

newsletter

2 / 2017

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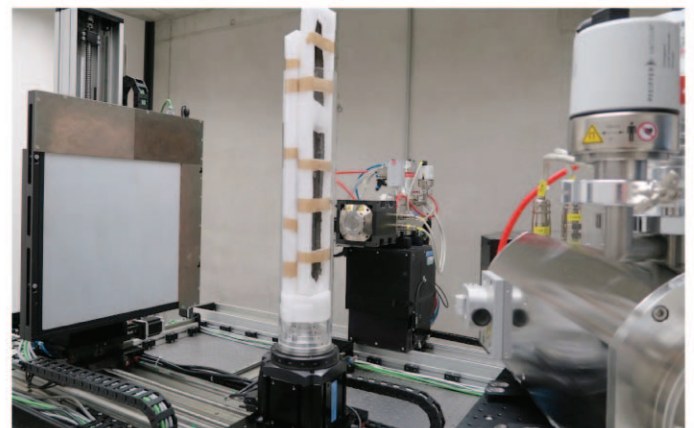
Centre of Excellence Telč

INSTITUTE OF THEORETICAL AND APPLIED MECHANICS CAS, v. v. i.



REVEALING THE SECRETS OF CELTIC SWORDS

Over the last year, rentgenography and tomography pilot tests have been performed on heavily corroded archaeological artefacts from the Iron Age in the Laboratory of X-Ray Tomography at the Centre of Excellence Telč in cooperation with the Historical Museum – National Museum, Prague. Most of the artefacts were Celtic swords of the La Tène culture, found on Czech territory. The patented TORATOM device could be set to the optimum parameters for scanning the objects. The first tests showed that in spite of totally corroded surfaces, after careful 3D model processing, it was possible to visualize the original shape of the blades, technological details such as rivets, and even the original engraved decorations on the swords. Based on these promising results, additional measures have been implemented which have revealed many new facts about the artefacts being investigated. In one case, for instance, it was shown that a compact piece was in fact a conglomerate of several individual fragments of different origins. In another case, an elaborate engraved decoration was revealed which was beyond expectations. Due to their archaeological importance, the results were immediately published in the renowned Czech journal *Archaeology of Western Bohemia*. Moreover, the results were presented from the perspective of physics and method at an important international symposium, SPIE Optical Metrology, in Munich. Modern tomographic methods, together with advanced data processing, have created completely new opportunities in archaeology. The method used for the data acquisition was partially developed with the support of the European Regional Development Fund as part of the project Com3D-XCT (ATCZ-0038) in the Interreg V-A Austria-Czech Republic programme.



A Celtic sword in the patented TORATOM device

M. Vopálenský

EDITORIAL

Dear readers, the autumn is coming with its pensive weather and so I would like to brighten your mood up with this 2nd Newsletter of the Centre of Excellence Telč (CET) of the Institute of Theoretical and Applied Mechanics of the Czech Academy of Sciences. I was very pleased that we had to carefully select from many good articles, not to exceed the usual four pages range. It shows that ITAM employees are active and that there is no shortage of interesting work and scientific subjects.

This year, our institute has achieved significant accomplishments and received several awards. Let me highlight the prizes received by our long-time colleague, Jiří Náprstek. The first is the domestic "Z. P. Bažant Prize" and the second is an international award given by the European Association for Structural Dynamics (EASD). Both prizes serve as a recognition of his lifelong scientific efforts as well as a promotion of our good name. The ITAM's achievements were also acknowledged by the European Commission, which awards the European Union Prize for Cultural Heritage Europa Nostra Awards 2017. ITAM has been ensuring the teaching within the awarded Advanced Master programme in Structural Analysis of Monuments and Historical Constructions since 2006.

The scientists of CET significantly contribute to the common ITAM activities. The evidence of that are the articles about the radiography experiments on the corroded archaeological artefacts from the Iron Age or the results from the Laboratory of Material Analyses using the unique CET equipment. The scientists present their results internationally, on the conferences and workshops. They also publish their articles in important scientific journals. So far this year, there has been almost 30 papers accepted by the peer-reviewed journals, largely the impacted ones. That deserves a praise. I wish you all an interesting reading.

Stanislav Pospíšil, director of ITAM

E-RIHS PP MEETING IN PRAGUE

From the 12th to 14th of September 2017, the 2nd interim meeting of the European project E-RIHS PP (European Research Infrastructure for Heritage Science Preparatory Phase) supported by the Horizon 2020 programme took place at the Czech Institute of Informatics, Robotics and Cybernetics in Prague. The event was organized by ITAM. The goal of the project is to develop a new European large research infrastructure for heritage science. E-RIHS PP combines the joint efforts of 18 countries and over 80 research institutions.

APPOINTMENT OF A NEW DIRECTOR

On June 1st, 2017, a new director of ITAM CAS, Assoc. Prof. Stanislav Pospíšil, Ph.D., was appointed. The previous director, Prof. Miloš Drdáký, DrSc., Dr.h.c., held the position for almost twenty years. The documents of appointment were presented by the president of the Czech Academy of Sciences, Professor Zažímalová, who also gave her heartfelt thanks to his predecessor Prof. Drdáký for his years of selfless work for the institute as she highlighted his outstanding qualities, both personal and in the field of science.



doc. Ing. Stanislav Pospíšil, Ph.D.

SPECIAL AWARD FROM THE EASD PRESENTED TO Eng. J. NÁPRSTEK, DrSc.

From the 9th to the 13th of September 2017, the 10th EURO DYN conference took place in Rome, hosted by the Faculty of Civil and Industrial Engineering of Sapienza University of Rome. The conference is an annual event organized by the European Association for Structural Dynamics (EASD). During this conference, a scientist from ITAM CAS, Eng. J. Náprstek, DrSc., was presented with a Special award for outstanding and sustained contributions in the field of Structural Dynamics. He received it from the president of EASD, Prof. G. Müller. The award is the highest European honour for scientific activities in Dynamics and is awarded only in special cases.

Z. P. BAŽANT PRIZE AWARDED TO Eng. J. NÁPRSTEK, DrSc.

In spring 2017, Eng. Jiří Náprstek, DrSc., was honoured with the Z. P. Bažant Prize for Engineering Mechanics. The prize is awarded annually by the Czech Society for Mechanics (CSM) for an article or a series of articles on an original topic, a book, a monograph, or a PhD thesis, written in Czech or English. The prize is 1,200 dollars and is the highest honour given in this field in the Czech Republic.

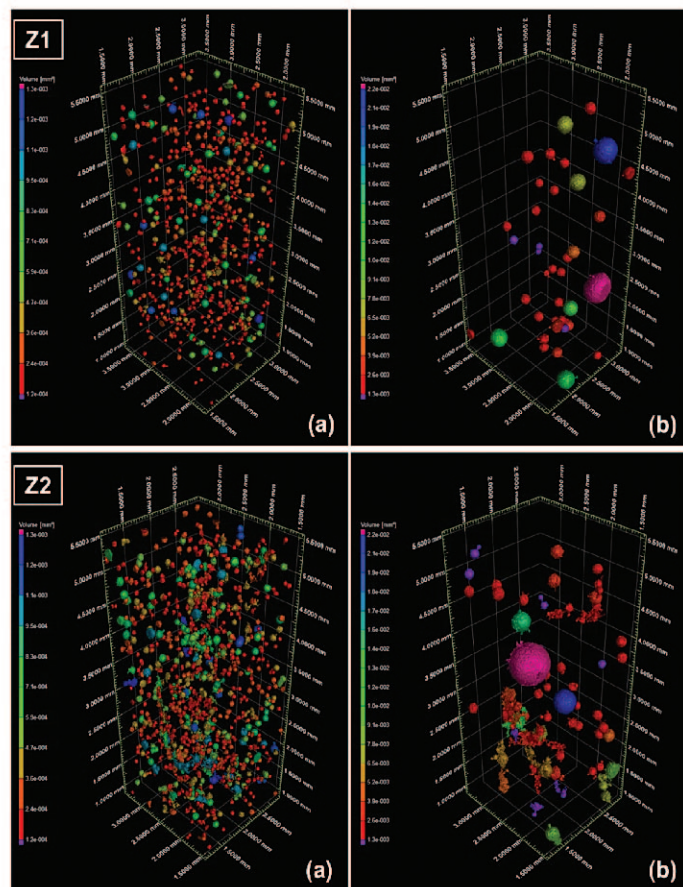
EUROPA NOSTRA AWARD

On the 5th of April 2017, the European Council together with the organization Europa Nostra announced the winners of the European Union Prize for Cultural Heritage / Europa Nostra Awards 2017. One of the winners in the category Education, Training and Awareness-Raising was the study programme Advanced Master in Structural Analysis of Monuments and Historical Constructions (SAHC), which ITAM helps guarantee as an associated partner. ITAM thus won for the second time – the first time was in 2009.

HOW POROUS ARE DENTAL CEMENTS?

The materials science team recently published a study on the microstructure of cements used for dental applications. The group used two advanced techniques available at international facilities: small-angle neutron scattering and synchrotron X-ray microcomputed tomography. In the first case, the experiment was performed at the nuclear reactor MLZ in Garching (Germany); in the second, the data were collected using the Italian synchrotron light accelerator at Elettra Sincrotrone Trieste. Thanks to the European research infrastructure CERIC, the team gained access to the facilities where they conducted the experiments free of charge. Moreover, the paper that was published has been recognised as a high quality / high impact publication and awarded a special grant of about 2,500 Euros covering the full cost of an open-access scientific paper publication. With this innovative approach, which is fully non-destructive, a wide range of porosity was covered in the dental cements studied (from the nanometric to the millimetric scale). The parameters derived from this study provide information about the release and uptake of fluoride and the dissolution of the cement once in the mouth – parameters of importance for improving the quality of the product.

Paper: A. Viani, K. Sotiriadis, I. Kumpová, L. Mancini, M-S. Appavou. Microstructural characterization of dental zinc phosphate cements using combined small angle neutron scattering and microfocus X-ray computed tomography. Dental Materials, 33, 4, 402-417 (2017). DOI: 10.1016/j.dental.2017.01.008.



3D rendering of two classes of pore sizes (a and b) in a volume of 2 dental cements (Z1 and Z2) that were studied as obtained using X-ray microcomputed tomography.

A. Viani

SURVEY OF THE NEW PROVOST RESIDENCE AT PRAGUE CASTLE

Over the last few months, a survey of the building materials (plasters, masonry units, slate roofing, mechanical and mycological evaluation of timber structures) and respective conservation status was carried out on the New Provost Residence at Prague Castle to aid in planning the restoration of the building. The technical report will help the contractor, restorers, and conservation scientists make decisions for the restoration campaign – for example, the design and selection of compatible materials and techniques. It was necessary to use primarily non-destructive methods and limit the extent of micro-destructive tests.

That is why only micro-samples of plaster and stone and 21 samples of slate roof were collected for laboratory analyses. A wide variety of methods were used for the analysis of the plaster samples; for example, conventional laboratory methods (gravimetric determination of moisture content, sieve analysis, water absorption kinetics) as well as instrumental testing such as thermal analysis, X-ray diffraction and scanning electron microscopy. The moisture distribution was assessed in-situ using a microwave-based sensing device (MOIST-210-GmbH) for the non-destructive moisture measurement of porous materials so that building moisture distribution maps of walls can be made. Capillary water absorption was also measured using Karsten tubes and a micro-tube device developed at ITAM CAS that makes it possible to measure the moisture uptake in conditions where the Karsten tube cannot be used – for example, horizontal surfaces, surfaces with high tortuosity, and surfaces showing a loss of cohesion.

The percentage of elements structurally damaged from the ceiling timber structures (trusses and roof decking) wooden window frames, and exterior and interior doors was evaluated. Mycological analyses were performed on selected samples.

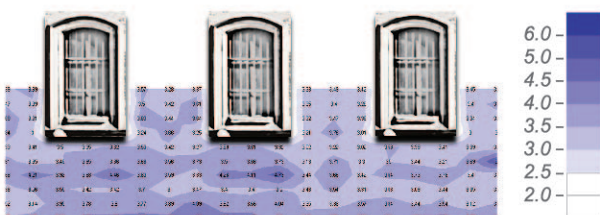


Figure 1: Moisture map of the Southern facade measured with the moisture sensor MOIST-210-GmbH

Figure 2: Color scale with corresponding water content in the material (wt. %)



Figure 3: Lower part of the rafter damaged by wet rot



Figure 4: Aspect of the fracture of a slate samples collected from the roof after tensile testing – North plane sample with visible delamination (left), South plane sample (right)

P.Hauková

NEW INSTRUMENTS AT CET

In August, a new titration machine, Titrand, with equipment and software for process automatization was installed in the Centre of Excellence Telč. This instrument can be used to perform a number of chemical analyses – that is, it takes pH, potential, concentration, temperature, and conductivity measurements as well as voltometric measurements with optional polarised currents, amperometric measurements with optional polarised voltage, and more. This instrument will be used for activities such as the online monitoring of chosen parameters during the synthesis of calcium carbonate polymorphs within project 17-05030S, funded by the Czech Science Foundation and led by Radek Ševčík.

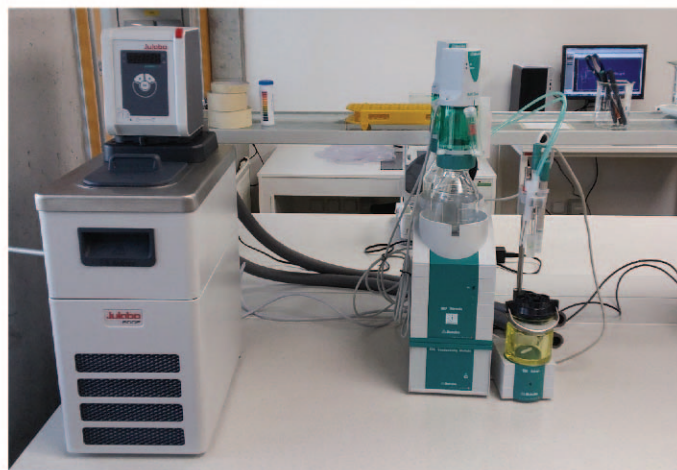


Figure 1: Automatic titrator Titrando with connected thermostat and with pH and conductivity modules.

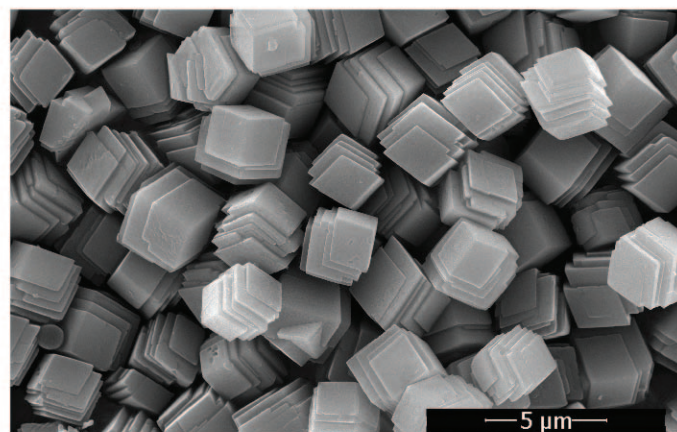


Figure 2: Calcite crystals formed during the synthesis from saturated salts solutions using the automatic titrator. The picture was obtained using a scanning electron microscope.

R. Ševčík

ACTIVITIES IN THE CLIMATIC WIND TUNNEL "VINCENC STROUHAL" CET

The initial calibration of the new equipment for measuring the aerodynamic properties of structures was carried out in the climatic wind tunnel in July and August. The miniature multi axis force transducers ATI NANO25 are built into the aerodynamic force balance designed for testing of the aeroelastic properties of slender beams and sectional bridge models.



Figure 1: Force transducer

The adjusted instrument can be used to measure both static and dynamic forces and moments during resonance or self-oscillation. The separation of inertial forces from aerodynamic forces during vortex induced oscillation is possible using the developed procedure.

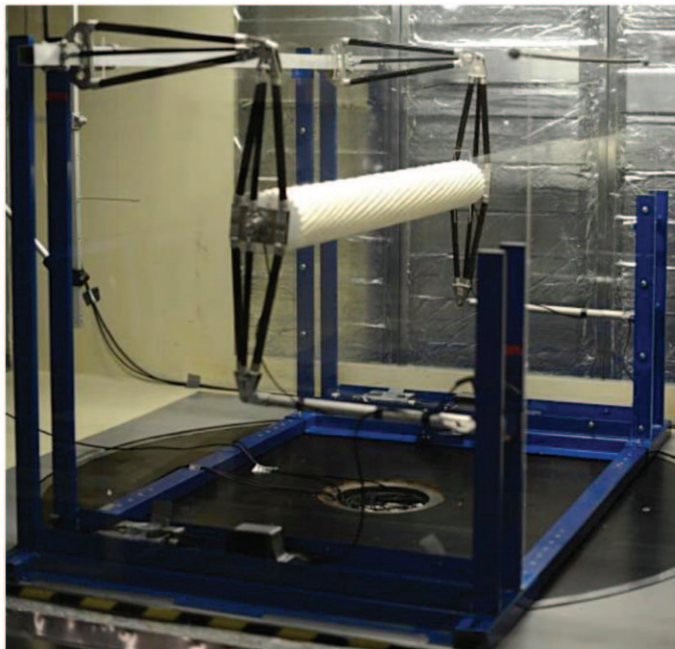


Figure 2: Aerodynamic balance

The force balance equipped with the new ATI NANO25 sensors is intended for the investigation of forced, self-excited, and resonant vibrations of sectional bridge models, wire rope models, and lightweight aerodynamic profiles. The force frequencies tested can reach 100 Hz and the model lengths can be up to 1.3 m.

S. Kuznetsov

TECHNART CONFERENCE

In May, the members of the laboratory of material analyses participated in the Technart conference in Bilbao, Spain. This established international conference focuses on the non-destructive and micro-analytical techniques used for art and cultural heritage. Our scientists presented their research done within the projects LO1219 and 17-05030S investigated at CET. Alberto Viani gave a lecture on the assessment of the burning temperature of historical bricks using the X-ray powder diffraction method and small angle neutron scattering. Radek Ševčík presented to the scientific community the study investigating calcium carbonate formation using micro-Raman spectroscopy. In all, there were more than 120 lectures in 3 parallel sections and 90 posters presented. The conference was attended by more than 350 scientists and other specialists working in the field of cultural heritage from all over the world. The participants were thus able to meet top-level scientists and present the research done at the Centre of Excellence Telč to a broad public.

R. Ševčík

HISTORIC SCAFFOLDING PRIOR TO THE INDUSTRIAL REVOLUTION

That was the name of the international colloquium held from the 4th to the 7th of May, 2017 in the Study centre of the State Castle Český Krumlov. Almost 50 experts (24 from the Czech Republic, 18 from Germany and 7 from Slovakia) participated in the event. CET ITAM CAS was both the initiator and the main organiser. Both of the two territorial departments of the National Heritage Institute in České Budějovice became our partners. Thus we continued the tradition founded by a similar meeting held in Munich in 2014 (Universität der Bundeswehr München). The aim was to offer opportunities for meetings of experts in the field of historical construction techniques and technologies. The presented results were focused either on important remnants of construction cranes, scaffolding, centering, formworks and other auxiliary structures or on historical records of them in period plans, written and iconographical sources. Part of the time was also focused on geometrical methods used in designing of the buildings and on experience with real scale structural experiments.



Excursion to the roof of St. Vitus Church.

J. Bláha