This project is co-funded by the European Union

EU HORIZON H2020-MSCA-RISE-2018
STructural stABiLity risk assEssment
STABLE

Workshop
"Protection of Cultural Heritage Sites under Risk"

School of Civil Engineering
National Technical University of Athens

Tuesday, 27th September 2022

PROGRAMME	
9.00 – 9.30	**Opening**
	C. Saroglou, Dr. School of Civil Engineering, NTUA Coordinator C. Spyrakos, Emeritus Professor, School of Civil Engineering, NTUA Alessio Di Iorio, ALMA Sistemi S.r.l. Project Coordinator
9.30 – 10.15	**Vasilis Sarhosis** Associate Professor, School of Civil Engineering, University of Leeds
	Structural inspection and assessment of our historic infrastructure stock: Future trends and new technologies
10.15 – 11.00	**Francesca Bozzano** Professor, Department of Earth Sciences, Sapienza University of Rome
	Engineering geology and remote sensing: together to protect Rome's cultural heritage
11.00 – 11.30	**Stefano De Angeli, F. Battistin** Professor, Cultural Heritage Center, University of Tuscia
	Earthquakes in Rome through history
11.30 – 11.45	Coffee break
11.45 – 12.15	**Michael Fragiadakis** Associate Professor, School of Civil Engineering, NTUA
	Seismic reliability assessment of ancient columns and colonnades
12.15 – 12.45	**Achilleas Papadimitriou** Associate Professor, School of Civil Engineering, NTUA
	Effects of surface topography and bedrock morphology on seismic ground motion affecting cultural heritage sites

12.45 – 13.30	Lunch Break
13.30 – 14.00	**Aggelos Mouzakiotis** Senior Researcher, National Observatory of Athens
	Implementation of Geophysical and Seismic Hazard methodologies for Cultural heritage protection against Strong Earthquakes in Greece
14.00 – 14.30	**Constantine Spyrakos** Emeritus Professor, School of Civil Engineering, NTUA
	Seismic analysis of Structures in a historic center
14.30 – 14.45	Coffee break
14.45 – 15.15	**Dimitris Alexakis** Assistant Researcher, Foundation for Research & Technology Hellas (FORTH)
	Satellite Remote Sensing for the analysis, monitoring and mapping of cultural environment
15.30 – 16.00	**Charilaos Maniatakis** Senior Researcher, School of Civil Engineering, NTUA
	Assessment of seismic risk of historic centers based on a computer code using a simplified mechanical method
16.00 – 16.30	**Christos Kontopoulos, Alexandros Paraskevas** Geosystems Hellas
	Monitoring with SAR Processes, the Nafplion city.
16.30 – 17.00	**Closing discussion**

Location:
National Technical University of Athens
Library, Amphitheatre
https://goo.gl/maps/fGSmwKHtt3FCSCht6

ABSTRACTS

Vasilis Sarhosis, Associate Professor, School of Civil Engineering

University of Leeds

Structural inspection and assessment of our historic infrastructure stock: Future trends and new technologies

Abstract

Inevitably, all structures deteriorate towards a state of unserviceability and collapse. Maintenance is the art of controlling the rate at which our structures deteriorate. Proficiency in this filed relies on judgement derived from regular inspection, monitoring and experience. This talk will present novel technologies and tools for the structural inspection and assessment of our existing and ageing masonry infrastructure (i.e., old masonry arch bridges, historic structures etc.). It will deal from identification of defects and their diagnosis using machine learning to development of high fidelity models for their structural assessment. It will also bring together information from proven techniques and illustrate these through case studies.

Francesca Bozzano, Professor, Department of Earth Sciences

Sapienza University of Rome

Engineering geology and remote sensing: together to protect Rome's cultural heritage

The present contribution combines engineering geology and remote sensing technologies for the protection and safeguarding of cultural heritage. Some examples from the city of Rome (Italy) are presented to illustrate the challenges and opportunities of the interaction of these two disciplines to enhance CH management by performing multiscale and multitemporal analysis to identify changes that might contribute to an increased cultural heritage vulnerability to some geological hazards.
The cause/effects relationships between the engineering geological properties of the subsoil of some Roman cultural heritage sites and their response with respect to some geological hazards are discussed, with specific emphasis from one side on the role of recent alluvial deposits of the Tiber river fluvial network, and thick man-made fill resulting from (more than 2000 years) urbanization history of the city of Rome, and from the other side on the implication of remote sensing techniques for the evaluation of the generated impacts on these historical assets

Michael Fragiadakis, Associate Professor, School of Civil Engineering,

National Technical University of Athens

Seismic reliability assessment of ancient columns and colonnades

Abstract

The performance-based seismic risk assessment of classical columns is presented. Despite their apparent instability, classical columns are, in general, earthquake resistant, as proven from the fact that many classical monuments have survived many strong earthquakes over the centuries. Nevertheless, the quantitative assessment of their reliability and the understanding of their dynamic behaviour are not easy, due to the fundamental non-linear character and the sensitivity of their response. The presentation will discuss the various components required for the analysis of these historical structures and the derivation of their fragility curves. Fragility analysis demonstrates some of the salient features of these systems under seismic excitations, as for example their decreased vulnerability for very strong earthquakes of magnitude 7 or larger. The work shows that risk-assessment can be used as a powerful decision-making tool for the preservation of ancient columns and colonnades.

Achilleas Papadimitriou, Associate Professor, School of Civil Engineering,

National Technical University of Athens

Effects of surface topography and bedrock morphology on seismic ground motion affecting cultural heritage sites

Abstract

The seismic hazard in cultural heritage sites depends significantly on the local geotechnical conditions, as well as on the ground surface topography and the underlying bedrock morphology in the greater area. Prominent examples include the Parthenon temple in Athens or the Pallatino hill in Rome with respect to topography effects and the alluvial valley in L' Aquila Italy for the importance of bedrock morphology. Seismic hazard estimation is rather straightforward in terms of geotechnical conditions, but less so in terms of the surface topography and bedrock morphology which require more elaborate site investigation and 2D or even 3D ground response analyses. Focusing on these complex effects from an engineering perspective, this presentation employs numerical analyses and idealizations for the governing seismological, geomorphological and geotechnical characteristics aiming at the quantification of the peak aggravation (in the horizontal and the parasitic vertical accelerations), as well as its spatial variability in the vicinity of 2D hills, slopes and canyons. The same perspective is then employed for studying the seismic response of alluvial valleys via a critique on EC8 design spectra in terms of 1D and 2D analyses. It underlines the need for decoupling (1D) soil effects from bedrock morphology effects, with the latter primarily affecting the high frequency components of the motion. The presentation ends with a discussion on when topographic reliefs and alluvial valleys interact in terms of seismic wave propagation thus disallowing their separate consideration.

Aggelos Mouzakiotis, Senior Researcher, National Observatory of Athens

Implementation of Geophysical and Seismic Hazard methodologies for Cultural heritage protection against Strong Earthquakes in Greece

Abstract

The multitude of Greek monuments, spread throughout the Greek region, are characterized by a large seismic risk, due to the large number of large earthquakes that are yearly recorded in Greece. Towards the protection of the Greek cultural heritage, a complete catalogue of all monuments, as well as all known active faults has been compiled by the National Observatory of Athens in the framework of “ASPIDA” project. A Deterministic Seismic Hazard assessment was carried out, in order to calculate the maximum expected ground acceleration for each monument. The results of the project are constantly being updated by the implementation of new data. In this context, by combining the compiled data with the results of several geophysical surveys, focused on the region of Herakleion (Crete), we update the Seismic Hazard Assessment for the local monuments. In particular, a local active fault that was further investigated by seismic profiles and was updated in the “ASPIDA” database and was used for the Seismic hazard assessment in the region, whereas the soil amplification was accurately estimated by several Passive and Active MASW (Multichannel Analysis of Surface Waves) surveys. A more accurate estimation of the expected ground motion is thus provided, both for the worst case earthquake scenario (using the deterministic methodology), as well as for specific return periods (probabilistic methodology). Finally, we demonstrate the simulated response of a monument to a specific synthetic ground motion, resulting from the worst case earthquake scenario in the study area.

Dimitris Alexakis
Assistant Researcher, Foundation for Research & Technology Hellas (FORTH)

Satellite Remote Sensing for the analysis, monitoring and mapping of cultural environment

Abstract
The presentation will initially focus on describing the basic principles of Remote Sensing and will thoroughly present the possibilities Remote Sensing offers in conducting archaeological research. Specifically, the present regime of Remote Sensing Archaeology and its prospects will be presented, highlighting issues of data availability, scale of detail, capabilities of different satellites and flying means of capturing images for archaeological research and discussion of all the future trends in the field. Finally, examples of selected case studies and highlight how Remote sensing provides answers to archaeological questions will be presented.

Charilaos Maniatakis
Senior Researcher, School of Civil Engineering, NTUA

Assessment of seismic risk of historic centers based on a computer code using a simplified mechanical method

Abstract

The aim of this lecture is to present the assessment of seismic risk by applying a simplified mechanical method with the help of a computer code that has been developed in the context of STABLE research project. Representative results will be shown for selected case-study historic city-centers, namely for Rieti in Italy, Nafplion in Greece and Strovolos in Cyprus. The seismic assessment is made for a range of buildings located in the abovementioned areas, for which an extensive survey was made in order to collect structural data that are essential to perform the calculation of structural vulnerability. Different seismic scenarios are used to address seismic hazard considering different probabilities of exceedance. The code allows for an easy calculation of the seismic risk; however, a discussion will be made regarding the accuracy of such simplified methodologies.

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Christos Kontopoulos, Alexandros Paraskevas, Geosystems Hellas

Monitoring with SAR Processes, the Nafplion city.

Abstract
Stacking interferometry methods are ideal to exploit a series of N SAR images (Interferometric stacking) to identify areas (pixels) that show coherent and consistent signal (displacement) over the time.
The Persistent Scatterers (PS) is intended for the analysis of point targets. The resulting product is relevant to the measurements of linear displacements and the derivation of precise heights of local scatterers, which are typically characterized by high coherence. The identification of PS is generally considered reliable when 20 or more acquisitions are used and regular, in temporal terms, acquisitions are available. PS should exclusively be used in urban areas, or in general, where scatterers remain stable in radiometric and interferometric phase terms. Depending upon the scatterer stability (time coherence), the achievable displacement precision can reach the precision of millimeters, while the maximum velocity is limited by the minimum time distance between the acquisition and the sensor wavelength. (Shamshiri 2018)
In Nafplion old city, the surface shows a tendency to rise, slightly (5 mm/year) but exhibits an overall stable behaviour. No particular subsidence can be noticed. Throughout the various areas, the time series showcase a tendency to remain stable, with only slight ground movements between 2013 and 2019.