human life has been so highly dependent on its progress. This can be observed from the beginning of human history up to the present day. Civil engineering deals with all aspects of the built environment (either physical or natural) and can be dated to the first time someone placed a roof over his or her head or laid a tree trunk across a river to make it easier to get across. And we can be confident that the role of civil engineering will continue to grow into the future.

Civil engineering as a domain of technological activity is a key element of the national and international economy. Economic progress is impossible without adequately developed social and physical infrastructure, including, for example, buildings, water distribution networks, and service and transport infrastructure networks.

Contemporary achievements of civil engineering, thanks to the progress of building knowledge and science, are spectacular. This is exemplified by numerous tall buildings, dams, large bridge structures, water infrastructure, motorways, sport stadiums and halls, theater houses, etc., constructed in the last decades and strongly influencing urban and extra-urban areas and landscapes. On the other hand, we should also note less spectacular but equally important achievements for social and economic reasons, such as residential buildings, smaller bridges, roads, industrial buildings, etc. The first field can be considered as extraordinary examples of civil engineering, illustrating its especially high level of achievement, while the second one can be considered as 'the work of the day' of civil engineers. Both of them are equally important.

The social, economic and cultural progress of every country is impossible without the contribution of civil engineers, based on their education, professional knowledge and experience. The impacts of their activity can be evidently observed in the form of buildings and structures of various types. Civil engineers are in general socially accepted or in many cases admired. In spite of its dynamic development and its very considerable modern achievements, civil engineering is commonly treated as a rather traditional domain of technology. This situation can be observed in many countries world-wide including in Europe.

However, the reality is that the role of civil engineers in advancing social, economic and cultural progress is especially high. Moreover, civil engineering is a profession that enjoys the highest level of public confidence. Civil engineers are ultimately responsible for the safe utilization of buildings and structures. This is an especially important and often forgotten aspect of the social role of civil engineers. Apart from their technological activities, civil engineers also increasingly consider the social effects of engineering decisions. To meet this condition, civil engineers continue to widen their knowledge of the economic and social sciences.

Ultimately, civil engineering is a very exciting profession. At the end of the day civil engineers can see the results of their work, whether this is a completed bridge, a port, a high-rise building, a subway station, a tunnel, a highway, a hydroelectric dam or even a small house.

Looking to the future, the civil engineering profession will play a fundamental role in dealing with many of the challenges that society will face. The world is becoming increasingly and relentlessly urbanized and this is bringing with it unprecedented social, economic and environmental stresses. Added to this will be the impacts of climate change and environmental degradation. While all aspects of civil engineering will be put to the test, there will be a particular focus on the areas of transportation, energy and water. Civil engineers will be tasked with providing infrastructure which is both sustainable and resilient to address these challenges.

The profession will also be challenged to proactively address the opportunities and efficiencies which will be brought about by the digital revolution, also known as the fourth industrial revolution. Digital technology will drive increasing automation in our industry and there will be opportunities to use the rapidly expanding ocean of data to better design, construct, operate and maintain physical infrastructure.

Taking into account the situation briefly presented above, the European Council of Civil Engineers (ECCE) has decided to proclaim year 2018 as the European Year of Civil Engineers (2018 EYCE). The main goals of this proclamation have been to reinforce the fundamental role of civil engineers in society in improving the standard of human life, to make the case for the prestige of the civil engineering profession in the social community of European countries and to stress the pivotal role that civil engineers will play in addressing the challenges that will face society in the future.

Włodzimierz Szymczak  
Acting President of ECCE

2018 will see activities and initiatives organized by the ECCE member countries all around Europe to get people interested and involved in civil engineering. The opening event was held on 2 December 2017, in Nicosia, Cyprus where the Cyprus Association of Civil Engineers held its 25th General Assembly and celebration of its 25th Anniversary. The closing of the 2018 EYCE will take place in London, during the week of 22-26 October 2018, when the Global Engineering Congress will be held to celebrate the 200th Anniversary of the U.K. Institution of Civil Engineers (ICE) in combination with the 50th World Federation of Engineering Organizations (WFEO) Anniversary, the Triennial with the American Society of Civil Engineers (ASCE) and the Canadian Society of Civil Engineers (CSCE) and the 68th ECCE General Meeting.

#### What are the goals of the 2018 EYCE?

- To reinforce the fundamental role of civil engineers in society in improving the standard of human life.
- To make the case for the prestige of the civil engineering profession in the community of European countries.
- To stress the pivotal role that civil engineers will play in addressing the challenges that will face society in the future.

#### How are we going to achieve them?

- Wide dissemination of the 2018 EYCE proclamation
- Designated logo to denote 2018 as the European Year of Civil Engineers
- Organization of various types of events related to the civil engineering profession by our Member Countries across Europe
- Designated standard presentation to be delivered during all EYCE events
- Marketing of the initiative through press, media, our website and our journal
- Free access to the two ECCE book editions "Civil Engineering Heritage in Europe" and "Footbridges – small is beautiful"
- Communication of our initiative to the European authorities

The European Council of Civil Engineers offers as part of the celebration of the European Year of Civil Engineers **free access to its two book editions Civil Engineering Heritage in Europe and Footbridges – Small is beautiful.**

Both books are downloadable and can be found at the ECCE website at the following links:

[ECCE Edition Civil Engineering Heritage in Europe](#)

[ECCE Edition Footbridges – small is beautiful](#)

[2018 EYCE Calendar of events \(pdf format\)](#)

[2018 EYCE Status Report – May 2018](#)

Please visit the [ECCE website](#) to stay tuned.

## 67<sup>th</sup> ECCE General Meeting



European Council  
of  
Civil Engineers



EESTI EHITUSINSENERIDE LIIT



67<sup>th</sup> ECCE General Meeting group photo

The [67<sup>th</sup> ECCE General Meeting](#) was held on 31<sup>st</sup> May and 2<sup>nd</sup> June 2018, in Tallinn, Estonia at the Tallink Spa & Conference Hotel hosted by the Estonian Association of Civil Engineers (EEL). On 30<sup>th</sup> May, the ECCE Executive Board meeting was held. The 67<sup>th</sup> ECCE General Meeting was organized in conjunction with the International Conference "Civil Engineering and Cultural Heritage" that was held under the umbrella of the ECCE Initiative "[2018 European Year of Civil Engineers](#)".

The 67<sup>th</sup> ECCE General Meeting was

very well attended with delegations from almost all of the ECCE Member organizations. The meeting was chaired by the ECCE Acting President Włodzimierz Szymczak. The opening speech was made by the President of the Estonian Association of Civil Engineers Mr. Margo Dengo who welcomed all the participants and introduced to them the structure and functions of the Estonian Association of Civil Engineers and presented the challenges that civil engineers in Estonia are facing.

Among the distinguished guests were EEL President Margo Dengo, EEL President Elect Kaspar Ots, ECCE Honorary President Yrjö Matikainen, WCCE Past President Emilio Colon, EAMC President Adil Al Hadithi, and EAMC Secretary General Nicola Monda.

During the 67<sup>th</sup> ECCE General Meeting the Russian Society of Civil Engineers – Moscow Department re-established its membership in the European Council of Civil Engineers and the Russian delegation was warmly welcomed by the ECCE Members aspiring to joint work and fruitful cooperation from now on.

In the meeting, the [ECCE activity report October 2017 – May 2018](#) was presented by the ECCE Acting President Włodzimierz Szymczak together with ExBo members describing briefly the ECCE activities since our last meeting in October, in Vienna. The main activities of ECCE during this period of time were focused mainly on the organization of the "[2018 European Year of Civil Engineers](#)", the finalization of the Position Paper "Appropriate regulation for the practice of civil engineering in Europe", the assessment of new proposals for Position Papers, ECCE's membership issues, ECCE's relationship with other European and World organizations, ECCE's participation in several initiatives from cooperating Associations as well as matters of internal organization and function. During this period, ECCE ExBo members and other ECCE representatives participated in various events organized by ECCE Members and other Associations with which ECCE cooperates.

The [2018 EYCE status report](#) on the progress of the [ECCE Initiative "2018 European Year of Civil Engineers"](#) was presented by the ECCE Acting President who briefly presented all the events that have already been organized under the umbrella of the 2018EYCE.

A presentation was delivered by Ingrid Farmer (UK delegate) on the progress of the organization of the [Global Engineering Congress](#) that will be held in London from 22 – 26 October 2018 celebrating the bicentennial of the ICE, the 50<sup>th</sup> WFEO Anniversary, the Triennial with the American Society of Civil Engineers and the Canadian Society of Civil Engineers, as well as the 68<sup>th</sup> ECCE General Meeting which will also be the closing event of the 2018EYCE.

During the 67<sup>th</sup> ECCE General Meeting the ECCE General Assembly ratified ECCE's subscription to the European Construction Forum (ECF) [Manifesto on Digitalization](#). ECCE is a member of ECF and Paul Coughlan (UK National Delegate) participated in the working group for the preparation of the Manifesto on Digitalization which will be circulated in the following weeks.

Furthermore, the ECCE General Assembly ratified ECCE's subscription to the [Madrid Declaration 2018 Water: the future we want](#). The Madrid Declaration has been jointly signed by the following organizations WFEO, WCCE, FEANI, ECCE, CICPC-CEPC, Ode Portugal, CICCPC, AICCP, IIE Spain in order to meet the challenges of engineering for climate change adaptation and mitigation solutions, focusing on the field of water, one of the most sensitive



EEL President Margo Dengo at the opening of the 67<sup>th</sup> ECCE GM

sectors for sustainable development and the adaptation to it.

The ECCE General Assembly also ratified ECCE's participation in the [World Construction Forum 2019](#) as a co-organizer. The World Construction Forum 2019 "Buildings and Infrastructure Resilience" will be held from 8 – 11 April 2019, and will be accompanied by the Annual Meeting of the WFEO Executive Board. The Forum will be organized under the auspices of the World Federation of Engineering Organizations (WFEO) by the Slovenian Chamber of Engineers and the University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG). The Forum is dedicated to the centennial of the organized integration of chartered engineers in Slovenia into chambers and to the centennial of the foundation of the University of Ljubljana and its Technical faculty, forerunner of UL FGG.

During the 67<sup>th</sup> ECCE General Meeting, the progress on the preparation of the ECCE booklet "The history and the role of civil engineers through the centuries" was presented. This proposal was submitted by Platonas Stylianou (Cyprus National Delegate) to the ECCE Executive Board. A working group has been formed and is already working to complete the booklet until October when it will be presented during the Global Engineering Congress in London concluding the European Year of Civil Engineers. This booklet will be part of ECCE's contribution to the 2018 EYCE.

The ECCE Financial matters were also presented and discussed. ECCE Vice President / Treasurer Dimitar Natchev described the ECCE financial report until the end of May for the information of the members. He also presented the Year End Report for 2017 which was approved by the ECCE General Assembly.

Another interesting point during the meeting was the presentation about the [STEM & Gender Assessment \(SAGA\) Project](#), a global UNESCO project aimed at identifying and addressing gender gaps in STEM fields at all levels of education and research. This project proposal was presented by ExBo member and WCCE Executive Director Jose Francisco Saez Rubio. As civil engineers represent more than half of world population of all engineers worldwide, at national, regional and international level, UNESCO SAGA Team has offered WCCE's Standing Committee on Women in Civil Engineering to contribute to such project by designing and carrying out this survey to collect accurate sex-disaggregated data on a specific objective of the STI GOL, the STI GOL 4.8 "Ensure gender equality in S&E professional certifications, in particular in engineering" in order to improve the measurement of the status of women and girls in engineering as an overall objective. All ECCE National Members have been requested to contribute to this project by completing an online survey which can be accessed at the link [here](#).

In addition, WCCE Executive Director Jose Francisco Saez Rubio presented the Jose Medem Civil Engineering Excellence Award which is a WCCE initiative. An open call for submission of candidacies can be found [here](#).

Finally, the ZDI representative Prof. Carsten Ahrens presented the [Foundation Prof. Joachim Lenz initiative](#) which offers an internship / practical placement for one or two students for one year in a German company.

## International Conference

### “Civil Engineering and Cultural Heritage”



**ECCE Acting President Włodzimierz Szymczak opening the Conference**

The International Conference "Civil Engineering and Cultural Heritage" was held on Friday 1<sup>st</sup> June 2018, at the Tallink Spa & Conference Hotel, organized by the Estonian Association of Civil Engineers under the umbrella of the European Year of Civil Engineers and the European Year of Cultural Heritage. The Conference was very well attended by ECCE Members as well as by Estonian Engineers, students, professionals and academics. The Conference was moderated by Kaur Lass, MA, OÜ Head.

The Conference was opened by ECCE Acting President Włodzimierz Szymczak who presented the ECCE initiative to mark 2018 as the European Year of Civil Engineers. Włodzimierz Szymczak delivered the [presentation](#) that was prepared for this purpose and also the [proclamation](#) of the 2018 EYCE. EEL President Margo Dengo addressed an opening speech as well.

The presentations that were delivered during the Conference are listed below:

- [History and experience of renovation of Cultural Heritages in Estonia: Restoration Works in Post-WWII Tallinn](#)  
(Kaarel Truu, MA, National Heritage Board)
- [Lessons learned. Renovation of Seaplane hangars](#)  
(Heiki Onton, PhD, Ramirent Baltic AS managing director)
- [Challenges for the structural engineer on renovation of ancient buildings](#)  
(Aris Chatzidakis, MSc Civil Engineer, ECCE Vice President)
- [History and experience of integrated renovation of Vilnius historic city centre](#)  
(Gediminas Rutkauskas, Dipl. Architect, ICOMOS international expert, Head of Vilnius Old Town Renewal Agency)

- [Fire safety in historical wooden buildings](#)  
(Johanna Liblik, MSc, Tallinn University of Technology)
- [Contemporary architecture & heritage – case of Latvia](#)  
(Janis Dripe, Expert, Ministry of Culture of Latvia, Head of RISEBA School of Architecture)
- [Lessons learned. Rotermann City, Tallinn](#)  
(Martin Vaga, MSc, YIT Infra Eesti AS)
- [The possibility that technology offers: The potential of HeritageBIM](#)  
(Dr. James Miles BA (hons), MSc, PhD, MCIfA)



Group photo at the House of Blackheads

*The European Council of Civil Engineers would like to express its gratitude to the Estonian Association of Civil Engineers for the successful organization of 67<sup>th</sup> ECCE General Meeting and the International Conference “Civil Engineering and Cultural Heritage” as well as for their exceptional hospitality.*

## ECCE position paper regarding “The infrastructure and management of water”

### Executive summary

Potable water and sanitary systems are critical to improve quality of life and upgrading public health. Water is a (public domain, public trust) resource, human right and a service at the same time.

In principle, ECCE supports that “water is not a commercial product” and recognizes the access to and the adequate supply of water and sanitation as a fundamental human right, as declared by the UN. ECCE aligns with the position by the European Commission on the importance of this human right as a public good of fundamental value.

ECCE realizes its role and responsibility to provide guidance to its members, to society and to governments regarding water management expertise in relation to economics and technical solutions for a sustainable development, which enhance the protection of water resources and water bodies.

The paper covers aspects related to water infrastructure and water resources management including, climate change adaptation, water scarcity and droughts, sanitation, sustainable water resources management, water supply and demand management, asset management, water loss management, water pricing, public awareness, pollution control and protection of water bodies and their ecosystems, drinking water and flood risk management, etc. For all aspects, background information is presented and commented and the position of the ECCE is then reported.

The main decisions in water management refer to investments in water management that usually have an economic and technical life span ranging from 30 to 100 years and even more. On the other hand, political decisions may be short term, not looking much further than the next elections. In order to balance short-term political decision making framework, management of water has to be more dependent on well-controlled technocratic decisions and less affected from political approaches and strategies. It is more beneficial to the society to regulate the procedures with legislation and directives in order to minimize political interference and achieve a state of the art implementation. ECCE supports that, in terms of planning, implementation and maintenance of water systems, it is better to think strategically in a long-term frame.

It is also necessary to keep a balance between water as a right and water as a service. Active stakeholder participation has a specific role in this balancing and should be clearly endorsed. ECCE agrees with the provision of the EU Water Framework Directive about the recovery of costs for the provision of water services. It is important to consider water as a human right and at the same time provide tools to recover the costs and incentives for efficient

water use in long-term perspective. Pricing policies should reflect the fact that water is a scarce resource and have to convey the right messages. Right pricing can and should be used as a tool in Demand Management.

Cost recovery should include infrastructure upgrading and maintenance so that underground infrastructure is not neglected. The approach “out of sight out of mind” is not professional; neither ethical and most importantly not sustainable. We strongly recommend to develop or upgrade financing and funding programs and to establish procedures and policies to keep infrastructure reliable and resilient to use for water distribution thus, provide to people the service they deserve. Civil Engineers must be committed in implementing the best practices and standards to develop and maintain the infrastructure proactively and in keeping people and governments informed on the strengths and weaknesses of the infrastructure with transparency. Countries are encouraged to define water infrastructure as critical and to introduce programs to assure its protection and its sustainability.

Targeted investments have to be associated with adaptation to a changing climate. Given the uncertainty of climate change impact on water resources balance, ECCE supports to focus adaptation efforts in No-regret Type Measures like maintaining and increasing strategic reserves of water resources, increase funding research for new water saving technologies, and exploitation of storm water and alternative water resources. Storm water should not be regarded as “waste” that needs to be disposed but as a valuable resource of water. To manage storm water, it is more efficient to collect and reuse the water at its source so, storm water management systems at property level should be promoted to a greater extent. With respect to alternative sources of water, ECCE considers that the use of desalination and recycled water, in water shortage areas seem to be a very promising solution. ECCE supports the use of desalination given that all other options, such as demand management, efficient use etc. are applied. The high cost of production in desalination plants and the environmental cost, have to be considered. ECCE supports the use of treated wastewater as a resource for agriculture, industry, artificial water recharge and other purposes. At the same time, best practices should be applied and appropriate requirements should be introduced to prevent any adverse impacts on public health, the environment, soils and crops. Research on the effects of irrigation with treated wastewater on soil and crops should be promoted to a greater extent.

With respect to sustainable management, all the fields related to water have to be considered integrally and assessed how they interact, how they affect sustainability and how the pressure on water is eliminated. It is ECCE's position that the right to development must be fulfilled in such a way in order to equitably meet developmental and environmental needs of present and future generations. With expanding global population and economic activity, pollution pressures on drinking water sources are dramatically increasing. Many drinking water sources both ground and surface are being abandoned globally due to pollution at a high pace. At the same time new emerging pollutants like pharmaceuticals, endocrine disruptors, nanomaterials, etc. make drinking water treatment more difficult and more expensive. To face the above challenges we need to increase efforts on protecting and safeguarding drinking water sources from pollution pressures. The further increase of pollution pressures needs to be halted by restricting new potentially polluting activities within the watershed of drinking water sources. This can be achieved by the establishment of protection zones and identification of potentially polluting activities that should not be allowed within the zones. At the same time, existing potentially polluting activities within the watersheds and protection zones need to be carefully monitored and strictly regulated.

ECCE considers that, the intention of European Commission to promote benchmarking of water services helps to introduce a critical tool to monitor and manage water activities concerning financial and technical performance indicators. It is without question that the quality of data will reflect the quality of water management. The regulatory bodies, which are usually important promoters of the benchmarking process and users of its results, are currently defined by national legislation. ECCE supports that, the role of regulatory bodies in water services should be enhanced by European legislation.

Further information on the topic may be consulted in the report's full version [here](#).

## Appropriate regulation for the practice of civil engineering in Europe - Common ECCE perspective

### Text analysis

The purpose of this document is to identify the most important points of the position paper approved during the last ECCE General Assembly held at the beginning of June 2018 in Tallinn, Estonia.

After a first assessment of the importance of engineering in the development of the economic activity of the countries and the risks derived from a poor quality of the infrastructures added to the appearance of extreme episodes and a structural deficit of these professionals in Europe, the report performs a critical analysis of European mobility policies within the scope of Directive 2013/55 and their future perspectives. In this sense, the document reviews the attempts to establish recognition mechanisms for the free establishment of professionals as well as for their freedom to provide services.

The document reviews initiatives such as the professional card, which has been relegated in its early stages to civil engineering, the creation of common training platforms, difficult to apply due to the heterogeneity of training in different countries, and the comparative analysis of transparency in order to identify national barriers to professional mobility.

Next, the study makes a series of considerations about the common features of these initiatives as a whole, overestimating a positive intra-regional effect of employability in Europe without the adequate analysis of externalities derived from the deregulation itself in the medium and long term. In this same sense, the report indicates that these measures are not taking into account the frameworks of professional mobility available through the Free Trade Agreements signed by the European Union itself.

After this criticism, the document presents areas for improving the current regulatory framework such as monitoring professional practice, as well as the obligation to provide professionals with the corresponding professional liability insurance or the introduction of a harmonized European framework for monitoring the Continuous professional

development, together with its possible license renewal. Finally, the participation of professional chambers in the mobility processes is demanded to speed up them, reduce their cost and make professionals aware of the existing procedures.

Subsequently, the ECCE offers to present these proposals in greater depth in any forums of interest and as a conclusion, the document makes the following considerations:

- **The new EU regulations will lack applicability without the committed participation of professional chambers, concurrent opinions with the European Council of Civil Engineers - ECCE** and other interested parties in its debate, implementation and operation.
- **The mechanisms of professional mobility require the active participation of professional chambers as current custodians of public trust.**
- **Any new EU regulation on professional issues should be discussed and agreed upon after a thorough evaluation**, taking into account intraregional and interregional mobility.
- **EU regulations should provide a balanced framework as a primary requirement to implement extra-community professional mobility** under the coverage of the current and future Free Trade Agreements of the EU (FTA).
- **All professional recognition regulations in civil engineering should take into account the specific characteristics of this professional sector oriented to public service and highly qualified**, with a duty of care towards all users of any infrastructure or public service.

**Any new professional regulation should provide a level field for global engineering conglomerates, SMEs** and independent professionals, both within the EU and among the free trade agreements signed by it.

Further information on the topic may be consulted in the report's full version [here](#).

## Eastern Mediterranean Science, Engineering and Technology Centre of Excellence for Archaeology and Cultural Heritage - MedSTACH



The Eastern Mediterranean area hosts the vestiges of major ancient cultures that have shaped the formation of modern European societies. Situated in the heart of Eastern Mediterranean, Cyprus formally constitutes the easternmost part of federal Europe, and an easternmost repository and steward of European heritage. Due to its unique geo-

graphical position, Cyprus has always been a crossroads between Europe, Africa and Asia, and a bridge between their respective cultures and civilizations; this geographical characteristic is heavily reflected on the rich and diverse cultural heritage (CH) of the island.

Project **MedSTACH** capitalizes on the strategic position of Cyprus to establish an excellence hub in archaeology and CH in the Eastern Mediterranean region, fostering multidisciplinary research and technological innovation. To this end, key Cypriot public academic institutions and national policy makers and stakeholders are teaming up with leading international research and academic institutions to design the Eastern Mediterranean Science, Engineering and Technology Centre of Excellence for Archaeology and Cultural Heritage (acronym MedSTACH). More precisely, the **MedSTACH** consortium is coordinated by the Department of Civil Engineering and Geomatics of the Cyprus University of Technology and includes the Archaeological Research Unit of the University of Cyprus, the Department of Antiquities of Cyprus -- the national stakeholder and policy maker responsible for cultural heritage management on the island, and the Cyprus Tourism Organisation -- the national stakeholder an policy maker responsible for the promotion of Cyprus's touristic product. The consortium also includes renowned key international partners; namely, the Institute of Archaeology of the University College London (UCL), and the Laboratory of Geophysical-Satellite Remote Sensing and Archaeo-environment of the Foundation for Research and Technology – Hellas (FORTH).

**MedSTACH's** vision is the development of the necessary scientific and technological environment for advancing the state-of-the-art in archaeology and CH research in Cyprus, the Eastern Mediterranean region and beyond; this will be accomplished by strengthening regional wellsprings of scientific and technological expertise, capacity for innovation, and synergies among related Science, Engineering and Technology disciplines. The Centre also aims to transform the way archaeologists, allied researchers, CH professionals and all relevant stakeholders handle geospatial and other relevant digital information, in an effort to modernise archaeological research and fully exploit the region's unique cultural capital. Last, the Centre aspires to become a research excellence hub for archaeologists working in the broader Eastern Mediterranean region for the promotion and protection of regional CH, as well as a key facilitator for the establishment of related synergies among neighbouring Mediterranean countries.

**MedSTACH** includes four (4) interconnected key research domains, namely, **Heritage Exploration, Spatial Analysis, Heritage Protection** and **Material Characterisation**, as well as a supporting **Heritage Information Technologies (IT) Unit**. Heritage Exploration encompasses innovative, targeted use of geophysical, remote sensing and related technologies for a variety of applications related to archaeological exploration, mainly focused on the detec-

tion/identification of areas bearing archaeological interest, not yet excavated. Spatial Analysis employs geographic information systems, geoanalytics and geocomputation, in order to better understand the role of artefacts, sites and landscapes within their unique context and their role and position within the socio-economic environment in different time periods. Heritage Protection involves detailed study, analysis and monitoring of standing monuments and sites via non-contact and/or lab analyses, as well as systematic studies on the effects of environmental and anthropogenic factors, e.g., natural hazards or air pollution, on exposed CH monuments and sites. Material Characterization aims at enhancing scientific knowledge about the materials, techniques, tools and technological know-how involved in the construction and manufacturing of archaeological artifacts. The Heritage IT Unit will constitute the technical backbone for the Centre, both in terms of data used for conducting research, as well as in terms of services and products for the scientific community and broader public (e.g. digitisation and database management, ontologies and metadata creation, digital archiving, web services). The methodologies, procedures, and services developed within **MedSTACH** will be continuously disseminated in the public and private sectors, and are expected to have a positive impact on tourism, thus stimulating local and regional sustainable economic growth.

The **MedSTACH** proposal was ranked 1<sup>st</sup> (attaining full marks 15/15, "Excellent") on a pan-European scale, among 208 proposals submitted to Programme "Teaming for Excellence" Phase 1, part of European Union's (EU) Horizon 2020 framework for Research and Innovation. Programme "Teaming for Excellence" (Teaming) aims at connecting, via the creation of new or the major upgrade of existing Centers of Excellence, renowned research institutions from countries with a strong tradition in Research and Innovation with institutions from countries with developing research activity, so that the latter countries become more competitive in securing research funds. The **MedSTACH** proposal was [awarded 0.4 million euros](#) for a period of one year (Phase 1 of the Programme) in order to develop a business plan for the **MedSTACH** Centre of Excellence. That business plan will be submitted for evaluation to the EU during Phase 2 of the Teaming Programme, seeking funding of 15 million euros for a period of 5-7 years, with the possibility of an additional equal amount of national co-funding for a period of 15 years. Phase 1 objectives aim to take advantage of the Teaming framework to lay the groundwork beneath the establishment of the **MedSTACH** Centre. Phase 2 objectives aim to build upon the future Centre's capabilities and materialise its research and innovation potential at the local, regional and European level.

The **MedSTACH** project has also received the **European Year of Cultural Heritage 2018 (EYCH) label** and was granted with the right to use the **EYCH's visual identity**.

## Tribute to the Late Prof. Iacint Manoliu †



Dear colleagues and friends,

It is with a heavy heart that we inform you that Professor Iacint Manoliu passed away on the afternoon of 12<sup>th</sup> June 2018.

Active professor and a professional engineer, full of energy and passion, he held key positions in international, European and national organizations.

Graduate of the Faculty of Civil, Industrial and Agricultural Buildings - Institute of Construction Bucharest (1957), ICB / UTCB university professor since 1959, Vice-Dean (1972-1976) and Dean (1976-1984) of the Faculty of Civil, Industrial and Agricultural Buildings, Vice-Rector (1990-2000) of UTCB, Chairman of the Council for International Cooperation and International Relations (2000-2011). Vice President (1990-1996), President (1996-2012) and Honorary President (2012) of the Romanian Society of Geotechnics and Foundations. Since 2004 he was a correspondent member of the Academy of Technical Sciences in Romania.

Professor Manoliu was part of the group of engineers who, in 1990, founded the Romanian Construction Engineers Association. He promoted AICR at European level and made it possible for AICR to become a member of the European Council of Civil Engineers (ECCE).

**Professor dr. ing. Iacint MANOLIU**  
**5 April 1934 – 12 June 2018**

"Education and Training in Geotechnical Engineering" of ISSMGE (International Society for Soil Mechanics and Geotechnical Engineering). Since 2008 he was the Secretary General of European Civil Engineering Education and Training (EUCEET).

But above all, Professor Manoliu was a valuable person and a true friend of those who had impressive results in our field.

dr. ing. Paul IOAN  
President of AICR

## Be an ECCE Member (EUCivEng)

### ECCE Individual Membership



#### The European Civil Engineer

The profession of the Civil Engineering is mostly performed where the construction is being made, in Europe or in any part of the world.

Today, within the European Union, construction companies have activities in many countries, so civil engineers have to move to foreign countries and to work all over Europe.

To allow this professional movement EU published a Directive on Professional Mobility, to facilitate the recognition of Civil Engineers across Europe.

Nevertheless the Directive considers under this title, professionals with quite different academic or professional backgrounds, what can lead to unclear situations for society.

The EU Directive on Mobility proposes the creation of a European Database of Civil Engineers, interconnected through national organizations.

ECCE appeared in 1985 to promote the quality of Civil Engineering with a professional recognition where academic/professional quality is guaranteed by the national organizations.

ECCE as representative of those organizations, and to promote quality in professional recognition, is opening its membership to individual members, allowing for their image recognition as European Civil Engineers.

#### Join ECCE, be a EUCivEng!

#### ECCE goals:

- To present in Brussels the views of the European civil engineers.  
(ECCE participates in the High Level Tripartite Forum for Construction in EU)
- To establish international contacts with other associations.  
(ASCE, JSCE, KSCE, ECCREDI, Mediterranean countries, etc.)
- To promote the relevant professional information across Europe  
(Publication of e-journal, books, reports, etc.)
- To organize Conferences across Europe about Civil Engineering  
(See the conferences presentations in ECCE website)

#### May I become an Individual ECCE Member?

Yes, although ECCE is an association of national organizations, individual civil engineers may also be Individual Associate Members, with access to all the information and discussion forums, but they may not vote in ECCE General Assemblies.

Being an ECCE individual member you will have the reference EuCivEng.

#### What do I get as an ECCE Individual Member?

- **If you just want to be an ECCE member**, you will receive:  
The e-journal and all relevant information from EU Commission
- **If you want to come to our meetings**, you will get:  
Participation in 2 International conferences per year;  
Participation in 2 General assemblies per year;  
Participation in Brussels Engineers Day each 3 years;  
To be in contact with civil engineers across Europe (EU and nonEU).
- **But if you want to be really active**,  
You are welcome to participate in the discussion forums or to propose position papers to be submitted to Brussels.



### May I become an Individual ECCE Member?

Yes, although ECCE is an association of national organizations, individual civil engineers may also be Individual Associate Members, with access to all the information and discussion forums, but they may not vote in ECCE General Assemblies.

Being an ECCE individual member you will have the reference EuCivEng.

### And you get also the ECCE membership card !

- The ECCE card identifies you, through your national organization, as a Professional of Civil Engineering in your country and a **EUCivEng** in ECCE.
- It is expected that in the future the card will allow an automatic civil engineering identification across Europe, according to the EU Mobility Directive, when national organizations implement their database of Civil Engineers.

### How can I become an ECCE Individual Member?

Please send to ECCE headquarters ([ecce\\_sps@otenet.gr](mailto:ecce_sps@otenet.gr)):

1. [Registration Form](#)
2. Document from your ECCE National Organization as a proof that you are member of it
3. [Excel sheet with your information](#)
4. Photograph
5. [Excel sheet with your name and address](#)

After receiving the notification of acceptance of your application from the ECCE General Secretary, you will be asked to proceed to the **Payment of the Subscription Fee** according to the **Payment Details** that follow.

### What are the Payment Details?

- To be an ECCE individual member there is an **annual fee of 20 euros**.
- If you are **older than 65 you pay only once 30 euros** and you become member with unlimited validity.
- You can pay in packages of 3 years (60 euros) or 5 years (100 euros), **plus 8 euros, with each package, for mail and printing of a new card.**

The payment should be sent by bank transfer to:

#### National Westminster Bank plc, Charing Cross Branch

**BIC** NWBK GB 2L  
**IBAN** GB28 NWBK 6072 1408 5260 60  
**Bank Address:** National Westminster Bank plc, PO Box 113, Cavell House, 2A Charing Cross Road, LONDONWC2H 0PD  
**Account Name:** European Council of Civil Engineers  
**Account Number:** 550/00/08526060  
**Sort Code:** 60-40-05

**Please ensure that your payment includes your name as a reference.**

After payment send a copy of the bank transfer to [ecce\\_sps@otenet.gr](mailto:ecce_sps@otenet.gr) and you will become ECCE member and you will receive the membership card.

**[Join us now!](#)**  
**[Become an ECCE Member \(EUCivEng\)](#)**

# Estimation of dynamic behavior of historical masonry arch bridges depending on dimensions

Berna CORUHLU<sup>1</sup>, Temel TURKER<sup>2</sup>, Yusuf YANIKand<sup>3</sup> Alemdar BAYRAKTAR<sup>4</sup>

<sup>1</sup>M. Sc., Karadeniz Technical University, Trabzon, bernacoruhlu@hotmail.com

<sup>2</sup>Doc. Dr., Karadeniz Technical University, Trabzon, temelturker@ktu.edu.tr

<sup>3</sup>Resch. Asst., Karadeniz Technical University, Trabzon, yusufyanik@ktu.edu.tr

<sup>4</sup>Prof. Dr., Trabzon, alemdarbayraktar@gmail.com

## ABSTRACT

*It is very important to predict the structural behavior of the historical bridges that have survived from the past to the present day. In this study, it was tried to be developed formulas for the natural frequencies on the historical stone arch bridges. As an application, it was selected thirty historical masonry arch bridges, with different geometric features from the East Black Sea Region, in Turkey. There were determined natural vibration frequencies obtained from modal analysis of bridges with mode shapes, on the developed finite element models of the selected bridges. After, the relation between the geometric dimensions of the bridges and the natural frequencies is evaluated and it was developed a formulation for calculation of the frequencies of the bridge depending on geometric dimensions. In addition, the change in mode shapes and bridge geometric dimensions has been determined. At the end of the study, it has been seen that the proposed formulas give very close results to reality on estimation of frequency values of single span arch bridges. It is believed that the presented formulation can be used as a reference in experimental studies and in the control of finite element models.*

**Keywords:** Natural frequency formula, Modal analysis, Finite Element Method, Masonry arch bridges

## Introduction

The historical bridges survived from past to present day have an immense significance in terms of human history as well as providing transportation in their region. When the historical bridges are subjected to the loads such as earthquakes, floods, explosions and impacts, various structural and non-structural members are damaged and demolished. Maintenance and repair of the historical bridges must be done periodically in order to prevent damages. In Turkey, there are many stone arch bridges of varying sizes and shapes belonging to different periods. It is likely to make mistakes both in the evaluation of structural behavior and in the finite element modelling of historical stone arch bridges. So some reference value or empirical formulas are needed to provide control of the correctness of the structural behavior of historical stone arch bridges. When considering number of the historical stone arch bridge number in countries, the development of an empirical formula for forecasting the natural vibration frequencies depending upon geometric features for historical stone arch bridges is very valuable.

Many theoretical and experimental studies have been carried out on historical bridges. In theoretical studies, the behavior of the bridge under the impact of static and dynamic loads is investigated. In the experimental studies it has been carried out to identify the dynamic characteristics and to examine the arch behavior. Beconcini et al. (2007) aimed to theoretically and experimentally determine the dynamic characteristics of the five-span historic stone arch bridge. They compared the theoretical results obtained from the finite element modelling with the experimental results obtained from Operational Modal Analysis. Ural et al. (2008) have emphasized the importance of determining the current situations of these structures in order to improve the protection of historic arch bridges and appropriate restoration projects in their works. For this purpose, they emphasized the architectural and engineering features of the historical arch bridges in Turkey. Birinci (2010) aimed to determine the dynamic characteristics of stone arch bridges experimentally and theoretically and to update the finite element models of bridges using Operational Modal Analysis Method. It was presented the theoretical analyzes by choosing Şenyuva and Ottoman bridges, which are historical stone arch bridges, and forming finite element models in ANSYS program. It was identified the dynamic characteristics of the similar bridges by using Operational Modal Analysis Method and compared the results of theoretical and experimental analysis with each other. Lastly, it was improved the finite element model in order to minimize differences between experimental and theoretical results using Operational Modal Analysis Method. At the end of the study, the Operational Modal Analysis Method, which is performed by using appropriate measuring instruments, has arrived the specification of the dynamic characteristics of the stone bridges with complex geometric and material properties and used safely with improved finite element models. Korkmaz et al. (2013) modeled the Timisvat Historical Bridge in Rize, Turkey, with the Finite Element Method in the SAP2000 computer program in order to determine the earthquake behavior of the stone arch bridges. On this model, dynamic analyses were made in the time domain using 10 different earthquake acceleration records. As a result of these analyzes, displacement and strain values of earthquake records were found and the results were compared. Ercan and Nuhoğlu (2015) aimed to investigate the static and dynamic structural properties of three-span historical arch bridge in their work with destructive and non-destructive methods. They chose a bridge located in the first degree earthquake zone in İzmir/Çeşme and evaluated their behavior in a severe earthquake. They found the ground structure and internal parameters of the bridge and formed a three dimensional solid model. They got the samples with destructive methods from the bridge and made tests on them. They have determined the dynamic characteristics with Operational Modal Analysis Method and assessed the experimental and numerical analysis results and determined the earthquake performance of the bridge by

analyzing the behavior spectrum on the improved model. Türker et al. (2015) aimed to experimentally investigate the dynamic behavior of the 1/10 scale stone arch bridge model formed in the laboratory field. They used the Ambient Vibration Test to determine the dynamic characteristics of the structure and performed modal analysis using solid three-dimensional elements in the SAP2000 program. They compared the dynamic characteristics obtained experimentally with the analytical results obtained from the modal analysis and revealed the differences.

In this study, it was developed an empirical formula for natural frequencies of historical stone arch bridges using Finite Element Method results. As an application, thirty historical stone arch bridges with different geometrical features were selected in the Eastern Karadeniz Region.

### Formulations

#### Modal Analysis Formulation for Multi Degree of Freedom Systems

The general dynamic equation of a system with multi degrees of freedom, which is used in determining natural frequencies and mode shapes, which are dynamic characteristics of a structure,

$$[M] \{\ddot{x}(t)\} + [K] \{x(t)\} = \{0\} \quad (1)$$

can be given equation (1) (Chopra, 2015). Here, [M] and [K] demonstrate the mass and stiffness matrices of the

multi-degree of freedom system and  $\{\ddot{x}(t)\}$  and  $\{x(t)\}$  display the time-dependent acceleration and displacement vectors of the multi-degree-of-freedom system.

#### Multiple Regression Method

The method used to explain the cause-result relations between two and more independent variables affecting a variable with a linear model and to identify the effect levels of these independent variables is called the multiple linear regression method (Ozdamar, 2003).

#### Controlling the Significance of Estimators ( $R^2$ )

$R^2$  indicates what percentage of change in the dependent variable is made with explanatory variables.  $0 \leq R^2 \leq 1$ 'dir. As  $R^2$  approaches one by one, the independent variables fully explain the dependent variable. As  $R^2$  approaches zero, the independent variables never disclose the dependent variable.

### Applications

#### Finite Element Models and Modal Analyses of Bridges

In this study, 30 historical stone arch bridges in the Eastern Karadeniz Region of Turkey were chosen to attain an empirical formula for the natural frequency of historical stone arch bridges. These bridges, which have different bridge width, arch clearance and height, were modeled with Finite Elements Method in SAP2000 (SAP2000, 2008) program and the modal analysis were performed. In the modeling of bridges, solid three-dimensional elements with eight nodes with three degrees of freedom are utilized at each point. The material values were got as average values given in the literature for historical masonry arch bridges. As supporting conditions, fixed support was accepted at the boundaries. Table 1 presents the mechanical properties of the materials considered in the analytical models of bridges.

Table 1. Material properties considered in the analytical model of bridges

Element	Elasticity modulus (N/m <sup>2</sup> )	Poisson ratio	Density (kg/m <sup>3</sup> )
Arch	3.00×10 <sup>9</sup>	0.20	2400
Wall	2.50×10 <sup>9</sup>	0.20	2400
Ornamental arch	3.00×10 <sup>9</sup>	0.20	2400
Railings	3.00×10 <sup>9</sup>	0.20	2400
Fill	1.50×10 <sup>9</sup>	0.05	1600
Platform	2.50×10 <sup>9</sup>	0.20	2200

Finite element models of the selected bridges were formed and modal analyzes were performed. By modal analysis, changes in natural vibration frequencies of bridges were clarified. Fig. 1 shows the finite element models of some of the selected bridges.

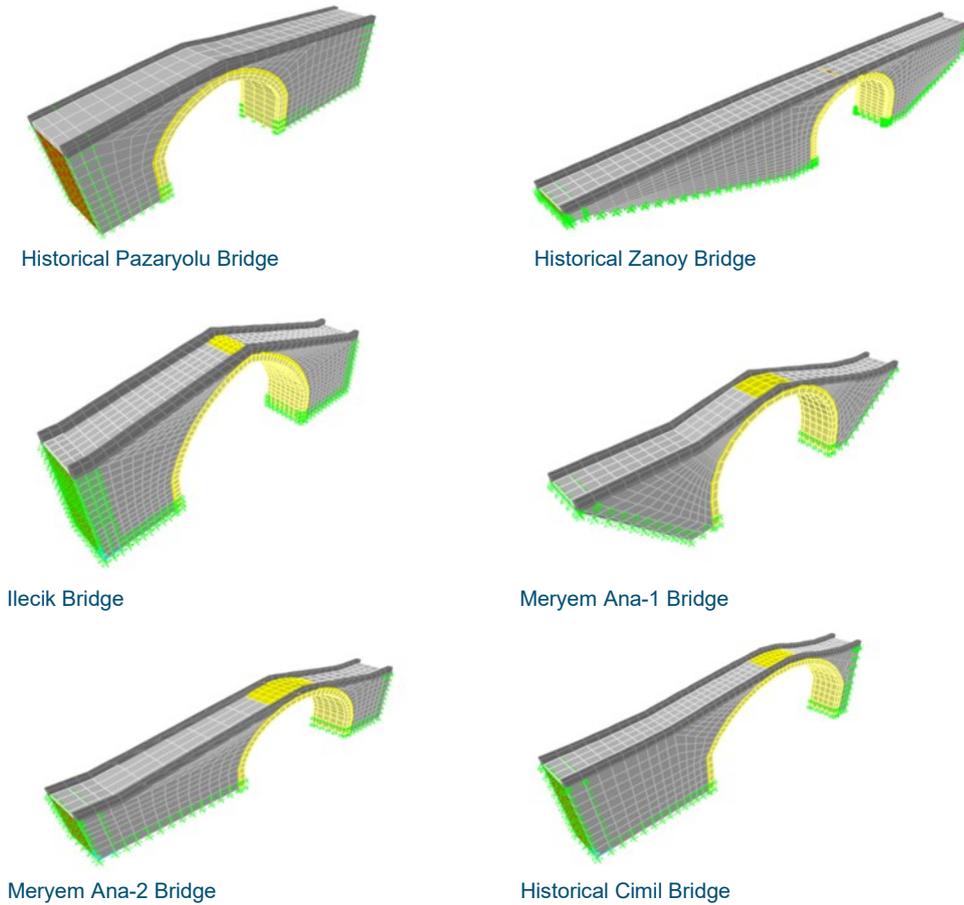


Fig. 1. Pictures belong to three-dimensional analytical model generated in SAP2000

**Results and discussion**

**Assessment of Natural Frequencies**

The natural frequency as a result of modal analysis of bridges were evaluated together with parameters such as natural frequencies, bridge width, arch height, bridge height, arch clearance and bridge length. Depending on these parameters, the first three natural frequencies of the bridges are given in Table 2. (Çoruhlu, 2017).

Table 2. Change of the first three natural frequencies depending on bridge dimension parameters

Bridge Name	Bridge width b (m)	Arch height h (m)	Bridge height H (m)	Arch clearance l (m)	Bridge length L (m)	1.Frequency (Hz)	2.Frequency (Hz)	3.Frequency (Hz)
Historical Pazaryolu Bridge	3.23	6.77	8.13	8.28	21.67	13.07467	23.01439	24.13224
Historical Zanoý Bridge	4.30	9.41	11.08	10.72	48.00	10.17928	15.81022	23.35760
Ilıcık Bridge	3.75	8.51	9.62	12.50	25.03	12.39091	23.17745	23.34432
Meryem Ana-1 Bridge	3.65	9.27	10.44	13.18	31.57	11.05053	19.81622	20.13195
Meryem Ana-2 Bridge	3.72	7.60	8.78	12.36	29.58	12.91953	22.55156	23.20552
Historical Akköy Bridge	3.06	5.46	6.50	8.51	16.37	20.67310	33.39057	34.08907
Historical Cimil Bridge	3.40	9.90	11.14	17.83	30.79	8.79505	15.73848	16.00709
Historical Demirkapı Bridge	3.58	8.36	9.64	12.00	30.26	10.34493	18.88840	23.25221
Diktas Bridge	3.10	9.01	10.16	13.52	28.08	10.14807	17.50696	18.43998
Historical Gültepe Bridge	3.85	8.06	9.46	15.36	27.03	11.47453	18.26905	21.81379
Historical Dibekli Bridge	4.37	7.85	8.98	12.98	28.27	15.37969	22.62546	24.10168
Historical Kamberli Bridge	4.02	8.07	9.28	12.32	23.35	13.83650	23.40694	24.97453
Historical Krom Bridge	3.08	5.28	6.54	7.08	16.84	22.15454	38.69001	39.59320
Historical Yağlıdere Bridge	4.09	8.98	10.51	15.36	29.88	10.52369	18.20260	19.53350
Historical Uğurtası (Bağava) Bridge	4.05	11.29	13.05	13.66	31.54	10.76393	20.75202	20.75275
Historical Kırıklı Bridge	6.08	5.64	7.15	9.97	23.37	21.81562	25.83915	34.89274

Historical Olucak Bridge	3.64	6.00	7.20	10.10	27.70	16.27551	26.77636	28.49379
Ortaköy Bridge	2.78	10.60	11.72	19.98	31.53	6.73018	12.59768	13.08990
Historical Senyuva Bridge	2.84	15.29	16.68	25.56	54.46	3.46837	6.26231	9.73259
Historical Yesilköy Bridge	2.47	7.41	8.49	13.08	21.92	12.46704	21.81447	23.70606
Historical Veliköy Bridge	2.50	6.65	7.68	11.60	19.34	13.50685	24.60962	25.12211
Historical Cami Mahallesi Bridge	2.55	4.45	5.17	7.74	13.53	23.53118	37.47502	40.36751
Historical Camlitepe Bridge	2.65	5.77	6.45	13.16	19.63	15.93477	19.42944	28.06590
Historical Erenköy Bridge	2.16	3.90	4.59	5.54	12.57	30.31503	49.72049	51.54524
Historical Halilli Bridge	2.77	4.99	6.12	8.18	18.53	20.60083	34.35091	38.79905
Historical Hayrat Bridge	4.06	5.22	6.76	9.46	19.89	20.97396	30.60075	38.20747
Historical Tasgeçit Bridge	2.3	4.37	5.52	6.12	13.51	25.85422	41.09309	52.30323
Tohumoğlu Bridge	5.21	10.36-9.10	11.59	18.76-16.78	64.72	7.989565	10.46817	12.38661
Historical Torul Bridge	6.00	6.45-6.45-6.49	8.88	10.44-12.40-12.12	65.31	10.65324	13.09035	15.68244
Koca bridge	3.03	7.19-10.72-8.55-8.60	12.10	10.4-19.00-11.54-5.58	68.77	4.19555	6.14759	8.32938

When the natural frequencies obtained from the modal analysis of the selected bridges are examined, it is determined that the first frequency changes in the range of 3.5-30Hz, the second frequency changes in the range of 6.2-50Hz and the third frequency changes in the range of 10-52Hz. When the relationship between the natural frequencies obtained from the modal analysis and the bridge dimensions was evaluated, it has been found that the natural frequencies were changed depending on the bridge dimensions. For the parameters except for the bridge width, it was determined that the natural frequency decreases as the value of the parameter increases, so these parameters are inversely proportional to the natural frequencies. Utilizing an excel program, an empirical formula has been obtained in order to identify the first natural frequency depending on the bridge dimensions. The formula had been obtained as follows linearly related to the arch height (h), the bridge height (H), the arch width (l) and the bridge length (L). The R2 value for this formula had 0.86 (Çoruhlu, 2017).

$$f_1 = 35.28938 - 2.23815 * h + 0.969321 * H - 0.52579 * l - 0.23352 * L \quad (2)$$

Formulas for estimating the second and third frequencies of the bridge can be formed as well as formulas based on the first frequency. In the literature investigations, it was generally determined that the second and third natural frequencies are related to the first natural frequency. When natural frequencies obtained as a result of modal analysis are examined for this purpose, the second natural frequency of the bridges is approximately 1.66 times of the first frequency; and the third natural frequency is about 1.83 times of the first frequency.

In order to check the accuracy of the frequency formula, İlecik and Kamberli bridges, which are not included in the determination of the formula, are considered and the error rates are determined by substituting the parameter values of these bridges in the formulas. The error rates for İlecik and Kamberli bridges are shown in Table 3-4.

Table 3. Determination of the frequency of İlecik Bridge by the proposed formulas and error rates

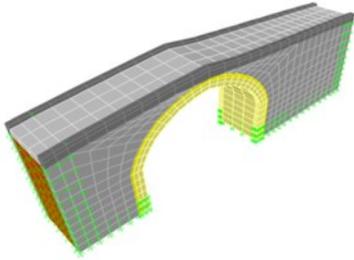
Natural frequencies	Recommended formulation	Analytical	Error rate (%)
$f_1$	13.150211 Hz	12.39091 Hz	6.13
$f_2$	21.82935 Hz	23.17745 Hz	5.82
$f_3$	24.06489 Hz	23.34432 Hz	3.09

Table 4. Determination of the frequency of Kamberli Bridge by the proposed formulas and error rates

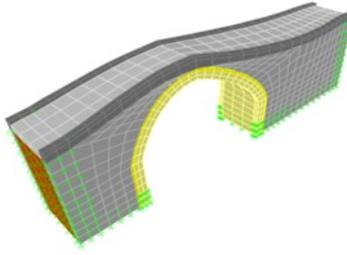
Natural frequencies	Recommended formulation	Analytical	Error rate (%)
$f_1$	14.2934 Hz	13.8365 Hz	3.3
$f_2$	23.72704 Hz	22.40694 Hz	5.89
$f_3$	26.15692 Hz	24.97453 Hz	4.73

### Evaluation of Mode Shapes

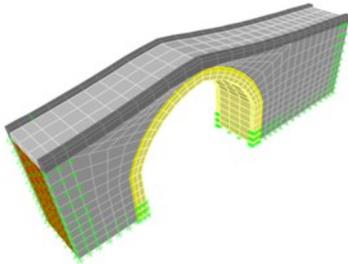
The mode shapes of the bridges were evaluated with parameters such as bridge width, arch height, bridge height, arch clearance and bridge length. Mode shapes of selected two bridges are given in Figs. 2-3. Depending on these parameters, the first three modes of bridges are given in Table 5 (Çoruhlu, 2017).



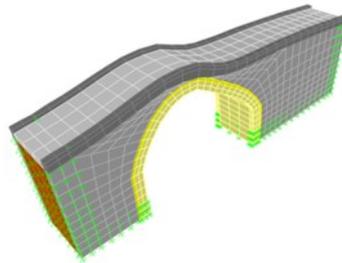
First mode (Lateral movement)  $f_1=13.07467\text{Hz}$



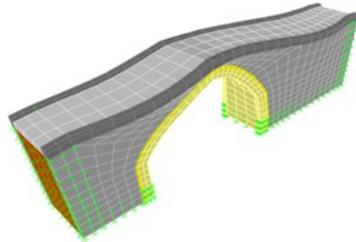
Second mode (Torsional movement)  $f_2=23.01439\text{Hz}$



Third mode (Arch vertical movement)  $f_3=24.13224\text{Hz}$

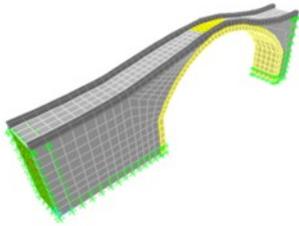


Fourth mode (Longitudinal movement)  $f_4=26.61921\text{Hz}$

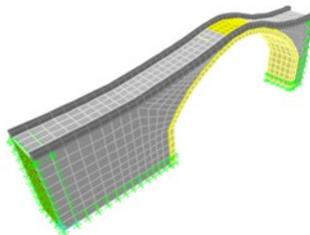


Fifth mode (Lateral torsional movement)  $f_5=34.22926\text{Hz}$

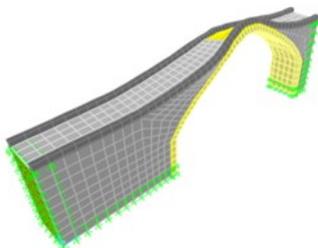
Fig. 2. The first five modes of the Historical Pazaryolu Bridge attained from the analytical model



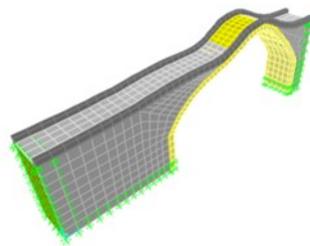
First mode (Lateral movement)  $f_1=8.79505\text{Hz}$



Second mode (Arch vertical movement)  $f_2=15.73848\text{Hz}$



Third mode (Lateral torsional movement)  $f_3=16.00709\text{Hz}$



Fourth mode (Longitudinal movement)  $f_4=16.26617\text{Hz}$

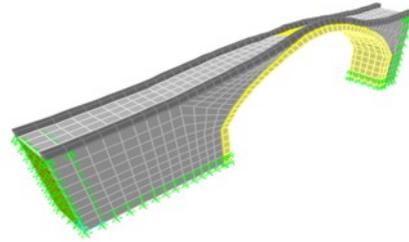
Fifth mode (Arch torsion movement)  $f_5=23.98462\text{Hz}$ 

Fig. 3. The first five modes of the Historical Cimil Bridge attained from the analytical model

Table 4. Variation of the first three modes of the bridges

Bridge Name	1 <sup>st</sup> mode shape	2 <sup>nd</sup> mode shape	3 <sup>rd</sup> mode shape
Historical Pazaryolu Bridge	Lateral	Torsion	Arch vertical
Historical Zanoý Bridge	Lateral	Torsion	Lateral torsion
Ilecik Bridge	Lateral	Longitudinally	Torsion
Meryem Ana-1 Bridge	Lateral	Longitudinally	Torsion
Meryem Ana-2 Bridge	Lateral	Longitudinally	Torsion
Historical Akköy Bridge	Lateral	Arch vertical	Arch torsion
Historical Cimil Bridge	Lateral	Torsion	Arch vertical
Historical Demirkapı Bridge	Lateral	Arch vertical	Torsion
Diktaş Bridge	Lateral	Arch vertical	Longitudinally
Historical Gültepe Bridge	Lateral	Arch vertical	Longitudinally
Historical Dibekli Bridge	Lateral	Arch vertical	Longitudinally
Historical Kamberli Bridge	Lateral	Arch vertical	Torsion
Historical Krom Bridge	Lateral	Arch vertical	Torsion
Historical Yaglidere Bridge	Lateral	Arch vertical	Arch torsion
Historical Ugurtası (Bağava) Bridge	Lateral	Longitudinally	Arch vertical
Historical Kırıklı Bridge	Lateral	Longitudinally	Arch torsion
Historical Olucak Bridge	Lateral	Torsion	Longitudinally
Ortaköy Bridge	Lateral	Arch vertical	Torsion
Historical Senyuva Bridge	Lateral	Arch vertical	Longitudinally
Historical Yesilköy Bridge	Lateral	Arch vertical	Longitudinally
Historical Veliköy Bridge	Lateral	Arch vertical	Longitudinally
Historical Cami Mahallesi Bridge	Lateral	Longitudinally	Arch vertical
Historical Camlitepe Bridge	Lateral	Arch vertical	Torsion
Historical Erenköy Bridge	Lateral	Arch vertical	Torsion
Historical Halilli Bridge	Lateral	Arch vertical	Torsion
Historical Hayrat Bridge	Lateral	Arch vertical	Longitudinally
Historical Tasgecit Bridge	Lateral	Longitudinally	Torsion
Tohumođlu Bridge	Lateral	Torsion	Longitudinally
Historical Torul Bridge	Lateral	Torsion	Lateral torsion
Koca Bridge	Lateral	Torsion	Lateral torsion

The modal analysis results showed that the first three modes were not significantly affected by parameters such as bridge width, arch height, bridge height, arch clearance and bridge length. The first mode shapes of all bridges were determined as lateral movement. Second mode shape was generally determined as vertical movement, except for the bridges having two or more arch clearances. The second mode shapes of the bridges having two or more clearances were determined as torsional motion, and finally the third mode shapes of the bridges are predominantly torsional.

### Conclusions

In this study, it is aimed to determine the theoretical dynamic characteristics of historical stone arch bridges using the Finite Element Method and to develop empirical formulas for the calculation of natural frequencies. As an application, thirty historical stone arch bridges with different geometrical features were chosen in the Eastern Karadeniz Region of Turkey. Three-dimensional finite element models were formed by using SAP2000 program of the selected historical stone arch bridges. Modal analyses are performed on the generated analytical models, and the mode shapes and natural vibration frequencies are obtained. Multiple Regression Method was used in the determining of empirical formulas. The results obtained from this study are given below:

- From the natural frequencies obtained from the modal analysis of the selected 30 bridges, it has been determined that the first frequency changes in the range of 3.5-30Hz, the second frequency changes in the range of

6.2-50Hz and the third frequency changes in the range of 10-52Hz. In order to determine the first natural frequency by using the Excel program depending on the bridge geometrical features ,

$$f_1 = 35.28938 - 2.23815 * h + 0.969321 * H - 0.52579 * l - 0.23352 * L$$

formula was obtained. The R2 value for this formula is 0.86.

- The second natural frequency of these bridges is approximately 1.66 times of the first frequency; and the third natural frequency is about 1.83 times of the first frequency.
- In order to check the accuracy of the frequency formula, Ilıcık and Kamberli bridges, which are not included in the determination of the formula, are considered and the error rates are determined as in the range of 3.09-6.13%.
- The first mode shapes of all bridges were determined as lateral movement, and the second mode shape was generally determined as vertical movement, except for the bridges having two or more arch clearances. The second mode shapes of the bridges having two or more clearances were determined as torsional motion, and finally the third mode shapes of the bridges are predominantly torsional.

In all these data lights, it is considered that the proposed empirical formulation for the frequency calculation of masonry arch bridges can be a reference for researches in this area.

### Acknowledgement

Due to the contributions made for the work to be carried out, we would like to thank the General Directorate of Highways Directorate of Historic Bridges that lent their aid in providing the bridge project data.

### References

- Beconcini ML, Buratti G, Croce P, Mengozzi M and Orsini P (2007) "Dynamic Characterization of a Five Spans Historical Masonry Arch Bridge", ARCH'07– 5th International Conference on Arch Bridges, 399-407.
- Birinci F (2010) Improvement of Finite Element Models of Taş Kemer Bridges by Operational Modal Analysis Method, M.Sc. Thesis, K.T.U, Institute of Natural and Applied Sciences, Trabzon.
- Chopra AK (2015) Structural Dynamic Theory and Earthquake Engineering Applications, Hilmi Lus, 4th Edition, Palme Publishing, Ankara.
- Coruhlu B (2017) Formulations for Natural Frequencies, Displacement and Stresses of Single Span Arch Bridge in East Blacksea Region, M.Sc. Thesis, K.T.U, Institute of Natural and Applied Sciences, Trabzon.
- Ercan E ve Nuhoglu A (2015) Determination of the Structural Behavior of the Three Spanned Historic Mooring Bridges, 3rd Bridges Viaducts Symposium, May, Bursa, Book of Proclamations, 92-105.
- Korkmaz KA, Zabin P, Carhoglu AI ve Nuhoglu A (2013) "Assessment of Earthquake Behavior of Stone Kemer Bridges: The Example of Timisvat Bridge", Journal of Advanced Technology Sciences, 2, 1, 66-75.
- Ozdamar K (2003) Biostatistics with SPSS, Nisan Bookstore, Eskisehir.
- Ozer SS (2006) Analysis of Structural Elements in Traditional Masonry Structures, M.Sc. Thesis, Institute of Natural and Applied Sciences, Erciyes University, Kayseri.
- SAP2000 (2008) Integrated Finite Element Analysis and Design of Structures, Computers and Structures Inc, Berkeley, California, USA.
- Türker T, Bayraktar A, Kocaman I ve Coruhlu B (2015) Experimental and Analytical Investigation of Dynamic Behavior of Scale Masonry Stone Belt Bridge Model, 5. Strengthening Historical Works and Safely Transferring the Future Symposium, October, Erzurum, Book of Proceedings, 113-126.
- Ural A, Oruc S, Dogangun A ve Tuluk ÖI (2008) "Turkish Historical Arch Bridges and Their Deteriorations and Failures", *Engineering Failure Analysis*, 15, 43-53.

## Conservation of Hagia Sophia in Instabul

Zeynep AHUNBAY

Professor emeritus of Architectural Conservation, Istanbul Technical University, Turkey

### ABSTRACT

*Hagia Sophia in Istanbul is a sixth century monument of universal significance. Originally a church, it was transformed into a mosque in the fifteenth century and a museum in 1935. Its exquisite interior, decorated with colorful marbles and mosaics, is impressive. In addition to ravages of time, the increased number of visitors and earthquake risk require careful maintenance and monitoring of this grand structure. Turkish Ministry of Culture and Tourism is responsible for the management of the monument. Since 1993, a scientific committee acts as an advisory body to guide the conservation activity. In this article, conservation efforts aiming to preserve the authenticity and the integrity of this significant monument are presented.*

*The seismic responses of the monument are being monitored. Non-destructive investigations have been carried on*

the main piers and the dome in order to assess the earthquake safety of the structure. Conservation projects are developed and implemented to safeguard the masonry structure and the decorative surfaces. The dome mosaics have been cleaned and conserved between the years 1992-1999 with technical support from UNESCO. Within the framework defined by the Advisory Committee, the roof covering was renewed, using 3 mm thick lead sheets. The cement plaster on the interior and exterior surfaces are being removed and replaced by traditional plaster mixes. During the recent years, the restoration of the west façade has been completed. Projects are underway for the restoration of the other façades. Inside the monument, the cement plaster on the western half of the north tympanum wall has been removed, revealing interesting details related to the damages and repairs conducted to the main arch.

**Keywords:** Hagia Sophia, World Heritage, conservation, restoration

### History of the monument

Hagia Sophia in Istanbul is an important monument in the history of world architecture (Fig 1). The present one is the third church erected over the ruins of the previous ones. The first, dated 360, was destroyed by a revolt in 404. The second one, raised by Emperor Theodosius II (Müller-Wiener 1977) suffered from a fire in 532, during the Nike revolt. The present Hagia Sophia was constructed by the order of Emperor Justinian between the years 532-537. Two architects- Anthemius of Tralles and Isidore of Miletus were engaged in the project, designing a new type of church, called "the domed basilica". Hagia Sophia is famous for its impressive interior, reflecting the grandeur of the Eastern Roman Empire. The dome, which rested on four gigantic piers, was quite shallow. The curvature of the pendentives continued to form a saucer dome with a 31 m span. To cover the rectangular plan of the church, the main dome was abutted to the east and west by lower semi-domes. For the construction of the walls, brick masonry reinforced with green stone bands was used. The mortar was composed of slaked lime and crushed brick. The interior was decorated with colored stones brought from North Africa, Greece, Syria and western Anatolia. Mosaics with gold and silver covered the vaults and domes, creating a magnificent space, very impressive with its size, form and fine workmanship.



**Fig.1** General view of Hagia Sophia from the northeast, with St Eirene on the right

Due to the slow setting of the lime based mortar used in construction, deformations occurred when the thrusts from the arches and the upper structure were transferred to the vertical supports. The main dome was seriously damaged in the earthquakes of 553 and 557. Emperor Justinian was still in power and called for the reconstruction of the dome. The architect, Isidore the Younger, modified the original design by building a higher dome (Mainstone 1988).

The earthquakes in the 10<sup>th</sup> and the 14<sup>th</sup> centuries caused further damages to Hagia Sophia. In the 10<sup>th</sup> century, the western semidome and part of the main dome collapsed. In the 14<sup>th</sup> century the eastern semidome gave way. The damages to the semidomes were not local but extended as far as the neighboring pendentives, main arches and the dome (Duppel 2010). As a result of the collapses and reconstructions in the 10<sup>th</sup> and 14<sup>th</sup> centuries, the present dome of Hagia Sophia consists of four sections. The two segments on the south and north are from the 6<sup>th</sup> century; the western segment is from the 10<sup>th</sup> and the eastern one is from the 14<sup>th</sup> century. In addition to the reconstruction work carried out in the upper level of the structure, architects tried to support the outward leaning walls and piers by enlarging the extant buttressing system or adding new ones.



**Fig.2** Interior of Hagia Sophia, looking towards the apse

Following the Ottoman takeover of Constantinople in 1453, Hagia Sophia was converted into a mosque (Fig 2). Sultan Mehmet II established an endowment, the income of which was to be used for the maintenance of Hagia Sophia. In the 16<sup>th</sup> century, there were repairs to the structure; the outward leaning walls were stabilized by buttresses (Necipoglu 2005). Maintenance and repair works continued in the 17<sup>th</sup> and 18<sup>th</sup> centuries. Upon the invitation of Sultan Abdulmecit, architects Gaspare and Giuseppe Fossati from Switzerland restored Hagia Sophia between 1847-1858 (Schlüter 1999, Doğan 2011).

Documentation by Fossati brothers before and after the restoration provide evidence about the extent of interventions in the 19<sup>th</sup> century (Fossati 1980). Gaspare Fossati conducted research in the interior of the monument and documented the mosaics he found under the plastered surfaces. During the work on the dome, the lacunae created by the losses of tesserae were plastered and gilded. Upon this base, stencil was applied to give a texture similar to mosaic finish.

Fossatis' restoration entailed structural interventions as well. The strengthening of the outward leaning columns of the gallery was a major intervention. An important intervention which affected the external appearance of Hagia Sophia is the removal of the flying buttresses which connected the main buttresses to the drum of the main dome. An iron belt was inserted at the top of the prismatic base of the dome. This reinforcement was hidden behind the cornice of the dome base, became visible during the recent restoration work conducted on

the eastern and western façades of Hagia Sophia (Fig 3).



**Fig.3 Fossati ring at the base of the dome**

Fossatis also added some architectural elements to the interior and exterior of the monument. The imperial loggia, timber sofas and the chandeliers in the interior are from their restoration. The exterior of the monument was painted in red and yellow stripes.

On 10 July 1894 Istanbul was shaken by an earthquake which caused some damages to the Hagia Sophia. An expert commission inspected the monument and proposed interventions (Batur and G. Tanyeli 1993). In a sketch attached to the damage assessment report after the 1894 earthquake, two radial cracks emanate from two of the windows at the base of the western semidome; there is a deep crack in the northwest pendentive. At the dome level, there are cracks above windows and in some of the ribs. Italian architect R. D'Aronco, who was in the service of the sultan prepared a report in which he drew attention to the condition of the main piers and the western semidome. Accord-

ing to him, the 1894 earthquake had not caused a lot of damage but had opened earlier scars. He proposed an examination of the foundations in order to see the reason for subsidence (Batur and Tanyeli 1993). In D'Aronco's report, there is also reference to extensive cracking in the interior and exterior renders.

Large areas of the inner surface of the dome had to be plastered during the subsequent repairs which are dated to 1910 and later (Avşar and Özil 2010). They were conducted by the Waqf administration (General Directorate of Pious Foundations), responsible for the upkeep of the monument. The conservators working on the dome mosaics in 1990's distinguished the areas from this restoration with its stencil decoration, having squares double the size of Fossati's (Özil 2001).

During the early years of the Turkish Republic, Hagia Sophia became a museum, a monument open to all mankind for research and enjoyment. After this conversion, excavations conducted by A.M. Schneider from the German Archaeological Institute in the atrium of the church revealed the in-situ preserved remains of the stylobate of the portico and steps leading to the second Hagia Sophia (Müller-Wiener 1977). The richly decorated architrave blocks found in 1935 provided new information about the western façade of the earlier church. Another important project, carried out by the Byzantine Institute, Dumbarton Oaks, was the uncovering and conservation of the figural mosaics (Teteriatnikov 1998). Architect R.L. Van Nice worked over 30 years to develop a full survey of the monument with plans, cross sections and elevations (Van Nice 1965 and 1986).

### The protection of Hagia Sophia's universal values

Hagia Sophia has dominated the skyline of the city since it was built in the 6<sup>th</sup> century (Fig 1). Its visual impact is undisturbed, thanks to planning regulations which limit building heights in the historic center of Istanbul. Surveys have been conducted to record the architectural features. The Turkish Ministry of Culture and Tourism is responsible for the protection of the monument which is a museum today. Three directorates attached to the Ministry of Culture and Tourism care for the management and protection of Hagia Sophia. The first is responsible for the operation of the monument as a museum. The second, the Directorate for Surveying and Monuments, is responsible for the development and supervision of conservation works related to Hagia Sophia. This directorate contracts firms to develop and implement projects. The third directorate, the Central Laboratory for Restoration and Conservation, is responsible for advising on proper conservation treatments. Established in 1984, the Laboratory has a large team specialized in conservation of cultural heritage. They conduct the analyses for materials, examine surfaces and give instructions for the conservation of traditional materials (brick, stone, wood, metals), wall paintings and mosaics. Some of the conservators from the Laboratory have worked on the conservation of the dome mosaics of Hagia Sophia (Özil 2001) and they contribute to the projects underway.

In 1985 Hagia Sophia was enlisted as a World Heritage. An Advisory Committee, established in 1993 by the Turkish Ministry of Culture and Tourism, supports the projects developed for the structural safety and conservation of the monument (Ahunbay M and Z 2003). At the invitation of the Turkish authorities, a mission comprising high-level experts like Professor R. Lemaire, Professor C. Mango, Professor T.P. Tassios and Dr. R. Mainstone was organized by UNESCO in 1993. The experts made recommendations on ways to ensure Hagia Sophia's continued safeguarding. Their report concluded that *"there is no evidence of immediate risk to the structure but there should be a full appraisal of what is now known about it, followed by further investigations and monitoring to serve as a basis for considering possible strengthening measures and realistically analyzing their effects on the response to possible future earthquakes"* (Mainstone 1996).

As one of the great architectural achievements of the sixth century, Hagia Sophia attracts the attention of scholars all over the world. Researches have been conducted to answer the questions related to its structure and extraordinary design (Kuniholm and Striker 1985, Mainstone 1988, Mark and Çakmak 1992, Hidaka 2001). In the recent years, the structure has been studied in detail ( Erdik and Croci 2010, Wenzel and Duppel 2010).

### Threats to the fabric and the structure

Natural and human factors affect Hagia Sophia's delicate surfaces and structure. Earthquake risks, decay of materials, rising damp, condensation, the movement of visitors are some of the problems which need to be addressed carefully. The roof is open to the elements. Strong winds remove lead covering; birds cause a lot of damage. Due

to action of rain and frost, the materials on the façades erode. In addition to cracks and surface losses, there are deformations. The control of the climate inside the monument is important for reducing the damages to the materials and the decorative surfaces.

Hagia Sophia Museum is open to visitors six days of the week. The number of visitors sometimes rise to 14 000 visitors/day. Precautions are taken for the safety of the museum premises and the visitors. The expert staff of the museum tries hard to take care of the emerging problems.

### Researches for the protection of Hagia Sophia

The protection of Hagia Sophia, the conservation of its authenticity and integrity are carried out with contribution of experts from different disciplines – archaeology, art history, conservation, structural engineering and material science. The researches and projects for the conservation and earthquake protection of the monument can be grouped under four headings:

1. Researches related to the safety of the structural system
2. The conservation and presentation of the interior surfaces
3. The conservation and presentation of the façades
4. The protection of the roof

#### 1. Researches related to the safety of the structural system

In order to propose some measures to improve the structural behaviour of a monument more than 1500 years old, it is necessary to have a good knowledge of its history, materials, construction techniques and repairs. The structure has been sustained by different interventions during its long history. Unfortunately, not all of them were recorded in detail. It is important to have reliable data about the condition of the structure in order to plan proper treatments and guarantee its safety.

Before the introduction of nondestructive research techniques, it was not easy to acquire information about the walls and other structural elements which are covered by plaster, mosaic or marble facing. We are grateful to scholars, structural engineers who have devoted time to conduct detailed researches about the materials and structure of Hagia Sophia, so that more information is compiled which contributes to the better understanding of the monument and its earthquake performance.

R. Mainstone worked with R. Van Nice and W. Emerson during the years 1964-1969 and examined the complex structural history of the structure. His book, *Hagia Sophia, Architecture, Structure and Liturgy of Justinian's Great Church* (Mainstone 1988), provides detailed information about the original design of the structure and the interventions it has gone through over the centuries.

In late 1980's, Prof. Ahmet Çakmak from Princeton University initiated a joint program with Bosphorus University and The Turkish Ministry of Culture and Tourism, in order to study the structure of Hagia Sophia and monitor its behaviour during earthquakes. Thus it has been possible to have a better understanding of the earthquake performance of the monument (Mark and Çakmak 1992). The monitoring system installed in 1992 has enabled the recording of earthquakes and computer models have been developed using the data (Durukal et al 2000).

Due to the significance of Hagia Sophia, the Turkish Ministry of Culture considered it an important task to make an assessment of the safety of Hagia Sophia's structure and take the necessary measures. Thus structural assessments pointing at the weak points of the structure were made as early as 1992 (Erdik and Çaktı 1992). The proposal was to connect the eastern semidome with the main arch in that direction, using iron bars (Erdik and Croci 2010).



**Fig.4 The dome with deformed ribs**

Although there was no significant damage to Hagia Sophia due to the 1999 Izmit Earthquake, experts warned about an earthquake of 7.4 magnitudes in 30 years. So the question arose whether technical reinforcement to Hagia Sophia's structure was essential. In order to refrain from unnecessary interventions, the Turkish Ministry of Culture invited experts to discuss the structural safety of Hagia Sophia in Istanbul. Prof. G. Croci from Rome University and Prof. F. Wenzel from Karlsruhe University were invited to review the prospects of intervention for the Hagia Sophia's structure.

Prof. G. Croci proposed detailed investigations into the structure; examination of the main piers and the dome by endoscopy and radar. He pointed out to the deformations and irregularities in the dome ribs (Fig 4). Prof. F. Wenzel proposed detailed examination of the structure using nondestructive techniques. After this meeting, Prof. Wenzel started a research for the detailed survey of the main piers and the dome, with support from the German Research Community (DFG). The scaffolding which had been put up by the Ministry of Culture for the conservation of the dome mosaics was helpful in enabling the research team to establish direct contact with the interior surface of the dome and reach the top, which is at 55 m.

As a result of the extensive research conducted by Prof. Wenzel and his team between 2004-2007, it has been possible to get precise information about the construction technique of the main piers and the thickness and condition of the 6<sup>th</sup>, 10<sup>th</sup> and the 14<sup>th</sup> century sections of the main dome (Wenzel and Duppel 2010). This research which included the results of the radar and micro-

seismic investigations at the dome and main piers was developed into a doctoral thesis by Prof. Wenzel's research assistant C. Duppel (Duppel 2010). As a conclusion derived from the research, Prof. Wenzel deferred the proposed intervention to connect the eastern arch with the semidome in the same direction. Relying on his experience in studying historic buildings in earthquake prone areas, he expressed his opinion as: "*the resilience of old buildings decreases the earthquake load and increases the resistance of the building fabric*" (Wenzel and Duppel 2010). Since there was no serious damage to Hagia Sophia's structure since the 14<sup>th</sup> century, he underlined the danger of local stiffening and reinforcements.

At the moment the seismic responses to the monument are being monitored by the Bosphorus University continues. The equipment has been renewed in 2008. The ongoing conservation projects unveil interesting details which were not known before. The removal of cement plaster from the north main arch revealed a crack which had been stitched by an iron bar. It is expected to discover several other interesting details during the continuation of the work.

## 2. The conservation and presentation of the interior surfaces

Within the interior of Hagia Sophia, there are marble, mosaic, wood, metal, glass surfaces. Mosaic surfaces contribute significantly to the beauty and appreciation of the monument. Especially the figural mosaics on the walls and on the vaulting are significant with their unique designs. The gold and silver plated tesserae contribute to the visual appreciation of the dome and the interior in general. Due to the height of the dome, it is difficult to maintain the mosaics at the extremities of the structure. Between 1992-2000 the Central Laboratory of Conservation and Restoration (Istanbul) of the Ministry of Culture and Tourism carried out conservation work at the northeastern and northwestern quarters of the dome, cleaning, stabilizing and conserving the mosaic surfaces in collaboration with experts supported by UNESCO World Heritage Center (Özil 2001, Avşar and Özil 2010). Cleaning targeted at the removal of surface deposits like efflorescence and soot and re-establishing the original surface structure. According to the survey, 50% of the original mosaic surface was preserved (Avşar and Özil 2010). Fossati repairs covered 15 % of the dome's inner surface. At the apex of the dome, there is a ring decorated with 19<sup>th</sup> century calligraphy. It was cleaned and conserved; no mosaic remains or tesserae were found under the calligraphy.

The original floor paving, mainly consisting of large Proconnesian marble slabs, with characteristic veins, were arranged in symmetrical order to create a special wave effect. Unfortunately this very impressive composition has not been preserved in its totality (Fig 5). During repairs conducted in the 19<sup>th</sup> and 20<sup>th</sup> centuries, the damaged or missing parts of the floor were covered by smaller sized or re-used slabs of different colors and sizes. Recently, projects have been developed to improve the marble floors of the ground and gallery levels.

Porphyry, serpentine, alabaster and Proconnesian, lasos, Dokimienium (*pavonazzetto*) marbles were used to decorate the walls (Yalçın 2014).

The marble facing covering the piers and walls also suffered from the earthquakes and ravages of time, cracking or falling down. During the Fossati restoration, the missing marble plates on the ground and gallery level walls were replaced by *stucco lustro*, imitating the colors and patterns of original marble facing (Schlüter 2000). The surviving stucco decoration are being cleaned and conserved. Those which have been lost were replaced during the 20<sup>th</sup> century interventions conducted by the Ministry of Culture and Tourism (Koyunlu 1990). At present, the cleaning and conservation of the marble surfaces is supervised by conservators from the Central Laboratory of Conservation and Restoration.



Fig.5 Marble floor of Hagia Sophia

## 3. The conservation and presentation of the façades



Fig.6 Marble facing from the west façade

The maintenance and presentation of the façades is important as they contribute to the image and perception of Hagia Sophia. On old engravings and Fossati drawings, the façades have large arched openings filled with marble framed windows but the rest is plastered. Today, indications suggesting marble cladding on the exterior of Hagia Sophia are preserved only on the west façade. The west façade is exposed to the sun which is quite strong in summer. Some of the in-situ preserved marble plates are distorted and cracked (Fig 6). Due to their documentary value, it is important to preserve the surviving pieces in situ.

During the repairs to the façades of Hagia Sophia in 1950's, the exterior was coated with a cement plaster mix. The stripes from the Fossati restoration were not repeated (Tamer 2003); the façades were painted yellow. After thirty years, the façades were painted again, this time using red (Koyunlu 1990). In a few years, the red paint was washed away by rain and exposed the cement plaster (Fig. 7).

In 1993, the Advisory Committee for Hagia Sophia made a decision to remove the cement renders on the exterior and interior of the monument. The work which started at the southwest corner of Hagia Sophia required utmost care, in order not to damage the original brick surface



**Fig.7 Weathered red paint applied on the façades in 1986**

while removing the hard, sticky cement mortar. The hard work resulted in pleasing results. The façade had interesting marks of a collapsed vault belonging to the Patriarchate. The brickwork was interesting as part of the history of the monument. Thus it was proposed to leave the brick masonry exposed. The proposal was accepted by the Monument Council. However, for the other façades, the decision was to cover the masonry with plaster again, although there were also interesting features to expose. On the eastern façade, the removal of the plaster revealed details related to the 14<sup>th</sup> century reconstruction (M Ahunbay 2010). It would have been interesting to expose the evidence on the fabric but the erosion at the southeast corner was considerable. The eastern façade of Hagia Sophia is open to salty winds coming from the sea. In order to protect the structure better, it was decided to cover the eastern façade with a plaster coating. The joints marking the sections from the 6<sup>th</sup>

and the 14<sup>th</sup> century masonry were indicated on the rendering. The stucco used for rendering is a mix consisting of lime and crushed brick; the brick powder in the mortar gives the stucco its pink color.

In Hagia Sophia, the recording of the façades is carried out with 1/25 scaled drawings which makes it possible to note fine details. Photographic documentation continues through the survey and the implementation phases. For the surveys in the 1990's, a total station was used to record the main features and points to create grids. Architects working on the scaffolding took the coordinates of each brick and finalized the drawings working in close connection with the wall. Now the teams use 3D scanners and finalize the drawings by occasional close up examinations at the site.

The 1/25 scaled surveys are reduced to 1/50 scale and used for developing analytical charts about the materials, chronology and damage assessment. The proposals for conservation work are developed with 1/50 scaled drawings, indicating the areas to be cleaned and pointed, bricks to be repaired, or replaced. Prior to implementation of the projects, mortar samples are taken from different points on the façades and analyzed at the Central Laboratory of Conservation. The mixes for repairs are also developed at the same institution, with collaboration from universities (Güleç et al, 2000). Bricks measuring 38x 38 x 4.5-5 cm were used for the walls in the sixth century; for later repairs, bricks with different sizes were produced. Bricks for restoration work at Hagia Sophia are produced according to the sizes needed for the work, at traditional kilns, upon special order.

#### 4. The protection of the roof

Hagia Sophia measures roughly 75x 115 in plan. Its roof is composed of vaults, semi-domes and domes and it is covered with lead sheets. Lead provides a good external weathering surface but when there is a crack or a hole, water penetrates through, damaging the decorated surfaces on the interior surfaces. The mortar supporting the mosaics is very sensitive to humidity. It is important to maintain the roof and keep it watertight all the time. Windows at the base of the dome and the semi-domes also require constant care in order to prevent penetration of water in from the edges.

In early 1990's the roof of Hagia Sophia was not in a good state of conservation. As a result, mosaics and painted surfaces in the upper structure were suffering from humidity. The Advisory Committee proposed the use of 3 mm lead sheets for the roof cladding. The renewal of the dome sheets started in 1993. During the work at the roof, the window frames at the base of the dome were renewed as well. The old frames, inserted in the 20<sup>th</sup> century, were of concrete and had wired glass panes. They were replaced by marble frames, having 4 mm sanded glass panes. The environmental studies conducted inside Hagia Sophia revealed interesting facts (Güleç 1996). The hot air rises up to the dome level and is trapped there if there is no outlet. In order to control condensation phenomena, it was recommended to provide cross ventilation at the base of the main dome. Thus, two of the windows at the base of the dome were provided with louvers.

#### Conclusion

To conserve a significant structure like the Hagia Sophia requires a good management team and qualified personnel. In order to overcome the problems related to action of time and weathering, earthquake risk, rising damp and condensation, it is important to keep vigilance and maintain the structure properly.

We continue to learn from Hagia Sophia's structure about its history and performance. Researches on its structure continue and it is being monitored. We hope that international expertise continues to support the expansion of knowledge about the structural characteristics of Hagia Sophia and this important monument lives on with the loving care, dedicated research and service of its multidisciplinary expert staff.

#### References

- Ahunbay M and Z (2003) "Conservation of Hagia Sophia in Istanbul", *International Millenium Congress, More than Two Thousand Years in the History of Architecture, Safeguarding the Structures of Our Architectural Heritage*, Proceedings of the International Congress, UNESCO Paris, 77-83
- Ahunbay M (2010), "Ayasofya Kubbesinin Kasnak Doğu Cephesi", *Ayasofya Müzesi Yıllığı*, No.13, 79-100
- Avşar A O, Özil R (2010) "Ayasofya Müzesinde UNESCO İşbirliği ile Yapılan Restorasyonlar Hakkında", *Ayasofya Müzesi Yıllığı*, No.13, 193-201
- Batur A, Tanyeli G (1993) "1894 Depremi ve İstanbul'un Tarihi Yapılarındaki Hasar Üzerine Bir Örneklemeye Çalışması: Ayasofya", *2. Ulusal Deprem Mühendisliği Konferansı, 10-13 Mart 1993*, 253-258

- Doğan S (2011) *Ayasofya ve Fossati Kardeşler (1847-1858)*, Istanbul
- Duppel C (2010) *Ingenieurwissenschaftliche Untersuchungen an der Hauptkuppel und den Hauptfeilern der Hagia Sophia in Istanbul*, KIT Scientific Publishing, Karlsruhe
- Durukal E, Cimilli S, Erdik M (2000) "Dynamic Response of Hagia Sophia and Süleymaniye in Istanbul inferred from the recordings of 1999 Kocaeli and Düzce Earthquakes", *Compatible Materials. Recommendations for the Preservation of European Cultural Heritage PACT 59*, Atina,19-28
- Erdik M, Çaktı E (1992) Determination of Earthquake Risk and Restoration Work Strengthening Project of Hagia Sophia (Research Report in Turkish)
- Erdik M, Croci G (2010) "Earthquake Performance of Hagia Sophia: A Review of Investigations", *Ayasofya Müzesi Yıllığı*, No.13, 101-134
- Eyice S (1993) "Ayasofya", *İstanbul Ansiklopedisi*, Vol I, 446-457
- Fossati G (1980) *Die Hagia Sophia*, Die bibliophilen Taschenbücher
- Gökçe G (2010) "Kubbe Bezemeleri Koruma ve Onarım Uygulamaları", *Restorasyon Konservasyon Çalışmaları*, 4, Istanbul,48-79
- Güleç A, Ersen A, Baturayoğlu N (2000) "Characterization of some mortar samples from Hagia Sophia", *Compatible Materials. Recommendations for the Preservation of European Cultural Heritage PACT 59*, Atina, 177-188
- Güleç A (1996) "Ayasofya Müzesinde İklim Araştırması: Pilot Çalışma", *III. Müzecilik Semineri Bildiriler Kitabı*, İstanbul, 216-232
- Hidaka K (2001) "History and Construction of Hagia Sophia", *Hagia Sophia Surveying Project Conference March 20, 2001*, Tokyo,1-16
- Koyunlu A (1990) "Ayasofya Restorasyonu Genel Sorunları", *Yapı* 105, İstanbul, 47-54
- Kuniholm P I, Striker C L (1985), *Dendrochronological Investigations at Hagia Sophia in Istanbul: A Preliminary Report*, AML 10, 41-45
- Mainstone R.L. (1988) *Hagia Sophia, Architecture, Structure and Liturgy of Justinian's Great Church*, Thames and Hudson
- Mainstone R.L. (1996) *Present State of the Hagia Sophia Monument with Recommendations for its Preservation and Restoration*, UNESCO Paris
- Mark R, Çakmak A (1992) *Hagia Sophia from the Age of Justinian to the Present*, Cambridge U Press, New York
- Müller-Wiener W (1977) "Aya Sofya", *Bildlexikon zur Topographie Istanbul*, Verlag E Wasmuth Tübingen, 84-96
- Necipoğlu G (2005) *The Age of Sinan, Architectural Culture in the Ottoman Empire*, Princeton U Press
- Özil R (2001) "The Conservation of the Dome Mosaics of Hagia Sophia", *ICOMOS International Millenium Congress, More than Two Thousand Years in the History of Architecture, Safeguarding the Structures of Our Architectural Heritage*, Proceedings of the International Congress, UNESCO Paris, Vol II, Sessions 3 and 6, 77-82
- Schlüter S (1999) "Gaspare Fossatis Restaurierung der Hagia Sophia 1847-49", *Die Hagia Sophia in Istanbul. Bilder aus Sechs Jahrhunderten und Gaspare Fossatis Restaurierung der Jahre 1847-49*, Bern,139-148
- Tamer C (2003) *İstanbul Bizans Anıtları ve Onarımları*, İstanbul, 208-236
- Teteriatnikov N B (1998) *Mosaics of Hagia Sophia. Istanbul. The Fossati Restoration and the Work of the Byzantine Institute*, Dumbarton Oaks, Other Titles in Byzantine Studies
- Van Nice R L (1965 ve 1986) *St Sophia in Istanbul. An Architectural Survey*, Washington (1. ve 2. Bölüm)
- Wenzel F, Duppel C (2010) "Investigations into the Construction and Repair History of the Hagia Sophia", *Ayasofya Müzesi Yıllığı*, No.13,177-192
- Yalçın A B (2014) "Tarihi Kaynaklar Işığında Aya Sofya'nın Altıncı Yüzyıl Süslemesine Dair Bazı Notlar", *Ayasofya Müzesi Yıllığı*, 14, 94-127

## News from ECCE Members

### Austria

#### Promoting excellent diploma theses in Civil Engineering



Photo credit: Johannes Zinner

The Austrian Federal Chamber of Architects and Chartered Engineering Consultants has decided to promote scientific theses on topics that are related to several engineering branches - among them Civil Engineering – and that are relevant for the profession. The selected projects are supported with an amount of 2.500 Euro each. Additionally they are made available for the public in different forms. In order to receive entries the Chamber approaches all relevant Universities with the request to propose excellent theses in their field of action. The entries are then selected by the Federal expert groups within the Chamber. Especially remarkable are the often interdisciplinary approaches of the participating young engineers that proved to be inspiring also for experienced experts. The project was initiated for a first round in 2016; the selection of the winners of 2017 is currently ongoing.

<https://www.arching.at/aktuelles/forschungspreis.html>

## A common declaration on BIM

Together with the German Federal Chamber of Engineers and the German Federal Chamber of Architects the Austrian Federal Chamber of Architects and Chartered Engineering Consultants presented a common declaration on BIM at a BIM symposium in Linz on 20 March 2018. The declaration addresses procuring authorities and politics and shows the basic requirements that have to be fulfilled for the successful digitalisation of building projects. Main aspects are guaranteeing the maintenance of the SME structure in the planning branch by using an open BIM approach, strengthening the leading role of planners in the process and keeping to the well-functioning and time-tested planning structures in the area, especially the principle of separation of planning and execution. Currently the agreement is subject of discussion with the Swiss SIA as it is intended to reach a D-A-CH declaration including the relevant professional representative organisations from Germany, Austria and Switzerland.

## Enhancing participation of planners in standardization

On 28 February 2018 an exchange of planners active in standardization committees on national and/or European level took place in Vienna. Experts from Germany, Austria and Switzerland discussed common problems and approaches of standardization policies in their countries. There was agreement that one of the main problems is securing a balanced participation in standardization committees. Industry representatives often have the financial means and personnel resources to cover a lot of committees and thus influence their outcomes without adequately considering public interests. As standards interfere in many societal areas and are a considerable factor in the professional lives of engineers there was a common agreement that it in order to secure public and professional interests it is extremely important to enhance the participation of independent planners in standardization committees.

# Bulgaria

## Balkan Engineering Forum

Balkan Engineering Forum "Regional cooperation for sustainable and consolidated European perspective of engineering organizations in the Western Balkans" was held on 21st May 2018 in Sofia, under the auspices of The Bulgarian Presidency of the Council of the EU. The forum was an event within celebration of "2018 – European Year of Civil Engineers". The forum was co-organized by Union of Civil Engineers in Bulgaria, ECCE and Ministry of Regional Development and Public Works of Bulgaria.

Formal guests of the forum were high-level government and civil society representatives: eng. Valentin Yovev Deputy Minister of Regional Development and Public Works of Bulgaria, Margarita Popova, Vice President of R Bugaria (2012-2017); Vice President and General Secretary of Bulgarian Industrial Association, prof. Zoran Sapuric, Minister for regulation and improvement of investment climate in the Government of the Republic of Macedonia, the former Yugoslav Republic of Macedonia, Ambassadors of some countries participating in the Forum, representatives of Bulgaria's EU Council Presidency, Aris Chatzidakis, ECCE President Elect, Klaus Thurriedl, ECEC Secretary General, Prof. Dr. Eng. Ivan Markov, Rector of University of Architecture, Civil Engineering and Geodesy (UACEG) and leaders of Bulgarian engineering organizations.

**Background:** Balkan Engineering Forum (BEF) brings together leaders of European Engineering Councils and Engineers Chambers and Associations from Balkan countries to exchange good practices and concerns of their organizations, debate the engineering contribution to the so-called "Connectivity Agenda" and seek common interests in many areas, such as strengthening of regional cooperation, education, recognition of professional qualifications and transport, infrastructure and digital connectivity of Balkan countries.

EU-related reforms and connectivity of the Western Balkan countries, wishing to join the EU, are at the core of Bulgarian Presidency's work, The Bulgaria's EU Council Presidency attaches great importance to deepening regional cooperation and developing good neighborly relations.

**Forum Objectives:** to contribute to deepening regional cooperation and developing good neighborly relations between the engineering organizations of Balkan countries; to contribute to achieving the goals and tasks of the two priorities of Bulgaria's EU Council Presidency: "European perspective and connectivity of the Western Balkans" and "Digital economy and skills needed for the future"; to share experiences and best engineering practices and to contribute to raising the role of profession of engineer in Europe.

### Extracts from the official opening:



eEng. Valentin YOVEV, Deputy Minister of Regional Development and Public Works of Bulgaria

"The Regional cooperation is the most important step to prosperity for everyone in the Balkans. Making common projects in the field of transport infrastructure will be the safest investment in the future and stability of the Balkans."

"Civil engineers are people who know how to set high goals and perform projects successfully. That is why I am convinced that today's Balkan Engineering Forum will make a concrete contribution to deepening regional cooperation."



**prof. Zoran SAPURIC, Minister for regulation and improvement of investment climate in the Government of the Republic of Macedonia, the former Yugoslav Republic of Macedonia**

"I am very glad that our Chamber of Authorized Architects and Engineers signed a memorandum of cooperation four years ago and now after 4 years we have an agreement for cooperation between the governments of the Republic of Bulgaria and the Republic of Macedonia and between the Chamber of Commerce of the Republic of Bulgaria and the Republic of Macedonia.

We are convinced that we need to build close cooperation in the Balkan region as well as between engineering organizations because construction and engineering work makes a significant contribution to GDP for all countries in the region. I wish success to the forum."



**Aris CHATZIDAKIS, ECCE Vice President / President Elect**

"I am here on behalf of the European Council of Civil Engineers. It is my honor to congratulate the Balkan Engineering Forum and to participate in it today. The forum is held within the celebration of "2018 - European Year of Civil Engineers."

Obviously, cooperation between the countries and between engineering organizations is an indisputable success factor. We cannot design and build the infrastructure if all countries do not cooperate and we do not have the same vision of the main roads, airports, ports that are responsible for communication between our countries. We are part of the same economic region and we must act as partners when designing our infrastructure.

I am impressed by the good organization that Dimitar has managed to do. I feel here among friends. I wish success to the forum."



**Klaus THURRIEDL, ECEC Secretary General**

"I am glad to be here and to have the pleasure to congratulate the Balkan Engineering Forum. On behalf of ECEC President, Mr. Remec and on myself, I wish fruitful work of the forum in the name of the prosperity of the Balkan countries.

We need to be aware of what is happening in the European Parliament and in the different European Commission directorates and we must work first in favor of national interests and national representation.

The ECEC works in Brussels for general professional interest and for the interests of engineers. Through our representation, we follow the processes related to the engineering profession by informing and proposing reasoned opinions that are both in the interest of the professional community and in the interest of society.

What we should not forget is that some of the common objectives in the EU will be successful and it will be necessary to work together,

but it must be clear to us, that not everything decided in Brussels is in our favor.

We have a lot of work to do.

I wish BEF success not only at the level at which it is now taking place - the Balkan region, but also to influence the higher European level, where important decisions are taken."



**CEng. Dimitar Natchev, ECCE Vice President / Treasurer**

"The History cannot and must not be forgotten. Reading and rethinking the past, we must move forward, creating conditions for stability and prospects for the peoples, engineers and architects in this part of Europe."

Today, we have new friends, we will help them to build sustainable engineering associations in their countries. ECCE and ECEC are ready for this.

"What challenges do the engineers in the Balkans face today? The panel discussion and presentations clearly mark them:

Make common efforts to increase the competitiveness of engineers and construction companies in the new, complicated global environment. We expect support from the state.

Mobility of engineering services and any issues arising from this."

"I hope the Balkan Engineering Forum will strengthen our cooperation, create fruitful new contacts among our colleagues, prepare the Declaration from Sofia –our message to society and governments."



**Margarita Popova, Vice President of Bulgaria (2012-2017); Vice President and General Secretary of Bulgarian Industrial Association**

"Congratulations! You're not from that part of society that loudly present in our daily lives. But are those that build strong foundations and pillars of our lives with care, responsibility and professional skills.

In the age of profound transformations of European societies, your place and importance are respected."

The Forum was held as a panel discussion, with introductory presentations of the Panelists.

**Panelists:**

**Aris CHATZIDAKIS, ECCE Vice President / President Elect**

*"Civil engineers. The profession that gave shape to the modern world - a brief historic review and some current concerns."*

**Klaus THURRIEDL, ECEC Secretary General**

*"Current European Developments"*

**Dr. Eng. Faruk KABA, President of Albanian Association of Consulting Engineers**

*"Albanian Association of Consulting Engineers – Presentation"*

**Dipl. Eng. Mirsad JASARPAHIC, President of Chamber of Economy of the Federation of Bosnia and Herzegovina**

*"Engineering services in Bosnia and Herzegovina"*

**Prof. Dr. Eng. Dragoslav SUMARAC, ECEC Vice President, member of the GB of Serbian Chamber of Engineers**

*"Engineering education and Continuing Professional Development (CPD)"*

**Eng. Cemal GÖKÇE, President of Turkish Chamber of Civil Engineers**

*"Civil Engineering Services and Sustainability"*

**Prof. Dr. Eng. Mile DIMITROVSKI, President of Chamber of authorized Architects and Engineers, FYR of Macedonia**

*"E-Building Permit and Electronic Signatures"*

**Eng. Maria STEFANOVA, Secretary of KIIP- Sofia, Representative of KIIP in BDS, TC 101 "Sustainable Construction"**

*"Digitalization of the construction industry – European Initiatives and BIM Standardization"*

## Cyprus

### CYACE Honorary Membership Award to Mr. Aris Chatzidakis

Among the distinguished guests of the 25<sup>th</sup> CYACE General Assembly that was held on 2<sup>nd</sup> December 2017 and consisted the opening event of the European Year of Civil Engineers, was Mr. Aris Chatzidakis, ECCE Vice President / President Elect who was also the key speaker of the Assembly.

Mr. Chatzidakis gave a remarkable lecture to the attendees, regarding the engineering profession and heritage.

The Central Board of CYACE awarded Mr. Chatzidakis as an Honorary Member of the Association, for his longstanding support and contribution to our Association and to the Civil Engineers' Society in general.



### Lefkara Project “Rehabilitation of the central area of Lefkara Municipality-Phase A”

Start Date: 01/03/2018

Scheduled Finish Date: 01/01/2019

Duration: 10 months

Status: Under construction

*This project is approved under Measure 7: Basic Services and Village Renewal in Rural Areas, of the Rural Development Programme 2014-2020, and is co-financed by the European Agricultural Fund for Rural Development, the Republic of Cyprus and Lefkara Municipality.*

Description: The project is located in Pano Lefkara Central Area, next to the Municipality Building and primarily includes the urban landscape rehabilitation of the two main commercial streets of Pano Lefkara. The construction works include removal of the asphalt, undergrounding of all public utilities’ networks (electricity, telecommunications), replacement of the old water supply network, construction of a stormwater drainage system, new stone pavement and addition of new urban furnishings (benches, dust bins, lamp posts). Along with the project, a one-way traffic regulation has been implemented on the two commercial streets, thus allowing the construction of wide sidewalks where the inhabitants and tourists can walk safely and undisturbed and the locals have the opportunity to exhibit their traditional products (embroidery, silverware, etc).

The removal of the asphalt and the construction of new stone pavements using the traditional methods, is expected to help restoring the traditional character of the area. All the above mentioned interventions aim to enhance the urban landscape, while improving the living conditions of inhabitants and at the same time, to benefit the economy and local tourism.

BEFORE



AFTER

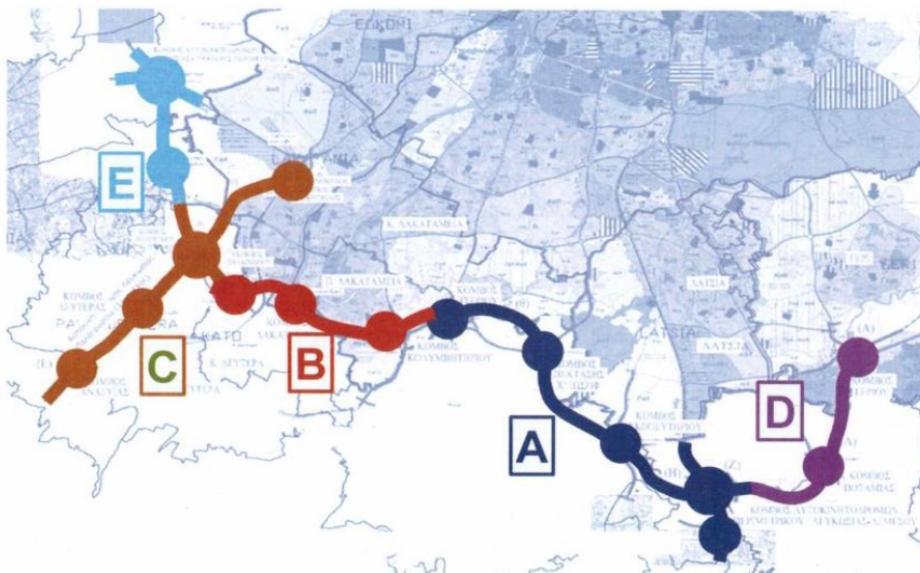


### Nicosia Perimeter Road Project

The project is a 32km long, 4-lane highway, will link the highways leading to Nicosia. It starts from the area of Yeri, ends with the Nicosia-Palaichori motorway (under study) and covers the section from Anthoupoli to Anagia. The study for the preparation of the construction plans has been divided into 5 phases and is at an advanced stage. The cost of the motorway is estimated to € 300 million.

At this stage, the construction of the first phase of the 7km long project, which will link the Nicosia-Limassol motorway to Tseriou Avenue, will be promoted, against a preliminary cost of € 52 million plus VAT. The road is part of the trans-European network and will be co-funded by the European Fund for Europe (CEF).

Tenders are expected to be launched in autumn 2018 and the project is expected to start in the first half of 2019, if no further delays occur in the bidding process. The duration of the construction will be 3 years.



**Reformation of the Historical Core of Peristerona Community – 3rd Phase**

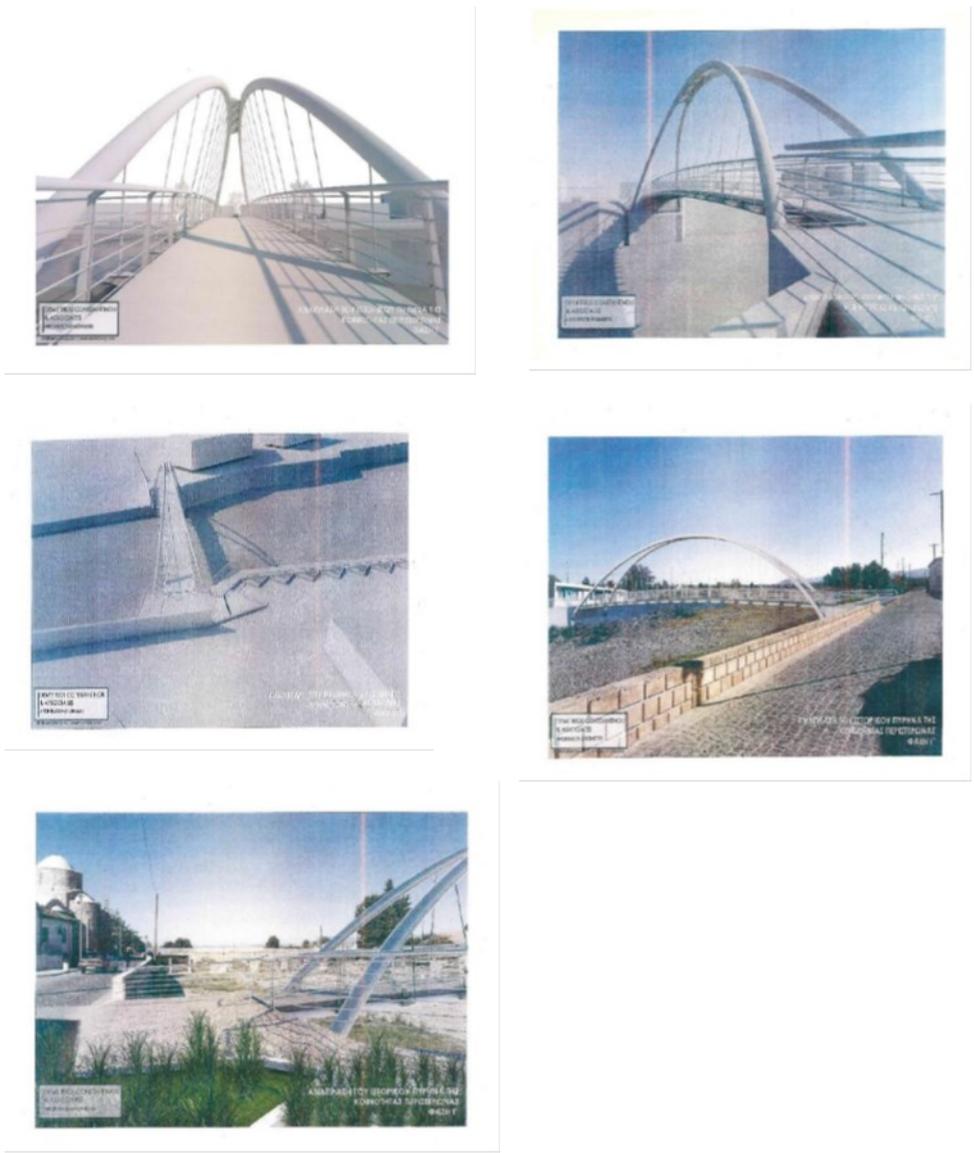
The Project is a continuation of the previous two (2) Phases of the above Project. By promoting the implementation of the 3rd Phase of the Project, the urban regeneration project of the traditional community of Peristerona will be completed.

This Department has proceeded with the design, by external consultants, of the pedestrian bridge linking the Community of Peristerona with the New Primary School, which has been operating since 2010.

This study, which concerns the 3rd Phase of the Project, includes the pedestrian bridge, access to the pedestrian bridge through the courtyard of the new elementary school and landscaping of nearby road, as well as the creation of new parking spaces.

With the implementation of the project, the very serious problem of safe pedestrian traffic, especially for students aged 6 to 12, will be solved.

The design of the project is in line with all the provisions and aspirations of the Development Plans and Urban Legislation.



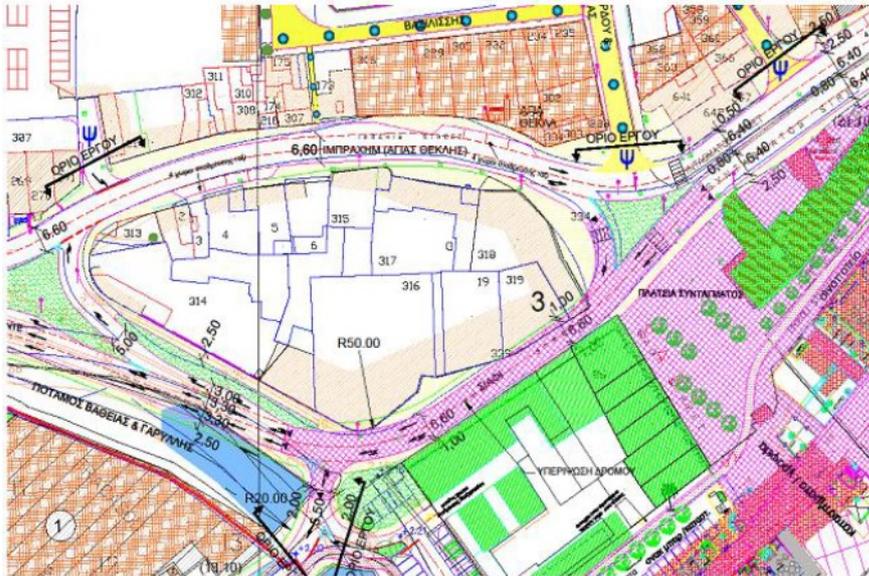
**Enlargement / Improvement / Road Construction linking Franklin Roosevelt Avenue, with coastal Limassol Avenue, in front of the Mole**

The overall project concerns the Enlargement and Improvement of the existing Road linking Franklin Roosevelt Avenue, with the coastal Limassol Avenue, with a total length of approximately 1.3 km. At this stage, the Enlargement / Improvement of the 1st Phase of the Project is promoted, from the junction of the coastal Limassol Avenue to Koumandaria Street, until its junction to the 500m long Siafi and Kiouproulouzante streets, which lies north of the Marina area and south of the Castle Square. This road, according to the Local Plan of Limassol, is a route of primary importance, connecting the eastern to the western Limassol. Its construction will improve the traffic connection of the two Avenues, it will help in decongesting the area, which is heavily loaded due to the tightness of the existing network, the operation of Limassol Marina and the Medieval Castle square.

For this project, the Regulatory Plan was taken into account by the Town Planning and Housing Department. The study was based on the expected Road form (primary consideration road), by ensuring comfortable and safe road traffic and design in accordance with the approved Geometric Standards.

The Plan provides a cross-section of 4 lanes. The roundabout in front of Syntagma Square was abolished and a

triangular green area was set up to adjust the two lanes of traffic direction from the west to the east of Ag. Thekli Street, with the two opposite traffic lanes passing through Siafi Street. Subsequently, this Project Phase is adapted to the existing Road by Kiouproulouzante and EVKAF streets. The extension of the Road to the west will follow at a second phase. Also, the cross section of the road includes the placement of a central dividing island, to prevent uncontrolled right sided movements and avoid frontal collisions. Moreover, creation of parking lots along the pavement, bus stops and Taxi parking, installation of utilities networks (road lighting etc.), rainwater drainage system, are included in this phase.



**Expansion / Improvement of the existing section of Agia Fylaxeos Avenue, from Limassol - Nicosia motorway roundabout to Spyros Kyprianou Avenue and part of the secondary road network**

The 1<sup>st</sup> phase of the project concerns the enlargement and improvement of a part of the existing avenue "Ag. Fylaxeos", from its junction to St. Kyriakides, by the roundabout of Ag. Fyla to Spyros Kyprianou Avenue (formerly Macedonia Avenue). The rest of the Avenue will be promoted in two other phases.

The referred Road is a Primary Road as an integral part of the Limassol District Primary Road Network. It unites the area of Ag. Fyla and the Municipality of Limassol, north of the motorway area and by extension along the Limassol coastal Avenue. Enlargement / improvement is very important because it passes through a busy commercial (Class I Activity Axis) and residential area, where traffic anarchy and danger to pedestrians prevail. This section of the Road, promoted with this project, has a total length of 1.0 km.

The project is Urban, so the State contributes to the construction cost by 80% and the Municipality of Limassol by 20%.

The Plan includes a cross section of the road, with four traffic lanes and a fifth one which is required for the right turns of the vehicles, a central, dividing, suitably planted islet, paved sidewalks on both sides of the road. In order to support the commerciality of the Road, there were parking areas along the pavement, bus stops and for safer pedestrian traffic and pedestrian crossings. On the basis of the above Plan, the Department of Public Works prepared the study of the Construction Plans, which included the studies / plans of the Utility Services and rainwater drainage system, and prepared the Specifications and Tender Documents for the implementation of the Project.



## Connecting Route of Limassol Port to Lemesos – Pafos Motorway (Vertical)

This road connects the port of Limassol with the Limassol-Pafos motorway in a new engraving, bypassing the densely populated area of Limassol. It is a 4-lane urban road, 8 km long. Urban standards, sidewalks, cycle tracks, central islands and electric lighting, which is part of the trans-European network and is co-funded by the European Union's Cohesion Fund for the years 2008-2013 and 2014-2020. The total cost of the project is € 86m, including storm sewage projects in the wider West Limassol area. It is promoted as follows:

### Phase 1

The first phase of the project, 4.7 km long, connects the Port with Pafos Street (Vertical Road) and includes the drainage works of the storms of the wider western Limassol area. This phase has been completed within the framework of the following four contracts:

- 1<sup>st</sup> section - Entrance of the harbor to the Industrial Area, 2,7km long: The works started on 28/12/2009 and were completed on 31/3/2012 for a contract amount of approximately € 23.9m + VAT.
- 2<sup>nd</sup> part - Limassol Industrial Area up to the old 2km Limassol-Pafos road: Work started on 10/1/2011 and was completed on 5/12/2013 for approximately € 20.6m. + VAT about.
- 3<sup>rd</sup> section - Drainage works from Port to the Sea: Work commenced on 31/12/2012 and completed on 16/1/2014, for a contract amount of € 4m + VAT.
- 4<sup>th</sup> section - Rainwater Drainage: Work commenced on 20/10/2014 for a contract amount of € 5,967,000 + VAT and was completed on 22/2/2016.

### Phase 2 - Under construction and includes:

- 5<sup>th</sup> section - Upgrading the junction with the Limassol-Pafos motorway, 1 km. The project is being promoted using the Design and Build method. Work commenced on 31/8/2016 and will be completed in May 2018, for a contract amount of € 9,683,000 + VAT.
- 6<sup>th</sup> section - Upgrading the parallel road with the 2.6 km long harbor enclosure. It is promoted using the Design and Build method. It was commenced on 6/4/2017 and will be completed on 5/4/2019 for a contract amount of € 14.632.300 + VAT.



## Poland

### 2<sup>nd</sup> Economic Forum for Construction and Architecture at MTP BUDMA 2018, 30 January – 2 February 2018, Poznan, Poland



The inauguration of the European Year of Civil Engineers (EYCE) in Poland was officiated by the ECCE Acting President Włodzimierz Szymczak, during the opening ceremony of the 2<sup>nd</sup> Economic Forum for Construction and Architecture at MTP BUDMA 2018.

It is the oldest, biggest and most prestigious construction industry event in Poland. The opening ceremony was attended by representatives of the government of the Republic of Poland.

BUDMA attracts tens of thousands of professionals interested in innovative solutions in the construction sector, exchange of experiences, gaining expertise, and above all business meetings every year.

During his speech at the opening ceremony of the 2nd Economic Forum for Construction and Architecture at MTP Budma 2018, Włodzimierz Szymczak stressed the challenges ahead of the construction industry in the coming years, such as urban sprawl, the digital revolution providing us with huge amounts of data, fighting environmental degradation, and climate change. Szymczak also described the events organised as a part of the European Year of Civil Engineers and encouraged listeners to participate in them.

## Serbia

### 15<sup>th</sup> Anniversary of Serbian Chamber of Engineers 14 June 2018, Legacy of Petar Lubarda, Belgrade

On the occasion of the 15<sup>th</sup> anniversary of the founding, the Serbian Chamber of Engineers officially marked the "Day of the Engineer Chamber of Serbia" on June 14, 2018 in the Legacy of Petar Lubarda in Belgrade.

Among numerous officials, there were prof. Prof. Dr. Mile Dimitrovski and Rade Lazarevski, President and Vice President of the Chamber of Architects and Engineers of Macedonia, Dimitar Natchev, ECCE Vice President, Maria Stefanova Secretary General of KIIP Sofia, Stefan Kinarev former President of KIIP, Boris Ostojić and Biserka Vujović President and Business Secretary of the Montenegrin Engineers' Chamber, Boris Vranešević, Deputy Chairman of the Croatian Chamber of Electrical Engineers, Prof. Dr. Nebojša Bojović, Dean of the Faculty of Transport Engineering in Belgrade, directors of companies, members of Management and Supervisory Board of the Chamber and the General Assembly and other distinguished guests.

Latinka Obradović, Vice President of the Serbian Chamber of Engineers, congratulated the participants, referring to the achievements of the Chamber during the past 15 years.

She mentioned also the blockade of the Chamber's work over the last year and a half and pointed out that the Chamber is already working and the licensing process runs smoothly.

Prof. Dr. Dragoslav Šumarac, ECEC Vice President and member of the Managing Board of the Serbian Chamber, emphasized the importance of the international cooperation of the Serbian Chamber with all engineering organizations in the region and with European and international organizations such as the European Council of Engineering Chambers, the European Council of Civil Engineers and the World Federation of Engineering Organizations.

Dimitar Nachev, ECCE Vice President congratulated Serbian Chamber on behalf of the ECCE and on behalf of Bulgarian engineers and handed over the icon of St. St. Cyril and Methodius, recalling the successful multi-year cooperation between Bulgarian and Serbian Chambers.

Representatives of the Engineering Chambers from the region congratulated Serbian Chamber - they stressed on the long-standing friendly and successful cooperation with the Serbian Chamber of Engineers, with the desire to make cooperation even more successful in the future.

At the ceremony, the annual awards of the Serbian Chamber of Engineers were awarded. After the awards, a mini concert soprano was held. The Celebration ended in the Belgrade Graffiker Restaurant.



## Spain

### 1<sup>st</sup> edition of Manuel Lorenzo Pardo Awards

On Wednesday, February 28<sup>th</sup>, the awarding ceremony of the first edition of Manuel Lorenzo Pardo's Awards on Water Management best practices was held. On a biennial basis, the Association of Civil Engineers awards people, organizations and institutions regarding water which stand out for their best practice in the integrated water resource management model.

The entities awarded this year were the Ebro river Basin Authority and Valencia's Water Court. In the awardee proclamation speech, Association of Civil Engineers' Vicepresident Tomás A. Sancho, highlighted the avant garde nature of both organizations in their different areas: Valencia' Water Court as a millenial institution regarding the



ruling of water rights and Ebro river Basin Authority, as the first basin organization, created by Mr. Manuel Lorenzo Pardo in 1926. WCCE President Alfonso González, offered the Manuel Lorenzo Pardo Award, in response to its exemplary water management model and the contribution of the Authority to the economic development of the regions which make up the Ebro River Basin, to Raimundo Lafuente, Ebro river Basin Authority President, on its behalf. In his acceptance speech, Mr. Lafuente highlighted the special value for the Ebro Hydrographic Confederation of receiving an Award from the Association of Civil Engineers and stressed the complexity of water management in an Organism that covers territories belonging to several regional governments, 18 provinces and manages water for a population of over three



million citizens. He also declared the Authority's public status and the commitment and good work of all its employees. Following, Colegio's President Juan Santamera took the floor to award in attention to its exemplary model of water management, its millenary character, and its condition as Intangible Cultural Heritage. Valencia's Water Court. The award was accepted on its behalf by Jose Font Sanchis, Trustee of Valencia Water Court's Mestalla Branch and President. During his acceptance speech, José Font, President of the Tribunal, thanked the awarding briefly explained the organization of the Water Court.

**"International Award on Road Innovation Juan Antonio Fernández del Campo"**



Deadline for the presentation of research works to the VII Edition of the "International Award on Road Innovation Juan Antonio Fernández del Campo" is on September 25<sup>th</sup> 2018. Researchers have already four months to submit!

This award, promoted by the Foundation of the Spanish Road Association Foundation (FAEC), was born in 2005 with the aim of contributing to the development of road technology worldwide through specific research activities focusing on the innovation in the road sector. Additionally, the award expects to spread Spanish as international scientific language on road matters. Throughout the five editions celebrated, research works have been mainly focused on paving –both techniques and materials-, technologies and tools to improve road safety and traffic management, etc. More than 150 research studies have been submitted to this award until now, developed by experts from 20 countries around the world (México, Colombia, Argentina, Venezuela, Chile, Brazil, Switzerland... and of course Spain). "International Award on Road Innovation Juan Antonio Fernández del Campo" is opened to natural persons and legal entities from any country, researches, PhD, etc. The original works, **written in Spanish**, must be innovative. If you are interested in participating in this 2017-18 edition of the Award, you must submit your work on-line. Please consult regulations of this award for more information. They are available, in Spanish, in the following link: [www.premioinnovacioncarreterasajfc.org](http://www.premioinnovacioncarreterasajfc.org) Juan Antonio Fernández del Campo Innovation Award has become an international reference in road research in Spanish language, due to the high level participation in previous editions. The winner will be awarded with 12.000 € [Check the Regulations of this edition](#) [Visit the official web page](#)

**Turkey**

**“6th SYMPOSIUM ON THE CONSERVATION AND REINFORCEMENT OF HISTORIC BUILDINGS” took place on November 2-4, 2017 in Trabzon, Turkey, organized by Turkish Chamber of Civil Engineers (TCCE).**

On behalf of the Turkish Chamber of Civil Engineers the Symposium was organized by İstanbul and Trabzon Branches and held in Karadeniz Technical University / Trabzon. The opening speeches of the meeting were made by TCCE Chairman Cemal Gökçe, TCCE' s İstanbul Branch President Nusret Suna, TCCE' s Trabzon Branch President Mustafa Yaylılı and Trabzon Metropolitan Mayor Orhan Fevzi Gümrükçüoğlu.





Turkey is home to several historical monuments due to its geographical location and many civilizations it has hosted throughout its history. Due to high seismicity of the country, stemming from the activities of the North Anatolian Fault extending along the north side of Turkey in the East-West direction, these historical monuments suffer from destructive effects of earthquakes besides the effects of aging. The Symposium, which has been organizing with the

contributions of different disciplines, aims to provide a forum for scientists, engineers, architects and enterprisers to present and discuss the recent applications and advances in mitigation of damage against earthquakes and other environmental factors, monitoring, modelling and assessment methods of these historical structures. At symposium, Presentations of 72 Articles, accepted by the Scientific Committee, were made in 16 sessions.

Called Speakers were; **Prof. Gianmarco de Felice** from Università Degli Studi Roma Tre, **Prof. Nicola Berlucchi**, **Prof. Dr. Zeynep Ahunbay** from Istanbul Technical University Faculty of Architecture, **Prof. Dr. Oğuz Ceylan** from Mimar Sinan University.



## 6th International Symposium on the conservation and reinforcement of historic buildings

November, 2-4, 2017, Trabzon

### Final Declaration

Having been organized by Trabzon and İstanbul branches on behalf of our chamber TCCE, on November 2-4, 2017 in Trabzon, 6<sup>th</sup> International Symposium on the Conservation and Reinforcement of Historic Buildings marked a great achievement along with the participation of engineers, architects, biologists, chemists and materials scientists. The symposium presented a wide range of activities in the field of conservation of the historic buildings ranging from inventory works, initial step of the conservation, to studies conducted with non-destructive techniques and from materials experiments to post-project implementations. The presentations of General Directorate for Foundations, responsible for the conservation of cultural assets within its body, and General Directorate for Highways, responsible for the historic bridges, enriched the content of the symposium.

It was quite pleasing to have witnessed the fact that the efforts of reviving the urban memory and of conserving the cultural historic sites gained impetus as well as that architects and engineers have considerably been concerned with the conservation. The success of conservation and reinforcement of cultural heritage lies in the interdisciplinary activities. It is clear that increasing variety of the methods and techniques used in the conservation shall also contribute to the quality of the restoration works. Investigating earthquake behaviours of masonry and exploration of reinforcement approaches with reference to their conservation and engineering aspects shall positively contribute to raising awareness regarding the issue. Speaking the same language and acting in harmony by guiding collective principles for purposes of interdisciplinary conservation projects and implementations are essential. Symposiums on the Conservation and Reinforcement of Historic Buildings ensure the exchange of experiences and knowledge by convening professionals from various fields together. Exploring the studies and implementations conducted both in Turkey and abroad shall help enrich the perspectives and gain a broader vision regarding conservation. We would like to express our gratitude to those who contributed to the achievement of the symposium through their presentations on certification, investigation with non-destructive techniques, modelling, protection from earthquake damages, exploring new materials compositions, reusing and adaptation into modern life.

It is essential to have a supreme knowledge on the characteristics of conveyor systems and materials in conservation applications. Decision-making process is to rest on knowledge and the changes that the buildings went through from their initial designs to current time are to be complemented with the fund of knowledge regarding the evolution of construction techniques. The studies conducted on this area are quite satisfactory.

The comprehensive studies on materials and techniques constitute an invaluable gain for Turkey. It is evident that the evaluation of the studies on the solid construction materials suitable for historic texture, intrusion mortars and techniques of reinforcement and the new technologies shall improve the quality of the implementation projects in Turkey.

However, the materials and techniques which have never been tested on the historic sites are not to be used in the restoration works. Article 10 of Venice Charter is as follows: "Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any modern technique for conservation and construction, the efficacy of which has been shown by scientific data and proved by experience." Thus, it is recommended that materials like carbon fibre and epoxide are to be restricted in restoration works.

The huge number and variety of the projects and implementations of conservation of cultural heritage in Turkey requires the staff working in these fields to be experienced and expert of his/her profession. Tangible cultural heritage assets are going to be kept alive and maintained only through the comprehensive knowledge and experience of professionals on the causes of damages and settlement methods. Monuments are to be restored by respecting its all segments and by not censoring any parts of them.

Novice engineers and architects who would like to specialize in the conservation in order to protect the buildings from the damages of inappropriate implementations are recommended they complete their master's and doctorate studies and have a complete grasp of international conservation principles. The curriculum of civil engineering programmes is to involve courses on masonry, cultural heritage and conservation principles and those programmes are to help students well understand the construction techniques, plan typology and conveyor systems of the historic masonry, timber structures, early-concrete and steel structured buildings as well as to offer experience on the buildings that incurred to change within the time span.

Constant maintenance of cultural heritage is a measure that will reduce the cost of costly renovations in the long run. In this respect, it is of great significance to monitor the historic buildings and to fix the problems before they get more serious. As Plato said "Time is more valuable than anything else.", it is crucial to use time effectively and to be prepared against the earthquakes and damages.

We would like to have you all in our next symposium.  
With our best regards,  
**Organization Committee**

## United Kingdom

### Project 13 launch will improve how infrastructure is delivered



ICE and the Infrastructure Client Group (ICG) have launched Project 13 to improve the way high-performing infrastructure is delivered and managed.

The industry-wide change programme aims to deliver better outcomes for the public and customers of infrastructure, a more highly skilled, innovative workforce and lead to a more sustainable, productive construction industry.

Dale Evans, Chair of the ICG and Director of @One Alliance said: "We are pleased launch the implementation phase of Project 13. This project has brought together individuals and organisations from across the sector and within government to think seriously about how we can better provide infrastructure for the future.

"We hope that industry will embrace this approach so we can begin working towards a more sustainable and productive future for our sector."

Nick Baveystock, ICE Director General said: "The launch of Project 13 is the chance for industry and government to change how we deliver our infrastructure. Developed between industry, clients and government over a number of years, Project 13 places customers at the heart of our national infrastructure programme, focusing on the social and economic value infrastructure can provide over the long-term.

"We look to government to continue to support a solution developed by and with the industry with all the potential benefits for the public and the taxpayer. This is a win-win. We should just ask ourselves why wouldn't we want to use Project 13 principles to deliver better value?"

Project 13 is sponsored by the ICG with support from ICE and is aligned with current UK government and industry initiatives to improve infrastructure performance. The ICG is a joint group of industry figures, academics and infrastructure owners with 19 members from 16 different client organisations. These represent public, private and regulated infrastructure sectors including Highways England, Network Rail and National Grid.

[Project 13's website](#) provides organisations with the tools and training to adopt this new business model. These include the Commercial Handbook and Project 13 Blueprint with detailed guidance to help businesses shift their thinking and commercial strategies.

### ICE Thinks challenges industry to make cities more inclusive

ICE Thinks has [published in-depth paper 'What is the city but the people?'](#) The role of the engineer in creating inclusive cities' which challenges industry and engineers to think harder about designing and building more inclusive cities.

The discussion paper focuses on issues such as the City at Night, the importance of the night-time economy and night workers; the Feminist City, how men and women use cities differently and how that can be incorporated from an engineering perspective; and the Accessible City, ensuring that people of all levels of mobility and accessibility requirements can use cities without issues.

This follows the Inclusive Cities conference last February where experts from across industry, policy, design, academia and the arts examined the role of the engineer in city planning and social sustainability.

ICE President Professor Lord Robert Mair says: "Our citizens have vast and varied lifestyles and it is essential that our cities are able to work for them. Helping people live better, less complicated lives is at the very heart of engineering and we're challenging the industry to do more to design and build cities that are inclusive for all, at all times, regardless of gender, mental or physical ability.

"As we celebrate ICE 200 it's apt that we not only recognise the important work of the past but consider what engineers can do for the future, helping build more inclusive communities and cities in the next 200 years."

Dr Ellie Cosgrave, lecturer in urban design at City Leadership Lab UCL, adds: "We want to lead our industry in debating how cities can be more inclusive. As well as value for money, we should be thinking about the social value of the things we build, and environmental and economic sustainability.

"Inclusivity is not a buzzword. How we design our cities impacts on people's lives so we must ensure the infrastructure which our cities depend on is welcoming to all."

In the paper ICE issues 3 challenges to industry and academia about how they can help to create more inclusive cities in the future:

- ensure greater female representation throughout the sector
- commission research on how infrastructure can better support the needs of night workers and the night-time economy
- engineers to think about design from the point of view of people with differing needs to their own

## News from ECCE Partners

### Madrid Declaration: Water, the future that we want



The Declaration of Madrid was signed in early March on the occasion of the 50<sup>th</sup> Anniversary of WFEO hosted by Instituto de Ingeniería de España organized jointly with Spanish Colegio de Ingenieros de Caminos, Canales y Puertos and its twin association, Asociación de Ingenieros de Caminos, Canales y Puertos.

Such statement declares the true commitment of the civil engineering community with the accomplishment of UN's Sustainable Development Goals and highlights the role of civil engineering in this deed.

Such declaration sponsored by the host organizations and the World Council of Civil Engineers was subscribed by the following international organizations:

- ECCE - European Council of Civil Engineers
- CICPC-CEPC Council of Civil Engineering Associations from Portuguese and Spanish Speaking Countries
- FEANI - European Federation of Engineering Organizations
- WFEO – World Federation of Engineering Organizations

This declaration is still open for any other organization that would like to subscribe the commitment stated in the Declaration. The document can be downloaded at the link [here](#).

### 2018 Civil Engineering Excellence Awards



**WCCE launches its fourth edition of the Civil Engineering Excellence Awards.** The first presentation of the Award was made in 2010 during the 5<sup>th</sup> General Assembly of WCCE. This fourth edition's awarding ceremony will be held during WCCE's 13<sup>th</sup> General Assembly to be held in Sucre, Bolivia on the last quarter of 2018. **Candidacy submissions are open until July 15<sup>th</sup>.**

The awardee, civil engineer as defined by the WCCE member society of the nation in which he or she resides is to be selected based on his or her noteworthy contributions to the practice, theory, or public status of civil engineering. Nominees should possess appreciable experience in the profession, international standing as well as significant educational accomplishments.

#### Nomination Process

##### CRITERIA

- Any professional civil engineer can be nominated without any restriction on the age or area of expertise.
- Award application should be based on a project or service to the public or profession performed throughout his/her civil engineering career.
- Only one award can be granted per individual.

##### PROCEDURE

Only national members of WCCE may submit nominations. Only one nomination per award term of two years may be filed by each WCCE member organisation. Updated unsuccessful nominations may later be submitted again.

The nomination file consisting of the nomination form and supporting documents is limited to 25 pages and has to be submitted electronically to the e-mail address indicated in the nomination form before 12:00 noon (Madrid, Spain Time) on the announced deadline. The file should contain,

- Properly completed official Nomination Form
- Curriculum Vitae which should clearly indicate the occupational history of the nominee
- Statement of compliance explaining the merits of the nominee that make him/her comply with the requirements of the Award.
- At least four supporting letters from senior personalities who know the nominee well.
- Any other supporting documents.

#### Evaluation Process

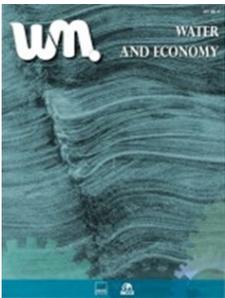
##### CRITERIA

Nominations shall be evaluated on the basis of the accomplishments and contributions of the nominees to the profession of civil engineering in the direction of WCCE principles. They should possess appreciable professional experience; their international standing and educational accomplishments will naturally add to their credit. Evaluation criteria include, but not limited to the following considerations:

- Major civil engineering projects proposed/initiated/directed/realised.
- Patents and other innovative contributions to civil engineering.
- Contributions to the theory/practice of civil engineering.
- Contributions to the public status of civil engineering.
- Academic/professional honours.
- Published works such as books, journal papers, conference papers etc.
- Educational/research accomplishments.
- Leadership abilities and potential as a role model.
- International standing.

Candidacy submission guidelines can be downloaded [here](#).

## Water Monographies IV: Water & Economy



WCCE introduced the fourth report of their Water monographies series, **Water & Economy** presented on the occasion of the WFEO's 50<sup>th</sup> Anniversary Meeting which took place in Paris during the last week of February. This initiative is published in collaboration with UN-Water and AQUAE Foundation and is published in English and Spanish.

This report has been dedicated to Water & Economy, on the grounds of the theme of 2016's International Year on Water & Sustainable Development. In this report, several agencies from the UN present different approaches to the topic, enriched by the contribution of several other stakeholders.

Digital versions may be downloaded here:

[Water Monographies IV - Water and Economy - English version](#)

[Water Monographies IV - Water and Economy - Spanish version](#)

## 15<sup>th</sup> ECEC General Assembly Meeting



On 11<sup>th</sup> of March 2018, the ECEC had its 15<sup>th</sup> General Assembly Meeting at the NH Collection Grand Sablon in Brussels, BE.

Mr. Gonçalo Asçensão from the CEN-CENELEC management gave a basic overview on the work done within CEN-CENELEC and the possibilities to get involved in the procedures of BIM Standardization. Mr Oscar Nieto from Construction Products Europe gave an insight on the on procedure of BIM projects and BIM Standardisation in Europe. Followed by a speech of Mr Vladimir Benko, President of SKSI, who presented the necessity of an active involvement of ECEC in the BIM thematics. The subsequent discussion with the member organisations resulted in the establishment of a separate WG on BIM, which will have its first meeting on 14<sup>th</sup> of April in Vienna, AT.

President Remec reported amongst other things about the World Construction Forum, taking place in Ljubljana in April 2019, which will be organised by the Slovenian Chamber of Engineers in cooperation

with the regional University. The event will focus on "Resilient Buildings and Infrastructure". You can read more on <https://www.wcf2019.org/>.

In his report on current European developments, Secretary General Thürriedl raised the question whether there should be made more efforts towards a possible implementation of a Common Training Framework (CTF).

The next ECEC General Assembly Meeting is scheduled on 17<sup>th</sup> of November 2018 in Zagreb, Croatia, where also the elections of a new Executive Board will take place.

## European Construction Forum (ECF) - The European Construction Industry Manifesto for Digitalisation



The [ECF](#) is a platform for cooperation on issues of common interest between independent organizations representing key players in the construction sector and participating on a voluntary basis. ECCE is an active member of ECF.

ECCE has joined forces with other major European construction industry associations to publish *The European Construction Industry Manifesto for Digitalisation*. The manifesto calls for strong political leadership from the EU, an appropriate regulatory framework on data policy and budgetary focus on digital skills, R&D and IT infrastructure.

You can download the manifesto [here](#).

## FIEC reacts to the European Commission's package on public procurement



EUROPEAN  
CONSTRUCTION  
INDUSTRY FEDERATION

During the winter, the European Commission presented a package of legislative and non-legislative measures on public procurement. In particular, the European Commission promoted the strategic use of public procurement (incl. innovative and social aspects), as well as greater professionalism of public buyers.

In a position paper recently sent to the European Commission and the European Parliament, FIEC welcomed the efforts of the European Com-

mission to help the implementation of the 2014 EU public procurement directives, especially when it comes to increasing the professionalism of public buyers.

However, FIEC also pointed out a number of remaining problems and in particular:

- the reduced number of bids due to high tender costs and overly complex procedures,
- the lack of innovation due to risk-aversion from public buyers,
- the dangers of integrating social criteria as award criteria,
- the abuse that exists in in-house and public-public cooperation,
- the challenges of digitalisation,
- the pros and cons of central purchasing bodies and joint procurement,
- the need to further promote the most economically advantageous tender (MEAT) and get rid of abnormally low tenders (ALTs),
- the need to further promote fair contract conditions.

Read more [here](#).

## Industry federations come together at ECCREDI meeting



Members and invited guests from other federations met on 3<sup>rd</sup> May 2018 during the bi-annual meeting of the European Council for Construction Research, Development and Innovation. On the agenda: digitalisation of the construction industry, recycling of construction and demolition waste and the re-use of steel buildings. For the next meeting it is planned to combine a visit to a company in Belgium, which uses virtual reality to show how BIM can be used to simulate a tour of a finished building. More information can be obtained by contacting the ECCREDI secretariat at [info@eccredi.org](mailto:info@eccredi.org).

## EU News

### EU Water conference 2018



The 5<sup>th</sup> European Water Conference aims to present and discuss progress in the implementation of EU water legislation. The event is jointly organised by the European Commission's Directorate-General for the Environment and the forthcoming Austrian EU Presidency.

Around 400 representatives from EU countries, stakeholder groups in relevant economic, social and environmental sectors, the European Commission, the European Environment Agency and other EU institutions will have the opportunity to debate about the findings of the different water-related reports and learn from each other's experiences in view of the next water planning cycles. The ongoing Fitness Check of the Water Framework Directive, its associated Directives and the Floods Directive, and the evaluation of the Urban Waste Water Treatment Directive (UWWTD) will also be discussed.

The main objective of EU water legislation is to achieve good status of the EU's water resources. During 2018, a new comprehensive assessment of the state of implementation will become available. This will include a forthcoming Commission report on the EU Member States' second River Basin Management Plans and first Flood Risk Management Plans, together with the forthcoming State of Water Report 2018 from the European Environment Agency.

For further information and registrations please visit the website [https://ec.europa.eu/info/events/eu-water-conference-2018\\_en](https://ec.europa.eu/info/events/eu-water-conference-2018_en).

### Review of the drinking water directive



The European Commission adopted on 1 February a [proposal for a revised drinking water directive to improve the quality of drinking water and provide greater access and information to citizens](#).

The proposal for modernizing the 20 year old drinking water directive (98/83/EC) comes as a result of the REFIT evaluation, the implementation of the Commission's response to the

European Citizens' Initiative 'Right2Water' and as a contribution to meeting the targets of the Sustainable Development Goals.

#### Main elements:

- The proposal updates existing safety standards in line with latest recommendations of the World Health Organisation (WHO) and ensure our drinking water is safe to use for the decades to come.
- It will empower authorities to better deal with risks to water supply and engage with polluters.
- It will empower consumers by giving them much more information and oversight over the efficiency and effectiveness of water suppliers.
- It contributes to the transition to a [circular economy](#). It will help EU countries to manage drinking water in a resource-efficient and sustainable manner so as to reduce energy use and unnecessary water loss. It will also help reduce the number of plastic bottles following increased confidence in tap water, improved access and promotion of use of drinking water.
- The proposal is a direct reply to the European Citizens' Initiative '[Right2Water](#)'. The Commission had committed to evaluate the Drinking Water Directive and to launch an [EU-wide public consultation on the quality of drinking water](#) in order to assess the need for improvements and how they could be achieved. Following this consultation and in line with the principles of the new [European pillar of social rights](#), the proposal contains an obligation for EU countries to improve access to safe drinking water for all and to ensure access for vulnerable and marginalised groups.

For further information on the topic please consult the website [http://ec.europa.eu/environment/water/water-drink/review\\_en.html](http://ec.europa.eu/environment/water/water-drink/review_en.html).

## EU budget: a new Social Fund and Globalisation Adjustment Fund



For the next long-term EU budget covering the period 2021-2027, the EU Commission proposes to further strengthen the Union's social dimension with a renewed European Social Fund, called European Social Fund Plus (ESF+), and a strengthened and more effective European Globalisation Adjustment Fund (EGF).

The European Social Fund Plus, with a proposed budget of 101,2 Bln €, will be a more flexible and simpler version of the current ESF, merging a number of existing funds and programmes.

Pooling resources will allow the EU and Member States to provide more integrated and targeted support in response to the social and labour market challenges that Europe is facing. The EGF, with a proposed budget of 1,6 Bln €, will be revised so that it can be used more effectively to support workers who have lost their jobs.

Currently, workers can only get support from the Fund when their dismissals are due to changing trade patterns or consequences of the financial and economic crisis. Under the new rules, other reasons for restructuring, such as automation, digitalisation and more, can be eligible for support, taking account of new challenges on the labour market.

The proposals related to ESF+ and the EGF are part of the overall Commission's proposals for the long-term EU budget adopted on 2/5/2018, which can be accessed by clicking on the link [here](#).

## Making skills and qualifications more visible across the EU

At a moment in which companies in various Member States are facing difficulties in finding the right workers with the right skills, the revised Europass framework has recently been adopted. This revised framework aims at simplifying and modernising the Europass CV and other skills tools for the digital age. It will offer an e-portfolio for storing and sharing information, tools for people to self-assess their skills and tools for describing formal and informal learning as well as qualifications and thereby it will enable people across the EU to make their skills and qualifications more visible.

For the first time, Europass will also offer information to support career management including information on trends and demands in the labour market and on guidance and learning opportunities across Europe, helping policy makers to better anticipate labour market needs and trends.

Read more [here](#).

## Open Public Consultations

Through public consultations you can express your views on the scope, priorities and added value of EU action for new initiatives, or evaluations of existing policies and laws.

[Public consultation on the evaluation of the Strategic Environmental Assessment Directive](#)

**Consultation period: 23 April 2018 - 23 July 2018**

**Topics: Environment**

[Public Consultation on the evaluation of the Ozone Regulation](#)

**Consultation period: 1 June 2018 – 24 August 2018**

**Topics: Climate Action**

[Public consultation on the Evaluation of the 7th Environment Action Programme](#)

**Consultation period: 3 May 2018 - 26 July 2018**

**Topics: Environment, Climate Action**

[Public consultation on integration of long-term unemployed into the labour market](#)

**Consultation period: 2 May 2018 - 31 July 2018**

Topics: Employment and social affairs

[Public Consultation to support the Fitness Check of the EU Ambient Air Quality Directives](#)

Consultation period: 8 May 2018 - 31 July 2018

Topics: Environment

## Upcoming events

### Global Engineering Congress



The poster for the Global Engineering Congress (GEC) features a night view of a city with lights reflecting on water. The text on the poster includes:

- ice 200** logo with 'WFEU / FMO 50 YEARS' text.
- GEC** in large white letters, with **GLOBAL ENGINEERING CONGRESS** below it.
- The global profession will come together for one week, collaborating to agree action that delivers the UN SDGs*
- 22 - 26 OCTOBER LONDON**
- ICE.ORG.UK/CONGRESS**
- Facilitated by the world's oldest professional engineering body via WFEO's International forum
- Building a practical plan
- Focusing on how to improve the lives of billions of people
- In association with logos for **ASCE**, **European Council of Engineers**, and **CEC Commonwealth Engineers' Council**.

The world urgently needs to take action on climate change and engineers have a vital role to play in delivering clean water, sustainable energy and a connected world.

In October ICE will bring together a worldwide community of engineers to look at how we can create real change and plan how the UN's Sustainable Development Goals can be met.

At the GEC you will collaborate with global engineers, national and international policy makers, asset owners and experts from across the built environment. Using the combined platforms of ICE and the World Federation of Engineering Organisations, it is an unmissable opportunity to learn from international peers, forge connections and contribute to a plan that tackles the big global challenges.

The GEC offers 5 full days of multi-streamed content. 2,000-plus engineers will take part in a practical programme designed to produce answers that can improve the lives of millions around the world.

Taking place at ICE in London, GEC is part of the ICE 200 bicentenary programme, the 50<sup>th</sup> anniversary of WFEO and the UK Government's Year of Engineering.

[View the 5 day programme](#)

[GEC Brochure](#)

[Conference Speakers](#)

#### Why you should attend the GEC

- Gain an understanding of global challenges and blockers
- Play your part in agreeing actions the global community needs to take
- Network with experts from engineering, government and the worldwide built environment
- Plan for changes affecting the profession – and your career
- Share your expertise on an international stage

Organised in association with



For further details, registration and accommodation information please visit the ICE website <https://www.ice.org.uk/congress>

**World Construction Forum 2019 - Buildings and Infrastructure Resilience**



**INVITATION**  
**to the World Construction Forum 2019**  
 Buildings and Infrastructure Resilience  
 April 8 – 11, 2019, Ljubljana, Slovenia

Respected Engineers, Professionals, Businessmen and Politicians,

Dear Ladies and Gentlemen, we would like to cordially invite you to be actively involved into the World Construction Forum WCF2019 that will be held in the Cankarjev dom – Cultural and Congress Centre in Ljubljana, Slovenia, from 8 – 11 April 2019 under the honorary patronage of His Excellency Mr. Borut Pahor, President of the Republic of Slovenia.

The event is jointly organized by the Slovenian Chamber of Engineers (IZS) under the auspices of the World Federation of Engineering Organizations (WFEO) and by the Faculty of Civil and Geodetic Engineering of the University of Ljubljana (UL FGG) with co-operation of several further international and national organizations and associations. The WCF2019 is dedicated to the 100th Anniversary of the Ljubljana Engineers Chamber predecessor of the Slovenian Chamber of Engineers and to the 100th Anniversary of the University of Ljubljana.

The WCF2019 overall theme is Buildings and Infrastructure Resilience from Climate Changes to Disaster Risk and Facility Management and we would like to attract different stakeholders interested into this topic, such as practicing engineers and architects, policy makers from administration bodies of all levels, researchers and scientists, university professors and students, construction industry representatives, developers and investors – all of you are invited to contribute to WCF2019 and be present at this important world event in Slovenia, a step forward from the successful World Engineering Forum WEF2012 in Ljubljana, Slovenia with its theme Sustainable Construction for People.

Sincerely Yours,

**Mag. Črtomir Remec**  
 President of the Slovenian Chamber of Engineers (IZS)  
 Executive Vice-President of the World Federation of Engineering Organizations (WFEO)

**Prof. Matjaž Mikoš**  
 Dean of the Faculty of Civil and Geodetic Engineering  
 University of Ljubljana (UL FGG)

**Organisers:**



**Co-organisers:**



## [WCF2019 First Announcement](#)

For further details and information regarding the WCF 2019 please visit the website <https://www.wcf2019.org/>

## 13<sup>th</sup> WCCE General Assembly



Summer is coming and the time for WCCE's General Assembly comes nearer. This time WCCE is travelling to America as 13<sup>th</sup> WCCE's General Assembly will be hosted by the SOCIEDAD DE INGENIEROS DE BOLIVIA, member of the organization. The activities regarding 13<sup>th</sup> WCCE General Assembly will be held from 18<sup>th</sup> to 20<sup>th</sup> September 2018 in Sucre.

This meeting will be an opportunity to review WCCE's contributions to UNESCO'S II Engineering Report as well as WCCE's several partnerships with UN agencies such as UN-Water, UNESCO, UNDSR, etc. Such WCCE contributions will require dissemination and contributions by WCCE member organizations in order to replicate successful schemes in the commitment of our profession as a whole on the accomplishment of UN's 2030 Sustainable Development Goals.

Further information will be delivered shortly on the [WCCE website](#).

## ASCE Convention 2018



See the future of mass transportation.

Join us at the 2018 ASCE Convention as we bring the global civil engineering community together.

This is your chance to meet your civil engineering peers, share knowledge, discover new innovative strategies, meet leaders in your field – the [ASCE Convention](#) continues to be the premier civil engineering event each year.

### This year's Convention includes:

- Opening [Speaker](#) Dirk Alhborn, CEO of HyperloopTT, will provide an insider's view into a massive transformative project.
- [Short Courses](#) such as *Essential Success Enabling Skills* and *Women in Engineering*.
- Opportunities to earn up to 17 PDHs.
- [Technical Tours](#) including the *National Earthquake Information Center*.

For further information and registration please visit the ASCE Convention website <https://www.asceconvention.org/>.

## 2018 JSCE Annual Meeting



JSCE Annual Meeting is one of major gathering of civil engineers in Japan. The annual meeting, which is usually held in early September, draws over 5,000 attendees across the country and abroad, and over 3,000 research papers and poster are presented.

The 2018 JSCE Annual Meeting's theme is "Role of Civil Engineering in Developing Social Innovations". It will be held on August 29 and 30, 2018, at Hokkaido University Sapporo Campus, Sapporo city, Hokkaido.

The International Program includes the following meetings

1) International Panel Discussion (IPD),

2) The 20th International Summer Symposium & International Workshop for Young Civil Engineers,

3) Technical tour, and receptions.

This year the theme of International Panel Discussion is "Comparison of Infrastructure Maintenance and Resilience among Asian and Western Countries."

The registration closes on 25<sup>th</sup> July 2018. For further information you can contact the JSCE at [shibuyayuki-ko@jsce.or.jp](mailto:shibuyayuki-ko@jsce.or.jp).

## EUCEET Conference 2018



### 4<sup>th</sup> International Conference on Civil Engineering Education: Challenges for the Third Millennium 5-8 September 2018, Barcelona, Spain

World economy is changing rapidly. On the one hand, issues like health and safety, quality, resilience, sustainability, social justice and environment are increasing their weight for decision makers compared with traditional pecuniary considerations.

On the other hand, the advent of cheap powerful computers, smart phones and robots is changing society drastically and also the economic interactions.

The general agreed on professional requirements for future generations are the ability to interact with computers and robots, and the ability to do what these are not able to do (the so called soft skills as ethics or creativity).

Civil Engineer practice is also impacted by this change.

In the frame of Bologna Treaty, most universities are striving to adapt their educational contents as well as their training methods. Is Civil Engineering Education able to keep pace?

In this conference, this question will be answered addressing the following topics:

1. **New contents and capabilities:** Resilience, sustainability, BIM (Building Information Modelling), soft skills, automation, artificial intelligence, smart cities, UAV (Unmanned Aerial Vehicles).
2. **Methodology:** Student centered teaching methods, online learning, flip learning, active learning, PBL (Project Based Learning)
3. **The impact of educational policies:** quality management, quality control and accreditation agencies, links between teaching, research and practice

For further information please visit the website <http://congress.cimne.com/EUCEET2018/frontal/default.asp>.

## ICSA2019 – 4<sup>th</sup> International Conference on Structures and Architecture



The **ICSA2019 - The 4<sup>th</sup> International Conference on Structures and Architecture** will be held in Lisbon, Portugal, July 24-26, 2019 ([www.icsa2019.com](http://www.icsa2019.com)).

This is the **world's leading and largest global conference bridging the gap between Structures and Architecture**. The contributions on creative and scientific aspects in the conception and construction of structures, on advanced technologies and on complex architectural and structural applications represent a fine **blend of scientific, technical and practical novelties** in both fields.

The conference is organized under the auspices of the **International Association of Structures and Architecture** ([www.structures-architecture.org](http://www.structures-architecture.org)). The association aims to explore and to promote the merging of Structures and Architecture, encompassing all the aspects related with the recent advances in the art, practice and theory of teaching, as well as with researching, designing and building structures.

The time lag since ICSA2016 has been decisive to build up solid basis for ICSA2019. Some relevant milestones were achieved which have provided this new edition with undeniably extra added values:

- Co-sponsored and endorsed by **highly prestigious institutions**
- **Extended World-wide Scientific Committee** integrated by researchers and practitioners with a significant background in architecture and in structural engineering;
- Stimulating **keynote lectures** by prominent experts;
- **Mini-Symposia and Special Sessions.**

Updated information on ICSA2019 can be found at [www.icsa2019.com](http://www.icsa2019.com).

# 68<sup>th</sup> ECCE General Meeting

## 22 - 24 October, London, United Kingdom



### SAVE THE DATE!

The **68<sup>th</sup> ECCE General Meeting** will be held from **22 - 24 October 2018**, in London, U.K., hosted by the Institution of Civil Engineers (ICE). The venue of the meeting will be the ICE Headquarters at One Great George Street, Westminster, London, SW1P 3AA.

The 68th ECCE General Meeting will be held during the week of the [Global Engineering Congress](#) (GEC) in parallel with the GEC activities.

The Global Engineering Congress will be held at [One Great George Street](#), the Grade II listed home of the Institution of Civil Engineers. Set in the heart of Westminster, the award-winning venue is very close to the Houses of Parliament, Westminster Abbey, Buckingham Palace and St James's Park.

#### Accommodation

ICE works with a specialist agency, Eventay, to provide access to a range of discounted accommodation options near One Great George Street. Please visit the Eventay website to book your accommodation quoting 10198.

t: +44 (0) 20 7592 3050

e: [hotels@eventay.co.uk](mailto:hotels@eventay.co.uk)

w: [eventay.co.uk](http://eventay.co.uk)

68th ECCE General Meeting participants are advised to book their accommodation at the **Park Plaza Westminster Bridge Hotel** following the link [here](#).

#### National and international travel

##### Tube

St James' Park - 5 minute walk

Westminster (exit 6) - 5 minute walk

##### Rail

Charing Cross - 14 minute walk

Waterloo - 18 minute walk

Victoria - 17 minute walk

##### Eurostar

St Pancras International - 35 minutes

##### Air

Heathrow - 47 minutes

Gatwick - 44 minutes

London City - 26 minutes

Stanstead - 1 hour 5 minutes

Luton - 47 minutes

#### London

Make the most of your visit to London, one of the world's most popular cities. Explore local attractions, things to do and top sights through [Visit London's pages](#).

Delegates are invited to attend from around the world, and can book for all five days, three days or a single day of the event. Discounts for group bookings are also available and [registration is open](#).

#### Visas

If you require a visa to enter the UK, ICE is able to send a visa invitation letter to delegates who have registered and paid. This letter will provide confirmation of the purpose of your trip when applying for your standard visitor visa. It does NOT substitute an official visa permit.



## European Council of Civil Engineers

Secretariat:

P.O. Box 136 41, NTUA Patission  
Street Complex, (28th October) &  
Stournari Street, 10682 Athens, Greece

Tel.: +30 210 9238170

Fax: +30 210 9235959

E-mail: [ecce\\_sps@otenet.gr](mailto:ecce_sps@otenet.gr)

Web: [www.ecceengineers.eu](http://www.ecceengineers.eu)

**“Civil Engineers at the Heart of Society  
Building Life Quality and a Sustainable  
Environment”**

The European Council of Civil Engineers (ECCE) was created in 1985 out of the common concern of the professional bodies for Civil Engineers in Europe that the Civil Engineers working together across Europe could offer much more to assist Europe advance its built Environment and protect the natural environment.

At the European Union level, ECCE aims to promote the highest technical and ethical standards, to provide a source of impartial advice, and promote co-operation with other pan-European organizations in the construction industry. ECCE also advises and influences individual governments and professional institutions, formulates standards and achieves a mutual compatibility of different regulations controlling the profession, and formulates standards for a European Code of Conduct of the Civil Engineering Profession and disciplinary procedures applicable throughout the Union.