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ITAM ARCCHIP
INSTITUTE OF THEORETICAL
AND APPLIED MECHANICS



Centre of Excellence Telč

2 / 2018

EDITORIAL

Dear readers and friends of science,

After a while we again hand you, this time for autumn evening reading under a lamp, another issue of the ITAM and CET Newsletter. Despite the summer holidays, the researchers from our departments have produced interesting results which are described in more detail on the following pages.

From the many results we can be proud of, I would like to mention the development of an effective method describing deformation processes and crack propagation in nonhomogeneous materials. Samples of the material are exposed to mechanical stress and irradiated at the same time. A unique device developed by ITAM employees has brought this method from theory into reality. ITAM research also has practical applications. A relatively complex analyses of a footbridge in Písek was carried out by scientists from the Department for Dynamics and Stochastic Mechanics. The footbridge consists of two different but connected bridges. The structure is therefore rather unusual and is characterised by a strong dynamic response to wind and pedestrian crossing on both parts.

In the text you can find e.g. a report on a prestigious award given to ITAM workers personally by the president of the Czech Academy of Sciences, Prof. Eva Zažímalová. It is a great honour, and we hope that this recognition will serve as inspiration to younger workers and proof that it is possible to attain high social prestige in the sciences. This is undoubtedly true of a former ITAM director Prof. Miroš Píner, who turned 90 in September and is still scientifically active. We congratulate him on behalf of the editorial board of the Newsletter and ITAM workers.

ITAM and CET are present at conferences, abroad or with foreign guests. Before the summer we organised the international conference Engineering Mechanics 2018 in Svatka, and at the end of the summer we established a collaboration with The National Laboratory of Additive Manufacturing, 3D digitalization and Computed Tomography in Mexico. ITAM joined the international project Conservation of concrete Cultural Heritage (CONSECH20), and participated on the nineteenth annual Documentation and surveys of historical timber roofs course in Slovakia. In short, the summer and the beginning of autumn was again a very busy time at ITAM and CET.

I should probably stop listing our institute's activities though, as the editorial should not aspire to reveal everything. I wish you an entertaining read.

S. Pospíšil, director ÚTAM

CONSERVATION OF 20TH CENTURY CONCRETE CULTURAL HERITAGE IN CHANGING URBAN ENVIRONMENTS

CONSECH20

CONSECH20 project proposed by ITAM CAS together with the Delft University of Technology (TUD), the University of Cyprus (UCY), the University of Genoa (UNIGE) and the Institute of Sociology of the National Academy of Sciences of Belarus (ISNAS) was amongst the 42 submitted proposals to the Joint Programming Initiative on Cultural Heritage call on the topic Heritage in Changing Environments. Out of these, 5 were recommended for funding, including the CONSECH20 proposal. CONSECH20 is a three year research project that aims to develop effective approaches for conservation and protection of 20th century heritage concrete buildings against the ever-changing urban impacts. 20th century concrete heritage is a major challenge for conservation both because of its remarkable architectural variety and experimental character in use of materials and technologies as well as due to the lack of recognition of its cultural and historical value by the general public. These aspects, together with the fast-changing urban environment, are leading causes of its deterioration and, sometimes, demolition. CONSECH20 focuses on structures built with early concrete (until 1960) of social interest in the sense of bringing people together (e.g. for recreation, inhabiting, working) to strengthen the link between society and 20th century architectural heritage. CONSECH20 will increase the potential of 20th century early concrete CH as a tool for social integration and cultural tourism and contribute to the establishment and development of the notion of Heritage Science, a relatively new and emerging field of science that aspires to bridge the gap between humanities and applied sciences. It will outline new approaches to participatory monitoring and conservation/restoration for future use of modern architectural heritage by stakeholders, and for citizen engagement in the protection of modern architectural heritage. The project will use representative case studies of early concrete buildings in four of the participating countries that can lead to the selection of appropriate evaluation and testing scenarios. ITAM CAS is the coordinating institution, and the project will start in January 2019.

C. Nunes

PROF. PIRNER TURNS 90!



Prof. Ing.
Miroš Pirner,
DrSc., dr.h.c.

Prof. Miroš Pirner, former director of ITAM CAS, celebrated his 90th birthday this year. He served as director from 1990 to 1998. He led the institute through the difficult period after 1989 when ITAM returned the Emmaus Monastery (where it had been located until then) to the Saint Benedict Order, and had to move to a new location. His expert and scientific work has been focused mainly on theoretical and experimental research of air flow effects on structures for which he received many awards. Currently Prof. Pirner

serves as senior researcher in the department of Dynamics and Stochastic Mechanics. The ITAM collective wishes him all the best for the coming years!

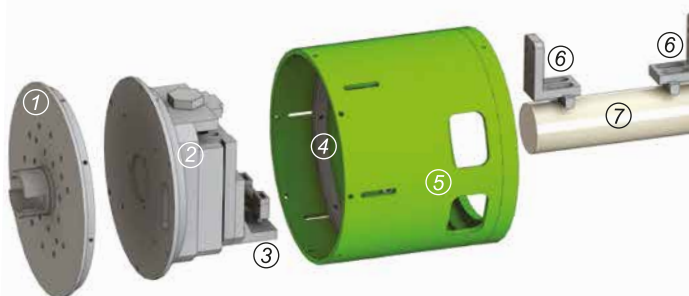
B. Přečová

FOUR-POINT BENDING TEST INSTRUMENTATION FOR 4D COMPUTED TOMOGRAPHY

High-resolution time-lapse micro-focus X-ray computed tomography (4D micro-CT) is a method for investigating the deformation processes and fracture propagation characteristics of non-homogeneous materials during loading.

For this purpose, a unique experimental device (patent pending PV2018-28) capable of four-point bending (4PB) testing during X-ray imaging has been developed. In contrast with standard bending setups, the proposed device is designed for vertical orientation of the investigated specimen, whose axis of rotation is identical to the rotational axis of the CT devices. The device is composed of three main components: a pair of a motorized loading units with integrated movable outer supports of the four-point bending arrangement, a pair of stationary inner supports of the four-point bending arrangement, and a cylindrical load bearing frame housing the loaded specimen together with the loading units and all the supports.

Proof of concept together with pilot experiments were successfully performed in the TORATOM CT scanner. Based on results acquired, fracture-process zone and macroscopic crack propagation in a quasi-brittle material can be observed in 3D using an in-situ loading procedure and high resolution 4D micro-CT.



Configuration of the 4PB loading device

P. Koudelka, D. Kytýř

SUMMER SCHOOL DOCUMENTATION AND SURVEYS OF HISTORICAL TIMBER ROOFS 2018

The 19th annual International Summer School, organized by the Czech Association of Construction Historians in collaboration with the CET, was held on September 10-14, 2018. This year, the territory of the southern part of Central Slovakia was chosen. The event was organised by our colleagues from the Monument Board of the Slovak Republics (Dr. Ľubor Suchý, Dr. Karol Ďurian). Thanks to the kind patronage of Prof. Pavel Gregor, Dean of the Faculty of Architecture of the STU in Bratislava, the participants could stay at the premises of the FASTU Educational and Scientific Research Centre in Banská Štiavnica. The course was attended by 21 participants from the Czech Republic, Slovakia and Romania. Other guests were also invited, especially the staff of the Regional Monument Office in Banská Bystrica and Banská Štiavnica. The program was focused on the practical aspects of study of historical roof trusses (on the recognition of features important for time and typological classification and so on). The participants got acquainted with regional features of traditional crafts, especially carpentry. The greatest impact was brought by a visit to the house at Štefan Moyzes Square No. 7 in the historical centre of Banská Bystrica. It is the only preserved roof with a unique chain structure made according to the patented design of Bedřich Schnirch from 1826. Very interesting were the evening lectures focused on methodological questions of surveys of roof trusses and their chronotypological division. Much appreciated was the presentation given by Boglárka Tóth about a state-of-the-art overview of dating results regarding timber roofs in Transylvania.



Photo: M. Kloiber

Inspection of the roof trusses of St. Lawrence Church in Beluj, near B. Štiavnica

J. Bláha



1. rotary table adapter
2. motorized loading unit
3. outer support with loadcell
4. docking ring

5. high-strength aluminium alloy frame
6. inner supports
7. specimen
8. carbon-composite frame
9. slip ring adapter

COLLABORATION BETWEEN ITAM AND THE NATIONAL AUTONOMOUS UNIVERSITY OF MEXICO

ITAM CAS with its Telč centre established a research collaboration with Mexican partners. Assoc. Prof. Michal Vopálenský, Head of the X-ray Tomography Laboratory at CET, visited Mexico in April 2018, where he gave a speech at a conference on additive production and material characterisation. The conference was organised by The National Laboratory of Additive Manufacturing, 3D digitalization and Computed Tomography (MADiT) at the National Autonomous University of Mexico (UNAM). UNAM, with its more than 300 thousand students, is the largest university in Latin America, and on a world scale a very prestigious one. *"My presentation about the imaging possibilities we have in Telč, thanks to a unique patented tomograph TORATOM, met with a positive response, and I had a chance to talk to a number of Mexican scientists professing an interest in cooperation. Then it was only a question of finding a suitable collaboration platform and funding,"* says Vopálenský. It has been successful to a certain degree, and in July of this year Dr. Aida Rodriguez visited the Telč centre. She gave a lecture on modern additive production technologies, or 3D printing, for the purpose of bone implant preparation used especially in dental medicine. *"From September we agreed on a 6-week CET internship for a Mexican doctoral fellow, Adriana Hernandez from MADiT. She is working on characterisation of materials produced by 3D printing with help from ITAM biomechanics led by Dr. Kytýř. The results will be used in Adriana's doctoral thesis, and a scientific paper is also being prepared,"* adds Vopálenský.



From the left: G. Presbítero, L. Ruíz, A. Hernández, M. Vopálenský, A. Caballero

The last week of September saw the arrival of the Head of MADiT, Dr. Leopoldo Ruíz, and his deputy, Dr. Alberto Caballero. They brought with them a model of an artificial human oesophagus which can simulate the real one's functions. The TORATOM device in Telč was again used to monitor the passage of food through the organ, and now a paper is being prepared. In Prague, Dr. Ruíz gave an interest-arousing lecture, and the discussion that followed generated other possibilities for collaboration. *"I'm planning another trip to Mexico in December as I have been invited to participate in a meeting of European and Latin-American scientists working on the investigation of cultural heritage in relation to the European project E-RIHS (European Research Infrastructure for Heritage Science), to be presented in Brazil and Mexico,"* reveals Vopálenský. Since June, another alumni of UNAM, Dr. Gerardo Presbítero, has been investigating micro-fractures in bone tissue at the centre in Telč. As a part of a mobility project, he will be staying for 11 months. *"A collaboration with Latin America and especially with Mexico is something that I have always wanted to realize, owing also to my year-long stay at UNAM in 2003, but it had always been difficult to find a suitable framework. I think now we've managed that, and I just hope that the enthusiasm on both sides will last,"* concludes Vopálenský.

J. Novotný, M. Vopálenský

THE INTERNATIONAL CHEMISTRY OLYMPIAD AT SOLVAY'S QUARRY

The 50th International Chemistry Olympiad, IChO took place in Prague and Bratislava from the 19th to 29th of July, 2018. More than 300 talented students from 76 countries participated. As part of a daylong excursion they visited the open-air museum at Solvay's Quarry where Dr. Válek and his team gave a presentation on the history and evolution of lime production. The young chemists learned about limestone, the raw material used in the production of quicklime, its extraction and processing, the history of the industry, and the development of various types of inorganic binding agents. Contemporary research and projects were covered as well. As part of the lectures there were demonstrations on lime slaking, stirring and application. The young Olympians were captivated by the experiments, and eagerly asked numerous questions. The presentations for each group usually ended in lively discussions. For most of them this was the first time encountering a practical demonstration in the processing of quicklime. Thus the lectures and the program gave them insight into a craft that utilizes chemical processes they normally only study on a theoretical level.



Dr. Válek during a lecture for the participant of IChO 2018

P. Kozlovceva

ITAM TEAM GIVEN THE CZECH ACADEMY OF SCIENCES AWARD

Dr. Jiří Náprstek and Dr. Radomil Král received the Czech Academy of Sciences Award for their exceptional research, experimental development and innovation results in Theoretical background and implementation of finite element method for multi-dimensional Fokker-Planck equation analysis. The award ceremony took place on 16th October, 2018 at Villa Lanna in the presence of Academy Board representatives and the Scientific Board of the CAS, representatives of the press and other guests. Their work contributes exceptionally to the development of theoretical and numeric mechanics, and includes several original findings and methods which will set a new course for research focused on solving problems of stochastic dynamics and stability for the future.



Laureates of the Award with president of the CAS, Prof. Eva Zažímalová. Dr. Náprstek second row in the middle, Dr. Král behind him on the left.

Source: Czech Acad Sci / Photo: P. Jáchymová / B. Přečková

DYNAMIC LOADING TEST OF FOOTBRIDGES IN PÍSEK

At the end of September, a team from the Department for Dynamics and Stochastic Mechanics performed a dynamic loading test of two successive footbridges in Písek. The author of both of them – a cable-stayed one leading from the left bank of Otava river and a suspension one leading from the right bank – is architect Josef Pleskot. The aim of the test was to determine modal characteristics of the bridges and to compare them to a theoretical calculation done by a longstanding industrial partner of ITAM, EXCON company. A part of the test comprised a crossing of both bridge decks by several formations of pedestrians walking with various gait frequencies, which aimed to simulate norm-prescribed loading conditions and expected traffic. The comfort of pedestrians was then evaluated based on the detected bridge deck acceleration.



Footbridges in Písek during the dynamic loading test

S. Hračov

ENGINEERING MECHANICS 2018 CONFERENCE

The 24th annual international conference Engineering Mechanics 2018 took place from 14th to 17th of May, 2018 in Svratka. Organised by ITAM CAS, it is the main event of its kind in Czechia. More than 250 experts were present, both from the academic sphere and professionals. Participants from several European countries arrived to exchange their experience and knowledge regarding development of mechanics of solid and deformable objects, fluid mechanics and thermodynamics, especially in relation to projects investigated in Czechia and at cooperating universities around the world. The output is a printed open access book of conference proceedings with 242 contributions available at: www.engmech.cz/im/proceedings/.



Participants of the EM2018 Conference

B. Přečová, C. Fischer

A MORNING WITH PRAGUE GAS WORKS



On the 19th of September, 2018, ITAM CAS organised a Morning with Pražská plynárenská, a.s. (Prague Gas Works). After a brief excursion into the history of our institute, our guests from the gas distribution company heard about possible applications of our research activities in industry. They had the opportunity to view our Prague laboratories as well as observe a practical demonstration of an experiment related to a particular contract for a real pipe segment. The topics covered in the lively discussion during the morning were e.g. present and future cooperation, existing and potential research topics and various practical technical problems.

B. Přečová, M. Šperl

COLLABORATION OF SIX INSTITUTIONS FORMALISED IN TELČ BY MEMORANDUM

A ceremonial event of international importance took place on Friday 21st September, 2018 at University centre of Masaryk University in Telč – six academic institutions signed a Memorandum of Collaboration. They were represented by the President of the Danube University Krems, Friedrich Faulhammer, the Vice-chancellor of Masaryk University, Naděžda Rozehnalová, the Dean of Faculty of Architecture of STU in Bratislava, Pavel Gregor, the Dean of Civil Engineering Faculty of CTU in Prague, Jiří Máca, the President of the Czech National Heritage Institute Naděžda Goryczková, and the Director of CET, ITAM CAS Jakub Novotný. The document contains an agreement on exchange of employees, students, teacher collaboration, collaboration on scientific research, and the sharing of results of joint research.

On the Czech side, all the institutions have workplaces in Telč, and have been collaborating for several years, e.g. on realization of summer and winter schools called SCOLA TELCZ, attended by experts from the institutions and chosen university students.

The aim of the SCOLA TELCZ activity, is not only the strengthening of relationships between the institutions and the participants, but also an opinion exchange forum on different approaches and solutions to specific problems of cultural heritage preservation and conservation from the point of view of different scientific disciplines. More information: www.scola-telcz.net



Signing of the memorandum

J. Novotný