

# Questionnaire

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

*Period: January 1, 2012 - December 31, 2015*

### **1. Basic information on the institute:**

#### **1.1. Legal name and address**

Institute of Construction and Architecture  
Dúbravská cesta 9  
845 03 Bratislava 45  
Slovak Republic

#### **1.2. URL of the institute web site – [www.ustarch.sav.sk](http://www.ustarch.sav.sk)**

#### **1.3. Executive body of the institute and its composition**

Directoriat	Name	Age	Years in the position
Director	Ing. Peter Matiašovský, CSc.	60	2005 -
Deputy director	prof. RNDr. Vladimír Sládek, DrSc.	62	2005 -
Scientific secretary	Ing. Jozef Kriváček, CSc.	59	2002 -

#### **1.4. Head of the Scientific Board**

Mgr. Miroslav Kocifaj, PhD. (2012 -)

#### **1.5. Basic information on the research personnel**

**1.5.1. Number of employees with university degrees (PhD students included) engaged in research projects, their full time equivalent work capacity (FTE) in 2012, 2013, 2014, 2015, and average number of employees in the assessment period**

	2012		2013		2014		2015		total		
	number	FTE	number	FTE	number	FTE	number	FTE	number	averaged number per year	averaged FTE
Number of employees with university degrees	33,0	26,960	35,0	29,410	36,0	28,430	37,0	26,830	141,0	35,3	27,908
Number of PhD students	3,0	0,500	2,0	1,000	2,0	1,000	2,0	0,666	9,0	2,3	0,792
Total number	36,0	27,460	37,0	30,410	38,0	29,430	39,0	27,496	150,0	37,5	28,699

### 1.5.2. Institute units/departments and their FTE employees with university degrees engaged in research and development

Research staff	2012		2013		2014		2015		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
Institute in whole	33,0	26,960	35,0	29,410	36,0	28,430	37,0	26,830	35,3	27,908
Department of Mechanics	5,0	3,470	5,0	3,750	5,0	4,300	8,0	5,610	5,8	4,283
Department of Structures	7,0	6,950	7,0	6,500	7,0	5,830	5,0	3,330	6,5	5,653
Dep. of Materials and Rheology	8,0	5,900	7,0	5,400	8,0	4,110	8,0	4,830	7,8	5,060
Department of Building Physics	7,0	6,300	8,0	8,000	8,0	8,000	10,0	8,360	8,3	7,665
Department of Architecture	6,0	4,340	8,0	5,760	8,0	6,190	6,0	4,700	7,0	5,248

### 1.6. Basic information on the funding of the institute

#### Institutional salary budget and others salary budget

Salary budget	2012	2013	2014	2015	average
<b>Institutional Salary budget</b> <i>[thousands of EUR]</i>	494,903	481,756	566,273	584,663	<b>531,899</b>
<b>Other Salary budget</b> <i>[thousands of EUR]</i>	295,048	255,967	268,214	83,404	<b>225,658</b>

### 1.7. Mission Statement of the Institute as presented in the Foundation Charter

- The institute pursues the fundamental research in the fields of construction engineering, material engineering and applied mechanics. It is orientated towards the research of:
  - the mechanical, temperature and acoustic fields in complex structures exposed to the impacts of various types of loads for optimal design,
  - the resistance of structures,
  - principles of the processes of hydration and creating the pore structure and the resulting physico-mechanical properties of silicate composites,
  - the heat, moisture and air transport in structures,
  - the influence of light and solar radiation on the creation of interior environment,
  - theory and critics of architecture.
- The institute provides consulting and other expert services connecting with the main activity of the institution.
- The institute carries out a doctoral study in the meaning of universally valid legal directives.
- The institute provides the publication of scientific and research results by means of periodical and non-periodical press. The publishing of the periodical and non-periodical press follows resolutions of the Presidium of SAS.

### 1.8. Summary of R&D activity pursued by the institute during the assessment period in both national and international contexts, (recommended 5 pages, max. 10 pages)

During the assessment period R&D was pursued within the framework of 4 fields: applied mechanics, non-metallic and building materials science, building structures, building physics and architecture and urbanism. It was realised within the frame of various domestic and international research programmes.

In the field of **applied mechanics** the research was orientated towards: A. mathematical-physical modelling and numerical simulations of multi physical phenomena in composite materials and B. development of advanced computational methods for modelling of smart materials.

A. *The mathematical-physical modelling and numerical simulations of multi physical phenomena in composite materials* was solved in the project of Slovak Research and Development Agency APVV-0032-10 „Numerical simulations of multi field problems in multiphase porous media“. During the solution of the project, we have developed a simple mathematical formulation for numerical solution of poroelastic boundary value problems with preserving the physical nature of complex coupled multi-field problems. The weak formulation on local subdomains as well as the strong formulation have been developed with compactly supported meshless approximations of the field variables. Substantial improvements have been achieved by introducing the analytical integration into local weak formulations and modified differentiation in evaluation of approximations for higher order derivatives of field variables. Another mesh-reduction methods known as the triple-reciprocity method and the completely de-singularized direct and indirect BEM have been elaborated too. The numerical simulations have been applied to fluid saturated porous geomaterials, piezoelectric porous materials, coupled non-Fick diffusion-thermoelastic problems, non-linear reaction-diffusion systems exhibiting the Turing instability and pattern formation, coupling effects in FGM composite plate structures, investigation of the influence of porosity on bending of plates involving dry pores and defects, etc. Experimentally and numerically has been solved the problem of heat convection from the surface of porous materials under small temperature gradients. New testing methods applicable to small samples in bioengineering of porous materials have been developed. Making use the experimental measurement data for various silicate building materials, the water vapour sorption hysteresis has been modelled; it was revealed that the hysteresis of moisture deformation of Ca-Si plates is determined by the capillary pressure during moisture and drying processes, TDR method was utilized in moisture diffusivity analysis.

Some of the significant results of the project are Advanced numerical simulations of multi physical effects in porous media: Development of sophisticated formulations and efficient computational techniques applicable to numerical simulations of multifield problems in advanced materials with functionally graded properties. Modern experimental measurements and numerical simulations become efficient tools in investigation of unexplored phenomena as well as in design of structural elements and/or equipments and finally helpful in transfer of advanced materials with sophisticatedly pre-programed properties into practice. One could name a wide application of piezoelectric porous materials with low acoustic impedance in medical ultrasonic imaging devices or low frequency hydrophones, vibration sensors etc. For optimum design, numerical analyses of the complex multi-physical problems are necessary. The advanced numerical methods based on meshless approximations enables us to solve the tasks in media with spatially variable material coefficients with the same difficulty as the tasks in homogeneous environments. This research continues in the project APVV-14-0440 „Multi physical problems in functionally graded materials plates“.

B. *The development of advanced computational methods for modelling of smart materials* was solved in the project APVV-0014-10. “Optimal design of smart composite materials”. A meshless method based on the local Petrov-Galerkin approach has been developed for numerical solution of initial-boundary value problems in magneto-electro-elastic solids with functionally graded material properties. An important role in the crack analysis of magneto-electro-elastic materials plays the definition of the electromagnetic boundary conditions on the crack-faces. The electric and magnetic boundary conditions on the crack-faces are determined by the shielding degrees of the electric and magnetic fields. The fully permeable crack does not shield the electric and magnetic field. In the second extreme case, the fully impermeable crack shields the electric and magnetic field completely. In the project it has been developed the model, where a finite value of the permittivity, permeability and crack-opening-displacement is considered. The electrical and magnetic fields in the crack-gap are approximated as the potential drop divided by the normal crack-opening-displacement. This model is leading to a boundary or initial-boundary value problem with nonlinear boundary conditions.

The significant result of the project is Optimal design of smart composite materials: Recently it has been found that significantly higher magneto-electric effect is obtained in composite materials as in their constituents at a suitable combination of materials. This effect can be two orders higher in these composites. Such a sharp increase in comparison with natural materials can lead to a wider application in ultrasonic imaging devices, sensors, actuators, transducers, etc. Therefore it is important to know the influence of thicknesses of particular layers in

laminated composite on the value of magnetoelectric coefficient. The local integral equations with meshless approximations have been utilized in numerical analyses. These works are the first of this type published in a literature and therefore their value is high. At the interface of two different magneto-electro-elastic materials the cracks can arise leading to delamination, so deterioration of a structure. In order to prevent this we designed a continuous gradation from purely piezomagnetic material to purely piezoelectric material, without any interface discontinuities. We analysed the influence of gradation of material coefficients to magnetoelectric coefficient. In functionally graded materials (FGM) a variability of material properties can be programmed by spatial distribution of volume fractions of micro-constituents. The solution of general boundary value problems for continuous and anisotropic magneto-electro-elastic body requires highly progressive numerical methods because of high mathematical complexity. Besides this complication magnetic, electric and mechanical fields are coupled and the relevant equations are much more complicated than in the classical elasticity. It is well known that in conventional formulation of FEM or BEM, the  $C^0$ -continuity is guaranteed, i.e., on interfaces of discretization elements there are discontinuities of secondary fields (gradients of primary fields), e.g. such as the electric field and magnetic induction. The great advantage of meshless techniques is higher order continuity of approximations of field variables. The higher continuity guarantees higher accuracy of the boundary value problem solutions in homogenous or continuously nonhomogenous media. The problem of discontinuity of the secondary fields at the interface of elements in conventional FEM formulation can be solved using so called hybrid formulation where the secondary fields are approximated independently on the primary fields with using  $C^0$  elements. We obtained excellent accuracy for laminated as well as FGM composites at the calculation. The research continues in the project APVV-14-0216 "Multiscale modelling of coupled fields in composite materials". Specific parts of this subject were solved in the project of Scientific grant agency (VEGA) 2/0011/13 „Computational methods for fracture analyses of quasicrystal materials“ and the project of the bilateral scientific cooperation between Slovak Academy of Sciences and National Science Council, Republic of China (Taiwan) „Applications of meshless methods in computational mechanics“. This project was concentrated on a computer solution of problems involving coupled elastic, electric or temperature fields in mechanics of solids and also in the problems of fluid mechanics. For solution of these tasks the meshless formulations were used. The obtained results represent a contribution to the development of knowledge on complex phenomena multi-field problems solved in continuous media with the variable material coefficients. Also the results in the field of modelling these phenomena are valuable. Considering the universal validity of the numerical formulations developed for studied phenomena, these formulations represent a valuable contribution to the field of numerical calculation methods. Many of the mentioned results have been achieved within informal cooperation with foreign researches.

In the field of **non-metallic and building materials science** a complex research of silicate composites: study of chemism, mechanism and kinetics of the hydration and hardening of hydraulic binders and development of specific low energy and ecological binders was pursued. It is the interdisciplinary research in a close connection with chemistry, physical chemistry, physics, mechanics and material engineering.

Within the project VEGA 2/0064/12 „Progressive ternary blended cement systems with high-performance properties for material technologies and hydrothermal conditions *Significant progress in improvement of physico-mechanical properties of cement for application in deep boreholes was achieved.* G-Oil well cement was cured under standard and hydrothermal conditions with different steam pressures and temperatures. The 7 days aged sample cured under standard conditions has the highest compressive strength with compact pore structure and hydrated products similar to those found after hydration of Ordinary Portland cement. With increasing the temperature and pressure from standard conditions to hydrothermal ones compressive strength has drastically decreased from due to the transformation of original hydrated products (C-S-H) to crystallized  $\alpha$ - $C_2S$ H and  $C_6S_2H_3$ . The addition of silica fume and blast-furnace slag caused the increase of strength and impermeability under hydrothermal conditions. Microparticles of silica fume contributed to the origin of stable fine crystalline phases of tobermorite and to marked improvement of pore structure parameters. The 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.

The research continued in the project VEGA 2/0082/14 "Synthesis and characterisation of the chemically bonded phosphate ceramic binders". *A new method for the preparation of materials with potential application in geothermal depth wells and in biomedicine was developed.* Aluminous cements (HAC) represent specific group of inorganic binders for production of refractory concretes for cement plant kilns. The microstructure and properties of the materials manufactured from these cements are strongly dependent on the temperature at production and application. Therefore HAC have limited application mainly in demanding conditions of deep boreholes in aggressive environment. A new group of materials was developed, so-called chemically bounded phosphate ceramic binders with excellent physical and mechanical properties, which predestine them for the application in hydrothermal oil and geothermal deep boreholes. The process of formation of phosphate ceramic binders was simulated in unique laboratory autoclave. Hydrothermal conditions and acidobasic reactions between aluminous cement and Natriumhexametaphosphat represent new way of in-site synthesis of products on the base of hydroxyapatite with potential application in biomedicine. The research continues in project VEGA 1/0696/15 „High porous inorganic materials for thermal insulating applications“

Simultaneously two ERDF projects have finished in the assessed period: In Cross Border Cooperation Programme Slovakia – Austria 2007-2013 project ENVIZEO "Applications of ecocements CEM V (A, B) kind according to EN 197-1 in structural concrete" physical and chemical properties of two cement kinds of CEM V/(A and B) according to EN 197-1 were estimated. Compared was the pozzolanic activity of blast-furnace slag, natural zeolite and fly ash, used as the cement additions. *Optimal concrete mixture composition and estimation of basic rheological properties of fresh concretes were proposed.* There were determined the important civil engineering properties of the proposed concrete and elaborated Technological Rule for the Manufacture of Concrete with the Cement of CEM V Kinds and Basic Recommendations for the Application. Microstructure study of the formed hydrate phase and developed pore structure including permeability on the cement pastes with the same composition than those occurring in the concretes was analysed. Demonstration of the results by field experiment and implementation of the gained experience along practise in Austria and Slovakia was performed.

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 – 2nd stage" brings together an excellent R&D and educational institutions in the region of Bratislava (Slovakia) to the monothematic centre focused on R&D of advanced composite materials for the engineering, construction and medical applications, is aimed to build a modern infrastructure of R&D in the field of composite materials with main emphasis on information and communication technology, is integrating institutions into the centre of international cooperation in R&D of composite materials especially in the European Research Area, engages in educational activities and works closely with Slovak economic sphere. CEKOMAT is active in the production technologies of structural composite materials and their applications. The team of experts has the knowledge of many technological methods for manufacturing composite materials for various engineering, construction and biomedical applications. We are pleased to support your business activities that help in developing new innovative products and technological processes in these areas. The Institute of Construction and Architecture is oriented to the development of methods for assessment of the stability of composites for construction applications under climatic changes and the creation of methodologies of modelling of structural materials and simulations of their properties in complex elements in this project.

Several projects dealing with the development of building structures were solved: Theoretical VEGA 2/0154/15 "Modelling of post-buckling behaviour and strength of thin-walled cold formed columns", VEGA 1/0090/12 "Influence of imperfections on resistance of structural members and load-bearing structures of machines" and experimental VEGA 2/0033/2015 "Influence of repeated and long - term loading on interaction of parameters at reconstruction of reinforced concrete elements", VEGA 2/0143/12 "Determination of parameters of interaction at

strengthening of reinforced concrete elements with regard to rheological properties”, APVV-0179-10 “Wind action in structural engineering”.

In the field of **Building physics** the research in two areas was pursued: A. Heat and mass transfer in building materials and structures, modelling of thermophysical properties of building materials, simulations of hygrothermal fields in porous media and B. Modelling of microphysical and optical properties of materials, radiation and heat transport of in nonhomogenous multicomponent media, nano- micro- structures, methods and theory of electromagnetic (optical) diagnostics of disperse systems.

*A. Heat and mass transfer in building materials and structures, modelling of thermophysical properties of building materials, simulations of hygrothermal fields in porous media* were pursued in Project APVV-0031-10 “Probabilistic modelling of hygrothermal performance of buildings” A development of probabilistic models of hygro-thermal performance of building was focused on rare events represented by the conditions of germination and mould growth in building interior and by the extreme conditions of interior environment during summer heat waves. Probabilistic model of germination and mould growth was illustrated on example of indoor surface of an external wall of a building in the first heating season. The concept of "time of wetness" (TOW) defining a cycle of favourable mould growth conditions was employed. A continuous heat stress period in interior environment (HSP) based on the PMV/PPD index or operation temperature was defined. The parameters of interior environment of a characteristic part of residential building with natural ventilation within summer seasons were calculated by the simulation code ESP-r. For determination of exceedance probabilities (mean return periods) of practically important TOW or HSP durations the theory of extreme values was applied. The uncertainties of material parameters, outdoor climate and behaviour of inhabitants were considered. As a decisive input parameter of both models the variability of climate conditions was identified. During the collection and statistical analysis of input data and parallelly with probabilistic modelling a treatment of extremes of stochastic processes of snow and wind climatic actions was developed. This allowed focus and a broader view on probabilistic modelling of rare events of hygrothermal performance of building. The project was solved in cooperation with project of IEA Energy in Buildings and Community Programme Annex 55 RAP-RETRO “Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost”.

Particular tasks of the problematic were solved in projects APVV bilateral SK-CZ-2013-0052 “Experimental and theoretical analysis of water vapour sorption in building materials” and VEGA 2/0145/13 “Moisture transfer and accumulation in building materials under service conditions”.

*B. Modelling of microphysical and optical properties of materials, radiation and heat transfer in non-homogenous multicomponent media, nano- micro- structures, methods and theory of electromagnetic (optical) diagnostics of disperse systems* were pursued in the Project APVV-0177-10 “Unified system of sky luminance patterns, characterizing daylight availability and conditions in urban spaces”. The radiance/luminance patterns that simulate more realistic skies are urgently needed in lighting engineering applications to model daylight availability in exterior and interior spaces under real conditions accepting stochastic cloud coverage. We have developed a universal sky radiance/luminance model that accommodates for higher scattering orders, aerosol optics, surface albedo, and the statistically relevant contributions of randomly distributed clouds. The model produces a radiance patterns that are more consistent with the measurements, while numerical tools are applicable to any cloud configuration. A common usability of the model and an incorporation of real environmental and atmospheric states are the main advantages of such a unified system of radiance patterns. Without any exaggeration we can conclude that the project was a pioneering and innovative work which encouraged our team and international daylighting community to go further in this field of science. There is no doubt that the project has finished with a great success.

The first significant result of the project is “*Spectral sky radiance under broken cloud arrays: a theoretical solution*”. A precise characterization of the optical state of a sky is important in the solution of many lighting technology tasks e.g. in the modelling of availability of solar and luminous energy on the earth surface – especially in densely inhabited urban areas with various

orientations of buildings. A large variability of atmospheric conditions, heterogeneity of optical characteristics of aerosol particles and clouds, and earth surface albedo all usually lead to rapid changes of diffuse radiation at the ground. The theoretical model developed simulates the radiance field below inhomogeneous cloudy skies. The model is applicable to any cloud configuration, i.e. positions of individual clouds can be arranged randomly as regularly occurs in nature. The solution follows the modified theory of successive orders of scattering in which single-scattering radiances from broken clouds and a cloud-free atmosphere are well separated, while their non-trivial superposition is used to determine a second-order approximation to the radiative field. The contributions of both single and secondary scattered beams form the total radiation field below the cloud level. The preciseness of this solution tends to be close to 3D radiation schemes, which however are computationally extremely demanding and thus inapplicable for routine use. In spite of the complexity of mathematical-physical solution the resulting numerical implementation of the model developed is highly effective.

The second significant result of this project and the project VEGA 2/0002/12 "Optical characterization of non-spherical atmospheric particles and retrieval of their microphysical properties" is *Quantitative analysis of night skyglow amplification under cloudy conditions*. A permanent increase of night lighting causes undesirable phenomena, specifically sky glow in urban centres and suburban areas. There is now a substantial demand for technological development to help to minimize the amount of light unnecessarily emitted upward. Different technologies are tested in order to predict their influence on over-illumination of ambient environment. An identification of the influence of the clouds and aerosols on the glow of a night sky is a priority challenge, because basic mechanisms are not known at all yet. The fundamental mechanism of the amplification of horizontal diffuse irradiation under cloudy conditions was solved in cooperation with H. A. Solano Lamphar from Mexico, whilst various cloud types were considered in the theoretical model and subsequent calculations. In addition, the reflectivity and the altitude of cloud base were taken into account together with various built areas of a town. It has been shown that the amplification factor peaks at the edges of a town and is a decreasing function of aerosol optical thickness, which is a parameter commonly employed to characterize a turbidity of the atmosphere.

The result of research performed in project: COST Action ES1204 "Loss of the Night Network (LoNNe)" is "Night sky brightness: theoretical prediction vs. Experiment". To compare various technologies and to choose a suitable illumination source with minimized impact on a diffuse light anywhere in its surroundings it is necessary to solve the radiation transfer equation. In the project the model was developed which gives the results consistent with experimental data and therefore it is applicable not only for numerical predictions, but also for a conversion of various types of measured data, as somewhere only the data on zenith brightness and somewhere only the data on horizontal luminance are available. The obtained results involved a cooperation with NPS team (USA) in order to verify the model using data from the whole American network and to determine the total emission function of selected towns. The inverse transformation uses the reduced integral operator for the model of single scattering. The research continues in the project APVV-14-0017 "Generalized skyglow model and its application to retrieval of city emission function".

In addition, the research project "Theoretical conditions for charge-induced normal modes in spherical particles" was pursued with aim to *identify the optical properties of electrically charged metallic and non-metallic materials, specifically nano- and micro-sized particles*. The theoretical conditions for charge-induced resonances are specified through the Mie expansion coefficient and are treated analytically. It is shown that the conditions for normal mode generation change with the order of the expansion coefficient, thus resulting in a complex optical response of charged spheres. The previously undisclosed analytical formulation of resonance conditions is a main strength of our approach. The theoretical findings could have important implications for laser beam modulation devices, as well as photonics. The result was published in a journal with high impact factor: KOCIFAJ, Miroslav. Theoretical conditions for charge-induced normal modes in spherical particles, *Laser Physics Letters*, 2013, vol. 10, no. 5, p. 1-4. (7.714 - IF2012). (2013 - Current Contents). Particular task was solved in project VEGA 2/0002/12 "Optical characterization of non-spherical atmospheric particles and retrieval of their microphysical properties".

Based on the above research a cooperation with US Army International Technology Center was initiated which resulted in a common project W911NF-14-1-0601, "Scattering of Electromagnetic Radiation by Electrically Charged and Neutral Particles: Similarities and Fundamental Differences". The emergence of resonant excitations due to electromagnetic radiation acting on charged nanoparticles is a fascinating phenomenon that has been recognized only recently, and it has important consequences for development of progressive methods in the field of material diagnostics. *Similarities and fundamental differences between optical properties of electrically charged and neutral (nano)-particles* were a subject of the project. In the phase of the project implementation it has been shown that the small electrically charged particles can resonate with the incident electromagnetic wave in a number of modes. These surface excitations are closely related to the surface charge density that has static and oscillatory components. Moreover, the excitations are also related to the flow of charges that can change the tangential electric field on the surface of the particle. The optical response of a system of charged particle was obtained by solving the Maxwell equations subject to modified boundary conditions and constitutive relations. It was shown that the effects of oscillatory part of the surface charge are significant mainly in the vicinity of resonances. The physics of net charges was introduced through a surface current density that is linearly proportional to a phenomenological surface conductivity and the tangential electric field at the surface of a particle.

The findings are exciting because they can explain a number of anomalous laboratory results that have challenged the electromagnetics community. The net surface charge can be a significant factor in many systems, for instance, colloids of metallic particles. Among colloidal particles at liquid interfaces, charged nanoparticles are a fertile subject of new technological concepts and can be decisive in the development of new devices and novel technologies in the nanosciences, such as optical attenuators, modulators, and switches that can be turned on or off through the application of charge, or for systems for enhancing absorption in thin films for solar cells. Charged particles are found in industrial plasma, because dust particles preferably accumulate charge from such media. Atmospheric hydrometeors also are usually charged; therefore, any change in scattering or absorption efficiency by small charged water droplets has the potential to affect the threshold-level data received by radars in the microwave and millimeter-wave spectral range. By incorporating a correction to the conventional surface-current density, we also have refined the conductivity model and found that the Rayleigh approximation known for more than a century is not a valid approach to analyse the optical effects by electrically charged particles much smaller than the wavelength of the incident radiation.

A cooperation with US Army International Technology Center and US Army Research Office also resulted in the project W911NF-13-1-0195 "Optical Characterization of Atmospheric Aerosols". *Monitoring, quantification and interpretation of sky states is of specific importance in solving lighting technology tasks, mainly in urban locations*. In respect to intensive construction activity in rapidly developing countries/areas the daylight availability in exterior spaces and also in interiors can significantly change. For this reason some scientific teams in the world focus on a simulation of daylighting in the built areas. As the windows in buildings have various orientations and sizes, it is necessary to assess the angular distribution of sky brightness or glare. A correct characterization of sky states is a legitimate motivation for systemic monitoring of the characteristics of visible radiation reaching the ground surface. A great effort is expended to the development of more universal scalable sky brightness model that depends on the actual weather situation. Such model can be obtained only by introducing the set of parameters characterizing a physical state of the atmosphere and surrounding environment. It is necessary to emphasize that the optical state of atmosphere in real conditions cannot be simulated neither by Rayleigh theory, nor by first order scattering approximation. The main reason is the presence of clouds and aerosols that are ubiquitous in the atmosphere. The aerosols are optically the mostly unstable component of the atmosphere influencing the visible part of electromagnetic radiation. Therefore, the information on a polydisperse system of aerosol particles is necessary for correct interpretation of sky radiance patterns. The project team intensively communicated among several international teams working in the field of light scattering, which resulted in autumn 2013 in organising the international conference "Optical Characterization of Atmospheric Aerosols" (OCAA-2013) <http://ocaa2013.sav.sk/>.

For Solar Consulting Services, Inc., Colebrook, New Hampshire, USA project "Numerical tool for

concentrating solar applications” was solved. The increasing demand for energies markedly intensifies a development of equipments utilizing renewable energy sources, including solar concentrators. The concentrators can make the utilization of both the solar energy and photons from circumsolar zone more effective. *In cooperation with SCS Inc. the numerical tool was developed, which can predict the energy gain on the basis of commonly available data for various solar altitudes, atmospheric turbidity, and in any season.*

Besides, projects APVV 0118-12 “Simulation of daylight in artificial sky”, VEGA 2/0029/11 “Research of quantitative and qualitative daylighting characteristics in buildings”, VEGA 2/0117/14 “Research of envelope construction influences on luminous and thermal environment in attic spaces”, IEA Solar Heating and Cooling Programme – Task 50 “Advanced lighting solutions for retrofitting buildings”, dealing with daylight availability in interior were solved.

In the field of **architecture and urbanism** a complex research of the 20th century and contemporary architecture in Slovakia, from the aspect of: history, structural, functional and typological specifics, international context and monument protection. The research is based on three pillars: comparative history, critical theory and investigation of the modern architecture as the architectonic heritage.

In Project APVV-0375-10 “Differentiated typology of modernism: the theoretical basis for maintenance and conservation of works of modern architecture” *the monitoring of modern architecture as an important tool of monuments protection was for the first time realised in Slovakia.* 51 works of modern architecture have been investigated and evaluated in course of the monitoring. The differentiated typology of modernism as a structured file of data about works of the 20th century modern architecture in Slovakia was constructed. It includes information on constructions, materials, concepts, authors, clients, social acceptance and functioning of the particular building types. The strategies and procedures of monument protection and renovation of the basic types of modern architecture works, as well as for the special typologies as modern interiors and monofunctional areas, have been created. The architectural and historical survey of the most important works of the 20th century modernism in Slovakia has been carried out (Synagogue in Žilina, swimming pool Zelená žaba in Trenčianske Teplice, housing complex Unitas in Bratislava and others). The recommendations regarding the methods of monument protection has been elaborated. In frame of the investigation of particular typologies of modern architecture the phenomenon of social housing, its origin in 1920s, mutations during the second half of the 20th century and actual perspectives in Slovakia have been identified and described. The main features of the Slovak variation of new objectivity (Neue Sachlichkeit) have been described and identified in frame of the European context. The connections between architecture form and state ideology have been investigated and their latent and operative potentials have been identified and described. The selected aspects of the phenomenon of woman architect have been identified, described and exemplified on the Slovak architecture scene of the 20th century.

*The first significant result of the project is New architectural and historical contexts and stratigraphy of selected types of modern architecture monuments:* Within the frame of the investigation of peculiarities of the typology of modernism in Slovakia we oriented to several diametrically different types of modern architecture: sacral buildings, residential buildings and industrial buildings from the first half of 20th century. We succeeded to discover remarkable context of origin, specifics of urban composition and material composition of these architectonic works, as well as their unique thought background determined by regional determinateness. This fact should have a fundamental influence on the procedure of renovation of the selected protected monument buildings and their complexes beginning with their position in the urban structure, through variegation, equipment with furniture up to the performance in use.

*Te second significant result is Discovery and explanation of architectural work of F. Weinwurm:* The research brought the first complex picture about the work and life of the architect Friedrich Weinwurm (1885 - 1942), the most significant representative of the new objectivity in Slovakia and one of the most important architects of the 20th century in the mid-European territory. It discovered connections of the origin of his architectonic work, explained a mechanism and unique characteristics of his works. Simultaneously we succeeded to interpret the work of the architect and to elucidate up to now unknown facts connected with his work, to compare this

work with the period architectonic efforts of the regional and international scene and incorporate it into the context of a wider European architectural situation. The results of the research were in detail described in a broad English-Slovak monograph and in also the study published in a significant periodical *Future anterior*, edited by Columbia University. The results were awarded by the “Martin Kusý prize” for the theoretical work in the field of architecture 2014.

Project: of The South East Europe Transnational Cooperation Programme SEE/B/0009/4.3/X ATRIUM “Architecture of Totalitarian Regimes of the 20th Century in Urban Management” pursued the following specific objectives: identification of case-studies in the areas concerned (analysis of urban maps, urban & architectonical works), and hence of their underlying concept of city and power as well as meanings in term of relationships between citizens and totalitarian institutions; selection of buildings and places of particular signification under past regimes, which could have (or currently have) a new aesthetical, functional and social task in contemporary democratic city; preparation of a trans-national Manual (also for training purposes) of wise management, preservation re-use and economic valorisation of this “inconvenient” heritage; identification, collection and digital cataloguing of photograph archives, films, oral witnesses, furniture, etc. of the epochs concerned; design of a cultural route on this heritage, in compliance with requisites set out by the Council of Europe; promotion of forms of cultural tourism for economic valorisation of heritage concerned (and training of necessary operators), capable of attracting segments of international, especially European, growing cultural tourism demand, and hence to create new services and jobs.

The result of Slovak team work is *Theoretical analysis of the Modern Architecture of Totalitarian Regimes of the 20th Century and its Sustainability Strategy*. The analysis reflects a controversial topic of European architecture, the influence of totalitarian regime on the architectonic production. And the specific attention is paid to the relationship between modernity and totalitarianism. It shows on the selected architectonic works of the 20th century the transformations the concepts of state representation about the formal site of architecture and reactions of architects to these changes. It presents how such architecture was accepted by public in time of its origin and how it is appraised today after several decades. The Slovak team focused on the architecture at the territory of Slovakia.

The significant result of project VEGA 2/0036/14 “Modern town-planning concepts and traditional town: analysis of conflicts and coexistences” is *Phenomenon of the unplanned city*. The unfinished and deformed intensions are in the urban planning so frequent that the relictness and partiality of a town is inherently a more principal and frequent that oneness. This phenomenon can be called as the „unplanned town phenomenon“. We investigated it on selected Bratislava locations representing certain situation types (river bank, generic structure on the place of original historical structure, nonlinear multipolar urban space formed from linear street space, gradual hybrid transformation of built-up area, crossing variety of modern and post modern approaches to the design and realisation of it on the ground plan of abstract idea of town diagonal axis). We compared the consequences of historical development, following the architectonic-urban innovation. On the basis of the comparing of planned and real changes of the form and function of built-up area and assessment of selected architectures we identified moments and parameters of the break in the development of urban structure and marked the factors of its stability and instability.

In further project VEGA 2/0171/10 “Values of modern architecture in Slovakia: specification and possibilities of protection” were analysed.

The Institute disposes with the only specialised Archive of architecture in Slovakia, which includes physical and digital documentation on more than 3000 buildings. The part of the materials is available also on-line via the Registry of modern architecture [www.register.ustarch.sav.sk](http://www.register.ustarch.sav.sk).

## **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 (ratios in percentage)**

basic research/applied research = 75% / 25%; international/regional research = 80% / 20%

**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) should be underlined**

1. DARULA, Stanislav - KITTLER, Richard - KÓMAR, Ladislav. Simulation of luminance sky patterns predetermining daylight illuminance on vertical house fronts with windows. In *Solar Energy*, 2015, vol. 120, p. 195-207. (3.469 - IF2014). (2015 - Current Contents). ISSN 0038-092X.
2. DRŽÍK, Milan - MIHÁLKA, Peter - MATIAŠOVSKÝ, Peter. Experimental and numerical analysis of the boundary layer  $\alpha_2$ ,  $n$  a vertical plate at low temperature differences. In *Journal of Building Physics*, 201vol. 35, no. 4, p. 309-326. (0.714 - IF2011). (2012 - Current Contents). ISSN 1744-2591.
3. IFKA, Tomáš - PALOU, Martin T. - BARAČEK, Jan - ŠOUKAL, František - BOHÁČ, Martin. Evaluation of P2O5 distribution inside the main clinker minerals by the application of EPMA method. In *Cement and Concrete Research*, 2014, vol. 59, p. 147-154. (3.848 - IF2013). (2014 - Current Contents). ISSN 0008-8846.
4. KOCIFAJ, Miroslav. Theoretical conditions for charge-induced normal modes in spherical particles. In *Laser Physics Letters*, 2013, vol. 10, no. 5, p. 1-4. (7.714 - IF2012). (2013 - Current Contents). ISSN 1612-2011.
5. KOCIFAJ, Miroslav - SOLANO LAMP HAR, H. A. Skyglow: a retrieval of the approximate radiant intensity function of ground-based light sources. In *Monthly Notices of the Royal Astronomical Society*, 2014, vol. 439, p. 3405-3413. (5.226 - IF2013). (2014 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711. DOI: 10.1093/mnras/stu180.
6. KOCIFAJ, Miroslav - SOLANO LAMP HAR, H. A. Quantitative analysis of night skyglow amplification under cloudy conditions. In *Monthly Notices of the Royal Astronomical Society*, 2014, vol. 443, p. 3665-3674. (5.226 - IF2013). (2014 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711.
7. KOCIFAJ, Miroslav - POSCH, Thomas - SOLANO LAMP HAR, H. A. On the relation between zenith sky brightness and horizontal illuminance. In *Monthly Notices of the Royal Astronomical Society*, 2015, vol. 446, p. 2895-2901. (5.107 - IF2014). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711.
8. KOCIFAJ, Miroslav - SOLANO LAMP HAR, H. A. - KUNDRACIK, F. Retrieval of Garstang's emission function from all-sky camera images. In *Monthly Notices of the Royal Astronomical Society*, 2015, vol. 453, p. 819-827. (5.107 - IF2014). (2015 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0035-8711.
9. KOCIFAJ, Miroslav - KLAČKA, Jozef. Scattering of electromagnetic waves by charged spheres: near-field external intensity distribution. In *Optics Letters*, 2012, vol. 37, p. 265-267. (3.399 - IF2011). (2012 - Current Contents). ISSN 0146-9592. DOI: 10.1364/OL.37.000265.
10. KOCIFAJ, Miroslav. Unified model of radiance patterns under arbitrary sky conditions. In *Solar Energy*, 2015, vol. 115, p. 40-51. (3.469 - IF2014). (2015 - Current Contents). ISSN 0038-092X.
11. KOCIFAJ, Miroslav - GUEYMARD, CH.A. Aerosol size distribution retrievals from sunphotometer measurements: Theoretical evaluation of errors due to circumsolar and related effects. In *Atmospheric Environment*, 2012, vol. 51, p. 131-139. (3.465 - IF2011). (2012 - Current Contents). ISSN 1352-2310.
12. KOCIFAJ, Miroslav - KLAČKA, Jozef - KUNDRACIK, F. - VIDEEN, Gorden. Charge-induced electromagnetic resonances in nanoparticles. In *Annalen der Physik*, 2015, vol. 527, no. 11-12, p. 765-769. (3.048 - IF2014). (2015 - Current Contents). ISSN 0003-3804.

13. KÓMAR, Ladislav - KOCIFAJ, Miroslav. Uncertainty of daylight illuminance on vertical building facades when determined from sky scanner data: A numerical study. In *Solar Energy*, 2014, vol. 110, p. 15-21. (3.541 - IF2013). (2014 - Current Contents). ISSN 0038-092X.
14. KÓMAR, Ladislav - RUSNÁK, Anton - DUBNIČKA, Roman. Analysis of diffuse irradiance from two parts of sky vault divided by solar meridian using portable spectral sky-scanner. In *Solar Energy*, 2013, vol. 96, p. 1-9. (2.952 - IF2012). (2013 - Current Contents). ISSN 0038-092X.
15. KÓMAR, Ladislav - DARULA, Stanislav. Determination of the light tube efficiency for selected overcast sky types. In *Solar Energy*, 2012, vol. 86, p. 157-163. (2.475 - IF2011). (2012 - Current Contents). ISSN 0038-092X.
16. KULIFFAYOVÁ, Marta - KRAJČI, Ľudovít - JANOTKA, Ivan - ŠMATKO, Vasilij. Thermal behaviour and characterization of cement composites with burnt kaolin sand. In *Journal of Thermal Analysis and Calorimetry*, 2012, vol. 108, p. 425-432. (1.604 - IF2011). ISSN 1388-6150.
17. MORAVČIKOVÁ, Henrieta. *Friedrich Weinwurm : architekt / architect*. Bratislava : Slovart, 2014. 373 s. ISBN 9788055611587.
18. PALOU, Martin T. - ŽIVICA, Vladimír - IFKA, Tomáš - BOHÁČ, Martin - ZMRZLÝ, Martin. Effect of hydrothermal curing on early hydration of G-Oil well cement. In *Journal of Thermal Analysis and Calorimetry*, 2014, vol.116, no 2, p. 597-603. (2.206 - IF2013). (2014 - Current Contents). ISSN 1388-6150.
19. PALOU, Martin T. - ŠOUKAL, František - BOHÁČ, Martin - ŠILER, Pavel - IFKA, Tomáš - ŽIVICA, Vladimír. Performance of G-Oil Well cement exposed to elevated hydrothermal curing conditions. In *Journal of Thermal Analysis and Calorimetry*, 2014, vol. 118, no. 2, p. 865-874. (2.206 - IF2013). (2014 - Current Contents). ISSN 1388-6150.
20. PALOU, Martin T. - BÁGEL, Ľubomír - ŽIVICA, Vladimír - KULIFFAYOVÁ, Marta - IFKA, Tomáš. Hydration of high alumina cement-silica fume composite with addition of Portland cement or sodium polyphosphate under hydrothermal treatment. In *Journal of Thermal Analysis and Calorimetry*, 2013, vol. 113, no 1, p. 385-394. (1.982 - IF2012). (2013 - Current Contents). ISSN 1388-6150.
21. PETRŽALA, Jaromír - KÓMAR, Ladislav. Data regression on sphere for luminance map creation from sky scanner measurements. In *Solar Energy*, 2015, vol. 117, p. 203-212. (3.469 - IF2014). (2015 - Current Contents). ISSN 0038-092X.
22. SÁTOR, Ladislav - SLÁDEK, Vladimír - SLÁDEK, Ján. Coupling effects in elastic analysis of FGM composite plates by mesh-free methods. In *Composite Structures*, 2014, vol.115, p. 100-110. (3.120 - IF2013). (2014 - Current Contents). ISSN 0263-8223. DOI: [10.1016/j.compstruct.2014.04.016](https://doi.org/10.1016/j.compstruct.2014.04.016).
23. SADOVSKÝ, Zoltán - KRIVÁČEK, Jozef - IVANČO, V. - ĎURICOVÁ, Antónia. Computational modelling of geometric imperfections and buckling strength of cold-formed steel. In *Journal of Constructional Steel Research*, 2012, vol. 78, p. 1-7. (1.251 - IF2011). (2012 - Current Contents). ISSN 0143-974X.
24. SADOVSKÝ, Zoltán - KORONTHÁLYOVÁ, Oľga - MATIAŠOVSKÝ, Peter - MIKULOVÁ, Katarína. Probabilistic modelling of mould growth in buildings. In *Journal of Building Physics*, 2014, vol. 37, no. 4, p. 348-366. (1.027 - IF2013). (2014 - Current Contents). ISSN 1744-2591.
25. SADOVSKÝ, Zoltán - KORONTHÁLYOVÁ, Oľga - MIHÁLKA, Peter - MATIAŠOVSKÝ, Peter - MIKULOVÁ, Katarína. Probabilistic modelling of extreme indoor heat exposure induced by heat waves. In *Building Simulation*, 2015, vol. 8, iss. 5, p. 477-485. (1.029 - IF2014). (2015 - Current Contents). ISSN 1996-3599.
26. OCHIAI, Y. - SLÁDEK, Vladimír - SLÁDEK, Ján. Three-dimensional unsteady thermal stress analysis by triple-reciprocity boundary element method. In *Engineering Analysis with*

*Boudary Elements*, 2013, vol. 37, no. 1, p. 116-127. (1.596 - IF2012). (2013 - Current Contents). ISSN 0955-7997.

27. SLÁDEK, Ján - SLÁDEK, Vladimír - PAN, E. Bending analyses of 1D orthorhombic quasicrystal plates. In *International Journal of Solids and Structures*, 2013, vol. 50, no. 24, p. 3975-3983. (1.871 - IF2012). (2013 - Current Contents). ISSN 0020-7683. DOI: [10.1016/j.ijsolstr.2013.08.006](https://doi.org/10.1016/j.ijsolstr.2013.08.006).
28. SLÁDEK, Ján - SLÁDEK, Vladimír - WÜNSCHE, Michael - ZHANG, Ch. Analysis of an interface crack between two dissimilar piezoelectric solids. In *Engineering Fracture Mechanics*, 2012, vol. 89, p. 114-127. (1.353 - IF2011). (2012 - Current Contents). ISSN 0013-7944.
29. SLÁDEK, Ján - SLÁDEK, Vladimír - BISHAY, P.L. - GARCIA SANCHEZ, F. Influence of electric conductivity on intensity factors for cracks in functionally graded piezoelectric semiconductors. In *International Journal of Solids and Structures*, 2015, vol. 59, p. 79-89. (2.214 - IF2014). (2015 - Current Contents). ISSN 0020-7683.
30. SLÁDEK, Vladimír - SLÁDEK, Ján - SÁTOR, Ladislav. Physical decomposition of thin plate bending problems and their solution by mesh-free methods. In *Engineering Analysis with Boudary Elements*, 2013, vol. 37, p. 348–365. (1.596 - IF2012). (2013 - Current Contents). ISSN 0955-7997.
31. SLÁDEK, Ján - SLÁDEK, Vladimír - SCHANZ, M. The MLPG applied to porous materials with variable stiffness and permeability. In *Meccanica*, 2014, vol. 49, p. 2359-2373. (1.815 - IF2013). (2014 - Current Contents). ISSN 0025-6455.
32. SLÁDEK, Ján - SLÁDEK, Vladimír - SCHANZ, M. A meshless method for axisymmetric problems in continuously nonhomogeneous saturated porous media. In *Computers and Geotechnics*, 2014, vol. 62, p. 100-109. (1.647 - IF2013). (2014 - Current Contents). ISSN 0266-352X.
33. SOARES, D., Jr. - SLÁDEK, Vladimír - SLÁDEK, Ján. Modified meshless local Petrov-Galerkin formulations for elastodynamics. In *International Journal for Numerical Methods in Engineering*, 2012, vol. 90, iss. 12, p. 1508–1528. (2.009 - IF2011). (2012 - Current Contents). ISSN 0029-5981.
34. WÜNSCHE, Michael - ZHANG, Ch. - SLÁDEK, Ján - SLÁDEK, Vladimír - SAEZ, A. - GARCIA SANCHEZ, F. The influences of non-linear electrical, magnetic and mechanical boundary conditions on the dynamic intensity factors of magneto-electroelastic solids. In *Engineering Fracture Mechanics*, 2013, vol. 97, p. 297-313. (1.413 - IF2012). (2013 - Current Contents). ISSN 0013-7944.
35. ŽIVICA, Vladimír - PALOU, Martin T. - IFKA, Tomáš - BÁGEL, Ľubomír. High strength metalhalloysite based geopolymer. In *Composites Part B: Engineering*, 2014, vol. 57, p. 155-165. (2.602 - IF2013). (2014 - Current Contents). ISSN 1359-8368.
36. ŽIVICA, Vladimír - PALOU, Martin T. Physico-chemical characterization of thermally treated bentonite. In *Composites Part B: Engineering*, 2015, vol. 68, p. 436-445. (2.983 - IF2014). (2015 - Current Contents). ISSN 1359-8368.

### 2.1.3 List of monographs/books published abroad

DARULA, Stanislav - ASHDOWN, I. - BARTZOKAS, A. - BISEGNA, F. - DUMORTIER, D. - GREENUP, P. - KAMBEZIDIS, H.D. - KENDRICK, D. - KITTLER, Richard - KOBAY, M. - KOGA, Y. - LO VERSO, V. R. M. - MARDALJEVIC, J. - MARKOU, M.T. - NG, E. - ROY, G. - UETANI, Y. - WITTKOPF, S. *Technical Report - CIE Standard General Sky Guide*. Recenzent P. Zwick. Vienna : CIE Central Bureau, 2014. 78 p. ISBN 978-3-902842-54-1.

DULLA, Matúš. *Kapitoly z historie bydlení* [Chapters from the History of Housing]. Praha: Nakladatelství ČVUT, 2014. 279 s. ISBN 978-80-01-05433-8.

KITTLER, Richard - KOCIFAJ, Miroslav - DARULA, Stanislav. *Daylight Science and Daylighting Technology*. New York Dordrecht Heidelberg London : Springer Science+Business Media, LLC, 2012. 341 p. ISBN 978-1-4419-8815-7.

RADU, Adrian - BARREIRA, Eva - SABER, Hamed - HENS, Hugo - VINHA, Juha - VASILACHE, Maricica - BOMBERG, Mark - KORONTHÁLYOVÁ, Oľga - MATIAŠOVSKÝ, Peter - BECKER, Rachel - KALAMEES, Targo - PEIXOTO DE FREITAS, Vasco - MAREF, Wahid. *Heat, air and moisture transfer terminology - Parameters and concepts*. Porto : FEUP edições, 2012. 52 p. ISBN 978-972-752-147-0.

#### 2.1.4. List of monographs/books published in Slovakia

ANDRÁŠIOVÁ, Katarína - BELIČKOVÁ, Katarína - BEŇUŠKOVÁ, Zuzana - BOBULOVÁ, Lenka - MLÁDEK-RAJNIAKOVÁ, Jana - NOVÁKOVÁ, Katarína - OLŠAVSKÁ, Miriam - PARÍKOVÁ, Magdaléna - PROFANTOVÁ, Zuzana - ŠEBO, Dušan. *Žili sme v socializme I. : kapitoly z etnológie každodennosti* [We Used to Live in Socialism I: Chapters from the Ethnology of Daily Life]. Bratislava : Ústav etnológie SAV, 2012. 350 s. ISBN 978-80-88997-49-8.

JANOTKA, Ivan - BERGMEISTER, K. - BÁGEL', Ľubomír - HALAŠA, Igor - JENTSCH, Tobias - KULIFFAYOVÁ, Marta - LETOVANCOVÁ, Zuzana - MARKO, Július - NAJDENÁ, Iveta - PROKEŠOVÁ, Katarína - ŠEVČÍK, Patrik - SMRČKOVÁ, Eva - ŠPAČEK, Antonín - VOIT, K. - ZELLER, H. *ENVIZEO Využitie ekocementov CEM V/ (A, B) druhu podľa EN 197-1 v konštrukčnom betóne* = Nutzung der Ökozementsorten CEM V (A, B) gemäß EN 197-1 in Konstruktionsbeton. Bratislava : Technický a skúšobný ústav stavebný, 2012. 154 s. ISBN 978-80-971296-9-9.

MORAVČÍKOVÁ, Henrieta. *Friedrich Weinwurm : architekt / architect*. Bratislava : Slovart, 2014. 373 s. ISBN 9788055611587.

POHANIČOVÁ, Jana - DULLA, Matúš. *Michal Milan Harminc – architekt dvoch storočí/architect of two centuries. 1869-1964*. Bratislava : Trio publishing, 2014. 184 s. ISBN 978-80-8170-003-3.

SZALAY, Peter - HABERLANDOVÁ, Katarína - ANDRÁŠIOVÁ, Katarína - BARTOŠOVÁ, Nina. *Moderná Bratislava 1918 – 1939* [Modern Bratislava 1918 – 1939]. Recenzenti Matúš Dulla, Elena Alexy. 1. vyd. Bratislava : Marenčin PT, 2015. 319 s. Bratislava-Pressburg. ISBN 978-80-8114-327-4.

#### 2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items

Several subjects have been elaborated compactly within informal foreign cooperation:

(i) Numerical simulations in self-organizing systems

SHIRZADI, A. - SLÁDEK, Vladimír - SLÁDEK, Ján. A local integral equation formulation to solve coupled nonlinear reaction- diffusion equations by using moving least square approximation. In *Engineering Analysis with Boudary Elements*, 2013, vol. 37, p. 8-14. (1.596 - IF2012). (2013 - Current Contents). ISSN 0955-7997.

SHIRZADI, A. - SLÁDEK, Vladimír - SLÁDEK, Ján. A meshless simulations for 2D nonlinear reaction-diffusion Brusselator system. In *CMES: Computer Modeling in Engineering & Sciences*, 2013, vol. 95, no. 4, p. 259-282. (0.849 - IF2012). (2013 - Current Contents). ISSN 1526-1492.

SLÁDEK, Vladimír - SLÁDEK, Ján - SHIRZADI, A. The local integral equation method for pattern formation simulations in reaction-diffusion systems. In *Engineering Analysis with Boudary Elements*, 2015, vol. 50, p. 329-340. (1.392 - IF2014). (2015 - Current Contents). ISSN 0955-7997.

(ii) Numerical study of piezoelectric and magneto-electro-elastic coupling effects in structural elements

SLÁDEK, Ján - SLÁDEK, Vladimír - KRAHULEC, Slavomír - PAN, E. Analyses of functionally graded plates with a magneto-electroelastic layer. In *Smart Materials & Structures*, 2013, vol. 22, no. 3, art. no. 035003. (2.024 - IF2012). (2013 - Current Contents). ISSN 0964-1726.

SLÁDEK, Ján - SLÁDEK, Vladimír - KRAHULEC, Slavomír - PAN, E. The MLPG analyses of large deflections of magneto-electroelastic plates. In *Engineering Analysis with Boudary Elements*, 2013, vol. 37, no. 4, p. 673-682. (1.596 - IF2012). (2013 - Current Contents). ISSN 0955-7997.

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. (1.662 - IF2013). (2014 - Current Contents). ISSN 0013-7944.

(iii) Electromagnetic resonances in nano- and micro-sized particles

KLAČKA, Jozef - KOCIFAJ, Miroslav - KUNDRACIK, F. - VIDEEN, Gorden - KOHÚT, Igor. Generalization of electromagnetic scattering by charged grains through incorporation of interband and intraband effects. In *Optics Letters*, 2015, vol. 40, no. 21, p. 5070-5073. (3.292 - IF2014). (2015 - Current Contents). ISSN 0146-9592.

KOCIFAJ, Miroslav - VIDEEN, Gorden - KLAČKA, Jozef. Backscatter in a cloudy atmosphere as a lightning-threat indicator. In *Journal of Quantitative Spectroscopy & Radiative Transfer*, 2015, vol. 150, p. 175-180. (2.645 - IF2014). (2015 - Current Contents). ISSN 0022-4073.

KLAČKA, Jozef - KOCIFAJ, Miroslav - KUNDRACIK, F. - VIDEEN, Gorden. Optical signatures of electrically charged particles: Fundamental problems and solutions. In *Journal of Quantitative Spectroscopy & Radiative Transfer*, 2015, vol. 164, p. 45-53. (2.645 - IF2014). (2015 - Current Contents). ISSN 0022-4073.

KUNDRACIK, F. - KOCIFAJ, Miroslav - VIDEEN, Gorden - KLAČKA, Jozef. Effect of charged-particle surface excitations on near-field optics. In *Applied Optics*, 2015, vol. 54 no. 22, p. 6674-6681. (1.784 - IF2014). (2015 - Current Contents). ISSN 0003-6935.

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

Patent applications registered in European Union:

PCT/SK2014/000020, Method of isolation of circulating cells from the peripheral blood (Kocifaj Miroslav, Mego Michal), co-owners: ÚSTARĤ SAV + Univerzita Komenského

PCT/SK2014/000024, Method and Apparatus for Lightning Threat Indication (Kocifaj Miroslav, Klačka Jozef, Videen Gorden), co-owners: ÚSTARĤ SAV + Videen Gorden + Univerzita Komenského

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

Patent applications registered in Slovakia:

PV: 00092-2013, Method of isolation of circulating cells from the peripheral blood (Kocifaj Miroslav, M. Mego), co-owners: ÚSTARĤ SAV + Univerzita Komenského

PV: 00114-2013, Method and Apparatus for Lightning Threat Indication (Kocifaj Miroslav, Klačka Jozef, Videen Gorden), coowners: ÚSTARĤ SAV + Videen Gorden + Univerzita Komenského

PV: 50064-2014, Method and system for 3D reconstruction of fine structure with use of RTG tomography combined with elastic scattering (Kocifaj Miroslav, Mego Michal), coowners: ÚSTARĤ SAV + Univerzita Komenského

PV: 05010-2014, Capsule for targeted application of the pharmaceutical agent and method its release out of the capsule (Kocifaj Miroslav, Mego Michal) co-owners: ÚSTARĤ SAV + Národný onkologický ústav

Patent registered in Slovakia:

PV: SK 288311 B6, Thermal insulation system and method of its application (Matiašovský Peter, Bágeľ Ľubomír), owner ÚSTARĤ SAV

### 2.1.8. Table of research outputs (as in annual reports).

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	2012			2013			2014			2015			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad (AAA, ABA)	2,0	0,073	0,004	0,0	0,000	0,000	2,0	0,068	0,004	0,0	0,000	0,000	4,0	1,0	0,035	0,002
Scientific monographs and monographic studies in journals and proceedings published in Slovakia (AAB, ABB)	2,0	0,073	0,004	0,0	0,000	0,000	2,0	0,068	0,004	1,0	0,036	0,002	5,0	1,3	0,044	0,002
Chapters in scientific monographs published abroad (ABC)	0,0	0,000	0,000	5,0	0,164	0,010	14,0	0,476	0,025	0,0	0,000	0,000	19,0	4,8	0,166	0,009
Chapters in scientific monographs published in Slovakia (ABD)	1,0	0,036	0,002	8,0	0,263	0,017	0,0	0,000	0,000	0,0	0,000	0,000	9,0	2,3	0,078	0,004
Scientific papers published in journals registered in Current Contents Connect (ADCA, ADCB, ADDA, ADDB)	24,0	0,874	0,048	34,0	1,118	0,071	23,0	0,782	0,041	45,0	1,637	0,077	126,0	31,5	1,098	0,059
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS (ADMA, ADMB, ADNA, ADNB)	7,0	0,255	0,014	6,0	0,197	0,012	13,0	0,442	0,023	6,0	0,218	0,010	32,0	8,0	0,279	0,015
Scientific papers published in other foreign journals (not listed above) (ADEA, ADEB)	9,0	0,328	0,018	7,0	0,230	0,015	8,0	0,272	0,014	12,0	0,436	0,021	36,0	9,0	0,314	0,017
Scientific papers published in other domestic journals (not listed above) (ADFA, ADFB)	18,0	0,655	0,036	8,0	0,263	0,017	14,0	0,476	0,025	8,0	0,291	0,014	48,0	12,0	0,418	0,023
Scientific papers published in foreign peer-reviewed proceedings (AEC, AECA)	31,0	1,129	0,063	29,0	0,954	0,060	33,0	1,121	0,058	3,0	0,109	0,005	96,0	24,0	0,836	0,045
Scientific papers published in domestic peer-reviewed proceedings (AED, AEDA)	22,0	0,801	0,044	28,0	0,921	0,058	10,0	0,340	0,018	8,0	0,291	0,014	68,0	17,0	0,592	0,032
Published papers (full text) from foreign and international scientific conferences (AFA, AFC, AFBA, AFDA)	9,0	0,328	0,018	2,0	0,066	0,004	1,0	0,034	0,002	22,0	0,800	0,038	34,0	8,5	0,296	0,016
Published papers (full text) from domestic scientific conferences (AFB, AFD, AFBB, AFDB)	0,0	0,000	0,000	2,0	0,066	0,004	1,0	0,034	0,002	2,0	0,073	0,003	5,0	1,3	0,044	0,002

- **Supplementary information and/or comments on the scientific outputs of the institute.**

The Impact Factor (IF) of scientific journals registered in WOS and Scopus in which research articles were published, ranges from 0.367 to 7.714, the average value of the IF is **1.944**, and median IF is **1.604**. It is interesting to compare these values with Median Impact Factor (MIF) for subject categories in which the scientific research and PhD study at the Institute predominates. According to the JRC Science Edition for years 2011-2014 the average values of the MIF for particular subjects are given as: 1.159 for Mechanics; 0.756 for Applied Mathematics; 1.205 for Physics multidisciplinary; 1.311 for Optics; 1.259 for Applied Chemistry; 0.784 for Materials Science, Composites; 0.544 for Materials Science, Ceramics; 0.837 for Civil Engineering; 0.839 for Mechanical Engineering; 0.745 for Construction & Building Technology. The overall average MIF for considered subjects is **0.944**. Among the total 119 impacted publications, there were 19 publications with IF higher than 3.000 and 25 publications with  $2 < IF < 3$ . One can see that the Institute is oriented on high quality research outputs.

## 2.2. Responses to the research outputs (citations, etc.)

### 2.2.1. Table with citations per annum.

*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) have to be listed separately.*

Citations, reviews	2011		2012		2013		2014		total		
	number	No. / FTE	number	averaged number per year	av. No. / FTE						
Citations in Web of Science Core Collection (1.1, 2.1)	398,0	14,494	386,0	12,693	459,0	15,596	460,0	16,730	1703,0	425,8	14,835
Citations in SCOPUS (1.2, 2.2) if not listed above	64,0	2,331	53,0	1,743	31,0	1,053	58,0	2,109	206,0	51,5	1,794
Citations in other citation indexes and databases (not listed above) (3.2,4.2,9,10)	0,0	0,000	0,0	0,000	0,0	0,000	0,0	0,000	0,0	0,0	0,000
Other citations (not listed above) (3, 4, 3.1, 4.1)	116,0	4,224	114,0	3,749	49,0	1,665	42,0	1,527	321,0	80,3	2,796
Reviews (5,6)	3,0	0,109	0,0	0,000	1,0	0,034	1,0	0,036	5,0	1,3	0,044

### 2.2.2. List of 10 most-cited publications, with number of citations, in the assessment period (2011 – 2014).

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. (38 citations)

DULLA, Matúš - MORAVČÍKOVÁ, Henrieta. *Architektúra Slovenska v 20. storočí*. Bratislava : Slovart, 2002. 511 s. ISBN 80-7145-684-5. (36 citations)

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. (33 citations)

BALAŠ, Ján - SLÁDEK, Ján - SLÁDEK, Vladimír. *Stress Analysis by Boundary Element Methods*. Amsterdam - Bratislava, 1989. (33 citations)

ŽIVICA, Vladimír. Effects of the very low water/cement ratio. In *Construction and Building Materials*, 2009, vol. 23, no.12, p. 3579-3582. (0.947 - IF2008). (2009 - Thomson Reuters Master Journal List). ISSN 0950-0618. (32 citations)

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. (30 citations)

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. (0.506 - IF2006). (2007 - Thomson Reuters Master Journal List). ISSN 0950-0618. (27 citations)

SLÁDEK, Ján - SLÁDEK, Vladimír - HELLMICH, Ch. - EBERHARDSTEINER, J. Heat conduction analysis of 3-D axisymmetric and anisotropic FGM bodies by meshless local Petrov-Galerkin method. In *Computational Mechanics*, 2007, vol. 39, no. 3, p. 323-333. (1.087 - IF2006). (2007 - Current Contents). ISSN 0178-7675. (25 citations)

SLÁDEK, Ján - SLÁDEK, Vladimír - TAN, C. L. - ATLURI, S. N. Analysis of transient heat conduction in 3D anisotropic functionally graded solids, by the MLPG method. In *CMES: Computer Modeling in Engineering & Sciences*, 2008, vol. 32, iss. 3, p. 161-174. (1.653 - IF2007). (2008 - Current Contents). ISSN 1526-1492. (25 citations)

SLÁDEK, Ján - SLÁDEK, Vladimír - ATLURI, S. N. Meshless local Petrov-Galerkin method for heat conduction problem in an anisotropic medium. In *CMES: Computer Modeling in Engineering & Sciences*, 2004, vol. 6, no. 3, p. 309-318. (1.957 - IF2003). (2004 - Current Contents). ISSN 1526-1492. (24 citations)

### 2.2.3. 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 (2011–2014).

	2011-2014	2011	2012	2013	2014
SLÁDEK, Ján	<b>964 cit.</b>	242 cit.	214 cit.	242 cit.	266 cit.
SLÁDEK, Vladimír	<b>964 cit.</b>	242 cit.	214 cit.	242 cit.	266 cit.
JANOTKA, Ivan	<b>275 cit.</b>	67 cit.	102 cit.	53 cit.	53 cit.
DARULA, Stanislav	<b>251 cit.</b>	70 cit.	35 cit.	74 cit.	72 cit.

- **Supplementary information and/or comments on responses to the scientific output of the institute.**

List of five employees with highest Hirsch index according to WOS:

SLÁDEK, Ján: h = 31;                      SLÁDEK, Vladimír: h = 31;  
 JANOTKA, Ivan: h = 13;                      KOCIFAJ, Miroslav: h = 13;                      ŽIVICA, Vladimír: h = 11.

## **2.3. Research status of the institute in international and national contexts**

### **• 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.**

IEA Energy in Buildings and Community Programme Annex 55 RAP-RETRO “Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost”.

COST Action ES1204 “Loss of the Night Network (LoNNe)”.

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

Project: U.S. Army W911NF-14-1-0601, “Scattering of Electromagnetic Radiation by Electrically Charged and Neutral Particles: Similarities and Fundamental Differences”.

IEA Energy in Buildings and Community Programme Annex 55 RAP-RETRO “Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost”.

IEA Solar Heating and Cooling Programme Task 50 “Advanced lighting solutions for retrofitting buildings”.

The South East Europe Transnational Cooperation Programme SEE/B/0009/4.3/X ATRIUM “Architecture of Totalitarian Regimes of the 20th Century in Urban Management”.

Cross Border Cooperation Programme Slovakia – Austria 2007-2013 project ENVIZEO “Applications of ecocements CEM V (A, B) kind according to EN 197-1 in structural concrete”.

Project of the bilateral scientific cooperation between Slovak Academy of Sciences and National Science Council, Republic of China (Taiwan) „Applications of meshless methods in computational mechanics“.

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

(RE)thinking architecture: Modern and totalitarian in Žilina architecture; International scientific colloquium; Žilina, Slovakia; 25 Oct. 1012.

Light Pollution Theory, Modelling and Measurements; Smolenice, Slovakia; 15 – 18 April 2013.

(Re)thinking architecture: How to present the historical heritage of Modernism? International conference; Žilina, Slovakia; 29 – 30 April 2013.

Optical Characterization of Atmospheric Aerosols; Smolenice, Slovakia; 5 – 7 November 2013.

Reworking Modern Movement Architecture; Bratislava, Slovakia; 21 – 24 November 2013.

International Conference on Light Pollution Theory, Modelling and Measurements; Jouvence, Québec, Canada; 26 – 28 May 2015.

#### **2.3.3. List of edited proceedings from international scientific conferences.**

#### **2.3.4. List of journals edited/published by the institute:**

##### **2.3.4.1. WOS (IF of journals in each year of the assessment period)**

Architektúra & Urbanizmus. Journal of Architectural and Town-planning Theory (Indexed and abstracted in Arts and Humanities Citation Index and Current Contents/Arts & Humanities, where Impact factor is not followed and no JCR is published). WOS, SCOPUS. Issued quarterly. ISSN 0044-8680.

##### **2.3.4.2. SCOPUS**

##### **2.3.4.3. other databases**

##### **2.3.4.4. not included in databases**

Building Research Journal. Editor in-chief Peter Matiašovský. Bratislava: Institute of Construction and Architecture Slovak Academy of Sciences. Change of title since Vol. 42, 1994. Issued quarterly. ISSN 1335-8863.

- **National position of the institute**

- 2.3.5. List of selected projects of national importance**

Unified system of sky luminance patterns characterizing daylight availability and conditions in urban spaces, APVV-0177-10, 05/2011 - 10/2014, Coordinator.

Probabilistic modelling of hygro-thermal performance of buildings, APVV-0031-10, 05/2011 - 10/2014, Coordinator.

Differentiated typology of modernism: the theoretical basis for maintenance and conservations of works of modern architecture, APVV-0375-10, 05/2011 - 10/2014, Coordinator.

Optimal design of smart composite materials, APVV-0014-10, 05/2011 - 10/2014, Coordinator.

Numerical simulations of multifield problems in multiphase porous media, APVV-0032-10, 05/2011 - 10/2014, Coordinator.

Generalized skyglow model and its application to retrieval of city emission function, APVV-14-0017, 07/2015 - 12/2018, Coordinator.

Multiscale modelling of coupled fields in composite materials, APVV-14-0216, 07/2015 - 12/2018, Coordinator.

Multiphysical problems in functionally graded material plates, APVV-14-0440, 07/2015 - 06/2019, Coordinator.

- 2.3.6. Projects of the Slovak Research and Development Agency (APVV)**

Unified system of sky luminance patterns characterizing daylight availability and conditions in urban spaces, APVV-0177-10, 05/2011 - 10/2014, Coordinator.

Probabilistic modelling of hygro-thermal performance of buildings, APVV-0031-10, 05/2011 - 10/2014, Coordinator.

Differentiated typology of modernism: the theoretical basis for maintenance and conservations of works of modern architecture, APVV-0375-10, 05/2011 - 10/2014, Coordinator.

Optimal design of smart composite materials, APVV-0014-10, 05/2011 - 10/2014, Coordinator.

Numerical simulations of multifield problems in multiphase porous media, APVV-0032-10, 05/2011 - 10/2014, Coordinator.

Wind action in structural engineering, APVV-0179-10, 05/2011 - 10/2013, Coordinator.

Simulation of daylight in artificial sky, APVV-0118-12, 10/2013 - 12/2016, Coordinator.

Generalized skyglow model and its application to retrieval of city emission function, APVV-14-0017, 07/2015 - 12/2018, Coordinator.

Multiscale modelling of coupled fields in composite materials, APVV-14-0216, 07/2015 - 12/2018, Coordinator.

Multiphysical problems in functionally graded material plates, APVV-14-0440, 07/2015 - 06/2019, Coordinator.

Experimental and theoretical analysis of water vapour sorption in structural materials, SK-CZ-2013-0052, 01/2015 - 12/2015, Coordinator.

- 2.3.7. Projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)**

Research of quantitative and qualitative daylighting characteristics in buildings, 2/0029/11, 01/2011 - 12/2013, Coordinator.

Optical characterization of non-spherical atmospheric particles and retrieval of their microphysical properties, 2/0002/12, 01/2012 - 12/2015, Coordinator.

Effective moisture capacity of building materials under dynamic conditions, 2/0159/10, 01/2010 - 12/2012, Coordinator.

Progressive ternary blended cement systems with high-performance properties for material technologies and hydrothermal conditions, 2/0064/12, 01/2012 - 12/2014, Coordinator.

Determination of parameters of interaction at strengthening of reinforced concrete elements with regard to rheological properties, 2/0143/12, 01/2012 - 12/2014, Coordinator.

Values of modern architecture in Slovakia: specification and possibilities of protection, 2/0171/10, 01/2010 - 12/2012, Coordinator.

Influence of imperfections on resistance of structural members and load-bearing structures of machines, 1/0090/12, 01/2012 - 12/2014, Investigator.

Moisture transfer and accumulation in building materials under service conditions, 2/0145/13, 01/2013 - 12/2015, Coordinator.

Computational methods for fracture analyses of quasicrystal materials, 2/0011/13, 01/2013 - 12/2016, Coordinator.

Research of envelope construction influences on luminous and thermal environment in attic spaces, 2/0117/14, 01/2014 - 12/2016, Coordinator.

Industrial Heritage - Theory and Methodology of Protection of Bratislava Region Research, 2/0095/14, 01/2014 - 12/2016, Coordinator.

Modelling of post-buckling behaviour and strength of thin-walled cold formed columns, 2/0154/15, 01/2015 - 12/2018, Coordinator.

Influence of repeated and long - term loading on interaction of parameters at reconstruction of reinforced concrete elements, 2/0033/2015, 01/2015 - 12/2018, Coordinator.

High porous inorganic materials for thermal insulating applications, 1/0696/15, 01/2015 - 12/2018, Investigator.

Modern town-planning concepts and traditional town: analysis of conflicts and coexistences, 2/0036/2014, 01/2014 - 12/2016, Coordinator.

Synthesis and characterization of chemically bonded phosphate ceramic binders, 2/0082/14, 01/2014 - 12/2016, Coordinator.

### **2.3.8. Projects of SAS Centres of Excellence**

Castles in Slovakia. Interdisciplinary cross-sectional view on the castle phenomenon. Centre of Excellence of the Slovak Academy of Sciences (project Coordinator Institute of History SAS)

### **2.3.9. National projects supported by EU Structural Funds**

Building the centre of excellence for research and development of structural composite materials – 2nd stage, 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, 07/2010 – 12/2012, W/P. Matiašovský.

### **2.3.10. List of journals (published only in the Slovak language) edited/published by the institute:**

**2.3.10.1. WOS (IF of journals in each year of the assessment period)**

**2.3.10.2. SCOPUS**

**2.3.10.3. Other databases**

**2.3.10.4. Not included in databases**

Urbanita, Pamiatky modernej architektúry (Urbanita, Monuments of modern architecture): journal on town planning. Editor Katarína Andrášiová. Bratislava: Ministry of Transport, Construction and Regional Development of the Slovak Republic, July 2015. Issued quarterly. ISSN 0139-5912.

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

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

SLÁDEK, Vladimír – SLÁDEK, Ján: Improved formulations for transient heat conduction by mesh-free methods, Int. Conf. on Computational & Experimental Engineering and Sciences ICCES' 2012, Crete, Greece, 30 April - 4 May 2012.

SLÁDEK, Ján – SLÁDEK, Vladimír – KRAHULEC, Slavomír – E. Pan: The MLPG analyses for composites with piezoelectric and piezomagnetic phases, Int. Conf. on Computational & Experimental Engineering and Sciences ICCES' 2012, Crete, Greece, 30 April - 4 May 2012.

SLÁDEK, Vladimír – SLÁDEK, Ján – SATOR, Ladislav: Meshless implementations of Local Integral Equations for bending of thin plates, In: Boundary Elements and other Mesh Reduction Methods XXXIV (C.A. Brebbia, D. Poljak, eds.), WIT Press, Southampton, 2012, pp. 15-26.

SLÁDEK, Ján – SLÁDEK, Vladimír – Ch. Zhang: Local integral equation method for prediction of effective magneto-electroelastic moduli in functionally graded composites, Ecomas 2012-European Congress on Computational Methods in Applied Sciences and Engineering, Vienna, Austria, 10 - 14 September 2012, pp. 284-284, <http://ecomas2012.conf.tuwien.ac.at>.

SZALAY, Peter: A Heritage of Totalitarianism? Slovak Postwar Modernism and Its Current Perception. 17. 3. 2012, Uncomfortable Architectural Heritage of Socialism, Berlin, German Historical Museum.

KOCIFAJ Miroslav: Modeling the night-sky radiances and inversion of multiangle and multispectral radiance data, Light Pollution: Theory, Modelling, and Measurements, April 15-18 2013, Smolenice.

KOCIFAJ Miroslav: Modelling the night sky radiances under broken cloud arrays, International Conference on Optical Characterization of Atmospheric Aerosols, November 5-7, 2013, Smolenice.

SLÁDEK, Vladimír – SLÁDEK, Ján – SATOR, Ladislav: Meshless formulations for bending of thin plates with variable stiffness, ICCES'13 - International Conference On Computational and Experimental Engineering & Sciences, May 24-28, 2013, Seattle, USA

SLÁDEK, Vladimír – SLÁDEK, Ján – SATOR, Ladislav: Analysis of FGM thin elastic plates by mesh-free methods, 5th Asia Pacific Congress on Computational Mechanics & 4th International Symposium on Computational Mechanics, December 11-14, 2013, Singapore

SLÁDEK, Ján – SLÁDEK, Vladimír – E. Pan: Modelling of porous piezoelectric structures by the MLPG, ICCES'13 - International Conference On Computational and Experimental Engineering & Sciences, May 24-28, 2013, Seattle, USA.

SLÁDEK, Ján – SLÁDEK, Vladimír: Modelling of smart materials by meshless methods, Machine Modelling and Simulations, Oščadnica, September 2013.

KOCIFAJ Miroslav: Modelling and inversion of night sky radiances. University of Vienna, 26. 5. 2014, Vienna.

MORAVČÍKOVÁ, Henrieta: Friedrich Weinwurm and his contribution to the engaged thinking in architecture. Invited lecture hold within the series of lectures organised by Research and documentation centre of the Villa Tugendhat, Vila Tugendhat, Brno, 26. 05. 2014.

SLÁDEK, Ján – SLÁDEK, Vladimír: Bending analysis of porous plates by the MLPG, ICCES'14 - International Conference On Computational and Experimental Engineering & Sciences, June 12-17, 2014, Changwon, Korea.

SLÁDEK, Ján – SLÁDEK, Vladimír: Meshless Analyses of Quasicrystal Structures, The 5th Workshop on Boundary Element and Related Methods in Taiwan, October 4-5, 2014, Kaohsiung, Taiwan.

SLÁDEK, Vladimír – SLÁDEK, Ján: Completely de-singularized indirect BEM formulation in elasticity, ICCES'14 - International Conference On Computational and Experimental Engineering & Sciences, June 12-17, 2014, Changwon, Korea.

SLÁDEK, Vladimír – SLÁDEK, Ján – SATOR, Ladislav: The study of porous elastic plates by mesh-free methods, BEM/MRM 37 - Int. Conf. on Boundary Elements and other Mesh Reduction Methods, September 8-10, 2014, New Forest, UK.

SLÁDEK, Vladimír – SLÁDEK, Ján: Pattern formation simulations in reaction-diffusion systems by local integral equation method with meshless approximations, The 5th Workshop on Boundary Element and Related Methods in Taiwan, October 4-5, 2014, Kaohsiung, Taiwan.

MORAVČÍKOVÁ, Henrieta: Bratislava, capital of Mass Housing. Invited lecture hold within the program of the international exhibition *Lifting the Curtain. Central European Architecture networks*. Faculty of Architecture University of Belgrade, 10.6.2015

SLÁDEK, Vladimír – SATOR, Ladislav – SLÁDEK, Ján: Multiple gradations coupling effects in bending of thin elastic plates, Int. Conf. on Boundary Element Method and Mesh Reduction Methods (BEM/MRM 38), 21-23 Sept. 2015, New Forest, UK.

SLÁDEK, Ján – SLÁDEK, Vladimír – P. L. Bishay – S. Hrcek: The MLPG method for Cowin-Nunziato's model of porous elastic materials, Int. Conf. on Comput. & Exper. Engn. And Sciences, 20-24 July 2015, Reno, USA.

### **2.3.12. List of researchers who served as members of the organising and/or programme committees**

BARTOŠOVÁ, Nina – member of organising committee, Science under construction, Bratislava 2012.

DARULA, Stanislav – member of programme committee (CLIMA 2013 - 11th REHVA World Congress, Prague 2013; Light 2013, Podbanské 2013; Int. conf. Lumen V4, Budapest 2014; 6th Int. Building Physics Conference, Torino 2015; Int. Light Conference 2015, Brno 2015).

KOCIFAJ, Miroslav – co-director of programme/organising committee (Light Pollution: Theory, Modelling, and Measurements, Smolenice 2013; Optical Characterization of Atmospheric Aerosols, Smolenice 2013); member of programme committee, Light Pollution: A New Frontier, Santiago de Compostela 2015; convener of Light Pollution Theory, Modelling and Measurements, Quebec 2015.

MATIAŠOVSKÝ, Peter – vice-chair of programme committee, 2nd Central European Symposium on Building Physic, Vienna 2013; member of programme committee (Nordic Symposium on Building Physics 2014, Lund 2014; Thermophysics 2015, Terchová 2015).

MORAVČÍKOVÁ, Henrieta – chairwoman of programme committee ((Re)thinking architecture: Moderné a totalitné v žilinskej architektúre 20. storočia, Žilina 2012; Science under construction Bratislava 2012).

SLÁDEK, Ján – member of programme committee (ICCES 12, Creta 2012; ICCES MM Meshless methods, Montenegro 2012; Int. Conference on Boundary Element Technique XIII, Praha 2012; CCES'14 - International Conference on Computational and Experimental Engineering & Sciences, June 12-17, 2014, Changwon, Korea; Int. Conf. on Comput. & Exper. Engn. and Sciences, 20-24 July 2015, Reno, USA).

SLÁDEK, Vladimír – organizator of minisymposium, European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2012), Vienna 2012; member of programme/organising committee, Int. conf. BEM/MRM 34, Split 2012; memembr of programme committee (Int. conf. on Boundary Element and Meshless Techniques XIV, Paris 2013; Int. conf. BEM/MRM 35, New Forest 2013).

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

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

DARULA, Stanislav – KÓMAR, Ladislav – R. Kittler: Parametrizácia vertikálnych osvetleností (Parametrisation of vertical luminances). Conf. Lumen V4, 26. - 28. 9. 2012, Bratislava, p. 74-85.

DARULA, Stanislav: EN kritéria pre hodnotenie denného osvetlenia v budovách (EN criteria for assessment of daylighting in Buildings). LIGHT 2013, 23. - 25. 10. 2013, Podbanské.

MORAVČÍKOVÁ, Henrieta: Architektúra koncernu Baťa ako činiteľ modernizácie: príklad Slovensko (Architecture of Bata Concern as modernisation factor). Sympóziu s medzinárodnou účasťou, Partizánske, 21. 10. 2015

SZALAY, Peter: Od Prešporka po Bratislavu - Urbanistický vývoj na pozadí spoločenských zmien pred a po I. svetovej vojne (From Prespork to Bratislava – Urban development on background of social changes). Konferencia Veľká vojna a Bratislavská župa, 30. 9. 2014, Zochova chata, Modra.

- 2.3.14. List of researchers who served as members of organising and programme committees of national conferences**

DARULA, Stanislav – member of programme/organising committee, Lumen V4, Bratislava 2012.

- **Supplementary information and/or comments documenting the international and national status of the Institute**

*List of significant cooperating foreign universities and institutions:*

Univeristy of Siegen, Siegen, Germany; National Taiwan Univ., Taipei, Taiwan; Technical Univ. Vienna, Austria; City University of Hong Kong, Hong Kong; University of New South Wales, Sydney, Australia; UCI, Irvine, USA; Univ. of Coimbra, Coimbra, Portugal; Univ. of Akron, Akron, USA; Graz Univ. of Technology, Graz, Austria; Ferdowsi univ. of Mashhad; Katholieke Universiteit, Leuven, Netherlands; Univ. of Technology, Brno, Czechia; Czech Technical Univ. in Prague, Czechia; Academy of Fine Arts in Prague, Czechia; Ion Mincu University of Architecture and Urbanism, Bucharest, Romania; Politecnico di Milano, Milano, Italy; Frankfurt University of Applied Sciences, Frankfurt am Main, German; German Cement Works Association, Düsseldorf, Germany; IRCELYON – Institut de recherches sur la catalyse et l'environnement de Lyon, Lyon, France.

*List of significant domestic universities and institutions:*

Comenius University, Bratislava; Slovak Technical Univ., Bratislava; Technical Univ. Košice, Košice; Univ. of Žilina, Žilina; Slovak Hydrometeorological Institute, Bratislava.

*Members/editors of editorial boards of international scientific journals:*

S. DARULA – Light and Engineering;  
M. DULLA – Architektúra & urbanizmus (chairman);  
M. KOCIFAJ – Journal of Quantitative Spectroscopy & Radiative Transfer (corresponding ed.),  
Lighting Research and Technology (corresponding ed.);  
P. MATIAŠOVSKÝ – Journal of Building Physics, Building Research Journal (ed. chief);  
H. MORAVČÍKOVÁ – Studies in History & Theory of Architecture (Universita Ion Mincu),  
Architektúra & Urbanizmus (ed.);  
Z. SADOVSKÝ – ESRA Newsletter;  
L. SÁTOR – Research on Engineering Structures and Materials (RESM);  
J. SLÁDEK – Electronic Jour. Boundary Elements, Jour. Computational and Applied Mechanics,  
Journal of Multiscale Modelling, SDHM-Structural Durability and Health Monitoring Journal,  
Strojnický časopis, CMES-Computer Modeling in Engineering & Sciences (correspond. ed.);  
V. SLÁDEK – Communications in Numerical Analysis, Int. Jour. Engineering Analysis with  
Boundary Elements, Jour. of Industrial Mathematics and Computational Mechanics,  
Newsletter of the Int. Soc. of Boundary Element Methods, Series Advances in Boundary  
Elements;

- P. SZALAY – A10 (Netherlands) (corresponding member)  
A. TESÁR – Building Research Journal, Positioning (USA), Selected Scientific Papers TU Košice;  
V. ŽIVICA – Revista Romana de materiale.

*Members of important international scientific boards/committees:*

- K. ANDRÁŠIOVÁ – DOCOMOMO International / Documentation and Conservation of Modern Movement;  
Ľ. BÁGEL – CIB / International Council for Research and Innovation in Building and Construction;  
S. DARULA – CIB / International Council for Research and Innovation in Building and Construction, CIE / Commission Internationale de l' Eclairage, ISES / International Solar Energy Society, IBPSA / International Building Performance Simulation Association, Lux Europa Board of Directors;  
M. DULLA – DOCOMOMO International;  
K. HABERLANDOVÁ – DOCOMOMO International;  
M. KOCIFAJ – ISES / International Solar Energy Society, OSA / Optical Society of America;  
O. KORONTHÁLYOVÁ – CIB W40 Heat and Moisture Transfer in Buildings;  
P. MATIAŠOVSKÝ – CIB W40 Heat and Moisture Transfer in Buildings;  
H. MORAVČÍKOVÁ – DOCOMOMO International;  
Z. SADOVSKÝ – ESRA / European Safety and Reliability Association, IABSE / International Association for Bridge and Structural Engineering;  
J. SLÁDEK – Central European Assoc. for Computational Mechanics, ICCES / Int. Soc. Comput. Eng. & Sciences;  
V. SLÁDEK – Central European Assoc. for Computational Mechanics, International Society for Boundary Elements;  
P. SZALAY – DOCOMOMO International;  
M. TOPOLČANSKÁ – DOCOMOMO International;  
A. TESÁR – Inženýrska akadémia Českej republiky.

*Members/editors of editorial boards of national journals:*

- S. DARULA – Projekt a Stavba, VTS News;  
M. DULLA – Arch o architektúre a inej kultúre, Encyclopaedia Beliana;  
P. MATIAŠOVSKÝ – Encyclopaedia Beliana;  
H. MORAVČÍKOVÁ – Alfa (chairwoman);  
M. TOPOLČANSKÁ – Alfa.

*Members of important national scientific boards/committees:*

- S. DARULA – SBkS / Slovenská bioklimatologická spoločnosť pri SAV, SNK CIE, SSTP / Slovenská spoločnosť pre techniku prostredia, SSTS / Slovenská svetelnotechnická spoločnosť, ZSVTS;  
M. KOCIFAJ – CIE Div5 (TC 5-28), Slovenská Astronomická Spoločnosť;  
L. KÓMAR – SSTS;  
O. KORONTHÁLYOVÁ – SFS / Slovenská fyzikálna spoločnosť, SSTP;  
M. KRÍŽMA – Slovenský komitét FIB;  
P. MATIAŠOVSKÝ – Slovenská bioklimatologická spoločnosť pri SAV, Slovenská fyzikálna spoločnosť pri SAV, SSTP;  
H. MORAVČÍKOVÁ – DOCOMOMO Slovensko (chairwoman);  
Z. SADOVSKÝ – SSOK / Slovenská spoločnosť pre ocelové konštrukcie;  
J. SLÁDEK – Slovenská spoločnosť pre mechaniku;  
V. SLÁDEK – Slovenská spoločnosť pre mechaniku;  
P. STAŇÁK – Slovenská spoločnosť pre mechaniku;  
P. SZALAY – DOCOMOMO Slovensko; Rada udržateľnosti národnej kultúrnej pamiatky SPU v Nitre.

*Awards:*

- J. SLÁDEK 2012, 1st place for 3-year citation response, Evaluator: Literary fund;  
P. STAŇÁK, Student personality of the Slovakia in academic year 2012/2013, Evaluator: JCI Slovensko, Description: category construction, architecture;  
P. SZALAY, Bauwelt Advancement Award 2013, Evaluator: Bauwelt magazine, Description:

Award for project and study of Neologic synagogue in Žilina;  
 V. SLÁDEK 2014, Plaque of Aurel Stodola, Evaluator: Presidium of SAV;  
 I. JANOTKA 2014, Personality of science and technique, Evaluator: MŠVVŠ SR;  
 M. KRIŽMA, 2014, Award of SNK FIB for lifetime contribution to development of concrete structures in Slovakia, Evaluator: Slovak national committee of FIB  
 J. SLÁDEK, 2014, Distinguished Fellow of ICCES, Evaluator: Committee;  
 V. SLÁDEK, 2014, Distinguished Fellow of ICCES, Evaluator: Committee;  
 L. SÁTOR, Student personality of the Slovakia in academic year 2014/2015, Evaluator: JCI Slovensko, Description: category construction, architecture;  
 H. MORAVČÍKOVÁ, 2015, DAM Architectural Book Award, Evaluator: Deutsches Architekturmuseum, Frankfurt Book Fair, Description: For the seventh time, in 2015 the Frankfurt Book Fair and Deutsches Architekturmuseum (DAM) jointly bestowed the International DAM Architectural Book Award. Now highly respected, the prize, the only one of its kind, honors the 10 best architecture books in a year.

## 2.4. Tables of project structure, research grants and other funding resources

### • International projects and funding

**2.4.1. Major projects within the European Research Area and other important project – Framework Programmes of the EU, ERA-NET, European Science Foundation, NATO, COST, INTAS, etc. (here and in items below please specify: 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”),**

	Project title	Typ / Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute / Responsible person
2012	Initiative Loss of the Night Network	ESSEM COST Action/ES1204	10/2012-10/2016	-	I / M. Kocifaj

### 2.4.2. Other international projects, incl. total funding and funding for the institute

Optical Characterization of Atmospheric Aerosols; Cooperation with US Army International Technology Center; Project W911NF-13-1-0195; 3700 EUR, 08/2013 – 01/2014; C/M. Kocifaj.

Scattering of Electromagnetic Radiation by Electrically Charged and Neutral Particles: Similarities and Fundamental Differences; Cooperation with US Army International Technology Center; W911NF-14-1-0601; 08/2014 – 08/2015; 35 7017 EUR; C/M. Kocifaj.

Applications of meshless methods in computational mechanics; Bilateral scientific; cooperation between Slovak Academy of Sciences and National Science Council, Republic of China (Taiwan); 01/2014 – 12/2015; 34 400 EUR; C/J. Sládek.

### 2.4.3. Other important, international projects and collaborations without direct funding (max. 10 projects)

Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost; IEA Energy in Buildings and Community Programme / Annex 55 RAP-RETRO; 10/2009 – 12/2013; I/P. Matiašovský.

Advanced lighting solutions for retrofitting buildings; IEA Solar Heating and Cooling Programme / Task 50; 01/2013 – 12/2015; I/S. Darula.

Docomomo virtual exhibition (MoMove). International project realised in collaboration with DOCOMOMO International. Researchers from the Department of architecture ÚSTARCH SAV (K. Andrášiová, M. Dulla, K. Haberlandová, H. Moravčíková, L. Pastoreková and P. Szalay) were responsible for the Slovak national output. Available at <http://exhibition.docomomo.com/>

On the Periphery / Slovak Architecture Outside Traditional Centres, international Czech-Slovak research project established in frame of the project Ex-Centric supported by Európsky sociální

fondy v ČR, Európska únia, OP Vzdelávaní pro konkurenceschopnost a Ministerstvo školství, mládeže a tělovýchovy ČR. Researchers from the Department of architecture ÚSTARČH SAV (H. Moravčíková, P. Szalay and L. Pastoreková) were responsible for the Slovak national output. Available at <http://www.ex-centric.eu/>.

- **National projects and their funding**

**2.4.4. Projects supported by the Slovak Research and Development Agency (APVV)**

Role of the Institute e.g. Coordinator “C”, investigator “I”.

	Project title	Typ / Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute / Responsible person
2012	Unified system of sky luminance patterns characterizing daylight availability and conditions in urban spaces	APVV-0177-10	01/2012 - 10/2014	81258	C/M. Kocifaj
	Probabilistic modelling of hygro-thermal performance of buildings	APVV-0031-10	01/2012 - 10/2014	188935	C/Z. Sadovský
	Differentiated typology of modernism: the theoretical basis for maintenance and conservations of works of modern architecture	APVV-0375-10	01/2012 - 10/2014	145656	C/H. Moravčíková
	Optimal design of smart composite materials	APVV-0014-10	01/2012 - 10/2014	195986	C/J. Sládek
	Numerical simulations of multifield problems in multiphase porous media	APVV-0032-10	01/2012 - 10/2014	200185	C/V. Sládek
	Wind action in structural engineering	APVV-0179-10	01/2012 - 10/2013	32400	C/A. Tesár
2013	Simulation of daylight in artificial sky	APVV-0118-12	10/2013 - 12/2015	99257	C/S. Darula
2015	Generalized skyglow model and its application to retrieval of city emission function	APVV-14-0017	07/2015 - 12/2015	19846	C/M. Kocifaj
	Multiscale modelling of coupled fields in composite materials	APVV-14-0216	07/2015 - 12/2015	45284	C/J. Sládek
	Multiphysical problems in functionally graded material plates	APVV-14-0440	07/2015 - 12/2015	33034	C/V. Sládek
	Experimental and theoretical analysis of water vapour sorption in structural materials	SK-CZ-2013-0052	01/2015 - 12/2015	2033	C/P. Matiašovský

**2.4.5. Projects supported by the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA) for each year, and their funding**

VEGA	2012	2013	2014	2015
Number	7	7	10	10
Funding in the year (EUR)	41890	45471	42662	55081 <sup>1</sup>

- **Summary of funding from external resources**

**2.4.6. List of projects supported by EU Structural Funds**

Building the centre of excellence for research and development of structural composite materials – 2nd stage; 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; 07/2010 – 12/2012, W / P. Matiašovský.

Applications of ecocements CEM V (A, B) kind according to EN 197-1 in structural concrete; Cross Border Cooperation Programme Slovakia – Austria 2007-2013 / project ENVIZEO, No. N-00086; 09/2010 - 08/2012, W/P. Matiašovský.

<sup>1</sup> Excluding projects for the popularisation of science

Architecture of Totalitarian Regimes of the 20th Century in Urban Management; The South East Europe Transnational Cooperation Programme / No. SEE/B/0009/4.3/X ATRIUM; 01/2011 - 10/2013, I/H. Moravčíková.

#### 2.4.7. Summary of external resources of the EU Structural Funds (ERDF/ESF)

Role of the Institute in the project, e.g. Coordinator “C”, work package leader “W”, investigator “I”.

Year	Project title	Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute
2012	Building the centre of excellence for research and development of structural composite materials – 2nd stage	26240120020	01/2012 - 12/2012	130822	W
	Applications of ecocements CEM V (A, B) kind according to EN 197-1 in structural concrete	N-00086	01/2012 - 08/2012	18557	W
	Architecture of Totalitarian Regimes of the 20th Century in Urban Management	SEE/B/0009/4.3/X	01/2012 - 10/2013	97256	I

External resources	2012	2013	2014	2015	total	average
External resources (milions of EUR)	0,140	0,030	0,093	0,000	0,264	0,066
External resources transferred to cooperating research institute (milions of EUR)	0,000	0,000	0,000	0,000	0,000	0,000

- **Supplementary information and/or comments on research projects and funding sources**

## 2.5. PhD studies and educational activities

### 2.5.1. List of accredited programmes of doctoral studies, period of validity

5.1.7 Applied mechanics, January 2012 – September 2015.

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

PhD study	31.12.2012			31.12.2013			31.12.2014			31.12.2015		
Number of potential PhD supervisors	18			18			15			10		
PhD students	number	defended thesis	students quitted									
Internal	3,0			2,0	1,0		2,0			2,0		
External												
Other supervised by the research employees of the institute	3,0			2,0	1,0		2,0			2,0		

### 2.5.3. Summary table on educational activities

Teaching	2012	2013	2014	2015
Lectures (hours/year) <sup>2</sup>	210	174	106	160
Practicum courses (hours/year) <sup>2</sup>	43	36	56	36
Supervised bachelor theses (in total)	0	0	0	0
Supervised diploma theses (in total)	12	5	10	2
Supervised PhD theses (in total)	14	13	12	9
Members in PhD committees (in total)	5	5	6	5
Members in DrSc. committees (in total)	1	0	0	0
Members in university/faculty councils (in total)	10	10	10	9
Members in habilitation/inauguration committees (in total)	0	2	2	2

2

### 2.5.4. List of published university textbooks

### 2.5.5. Number of published academic course books

1

### 2.5.6. List of joint research laboratories/facilities with universities

- **Supplementary information and/or comments on doctoral studies and educational activities**

During the PhD study our students completed the long term research fellowships abroad:

P. Staňák: 130 days stay 2013 at Department of Civil Engineering, Faculty of Sciences and Technology, University of Coimbra, Coimbra, Portugal (Prof. A. Tadeu);

S. Krahulec: 116 days stay in 2014 at Department of Mathematics, City University of Hong Kong, Hong Kong (Prof. Y.-Ch. Hon) and 142 days stay in 2014 at School of Civil and Environmental Engineering, The University of New South Wales, Sydney, NSW 2031, Australia (Prof. Ch. Song).

Despite of low interest of young people to continue in PhD study we won three PhD students which were accounted as the best in all university programme study and were awarded by the Rector Price.

## 2.6. Social impact

### 2.6.1. List of the most important results of applied research projects. Max. 10 items

Technological Rule for the Manufacture of Concrete with the Cement of CEM V Kinds and Basic Recommendations for the Application.(Cross Border Cooperation Programme Slovakia – Austria 2007-2013 project ENVIZEO “Applications of ecocements CEM V (A, B) kind according to EN 197-1 in structural concrete”).

Numerical tool for concentrating solar applications (Solar Consulting Services, Inc., Colebrook, New Hampshire, USA project).

<sup>2</sup> Do not include time spent with bachelor, diploma or PhD students during their supervising

Theoretical analysis of the Modern Architecture of Totalitarian Regimes of the 20th Century and its Sustainability Strategy. (The South East Europe Transnational Cooperation Programme SEE/B/0009/4.3/X ATRIUM "Architecture of Totalitarian Regimes of the 20th Century in Urban Management").

Registry of modern architecture [www.register.ustarch.sav.sk](http://www.register.ustarch.sav.sk).

### **2.6.2. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes**

Architectural and historical research and assessment of the renovation strategy of the New Synagogue in Žilina (P. Szalay, H. Moravčíková, M. Dulla) Available at <http://www.novasynagoga.sk/rekonstrukcia/>

Duration of the work: since 2012

Commissioner: Truc Sféric NGO, Krajský pamiatkový úrad Žilina / Regional board of monuments Žilina

Architectural and historical research and assessment of the renovation strategy of the site of the Slovak University of Agriculture in Nitra (P. Szalay)

Duration of the work: since 2015

Commissioner: Slovenská poľnohospodárska univerzita v Nitre, Krajský pamiatkový úrad Nitra / Regional board of monuments Nitra

Architectural and historical research and assessment of the renovation strategy of the Swimming pool Green Frog in Trenčianske Teplice (P. Szalay, H. Moravčíková)

Duration of the work: 2010 – 2015

Commissioner: Krajský pamiatkový úrad Trenčín / Regional board of monuments Trenčín, Expoline, s.r.o.

### **2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues**

*Over 2 000 €:*

Zistenie odolnosti pórobetónu v prostredí s vysokým obsahom oxidu uhličitého (Evaluation of AAC resistance in CO<sub>2</sub> high concentration environment), Partner: PORFIX CZ, a.s., Trutnov, Česká republika, Revenue (€): 2 000

Posúdenie príčin väd liatej podlahy FLOORPACT (Assessment of casted floor defects), Partner: HOLCIM, a.s. Rohožník, Revenue (€): 8 000

Vplyv časového faktora na pretvorenia, priehyby a objemovú vlhkosť ľahkých stenových panelov typu ISOLET – LBW 30008 pri ich vysychaní (Influence of time factor on moisture induced deformations of lightweight wall panels), Partner: Hornex, a.s. Bratislava, Revenue (€): 4 000

Vyhodnotenie aktuálneho technického stavu objektu "Mestská obytná vila", ul. Dlhé Diely III, č. 1, Bratislava (Assessment of technical state of building...), Partner: Skanska, a. s. Bratislava, Slovensko, Revenue (€): 3 000

Identifikácia druhu použitého cementu a kontrola stavu betónu konštrukcie Leopoldov (Identification of used cement and assessment of concrete state...), Partner: ISPO spol.s.r.o.inžinierske stavby, Prešov, Revenue (€): 2 886

Stanovenie základných parametrov pórovej štruktúry pre výskum a diagnostiku stavu cementových kompozitov, betónov a stavebných hmôt pre stavebnú prax (Determination of pore structure parameters for research and diagnostics of building materials), Partner: TSUS-Technický a skúšobný ústav stavebný, n.o., Bratislava, Revenue (€): 3 500

Meranie výkonu ohrevných/chladiacich panelov (Measurement and analysis of heating/cooling panels power), Partner: Technologický inštitút SAV, Revenue (€): 25 000

Pórová štruktúra betónov - overenie ich fyzického stavu ako dôležitého poznatku pre stavebnú prax (Pore structure of concretes – assessment of their physical state), Partner: TSUS, n. o., Bratislava, Revenue (€): 3 000

Determination of relevant operative compression working characteristics and stress - strain diagrams of cement – composite samples based on fine crushed abyssal rocks aggregate, Partner: GA Drilling, a. s., Trnava, Revenue (€): 3 500

Sledovanie vplyvu odpadu na tuhnutie cementovej pasty - Diagnóza problému tuhnutia a navrhnutie technicky spôsobilu riešenia (Investigation of influence of waste to cement paste hardening), Partner: Knauf Insulation, s.r.o. Revenue (€): 2 970

Verifikácia odolnosti a deformačných charakteristík prvkov predpínacieho systému PROJSTAR únavovými skúškami podľa predpisu ETAG 013/B 2.1 (Verification of prestressing system resistance), Partner: Váhostav – SK, a. s., Bratislava. Revenue (€): 12 210

Vyhodnotenie pórovej štruktúry betónov pre overenie ich fyzického stavu ako dôležitého poznatku pre stavebnú prax (Evaluation of pore structure of concretes...), Partner: Technický a skúšobný ústav stavebný, n. o., Bratislava, Revenue (€): 3 000

#### **2.6.4. List of licences sold abroad and in Slovakia, incl. revenues**

#### **2.6.5. List of most important social discourses under the leadership or with significant participation of the institute (max. 10 items)**

#### **2.6.6. Summary of relevant activities, max. 300 words**

The activities with social impact include: reviewing and editorial activities, expert opinions, participations in the boards of universities and accreditation and attestation committees, application projects, consulting and diagnostic activities, presentations of the modern architecture as the architectonic heritage, archiving of modern architecture in Slovakia, its physical and digital documentation, cooperation with The Monuments Board of the Slovak Republic, organisation of expositions, popularisation in mass media.

The social impact of these activities consists in the prosperous application the scientific results in development of technologies, creating new methodologies and providing information or data important for decision making, addressed to given target groups. Their satisfaction is expressed by repeated cooperation on specified topics, started many times already ago the assessment period. A sponsorship of our activities by some industrial and public sector partners represents a specific form of the acknowledgement.

### **2.7. Popularisation of Science (outreach activities)**

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

*Exhibitions:*

Vitajte v panelstory! Hromadná bytová výstavba v Bratislave 1955 - 1995. Welcome to prefabstory! Mass housing in Bratislava in 1955 - 1995. Curators: H. MORAVČÍKOVÁ, P. SZALAY, M. TOPOLČANSKÁ. Exhibition, Galerie Jaroslava Frágnera, Prague, 31.1. - 2.3.2012.

MORAVČÍKOVÁ, Henrieta: Sensing the common ground: Czech and Slovak Pavilion. In: Common Pavilions. Curator: Adele Re Rebaudengo, Diener & Diener, with photos by Gabriele Basilico. 13th International architectural exhibition - La Biennale di Venezia, 29.8. - 25.11. 2012.

Fake Cities True Stories in Archizines world tour 2013/14. Exhibition. Curator: M. TOPOLČANSKÁ. Architecture triennial, Lisbon, Portugal, October 2013.

Moderné a/alebo totalitné v slovenskej architektúre 20. storočia. Modern and/or totalitarian in Slovak architecture of the 20th century. Exhibition. Curators: H. MORAVČÍKOVÁ, P. SZALAY, M. TOPOLČANSKÁ. ÚSTARČH SAV, Bratislava, 7.12.2012 - 1.2.2013.

Na okraji alebo Miesta architektonického vz(d)oru. On the Periphery or Sites of Architectural Example / Defiance. Exhibition. Curators: P. Wolf, H. MORAVČÍKOVÁ, collaboration: P.

SZALAY, L. PASTOREKOVÁ, visual conception: L. PASTOREKOVÁ. Faculty of architecture STU Bratislava, 26. 5 - 6.6. 2014.

Monitoring modernizmu / Monitoring of Modernism. Exhibition. Curators: P. SZALAY, M. TOPOLČANSKÁ, H. MORAVČÍKOVÁ, I. Pilný, visual conception: L. PASTOREKOVÁ, Exhibition space oA ÚSTRACH SAV, Bratislava, 15. 5. 30. 6. 2014.

Na okraji: Súčasná slovenská architektúra mimo centra / On the edge: Contemporary architecture in Slovakia outside the centre. Exhibition. Curator: H. MORAVČÍKOVÁ, collaboration: P. SZALAY, L. PASTOREKOVÁ, visual conception: L. PASTOREKOVÁ, P. SZALAY, Slovak Institute, Prague, 26. 3. - 23. 4. 2014.

Spätmoderne Slowakei: gebaute Ideologie? Exhibition. Curator: A. Stiller, collaboration: H. MORAVČÍKOVÁ, P. SZALAY, M. DULLA, M. TOPOLČANSKÁ, M. Potočár, K. HABERLANDOVÁ. Architektur im Ringturm gallery, Vienna, 10. 2. - 14. 3. 2014.

Lifting the curtain. Central European Achitectoral Networks, Exhibition. Collaboration: P. SZALAY. 14th International architectural exhibition - La Biennale di Venezia, 7. 6. - 23. 11. 2014

Architekt Vladimír Dedeček Arbeiten. Exhibition. Curators: P. SZALAY, M. Zaiček, AT, f.e.a., forum für experimentelle architektur, Vienna, 12. 12. - 31. 12. 2015

Architecture is here! Architekt Vladimír Dedeček Práce. Exhibition. Curators: P. SZALAY, M. Zaiček. Fórum pro architekturu a média, Brno, 4. 12. 2015 - 15. 1. 2016

Prečo pyramída? Náučný chodník budovou Slovenského rozhlasu. / Why pyramid? Educational trail through the building of Slovak Radio. Permanent exposition. Curators: Štefan Bekeš, P. SZALAY, Visual conception: Boris Meluš. Slovak Radio, Bratislava, since 27. 3. 2015

Emancipované: prvá generácia architektiek na Slovensku / Emancipated: first generation of women architects in Slovakia. Exhibition. Curator: H. MORAVČÍKOVÁ, Visual conception: L. PASTOREKOVÁ, M. Zaiček. Faculty of architecture STU, Bratislava 9.12.2015 - 15.01.2016.

### 2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2012	2013	2014	2015	total
Articles in press media/internet popularising results of science, in particular those achieved by the Institute	11	11	7	14	43
Appearances in telecommunication media popularising results of science, in particular those achieved by the Institute	7	12	7	11	37
Public popularisation lectures	9	8	8	6	31

- **Supplementary information and/or comments on popularisation activities, max. 300 words**

Researchers from the Department of architecture have been awarded several national and international awards for their research and publication activities. Award of the Slovak literary fund for scientific publication of the year (twice in 2012); Award of the Slovak architects Society for theoretical work in architecture (2012, 2014); National award for the best book of the year (2015); Deutsches Architektur Museum Architectural Book Award (2015).

## 2.8. Background and management. Human resources and implementation of recommendations from previous assessment

### 2.8.1. Summary table of personnel

Personnel	2012	2013	2014	2015
All personnel	61,0	59,0	54,0	49,0
Research employees from Tab. Research staff	33,0	35,0	36,0	37,0
FTE from Tab. Research staff	26,960	29,410	28,430	26,830
Average age of research employees with university degree	49,5	49,3	48,8	46,4

#### 2.8.1.1. Professional qualification structure (as of 31.12. 2015) FEMALE

FEMALE	AGE								
Number of	< 30	31 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	> 65
DrSc. / prof.						1			
II.a / Assoc. prof.								1	
Other researchers PhD./CSc.	1		1	1					
doc. / Assoc. prof.									

#### 2.8.1.2. Professional qualification structure (as of 31.12. 2015) MALE

MALE	AGE								
Number of	< 30	31 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	> 65
DrSc. / prof.						1		2	
II.a / Assoc. prof.				1	1		2	2	
Other researchers PhD./CSc.	3	3	2				1		
doc. / Assoc. prof.									

#### 2.8.2. Postdoctoral and mobility scheme

##### 2.8.2.1. Postdoctoral positions supported by national and international resources

##### 2.8.2.2. Postdoctoral positions supported by external funding

SOLANO LAMPHAR, Hector, Antonio, SAIA and Cátedras CONACYT # 2723/National Council of Science and Technology of Mexico, 2012 – 2014.

##### 2.8.2.3. SAS stipends and SASPRO stipends

WÜNSCHE, Michael – Multiscale modeling of layered, fibre reinforced and porous magnetoelectric materials, project SASPRO no. 0106/01/01, 09/2015 – 08/2017.

##### 2.8.2.4. Internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz

#### 2.8.3. Important research infrastructure (max. 2 pages)

The institute is equipped with advanced soft- and hardware and experimental facilities located in three main laboratories for research and development of building construction materials, with

a special attention to experiments and measurements in the field of material functional properties. In the assessment period a reconstruction and acquisition of new R&D technical infrastructure was completed in Laboratory of material research, Thermophysical laboratory and Mechanical and technological laboratory.

**Material research laboratory** is to measure a pore structure of materials and relevant chemical and physical properties, to test materials durability in short-term and long-term experiments, 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, Pycnopyc 5200e
- Mercury pressure porosimeter PoreMaster 60GT
- Gas sorption analyser – Autosorb IQ Anygas model
- Portable equipment for measurement 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<sub>2</sub> concentration environment CO<sub>2</sub> in incubator INCO2/246
- Measurement 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 Portable 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 Data acquisition system 1-MX840 PAKEASY, 1-SCM-SG350, ¼ 350 ohm strain gauges.

The modernisation included adaptations of laboratories.

The computer facilities required for modelling of advanced material properties and development of sophisticated computational methods are available.

The acquired 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 disposal of other institutes, including the institutions out of Slovak Academy of Sciences. The principles of utilisation of 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”.

#### **2.8.4. Description of how the results and suggestions of the previous assessment were taken into account**

Comments, objectives to organization activities in form of suggestions and specific tasks which must be performed by organization before next regular evaluation:

*1) Due to the increased number of research equipments and improved infrastructure, special care should be taken for effective managing at using these equipments.*

The research equipment is placed in three closely cooperating laboratories. Its application is in the projects of interdisciplinary character, concerning the research and development of building materials.

*2) It is necessary to pay increased attention to recruit high quality PhD students, level of doctoral study. In parallel to apply scholarships supporting doctorands and post-doctorands.*

An effort was done to recruit high quality PhD students in doctoral programme Applied mechanics, which defended theses successfully awarded with Price of rector of STU Bratislava. Two of three were awarded also by the President of Slovak Republic. Simultaneously for excellent PhD students we use our own salary budget or we apply for scholarships.

*3) Some further means for the activation of less effective individuals and groups have to be applied.*

The effectivity of research staff is motivated by remuneration system, regular attestations and team responsibility for results. The increased activity can be documented by increasing the number of researchers publishing in high quality journals.

*4) Improve significantly the activities to transfer knowledge to the industry.*

We utilize all available co operations with industrial partners. Two proposals were applied in program Horizon 2020 Industrial Leadership. The ability of industry to involve to research projects is influenced by contemporary economical situation.

*5) Special care should be given to use new equipments effectively, both from the point of view of managing them personally and finding some new attractive and useful research problems.*

We apply the equipment in research building materials in projects dealing with research and development of silicate-based building materials.

- **Supplementary information and/or comments on management, research infrastructure, and trends in personnel development**

The management of the Institute is based on two main principles: the freedom of scientific research and the responsibility of individual researchers for quality of their results.

Research infrastructure includes: the advanced hardware and software for theoretical fundamental research in mechanics and physics and for the simulations, the complex laboratories for experimental applied research in building materials.

The trends in personnel development of the Institute are characterised by the defragmentation of research topics and by the effort to create adequate flexible teams around the research projects. In the next period the organisational structure of the Institute will be modified and simplified. The professional qualification structure is getting to be well balanced. The proportion of employees without PhD degree will decrease.

In an effort to rejuvenate the research staff of the institute, several young people which just finished the PhD study have been employed during last years. The aim is to continue this trend also in the future.

### **3. Research strategy and future development of the institute for the next five years (2016-2020) (Recommended 3 pages, max. 5 pages)**

The Institute of Construction and Architecture will continue to pursue the fundamental research in the selected domains applicable in construction and architecture:

- Applied mechanics,
- Building materials and structures,
- Building physics,
- Architecture and town planning.

### **3.1. Present state of the art in both the national and the international contexts**

A synergy effect can be observed in the rapid development of advanced materials and technologies on one side and the great progress in related branches of research and science on the other side. Multi-field interactions in composite materials yield various coupling effects which finally lead to new properties of sophisticated materials developed on the basis of programmed design. Many new effects on macroscale level cannot be explained without incorporation of some micro-features. Therefore new constitutive equations are needed with including multi-field interactions in the governing equations as well as multiscale treatment. Great demands are made on physical modelling the processes in new materials and development of advanced numerical methods applicable to numerical simulations of such effects and processes as well as on experimental measurements necessary for modelling. The development of new materials and technologies evokes the development of new sophisticated computational methods challenging not only in explanation of new phenomena but also in multi-field and multi-scale modelling with applications in structural design. In modern structures and products still often one can meet materials with properties originated in mentioned effects. In the most cases the coupled effects are obtained in the materials particular constituents of which show various physical properties. Recently it has been found that significantly higher magneto-electric effect is obtained in composite materials as in their constituents at a suitable combination of materials. This effect in the composites can be by two orders of magnitude higher than in other materials. Such sharp increase in a comparison with natural materials can lead to wider applications in ultrasonic imaging devices, sensors, actuators, transducers, etc. The main goal of the research for next period is the development of meshless formulations for multi-field problems as well as other applications for engineering problems paying attention to some mathematical aspects of the computational methods, such as the numerical stability, convergence accuracy, and computational efficiency. The main interest is given in multi physical problems in functionally graded material plates as well as incorporation of multiscale effects into macroscopic modelling of micro-composite materials.

A complex research of silicate composites is devoted to: study of chemism, mechanism and kinetics of the hydration and hardening of hydraulic binders, mainly multicomponent cements under the impact of increased temperature, modifying admixtures and further factors influencing hydration and hardening of the composites, explanation of the relationships between crystallochemical phase composition, character of structure and basic physical and physico-mechanical properties of the composites, development of specific low energy and ecological binders, corrosion of composites due to impact various aggressive gas and liquid media. It is the interdisciplinary research, a close connection of chemistry, physical chemistry, physics, mechanics and material engineering. The results of the research allow for development of new progressive technologies and materials with programmed qualitative parameters and provide possibilities of a better utilisation of alternative raw materials with bearing in mind environmental aspects too. Therefore the research in the field is very attractive, resulting in a potential decrease of the energy demandingness of the production of building materials and emissions of carbon dioxide in the earth atmosphere. High quality results are achieved thanks to the advanced experimental equipment. This concerns the development of high performance cementitious Composites under hydrothermal conditions for potential applications in deep borewells. The objective deals with the research and development of two kinds of High performance cementitious composites (geopolymer binders -GPB and chemically bound phosphate ceramic binders - CPCB) for potential application in severe chemical, physical and mechanical load conditions based on numerical simulation of geothermal wells. It also deals with the synthesis of geopolymer zeolites (GPZ) and hydroxyapatite (HA) thank to their sorption and selectivity capacity for application in chemistry and energy industry, in environment and biomedicine.

A potential cooperation is in domain of the development of new concrete materials based on geopolymers, the development of Ultra-high performance concrete (UHPC) in laboratory conditions, the development of Modified Ultra-high performance concrete (MUHPC) with improved material properties in laboratory conditions based on new formulations of composition, particle size distribution, thermally activated materials, chemical admixtures, new superplasticizers etc, the development of reinforced concrete composites (steel tubes, metal

tube and fibres, ceramics fibres), characterization of starting materials. The results of building material research are planned to be utilized in structural design.

Thermophysics and mass transfer in materials science and construction is directed toward the modelling of thermophysical properties of building materials, simulations of hygrothermal fields in porous media and the development of so-called hydro-thermo-mechanical models. The models involve the transport of heat and water in porous space and also the deformation processes in solid matrix. The research activities are of two-fold: design of material properties, which is performed using suitable computer simulation tools for modelling the hygrothermal and mechanical performance, partially based on multi-scale modelling, connected with the application of laboratory measurement and testing methods for determination of thermal, hygric and mechanical properties on different scales. The results are applied in the development of integrated computational tools for simulation of the complex hygrothermal performance of building thermal systems.

Modelling of microphysical and optical properties of materials, radiation and heat transfer in non-homogenous multicomponent media, nano- micro- structures, methods and theory of electromagnetic (optical) diagnostics of disperse systems. The radiance/luminance patterns that simulate more realistic skies were urgently needed in lighting engineering applications to model daylight availability in exterior and interior spaces under real conditions accepting stochastic cloud coverage. The preciseness of the characterisation of optical state of a sky is important in solving many associated problems e.g. the modelling the availability of solar and light energy on the earth surface – especially in densely inhabited urban areas with various orientation of buildings. A large variability of atmospheric conditions, heterogeneity of optical characteristics of aerosol particles and clouds, and earth surface albedo all usually lead to rapid changes of diffuse radiation at the ground. A permanent increase of night lighting causes undesirable phenomena, specifically sky glow in urban centres and suburban areas. There is now a substantial demand for technological development to help to minimize the amount of light unnecessarily emitted upward. Different technologies are tested in order to predict their influence on over-illumination of ambient environment. An identification of the influence of the clouds and aerosols on the glow of a night sky is a priority challenge, because basic mechanisms are not known at all yet.

Monitoring, quantification and interpretation of sky states became significant in solving lighting technology tasks, mainly in the last decades and mainly in urban locations. In respect to intensive construction activity in rapidly developing countries/areas the daylight availability in exterior and also in interior can significantly change. For this reason some scientific teams in the world focus on a simulation of daylighting in the built areas. As the windows in buildings have various orientation and size, it is necessary to assess the angular distribution of sky brightness or glare. The need of a correct characterisation of sky states is legitimate motivation for systemic monitoring of the characteristics of visible radiation reaching the ground surface. A great effort is expended to the development of more universal scalable sky brightness model that depends on the actual weather situation.

The increasing demand for energies markedly intensifies a development of equipments utilising renewable energy sources, including solar concentrators. Within this context a common interest is given to a specific topic, i.e. thermal management design for BIPV modules incorporating MEPCM: This study proposes an innovative building-integrated photovoltaic (BIPV) by integrating building structure, a heat flow mechanism, and a microencapsulated phase change material (MEPCM) with a photovoltaic (PV) module. Parametric simulations and experiments of the thermal and electrical performances of this BIPV module need to be performed to account for the influences of external and internal environments, daily solar irradiation, and thickness of the MEPCM layer as well as its melting point.

In the field of architecture and urbanism a complex research of the 20th century and contemporary architecture in Slovakia, from the aspect of: history, structural, functional and typological specifics, international context and monument protection. The research is based on three pillars: comparative history, critical theory and investigation of the modern architecture as the architectonic heritage.

The Institute disposes with the only specialised Archive of architecture in Slovakia, which includes physical and digital documentation on more than 3000 buildings. The part of the

materials is available also on-line via the Registry of modern architecture [www.register.ustarch.sav.sk](http://www.register.ustarch.sav.sk)

The research team of the Department of architecture plays important role in the research of 20<sup>th</sup> and 21<sup>st</sup> century architecture. On national level it represents the leading authority, which sets the trends in heritage issues of modern architecture. With their particular research results in the field of mass housing and late modernism the team of Department of architecture invented methodological principles that are applied by other researchers on European level. The same goes for the biographical investigations of the representatives of architecture avant-garde of 20<sup>th</sup> century that are recognised on international level as well.

In the field of architectural research the main objective is to retain the role of the institute as the national centre of investigation and documentation of modern architectural heritage. It means to develop paralelly the architectural and historical research of modern architecture, anticipate the social situation and permanently generate new strategies of curating and preservation of modern architectural heritage. In the same time it is necessary to strengthen the position of the Slovak architectural research in the international context. Important role in that connection is played by *Architektúra & Urbanizmus* the journal of architecture and town planning theory (published by the institute and indexed and abstracted by Arts and Humanities Citation Index and Current Contents / Arts & Humanities), which represents prominent platform for international discourse on the issues of Central and Eastern European architectural theory and history. Beside the high quality of the research outputs it will be necessary to improve the collections of the Archive of architecture of Slovakia with special focus on digitalisation of the unique collection of drawings and photographs of 20th century architecture.

### **3.2. Research strategy of the institute in the national and the international contexts, objectives and methods**

The objectives enunciated for the next period consist of:

- Concentration to the fundamental research in selected domains of applied mechanics, building materials and constructions, building physics, architecture and town planning. Specifically:
  - The mathematical-physical modelling and numerical simulations of multi physical phenomena in composite materials
  - The development of advanced computational methods applicable to structural design with including the multi-field and multiscale modelling of smart materials
  - Complex research of silicate composites and building structures
  - Study of chemism, mechanism and kinetics of the hydration and hardening of hydraulic binders
  - Development of specific low energy and ecological binders
  - Heat and mass transfer in building materials and structures,
  - Modelling of thermophysical properties of building materials,
  - Simulations of hygrothermal fields in porous media,
  - Dvelopment of integrated tools for simulation of complex hygrothermal performance of building thermal systems,
  - Modelling of microphysical and optical properties of materials,
  - Radiation and heat transport of in nonhomogenous multicomponent media,
  - Nano- micro- structures, methods and theory of electromagnetic (optical) diagnostics of disperse systems.
  - Complex research of the 20th century and contemporary architecture in Slovakia, from the aspect of: history, structural, functional and typological specifics, international context and monument protection.
- Increase of the participation in international, especially EU research programmes.
- Emphasize of the activities to apply the scientific results in industry.
- Increase the attention to education and recruitment of young scientists applying the scholarships supporting doctorands and post-doctorands.
- Use new equipment effectively, both from the point of view of its personal management and finding utilizing in new attractive and useful research problems.
- Pay attention to popularization of the research in construction and architecture.

Accordingly, the following methods will be applied for achieving of these objectives:

The research activities are focused on the above topics, while a permanent effort is made to create satisfactorily large competitive research teams of excellent quality, inherently with stable participation of young scientists.

The fundamental condition of this is a successful education of new scientists, provided by the accreditation of continuing and new programmes of doctoral studies in the Institute.

In the previous periods yearly evaluations of individual research workers from the aspect of their scientific results and activities, connected with their consequent remuneration was confirmed as very effective system in promotion their activity in the whole range of the anticipated objectives. Of course this effectiveness is explicitly dependent on financial sources in budget, namely from projects.

The number and structure of research departments are accommodated to the developing conditions. In the next period the organisational and professional structure of the Institute will be modified and simplified. The dominant will be creation of research teams associated to research projects.

The international activities of our excellent teams will use the existing collaborations and partnerships, within the existing informal consortia with e.g. University of Siegen, KU Leuven, TU Vienna, CVUT Prague, TU Dresden, National Cheng-Kung University, Taiwan, US Army Research Laboratory, Adelphi, CÉGEP de Sherbrooke, Canada, as well as the participations in international organisations, e.g. CIB (International Council for Research and Innovation in Building and Construction), fib (federation internationale du beton, CEACM (Central European Association for Computational Mechanics), ISCES (International Society for Computational Engineering & Sciences, CIE (International Commission on Illumination), ISES (International Solar Energy Society), OSA (Optical Society of America). DOCOMOMO (International working party for documentation and conservation of buildings, sites and neighbourhoods of the modern movement).

The cooperation with industry is stable and prospective mainly with large companies, the Institute has long term subscribers of R&D results e.g. Doprastav, CRH Slovensko, TSUS Building Testing and Research Institute, etc. The activities in this area enable the applications of the results of our research.

<b>Project proposals submitted to 7RP or H2020</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
<b>Institute as coordinator</b>	0	0	1	0
<b>Institute as participant</b>	2	0	2	0

#### **4. Other information relevant for the assessment**