Questionnaire
Summary of the main activities of a research institute of the Slovak Academy of Sciences

Period: January 1, 2016 - December 31, 2021

1. Basic information on the institute:

1.1. Legal name and address

Institute of Construction and Architecture, Slovak Academy of Sciences
Dúbravská cesta 9, 845 03 Bratislava

1.2. URL of the institute web site

www.ustarch.sav.sk

1.3. Executive body of the institute and its composition

Directoriat	Name	Age	Years in the positions, from - to
Director	Peter Matiašovský	65	2006-2021
	Martin-T. Palou	59	2021 -
Deputy director	Vladimír Sládek	67	2006-2018
	Martin-T. Palou	59	2018-2021
	Peter Matiašovský	65	2021 -
Scientific secretary	Jozef Kriváček	64	2006-2018
	Ladislav Kómar	38	2018 -

Add more rows for any changes during the evaluation period.

1.4. Head of the Scientific Board

Dr. Miroslav Kocifaj, Ph.D.

1.4.1 Composition of the International Advisory Board

Dr. Zoltán Kolláth, Ass. prof, Eotvos Loránd University, Szombathely, Hungary
Dr.Robert Černý, prof, České vysoké učení technické v Praze, Czech Republic
Dr. Arnon Chaipanich, Ass. prof., Chiang Mai University, Thailand

1.5. Basic information on the research personnel

1.5.1. Fulltime equivalent work capacity of all employees (FTE all), FTE of employees with university degrees engaged in research projects (FTE researchers)

2016		2017		2018		2019		2020		2021		2016-2021	
FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	average FTE all per year	average FTE researchers per year
44,68	23,79	43,67	23,18	39,52	18,76	33,63	18,65	33,77	17,65	33,55	17,18	**38,14**	**19,87**

1.5.2. If applicable, add also a short information on the merger of the institute in the evaluation period. You can also add rows in the above table corresponding to the founding institutes

1.6. Basic information on the funding of the institute

1.6.1. Institutional salary budget, other salary budget[1], non-salary budget[2]

Salary budget	2016	2017	2018	2019	2020	2021	average
Institutional salary budget *[millions of EUR]*	0,810	0,736	0,790	0,846	0,946	0,900	**0,838**
Other salary budget *[millions of EUR]*	0,195	0,284	0,270	0,210	0,198	0,170	**0,221**
Total salary budget *[millions of EUR]*	1,005	1,020	1,060	1,056	1,144	1,070	**1,059**
Non-salary budget *[millions of EUR]*	0,347	0,295	0,312	0,228	0,196	0,209	**0,264**

1.7. Mission Statement of the Institute as presented in the Foundation Charter indicating the years when it was adopted and revised

The Institute of Construction and Architecture of the Slovak Academy of Sciences was established by the Presidency of the Slovak Academy of Sciences at the 8th session on 30.11.1953 on the proposal of the Technical Sciences Section of 17.11.1953, reference number 2197/53. By Resolution No. 375 of August 30, 1993, with effect from January 1, 1994, the Presidency of the Slovak Academy of Sciences approved a change in the form of financing of the Institute of Construction and Architecture of the Slovak Academy of Sciences from a budgetary to a contributory organisation.

Pursuant to § 21a par. 1 of the Law of the Academy and the founding document of a Public Research Institution issued by the Slovak Academy of Sciences pursuant to § 21a par. 2 letter a) of the Law of the Academy, the Institute of Construction and Architecture of the Slovak Academy of Sciences became a Public Research Institution on July 1, 2018. On September 10, 2018, the Ministry of Education, Science, Research and Sports of the Slovak Republic issued a decision, number: 2018/11372: 4-01CC, which stopped the proceedings on the registration of organisations of the Slovak Academy of Sciences in the register of Public Research Institutions. On September 26, 2018, Law no. 270/2018 Coll. amended and supplemented o. i. also the Law of the Academy; according to § 21b par. 1 and 2 of the Law of the Academy as amended by Law no. 270/2018 Coll.

[1] Salary budget originating outside the regular budgetary resources of the organization, e.g. from the project funding.
[2] Includes Goods and Services and PhD fellowships

As of September 26, 2018, the Slovak Academy of Sciences organisations have again become budgetary or contributory organisations.
On 5.10.2021, Law no. 347/2021 Collection of laws came into force, which amended the Law of the Academy and the Geological Law, according to § 21aa par. 1 of the Law of the Academy as amended by Law no. 347/2021 Collection of laws, organisations of the Slovak Academy of Sciences, are changing the legal form to Public Research Institutions on 1 January 2022. Pursuant to § 21aa par. 1 of the Law of the Academy and based on this charter, the legal form of the Institute of Construction and Architecture of the Slovak Academy of Sciences was changed from a state-subsidized organisation to a Public Research Institution.
The principal main activity of the organisation is the implementation of research in the fields of science and technology (hereinafter also "fields"): Civil Engineering (020100), Applied Mechanics (020420), and Science of Nonmetallic Materials and Building Materials (020424), Quantum Electronics and Optics (010309).

1.8. Summary of R&D activity pursued by the institute during the evaluation period in both national and international contexts. Describe the scientific importance and societal impact of each important result/discovery. Explain on general level – the information should be understandable for a non-specialist (recommended 5 pages, max. 10 pages for larger institutes with more than 50 FTE researchers as per Table 1.5.1.)

The main R&D activity pursued by the Institute during the evaluation period in both national and international contexts was in accordance with the Foundation Charter approved by the Presidency of the Slovak Academy of Sciences within the following research in the fields of Science and Technology: Civil Engineering (020100), Applied Mechanics (020420), Science of Nonmetallic Materials and Building Materials (020424), Quantum Electronics and Optics (010309). Civil engineering uses the results of many scientific disciplines. Therefore, research in the field of construction often has an interdisciplinary character, significantly when solving tasks required by construction practice. However, this does not mean that only research focused on specific problems formulated by the requirements of construction practice makes sense. Fundamental research is also needed, which has the potential to be used in solving particular construction tasks. Therefore, research in the field of civil engineering is very broad-based, including mainly applied branches of basic scientific disciplines. The primary scientific disciplines of technical construction research include mainly applied mathematics, applied physics, applied mechanics, and materials research, from which more detailed scientific disciplines are derived, such as research of building structures, including their performance and durability, building materials, and heat transfer, and light technology.
Over the years, the research topics have progressively moved from the classical research of building structures (1) to the physical and mathematical modelling of multiscale phenomena in nanocomposite materials and micro/nano-size structures as well as near defects and/or stress/strain concentrators in macrostructures (2) to the space science considering the scattering of light as a phenomenon related to the debris of satellites and other particles in the atmosphere, and (3) to the physical-chemistry of hydration, which governs the main engineering properties of building and construction materials including durability under severe conditions. The fundamental research activities of the Institute, which are achieved through the different departments, are very topical and follow the world research trend**,** and were focused on:

- Optimal design of micro/nanostructures for metamaterials
- A multiscale flexoelectric theory and a new method for real-time detection of microcracks in dielectric materials
- Multiphysical problems in functionally graded materials plates
- Multiscale modelling of coupled fields in composite materials
- Characterization of light-pollution sources
- Modeling of the diffuse light of a night sky
- Novel thermal management design for BIPV modules incorporating MEPCM layers
- Luminance patterns on standard sky types
- Study of carbonation and combined chemical corrosion of cement composites caused by the effect of geothermal water

- Investigation of the degradation impact of high temperature and pressure
- Design and optimisation of heavy-weight concrete compositions for the fields with different degrees of ionising radiation
- Development of fibre-reinforced heavy-weight self-compacting mortars with special protection properties against ballistic missiles

During the evaluation period 2016-2021, the Institute was constituted of 5 Departments:
1. Department of Mechanics,
2. Department of Structure to 31.12.2017 (From 1.1.2019 Department of Materials and Structure)
3. Department of Building Physics
4. Department of Materials and Rheology to 31.12.2018 (From 1.1.2019 Department of Materials and Structure)
5. Department of Architecture to 1.6.2018 (delimitation to the Historical Institute)

The Institute has undergone several transformations in the last three decades, with a significant reduction in the number of researchers as well as scientific disciplines. Today, the main disciplines are applied mechanics, building engineering and structures, optics and thermophysics (building physics), which are developed in 3 scientific departments: Department of Mechanics, Department of Optics and Thermophysiand cs, Department of Building materials and structures.

Department of Mechanics

Through various national and international projects, the department of Mechanics has highlighted the research program on multiphysical mathematical modelling and multiscale computer modelling of engineering structures with functional properties of materials. There are four main streams of the basic research implemented by the Department of Mechanics:

1. **Multiscale modelling of coupled fields in composite materials (APVV-14-0216)**

The smart composites, where piezoelectric/magneto-electro-elastic fibres are embedded into an elastic matrix, can be utilized in advanced structures like sensors or energy harvesting devices. These composites provide superior properties compared to their virgin monolithic constituent materials. Real modelling of piezoelectric or magneto-electro-elastic composite materials requires to consider voids and cracks in these materials. The special theory which considers porosity as a function in constitutive equations has been considered here for smart composites with coupled fields. In the present research project, the hybrid/mixed finite element method and the scaled boundary finite element method have been developed to study the effect of porosity on the electromechanical response of piezoelectric materials. Numerical analyses help to enhance the piezoelectric effect in composites. Piezoelectric materials can be characterised as either dielectrics or semiconductors. In semiconductors, the induced electric field also produces the electric current. The acoustic-electric effect in piezoelectric semiconductors is the interaction between the mechanical fields and the moving charges. The finite element method is developed to analyse three-dimensional boundary value problems under stationary boundary conditions and with functionally graded material properties in piezoelectric semiconductors. The gradation of material properties can be utilized for the optimal design of piezoelectric semiconductor structures. Advances in technology have resulted in the development of small microelectronic components and devices, where classical continuum models cannot be applied due to the size effect in micro/nano-sized structures. The size effect is considered by including the strain gradients in advanced continuum models. The size effect reduces the crack opening and J-integral with respect to results obtained by the classical theory.

2. **Multiphysical problems in functionally graded materials plates (APVV -14-0440)**

Nowadays, the multi-layered composite plates are widely used in various engineering fields. However, laminated composite structures suffer from failure because of concentrations of gradient fields on interfaces due to discontinuity of material properties. This became dangerous, especially in cosmic and aerospace systems exploited in extremely hard conditions. The rapid development of materials science enables designers to replace classical laminated plate elements in aerospace structures with more advanced ones made of functionally graded materials (FGM), which are

microscopic composite materials with continuous variation of material coefficients according to the contents of their micro-constituents. It is a potential to utilize these materials also in other engineering fields. Utilisation of FGM eliminates the inconvenience of laminated structures but gives rise to substantial changes in structural design. Therefore, the study of the behaviour of FGM plates has become attractive among others. In the project APVV-14-0440, we developed a unified formulation for three plate bending theories and the strong form as well as a weak form of a meshless method for the solution of FGM composite plates. For plates with variable thickness and/or FGM plates with an in-plane gradation of material coefficients, the governing equations are given by the partial differential equations (PDE) with variable coefficients, which become much more complicated for a solution than the PDE with constant coefficients. The advantage of the proposed meshless method for solving such boundary value problems is that the complexity is not increased as compared with the case of homogeneous media.
On the other hand, the evaluation of shape functions in meshless methods consumes more computational time than in the case mesh base discretisation method. This handicap has been solved by decreasing the amount of evaluations of shape functions by using the strong formulation, which can be shown to be a limit case of local weak formulations approaching the size of the local subdomain to zero. Recently, we proposed and developed the Moving Finite Element (MFE) approximation which, combined with the meshless formulation, is superior to the standard FEM. Furthermore, the accuracy of approximation of high-order derivatives in plate bending problems has been solved by decomposition of governing equations into governing equations with lower order derivatives and the development of a modified technique for differentiation. Finally, the proposed methods have been applied to investigate the response of elastic FGM plates under stationary and/or transient mechanical and thermal loadings. New physical coupling effects have been revealed during this study by numerical experiments.

3. A multiscale flexoelectric theory and a new method for real-time detection of microcracks in dielectric materials (APVV-CN-RD-18-0005)

Straintronics is a rapidly developing new research area in micro-, nano-electronics and material science, where strains induce physical effects in solids and is utilised for new generation electronic devices. It is well known that strain-gradients can induce polarisation even in non-piezoelectric solids, which is called direct flexoelectricity. The size effect at nanostructures is observed due to comparable nanostructure sizes and the microstructural material length scale. However, classical continuum mechanics cannot be applied since the influence of material microstructure is neglected, and the results are size-independent. Although great success has been made for piezoelectric materials with macroscopic characteristic dimensions, applications of the conventional continuum theory to nanoscale structures are not acceptable because the size effects may be prominent in the behaviour of nanoscale samples as it follows from atomistic simulations and experiments. Although higher-grade continuum models give the possibility to explain size effects, the mathematical formulation becomes much more complex than in classical theory. The strain gradients play a significant role in the vicinity of crack fronts not only for the influence of elastic stresses but also because the electricpolarisationn can be induced in dielectric materials (the so-called direct flexoelectric effect). We have developed a variational formulation resulting in the governing equations and possible boundary conditions to describe the electro-elastic response within the gradient theory of continua. Because of high order derivatives of field variables, the standard FEM and commercial computer codes are inapplicable. The mixed FEM has been developed for the numerical solution of the derived mathematical formulation of considered coupled-field problems. Numerical simulations have been accomplished for fracture mechanics analysis of piezoelectric nano-sized structures under a thermal load, including flexo-effects. Results indicate that the value of *J*-integral and the crack displacements are decreased owing to flexoelectricity, and it should be considered in dielectric solids. A change ofpolarisationn due to the appearance of micro-cracks can be used for their instantaneous detection.

4. Optimal design of micro/nanostructures for metamaterials (APVV 18-0004)

Progress in manufacturing processes is going so far that now one can design and fabricate materials for engineering practice exhibiting properties that are not directly found in nature – i.e. metamaterials. Metamaterials are composites prepared with planned utilisation of micro/nano size

structural properties. The composition is usually arranged in specific periodic patterns. Therefore, metamaterials gain their specific excellent properties. The 3D printing, electrospinning, self-assembly and many other advanced manufacturing techniques are raising many scientific questions, which must be answered if the potential of the existing and foreseeable manufacturing novelties is to be fully realized. A typical example for metamaterials there are materials, in which the pizoelectric or piezomagnetic response of the materials originates from their special geometries or structures and flexoelectricity or flexomagneticity is utilized. Both flexoelectricity and flexomagneticity represent electromechanical coupling between the electric polarisation or mapolarisationand strain gradients, respectively. New sensors based on flexoelectricity or flexomagneticity can be designed for structural health monitoring with better accuracy than earlier one since strain gonesient can give more convenient info than a strain. For a successful application of gradient theory in flexoelectricity it is needed to ,determine the higher-order elastic and flexoelectric parameters staying at strain gradients in constitutive equations for higher-order stresses and electric displacements (polarisation). Due to some experimental difficulties there are missing experimental measurements of these material parameters. In this project an attempt is made to correlate the results of atomistic calculations with results by the gradient theory of continuum involving unknown flexoelectric coefficient. The finite element method (FEM) and meshless formulations are developed for the derived governing equations of flexoelectricity. The mixed FEM in the project uses the C^0 continuous interpolation independently for displacement and displacement gradients. Similarly the electric potential and electric intensity vector are approximated by C^0 elements. The kinematic constraints between strains and displacements are satisfied by collocation at some cleverly chosen internal points in finite elements. The constraint between the electric potential and electric intensity vector is satisfied analogically by collocation meththe od. The present collocation method reduces the number of DOFs with respect to the approach based on the concept of Lagrange multipliers. Finally, the aim of the present project is also to investigate the influence of surface stress effects in nano-sized structural elements made from metamaterials.

Department of Building Physics (Optics and Thermophysics)

In the field of Quantum Electronics and Optics, the Department has focused its research on urban light emission and global characterisation of skyglow while developing its Mathematical Method of Cumulative Emission Function (CEF) and Effective Modeling, whose purpose is to predict changes in light pollution levels depending on the characteristics of the site and the lighting technology used.

Exposure to natural lighting conditions during the day and nighttime lighting both show significant societal impacts and scientific importance. However, while the first is connected to energy-saving purposes and indoor visual comfort, the latter is primarily related to negative environmental impacts coming from urban areas. This global phenomenon, linked to parameters like population behaviour and growth, the emission of lighting sources, or other structural elements, must not be forgotten during city planning processes in order to reduce potential harm to wildlife and people. Therefore, in the field of Optics, the Institute focused its research priority on thecharacterisationn of urban skyglow (the diffuse luminance of the night sky) while developing various mathematical modelling approaches, aiming to predict changes in light pollution levels depending on the characteristics of the site and the lighting technology used. Over the past five years, the members conducted excellent research, successfully placing the Institute in top spots worldwide in this area. In the future, the team will continue focusing on urgent societal open questions regarding critical side effects of nighttime lighting in civil engineering.

Implementing various national and international projects has led to significant scientific findings with the following results.

1. **Detailed characterisation of the urban light emission function (APVV-18-0014, UNESCO: SkyMeAPP, APVV-14-0017)**

Artificial light emitted from cities at night is known to spread over considerable distances and results in the over-illumination of nocturnal environments. Predicting the collective optical effects

that all city lights can have on the diffuse light of a night sky is generally impossible without information on the city emission function (CEF). However, the CEF is difficult to determine due to diverse and generally unavailable inventories of light sources and because of manifold light interactions with light-emitting or blocking constructs in the built environment. The research performed by our team promises great progress in light-pollution modelling as this is the first time the indirect remote-sensing mehod, used to retrieve the CEF from sky brightness measuremets, has been developed and successfully applied to experimental data. The angular emission component of the CEF is determined by applying an inverse operator on first-mode radiance data. This is an entirely new technique in the field of light pollution, and we believe it carevolutionisezthe e acquisition of CEFs worldwide because no aerial survey is necessary. Such surveys are however expensive when carried out routinely and are designed for spatial analyses of sources of light pollution rather than for obtaining the cumulative CEF. In contrast, the technique we have developed is numerically fast, experimentally simp cost-efficient, thus having great potential for use as a CEF solver to which no competitive alternatives yet exist. We published key research papers with high-impact impact, in internationally respected journals *PNAS* and *Optica*.

2. **Modelling of night sky brightness and development of a prediction tool performing mass computations in real-time (APVV-14-0017, APVV-18-0014, Open Academy)**

Modelling of skyglow is very complex. There are two main factors that affect the behaviour of emitted light and its potential to cause skyglow over a city. One is the Earth's atmosphere, which provides the most variable part of the simulations. The other factor is information about the emitting light source itself. When this information is incomplete or absent, it leads to approximations and assumptions whose significance scales up with increasing size of the examined areas. In order to overcome these difficulties, the team developed a skyglow prediction tool which has been validated in unique experiments in Tucson, USA. ‘SkyGlow Simulator’ stands out for itssignificantlyy reduced computation time; the ability to investigate large domains with high spatial resolution; the inclusion of an unlimited number of light sources widely distributed over the investigated area; and the capacity to perform calculations with a large number of source spectral power distributions. The tool enjoys notoriety globally in the research field as it is the only simulation software providing those advantages. It therefore features in numerous scientific works by research groups worldwide.

3. **Characterize optimal methods to quantify skyglow on various scales (APVV-14-0017, APVV-18-0014, VEGA 2/0010/20)**

Practically all applications related to outdoor lighting, including street and area lighting, sports lighting, billboards and advertisements, industrial lighting, light escaping from the interior of commercial and residential buildings through windows, and landscape lighting, fall within the scope of the Institute. Over the past five years, the team not only enabled the possibility of exercising various techniques of in-situ measurements, those techniques were further advanced. This is especially true of all-sky and vertical fisheye imaging, the use of large light-monitoring network data, and new possibilities for the use of satellite imaging of Earth's surface at night highlighted here. Results of numerous scientific studies have shown that the team’s expertise in those techniques lleadsto a better understanding and estimation of the effects of spectra, spatial distribution, and characteristics of light sources, as well as radiation transfer processes in the Earth's atmosphere, which are essential elements of a strategy to correct the current state of nighttime lighting. Furthermore, it was possible to perform analyses on a great scale regarding area sizes and time with studies incorporating individual light sources at certain time points to whole cities, and even countries, through multiple years. Our key results have appeared in *MNRAS Letters* (Nature-index journal) or *Scientific Reports*.

4. **Development of new devices to measure artificial light at night with great accuracy (APVV-14-0017, APVV-18-0014, VEGA 2/0010/20, VEGA 2/0016/16)**

Earlier-generation devices, which are among those still in use by the research community, were not able to address every single issue needed to characterise and quantify skyglow in great detail.

As a consequence, the Institute developed multiple instruments successfully meeting current demands, e.g., measuring extremely low night sky brightness values, recovering spectra from distance light pollution sources or performing multi-wavelength radiometry of atmospheric aerosols. These innovative designs fill in the gaps especially for future investigations regarding characteristics of light-emitting sites, technologies used in various lighting applications, and refining predictive models. The most important results were published in *MNRAS* or *JQSRT*.

5. **Identification of satellite "mega-constellations" as a new light pollution challenge (APVV-18-0014, VEGA 2/0010/20)**

Overall, there are two possibilities aiming to reduce unwanted impacts by light emissions with potential improvements either relating to light sources themselves or to the environment. Especially for the latter, a brand new topica the non-negligible impact on night sky pollution from space. So-called satellite mega-constellations are the apparent cause. In the near future, a total of over 96,000 satellites are expected to be in orbit. As the number of satellites increases, so too does the impact of light coming from sunlight reflections of their surfaces. Calculations performed at the Institute were the first to show that the brightness of all artificial objects in Earth's orbit can in fact lead to a non-negligible contribution to the brightness of the night sky. In more detail, this can correspond to an addition of 10% to the natural night sky brightness. With those results having been globally acclaimed in research communities, our team tackles a topic of high value and is capable of finding computational solutions nobody thought of before. This is one of the reasons why our work has been widely discussed in the media (BBC, The Telegraph, The Guardian, etc.), in the news sections of major scientific journals (e.g., Science), and thin e press releases of some scientific societies (e.g., the Royal Astronomical Society). In the future, it is intended to also use ground-based observations in order to study this issue in an even greater scope. The key papers were published in *MNRAS Letters* (Nature-index journal) and currently in *Atmospheric Research*.

Department of Materials and Structures

The research activities on Structures, Nonmetallic and Building Materials (020424) realised at the Department since the last accreditation were logically in conformity with the concept of two Centers of Excellence: CEKOMAT (CE for research and development of composite materials for structural engineering, construction, and medical applications), and GEOTHERMY (Centre for Applied Research of Composite Materials for deep Geothermal Energy). Furthermore, besides the research on material engineering through the projects funded by national agencies, namely APVV-15-0631, APVV-19-0490, VEGA 2/0097/17, VEGA 2/0017/21, and VEGA 2/0032/21, the Department was involved in two international projects: V4-KOREA_RADCON „The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment" and APVV-SK-KR-006 „Material and mechanical performance of heavyweight self-compacting concrete (SCC)". The implementation of these projects has established a tight relationship between countries of Central Europe and the Republic of Korea.

Indeed, the fundamental research was targeted at the development of advanced inorganic binders based on multicomponent cement for a specific design of cementitious composites for geothermal wells, Heavyweight Concrete, and Fiber-Reinforced Heavyweight Self-Compacting Mortars. The primary research was focused on studying the chemistry, mechanism, and kinetics of the hydration reactions, including the carbonation of the hydraulic binders under normal and hydrothermal curing conditions. Detailed knowledge of these processes is the basis for designing materials suitable for carbon dioxide sequestration. The multi-component cements were developed taking into consideration environmental aspects of cement production and the specific requirement for high-performance concrete used in geothermal wells and environments exposed to nuclear radiation.

1. **Research on High-Performance Cementitious Composites under hydrothermal conditions for potential applications in deep bore wells (APVV-15-0631)**

Within the given project, substantial progress was achieved through the numerical simulation of the conditions in deep geothermal wells and the development of various variants of finite-element models simplified 3D models. The research team has developed its own software programs, and the complete outputs are available at the researcher's workplace. In addition, different binders

based on multicomponent cement compositions have been proposed and tested under different hydrothermal conditions in laboratory autoclaves to compare the experimental results with those obtained by simulation. In the first step, the achieved results did not correspond to the real conditions in the wells. Therefore, the calculations for the spatial model of the well have been improved, taking into account the temperature gradient and thermal conductivity of the geological subsoil along the borehole, the material composition of sealing slurry, and the chemical composition of geothermal water. As a result, the variation in mechanical properties with increasing temperatures and vapour pressure simulating hydrothermal conditions in a geothermal borehole has matched the simulated 3D model results.

In oil well-cementing operations, the cement slurry, initially prepared at ordinary temperatures, is routed by pressure through the steel casing to the bottom of the well, then back to the top via the annulus between the casing and the surrounding geological rocks. Therefore, the cement slurry fills and seals the annular space between the casing steel and the drilled hole. Temperatures and vapour pressures increase with the depth of the well, causing the cement slurry to hydrate under various conditions, including hydrothermal ones. The durability of cement seals depends on hydrothermal conditions found in oil or geothermal wells. The study of hydration reactions of sealing slurry under different hydrothermal conditions (0.5, 1.2, and 2 MPa corresponding to 165, 195, and 220 °C forseven7 days, respectively) using the Class G HSR Dyckerhoff Oil-Well cement has proved that the calcium silicate hydrates (C–S–H) changed the structure from semi-crystalline to crystalline α-C_2SH phase at a hydrothermal temperature exceeding 150°C. These changes continued with increasing temperature/pressure causing the transformation of α-C_2SH to $C_6S_5H_3$. Some products like $C_5S_2H_2$ and scawtite ($C_7S_6CH_2$), to some extent, are also formed. These structural transformations impacted the pore structure with a corollary deterioration in strength. To avoid these transformations, supplementary cementitious materials (blast furnace slag, silica fume, metakaolin, fly ash) were added, concomitantly or individually, to the commercial Oil-well cements to prepare multicomponent cements. The addition of silica fume and blast-furnace slag caused an increase in strength and impermeability under hydrothermal conditions. In addition, microparticles of silica fume contributed to the formation of fine crystalline phases of tobermorite, gyrolite, and cowlesite, which are thermodynamically stable at a higher temperature. The pore structure was refined reducing thus drastically the permeability coefficient. Metakaolin and slag contributed mainly to the increase of compressive strength, which significantly exceeds the values recommended by the standard of API (American Petroleum Institute) to casings of oil wells in geothermal boreholes.

2. The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment. (Joint Research Program On Chemistry and Chemical Engineering, Visegrad Group (V4) -Korea, V4-KOREA_RADCON)

The Institute has developed Heavyweight Concrete through the project. It was interdisciplinary project, integrating the procedure of numerical simulation of ageing in heterogeneous composite materials exposed to ionising environment *(*Yonsei University, Czech Technical University*),* experimental verification of concrete properties based on elemental analysis using neutron activation analysis (NAA), prompt gamma activation analysis (PGAA) and X-ray fluorescence analysis (EDXRF) of proposed aggregates, mineral admixtures and multi-component cements *(*Hungarian Academy of Sciences, MTA Energy Research Center, Polish Academy of Sciences, Slovak Academy of Sciences*).* For this purpose, Portland cement CEM I 42.5 R was replaced by a different portionsion of supplementary cementitious materials (blast furnace slag, metakaolin, silica fume/limestone) at 75 %, 65 %, 60%, 55 % and 50 % levels. Reference cement CEM I 42.5 R Extra and its blends (4) were used to prepare two kinds of two strength classes of heavyweight concretes: (1) two samples of High -Strength concrete exceeding 70 MPa with bulk density upper to 3200 $kg.m^{-3}$ after 28 days, and (2) three samples of Normal-Strength heavyweight concrete with strength about 45 MPa and bulk density ranging between 3450 $kg.m^{-3}$ and 3560 $kg.m^{-3}$. The convenient design of heavyweight concrete for massive structures as biological shielding in the nuclear plant has considered the complete chemical composition of high-density aggregates and cementitious binders based not only on XRF analysis but aon lso PGAA and NAA to pcomprehensiveomplete knowledge on elemental composition including isotopes. Furthermore, the hydration heat and its rate were carefully designated for massive structures in order to avoid thermal stress, internal and external strain, and surface thermal cracking. The ongoing project

implementation is the irradiation of samples by neutron flux and the determination of attenuation capacity to gamma radiation.

3. **Research and development of multi-component cementitious blends for special construction materials and material composition and properties of Self-Compacting Heavyweight Concrete. (APVV-19-0490, VEGA 2/0017/21)**

The topic is a great challenge. The study aimed at determining the mix proportion of binder, heavyweight aggregates, water to binder ratio, and additives to develop Self-Compacting Concrete with bulk density higher than 2,600 kg/m^3. It aimed also at evaluating the engineering properties, pore structure and microstructure of established heavyweight self-compacting concrete. Grading curves of aggregates: Barite (BA), magnetite (MAG) or their mix (MIX) used as fillers were set, while multicomponent binder was constituted of Portland cement, blast furnace slag, metakaolin and limestone at the ratio of 65:15:5:15.Basedg on test results of V-funnel, S-Cone diameter, and S-Cone time, the mixing proportion of binder: filler: binder to cement ratio was optimised as follows: (1) BA 1:3.5:0.42, (2) MAG 1:4:0.42, (3) MIX 1:3.75:0.42 with the maximum aggregate size no exceeding 20 mm. Not only bulk density was influenced by aggregate density, but also the mechanical properties, shrinkage, dynamic modulus of elasticity, pore structure, and microstructure were found deto be pendent on fillers.

A specific class of Heavyweight structures, so-called Self-Compacting Heavyweight Concrete and Fiber-Reinforced Self-Compacting Heavyweight Mortars ,were developed through APVV-SK-KR-006 (Material and mechanical performance of (SCC) and are still implementing through the projects.

Several projects dealing with the development of building structures were solved: Theoretical project VEGA 2/0154/15 “Modelling of post-buckling behaviour and strength of thin-walled cold-formed columns,” and experimental VEGA 2/0033/15 “Influence of repeated and long - term loading on the interaction of parameters at the reconstruction of reinforced concrete elements.” Were implemented during the accreditation period

Department of architecture

The Architecture Department moved in 2018 to the Institute of History for compatibility with their scientific activities. Indeed, their main research activities were oriented rather to history than to technical architecture. This fact caused a departure of 3-5 scientific workers without any harmful influence on the scientific results of the Institute.

From 2016 to 2017, the Department was involved in project “Identification and assessment of problematic aspects of the coporary Slovak architecture” - VEGA/2/0036/2014 „Modern town-planning concepts and traditional town: analysis of conflicts and coexistences, “- VEGA-2-0074-17 „Neplánované Mesto: architektonické a urbanistické koncepcie 20. storočia a ich priemet do mestskej štruktúry Bratislavy- Unplanned city: architectural and urban concepts of the 20th century and their projection into the urban structure of Bratislava”.

The working team has elaborated an international monography published by MORAVČÍKOVÁ, Henrieta “Emancipated but still accompanied: the first generation of women architects in Slovakia. In Ideological Equals: Women Architects in Socialist Europe 1945-1989”, Oxford: Taylor and Francis, 2017, p. 48-62. ISBN 978-1-315-58777-6; 978-1-472-46926-7. The book retraces the path of the emancipation of women in architecture since the first creation of the Faculty of Architecture in 1946 in Bratislava (Czechoslovakia). The editors have collected information on the life and work of 13 women architects. However, the presentation of this research revealed the pervasive ambivalence that surrounds women who work in a professional context.

The first wave of women to enter the architectural profession in Slovakia was in the 1950s and 1960s. Although architecture is considered as a domain reserved for men, Slovak women have realised a lot of progress in this area. As proof, in 1968, women represented only 15% of graduates in architecture, while in 1990, this number had reached 45.8%, and now is higher than 50 %.

Women architects did not intend to fight for gender equality issues through their "right to an evaluation of their work that is equal to that of men”, but naturally and purposefully they reached the top of the rankings through their own hard work.

2. Partial indicators of main activities:

2.1. Research output

2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (in percentage)

Basic research covers 75 % of the primary research activities of the Institutes, while 25 % are oriented toward applied research. Regarding our collaborations with worldwide known universities and institutes, our research through different published papers can be considered more than 90% international. Few works were published in national or regional journals apart from Architecture, representing a specific case. Some results published in Proceedings were from international conferences held in Slovakia.

2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications listed for the assessment period should not exceed the average number of employees with university degrees engaged in research projects. The principal research outputs (max. 5, including Digital Object Identifier – DOI if available) should be underlined. Authors from the evaluated organisations should be underlined.

1. ZHENG, H. - ZHANG, Chuanzeng - WANG, Yong - SLÁDEK, Ján - SLÁDEK, Vladimír. A meshfree local RBF collocation method for anti-plane transverse elastic wave propagation analysis in 2D phononic crystals. In *Journal of Computational Physics*, 2016, vol. 305, p. 997-1014. (2015: 2.556 - IF, Q1 - JCR, 2.054 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0021-9991. Available on: https://doi.org/10.1016/j.jcp.2015.10.020
2. SLÁDEK, Ján - SLÁDEK, Vladimír - KRAHULEC, Slavomír - SONG, Chunqing. Micromechanics determination of effective properties of voided magnetoelectroelastic materials. In *Computational Materials Science*, 2016, vol. 116, p. 103-112. (2015: 2.086 - IF, Q2 - JCR, 0.953 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0927-0256. Available on:
3. SLÁDEK, Ján - SLÁDEK, Vladimír - STAŇÁK, Peter - ZHANG, Chuanzeng - TAN, C. L. Fracture mechanics analysis of size-dependent piezoelectric solids. In *International Journal of Solids and Structures*, 2017, vol. 113, p. 1-9. (2016: 2.760 - IF, Q1 - JCR, 1.548 - SJR, Q1 - SJR, Current Contents - CCC). (2017 - Current Contents). ISSN 0020-7683. Available on: https://doi.org/10.1016/j.ijsolstr.2016.08.011
4. SAPUTRA, A. A - SLÁDEK, Vladimír - SLÁDEK, Ján - SONG, Chongmin. Micromechanics determination of effective material coefficients of cement-based piezoelectric ceramic composites. In *Journal of Intelligent Material Systems and Structures*, 2018, vol. 29, no. 5, p. 845-862. (2017: 2.211 - IF, Q2 - JCR, 0.828 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents). ISSN 1045-389X. Available on: https://doi.org/10.1177/1045389X17721047
5. SLÁDEK, Ján - BISHAY, P.L. - REPKA, Miroslav - PAN, E. - SLÁDEK, Vladimír. Analysis of quantum-dot systems under thermal loads based on gradient elasticity. In *Smart Materials & Structures*, 2018, vol. 27, no. 9, art. no. 095009, 15 p. (2017: 2.963 - IF, Q1 - JCR, 1.152 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents). ISSN 0964-1726. Available on: https://doi.org/10.1088/1361-665X/aad2ae
6. SÁTOR, Ladislav - SLÁDEK, Vladimír - SLÁDEK, Ján. Coupling effects in transient analysis of FGM plates bending in non-classical thermoelasticity. In *Composites Part B: Engineering*, 2019, vol. 165, p. 233-246. (2018: 6.864 - IF, Q1 - JCR, 2.499 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 1359-8368. Available on: https://doi.org/10.1016/j.compositesb.2018.11.093
7. SLÁDEK, Ján - SLÁDEK, Vladimír - REPKA, Miroslav - SCHMAUDER, Siegfried. Gradient theory for crack problems in quasicrystals. In *European Journal of Mechanics A: Solids*, 2019, vol. 77, art. no. 103813. (2018: 2.931 - IF, Q1 - JCR, 1.389 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 0997-7538. Available on: https://doi.org/10.1016/j.euromechsol.2019.103813

8. SLÁDEK, Ján - SLÁDEK, Vladimír - REPKA, Miroslav - PAN, E. A novel gradient theory for thermoelectric material structures. In *International Journal of Solids and Structures*, 2020, vol. 206, p. 292-303. (2019: 3.213 - IF, Q1 - JCR, 1.295 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 0020-7683.
9. SLÁDEK, Vladimír - SLÁDEK, Ján - REPKA, Miroslav - SÁTOR, Ladislav. FGM micro/nano-plates within modified couple stress elasticity. In *Composite Structures*, 2020, vol. 245, art. no. 112294. (2019: 5.138 - IF, Q1 - JCR, 1.784 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 0263-8223. Available on: https://doi.org/10.1016/j.compstruct.2020.112294
10. TIAN, Xinpeng - SLÁDEK, Ján - SLÁDEK, Vladimír - DENG, Qian - LI, Qun. A collocation mixed finite element method for the analysis of flexoelectric solids. In *International Journal of Solids and Structures*, 2021, vol. 217-218, p. 27-39. (2020: 3.900 - IF, Q1 - JCR, 1.229 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0020-7683. Available on: https://doi.org/10.1016/j.ijsolstr.2021.01.031
11. SLÁDEK, Ján - SLÁDEK, Vladimír - REPKA, Miroslav - DENG, Qian. Flexoelectric effect in dielectrics under a dynamic load. In *Composite Structures*, 2021, vol. 260, art. no. 113528. (2020: 5.407 - IF, Q1 - JCR, 1.630 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0263-8223. Available on: https://doi.org/10.1016/j.compstruct.2020.113528
12. HRYTSYNA, Olha. Local gradient Bernoulli-Euler beam model for dielectrics: effect of local mass displacement on coupled fields. In *Mathematics and Mechanics of Solids*, 2021, vol. 26, no. 4, p. 498-512. (2020: 2.341 - IF, Q2 - JCR, 0.672 - SJR, Q2 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 1081-2865. Available on: https://doi.org/10.1177/1081286520963374
13. KOCIFAJ, Miroslav - SOLANO LAMPHAR, H. A. - VIDEEN, Gorden. Night-sky radiometry can revolutionize the characterization of light-pollution sources globally. In *Proceedings of the National Academy of Sciences of the United States of America*, 2019, vol. 116, no. 16, p. 7712-7717. (2018: 9.580 - IF, Q1 - JCR, 5.601 - SJR, Q1 - SJR, Current Content - CCC). (2019 - Current Contents). ISSN 0027-8424. Available on: https://doi.org/10.1073/pnas.1900153116
14. KITTLER, Richard - DARULA, Stanislav. Scattered sunlight determining sky luminance patterns. In *Renewable and Sustainable Energy Reviews*, 2016, vol. 62, p. 575-584. (2015: 6.798 - IF, Q1 - JCR, 2.921 - SJR, Q1 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 1364-0321. Available on: https://doi.org/10.1016/j.rser.2016.05.012
15. KOCIFAJ, Miroslav - KÓMAR, Ladislav. Modeling diffuse irradiance under arbitrary and homogeneous skies: Comparison and validation. In *Applied Energy*, 2016, vol. 166, p. 117-127. (2015: 5.746 - IF, Q1 - JCR, 2.835 - SJR, Q1 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 0306-2619. Available on: https://doi.org/10.1016/j.apenergy.2016.01.024
16. KOCIFAJ, Miroslav. Multiple scattering contribution to the diffuse light of a night sky: A model which embraces all orders of scattering. In *Journal of Quantitative Spectroscopy & Radiative Transfer*, 2018, vol. 206, p. 260-272. (2017: 2.600 - IF, Q2 - JCR, 0.779 - SJR, Q1 - SJR, Current Content - CCC). (2018 - Current Contents, WOS, SCOPUS). ISSN 0022-4073. Available on: https://doi.org/10.1016/j.jqsrt.2017.11.020
17. FABIAN, Miroslav - UETANI, Y. - DARULA, Stanislav. Monthly luminous efficacy models and illuminance prediction using ground measured and satellite data. In *Solar Energy*, 2018, vol. 162, p. 95-108. (2017: 4.374 - IF, Q1 - JCR, 1.615 - SJR, Q1 - SJR, Current Content - CCC). (2018 - Current Contents). ISSN 0038-092X. Available on: https://doi.org/10.1016/j.solener.2017.12.056
18. WANG, Shiuan-Man - MATIAŠOVSKÝ, Peter - MIHÁLKA, Peter - LAI, Chi-Ming**. Experimental investigation of the daily thermal performance of a mPCM honeycomb wallboard. In *Energy and Buildings*, 2018, vol. 159, p. 419-425. (2017: 4.457 - IF, Q1 - JCR, 2.061 - SJR, Q1 - SJR, Current Content - CCC). (2018 - Current Contents). ISSN 0378-7788. Available on: https://doi.org/10.1016/j.enbuild.2017.10.080

19. PETRŽALA, Jaromír - KÓMAR, Ladislav - KOCIFAJ, Miroslav. An advanced clear-sky model for more accurate irradiance and illuminance predictions for arbitrarily oriented inclined surfaces. In *Renewable Energy*, 2017, vol. 106, p. 212-221. (2016: 4.357 - IF, Q1 - JCR, 1.661 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents). ISSN 0960-1481. Available on: https://doi.org/10.1016/j.renene.2017.01.025
20. KOCIFAJ, Miroslav. Retrieval of angular emission function from whole-city light sources using night-sky brightness measurements. In *Optica*, 2017, vol. 4, no. 2, p. 255-262. (2016: 7.727 - IF, Q1 - JCR, 4.761 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents). ISSN 2334-2536. Available on: https://doi.org/10.1364/OPTICA.4.000255
21. KOCIFAJ, Miroslav - KUNDRACIK, F. - BARENTINE, John C. - BARÁ, Salvador. The proliferation of space objects is a rapidly increasing source of artificial night sky brightness. In *Monthly Notices of the Royal Astronomical Society: Letters*, 2021, vol. 504, p. L40-L44. (2020: 5.287 - IF, Q1 - JCR, 2.067 - SJR, Q1 - SJR). ISSN 1745-3925. Available on: https://doi.org/10.1093/mnrasl/slab030
22. ADCA09 DOLNIKOVA, E.** - KATUNSKY, D. - DARULA, Stanislav. Assessment of overcast sky daylight conditions in the premises of engineering operations considering two types of skylights. In *Building and Environment*, 2020, vol. 180, art. no. 106976. (2019: 4.971 - IF, Q1 - JCR, 1.871 - SJR, Q1 - SJR, Current Content - CCC). (2020 - Current Contents). ISSN 0360-1323. Available on: https://doi.org/10.1016/j.buildenv.2020.106976
23. KOCIFAJ, Miroslav - BARÁ, Salvador. Aerosol characterization using satellite remote sensing of light pollution sources at night. In *Monthly Notices of the Royal Astronomical Society: Letters*, 2020, vol. 495, p. L76-L80. (2019: 5.357 - IF, Q1 - JCR, 1.964 - SJR, Q1 - SJR, Current Content - CCC). (2020 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 1745-3925. Available on: https://doi.org/10.1093/mnrasl/slaa060
24. BARENTINE, John C. - KUNDRACIK, F. - KOCIFAJ, Miroslav - SANDERS, Jessie C. - ESQUERDO, Gilbert A. - DALTON, Adam M. - FOOTT, Bettymaya - GRAUER, Albert - TUCKER, Scott - KYBA, Christopher C. M. Recovering the city street lighting fraction from skyglow measurements in a large-scale municipal dimming experiment. In *Journal of Quantitative Spectroscopy & Radiative Transfer*, 2020, vol. 253, art. no. 107120. (2019: 3.047 - IF, Q1 - JCR, 0.888 - SJR, Q1 - SJR, Current Content - CCC). (2020 - Current Contents, WOS, SCOPUS). ISSN 0022-4073. Available on: https://doi.org/10.1016/j.jqsrt.2020.107120
25. SADOVSKÝ, Zoltán - KRIVÁČEK, Jozef. Influence of boundary conditions and load eccentricity on strength of cold-formed lipped channel columns. In Thin-Walled Structures, 2018, vol. 131, p. 556-565. (2017: 2.881 - IF, Q1 - JCR, 1.672 - SJR, Q1 - SJR, Current Content - CCC). (2018 - Current Contents). ISSN 0263-8231. Available on: https://doi.org/10.1016/j.tws.2018.07.031
26. SADOVSKÝ, Zoltán - KRIVÁČEK, Jozef - SOKOL, Milan. Imperfection sensitivity of axially compressed cylindrical shells under varying dimensions. In Engineering Structures, 2021, vol. 247, art. no. 113133. (2020: 4.471 - IF, Q1 - JCR, 1.567 - SJR, Q1 - SJR, Current Content - CCC). (2021 - Current Contents). ISSN 0141-0296. Available on: https://doi.org/10.1016/j.engstruct.2021.113133
27. SADOVSKÝ, Zoltán - KRIVÁČEK, Jozef. Influential geometric imperfections in buckling of axially compressed cylindrical shells – A novel approach. In Engineering Structures, 2020, vol. 223, p. 111170. (2019: 3.548 - IF, Q1 - JCR, 1.595 - SJR, Q1 - SJR, Current Content - CCC). (2020 - Current Contents). ISSN 0141-0296. Avaiôable on: https://doi.org/10.1016/j.engstruct.2020.111170
28. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - NOVOTNÝ, Radoslav - PALOU, Martin T. Simultaneous effect of silica fume, metakaolin and ground granulated blast-furnace slag on the hydration of multicomponent cementitious binders. In Journal of Thermal Analysis and Calorimetry, 2019, vol. 136, iss. 4, p. 1527–1537. (2018: 2.471 - IF, Q2 - JCR, 0.634 - SJR,

Q2 - SJR, Current Content - CCC). (2019 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-018-7813-7

29. PALOU, Martin T. - KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - NOVOTNÝ, Radoslav - MÁSILKO, Jiři. The effect of metakaolin upon the formation of ettringite in metakaolin–lime–gypsum ternary systems. In Journal of Thermal Analysis and Calorimetry, 2018, vol. 133, no. 1, p. 77–86. (2017: 2.209 - IF, Q2 - JCR, 0.587 - SJR, Q2 - SJR, Current Content - CCC). (2018 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-017-6885-0
30. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - MÁSILKO, Jiři - PALOU, Martin T. Effect of additives on the performance of Dyckerhoff cement, Class G, submitted to simulated hydrothermal curing. In Journal of Thermal Analysis and Calorimetry, 2018, vol. 133, no. 1, p. 63-76. (2017: 2.209 - IF, Q2 - JCR, 0.587 - SJR, Q2 - SJR, Current Content - CCC). (2018 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-017-6806-2 (
31. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - MÁSILKO, Jiři - PALOU, Martin T. Pore structure development of blended G-oil well cement submitted to hydrothermal curing conditions. In Geothermics, 2017, vol. 68, p. 86–93. (2016: 2.553 - IF, Q2 - JCR, 1.010 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents). ISSN 0375-6505. Available on: https://doi.org/10.1016/j.geothermics.2017.03.001
32. KUZIELOVÁ, Eva - PACH, Ladislav - PALOU, Martin T. Effect of activated foaming agent on the foam concrete properties. In Construction and Building Materials, 2016, vol. 125, p. 998-1004. (2015: 2.421 - IF, Q1 - JCR, 1.503 - SJR, Q1 - SJR). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2016.08.122 Typ: ADMA
33. PALOU, Martin T. - KUZIELOVÁ, Eva - NOVOTNÝ, Radoslav - ŠOUKAL, František - ŽEMLIČKA, Matúš. Blended cements consisting of Portland cement-slag-silica fume-metakaolin system. In Journal of Thermal Analysis and Calorimetry, 2016, vol. 125, no. 3, p. 1025-1034. (2015: 1.781 - IF, Q2 - JCR, 0.591 - SJR, Q2 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-016-5399-5 Typ: ADCA
34. PALOU, Martin T. - KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - BOHÁČ, Martin - NOVOTNÝ, Radoslav. The effect of curing temperature on the hydration of binary Portland cement. In Journal of Thermal Analysis and Calorimetry, 2016, vol. 125, no. 3, p. 1301-1310. (2015: 1.781 - IF, Q2 - JCR, 0.591 - SJR, Q2 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-016-5395-9
35. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - NOVOTNÝ, Radoslav - PALOU, Martin T.. Simultaneous effect of silica fume, metakaolin and ground granulated blast-furnace slag on the hydration of multicomponent cementitious binders. In Journal of Thermal Analysis and Calorimetry, 2019, vol. 136, iss. 4, p. 1527–1537. (2018: 2.471 - IF, Q2 - JCR, 0.634 - SJR, Q2 - SJR, Current Content - CCC). (2019 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-018-7813-7
36. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - BARTONIČKOVÁ, Eva - PALOU, Martin T.. The correlation between porosity and mechanical properties of multicomponent systems consisting of Portland cement–slag–silica fume–metakaolin. In Construction and Building Materials, 2017, vol. 135, p. 306-314. (2016: 3.169 - IF, Q1 - JCR, 1.511 - SJR, Q1 - SJR). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2016.12.105
37. ŽIVICA, Vladimír - PALOU, Martin T. - KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš. Super high strength metabentonite based geopolymer. In Procedia Engineering, 2016, vol. 151, p. 133-140. (2015: 0.238 - SJR). ISSN 1877-7058. Available on: https://doi.org/10.1016/j.proeng.2016.07.354

2.1.3 List of monographs/books published abroad

1. ABC01 WÜNSCHE, Michael - ZHANG, Ch. - SLÁDEK, Ján - SLÁDEK, Vladimír. Numerical analysis of interface cracks in layered piezoelectric solids. In Recent Trends in Fracture and Damage Mechanics. - Springer, 2016, p. 283-299. ISBN 978-3-319-21466-5.
2. AAA01 NEKVINDOVÁ, Terezie - KRAMEROVÁ, Daniela - MORAVČÍKOVÁ, Henrieta - STRAKOŠ, Martin - BERNÁTEK, Martin - BÜNGEROVÁ, Vladimíra - SYLVESTROVÁ, Marta. Automat na výstavu : československý pavilon na Expo 67 v Montrealu. Recenzenti Martina Pachmanová, Jan Wollner. Galerie výtvarného umění v Chebu : Akademie výtvarných umění v Praze, 2017. 298 s. ISBN 978-80-87395-31-8.
3. ABC01 MORAVČÍKOVÁ, Henrieta. Emancipated but still accompanied : the first generation of women architects in Slovakia. In Ideological Equals: Women Architects in Socialist Europe 1945-1989. - Oxford : Taylor and Francis, 2017, p. 48-62. ISBN 978-1-315-58777-6; 978-1-472-46926-7.
4. HRYTSYNA, Olha. Kontynuaľno-termodynamičnyj pidchid do pobudovy gradientnoho typu modeli bagatokomponentnych vjazkych ridyn = Continuum-thermodynamic approach to the construction of the gradient-type model of multicomponent viscous liquid. In Matematyčne modeljuvannja nerivnovažnych procesiv u skladnych systemach. - Lviv : Rastr-7, 2019, p. 59-81. ISBN 978-617-7726-67-7.
5. HRYTSYNA, Olha - KONDRAT, Vasyl. Local Gradient Theory for Dielectrics : Fundamentals and Applications. Jenny Stanford Publishing, 2020. 330 p. Available on: https://doi.org/10.1201/9781003006862 . ISBN 978-981-4800-2-4

2.1.4. List of monographs/books published in Slovakia

1. AAB01 BARTOŠOVÁ, Nina - HABERLANDOVÁ, Katarína. Industriál očami odborníkov/pamätníkov : teória a metodológia ochrany priemyselného dedičstva v kontexte Bratislavy. Bratislava : STU Bratislava, 2016. 128 s. ISBN 978-80-227-4476-8.
2. AAB02 MORAVČÍKOVÁ, Henrieta - SZALAY, Peter - PASTOREKOVÁ, Laura - HABERLANDOVÁ, Katarína - RUTKOWSKI, Roman. Ročenka Slovenskej architektúry 2014/2015. Bratislava : Slovart, 2016. 168 s. ISBN 9788055623894.

2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items for institute with less than 50 FTE researchers, 20 for institutes with 50 – 100 FTE researchers and so on

Advanced continum models for micro-structural effects

1. SLÁDEK, Ján - SLÁDEK, Vladimír - HRCEK, S. - PAN, E. The nonlocal and gradient theories for a large deformation of piezoelectric nanoplates. In Composite Structures, 2017, vol. 172, p. 119-129. (3.858 - IF2016). ISSN 0263-8223. ADCA
2. SLÁDEK, Ján - SLÁDEK, Vladimír - WÜNSCHE, Michael - TAN, C. L. Crack analysis of size-dependent piezoelectric solids under a thermal load. In Engineering Fracture Mechanics, 2017, vol. 182, p. 187-201. (2.151 - IF2016). ISSN 0013-7944. ADCA
3. SLÁDEK, Ján - SLÁDEK, Vladimír - LU, H. H. H. - YOUNG, D. L. The FEM analysis of FGM piezoelectric semiconductor problems. In Composite Structures, 2017, vol. 163, p. 13-20. (3.858 - IF2016). ISSN 0263-8223. ADCA
4. SLÁDEK, Ján - SLÁDEK, Vladimír - STAŇÁK, Peter - PAN, E. FEM formulation for size-dependent theory with application to micro coated piezoelectric and piezomagnetic fiber-composites. In Computational Mechanics, 2017, vol. 59, no. 1, p. 93-105. (2.861 - IF2016). ISSN 0178-7675. ADCA
5. SLÁDEK, Ján - SLÁDEK, Vladimír - KASALA, J. - PAN, E. Nonlocal and Gradient Theories of Piezoelectric Nanoplates. In Procedia Engineering, 2017, vol. 190, p. 178-185. ISSN 1877-7058. ADMB

Daylight availability and nighttime skyglow under arbitrary sky conditions

1. KOCIFAJ, Miroslav - KÓMAR, Ladislav. A role of aerosol particles in forming urban skyglow and skyglow from distant cities. In Monthly Notices of the Royal Astronomical Society, 2016, vol. 458, p. 438-448. (4.952 - IF2015). (2016 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711.
2. KOCIFAJ, Miroslav - SOLANO LAMPHAR, H. A. Angular Emission Function of a City and Skyglow Modeling: A Critical Perspective. In Publications of the Astronomical Society of the Pacific, 2016, vol. 128, 124001. (4.422 - IF2015). (2016 - Current Contents). ISSN 0004-6280.
3. KOCIFAJ, Miroslav - KUNDRACIK, F. - VIDEEN, Gorden. Optical characterization of electrically charged particles using discrete dipole approximation. In Journal of Quantitative Spectroscopy & Radiative Transfer, 2016, vol. 184, p. 161-166. (2.859 - IF2015). (2016 - Current Contents). ISSN 0022-4073.
4. KÓMAR, Ladislav - KOCIFAJ, Miroslav. Statistical cloud coverage as determined from sunshine duration: a model applicable in daylighting and solar energy forecasting. In Journal of Atmospheric and Solar-Terrestrial Physics, 2016, vol. 150, 1-8. (1.463 - IF2015). (2016 - Current Contents, WOS, SCOPUS). ISSN 1364-6826.
5. SOLANO LAMPHAR, H. A. - KOCIFAJ, Miroslav. Urban artificial light emission function determined experimentally using night sky images. In Journal of Quantitative Spectroscopy & Radiative Transfer, 2016, vol. 181, p. 87-95. (2.859 - IF2015). (2016 - Current Contents). ISSN 0022-4073.

Structure and Pore structure analysis of special binder materials

1. PALOU, Martin T. - KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - ŽIVICA, Vladimír. The influence of sodium hexametaphosphate ($Na_6P_6O_{18}$) on hydration of calcium aluminate cement under hydrothermal condition. In Procedia Engineering, 2016, vol. 151, p. 119-126. (2015: 0.238 - SJR). ISSN 1877-7058. Available on: https://doi.org/10.1016/j.proeng.2016.07.371
2. ŽIVICA, Vladimír - PALOU, Martin T. Influence of heat treatment on the pore structure of some clays - precursors for geopolymer synthesis. In Procedia Engineering, 2016, vol. 151, p. 141-148. (2015: 0.238 - SJR). ISSN 1877-7058. Available on: https://doi.org/10.1016/j.proeng.2016.07.401
3. ŽIVICA, Vladimír - PALOU, Martin T. - KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš. Super high strength metabentonite based geopolymer. In Procedia Engineering, 2016, vol. 151, p. 133-140. (2015: 0.238 - SJR). ISSN 1877-7058. Dostupné na: https://doi.org/10.1016/j.proeng.2016.07.354

2.1.6. List of patents, patent applications, and other intellectual property rights registered abroad, incl. revenues

EP No. 3105614 B1
Kocifaj Miroslav, Videen Gorden, Klačka Jozef
Method and apparatus for lightning threat indication

EP No. 3052026 A1
Kocifaj Miroslav, Mego Michal
System for isolation of circulating cells from peripheral blood

United States Patent and Trademark Office US 10,859,694
Videen Gorden, Kocifaj Miroslav, Klačka Jozef
Method and apparatus for lightning threat indication

2.1.7. List of patents, patent applications, and other intellectual property rights registered in Slovakia, incl. revenues

SK 288616 B6
Kocifaj Miroslav, Videen Gorden, Klačka Jozef
Spôsob a zariadenie na indikáciu ohrozenia bleskom

SK 288562 B6
Systém na izoláciu cirkulujúcich buniek z periférnej krvi
Kocifaj Miroslav, Mego Michal

Patent application: PP50038-2020: Čistá kubická forma kryštalického analcímu a spôsob jej prípravy
Eva Kuzielová, Martin T. Palou, Matuš Žemlička

Patent application: PP 50053-2020: Cementová zmes na použitie v hydrotermálnych vrtoch pri teplotách medzi 200 a 300 °C
Martin T. Palou, Eva Kuzielová, Matuš Žemlička

2.1.8. Table of research outputs

Papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately

Scientific publications	2016			2017			2018			2019			2020			2021			total			
	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. /1 million total salary budget	number	averaged number per year	av. No. / FTE researches	av. No. / one million total salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad *(AAA, ABA)*	0	0.000	0.000	1	0.043	0.981	0	0.000	0.000	0	0.000	0.000	1	0.057	0.874	0	0.000	0.000	**2**	**0.333**	**0.017**	**0.315**
Scientific monographs and monographic studies in journals and proceedings published in Slovakia *(AAB, ABB)*	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	**0**	**0.000**	**0.000**	**0.000**
Chapters in scientific monographs published abroad *(ABC)*	1	0.042	0.995	1	0.043	0.981	**0**	0.000	0.000	1	0.054	0.947	0	0.000	0.000	0	0.000	0.000	**3**	**0.500**	**0.025**	**0.472**
Chapters in scientific monographs published in Slovakia *(ABD)*	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	**0**	**0.000**	**0.000**	**0.000**
Scientific papers published in journals registered in Current Contents Connect *(ADCA, ADCB, ADDA, ADDB)*	32	1.345	31.846	28	1.208	27.455	24	1.279	22.645	24	1.287	22.723	34	1.926	29.717	32	1.863	29.904	**174**	**29.000**	**1.460**	**27.380**
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS not listed above *(ADMA, ADMB, ADNA, ADNB)*	13	0.546	12.937	16	0.690	15.688	6	0.320	5.661	12	0.643	11.361	7	0.397	6.118	7	0.407	6.541	**61**	**10.167**	**0.512**	**9.599**
Scientific papers published in other foreign journals (not listed above) *(ADEA, ADEB)*	9	0.378	8.957	4	0.173	3.922	4	0.213	3.774	1	0.054	0.947	0	0.000	0.000	1	0.058	0.934	**19**	**3.167**	**0.159**	**2.990**
Scientific papers published in other domestic journals (not listed above) *(ADFA, ADFB)*	7	0.294	6.966	3	0.129	2.942	2	0.107	1.887	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	**12**	**2.000**	**0.101**	**1.888**
Scientific papers published in foreign peer-reviewed proceedings *(AECA)*	12	0.504	11.942	9	0.388	8.825	6	0.320	5.661	0	0.000	0.000	0	0.000	0.000	1	0.058	0.934	**28**	**4.667**	**0.235**	**4.406**
Scientific papers published in domestic peer-reviewed proceedings *(AEDA)*	0	0.000	0.000	7	0.302	6.864	2	0.107	1.887	0	0.000	0.000	0	0.000	0.000	0	0.000	0.000	**9**	**1.500**	**0.075**	**1.416**
Published papers (full text) from foreign scientific conferences *(AFA, AFC)*	16	0.673	15.923	22	0.949	21.571	8	0.426	7.548	14	0.751	13.255	1	0.057	0.874	5	0.291	4.672	**66**	**11.000**	**0.554**	**10.386**
Published papers (full text) from domestic scientific conferences *(AFB, AFD)*	12	0.504	11.942	2	0.086	1.961	6	0.320	5.661	4	0.214	3.787	3	0.170	2.622	2	0	2	**29**	**5**	**0**	**5**

2.1.9. Narrative on the most important research outputs of the institute – especially focused on their importance for society (3-5 pages)

For thousands of years, material properties have been regarded as being given, and on this basis, many technical solutions could be conceived and constructed. Nowadays, it is clear that the manufacturing processes have advanced so much that one can design and fabricate materials for engineering practice exhibiting properties that are not directly found in nature – i.e., metamaterials. Metamaterials are composites with micro/nano-sized structures. The composition is usually arranged in specific periodic patterns. Therefore, metamaterials gain their specific excellent properties. 3D printing, electrospinning, self-assembly, and many other advanced manufacturing techniques are raising many scientific questions, which must be answered if the potential of the existing and foreseeable manufacturing novelties is to be fully realised. One must admit that, as sometimes happens in the history of science, technological innovation is ahead of scientific modeling in this crucial context.

Piezoelectric metamaterials, in which the piezoelectric response of the materials originates from their special geometries or structures and flexoelectricity, have been proposed in recent years, and the concept can provide a solution for this issue in conventional piezoelectrics. The flexoelectricity is the electromechanical coupling between the electric polarisation and a strain gradient (direct effect) or stress and an electric field gradient (converse effect) in solid dielectrics. Even a centrosymmetric material can exhibit a piezo-electric-like response if the material has special geometries or structures to convert the applied stress into a strain gradient or electric potential into an electric field gradient.

Straintronics is a rapidly developing new research area in micro-, nano-electronics, and material science, where strains induce physical effects in solids for new generation electronic devices. A non-uniform strain or the presence of strain gradients may potentially break the inversion symmetry and induce magnetisation even in centrosymmetric crystals. The coupling between the strain gradient and induced magnetisation is flexomaneticity, mainly observed in nanostructures. The flexomagnetism can be ignored in macro-structures owing to negligible strain gradients. This coupling is phenomenologically described by adding higher-gradient terms to the expression for the thermodynamic potential. In nano-scale size structures, it is needed to consider also the size effect. All the problems mentioned above lead to the necessity for the development of gradient theories. In such theories, the order of partial differential equations representing the governing equations is higher than in classical counterparts. The next research aims to develop a reliable computational method based on gradient theory. The size-effect is considered by including the strain gradients in the double stress tensor and magnetic induction constituting equations. Both material parameters higher-order elastic and flexomagnetic coefficients can be determined on the base of the atomistic model. The governing equations and the corresponding boundary conditions will be derived from the variational principle. The standard C0 continuous finite element method cannot be applied to numerical analyses of general boundary value problems with strain gradients. The mixed FEM (MFEM) has to be developed, where C0 continuous approximation is applied independently for displacement and strains. The kinematic constraints between the independent variables of displacements and the strains can be satisfied by a collocation method at some internal points of the elements.

The first-principles density functional theory (DFT) calculations will be performed using the Vienna ab initio simulation package (VASP) to obtain the flexomagnetic coefficients. Flexomagnetic coefficients are obtained by fitting the numerical results from atomistic modelling results with the analytical solution for a simple problem involving gradient theory. An analytical solution can be derived for a square domain with a simple polynomial variation of displacements.

Piezoelectricity is the most exploited electromechanical coupling that links electric polarisation and strain. A uniform mechanical strain can induce an electric polarisation, and conversely, a uniform electric field can cause mechanical deformations in piezoelectric materials. It is observed in materials with non-centrosymmetric crystal structures. The polarisation vector in natural piezoelectric material is related to the second-order strain

tensor through the third-order piezoelectric material property tensor. Tensor transformation properties require that under inversion-centre symmetry, all odd-order tensors vanish. Thus, most common crystalline materials are not piezoelectric if their structure is centrosymmetric. Physically, however, it is possible to visualise how a non-uniform strain or the presence of strain gradients may potentially break the inversion symmetry and induce polarisation even in centrosymmetric crystals. Then, the polarisation is proportional to the strain gradients. This phenomenon is called flexoelectricity. The flexoelectricity is the electromechanical coupling defined as the generation of electric polarisation by a strain gradient (direct effect) or stress by an electric field gradient (converse effect) in solid dielectrics. Even a centric material can exhibit a piezo-electric-like response if the material has special geometries or structures to convert the applied stress into a strain gradient or electric potential into an electric field gradient.

The proliferation of artificial light at night, and the light pollution it yields, is a global challenge that relates strongly to cities. Urban light emissions are observed to extend several hundreds of kilometres away from their origins, crossing jurisdictional boundaries and impacting distant, protected areas such as nature reserves and national parks. Light pollution touches on several social concerns, from urban ecology to human health, energy security, and sustainability. Furthermore, it directly addresses the Institute of Construction and Architecture's main research focus, which includes the overall urban environment's condition. Of our research output in the past five years, we think the study with the greatest direct societal impact is “Air pollution mitigation can reduce the brightness of the night sky in and near cities” (*Scientific Reports*, Vol. 11, No. 14622, 2021). This work makes a strong case for the reduction of air pollution given clear indications of concomitant reductions in skyglow over cities. This is true even in cases where there are no changes to outdoor lighting in those same cities; by merely clearing the air of anthropogenic aerosols, a significant darkening of the night sky may be obtained. It entails a definite social benefit beyond the public health advantage associated with reducing air pollution, and the approach involves essentially no risk.

While light pollution campaigners have typically focused their efforts on improving outdoor lighting, or reducing its presence, as a means of lowering light pollution in and near cities, one expects diminishing returns as the use of light at night approaches a minimum safe level. There is an unambiguous relationship between urban light emissions and the resulting brightening of the night sky, which in turn partially determines the illumination of the ground. We have observed this directly in the case of Tucson, U.S., a city which modernized its stock of publicly owned roadway luminaires about five years ago. Taking advantage of the engineering characteristics of modern light-emitting diode (LED) lighting, Tucson substantially reduced its city light emissions during the modernization. At the same time, skyglow over the city diminished, especially as seen from intermediate distances in the surrounding region. (*Journal of Quantitative Spectroscopy and Radiative Transfer*, 212, 10, 2018). After completion of the project, we found that public lighting constituted a distinct minority of Tucson’s urban light emissions. (*JQSRT*, 253, 107120, 2020)

We asked whether further gains could be made in this regard once opportunities to improve outdoor lighting in a city were exhausted, particularly given that new lighting equipment is expected to perform well in field conditions for perhaps as long as 20-30 years. Based on the mechanism of skyglow formation, we hypothesized that reducing aerosol pollution of the air over cities would reduce skyglow and darken the night sky even when no other changes were made to outdoor lighting on the ground. As a matter of public policy, such initiatives are highly defensible in consideration of the known public health benefits associated with air pollution reduction.

We modeled the change in night sky brightness over a city given a fixed light emission, allowing only the air quality to change. In order to test our predictions, we used the clearing effect of a weather front passing over the city of Vienna, Austria, as a kind of proxy for more permanent reductions in the aerosol load of the lower atmosphere associated with successful air pollution reduction campaigns. The reduction in skyglow we measured was

consistent with our model predictions, and we concluded that similar results would be obtained for any situation that reduced anthropogenic aerosols in city air. Our study attracted some media attention upon its publication in July 20 21. For an example, see "Cleaner air could darken the night sky" (*Physics Today*, Vol. 2021, Issue 1, p. 0729a).

Our work in light pollution and related subjects is foundational to a field that is still maturing and whose study requires making a synthesis of a number of disciplines. For this reason, opportunities to address questions of social interest are always appearing. As we discover previously unknown effects of light pollution, we are able to discern which topics are of the most broad interest to the public. In recent years, these have included investigating the relationship between light pollution and other forms of environmental pollution; understanding how the nature of anthropogenic particles in the atmosphere relates to the formation of skyglow over cities; using increasingly realistic models to predict how much light at night reaches the ground in and near cities; and interpreting the value of specific outdoor lighting modernization efforts in reducing light pollution. Along the way, we have worked to further elucidate the physics of light and its interaction with matter as it pertains to these topics.

In materials research, the scientific workers have gained fundamental knowledge of the phenomenon occurring during the hydration of cementitious materials, even under hydrothermal conditions, where temperature and vapor pressure have an important influence. The phase transformation and thermodynamic equilibrium at different temperature-vapour pressure stages were identified, enabling us to determine the real condition of using binder materials as sealing of casting in geothermal wells. Indeed, cement slurry is used for three primary purposes in cementing geothermal wells: (1) Zonal isolation (to isolate fluids such as water or gas in one area from petroleum to another); (2) Resistance against corrosion control; (3) Stability of the casing steel.

Under such conditions, the chemical composition of underground water significantly influences the hydration reactions, the stability and durability of the hydrated products, and the whole construction. Mathematical modelling considering temperature, vapor pressure, and chemical composition of the groundwater through 3D has enabled the design of the composition of cementitious materials, which can withstand severe conditions in geothermal wells. The carbonation process under these conditions is simulated in a high-pressure reactor operating up to 20 MPa and 220 °C to determine the conditions under which the sequestration of CO_2 is possible and in which of carbonates.

For special structures such as Heavyweight Concrete, Sef-Compacting Concrete, and High-Performance concrete, our Ph.D. students were involved in implementing projects relative to the abovementioned topics. It is of fundamental interest for the Institute to educate the Ph.D. students as searchers for future research. For example, Heavyweight Concrete was developed not only for its structural properties but also for its biological shielding structure. The attenuation capacity against gamma radiation using 60Co was excellent. The results are collected and processed in the form of a dissertation waiting for defence this summer.

2.2. Measures of research outputs (citations, etc.)

2.2.1. Table with citations per annum (without self-citations)

Citations of papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) are listed separately

Citations, reviews	2015		2016		2017		2018		2019		2020		total		
	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	averaged number per year	av. No. / FTE researchers
Citations in Web of Science Core Collection (1.1, 2.1)	607	25.51	609	26.27	673	35.87	754	40.43	820	46.46	889	51.75	**4 352**	**725.33**	**36.51**
Citations in SCOPUS (1.2, 2.2) if not listed above	40	1.68	33	1.42	57	3.04	73	3.91	103	5.84	96	5.59	**402**	**67.00**	**3.37**
Citations in other citation indexes and databases (not listed above) (3.2,4.2)	0	0.00	1	0.04	1	0.05	0	0.00	0	0.00	0	0.00	**2**	**0.33**	**0.02**
Other citations (not listed above) (3.1, 4.1)	51	2.14	27	1.16	19	1.01	18	0.97	2	0.11	1	0.06	**118**	**19.67**	**0.99**
Reviews (5,6)	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	**0**	**0.00**	**0.00**

2.2.2. List of 10 most-cited publications published any time with the address of the institute, with number of citations in the assessment period (2015 – 2020)

1. ŽIVICA, Vladimír - BAJZA, A. Acidic attack of cement based materials - a review. Part 1. Principle of acidic attack. In *Construction and Building Materials*, 2001, vol. 15, no. 8, p. 331-340. ISSN 0950-0618. Available on: https://doi.org/10.1016/S0950-0618(01)00012-5
   Number of citations: 101
2. ŽIVICA, Vladimír. Effects of type and dosage of alkaline activator and temperature on the properties of alkali-activated slag mixtures. In *Construction and Building Materials*, 2007, vol. 21, no. 7, p. 1463-1469. (2006: 0.506 - IF, Q3 - JCR, 1.197 - SJR, Q1 - SJR). (2007 - Thomson Reuters Master Journal List). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2006.07.002
   Number of citations: 73
3. KOMLOŠ, Karol - POPOVICS, S. - NÜRNBERGEROVÁ, Terézia - BABÁL, Bohumil - POPOVICS, J. S. Ultrasonic pulse velocity test of concrete properties as specified in various standards. In *Cement and Concrete Composites*, 1996, vol. 18, p. 357-364. ISSN 0958-9465. Available on: https://doi.org/10.1016/0958-9465(96)00026-1
   Number of citations: 70
4. SLÁDEK, Ján - SLÁDEK, Vladimír - ZHANG, C. Transient heat conduction analysis in functionally graded materials by the meshless local boundary integral equation method. In *Computational Materials Science*, 2003, vol. 28, no. 3-4, p. 494-504. (2003 - Current Contents). ISSN 0927-0256. Available on: https://doi.org/10.1016/j.commatsci.2003.08.006
   Number of citations: 54
5. SLÁDEK, Ján - STAŇÁK, Peter - HAN, Z. - SLÁDEK, Vladimír - ATLURI, S. N. Applications of the MLPG Method in Engineering & Sciences: A Review. In *CMES: Computer Modeling in Engineering & Sciences*, 2013, vol. 92, no. 5, p. 423-475. (2012: 0.849 - IF, Q2 - JCR, 0.727 - SJR, karentované - CCC). (2013 - Current Contents). ISSN 1526-1492.
   Number of citations: 49
6. JANOTKA, Ivan - NÜRNBERGEROVÁ, Terézia. Effect of temperature on structural quality of the cement paste and high-strength concrete with silica fume. In *Nuclear Engineering and Design*, 2005, vol. 235, no. 17-19, p. 2019-2032. (2004: 0.440 - IF, karentované - CCC). (2005 - Current Contents). ISSN 0029-5493. Available on: https://doi.org/10.1016/j.nucengdes.2005.05.011
   Number of citations: 45
7. SLÁDEK, Ján - SLÁDEK, Vladimír - KRAHULEC, Slavomír - PAN, E. The MLPG analyses of large deflections of magnetoelectroelastic plates. In *Engineering Analysis with Boudary Elements*, 2013, vol. 37, no. 4, p. 673-682. (2012: 1.596 - IF, Q1 - JCR, 1.244 - SJR, Q1 - SJR, karentované - CCC). (2013 - Current Contents). ISSN 0955-7997. Available on: https://doi.org/10.1016/j.enganabound.2013.02.001
   Number of citations: 45
8. SLÁDEK, Ján - SLÁDEK, Vladimír - PAN, E. - WÜNSCHE, Michael. Fracture analysis in piezoelectric semiconductors under a thermal load. In *Engineering Fracture Mechanics*, 2014, vol. 126, p. 27-39. (2013: 1.662 - IF, Q2 - JCR, 1.483 - SJR, Q1 - SJR, karentované - CCC). (2014 - Current Contents). ISSN 0013-7944. Available on: https://doi.org/10.1016/j.engfracmech.2014.05.011
   Number of citations: 45
9. KUZIELOVÁ, Eva - PACH, Ladislav - PALOU, Martin T.. Effect of activated foaming agent on the foam concrete properties. In *Construction and Building Materials*, 2016, vol. 125, p. 998-1004. (2015: 2.421 - IF, Q1 - JCR, 1.503 - SJR, Q1 - SJR). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2016.08.122
   Number of citations: 42
10. DARULA, Stanislav - KITTLER, Richard. CIE General Sky standard defining luminance distributions. In *Proceeding Conference eSim 2002. The Canadian conference on building energy simulation : september 11th - 13th, 2002, Montreal*. Available on

internete:<http://www.ustarch.sav.sk/wp-content/uploads/darula_kittler_proc_conf_esim_2002.pdf>
Number of citations: 41

2.2.3. List of 10 most-cited publications published any time with the address of the institute, with number of citations obtained until 2020

1. TANAKA, M. - SLÁDEK, Vladimír - SLÁDEK, Ján. Regularization techniques applied to boundary element methods. In *Applied Mechanics Reviews*, 1994, vol. 47, p. 457-499. ISSN 0003-6900. Available on: https://doi.org/10.1115/1.3111062
   Number of citations: 245

2. ŽIVICA, Vladimír - BAJZA, A. Acidic attack of cement based materials - a review. Part 1. Principle of acidic attack. In *Construction and Building Materials*, 2001, vol. 15, no. 8, p. 331-340. ISSN 0950-0618. Available on: https://doi.org/10.1016/S0950-0618(01)00012-5
   Number of citations: 176
3. BALAŠ, Ján - SLÁDEK, Ján - SLÁDEK, Vladimír. *Stress Analysis by Boundary Element Methods*. Amsterdam - Bratislava, 1989
   Number of citations: 163
4. DULLA, Matúš - MORAVČÍKOVÁ, Henrieta. *Architektúra Slovenska v 20. storočí*. Bratislava : Slovart, 2002. 511 s. ISBN 80-7145-684-5
   Number of citations: 154
5. SLÁDEK, Ján - SLÁDEK, Vladimír - ZHANG, C. Transient heat conduction analysis in functionally graded materials by the meshless local boundary integral equation method. In *Computational Materials Science*, 2003, vol. 28, no. 3-4, p. 494-504. (2003 - Current Contents). ISSN 0927-0256. Available on: https://doi.org/10.1016/j.commatsci.2003.08.006
   Number of citations: 138
6. ATLURI, S. N. - SLÁDEK, Ján - SLÁDEK, Vladimír - ZHU, T. The local boundary integral equation (LBIE) and it's meshlles implementation for linear elasticity. In *Computational Mechanics*, 2000, vol. 25, no. 2-3, p.180-198. ISSN 0178-7675. Available on: https://doi.org/10.1007/s004660050468
   Number of citations: 136
7. ŽIVICA, Vladimír. Effects of type and dosage of alkaline activator and temperature on the properties of alkali-activated slag mixtures. In *Construction and Building Materials*, 2007, vol. 21, no. 7, p. 1463-1469. (2006: 0.506 - IF, Q3 - JCR, 1.197 - SJR, Q1 - SJR). (2007 - Thomson Reuters Master Journal List). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2006.07.002
   Number of citations: 108
8. KOMLOŠ, Karol - POPOVICS, S. - NÜRNBERGEROVÁ, Terézia - BABÁL, Bohumil - POPOVICS, J. S. Ultrasonic pulse velocity test of concrete properties as specified in various standards. In *Cement and Concrete Composites*, 1996, vol. 18, p. 357-364. ISSN 0958-9465. Available on: https://doi.org/10.1016/0958-9465(96)00026-1
   Number of citations: 96
9. SLÁDEK, Ján - SLÁDEK, Vladimír - ATLURI, S. N. Local boundary integral equation (LBIE) method for solving problems of elasticity with nonhomogeneous material properties. In *Computational Mechanics*, 2000, vol. 24, no. 6, p. 456-462. ISSN 0178-7675. Available on: https://doi.org/10.1007/s004660050005
   Number of citations: 95
10. DARULA, Stanislav - KITTLER, Richard. CIE General Sky standard defining luminance distributions. In *Proceeding Conference eSim 2002. The Canadian conference on building energy simulation : september 11th - 13th, 2002, Montreal*. Available on internete: <http://www.ustarch.sav.sk/wp-content/uploads/darula_kittler_proc_conf_esim_2002.pdf>
    Number of citations: 92

11. SLÁDEK, Vladimír - SLÁDEK, Ján - TANAKA, M. Regularization of Hypersingular and Nearly Singular-Integrals in the Potential-Theory and Elasticity. In *International Journal for Numerical Methods in Engineering*, 1993, vol. 36, no. 10, p. 1609-1628. ISSN 0029-5981. Available on: https://doi.org/10.1002/nme.1620361002
    Number of citations: 87

2.2.4. List of 10 most-cited publications published during the evaluation period (2016-2021) with the address of the Institute, with number of citations obtained until 2021

1. KUZIELOVÁ, Eva - PACH, Ladislav - PALOU, Martin T.. Effect of activated foaming agent on the foam concrete properties. In *Construction and Building Materials*, 2016, vol. 125, p. 998-1004. (2015: 2.421 - IF, Q1 - JCR, 1.503 - SJR, Q1 - SJR). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2016.08.122
    Number of citations: 64
2. SCHMIDT, F. - ANDRIEU, F. - COSTARD, F. - KOCIFAJ, Miroslav - MERESESCU, A. G. Formation of recurring slope lineae on Mars by rarefied gas-triggered granular flows. In *Nature geoscience*, 2017, vol. 10, p. 1-5. (2016: 13.941 - IF, Q1 - JCR, 7.274 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents). ISSN 1752-0894. Available on: https://doi.org/10.1038/NGEO2917
    Number of citations: 50
3. SÁNCHEZ DE MIGUEL, A. - AUBÉ, Martin - ZAMORANO, J. - KOCIFAJ, Miroslav - ROBY, Johanne - TAPIA, C. Sky Quality Meter measurements in a colour-changing world. In *Monthly Notices of the Royal Astronomical Society*, 2017, vol. 476, p. 2966-2979. (2016: 4.961 - IF, Q1 - JCR, 2.388 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711. Available on: https://doi.org/10.1093/mnras/stx145
    Number of citations: 41
4. ZHENG, H. - ZHANG, Chuanzeng - WANG, Yong - SLÁDEK, Ján - SLÁDEK, Vladimír. A meshfree local RBF collocation method for anti-plane transverse elastic wave propagation analysis in 2D phononic crystals. In *Journal of Computational Physics*, 2016, vol. 305, p. 997-1014. (2015: 2.556 - IF, Q1 - JCR, 2.054 - SJR, Q1 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 0021-9991. Available on: https://doi.org/10.1016/j.jcp.2015.10.020
    Number of citations: 35
5. MAN, Yi - WANG, Bo - WANG, Jianxu** - SLANÝ, Michal - YAN, Haiyu** - LI, Ping - EL-NAGGAR, Ali - SHAHEEN, Sabry M. - RINKLEBE, Jörg - FENG, Xinbin. Use of biochar to reduce mercury accumulation in Oryza sativa L: A trial for sustainable management of historically polluted farmlands. In *Environment International*, 2021, vol. 153, p. 106527-1-106527-11. (2020: 9.621 - IF, Q1 - JCR, 2.582 - SJR, Q1 - SJR, Current Content - CCC). (2021 - Current Contents). ISSN 0160-4120. Available on: https://doi.org/10.1016/j.envint.2021.106527
    Number of citations: 24
6. AUBÉ, Martin - KOCIFAJ, Miroslav - ZAMORANO, J. - SOLANO LAMPHAR, H. A. - SANCHEZ DE MIGUEL, A. The spectral amplification effect of clouds to the night sky radiance in Madrid. In *Journal of Quantitative Spectroscopy & Radiative Transfer*, 2016, vol. 181, p. 11-23. (2015: 2.859 - IF, Q1 - JCR, 1.156 - SJR, Q1 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 0022-4073. Available on: https://doi.org/10.1016/j.jqsrt.2016.01.032
    Number of citations: 24
7. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - BARTONIČKOVÁ, Eva - PALOU, Martin T.. The correlation between porosity and mechanical properties of multicomponent systems consisting of Portland cement–slag–silica fume–metakaolin. In *Construction and Building Materials*, 2017, vol. 135, p. 306-314. (2016: 3.169 - IF, Q1 - JCR, 1.511 - SJR, Q1 - SJR). ISSN 0950-0618. Available on: https://doi.org/10.1016/j.conbuildmat.2016.12.105
    Number of citations: 22

8. PALOU, Martin T. - KUZIELOVÁ, Eva - NOVOTNÝ, Radoslav - ŠOUKAL, František - ŽEMLIČKA, Matúš. Blended cements consisting of Portland cement-slag-silica fume-metakaolin system. In *Journal of Thermal Analysis and Calorimetry*, 2016, vol. 125, no. 3, p. 1025-1034. (2015: 1.781 - IF, Q2 - JCR, 0.591 - SJR, Q2 - SJR, Current Content - CCC). (2016 - Current Contents). ISSN 1388-6150. Available on: https://doi.org/10.1007/s10973-016-5399-5
   Number of citations: 21
9. KUZIELOVÁ, Eva - ŽEMLIČKA, Matúš - MÁSILKO, Jiři - PALOU, Martin T.. Pore structure development of blended G-oil well cement submitted to hydrothermal curing conditions. In *Geothermics*, 2017, vol. 68, p. 86–93. (2016: 2.553 - IF, Q2 - JCR, 1.010 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents). ISSN 0375-6505. Available on: https://doi.org/10.1016/j.geothermics.2017.03.001
   Number of citations: 18
10. SLÁDEK, Ján - SLÁDEK, Vladimír - REPKA, Miroslav - KASALA, J. - BISHAY, P.L. Evaluation of effective material properties in magneto-electro-elastic composite materials. In *Composite Structures*, 2017, vol. 174, p. 176-186. (2016: 3.858 - IF, Q1 - JCR, 2.162 - SJR, Q1 - SJR, Current Content - CCC). (2017 - Current Contents). ISSN 0263-8223. Available on: https://doi.org/10.1016/j.compstruct.2017.03.104
    Number of citations: 18

2.2.5. List of most-cited authors from the Institute (at most 10 % of the research employees with university degree engaged in research projects) and their number of citations in the assessment period (2015– 2020). The cited papers must bear the address of the institute

	Name	Number of citations
1.	Sládek Ján	**2120**
2.	Sládek Vladimír	**2119**
3.	Kocifaj Miroslav	**639**
4.	Živica Vladimír	**507**
5.	Darula Stanislav	**411**

2.2.6. List of most-cited authors from the Institute (at most 10 % of the research employees with university degree engaged in research projects) and their number of citations obtained until 2020. The cited papers must bear the address of the Institute

	Name	Number of citations
1.	Sládek Ján	**4603**
2.	Sládek Vladimír	**4602**
3.	Živica Vladimír	**964**
4.	Kittler Richard	**934**
5.	Darula Stanislav	**933**

2.2.7. List of most-cited authors from the Institute (at most 10 % of the research employees with university degree engaged in research projects) and their number of citations obtained until 2021 of their papers published during the evaluation period (2016– 2021). The cited papers must bear the address of the Institute

	Name	Number of citations
1.	Sládek Ján	**360**
2.	Sládek Vladimír	**360**
3.	Kocifaj Miroslav	**322**
4.	Palou Martin T.	**202**
5.	Kuzielová Eva	**193**

2.3. Research status of the institute in international and national context

- **International/European position of the institute**

2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items for institute with less than 50 FTE researchers, max. 20 for institutes with 50 – 100 FTE researchers and so on

1. Project W911NF-13-1-0195 Cooperation with US Army International Technology Center "Optical Characterization of Atmospheric Aerosols".

2. Project: U.S. Army W911NF-14-1-0601, "Scattering of Electromagnetic Radiation by Electrically Charged and Neutral Particles: Similarities and Fundamental Differences". Optical characterization of electrically charged particles using discrete dipole approximation.

3. Novel thermal management design for BIPV modules incorporating MEPCM layers, SAS-MOST JRP 2015/7.

4. UNESCO: SkyMeAPP

5. Building Integrated Solar Envelope Systems for HVAC and Lighting- IEA SHC Task 56

6. Programa en Estudios Metropolitanos (Metropolitan Studies Programme- 2723 CONACYT.

7. V4-KOREA_RADCON: The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment.

8. APVV SK-CN-RD-18-0005: A multiscale flexoelectric theory and a new method for real-time detection of microcracks in dielectric materials within implementation period from 1.10.2018 to 30.9.2021.

9. APVV SK-KR-18-0006: Material and mechanical performance of heavyweight self compacting concrete (SCC) within implementation period from 1.9.2018 to 31.12.2019

2.3.2. List of international conferences (co)organised by the institute

2016

1. Dni architektúry 2016 Hodnota a postoj, Nové bývanie v Bratislave, Bratislava - Viedeň, Slovakia – Austria, 3rd -4th June 2016

"Architecture Days 2016": Value and Attitude, New Housing in Bratislava, Bratislava-Vienna, Slovakia – Austria, 3rd -4th June 2016

2017

1. Light Pollution: Theory, Modelling, and Measurements 2017, Cellers, Spain, 27th – 30th June.2017

Neplánované / plánované mestá, Bratislava, Slovakia, 8th November.2017
Unplanned / planned cities, Bratislava, Slovakia, 8th November.2017

2018

1. Thermophysics 2018, Smolenice, Slovakia, 7th – 9th November 2018

2019

1. Thermophysics 2019, Smolenice, Slovakia, 22nd -24th October 2019

2. International Conference on Light Pollution Theory, Modelling and Measurements, Zselic Valley Leisture Farm, Hungary, 25th – 28th June. 2019

3. 3rd Workshop Radcon "The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment „RADCON"- Visegrad Group (V4) - Korean Republic (KR), Smolenice, Slovakiam 11th -14th March, 2019

4. The 2nd SK-KR International Workshop SK-KR-18-0006 „Materiálové zloženie a mechanické vlastnosti ťažkého a samozhutňujúceho sa betónu ", Smolenice, Slovakia, 11th – 14th March 2019

2020

1. Thermophysics 2020, Smolenice, Slovakia, 7th – 9th September 2020

2021

1. Analysis of multi-field problems by advanced computational methods, Symposium at the conference ICCES 20/21, Phuket, Thailand, 6th -10th January 2021

2.3.3. List of edited proceedings from international scientific conferences

1. TRNIK, A. - MATIAŠOVSKÝ, Peter - MEDVED, I. Thermophysics 2018. In AIP Conference Proceedings, 2018, vol. 1988, art. no. 010001. (2017: 0.165 - SJR). (2018 - SCOPUS, WOS). ISSN 0094-243X.
2. ZMESKAL, Oldrich - MATIAŠOVSKÝ, Peter - PAVLÍK, Z. Thermophysics 2019: 24th International Meeting of Thermophysics and 20th Conference REFRA. In AIP Conference Proceedings, 2019, vol. 2170, art. no. 010001. (2018: 0.182 - SJR). (2019 - SCOPUS, WOS). ISSN 0094-243X.
3. ZMEŠKAL, Oldřich - MATIAŠOVSKÝ, Peter - PAVLÍK, Z. Thermophysics 2020 : 25th International Meeting on Thermophysics 2020. In AIP Conference Proceedings, 2020, vol. 2305, art. no. 010001. (2019: 0.190 - SJR). ISSN 0094-243X.

2.3.4. List of journals edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

Architektúra & urbanizmus, ISSN 0044-8680

The Department of Architecture edited the Journal, but they moved to the Historical Institute in July 2018.

	SJR	SJR Q (best)
2016	0.114	Q3
2017	0.1	Q4
2018	0.139	Q2

CiteScore in SCOPUS
2016 0,2
2017 0,3,
2018 0,2

- **National position of the institute**

2.3.5. List of selected activities of national importance

Membership in advisory boards of the Government of the Slovak Republic, the National Council of the Slovak Republic, ministries of the Slovak Republic, EU bodies, EP, NATO, etc.

1. Dr. Peter Matiašovský. Working Group of the Accreditation Commission of the Government of the Slovak Republic for Research 5: Design, Engineering, Technology, and Water Management. Member
2. Prof. Dr. Ing. arch. Henrieta Moravčíková: Board of Guarantors of the Central Register of Records of Artistic Activities of Higher Education Institutions, Ministry of Education of the Slovak Republic, member of the board

Memberships of Scientific Boards

Dr. Peter Matišovský,

1. Member of the scientific board of the Slovak Technical University in Bratislava
2. Member of the Scientific Board of the Faculty of Civil Engeering of the Slovak Technical University in Bratislava

Dr. Stanislav Darulla

1. Member of the Scientific Board of the Faculty of Civil Engeering of the Slovak Technical University in Košice

Memberhips in the commsiion of programmes for doctoral studies

Prof. Martin Palou

- Building Technology (TS), Civil Engineering/ Slovak University of Technology in Bratislava
- Inorganic Technology and Materials, Faculty of Chemical and Food Technology/ Slovak, University of Technology in Bratislava

Dr. Peter Matiašovský

- Building Technology (TS), Civil Engineering/ Slovak University of Technology in Bratislava
- Theory and Structures of Buildings (TKPS)

Slovak Commission for the doctor of Science Degrees

1. Prof. RNDr. Vladimír Sládek, DrSc. SKVH pri MŠ SR, člen

Members of the Scientific Grant Agency of the Ministry of Education of the Slovak Republic

1. Prof. Ján Sládek, DrS.
2. Prof. Vladimír Sládek DrS.
3. Prof. Martin T. Palou,
4. Dr. Peter Matiašovský
5. Dr. Miroslav Kocifaj
6. Dr. Eva Kuzielová
7. Dr. Ladislav Kómar
8. Dr. Miroslav Repka

Members of the Commission of the Slovak Institute of Technical Standardization (SITS) - Commission No

1. Prof. Martin T. Palou
2. Dr. Matúš Žemlička
3. Dr. Stanislav Darula

2.3.6. List of journals (published only in the Slovak language) edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

- **Position of individual researchers in the international context**

2.3.7. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter

1. J. Sládek, V. Sládek, H.H.-H. Lu, D.L. Young: Three-dimensional Analyses of Piezoelectric Semiconductor Problems, In: Proc. Of CCCM-ISCM 2016 Conf., Hangzhou, China, October 16-20, 2016.

2. J. Sládek, V. Sládek, J. Kasala: Crack problems in micro/nano-sized piezoelectric bodies, In: Proc. of the 17th International Scientific Conf. TRANSFER 2016, Trencianske Teplice, Slovakia, 11-13 October 2016.

3. V. Sládek, B. Musil, J. Sládek: Effective elasticity coefficients in dry porous materials. Numerical and semi-analytical approaches, In: Proc. of theVII European Congress on Computational Methods in Applied Sciences and Engineering - ECCOMAS Congress, Crete Island, Greece 5-10 June 2016.

4. V. Sládek, L. Sator, J. Sládek: Simulations of coupling effects in vibration of FGM plates by mesh-free methods, Int. J. Comp. Meth. and Exp. Meas. (DOI: 10.2495/CMEM-V5-N3-306-316); BEM/MRM 39 Int. Conf., Siena, Italy 20-22 Sept. 2016.

5. V. Sládek, B. Musil, J. Sládek, J. Kasala: Homogenization of materials with micro-voids: optimization of representative volume elements, In: Proc. of the 17th International Scientific Conf. TRANSFER 2016, Trencianske Teplice, Slovakia, 11-13 October 2016.

6. H. A. Solano-Lamphar, M. Kocifaj: The modelling of skyglow: the experiences of the light pollution research group from the Slovak Academy of Sciences. 2016 SSA Technology Development Workshop, November 16-17, 2016, Grand Hyatt, Denver, CO, USA.

7. K. Haberlandová: Význam bratislavského prístavu v kontexte života mesta. Industrial day 2016, Design factory, Bratislava, 15.11. 2016.

8. H. Moravčíková: Ročenka slovenskej architektúry. To nejlepší za rok: Diskuse o smyslu sestavování ročenek architektury. Galerie VIPER, Praha 15.9. 2016.

9. H. Moravčíková: Reuse as Activism: Towards Hybrid Strategies of Curatin and Preservation of Modern Architectural Heritage. In: 14th DOCOMOMO International Conference, The Modern Movement Towards the Future, 6-9. 9. *2016*, Calouste Gulbenkian Foundation Lisabon.
10. L. Pastoreková, P. Vodrážka: Architektúra pre erár: Vplyv vojenských udalostí na obraz slovenských miest. Pohromy, katastrofy a nešťastia v dejinách našich miest. Bratislava, 18. – 20. 10. 2016.

11. L. Pastoreková: (In)Visible elements of the city: Military architecture in the context of urban structure development. World Multidisciplinary Civil Engineering – Architecture – Urban Planning Symposium, Praha, 13. – 17. 6. 2016.

12. P. Szalay: New practice? On the preservation process of the Peter Behrens Synagogue in Žilina. In: Jewish Cultural Heritage. Projects, Methods, Inspirations. Varšava, Polin - Museum of Polish Jews, 8 – 10. 6. 2016.

13. P. Szalay: New Practice? On the Process of Preservation of Peter Behrens's Synagogue in Žilina. In: 14th DOCOMOMO International Conference, The Modern Movement Towards the Future, 6-9. 9. *2016*, Calouste Gulbenkian Foundation Lisabon.
14. M. T. Palou: Application of thermoanalytical methods to investigate glass transformation and cement hydration. In TAS 2017 - Termoanalytický seminář, 10 October 2017, Ostrava, Česko.
15. V. Sládek: Thermoelastic analysis of bending problems in FGM plates, In: BEM/MRM 40 (40th Int. Conf. On Boundary Elements and other Mesh Reduction Methods), 12-14 September 2017, New Forest, UK.
16. J. Sládek: Crack analysis of piezoellectric solids under a thermal load, In: Proc. of the 18th International Scientific Conf. TRANSFER 2017, 23-24 November 2017, Trenčianske Teplice, Slovensko.

17. V. Sladek, M. Repka, J. Sladek: Moving finite element method. WIT Transactions on Engineering Sciences, vol. 122, WIT Press: Southampton and Boston, 2018, witpress.com/elibrary, ISSN 1743-3533.

18. M. Palou: Multicomponent cementitious composites: advantages and risks. 21st International Conference-- Building materials, products and technologies ICBMPT 2018 from 29th – 31st May 2018, Češkovice, Česká republika

19. M. Kocifaj, A. Kocifajová: Fundamentals of skyglow theory. 1st International Conference on Environmental and Astronomical Light Pollution EALPO 2019. Kraków, September 20th-21st, Poľsko.

20. V. Sladek: Bending of piezo-electricFGM plates by a mesh-free method, Semi-plenary lecture in The International Conference on Computational & Experimental Engineering and Sciences, March 24-28, 2019, Tokyo, Japan

21. J. Sladek: Micro/Nano-Sized Piezoelectric Structures Analyzed by Strain Gradient Theory, Semi-plenary lecture in The International Conference on Computational & Experimental Engineering and Sciences, March 24-28, 2019, Tokyo, Japan

22. V. Sladek: Platre bending problems in higher-gradetheories: Comparison of formulations in Strain-gradient theory and Couple stress theory of elasticity, Keynote lecture in 22-nd International Conference on Composite Structures (ICCS22) and 1-st Chinese Conference on Composite Structures (CCCS1), October 31-Novenber 3, 2019, Wuhan, China

23. V. Sladek: Mesh-free analysis of plate bending problems by Moving Finite Element approximation, Invited lecture in 42-nd International Conference on Boundary Elements and Other Mesh Reduction Methods (BEM/MRM 42), July 2-4, 2019, Coimbra, Portugal

24. M.-T. Palou: 2nd JTACC(Journal of Thermal Analysis and Calorimetry) Conference with the V4 (Joint Czech-Hungarian-Polish-Slovakian) Thermoanalytical Conference
25. M.-T. Palou: ICBMPT-International Conference Building Materials, Products and Technologies v ČR
26. J. Sladek: Modelling of advanced thermoelectric material structures. 2020 Silk Road International Conference on the Cooperation and Integration of Industry, Education, Research and Application of Aeronautics and Astronautics, Xian, December 11, 2020
27. M. Kocifaj: Calculation methods and models. CIE Online Workshop on the Calculation and Measurement of Obtrusive Lighting, November 12-13 2020, Ostrava, Czech Republic.

28. J. Sladek: The MPLG Method in Multiphysics and Scale Dependent Problems, Plenary lecture at ICCES 2020/2021, January 6-10, 2021, Phuket, Thailand

29. V. Sladek: Element-free discretization method with Moving Finite Element Approximation, Semi-plenary lecture at ICCES 2020/2021, January 6-10, 2021, Phuket, Thailand
30. L. Kómar: Light pollution quantification possibilities. International Day of Light (IDL). 24.5.2021, Día Internacional de la Luz, Nodo México, Universidad Nacional Autónoma de México.

31. M. Kocifaj: Fundamentals of skyglow modeling. International Day of Light (IDL). 24.5.2021, Día Internacional de la Luz, Nodo México, Universidad Nacional Autónoma de México.

32. J. Barentine, M. Kocifaj, F. Kundracik, S. Bará: The proliferation of space objects is a rapidly increasing source of artificial night sky brightness. Dark and Quiet Skies for Science and Society II, Implementing the recommendations, La Palma, Canary Islands, Spain, 3-8 October, 2021

33. M. T. Palou: Investigation of the hydration of Dyckerhoff G-Oil Cement and its blends by Calorimetry and Thermal methods. Invited speaker at 17th International Congress on Thermal Analysis and Calorimetry (ICTAC17) including 8th Joint Czech-Hungarian-Polish-Slovakian Thermoanalytical Conference (V4 8) and 14th Conference on Calorimetry and Thermal Analysis of the Polish Society of Calorimetry and Thermal Analysis (CCTA 14) – ICTAC2020. 29 Aug. – 2 Sept. 2021,Krakow, Poland

34. M. T. Palou: Carbon capture, reuse and storage: Challenge for cement and construction industry. Keynote speaker at 24th In ICBMPT 2021. 24 th International Conference of the Research Institute for Building Materials “Building Materials, Products and Technologies“ September 29 - October 1, 2021, Telč, Czech Republic

The membership in international scientific societies or in editorial borads of the International Journals can also characterize the position of individual researchers in the global context.

Ing. Stanislav Darula, CSc.

1. CIB - International Council for Research and Innovation in Building and Construction (Member)
2. CIE - Commission Internationale de l' Eclairage (Member)
3. CIE TC3-39, Discomfort Glare from Daylight in Buildings (Member)
4. CIE TC3-52 Energy Performance of Buildings – Energy Requirements for Lighting (Member)
5. IBPSA – the International Building Performance Simulation Associati (Member)
6. Lux Europa Board of Directors (Member)
7. TC 3-54: Revision of CIE 16-1970: Daylight (Member)

PhDr. Katarína Haberlandová, PhD.

1. DOCOMOMO International (Member)

Mgr. Peter Szalay, PhD.

1. DOCOMOMO International (Member)

Dr. Miroslav Kocifaj

1. International Astronomical Union (Member)
2. International Solar Energy Society (ISES) (Silver member)
3. Optical Society of America (OSA) (Member)
4. The Illuminating Engineering Society (Member - Sky Glow Committee)

Dr. Oľga Koronthályová, CSc.

1. CIB W040 Heat and Moisture Transfer in Buildings (Member)

Prof. Dr. Ing. arch. Henrieta Moravčíková

1. Documentation and Conservation of Modern Movement (Mmember of the International comitee for landscape and town planing)
2. Documentation and Conservation of Modern Movement (Member of the International comitee for registers)

Prof.Dr.Ing. Martin-Tchingnabé Palou

1. CIB- International Counil for Research and Innovation in Building and Construction (Member)
2. ICIC – International Committee on Irradiated Concrete (Member)

Prof. Ing. Ján Sládek, DrS.

1. Central European Assoc. for Computational Mechanics (Member)
2. Int. Soc. Comput. Eng. & Sciences (ICCES) (Member)

Prof. RNDr. Vladimír Sládek, DrS.

1. Central European Assoc. for Computational Mechanics (Member)
2. International Society for Boundary Elements (Member)

Membership in the editorial boards of Journals

Membership in the editorial boards of Journals

Dr. Stanislav Darula

1. Light and Engineering (Member of Editorial boards)
2. Lighting Research and Technology (Member of Editorial boards)

3. VTS News (Member of Editorial boards)

Dr. Kocifaj as member

1. Building Research Journal (Editor in Chief)
2. Journal of Quantitative Spectroscopy & Radiative Transfer (Guest Editor)

Dr. Kocifaj as editor

1. Journal of Quantitative Spectroscopy & Radiative Transfer https://www.sciencedirect.com/journal/journal-of-quantitative-spectroscopy-and-radiative- transfer/vol/181
2. Journal of Quantitative Spectroscopy & Radiative Transfer https://www.sciencedirect.com/journal/journal-of-quantitative-spectroscopy-and-radiative-transfer/special-issue/10CCF9DQRCC

Dr. Peter Matiašovský

1. CIB W040 Heat and Moisture Transfer in Buildings (Member)
2. Building Research Journal (Chairman of the Editorial Board)
3. Encyclopaedia Beliana (Member of Editorial board)
4. Journal of Building Physics (Member)

Prof. Dr. Ing. arch. Henrieta Moravčíková

1. ALFA (STU) (Chairman of the Editorial Board)
2. Architektúra & Urbanizmus (funkcia: členka a editorka) Studies in History & Theory of Architecture (Universita Ion Mincu, Bukurešť) (Member of Editorial boards)

Prof. Ing. Ján Sládek, DrS.

1. CMES-Computer Modeling in Engineering &Sciences (Editor Corresponding editor)
2. Electronic Jour. Boundary Elements (Member)
3. Jour. Computational and Applied Mechanics (funkcia: člen) Journal of Multiscale Modelling (Member)
4. SDHM-Structural Durability and Health Monitoring Journal (funkcia: člen) Strojnícky časopis (Member)

Prof. RNDr. Vladimír Sládek, DrS.

1. Communications in Numerical Analysis (Member of Editorial boards)
2. Int. Jour. Engineering Analysis with Boundary Elements (Editor)
3. Journal of Industrial Mathematics and Computational Mechanics (Member of Editorial boards) Newsletter of the Int. Soc. of Boundary Element Methods (Member of Editorial boards)
4. Series Advances in Boundary Elements (Member of Editorial boards)

Prof. Dr. Martin T. Palou

1. Journal of Thermal Analysis and Calorimetry (Member of Editorial boards)
2. Journal of Ceramics/Silikaty (Member of Editorial boards).

2.3.8. List of researchers who served as members of the organising and/or programme committees

Prof. Henrieta Moravčíková, Dr. K. Haberlandová,

1. Dni architektúry 2016 Hodnota a postoj, Nové bývanie v Bratislave, Bratislava - Viedeň, 60 účastníkov, 03.06.-04.06.2016
2. Neplánované / plánované mestá, Bratislava, 50 účastníkov, 08.11.-08.11.2017

Dr. Miroslav Kocifaj,

1. Light Pollution : Theory, Modelling, and Measurements 2017/Svetelné znečistenie: Teória, modelovanie a meranie 2017, hotel Terradets, Cellers, Španielsko, 27.06.-30.06.2017
2. International Conference on Light Pollution Theory, Modelling and Measurements, 25–28. 6. 2019, Zselic Valley Leisture Farm, Hungary.

Dr. Peter Matiašovský, Dr. Ladislav Kómar, Dr. Peter Mihálka,

1. Thermophysics 2018, Smolenice, 07.11.-09.11.2018
2. Thermophysics 2019, Smolenice, 22. 10. - 24. 10. 2019
3. Thermophysics 2020, Smolenice, 7. 9. - 9. 9. 2020

Prof. Vladimír Sládek, DrS.

1. Analysis of multi-field problems by advanced computational methods, Symposium organized by V. Sladek at the conference ICCES 20/21, January 6-10, 2021, Phuket, Thailand

Prof. Dr. Martin T. Palou

1. 5th Central and Eastern European Conference on Thermal Analysis and Calorimetry (CEEC-TAC5) and 14th Mediterranean Conference on Calorimetry and Thermal Analysis (Medicta2019), 27th and 30th of August 2019 in Roma/Rome, Italy. www.ceec-tac.com
2. 6th Central and Eastern European Conference on Thermal Analysis and Calorimetry (CEEC-TAC6) and 15th Mediterranean Conference on Calorimetry and Thermal Analysis (Medicta2021) 20th-24th of July 2021 in Split, Croatia. www.ceec-tac.com
3. ICCC 2019 – 15th International Congress on Cement Chemistry
4. 3rd Workshop Radcon “The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment „RADCON“ - Visegrad Group (V4) - Korean Republic (KR) - 11th -14th March, 2019 , Smolenice
5. The 2nd SK-KR International Workshop SK-KR-18-0006 „Materiálové zloženie a mechanické vlastnosti ťažkého a samozhutňujúceho sa betónu“ 11.03.219 do 14.03.219, Smolenice

2.3.9. List of researchers who received an international scientific award

The Humboldt Research Award is the prestige scientific award given by the Alexander von Humboldt Foundation to internationally renowned scientists and scholars from all countries, excluding Germany. It is the highest scientific award in Germany for scientists and scholars from abroad.

Awarded researchers made fundamental discoveries, and new theories on their discipline beyond their immediate research area and who are expected, moreover, to continue producing outstanding research in the future.

The Humboldt Research Awards have been a central pillar of the Alexander von Humboldt Foundation’s sponsorship activities since 1972. The awards honour the academic achievements to date of internationally recognised scientists and scholars from abroad. A not insignificant number of award winners has subsequently been granted the Nobel Prize.

Alexander von Humboldt
Stiftung/Foundation

47th Symposium for Research Award Winners
Conferment of Awards

Laudation

for

Professor Jan Sladek

delivered on the occasion of the conferment of the
Award Certificates in Bamberg on 29 March 2019

Professor Sladek is a highly recognised scientist in the international research community of solid mechanics, especially in computational mechanics. He is a leader and one of the pioneers in the systematic and fundamental development of the boundary element method and meshfree methods for engineering applications. In Germany, Professor Sladek intends to optimize nanoscale structures by advanced continuum models.

Alexander von Humboldt
Stiftung/Foundation

Urkunde

Prof. Dr. Jan Sladek
Slowakei

erhält in Würdigung herausragender wissenschaftlicher Leistungen

den

Humboldt-Forschungspreis

Dieser Preis ermöglicht einen langfristigen
Forschungsaufenthalt in Deutschland.

Bonn-Bad Godesberg, im Jahre 2018

Der Präsident

Prof. Dr. Hans-Christian Pape

- **Position of individual researchers in the national context**

2.3.10. List of invited/keynote presentations at national conferences, as documented by programme or invitation letter

2016

H. Moravčíková: Pochovaní pod pamiatkami, alebo ako pamiatkový úrad zaspal dobu. Živá kultúra a pamiatky: Pochovaní pod pamiatkami, konferencia Via Cultura, Pistoriho palác, Bratislava, 8. 12. 2016.

2018

V. Sladek, M. Repka, J. Sladek: Bending of elastic plates by Moving Finite Element method, Proceedings of the 19th International Scientific Conference Transfer 2018, 22-23 November 2018, Trencianske Teplice, Slovakia, CD ROM, ISBN 978-80-8075-827-1.

J. Sladek, V. Sladek: Optimal design of metamaterials, Proceedings of the 19th International Scientific Conference Transfer 2018, 22-23 November 2018, Trencianske Teplice, Slovakia, CD ROM, ISBN 978-80-8075-827-1.

M. Palou: Vápenický Seminář 2018, Congress Hotel Centrum, Košice 15. – 16. listopadu 2018

2.3.11. List of researchers who served as members of organising and programme committees of national conferences

2.3.12. List of researchers who received a national scientific award

Darula Stanislav
Bronze commemorative plaque, Award from the Faculty of Civil engineering, SvF TU v Košiciach

Haberlandová Katarína
Prize for scientific and professional literature in 2016

Kocifaj Miroslav

- Award for a three-year scientific citations, 2017
- Top publication in scientific journal: Award from the Presidium of SAS for the work published in: Nature Geoscience, Vol. 10, No. 4, pp. 270-273, 2017
- Premium for three-year scientific citations. Awarded from Literary Fund in the Section for Scientific and Professional Literature and Computer Programs, 2018
- Award for top SAS publication (Nature index), 2020
- Award for top SAS publication, 2021

Darula Stanislav
Silver medal from Association of Slovak Scientific and Technical Societies : For the development of lighting technology and science in the context of domestic and international development, 2017

Darula Stanislav
Silver medal from Association of Slovak Scientific and Technical Societies : For the development of lighting technology and science in the context of domestic and international development, 2018

2.4. Research grants and other funding resources

(List type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator "C", work package leader "W", investigator "I". Add information on the projects which are interdisciplinary, and also on the joint projects with several participating SAS institutes)

- **International projects and funding**

2.4.1 List of major projects of Framework Programmes of the EU (which pilar), NATO, COST, etc.

1. COST - ESSEM COST Action ES1204. Loss of the Night Network. 31.10.2012 – 30.10.2016
   Miroslav Kocifaj "I"
   0.00 €
2. IAEA - IEA SHC Task 56r. Building Integrated Solar Envelope Systems for HVAC and Lighting. 1.2.2016 – 1.1.2020
   Stanislav Darula "W"
   0.00 €
3. SAS-MOST JRP 2015/7. Novel thermal management design for BIPV modules incorporating MEPCM layers. 1.1.2016 / 31.12.2021
   Peter Matiašovský "W"
   66 000.00 €
4. UNESCO: SkyMeApp. 1.1.2017 – 31.12.2020
   Miroslav Kocifaj "I"
   0.00 €
5. OA: Anthroposphere and light pollution within implementation 1.1.2018 – 31.12.2018
   Miroslav Kocifaj "I"
   900.00 €
6. US Army International Technology Center - W911NF-14-1-0601 29.8.2014 – 28.8.2016
   Miroslav Kocifaj "W"
   17 102.00 €

Add information on your activities in international networks

- **National projects and their funding, incl. international projects with only national funding**

2.4.2. List of ERA-NET projects funded from SAS budget

2.4.3. List of projects of the Slovak Research and Development Agency (APVV)

1. APVV 0118-12
   Simulation of daylight in artificial sky
   1.10.2013 – 12.12.2016
   Stanislav Darula "C"
   138 158.00 €

2. APVV-14-0216
   Multiscale modelling of coupled fields in composite materials,
   1.7.2015– 31.12.2018,
   Ján Sládek "C"
   199 424.00 €

3. APVV-14-0017
Generalized skyglow model and its application to retrieval of city emission function
1.7.2015 – 31.12.2018
Miroslav Kocifaj "C"
239 936.00 €

4. APVV-14-0440
Multiphysical problems in functionally graded materials plates,
1.7.2015 – 30.6.2019,
Vladimír Sládek "C"
214 935.00 €

5. APVV-16-0584
Unintended City: Architectural and town-planning Conceptions of 19th and 20th century in the Urban Structure of Bratislava
1.11.2017-30.6.2020
Henrieta Moravčíková "C"
129 294.00 €

6. APVV-15-0631
Research on High Performance cementitious Composites under hydrothermal conditions for potential application in deep borewells
1.7.2016– 30.6.2020
Martin-T. Palou "C"
203 361.00 €

7. APVV SK-KR-18-0006
Material and mechanical performance of heavyweight self compacting concrete (SCC),
1.9.2018 – 31.12.2019,
Martin-T. Palou "C"
7 800 €

8. APVV SK-CN-RD-18-0005
A multiscale flexoelectric theory and a new method for real-time detection of microcracks in dielectric materials
1.10.2018 – 30.9.2021
Ján Sládek "C"
234122 €

9. APVV-18-0004
Optimal design of micro/nano structures for metamaterials
1.7.2019 – 30.6.2023
Ján Sládek "C"
155 856.00 €

10. APVV-18-0014
Global Characterization of Skyglow
1.7.2019 – 30.6.2023
Miroslav Kocifaj "C"
108 209.00 €

11. APVV-19-0490
Research and development of multi-component cementitious blends for special construction materials
1.7.2020 – 30.6.2024
Martin-T. Palou "C"
82 580.00 €

2.4.4. List of projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)

1. VEGA 2/0117/14
   Research of envelope construction influences on luminous and thermal environment in attic spaces,
   1.1.2014 – 31.12.2016,
   Stanislav Darula "C"
   5 097.00 €

2. VEGA 2/0011/13
   Computational methods for fracture analyses of quasicrystal materials
   1.1.2013 – 31.12.2016
   Ján Sládek "C"
   10 890.00 €

3. VEGA 2/0082/14
   Synthesis and characterization of chemically bonded phosphate ceramic binders
   1.1.2014 – 31.12.2016
   Martin-T. Palou "C"
   8282 €

4. VEGA 1/0696/15
   High porous inorganic materials for thermal insulating applications
   1.1.2015 – 31.12.2018
   Eva Kuzielová "C"
   10 440.00 €

5. VEGA 2/0033/2015
   Influence of repeated and long – term loading on interaction of parameters at reconstruction of reinforced concrete elements
   1.1.2015 – 31.12.2016
   Martin Ktižma "C"
   10 490.00 €

6. VEGA 2/0105/16
   Monitoring of the hygrothermal regime of the UNESCO object of St Jame's Church in Levoča and national herritage object St Martin's Cathedrale in Bratislava
   1.1.2016 – 31.12.2018
   Peter Matiašovský "C"
   5 699.00 €

7. VEGA 2/0154/15
   Modellintg of post-buckling behaviour and strength of thin-walled cold formed columns
   1.1.2015 – 31.12.2018
   Jozef Kriváček "C"
   10 090.00 €

8. VEGA 2/0042/17
   Research of solar energy influences and integrated envelopes on the quality of the environment in buildings and cities
   1.1.2017 – 1.1.2019
   Stanislav Darula "C"
   13 145.00 €

9. **VEGA 2/0074/17**
   Architektonické a urbanistické koncepcie 20. storočia a ich priemet do mestskej štruktúry Bratislavy
   1.1.2017 to 31.12.2019
   Henrieta Moravčíková "C"
   17014.00 €

10. VEGA 2/0046/16
    Coupled problems of thermal and electromechanical fields in advanced materials with porous microstructure
    1.1.2016 – 31.12.2019
    Vladimír Sládek "C"
    36 508.00 €

11. VEGA 2/0016/16
    Effectiveness of bended light guides under arbitrary sky conditions including broken cloud arrays
    1.1.2016 – 31.12.2019
    Miroslav Kocifaj "C"
    28 249.00 €

12. VEGA 2/0097/17
    Study of hydration process and microstructure development in multi-component cementitious binders
    1.1.2017 – 31.12.2020
    Martin-T. Palou "C"
    35 333.00 €

13. VEGA 2/0017/20
    Research of direct component of daylighting in architectural and interior environment
    1.1.2020 – 31.12.2022
    Stanislav Darula "C"
    4 540.00 €

14. VEGA 2/0095/20
    The energy efficiency of an innovative BIPV/T-TE-PCM module with PCM passive cooling
    1.1.2020 – 31.12.2023
    Ladislav Kómar "C"
    8 172.00 €

15. VEGA 2/0061/20
    Multiscale study and modelling of composite macrostructures
    1.1.2020 – 31.12.2023
    Vladimír Sládek "C"
    27 239.00 €

16. VEGA 2/0010/20
    Diffuse light in urban environment: A new model which embraces the optical properties of a local urban atmosphere
    1.1.2020 – 31.12.2023
    Miroslav Kocifaj "C"
    12 962.00 €

17. VEGA 2/0017/21
    Material composition and properties of Self-Compacting Heavyweight Concrete
    1.1.2021 – 31.12.2023
    Martin-T. Palou "C"
    4 391.00 €

18. VEGA 2/0032/21
    Study of multicomponent cement material degradation under conditions simulating CO2 enriched geothermal environment
    1.1.2021 – 31.12.2024
    Eva Kuzielová "C"
    7 588.00 €

2.4.5. List of projects supported by EU Structural Funds

2.4.6. List of other projects funded from national resources

1. ES1204 (MVTS)
   Skyglow and air pollution relationship
   13.2.2013 – 30.10.2016
   Miroslav Kocifaj "C"
   000.00 €

2. SASPRO 0106/01/01
   Multiscale modeling of layered, fibre reinforced and porous magnetoelectric materials
   – 31.8.2017
   Michael Wunsche "I"
   101 614.00 €

3. SEMOD-74-2/2019
   The mechanisms of targeted resonant attenuation of microwave signals
   – 30.6.2021
   Miroslav Kocifaj "C"
   72 614.00 €
4. V4-KOREA_RADCON: The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment
   Palou Martin (W) 120 000 €

5. Centre of Excellence of the Slovak Academy of Sciences
   Castles in Slovakia. Interdisciplinary cross-sectional view on the castle phenomenon
   1.10.2013 - 30.9.2017
   Henrieta Moravčíková "I"

2.4.7. List of projects funded from private funds

2.4.8. List of projects funded from other competitive funds

2.5. PhD studies and educational activities

2.5.1. List of accredited programmes of doctoral studies, period of validity, source of funding

Accredited programmes	Faculty	
Applied mechanics	Machinery Engineering/ Slovak University of Technology in Bratislava	2015-present
Building Technology	Civil Engineering/ Slovak University of Technology in Bratislava	2017-present
Inorganic technology and materials	Faculty of Chemical and Food Technology/ Slovak University of Technology in Bratislava	2021-present

2.5.2. Summary table on doctoral studies (number of internal/external PhD students at the end of the year; number of foreign PhD students, number of students who successfully completed their theses during the year, number of PhD students who quit the programme during the year*)*

PhD study	2016			2017			2018			2019			2020			2021		
Number of potential PhD supervisors																		
PhD students	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	unumber, end of yea	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted
Internal total	0	0	0	1	0	0	1	1	0	1	0	0	2	0	0	3	0	0
from which foreign citizens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other supervised by the research employees of the institute	2	0	0	3	0	0	2	0	0	0	0	0	1	0	0	5	0	0

2.5.3. PhD carrier path – Information on the next career steps of the PhD graduates who received their degree from the institute

2.5.4. Summary table on educational activities

Teaching	2016	2017	2018	2019	2020	2021
Lectures (hours/year)*	84	60	65	78	78	116
Practicum courses (hours/year)*	155	47	40	22	0	0
Supervised diploma and bachelor thesis (in total)	0	10	3	0	1	1
Members in PhD committees (in total)	3	4	2	3	5	2
Members in DrSc. committees (in total)	0	0	0	0	3	1
Members in university/faculty councils (in total)	0	0	0	0	0	0
Members in habilitation/inauguration committees (in total)	2	2	2	0	2	3

2.5.5. List of published university textbooks

2.5.6. Number of published academic course books

2.5.7. List of joint research laboratories/facilities with universities

2.5.8. Supplementary information and/or comments on doctoral studies and educational activities – focused on what changes have occurred since the last evaluation in 2016

Since the last evaluation in 2016, the Institute has intensified its cooperation with universities not only in the scientific research program but also in educational activities. Our university partners are the Slovak University of Technology in Bratislava (Faculty of Chemical and Food Technology, Faculty of Civil Engineering, Faculty of Mechanical Engineering), Comenius University in Bratislava, (Faculty of Mathematics, Physics, and Informatics), University of Žilina (Department of Physics), Technical University in Košice (Faculty of Civil Engineering), Brno University of Technology (Faculty of Chemistry). The Institute has actively participated in all high-education degrees (Bachelor, Master and Doctoral) and some of its members are guarantors of subjects, teaching in Slovak as well as in English. Diploma works and bachelor thesis were solved and surpervised by the members of the Institut. This cooperation supplemented by personal skills has enabled the institute to obtain two new accreditations in the doctoral program in Chemistry Technology and Civil engineering. Besides Applied Mechanics, the Institute expects to obtain further accreditation in Quantum Electronics and Optics. Presently, three doctoral students with active participation in the implementation of projects are at the Institute. Many domestic and foreign students have completed short or long-term internships at the Institute through a government scholarship.

2.6. Societal impact

2.6.1. The most important case studies of the research with direct societal impact, max. 4 for institute with up to 50 FTE researchers, 8 for institutes with 50 – 100 FTE researchers and so on. Structure: Summary of the impact; Underpinning research; References to the research; Details of the impact; Sources to corroborate the impact. One page per one case study

Societal impact (Department of Material and Structure)

The social impact of the development of multicomponent cement and heavyweight concrete

The development of multicomponent cement corresponds to the key target of the Paris Agreement on climate change in the cement and construction industry sector to reach carbon neutrality by 2050. Cement is one of the massive produced inorganic materials with volume

production of more than four billion tons per year. The thermal decomposition of limestone coupled with the high-energy consumption makes the cement industry responsible for 6-10 % of global CO_2 emissions. The energy consumption per ton of cement is cca 3-4 Gj, with approximately an emission of 600-800 tons of CO_2. Therefore, replacing cement with industrial wastes and by-products becomes vital in developing eco-friendly binders for environmental protection, which has a tremendous societal impact. Indeed, the development of multicomponent cement enables to reduce CO2 emission by more than 50 % compared to pure cement. The research at the Institute deals with the study of chemistry, kinetics, and mechanism of hydration reactions of multicomponent cement with substitution levels of more than 50 %. Besides the economic, environmental, and societal aspect of such cement, the performance of particular concrete requires the combination of pure Portland cement with supplementary cementitious materials that reduce the hydration heat and slows down the mechanical properties at an earlier period of curing but enhances the long-term properties and durability of such concrete. 2/0097/17 VEGA: Study of hydration process and microstructure development in multi-component cementitious binders, VEGA 2/0032/21: Study of multicomponent cement material degradation under conditions simulating CO_2 enriched geothermal environment

Another societal benefit is the biological shielding capacity of concrete. Concrete is a low-cost material and easy to produce in varied compositions compared to other shielding materials based on ceramics. It remains the most widely used materials for reactor shielding due to its engineering structural properties and its well-proportioned mixture of light and heavy nuclei. Therefore, it is efficient both in absorbing gamma rays and slowing down fast neutrons by elastic and inelastic scattering. Heavyweight concrete of different classes was developed at the Institutes for potential application in the Nuclear Power Plant, medical units.
MVTS: Joint Research Program on Chemistry and Chemical Engineering-Visegrad Group (V4)-Korea The Effect of Chemical Composition of Concrete on Its Long-term Performance in Irradiated Environment, VEGA 2/0017/21: Material composition and properties of Self-Compacting Heavyweight Concrete.

Societal impact (Department of Optics and Thermophysics)
Light pollution societal impact

Illuminating the night sky with excessive amounts of artificial light is defined as light pollution. Our health and our environment could be in jeopardy. The dome-like shield of light pollution known as skyglow is created by a combination of street lighting, interior, and exterior illumination, moving cars, and security lighting. Urbanization and industrialization are to blame for the prevalence of excessive amounts of artificial light. Just like plastic garbage, greenhouse gases, and sewage, it is just one of many forms of pollution on Earth. Many people are aware of the notion of light pollution, but they are less conscious of its adverse impacts on society and nature. In the eyes of the general public, regions that have been illuminated suggest a high degree of security, wealth, and well-being. While this may be desirable, it comes at the expense of nature, the environment, and human health. Smoke and dust are two more types of pollution harmful to human health that can intensify the effects of light pollution because these pollutants scatter light in all directions, making the sky brighter yet. Thus, the relation between air and light pollution is evident.
Even in the most isolated parts of the planet, human activity increases the harmful impact of artificial skyglow. Assessing the actual impact necessitates an understanding of light propagation through the atmosphere and the emission function of cities, hence enhancing light pollution computational modeling. Because of personal computers' rapid advancement, high-performance computing may now be performed at a low cost. As a result, creating a heterogeneous light pollution model in which a city can take any shape and have a varied distribution of light sources is straightforward.

The transition from older lighting technologies to more cost-effective light-emitting diodes (LEDs) represents a substantial shift in using artificial light at night. The lighting design is meant to reduce skyglow increases to protect natural places while maintaining public safety. Radiative transfer computation models, therefore, can predict the transition from older technologies to LEDs in terms of light pollution level change and financial benefits, allowing the optimal trade-off to be found. Otherwise, the growth of artificial light at night worldwide has also made dark skies less accessible to everyone in modern societies and to professional astronomers as well, which has the potential to limit our collective understanding of the universe.

The proliferation of artificial light at night, and the light pollution it yields, is a global challenge that relates strongly to cities. Urban light emissions are observed to extend many hundreds of kilometers away from their origins, crossing jurisdictional boundaries and impacting distant, protected areas such as nature reserves and national parks. Light pollution touches on a number of social concerns from urban ecology to human health, energy security, and sustainability. Furthermore, it directly addresses the main research focus of the Institute of Construction and Architecture, which includes the condition of the overall urban environment.

The societal impact of photovoltaic technologies

The solar photovoltaic (PV) system contributes to sustainable development by providing considerable social and environmental advantages over conventional energy sources. Since PV creates no greenhouse gas emissions and is a cleaner alternative than fossil fuels for generating power, these are promising developments. Building-integrated photovoltaic (BIPV) refers to an architectural design approach that combines photovoltaic (PV) panels with the building construction system. This combination allows BIPV to feature a power generation function and become part of the building. A reduction in the total energy consumed by the building can be achieved when BIPV is integrated with shading devices, daylighting, and illumination. Thus, BIPV transforms buildings from energy consumers into active power generators and is essential to promoting sustainable development in the building sector. Generally, the power output from a PV system is roughly proportional to the PV cell area and the solar irradiation on the PV cell surface. The PV cell temperature is associated with the generation efficiency of the solar irradiation energy that is converted to electricity. It is possible to control outdoor heat transmission through the absorption and release of latent heat by integrating MEPCMs (micro-encapsulated phase change materials) with PV modules. During the melting or solidification of PCM (phase change material), such a combination would efficiently lower the cell temperature and effectively release or store a considerable amount of latent heat used, for example, for water heating. Reducing energy consumption and new promising technologies in the field of renewable energy improve human well-being and protect nature.

Societal impact (Department of Mechanics)

Monitoring high-performance structures is very important since their collapse can lead to disasters. Damages in structures are detected in real-time, mainly in case of strong dynamic loads like in natural disasters such as hurricanes, tornadoes, and earthquakes. It requires developing a sensing method for in-situ monitoring of the onset and growth of cracks at the early stage, especially near the severe strain gradient fastener areas is of growing interest. Nowadays, used sensing technology (e.g., strain gauges, accelerometers, linear voltage displacement transducers) is not effective for monitoring damage because of its limited sensitivity, bandwidth, and accessibility to the hidden localized areas, let alone damage initiation and progression. Structures with the ability to sense and assess the damage are referred to as intelligent structures. The materials that perform the sensing and reacting (actuating) tasks are called smart materials. The structural health monitoring (SHM) system is utilized to prevent catastrophic failure of structures, decrease maintenance costs, and guide construction.

About 70% of the damage discovered in metallic structures resulted from fatigue cracks. The holes were the second most common fatigue damage initiation site that led to the major accident of aircraft between 1947 and 1983. It requires developing a sensing method for in-situ monitoring of the onset and growth of cracks at the early stage, especially near the severe strain gradient fastener areas is of growing interest. Recent research progress on flexoelectricity (FE) suggests a new type of sensor - strain gradient sensors (SGS), which enable highly sensitive detection of strain gradient - the most sensitive measurement near the localized damage location.

It is well known that classical continuum mechanics ignore material microstructure features, and the results are size-independent. The atomistic description of materials is impracticable for modelling macrostructures in order to get their global response to external impacts. Moreover, the hardware capabilities are insufficient for calculations based on modelling micro-constituents of macro-structures. Therefore, the development and application of higher-order continuum modelling with integrated multifield interactions become inevitable for accurate description and analyses of multiscale effects occurring in the design of progressive structures. The research in the dept. of Mechanics has been formed within the above-presented scope accenting the scientific originality and innovation.

2.6.2. List of the most important studies and/or other activities commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes (title, name of institution, contract value, purpose (max 20 words))

1. D. Haberland, Peter Szalay, I. Pilný: Architektonicko-historický výskum národnej kultúrnej pamiatky- Bývalý Ústav pre hluchonemé deti v Bratislave, (Interiéry), Bratislava 2016, pre Lekársku fakultu UK v Bratislave. (Architectural and historical research of a national cultural monument - Former Institute for Deaf and Dumb Children in Bratislava, (Interiors), Bratislava 2016, for the Medical Faculty of Charles University in Bratislava)
2. H. Moravčíková, P. Szalay, K. Haberlandová, L. Pastoreková: Hodnotenie metódy„Rekonštrukcie a nadstavby" Národnej kultúrnej pamiatky Nemocnica s poliklinikou (ÚZPF č. 10458/1 a 10459/1) na Bezručovej ulici č. 3 a 5 v Bratislave. Ministerstvo kultúry SR, október 2016. (Evaluation of the method "Reconstructions and superstructures" of the National cultural monument Hospital with polyclinic (ÚZPF no. 10458/1 and 10459/1) on Bezručová street no. 3 and 5 in Bratislava. Ministry of Culture of the Slovak Republic, October 2016.)
3. H. Moravčíková, P. Szalay, K. Haberlandová, L. Pastoreková: Hodnotenie výkonu pamiatkovej starostlivosti o národné kultúrne pamiatky moderného hnutia na území Bratislavy. Krajský pamiatkový úrad Bratislava, marec 2016. (Evaluation of the performance of monument care for the national cultural monuments of the modern movement in the territory of Bratislava. Bratislava Regional Monuments Office, March 2016.)
4. H. Moravčíková, P. Szalay: Pripomienky a námety k Urbanistickej štúdii výškového zónovania hl. m. SR Bratislavy, 2016 pre Magistrát hlavného mesta SR Bratislavy Oddelenie stratégii rozvoja mesta a tvorby územnoplánovacích dokumentov. (Comments and suggestions for the Urban Study of Height Zoning of the Capital City of Prague m. Of the Slovak Republic, 2016 for the City of the Capital City of the Slovak Republic, Department of City Development Strategy and Creation of Spatial Planning Documents)

2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues (study title, name of institution, contract value, country of partner, purpose (max 20 words))

Year	Contract title	Name of institution/Partner	Contract value (€)
2016	Determination of relevant engineering characteristics in compressure strength and working diagrams of samples from boreholes of real construction	Centroom, s.r.o., Bratislava, Slovakia	**1400**
	Evaluation of the pore structure of concretes to verify their physical condition as an important finding for construction practice	Building Testing and Research Institute, Bratislava, Slovakia	**4200**
2017	Evaluation of the pore structure of concretes to verify their physical condition as an important finding for construction practice	Building Testing and Research Institute, Bratislava, Slovakia	**4000**
2018	Diffuse light transmission factor	Terkoplast a.s., Bratislava	
2019	Evaluation of the pore structure of concretes to verify their physical condition as an important finding for construction practice	Building Testing and Research Institute, Bratislava, Slovakia	**3000**
	Odborno legislatívna pracovna skupina. Expertízna činnosť k návrhu zákona o	Ministerstvo dopravy a výstavby SR	

	územnom plánovaní a zákona o výstavbe		
2021	Expert evaluation of the created pore structure and permeability of bridge concretes from the point of view of the evaluation of further service life and safety of bridges	Building Testing and Research Institute, Bratislava, Slovakia	**3000**
	Characterization of pore structure by mercury porosimetry	RHP-Technology GmbH, Seibersdorf 2444, FN352783z	**2400**
	Characterization of pore structure of rocks by mercury porosimetry	Faculty of Natural sciences, Comenius University in Bratislave, Slovakia	**300**

2.6.4.1 List of intangible fixed assets (internally registered IP (confidential know-how), patent applications, patents granted, trademarks registered) denoting background IPR

EP No. 3105614 B1
Kocifaj Miroslav, Videen Gorden, Klačka Jozef
Method and apparatus for lightning threat indication

EP No. 3052026 A1
Kocifaj Miroslav, Mego Michal
System for isolation of circulating cells from peripheral blood

United States Patent and Trademark Office US 10,859,694
Videen Gorden, Kocifaj Miroslav, Klačka Jozef
Method and apparatus for lightning threat indication

2.6.4.2 List of licences sold abroad and in Slovakia, incl. revenues (background IPR identification, name of institution, contract value, country of partner, purpose (max 20 words))

2.6.5. Summary of relevant activities, max. 300 words (describe the pipeline of valorization in terms of Number of disclosure, Number of registered IP internally, number of CCR/LIC contracts and their respective summary values, the support you are receiving in specific points internally at the institute, at SAS, externally – also the limitations and drawbacks.

The Institute of Construction and Architecture occupies a large plot of land with real estate in the form of a building and rooms, which we should keep in repair. A part is rented, representing external income, of which 40% is transferred to the SAS fund and 60%, reduced by 20% tax on total income, is invested in reconstruction. Unfortunately, the recent COVID crisis has caused revenue to fall, and now the energy crisis is forcing us to look for other financing options. Valorizing our building for extended research programmes and rent to other institutes or public research institutions requires enormous investments, which we do not currently have.
Also, our contact with cement plants in Slovakia brings some cooperation and individual sponsoring providing materials or helping in the participation of the International Congress or Symposium.

2.7. Popularisation of Science (outreach activities)

2.7.1. List of the most important popularisation activities, max. 20 items

Stanislav Darula. Nová európska norma pre denné osvetlenie v budovách. https://www.sav.sk/ index.php?lang=sk& doc=services-news& source_no=20&new s_no=8326

Mgr. Miroslav Kocifaj, PhD. Metóda na zmiernenie dosahov svetelného znečistenia. https://www.teraz.sk/v eda/vedci-zo-sav-vyvi nuli-metodu-na-zmiern e/522419-clanok.html

PhDr. Katarína Haberlandová. Výstava Industriál očami odborníkov/pamätníkov. https://www.sav.sk/ind ex.php?lang=sk&doc= services-news&source _no=20&news_no=66 46

PhDr. Katarína Haberlandová. Dni architektúry 2016, Hodnota a postoj - Nové bývanie v Bratislave. http://www.register.ust arch.sav.sk/index.php/ sk/udalosti/707-dni-arc hitekt%25C3%25BAr y-2016.html

Mgr. Miroslav Kocifaj, PhD. IN SAS. Scientists have developed a method to mitigate the effects of light pollution. https://tekdeeps.com/s as-scientists-have-deve loped-a-method-to-mit igate-the-effects-of-lig ht-pollution-human-sci ence-and-technology/

Mgr. Miroslav Kocifaj, PhD. Významné výsledky štúdie o svetelnom znečistení zaujali prestížny časopis Science. https://www.sav.sk/?la ng=sk&doc=services-n ews&source_no=20&n ews_no=9488

Mgr. Miroslav Kocifaj, PhD. Andrew Grant (autor), Kocifaj (podklady). Cleaner air could darken the night sky. https://physicstoday.sc itation.org/do/10.1063/ PT.6.1.20210729a/full /

Mgr. Miroslav Kocifaj, PhD. Barentine (interview), Kocifaj, Bará, Kundracik. BBC Two Newsnight appearance. https://www.johncbare ntine.com/media/bbc-t wo-newsnight-appeara nce-31-march-2021

Mgr. Miroslav Kocifaj, PhD. International Dark-Sky Association, Kocifaj (podklady). New Study Finds Satellites Contribute Significant Light Pollution To Night Skies. https://www.darksky.org/new-satellite-study/

Mgr. Miroslav Kocifaj, PhD. Joshua Sokol (redaktor), Barentine a Kocifaj. Study finds nowhere on Earth is safe from satellite light pollution. https://www.science.or g/content/article/studyfinds-nowhere-earth-sa fe-satellite-light-pollut

Mgr. Miroslav Kocifaj, PhD. Kocifaj a Barentine (podklady). Satellites contribute significant light pollution to night skies. ttps://ras.ac.uk/newsand-press/news/satellit es-contribute-significa nt-light-pollution-night –skies.

Mgr. Miroslav Kocifaj, PhD. The Telegraph (UK), Kocifaj a Barentine (podklady). Satellite mega constellations making night skies 10pc brighter. https://www.telegraph. co.uk/technology/2021 /03/30/satellite-mega-c onstellations-making-n ight-skies-10pc-bright er/

Mgr. Miroslav Kocifaj, PhD. Vedci SAV navrhujú nové možnosti využitia satelitného monitorovania zdrojov svetelného znečistenia. https://www.sav.sk/i ndex.php?lang=sk& doc=servicesnews&source_no=2 0&news_no=8917.

Mgr. Miroslav Kocifaj, PhD. Vedci poznajú nové možnosti využitia satelitného monitorovania zdrojov svetelného znečistenia. https://www.webnov iny.sk/nasvidiek/ved ci-poznaju-novemoznosti-vyuzitiasatelitnehomonitorovaniazdrojov-svetelnehoznecistenia/.

Mgr. Miroslav Kocifaj, PhD. V PNAS uverejnili revolučnú metódu charakterizovania svetelného znečistenia. https://www.sav.sk/ ?lang=sk&charset=& doc=services-news& source_no=20&new s_no=8166

Prof.Dr.Ing. Martin-Tchingnabé Palou. Priesečníky. https://www.rtvs.sk/radio/archiv/1198/16237 35?fbclid=IwAR3CXF XI85dnHzMPFHqkjBi EkvdohlcPQoiBRTAn uvIMkDsZz0IxEfXwn Yw.

Prof.Dr.Ing. Martin-Tchingnabé Palou. Veda v centre. https://www.youtube.com/watch?v=Tf2rDyy 4sZg

Prof.Dr.Ing. Martin-Tchingnabé Palou. Vedecký podcast 27. https://www.youtube.com/watch?v=lDQPTk Qxro0.

Prof.Dr.Ing. Martin-Tchingnabé Palou. Popularizácia vedy. https://www.sav.sk/index.php?lang=sk& doc=servicesnews&source_no=2 0&news_no=9126.

Prof.Dr.Ing. Martin-Tchingnabé Palou. Nové betóny môžú prispieť k ochrane životného prostredia. https://vat.pr avda.sk/clovek/clano k/568195-novebetony-mozuprispiet-k-ochranezivotnehoprostredia/

https://youtu.be/ng0ue9IkZHE

Prof. Ing. Ján Sládek, DrSc. VedaSk RTVS Bratislava

Mgr. Peter Szalay, PhD. Prenos prednášky: Restaurovat modernu. Dvě polohy moderního architekt.dědictví. Česká televize http://www.ceskatelevi ze.cz/porady/10000000006-stredy-na-avu/21 6251000070004-restau rovat-modernu-dve-po lohy-moderniho-archit ekt-dedictv

Mgr. Peter Szalay, PhD. Po Bezručovej sú ohrozené aj ďalšie moderné pamiatky, rozhovor Daniela Suchého s Henrietou Moravčíkovou a Petrom Szalayom. Reality trend http://reality.etrend.sk/ komercne-nehnutelnos ti/po-bezrucovej-su-oh rozene-aj-dalsie-moder ne-pamiatky.html

Mgr. Peter Szalay, PhD. Reportáž o dňoch architektúry 2016. Túlačka, Rádio FM, RTVS, http://fm.rtvs.sk/rubrik y/temy_fm/108853/tul acka_fm-dni-architektury

Mgr. Peter Szalay, PhD. Rozhovor: Úľavy pre developerov nabúrajú demokraciu na úrovni mesta, tvrdia architekti SAV. Denník N https://dennikn.sk/967_272/ulavy-pre-develop erov-naburaju-demokr aciu-na-urovni-mesta-t vrdia-architekti-sav/

Ing. Janette Podhorská, Ladislav Kómar, Ladislav Sátor, Stanislav Darula, Jana Čepčianska. Deň otvorených dverí USTARCH SAV. https://www.tyzdenvedy.sk

Žemlička M. https://www.youtube .com/watch?v=bRHf DXgJjFM

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2016	2017	2018	2019	2020	2021	total
Articles in press media/internet popularising results of science, in particular those achieved by the Organization	6	3	15	4	6	19	53
Appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	7	1	0	0	0	4	12
Public popularisation lectures	12	21	0	6	3	6	48

2.8. Background and management. Infrastructure and human resources, incl. support and incentives for young researchers

2.8.1. Summary table of personnel

2.8.1.1. Professional qualification structure (as of 31 December 2021)

	Degree/rank				Research position		
	DrSc./DSc	CSc./PhD.	professor	docent/ assoc. prof.	I.	II.a.	II.b.
Male	2	15	4	1	4	6	10
Female	1	1	0	0	0	1	1

I. – director of research with a degree of doctor of science/DrSc.

II.a – Senior researcher

II.b – PhD holder/Postdoc

2.8.1.2. Age and gender structure of researchers (as of 31 December 2021)

Age structure of researchers	< 31		31-35		36-40		41-45		46-50		51-55		56-60		61-65		> 65	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Male	0,0	0,0	4,0	3,1	3,0	3,0	1,0	0,5	0,0	0,0	2,0	2,0	1,0	1,0	2,0	2,0	3,0	3,0
Female	1,0	0,3	0,0	0,0	0,0	0,0	1,0	1,0	0,0	0,0	1,0	1,0	0,0	0,0	0,0	0,0	0,0	0,0

A – number

B – FTE

2.8.2. Postdoctoral fellowships (list of positions with holder name, starting date, duration. Add brief information about each fellow's career path before and after receiving PhD degree, etc.)

2.8.2.1. MoRePro and SASPRO fellowships

Michael Wunsche

SASPRO 0106/01/01
Multiscale modeling of layered, fibre reinforced and porous magnetoelectric materials
1.9.2015 – 31.8.2017

2.8.2.2. Stefan Schwarz fellowships

2.8.2.3. Postdoctoral positions from other resources (specify)

2.8.3. Important research infrastructure introduced during the evaluation period with the information about the sources of funding *(max. 2 pages)*

The Institute is equipped with advanced soft- and hardware and experimental facilities located in three leading laboratories for research and development of building construction materials, with particular attention to experiments and measurements of the functional and structural properties of construction material

The computer facilities required for modelling advanced material properties and developing sophisticated computational methods are continually upgraded.

The existing infrastructure represents the issue basis of experimental research pursued by the Institute. It is the fundamental condition for participation and cooperation in research projects. The infrastructure is at the disposal of other institutes, including the institutions out of Slovak Academy of Sciences. The principles of utilizing our infrastructure by other institutions are formulated in

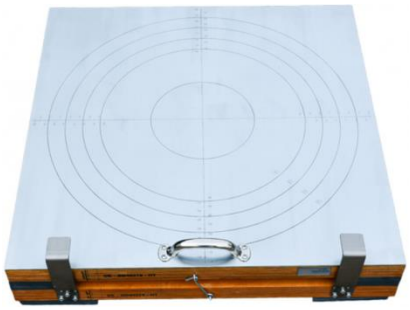
consortium agreements valid e. g. within the “Centre of excellence for research and development of composite materials for structural engineering, construction, and medical applications.”

Like other Slovak Academy of Sciences institutes in the 2010s, ours was also granted under the Operational Programme Research and Development /Measure 4.1 Support of networks of excellence in research and development as the pillars of regional development and support to international cooperation in the Bratislava region, Project No. 26240120020 “Building the Centre of Excellence for research and development of structural composite materials CEKOMAT and Centre for Applied Research of Composite Materials for deep Geothermal Energy GEOTHERMY. During the assessment period 2016-2021, a reconstruction and acquisition of few R&D technical infrastructure was completed in Laboratory of material research, Thermophysical laboratory and Mechanical and technological laboratory. The main attention was paid to the effective use of these tools for solving different projects and especially to maintaining them in the standard state.

Nevertheless, the Department of Materials has been provided with laboratory instruments such as CO_2 climate chamber with a temperature range from -10 °C up to 100 °C, relative humidity 10 – 98 %, and CO_2 concentration 0 - 20 vol. %;(Binder KMF115 (E6)), high-pressure reactor operating up to 20 MPa and 220 °C (Parr Instrument (Germany) GmbH), ultrasonic measuring system IP-8; UltraTest, facilities for testing the Self-Compacting Concrete. Upgraded mechanical tests of concrete by Tiratest 2300, universal pulling test machine

1

2



3

4

5

6

7

1 Ultrasonic measuring system IP-8
2 L-box
3 Slump table based on Graf, complete and with circle markings
4 S-Cone
5 V-funnel for the lead time of concrete
6 Vicat needle apparatus, without water bath
7 Pressure vessel

Our laboratories were already equipped with the following facilities.

The Materials Research Laboratory is equipped with instruments and devices to characterize the pore structure of materials and relevant chemical and physical properties, to test materials durabilty in shor-tterm and long-term experiements, and to analyze elements under various loadings and environmental conditions. The most important devices include:

- Device for thermal analysis (DTA, DTG, TG) up to 1500°C
- Compatible differential scanning calorimeter for temperatures up to 700°C
- Optical microscope OLYMPUS BX61
- High temperature drying chamber up to 650°C PP140/65 with accessories
- High temperature autoclave Testing
- Pycnometer, CPV: 31640000-4, Pentapyc 5200e
- Mercury pressure porosimeter PoreMaster 60GT
- Gas sorption analyser – Autosorb IQ Anygas modell
- Portable equipment for mesurement of gas and water permeability of concrete
- Measurement of specific surface area of powder materials Device Blaine for characterisation of surfaces of powder materials

Thermophysical laboratory provides measurements for determination of thermophysical properties of porous building materials, including mass transport properties. The most important devices provide:

Measurement of water vapour sorption by Automatic equipment for precise measurement of adsorption and desorption isotherms for water vapour Aquadyne DVS

Measurement of expansivity of materials by Laser extensometer.

- Testing of materials under various ambient temperatures and humidities in Climatic chamber DY 600C for simulation of nonsteady conditions
- Measurement of surface temperature fields by Thermo Tracer TH7102MX/WX
- Measurement of moisture content, salinity and capillary pressure in materials by LOM
- Testing of materials in high CO_2 concentration environment CO_2 in incubator INCO2/246
- Mesurement of thermal conductivity PMV 01

Mechanical and technological laboratory has the systems to test various strong building materials and structural elements. The most important devices provide:

- Mechanical tests of construction materials by Tiratest 2300, universal pulling test machine
- Mechanical tests of structural elements by Loading servohydraulic system SCHENCK
- Measurement of dynamic elasticity modulus by Pertable ultrasound equipment for nondestructive tests of concrete, model Ultrasonik tester C372N
- Measurement of dynamic response of structures tested in aerodynamic tunnel Measuring set for aerodynamic tunnel
- Analysis of surface structure of materials by Stereomicroscope KAPA STM, - Camera Moticam 2300, optical reduction k Moticam 1000/2000/2300, reduction for Canon G9
- Detection of metallic reinforcement in composites by Profometer 5+Rebar Dector Type Scanlog
- Continual measurements by Dta acquisition system 1-MX840 PAKEASY, 1-SCM-SG350, ¼ 350 ohm strain gauges.

2.9 Supplementary information and/or comments on all items 2.1 – 2.8 (max. 2 pages in total for the whole section)

The Institute has international cooperation with many foreign scientific institutes and universities. In addition, the researchers of the Institute are members of several scientific organizations and associations, and they are members of editorial boards of international scientific journals (WOS, Scopus) and scientific committees of conferences.

The above-mentioned cooperation of the Institute provides opportunities to continue to apply for major scientific projects and collaborations in Slovakia and also in foreign countries. However, the condition for applying for significant project calls is to have a sufficient number of high qualified researchers in the department.

The national and international press (BBC) frequently invites our scientists to interviews about their discoveries. The Presidium of the Slovak Academy of Science or other national organizations has regularly awarded the staff members. As a matter of fact, Prof. Sláded Ján was awarded the prestigious Humboldt Research Award as the third Slovak in history.

The Institute is in the process of significant generational evolution. At present, the Institue is consisting of 20 scientific researchers. Therefore, in the next period a great effort will be provided to find perspective young researchers, PhD students and involve them into the solution of interesting scientific problems, and build a team capable of acquiring major national and international projects.

Admission of researchers from abroad on the basis of agreements

	State	Name	Number of days
2016	Mexico	Héctor Antonio Solano Lamphar	12
	Taiwan	Chi-Ming Lai	4
		Chia-Wang You	4
		Ching-Yueh Teng	4
		Hsiao-An Shan	4
		Pin-Feng Liu	4
		Rong-Hong Chen	4

	State	**Name**	**Number of days**
2017	**Mexico**	Héctor Antonio Solano Lamphar	**28**
		José Manuel Ramírez Bernardino	**21**
	Taiwan	Pin-Feng Liu	**9**
		Chia-Wang You	**9**

	State	**Name**	**Number of days**
2018	**Mexico**	Héctor Antonio Solano Lamphar	**72**
	India	S. Venkateswara Rao	**60**
	Taiwan	C.J. Ho,	**8**
	Taiwan	C.J. Ho, Rong-Horng Chen	**8**
	Taiwan	Chi-Ming Lai	**8**

	State	**Name**	**Number of days**
2019	**Thailand**	Prof. Dr. Phongthorn Julphunthong	**60**
	Thailand	Pithiwat Tiantong	**1**

3. ***Implementation of the recommendations from the previous evaluation period***

Recommendations from the last regular evaluation of SAS organizations (accreditation)
The International Panel Committee has classified the Institute of Construction and Architecture in Category C with the following arguments:

- The lack or weak strategy in planning and management. Without substantial developments in strategic planning and management, it isn't easy to understand how an Institute (in its structure) can be considered sustainable.
- The described activity of the Institute is scientific research rather than related to construction.
- Process identifying research lines, including authoritative external advice, need to be improved.
- The Institute is encouraged to become more outward looking, both in terms of its linkages to the Construction Industry and its visibility to and interactions with the international research communities in the relevant subject areas
- The Institute should look more externally in terms of its links to the construction industry and its visibility in interactions with the international research community in relevant thematic areas.
- Once a clear strategy is in place, it should attract more PhD students as well as encourage existing staff to work with universities to structure doctoral candidates bringing more vitality.
- Staff should always seek ways in which the output from their research can go beyond the production of papers.

Unquestionably, such an assessment cannot be satisfactory. Therefore, the Institute has done everything possible to improve this situation. An "Action Plan" has been drawn up, updated each year, reviewed and reworked by the Scientific Council and the College of External Advisors to improve the Institute's quality permanently.

1. **The lack or weak strategy in planning and management. Without substantial developments in strategic planning and management, it isn't easy to understand how an Institute (in its structure) can be considered sustainable.**

Considering the recommendation of the international panel from the last accreditation and the fact that the Institute became a "Public Research Institution" through the transformation of the Slovak Academy of Sciences on 1.1.2022, the Institute's Action Plan is based on the fact that the organization is a fundamental scientific research institute. Still, it will orientate its activities towards the field of applied research and in the economic sphere to find applications for its outups. In this way, the Institute can successfully implement knowledge transfer into practice. Otherwise, its current structure results from the development given by the specific needs of construction research, specifically in applied mechanics, building physics, and materials engineering.

To improve the situation, the management of the Institute has set three main principles: (1) the freedom of scientific research, (2) the responsibility of individual researchers for the quality of their results and (3) the remuneration of scientists according to the criteria set by the Scientific Board.

The research infrastructure including the advanced hardware and software for fundamental theoretical research in mechanics and physics has been well maintained and upgraded .

Laboratories for experimental applied research in building materials have been renovated. Trends in the development of human resource of the institute were characterised by the defragmentation of research topics and the effort to create solid and flexible teams around research projects led by a top researcher.

In the last year, 4 Departments were split into three around top researchers. The Chiefs of the Department are also the leaders of the research teams. The professional qualification structure is getting to be well balanced. The proportion of employees without PhD degrees has decreased.

To motivate the young PhD students, the Management of the Institute financially encouraged them to be more active in publishing and presenting the results of their works. The aim is to continue this trend also in the future.

2. **The described activity of the Institute is scientific research rather than related to construction.**

The explanation is closely linked to the name of the Institute, which at first glance seems to be an Applied Research Institute rather than a Scientific Institute. Indeed, the Institute is a fundamental research institution with freedom of creativity and a high degree of interdisciplinarity according to its Founding Charter (Civil Engineering, Applied Mechanics and Science of Non-Metallic Materials and Building Materials, Quantum Electronics, and Optics) with Research focused on a global focus.

The achieved results are used in applied Research and practice and significantly increase the credibility of the Institute and make its position within scientific and Research workplaces more visible.

The Institute has a close link with the domestic cement and construction industry. It is a co-organizer with the Research Institute of construction materials in Brno (Czech Republic) of the "Cement quality" seminar for Czech and Slovak quality managers of cement plants. Furthermore, the members of the Institutes participate actively in the conferences, seminars and workshops organized by the Slovak Ready Mixed Concrete Producers Association, Association of Slovak Cement Producers ZVC and Faculties of Civil Engineering in the Slovak Republic.

Also, the Institute provide consultation and expertise to the cement and construction industry in the Slovak Republic.

3. **Process identifying research lines, including authoritative external advice, need to be improved.**

Since the laste evaluation, the Institute has set a trio of external advisors.

Dr. Zoltán Kolláth, Ass. prof, Eotvos Loránd University, Szombathely, Hungary

Dr.Robert Černý, prof, Czech Technical University in Prague (CTU)**,** Czech Republic

Dr. Arnon Chaipanich, Ass. prof., Chiang Mai University, Thailand

The external advisors were permanently consulted, and they have helped to establish an international relationship with universities. As a matter of fact, Dr Arnon Chaipanich has initiated contact between the Institute and Naresuan University in Thailand.

The new structure of the Institute as the Public Research Institution is composed of the Management of the Institute, Board of directors, and Supervisory Board. This structure ensures more transparent management and distributes responsibilities in major decisions.

4. **The Institute is encouraged to become more outward looking, both in terms of its linkages to the Construction Industry and its visibility to and interactions with the international research communities in the relevant subject areas**

The institute is a workplace of fundemental research with a wide range of international cooperation based on scientific research. The institute has been involved in international projects: MVTS (MVTS - Visegrad Group (V4) - Korea Joint Research Program on Chemistry and Chemical Engineering), SK-CN-RD-18-0005: Multiscale flexoelectric theory, and a new method for microcrack detection in real-time dielectrics, SK-KR-18-0006: Material composition and mechanical properties of heavy and self-compacting concrete. Involvement in research projects and publication of results in impacted journals after review by international experts are considered by all scientific authorities to be a clear representative indicator of the quality of the research carried out and its usefulness.

The statistics publication category reported that within the accreditation period, the Institute has produced 138 out-ups in several categories with 103 papers in ADCA (Scientific articles in foreign journals registered in Current Contents Connect with a higher IF.

Furthermore, we have undertaken the steps to change the name of the Institute to better adapt it to current times in the field of Research and development.

Our scientific workers are involved in the cooperation with the universities and institutes, such as: School of Aerospace, Xi'an Jiaotong University, Xi'an, China - University of Vienna, Austria - University Cégep de Sherbrooke, Canada - Czech Technical University in Prague/Faculty of Civil Engineering - Centre for Energy Research, Hungarian Academy of Sciences - Institute of

Fundamental Technological Research, Polish Academy of Sciences (IPPT PAN) - National Academy of Sciences of Ukraine- Yonsei University, KR - Naresuan University, Thailand.

The Institute of Construction and Architecture, Slovak Academy of Sciences, has signed three Agreements of bilateral cooperation with three Ukrainian Institutions in 2022, 2021, and 2020:

- the Pidstryhach Institute for Applied Problems of Mechanics and Mathematics National Academy of Sciences of Ukraine (Lviv);
- the Prydniprovska State Academy of Civil Engineering and Architecture (Dnipro);
- the Center of Mathematical Modeling of Pidstryhach Institute for Applied Problems of Mechanics and Mathematics National Academy of Sciences of Ukraine (Lviv)

The Institute organised international conferences (Thermophysics 2021, Brno CR and Analysis of multi-field problems by advanced computational methods, Phuket, Thailand).

5. **Once a clear strategy is in place, it should attract more PhD students as well as encourage existing staff to work with universities to structure doctoral candidates bringing more vitality.**

The Institute has taken steps with the faculties with which it has scientific and pedagogical relationships to obtain accreditation for doctoral training. Thus, the Institute acquired two new postgraduate programs in Structures and Chemical Technologies next to an existing one (Applied Mechanics), allowing the Institute to welcome more doctoral students. However, it should also be noted that the Institute can only obtain two scholarships annually. Furthermore, the COVID situation has dramatically slowed the welcoming process of international students. Therefore, the Institute has only three doctoral students. In the meantime, the Institute has hosted:

- postdoc research, Mr. Pithiwat Tiantong (Ph.D. Student) from the Department of Civil Engineering, Faculty of Engineering, Naresuan University (Thailand) from 20 August 2021 - 20 April 2022,
- Assistance professor, director of the research unit for innovative construction materials, Phongthorn Julphunthong, Department of Civil Engineering, Faculty of Engineering, Naresuan University (Thailand),
- Dr. Associate Professor Venkateswara Rao, Head, Structures Division, Civil Engineering Department, National Institute of Technology, Warangal – 506004, India.

Regarding the title of state doctorate, a colleague defended his thesis in 2021 and has completed the process before the university's scientific council with the acquisition of the title DrS. In addition, a woman with this title joined the group in 2020. So, practically, the Institute has 4 DrS.

6. **The Institute should look more externally in terms of its links to the construction industry and its visibility in interactions with the international research community in relevant thematic areas.**

The current international position of the Institute is expressed by cooperation with many foreign scientific institutions such as universities and scientific institutes, institutional and personal memberships in scientific organizations and associations, editorial boards of international scientific journals (CC, Scopus), scientific committees, conferences, project and informal cooperation working stays (funded by SAIA, SASPRO), short-term working stays, a large number of joint CC publications with leading scientific institutes in the world, active participation in conferences and invited keynote lectures, organization and co-organization of international scientific conferences, participation in exhibitions.

Our top scientists regularly participate in international events and are active in various international scientific committees:

- International Astronomical Union
- International Solar Energy Society (ISES)
- Optical Society of America (OSA)
- The Illuminating Engineering Society
- ICIC International Committee for Irradiated Concrete
- Central European Assoc. for Computational Mechanics
- International Society for Boundary Elements a pod.

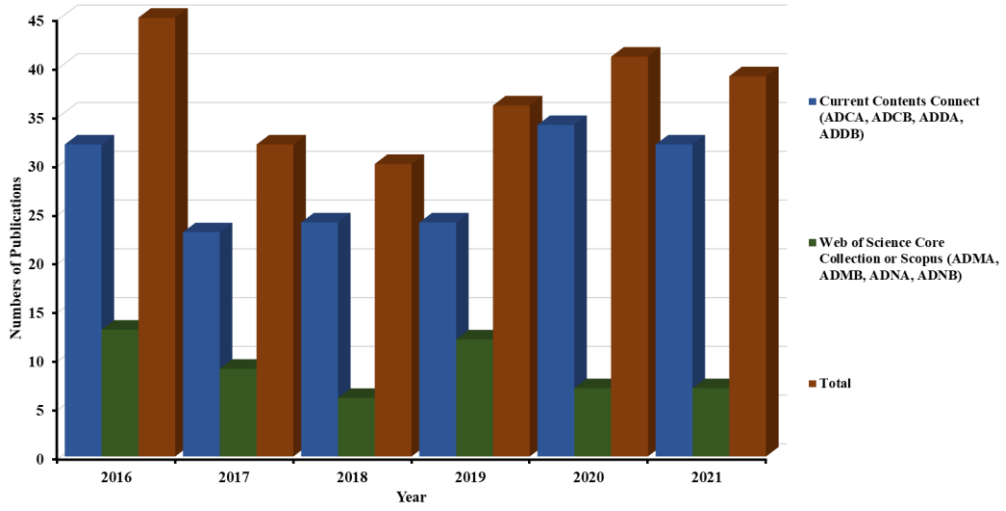
The institute is not only sustainable but is growing and attracting the attention of international scientists who are now associated with the institute. For instance, the working group of Optics hosts scientists from Mexico, Hong Kong and Austria. The latter has succeeded with the

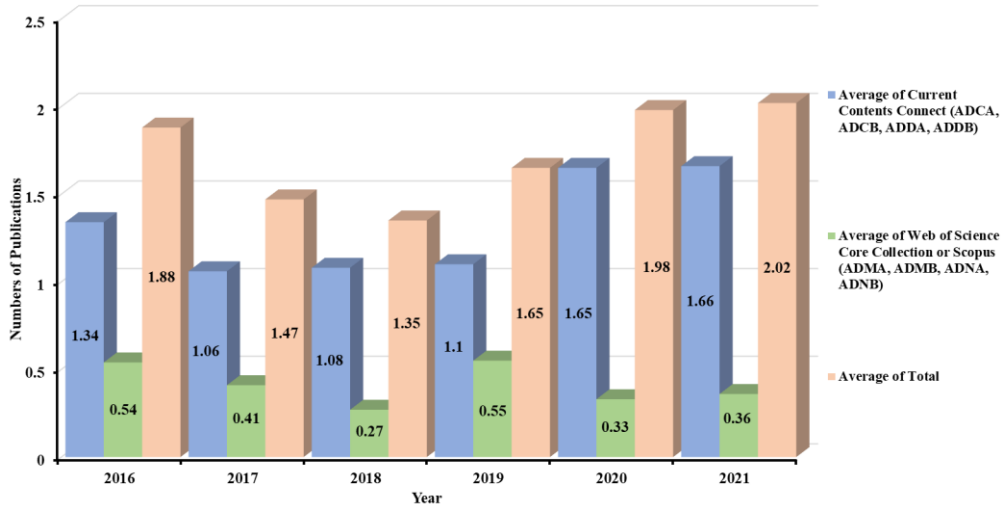
SASPRO2 application and started the negotiation process recently. As a result, the light-pollution group of the department of Optics is now a leading player in the World with a progressively increasing number of international collaborations among engineering and natural sciences research teams. Also, in 2021, a top researcher through SASPRO has succeeded, and he intends to start in July of this year.

7. **Staff should always seek ways in which the output from their research can go beyond the production of papers**

The Institute's management's goal is the full support of quality publications outputs, taking into account the impact factor of the periodical and inclusion in the quartile with the highest evaluation (Q1). The number of publications and citations is growing. This makes the Institute one of the leaders in the number of publications per person and year among the institutes of Technical sciences at SAS.

7





The action plan of the institute is a tool for the implementation of the strategic goals of the institute, which are the advanced research topics:

- Development of advanced multiscale continuous mathematical-physical models needed for the description of composites with nanoconstituents, modeling of advanced structures of thermoelectric materials, flexoelectricity theory, and new methods for real-time microcrack detection in dielectric materials
- Development of advanced inorganic binders based on multicomponent cement containing admixtures, geopolymers, ceramic phosphate binders, and high-quality concrete structures. Study of the kinetics and mechanism of hydration and delimitation of the area of thermodynamic equilibria under normal and hydrothermal conditions

- Research into the mechanism by which cumulative light emissions from many sources affect the brightness of the night sky and diffuse light in the urban environment: a new model is taking into account the characteristics of the local atmosphere, and the characterization of light pollution is innovative topics in building physics and urbanism.
- Innovative solutions for thermal regulation of surface layers of non-transparent external structures of buildings.

The management and the scientific board of the Institute monitor the implementation of the action plan on an ongoing basis. The scientific workers are informed of the results of the work of the Institute at the annual meetings of the Institute.

4. ***Research strategy and future development of the institute for the next five years*** (Recommended 3 pages, max. 5 pages)

Research strategy of the institute in the national and international contexts, objectives, and methods (including the information on when the strategy was adopted)

Generality

The current strategy of the Institute is focused on creating better conditions for the implementation of research and its sustainability and development in the long term. The Institute will strive to strengthen scientific cooperation at European and international levels by articulating its programming with European and international initiatives and following the global scientific strategy guidelines. The strategy is based on four fundamental axes:

1. Human resources
2. Innovative topics and cooperation with renowned universities and institutes
3. Popularisation and application of our outputs
4. Gender equality and gender equity

In the human resources policy, the Institute's strategy will be oriented towards the training and preparation of young scientists capable of confronting future challenges. For this, it is necessary to get new postgraduate study programs and supervise future researchers better.

Furthermore, we will actively seek to use the scholarship funds allocated by the Government of the Slovak Republic (SAIA), the intergovernmental agreement, or the European Union (SASPRO, MoRePro, IMPULZ programs) to attract top scientific researchers in the field of Mechanics, Optics, materials Sciences, or scientists capable of creativity in other scientific areas.

The Institute will support and motivate the active participation of all creative workers in research of international quality with an adequate link to innovation. The focus of the Institute is mainly on top research activities within the framework of international scientific cooperation projects and within the framework of large national projects, with an emphasis on a high level of scientific results as well as a maximum economic benefit.

The Institute will build and strengthen the structure of the Institute as a "Public Research Institution" for Research, Development, and Innovation. In the meantime, the Institute will actively cooperate with the public sector and industry for the transfer of knowledge and applications of our licenses/patents.

We also plan the popularization of our result for a broader circle of non-professional public and take lectures on technical universities and/or technical secondary schools to encourage young people to decide to continue their studies and optionally earn their scientific degree in Building Science at our Institute.

We will continue organizing yearly conferences and seminars, "Central European Symposium on Building Physics" and "Quality of Cement – Kvalita cementu" for cement plants in the Czech and Slovak Republic.

We will continue updating the criteria for evaluating scientific workers following the requirements for performance financing of scientific workplaces at the Slovak Academy of Sciences.

Though the current name of the Institutes has a domestic and international reputation through the famous scientific workers, we will find a consensus on changing the name of the Institute.

The Institute should apply through European calls with renowned universities from European countries.

In the chapter on the popularization of the application of our results, the Institute intends to continue publishing in high-quality journals according to the impact factor or quartile. During the last two years, the Institute produced 35 to 40 publications per year, with 90% belonging to Quartile 1 and 2. We will continue to do it quantitatively and qualitatively.

The research strategy and the future development of the whole Institute for the next five years are the combinations of the strategies adopted by the individual scientific departments.

The Department of Mechanics

The research strategy will focus on the optimal design of advanced metamaterials for health monitoring structures. For this purpose, it is needed to develop a reliable computational method based on gradient theory, where the size-effect is considered by including the strain gradients in the constitutive equations for the double stress tensor and electric displacements and gradient of electric intensity vector in the constitutive equation for stress and quadrupole.

The desire to design and construct metamaterials calls for an intrinsically high-risk approach. The ground-breaking results needed may demand major advancements in the mechanics and physics of solids, mathematical and numerical modeling, and advanced computer-aided technology in material construction. Moreover, to meet this challenge, a strong theoretical foundation and a realistic and up-to-date knowledge of what is concretely feasible today are both essential. Multiscale and multiphysics structures are capable of exhibiting a wide range of peculiar behaviours, and may involve an extraordinary level of complexity in their internal organization.

The above formulated research goals are determined by many factors, mainly by finance support limits and personal limits. Because of costly equipment for experimental research in the field of advanced material research we focus the research activities on mathematical/physical modelling of new phenomena occurring in small-scale structures and or in structures where large gradients of field variables take place, and the classical continuum theories fail in the description of experimentally evident multiphysical effects. Since the increase in mathematical complexity of the problems formulated within higher-grade continuum models is substantial, the task of developing advanced numerical methods is inevitable. Because of the inappropriate economic situation for supporting the research in-country, it is challenging to find young people willing to work as researchers. Despite this disadvantage, we aim to develop an enormous effort to draft clever young people for research and to utilize their experience in applied mechanics and mathematics to further proceed in meaningful research activities and achievements.

Department of Materials and Structures

(1) The primary strategy of fundamental research will focus on studying the kinetics and the mechanism of hydration and determining the thermodynamic equilibriums of the products of hydration under normal and hydrothermal conditions.

(2) The main strategy of applied research will focus on:
   - The development of Low-Carbon Cement, Low-Carbon Concrete, and Green Concrete by sequestration of CO_2 to achieve the goals set by the Paris Agreement and to reach climate neutrality by 2050
   - Renewable energy, namely the geothermal one by developing cement slurry
   - Development of specific building materials (High-performance concrete, Self-Compacting Heavy Concrete, Geopolymers, etc.,)

The justness of ongoing research in the area of cement material science lies in the importance and irretrievability of cement-based materials like concrete with other building materials with a lower environmental footprint on a global scale. Nevertheless, it is still necessary to considerably reduce anthropogenic CO_2 emissions connected with the production of cement clinker. One of the well-established strategies, developed also in this department, is the development of Low-Carbon Cement and Low-Carbon Concrete using supplementary cementitious materials (SCM) to reduce drastically the content of cement clinker and, in the meantime, to perform the engineering properties of final products (Concrete). Although much has been already done in this way, the very limited availability of the most used supplementary materials leads to the need for new ones. On the other hand, cementitious materials have great potential for sequestration of CO_2. Our current and future research activities are focused on meeting these main challenges, relate also to the better use of geothermal energy, and involve:

- Development of multi-component binder materials based on the widely available clays, limestone, and locally available wastes and by-products, which can be designated as low-carbon. Besides cementitious matrix, demolished and recycled concrete will be used as fillers to further reduce the environmental aspects due to the extraction of natural raw materials.
- Fundamental research devoted to the study of kinetics and thermodynamic equilibriums reached under different curing conditions, including the hydrothermal ones. A comprehensive approach involving simultaneous action of several external factors

(temperature, pressure, chemical composition of environment) must be chosen to ensure good optimization of material composition.

- Utilization of acquired knowledge in the development of specific building materials (High-performance concrete and Self-Compacting Heavy Concrete).
- Investigation of carbonation resistance / CO_2 capture capacity, taking into consideration different temperatures, pressures, CO_2 concentrations, and its states (gaseous, dissolved in geothermal water).
- sequestration of CO_2 by chemical reaction leading to the formation of solid limestone in concrete. Such concrete, which captures CO_2 and performs well its engineering properties, can be considered Green Concrete.
- Study of combined chemical corrosion (especially by geothermal water) under normal and severe conditions.
- Development of geopolymers and zeolites from available and till now poorly studied clay minerals, and investigation of their ability to immobilize heavy metals. Different approaches will be studied to increase their reactivity, including mechanical, chemical treatment, and nano-clay addition. In the case of the second one, it is necessary to avoid an undesirable change in composition due to the leaching of ions.

(3) The priority strategy is the cooperation with universities and institutes in Europe and worldwide.

Already in 2022, the department is involved in two applications of research projects:

- "Circular and digital renewal of central Europe construction and building sector- ReBuilt" within the INTERREG framework with 14 partners institutes from 8 different countries under the Programme SO2.3- Taking circular economy forward in central Europe,
- Geochemical and transport modelling of concrete carbonatation process and its suppression with the use of nanomaterials to slow down of steel reinforcement corrosion- NANOCOR M-ERA.NET call 2022 with 4 institutes from 3 countries.

(4) At domestical level, we will strengthen the cooperation with cement plans and construction industry

Department of Optics and Physics

It is our goal in the next 5-year period to find a stronger link between air pollution and light pollution than previously understood, suggesting further environmental benefits to active efforts to reduce polluted air over cities. Despite last years' achievements, the variety of impacts on the skyglow expected under arbitrary meteorological conditions still constitutes a challenge in being completely conceivable. This includes the abundance of artificial light at some wavelengths (or directions) due to complex aerosol microphysics, cloud properties or emissions from whole-city light sources in preferential angles.

We propose to i) derive novel formulations and solutions to the light field in the nocturnal atmosphere with arbitrary cloud configurations; ii) uncover spectral "light-scattering and polarisation fingerprints" that distinct types of aerosols can have in different parts of the sky; iii) identify the manner in which both the atmosphere and light emissions from ground sources control artificial light at night; and iv) quantify the true effectiveness of current used measurement devices, find novel approaches in their usage or identify a new generation of instruments. This could revolutionize the characterization of light pollution sources.

The primary challenge of our forthcoming work is to accomplish the following research goals:

- Derive novel formulations and solutions to the electromagnetic (polarized) field in nocturnal atmospheres with arbitrary cloud configurations. Changes to the night sky radiance patterns expected from isolated or clustered clouds have never been predicted theoretically because fundamental theories are missing. However, the theoretical treatment of artificial light at night in a cloudy atmosphere is essential in order to explain a huge number of observations that fundamentally differ from what we measure under ideal cloudless conditions. The mechanism by which polarisation alters the properties of the diffuse night-light could be applied to formulate solutions to the radiative transfer equation (RTE) with considerably enhanced accuracies and to develop novel techniques for rapid characterization of the light emission function (EF), using relatively inexpensive ground-based observations.

- Reveal the effects the aerosol microphysics can primarily have on night sky brightness. We will carry out size, shape, and composition analyses (for aerosols) by comparing numerical computations of diffuse light in the celestial hemisphere for ideal homogeneous spherical particles first and for distinct materials and shapes that regularly occur in nature afterwards. Here, our motivation comes from the fact that it is completely unknown what the effects of specific shape irregularities and other aerosol microphysical properties are. The light output from artificial sources is known to control the amplitude of the night sky brightness, but the same or even wider range of effects can emerge from light scattering in a turbid atmosphere.
- Develop a novel and compact solution to retrieve light output patterns from urban areas using night-sky radiometry/photometry and apply results found from those data, taken at different locations in different territories. The acquisition of the EF from night-sky observations is a difficult mathematical challenge. However, potential gain is high because the EF will be obtained from routine ground-based observations. Derivation of an inverse algorithm for complex environments would suggest a scientific breakthrough in remote sensing of EF, as it removes an imaginary barrier for systematic EF monitoring worldwide and would make it independent of any territorial arrangement of human settlements.
- Investigate potential ways to offset skyglow effects in city surroundings through modelled light-source properties. There is a great demand in techniques for the identification of an optimum lighting technology for a respective locality aiming to maintain on-street illuminance at a required level while sky brightness in nocturnal landscapes reduces. Designing optimum light-sources properties is an inverse problem that has to be solved in respect to prevailing meteorological conditions in a site.
- Identify and quantify impacts of seasonal variations, atmospheric changes and instrumental influences on long-term analyses of light pollution development in urban, sub-urban and rural environments. Those effects have already shown to play an important role for in-situ measurements in the past. However, still there is a huge unawareness of precise influences and their treatment for various analyses. Therefore, current used devices must be investigated in their true effectiveness, novel usages or even instruments found, peripheral factors identified and their management in further research approaches improved significantly.

Gender equality and gender equity

Gender equality is not just a fundamental human right but a fundamental pillar for a peaceful, prosperous community and sustainable development. We understand that women have the same abilities as men, and therefore both sexes should have access to equal opportunities, responsibilities and activities and should be assessed equally (gender equity).

On the other hand, we realize that women and men are different and that particular abilities and characteristics of women should be recognized as valuable as specific characteristics of men. This means fair treatment of women and men, but also treatment, which is different, but at the same time, it is proportionate in terms of rights, benefits, obligations and possibilities.

These two concepts complement each other, but the different behaviours, aspirations and needs of women and men must be recognized and promoted in the same way.

In accordance with the principles of gender equality and the provisions of the Code of Ethics, the gender equality strategy for the years will focus on the following four (4) strategic areas:

1. To take action against gender-based harassment, violence and sexual harassment in the workplace.

2. To ensure proportional or balanced representation of women and men in public decision-making (Scientific Council, Administrative Board, Attestation Commission, etc.)

3. To create conditions for work-life balance, including the establishment of crèches and kindergartens, sports structures and sporting events, and social activities.

4. Incorporation of the particularity of the gender feature into the services of the Institute (popularization, research, and teaching).