newsletter

INTERVIEW
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CURRENTLY WORKING ON

Czech Academy of Sciences

ITAM ARCCHIP
INSTITUTE OF THEORETICAL AND APPLIED MECHANICS

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EDITORIAL

In editorial writing the “shorter is more difficult“ rule applies. So this time it is a very difficult task for me to fit into these few lines. And the reason is that this time the contributors were very fruitful and filled up the designated area to the very last letter. Therefore only briefly.

An interesting read is certainly the article on the aeroelastic stability of steel hangers, which was prepared by the Department of Dynamics and Aerodynamics. Furthermore, I must mention the interview with Dr Cyril Fischer, who runs the intern program in applied mathematics for high-school students within the Open Science project. And no less interesting is the view from the other side – that of the students themselves.

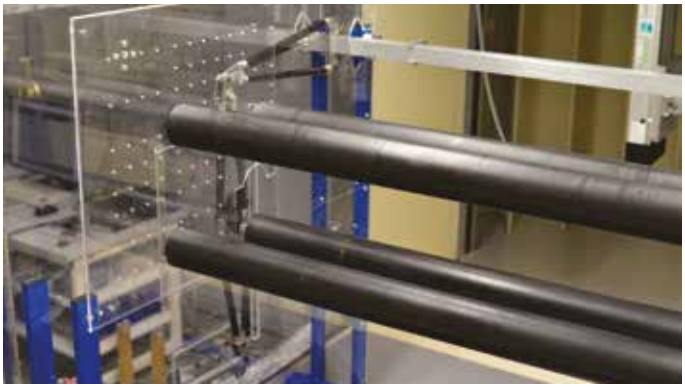
But now, I really have to conclude. Have a nice spring, summer and enjoyable read!

Stanislav Pospíšil, director

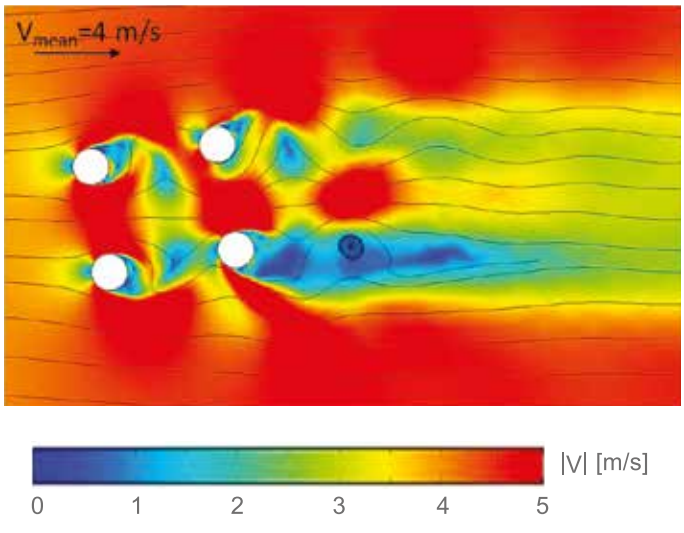
AEROELASTIC STABILITY OF FOUR HANGERS

Suspension rods (hangers) carrying the loads of bridges and roofs of large spans are generally slim, flexible and very low-damped structural elements. The combination of these properties and geometry allows for the formation of a physical phenomenon, even at normal wind speeds, where energy is drawn from the air stream for a relatively long period of time and converted into kinetic energy of the vibrating rod. Such vibrations usually have high vibration amplitudes and lead to significant fatigue stress and eventually to destruction of the entire hinge structure.

The aeroelastic behaviour of one hanger in the air stream is already a traditional task of building aerodynamics and aeroelasticity which we can solve. However, in the case of a pair, a trio or a larger group of rods placed in close proximity, there may be modifications to the case with a single rod, and here "all advice is valuable". The influence of the surrounding elements and the interaction with the current will begin to manifest, and thus a significant increase in load will occur. The pull rod placed in the winding creates a periodic vortex field that "hits" the rods placed in the wake, and this periodic load leads to oscillation of the elements that would not independently oscillate. The European standard dealing with wind loads on building structures addresses this phenomenon in a very simplified way. There are even known cases in which, despite the proposal realized under this regulation, undesirable rod vibrations have occurred. We are now conducting a detailed analysis of this phenomenon at our institute, which is examined both by numerical methods modelling the wind flow around vibrating rods and experimentally in a wind tunnel. From the results of calculations and experiments, we are able to predict the behaviour of the actual structure and take into account this interference phenomenon in the design of the structure.



Aeroelastic model of four hangers placed in the wind tunnel



Wind speed distribution for four hangers obtained by numerical simulation

M. Macháček

DOCUMENTATION OF MODERN ARCHITECTURE BY MODERN TECHNOLOGIES

BIM model of Ostrava-Vítkovice Railway Station visualized in the cloud service A360 by Autodesk

The topic of preservation of architecture from the 1960s and 1970s has recently gotten wider attention mostly due to planned or already realized demolitions of several objects (Transgas, Praha Hotel). Buildings from that period can disappear irretrievably, without society clarifying whether they (as cultural heritage) deserve to be protected or not. Therefore, the project "Analysis and presentation of the values of modern architecture of the 1960s and 1970s as part of the national and cultural identity of the Czech Republic" was initiated; supported by the Czech Ministry of Culture's NAKI program (2016-2020). ITAM CAS is one of the co-researchers of the project, which focuses on a deeper knowledge of buildings from the mentioned period and on defining the proper approach to their protection and reconstruction. Simultaneously, the project also studies options for documentation digitization and virtual preservation of buildings, whose authentic appearance, or even very existence, are endangered.

The webpage *www.ma6070.cz* is dedicated to the project. The first of the applied outputs achieved by ITAM CAS can be found there: a specialized map of the Ostrava-Vítkovice Railway Station including expert content created as a 3D dynamic model.

The digitization of cultural heritage is a rapidly developing field that utilizes the potential of modern technologies. The creation of authentic 3D models is one way of preserving valuable and unique monuments for future generations and, at the same time, of presenting them to the current one through the interactive online world. The BIM technology ("Building Information Modelling"), which enables the creation of information databases about buildings and their management during the buildings' lifetime, is used for the project works. Geometric data on the building in the form of a 3D model is part of the database. This technology is used nowadays mainly for project documentation of new buildings (part of the so called Industry 4.0), but lately it is being applied more and more abroad also on culture heritage as HBIM ("Historical/Heritage Building Information Modelling").

The data concerning the building geometry was, due to incomplete project documentation, collected with the help of photogrammetry, which is a fast and cheap method enabling the creation of a pointcloud that substitutes the classic data from surveying by e.g. laser scanning. The level of detail of the model is defined by its purpose. In the case of the Ostrava-Vítkovice Railway Station, the model is the combination of a structural model of the load-bearing elements made of reinforced concrete that is linked to the database of (not only) the material properties, and digital 3D mesh models of unique entities such as the watch tower from Vladimír Kopecký or decorative glass panels of banisters in the departure hall by František Burant and Benjamin Hejlek. Individual 3D models of the art are also presented on the "Sketchfab" server (sketchfab.com) in the profile MA6070 dedicated to the project.

Currently, the model of the Prior/Kotva Depertment Store (its heritage protection is a long lasting question), is being processed. The workflow is shown in Fig. 1. The study of building volumes emphasizes the architect's idea of the hexagon as a main geometrical structural element. In cases where the project documentation is missing or some of the elements are inaccessible (strut), the possibility to assess the dimensions from the photogrammetric pointcloud is advantageous (the column element). Thanks to 3D printing, the model can be easily shown in the real world again.

The digital documentation workflow: a volume model - from reality to 3D print (up), SCAN-to-BIM – pointcloud of the column from photogrammetry as a base for 3D modelling (bottom)

Project related publications:

Strakoš, M.; Anton, O.; Bydžovský, J.; Cikrle, P.; Černá, A. M.; Dufka, Á.; Hasníková, H.; Keršner, Z.; Kugl, J. - Kunecký, J.; Popelová, L.; Přendík, P.; Rotter, T.; Rovnaníková, P.; Šenberger, T.; Šimonová, H.; Urlich, P. Ostrava-Vítkovice Railway Station. History – architecture – heritage potential). Praha: Národní památkový ústav, 2017. 256 s. ISBN 978-80-87967-14-0.

Urlich, P.; Bydžovský, J.; Cikrle, P.; Hasníková, H.; Kunecký, J.; Moos, J.; Popelová, L.; Rovnaníková, P.; Sedláková, R.; Sedlmajer, M.; Šenberger, T.; Tryml, M. Prior/Kotva department store. History - architecture - heritage potential. Praha: Národní památkový ústav, České vysoké učení technické v Praze, 2018. 255 s. ISBN 978-80-87967-19-5.

H. Hasníková, K. Kulawiecová, J. Kunecký

WITH CYRIL FISCHER ABOUT OPEN SCIENCE INTERNSHIPS

For the second year in a row, Dr Cyril Fischer is running an internship intended for secondary school students within the Czech Academy of Sciences Open Science project. In this issue we bring you an interview with Cyril Fischer and his trainees: Anna Kneselová, Ondra Hamala, Adam Pazderka and Šimon Pekár. You can find the unabridged interviews at www.itam.cas.cz in the News section.

What motivated you to participate in Open Science project?
My children are of the same age as my students, near graduation. I can see that at eighteen they are too old for sitting in a classroom, school itself is not enjoyable for them. But I can sense in them a desire for „real information", something that will finally be useful, or at least that seems like it.

How do you come up with a topic?
It's hard to say in general. I think that a topic must be interesting and playful, but also difficult enough. It is optimal when a student comes to the edge of his/her abilities. It should be something that is not taught at school. And yet the topic must be broad enough because you never know who will be applying. Everyone has their edge somewhere else. So I try to bring myself back in time and imagine what might have interested me at that time.
Last year's topic had been prepared for a college student for a very long time as a bachelor thesis, but no one signed up at that time. It turned out pretty well this time however, the guys enjoyed it. They divided the tasks and wrote a nice program. This year I thought we could switch the roles. The seminars are led by the students, and I listen, learn and do the homework. I think this is a better concept.

How did you choose the trainees?
The propositions assume that the participants are selected based on motivation letters and CVs. But how do you choose when all the candidates are amazingly skilled and motivated? This year, I sent an intimidating exercise program to the enrolled candidates, hoping that some would give up. In vain.

B. Přechová, C Fischer

TRAINEES

Would you describe to me the topic of your internship? Why did you find this topic interesting?
Anna: I was interested in the topic because I knew from the title that it would be a challenge for me and very difficult. If I can persevere, I will gain a lot of new knowledge, which I would not otherwise get at my level of education.
Since I am also a laic regarding the subject matter, it is hard for me to simplify it. Mathematics has order, and things are given and defined in it. Using stochastic (random) processes, we try to simulate the real world and "translate" its chaotic form into a clear language that the mathematical tools offer.
Ondřej: The topic of our internship is not exactly defined, but we do mathematical tasks in Mathematica and Python, which will gradually introduce us to the solution of differential equations with random elements that need to be solved using computers. Because of its complexity it is analytically impossible.

How did you get involved in the Open Science internship?
Ondřej: I wanted to expand my knowledge in the field that interests me beyond the scope of schooling. And, if possible, under professional guidance. So when a friend told me about the Open Science Internships, I checked to see whether one of them would suit me.
Šimon: I attend a general high school and sometimes I have a problem with subjects that do not interest me. With subjects such as mathematics and physics I am hampered by the slow teaching of the subject matter. That's why it occurred to me to participate in Open Science, where I could gather interesting knowledge in those fields and develop my abilities.

Do you plan to pursue scientific work in the future?
Anna: In this respect, I still don't know what I want in the future. To practise science and discover new methods pushes the world forward. But it is always necessary to translate the theory into practice and launch a new idea so that it can be practically used. I would love to be a hybrid – to be able to do scientific work and at the same time put it into practice.
Adam: I feel quite motivated thanks to the internship and I like the academic environment. In the future I would rather focus on informatics, more precisely AI. But I don't know what research looks like in that field. As for physics and applied mechanics, I would definitely like it there.

Is there something you were afraid of before the internship? Has it become reality?
Anna: Yes, and again yes. I was afraid I wouldn't be able to keep up with the (for me) high level of mathematics. That happened, and it has been demanding hard work. Sometimes I am not able to absorb all the information. Despite that I am slowly moving forward.
Šimon: I was afraid I wouldn't understand it at all. I am the youngest of the interns, and I was worried because the topic is a huge leap into the unknown for me. Fortunately, my concern has only been partly realized.

Is this your first encounter with practical science?
Ondřej: Yes, for the first time I can see in detail what systematic scientific work looks like. So far, I have been to several lectures on school excursions that did not give me much.
Adam: I participated in an internship last year, so this is not my first encounter. In this internship I appreciate that it is both theoretical as well as practical. One really needs to know what one is doing to make it work.

How are these activities regarded by your teachers?
Šimon: My teachers are absolutely ok with it. There is no problem with notes, nor are the intern days included in my absence. Several times I have discussed the topic with a few of them and they have always tried to help me.
Adam: My school is very accommodating. Not only can I be absent once a month, but I don't have to do our yearly project and I can devote myself to the internship. I would like to add that it takes most of our free time, including weekends, so I wouldn't be able to manage it all anyway. I appreciate it.

The trainees with their lecturer Cyril Fischer

B. Přechová

KICK-OFF MEETING OF THE INTERNATIONAL PROJECT CONSECH20

CONSECH20 (CONSErvation of 20th century concrete Cultural Heritage in urban changing environments) is a 3-year JPICH international research project that aims to develop effective approaches for conservation and protection of 20th century heritage concrete buildings against ever-changing urban impacts, taking into account both technical and social aspects.
The kick-off meeting of CONSECH20 held on 14-15 February 2019 at ITAM, successfully brought together representatives from all five institutions from the CONSECH20 consortium: ITAM CAS, Delft University of Technology, University of Cyprus, University of Genoa and the Institute of Sociology of the National Academy of Sciences of Belarus, a total of 15 participants.
The main aim of the CONSECH20 meeting was to ensure that all the partners have a common understanding of the project and their respective roles in it. The meeting was an opportunity for all partners to establish closer relationships and present their prospective contribution to the project.

C. L. Nunes

UPCOMING EVENTS

On **5th and 6th June 2019** the **High-Resolution 3D X-ray Imaging Workshop** will take place at the University Centre Telč, summarizing the results of the Interreg ATCZ38 Com3d-XCT project. In addition to the participants of the project, foreign experts dealing with advanced X-ray imaging methods will be present at the workshop. Details of the event can be found at *http://xctw.itam.cas.cz/.*

After six years, the conference for students and young researchers, dealing mainly with experimental mechanics, returns to the Czech Republic. **The 17th Youth Symposium on Experimental Solid Mechanics** will take place at the University Centre Telč on **6-8th June 2019** under the auspices of IMEKO and with financial support of the CAS. Details can be found at the workshop website *http://ysesm2019.itam.cas.cz/.*

On **June 27th 2019**, ITAM CAS and the Municipal District Prague – Troja will host an **international conference on the topic „Managing the Protection of Cultural Heritage in a Changing Environment"**. The main objective of the event is to present the latest results of the Interreg CE ProteCHt2save project to stakeholders with emphasis on Czech experience and to present the issue from the perspective of managing cultural heritage protection in a changing environment. More information at: *www.interreg-central.eu/Content.Node/ProteCHt2save.html*

D. Kytýř, B. Přechová

INTERNATIONAL WORKSHOP SCOLA TELCZ 2019

An international student workshop focusing on the former Jesuit College garden was held in Telč from February 22nd – 27th 2019. The aim this year was to design a solution for the garden space of the former Jesuit College, which today belongs to the Faculty of Civil Engineering of the CTU in Prague and is also adjacent to the building of the University Centre Telč of Masaryk University. The garden area, historically connected mainly with the operation of the Jesuit order in Telč, is located in the very centre of the city and represents a hidden and unused potential for the cultural life of the city.
The programme consisted of lectures by experts focused not only on the Jesuit order and its activities in Telč, but also on the principles of care for the UNESCO monument or city gardens at present. Central to the workshop was the collaboration of teams of students from different disciplines. The individual teams then tried to capture not only the history of the place, but also the needs of the contemporary city and its inhabitants, and introduce these in the form of a site-specific installation on the future use of the garden. The workshop was concluded in the late afternoon on Wednesday February 27th with the opening of the garden to the public and the presentation of student proposals along with the participation of representatives of Telč, individual universities and cooperating professional institutions.

J. Novotný

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