J. J. Strossmayer University of Osijek
FACULTY OF CIVIL ENGIENERING OSIJEK

STRATEGIC PROGRAMME OF SCIENTIFIC RESEARCH

Osijek, April 2016

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1. HISTORICAL OVERVIEW AND ACTIVITY

In 1967, a Department of the Zagreb Technical Faculty was established in Osijek. It was the result of long-time efforts of civil engineering experts at the time, but also a practical response to ever-increasing demands for civil engineers in Slavonia and Baranja. In 1976, the Technical Polytechnic was established, and since that time, it has continuously provided education for civil engineers coming from the region comprising five counties in Slavonia and Baranja, northern part of Bosnia and Herzegovina and part of Vojvodina.

At first, the Polytechnic functioned independently, but after some time it became an organizational unit of the Civil Engineering Education Centre in Osijek, whose constituent it remained until 1982. In 1982, it briefly operated autonomously as the Civil Engineering College Osijek. That period was used for preparatory activities for the establishment of the Faculty of Civil Engineering in Osijek.

With that in mind, the Civil Engineering College merged with the Department for Materials and Structures in Osijek, as an organizational unit of the Civil Engineering Institute in Osijek. On March 1, 1983, a new higher education institution in Osijek began its operation, being at the same time a constituent of the University of Osijek and an organizational unit of the Civil Engineering Institute Zagreb – OOUR (*Basic Organization of Associated Labour*) Faculty of Civil Engineering Science of the University of Osijek. In the academic year 1986/1987, the Faculty obtained a licence to independently deliver the study programme in civil engineering, general study course.

It continued to carry out its scientific-educational, development and expert activities until 1991, after which it became independent, but kept in its organizational structure the Department of Development & Expert Activities. On February 7, 1992, today's autonomous Faculty of Civil Engineering of the Josip Juraj Strossmayer University of Osijek was established. Department of Development & Research Activities was separated from the organizational structure of the Faculty and incorporated into the Croatian Civil Engineering Institute Zagreb – Business Centre Osijek.

Today, at the Faculty of Civil Engineering, there are 93 employees (53 of whom hold scientific-teaching, teaching and associate titles) and over a 1000 students studying in all study programmes and available specialisations. Basic organisational units of the Faculty are its departments, which are the holders of educational, research and expert activities. In the last several years, we have set up and equipped laboratories that serve as venues for practical classes in the educational process and as scientific and research units. That was done with our own funds, funds allocated for research projects and funds of the Ministry of Science, Education and Sports. Construction of the Faculty's new building at the University campus is completed. After relocation and beginning of work in the new building, we can expect improvement in work quality and the Faculty's advancement in educational, expert and research activities.

Scope of activities of the Faculty of Civil Engineering Osijek, in accordance with the Statute, is as follows:

- Higher education
- Implementation of undergraduate university study programme, graduate university study programme and postgraduate university study programme
- Organization and delivery of curricula of professional study programmes in accordance with the authorisation of the University Centre for Professional Studies
- Research and experimental development in natural, technical and technological sciences
- Research activities in the scientific field of civil engineering, especially in the following scientific areas: load bearing structures, geotechnics, roads, hydrotechnical engineering, technology and organisation in construction and building design and construction

- Research activities in the scientific fields and branches related to civil engineering
- Interdisciplinary research, in particular related to current and development problems in civil engineering and construction
- Organizing and implementing the programmes of professional training and lifelong learning
- Organizing and implementing energy performance assessment and certification of buildings with simple and complex technical systems, as well as of other structures in the part related to architecture and construction
- Performing reviews and expertise, providing expert opinion – consulting in the field of civil engineering
- Technological improvements, rationalization and innovation in building technology and ecological use of space
- Building and architectural design and making of tender documents
- Project review in terms of safety, functionality and cost-effectiveness
- Making and keeping a register of buildings and infrastructure, as well as monitoring of the construction, exploitation and maintenance status of structures
- Collaboration in drafting of construction-related regulations (guidelines, regulations, norms, laws)
- Advancement of development and technology for ecological use of space and construction – announcing public calls in the field of architecture, urban planning, interior decoration and landscaping.

1.1. Mission

The mission of the Faculty of Civil Engineering is to contribute to society through the advancement of knowledge/education of students at undergraduate, graduate and postgraduate levels and to pursue scientific and technological research in the field of civil engineering.
By upholding the fundamental values of academic integrity such as ethics, transparency, affirmative competitiveness, cooperation and communication, the Faculty seeks to foster the development of creative ability in every community member and to develop his/her competence to work wisely, responsibly and effectively towards general community progress, thus reinforcing the Faculty's status as a desirable place of studying at the regional, national and European level. In that sense, the Faculty will permanently focus on the ever-increasing need for learning and knowledge. In addition, the Faculty will ensure that its vision, organisation, services, quality arrangements and quality enhancement continue to contribute to its recognition as a centre of excellence in education, research and professional activities in the field of civil engineering.

1.2. Vision

The Faculty of Civil Engineering Osijek will continuously pursue its mission and steer its development towards becoming a centre of excellence in education and research in the field of civil engineering. In this sense, the Faculty will strive to become the leading higher education centre in the field of civil engineering in eastern Croatia, both at the level of university education and at the level of vocational education. It will offer its users quality services in the field of higher education, which will be based on the collection, processing and use of information about learning outcomes. It will provide and develop opportunities for lifelong learning and encourage active participation in the European Higher Education Area. The Faculty will also try to connect, as much as possible, educational process with research and economy through active participation in science and technology projects and through cooperation with other educational institutions, institutes, and experts from outside academia. In addition to these basic objectives, the Faculty will especially endeavour to achieve the following:

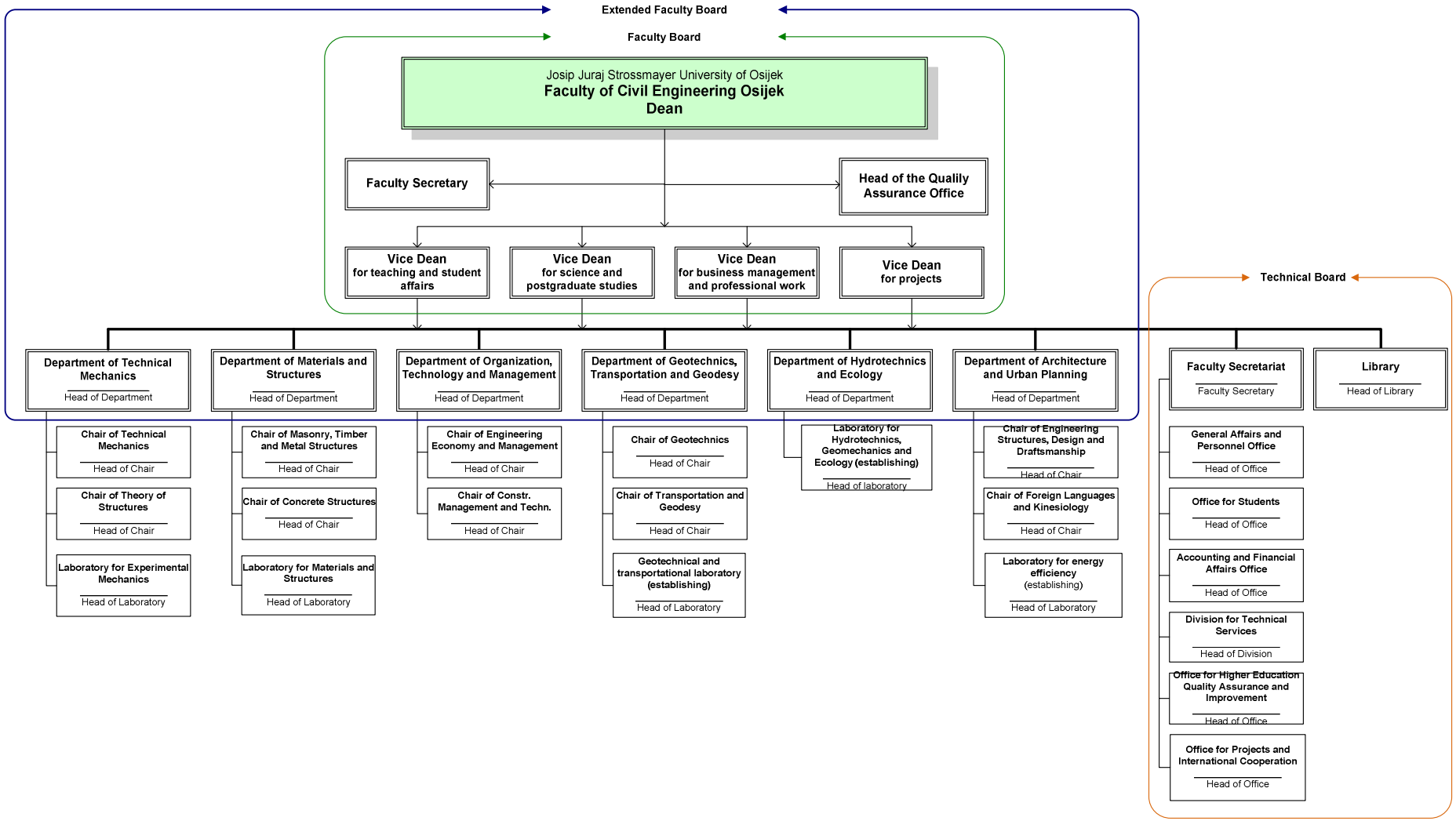
- Achieve the desired (and measurable) level of knowledge in students who have completed certain educational cycles;
- Permanently optimise the number of students and teachers, and organise classes in accordance with the latest Bologna principles (number of students per group, teaching methods, high-quality equipment and alike);
- Provide quick and efficient “flow” of ideas, young researchers and scientific projects;
- Continuously work on improvement of better international cooperation, especially in the region;
- Equip Faculty's own laboratories in accordance with its own defined scientific recognition, and create new data for the entire scientific domain;
- Develop motivating interpersonal relationships based on trust, mutual appreciation and affirmative competitiveness;
- Support establishing of a strong alumni club that will enable permanent communication between the former Faculty graduates and their alma mater, to our mutual benefit;
- Develop the capacities necessary for organising and heading of professional and scientific symposiums;
- Encourage publication of professional and scientific literature.

Values

Faculty of Civil Engineering applies the following values in its day-to-day operation:

- Ethical principles
- Transparency
- Affirmative competitiveness
- Cooperativeness
- Communicativeness
- Professionalism

1.3. *Organizational structure of the Faculty*



2. ANALYSYS OF THE FACULTY'S SCIENTIFIC POTENTIAL AND POSITION WITH RESPECT TO THE SCIENTIFIC AND BUSINESS SURROUNDINGS

2.1. Structure of employees holding scientific-teaching, teaching and associate titles

2.1.1. Employees holding scientific-teaching titles as at April 1, 2016

Number of employees holding scientific-teaching titles (full-time equivalent – FTE):		31.9
Of whom	Professors:	6.4
	Associate professors:	12.5
	Assistant professors:	13

Number of employees holding scientific-teaching titles, employed full time:		30
Of whom	Professors:	5
	Associate professors:	12
	Assistant professors:	13

Number of employees holding scientific-teaching titles in the field of Technical Sciences (FTE):		28.9
Of whom	Professors:	4.4
	Associate professors:	12.5
	Assistant professors:	12

Number of employees holding scientific-teaching titles in the field of Technical Sciences, employed full time:		27
Of whom	Professors:	3
	Associate professors:	12
	Assistant professors:	12

2.1.2 Employees holding teaching titles as at April 1, 2016

Number of employees holding teaching titles, employed full time:		11
Of whom	Higher school professors	1
	Senior lecturers:	9
	Lecturers:	1

Number of employees holding teaching titles in the field of Technical Sciences, employed full time:		6
Of whom	Higher school professors	1
	Senior lecturers:	4
	Lecturers:	1

*All employees holding teaching titles are employed full time

2.1.3 Employees holding associate titles as at April 1, 2016

Number of employees holding associate titles:		15
Of whom	Postdoctoral candidates:	2
	Assistants	13

* All employees holding teaching titles in the field of Technical sciences are employed full time

2.2. Information on papers published in journals indexed in the Web of Science (WoS) database

Table 2.1 gives an overview of papers published per Departments in the period between 2011 and 2015.

Previous Development Strategy determined the necessity of improving the level of research work and scientific production. With that in mind, in the last five years the following measures have been gradually implemented:

1. Every employee holding the associate, teaching and scientific-teaching title annually receives HRK 7,000.00 to spend on research
2. Employees are reimbursed for the costs of proofreading in English (foreign *academic editing* services)
3. All publishing costs for papers in the journals included in WoS are borne by the Faculty
4. Authors of papers published in journals included in WoS and in Q1 and Q2 receive a lump sum remuneration of HRK 3,000.00 per paper
5. Part of the funds the Faculty receives from the University under Programme Agreements is allocated to researchers according to the criterion of scientific production, for the purpose of research
6. The Faculty funds employees' research projects ("Internal projects"). All such projects have to be reviewed externally and get a positive review of independent reviewers.

Table 2.1 Number of published papers indexed in WoS in the period between 2011 and 2015

	2011		2012		2013		2014		2015		2011-2015	
	Number of papers	Number of papers /FTE*	Number of papers	Number of papers /FTE*	Number of papers	Number of papers /FTE*	Number of papers	Number of papers /FTE*	Number of papers	Number of papers /FTE*	Total papers	Average number of papers /FTE
Department of Materials and Structures	4	0.17	3	0.13	2	0.07	3	0.10	4	0.13	16	0.60
Department of Technical Mechanics	1	0.04	0	0.00	3	0.10	2	0.07	1	0.03	8	0.24
Department of Hydrotechnics and Ecology	0	0.00	0	0.00	1	0.03	2	0.07	1	0.03	4	0.13
Department of Geotechnics, Transportation and Geodesy	1	0.04	1	0.04	2	0.07	1	0.03	1	0.03	6	0.21
Department of Organization, Technology and Management	0	0.00	1	0.04	1	0.03	1	0.03	0	0.00	3	0.10
Department of Architecture and Urban Panning	0	0.00	1	0.04	0	0.00	0	0.00	0	0.00	1	0.04
Faculty of Civil Engineering total	6	0.25	6	0.25	9	0.30	9	0.30	7	0.22	37	1.32

FTE* (Full Time Equivalent) – equivalent of work on a full time basis for employees holding scientific-teaching titles

Table 2.2 Information on number of papers, citations and impact factor for the period between 2011 and 2015

	2011	2012	2013	2014	2015	Total
Number of papers in WoS	6	6	9	9	7	37
Number of papers in WoS base/FTE	0.25	0.25	0.30	0.30	0.22	1.32
Number of citations in WoS	33	7	20	18	6	84
Total impact factor	7.92	3.48	10.92	15.07	11.81	49.2
Average impact factor per paper	1.32	0.58	1.21	1.67	1.69	1.33

2.3. Information on scientific projects

In the period between 2011 and 2015, at the Faculty of Civil Engineering, research was carried out within **6** projects financed by the Ministry of Science, Education and Sports of the Republic of Croatia (MZOS) and Croatian Science Foundation (HRZZ). In that period, MZOS and HRZZ financed projects with the total amount of HRK 1,228,000.00.

In addition to the projects financed by the MZOS and HRZZ, the Faculty of Civil Engineering is the holder of many other research and technological projects financed by other state institutions, Josip Juraj Strossmayer University of Osijek and the European Union. In the period between 2011 and 2015, 38 research projects were agreed upon, in the total amount of HRK 7,926,120.33. The list of research projects conducted at the Faculty of Civil Engineering in the period between 2011 and 2015 is provided in Annex A.

In addition to accomplishing notable scientific results and publications, the experience gained in application, managing and administering of these projects helped strengthen the administrative capacities of the Faculty. It also contributed to the fulfilment of conditions for setting up an organizational unit for expert and technical assistance in the preparation and implementation of administratively demanding projects – the Office for International Cooperation, Scientific and Expert Projects.

2.4. Number of defended doctoral theses

Postgraduate Study Programme in Civil Engineering, harmonised with the Bologna declaration, has been delivered since the academic year 2005/2006. The number of students enrolled in the first year of the postgraduate study programme and the number of defended doctoral theses for academic years from 2010/2011 to 2014/2015, is given in Tables 2.3 and 2.4.

Due to noticeable problems arising from the general economic crisis and crisis in construction sector, visible in the small number of students enrolled in the postgraduate study programme in the period between 2010 and 2015, the Faculty of Civil Engineering reduced tuition fees from HRK 51,000.00 to HRK 30,000.00 and introduced and approved internal research projects, in accordance with Dean's decision. Internal research projects are intended primarily for conducting research in which students of the postgraduate study programme may participate. The result of reducing tuition fees and introducing internal research projects at the Faculty of Civil Engineering in Osijek can be seen in the increased number of enrolled students in the academic year 2015/2016 – 13 students.

Table 2.3 Number of enrolled students and defended doctoral theses in the period from 2010/2011 to 2014/2015

	2010/2011	2011/2012	2012/2013	2013/2014	2014/2015
Number of students enrolled in the first year of the postgraduate study programme	5	0	0	0	0
Number of defended doctoral theses	1	2	3	4	4

2.5. SWOT analysis per Departments

Basis for defining the future direction of research at the Faculty of Civil Engineering in Osijek is the SWOT analysis of every Department. Every scientist needs to be able to identify his/her own weaknesses and shortcomings, as well as the weaknesses and shortcomings of his/her associates, so that productive research environment can be established. As can be seen from the text below, Departments have realistically analysed their strengths, opportunities, weaknesses and threats.

DEPARTMENT OF MATERIALS AND STRUCTURES	
Strengths	**Weaknesses**
- Relatively high number of young scientists holding a D.Sc. title - State-of-the-art laboratory for materials and structures - Complementing of the Department members in scientific research due to their election to different scientific fields of technical sciences - Good scientific cooperation of the Department members with members of other Departments, visible in joint scientific publications and joint applications for research projects - Good scientific cooperation with similar national institutions - Good cooperation with economic operators in the field of professional work and recognisability of experts working at the Department within the economic sector	- Insufficient international recognisability / visibility of research - Relatively poor connections / cooperation with similar international institutions - Insufficient training of laboratory technicians in independent test implementation - Low number of teachers holding the highest scientific-teaching titles - Small number of research projects that Department employees lead or participate in at the national and international level
Opportunities	**Threats**
- Establishing connections with similar international institutions through involving more teachers in COST actions (TU 1404, TU 1301, TU 1304, TU 1208) and higher outgoing mobility of teachers - Improving visibility of research through recently publishing more papers in	- The state does not invest enough into science and scientific–research projects - Limited number of employment positions in development - Limited opportunities for advancement into higher teaching-scientific titles through redistribution of coefficients

journals with high impact factor - Strengthening the recognisability of the institution by including the journal e-GFOS in more citation bases - Accomplishing the prerequisites to found the Office for Application and Administrative Implementation of Projects	- Economic crisis in construction sector

DEPARTMENT OF ORGANIZATION, TECHNOLOGY AND MANAGEMENT	
Strengths	**Weaknesses**
- High scientific competencies of Department members, which has resulted in sufficient number of employees holding scientific titles to maintain the organizational status of the Department - High expert competencies of Department members – most members have had work experience outside the Faculty - Department has a representative in every committee of the Faculty of Civil Engineering Osijek - Satisfactory visibility of publication activities – updated information in the bib.irb base - Curriculum and syllabus of relevant courses are up-to-date, which is partly achieved by including the results of different research - Multidisciplinarity of Department members - Research and scientific activities of Department members are on the rise, as measured by the number of published scientific papers - Project activities of Department members in their own projects and/or projects of other institutions - Favourable age structure and structure of scientific titles of Department members - Good communication and cooperation with other departments and the Board of the Faculty of Civil Engineering Osijek	- Too heavy workload for some Department members (as measured by norm hours and student enrolment quotas) - Occasionally, too many administrative duties - Results of the University-wide survey – lower average grade of the Department employees - Succession of mentors' knowledge – not appointing co-mentors for doctoral theses - Poor communication and cooperation between the members of the Department
Opportunities	**Threats**
- More active scientific and research work that would include students - Moving to a more appropriate work area where all the Department members would be situated in one place - Cooperation with relevant institutions in Croatia and abroad	- Tendency to make the requirements for advancement into teaching-scientific titles more rigorous - It is difficult to employ the necessary personnel - Reduced funding of research projects at the national level - Declining number of interested students

- Forthcoming inclusion of e-journal e-GFOS into an A base - Mobility of Department members - Learning outcomes (CROQF) – raising the quality of education process - Drafting of the Strategy of the Faculty of Civil Engineering Osijek for the period 2016-2020, with defined objectives, priorities, measures and performance indicators	- Learning outcomes (CROQF) – loss of specificity of courses and possible need to achieve certain standards - Existing quantity and quality of IT equipment and software

DEPARTMENT OF GEOTECHNICS, TRANSPORTATION AND GEODESY	
Strengths	**Weaknesses**
- Possibility of further development in scientific, professional and teaching segments - Motivation of Department members - Beginning of work in new environment – laboratories and premises in the new building - Achieved favourable status regarding geotechnical expertise and participating in the market of highly-specialised services enables the continuation of cooperation with economic operators in Croatia and abroad through scientific and professional activities	- Having too many classes does not leave enough time for teachers to pursue scientific and expert activities - Lack of associates – assistants - Insufficient cooperation with relevant centres abroad - Shortage of scientific projects - Unsatisfactory number of publications
Opportunities	**Threats**
- Initiating cooperation with external science centres and faster and more successful education of younger associates - Better education for students in the new building – laboratories and other equipment - Continuing with activities of providing highly-expert geotechnical services to economic operators on the market - Application for international projects with other institutions from neighbouring and far away countries via various EU funds	- Insufficiently recovered market - Absence from teaching when participating in projects that require three to six months' absence - Lack of funds for development projects – long-term research - Restrictions imposed by state policy regarding science and education

DEPARTMENT OF HYDROTECHNICS AND ECOLOGY	
Strengths	**Weaknesses**
- Active collaboration with similar groups in Croatia and abroad - Active participation in the implementation of postgraduate doctoral study programme and in internal projects - Good cooperation with external stakeholders	- Insufficient number of scientific and teaching personnel - Diverse structure of employees within the Department (different professions, external associates) - Teaching workload and administrative workload is overwhelming

- Good cooperation with other (similar) constituents of the University - Number of assistants (3) and senior lecturers enrolled in the postgraduate study programme (2) - Procurement of new laboratory equipment in the last two years - Participation of employees in an international project - Participation of scientific and teaching staff in various associations - Participation of foreign guest lecturers in classes; introducing and implementing of new courses in the graduate study programme - Compliance with the needs and values of the economy - Good cooperation with practical experts for the purpose of delivering classes and exercises - Transparency of knowledge - Encouraging mobility - There are employees of different professions within the Department, which can contribute to interdisciplinarity - Long-time experience of employees with teaching and scientific-teaching titles in various areas (educational, professional and scientific) - Employees deliver classes at all levels of university and professional study programme	- Unsatisfactory scientific productivity as a consequence of the items 1 and 3 - Insufficient number of research projects as the consequence of items 1 and 3 - Too few assistants - Lacking experience in application of scientific projects - Insufficient scientific productivity - Insufficient number of expert projects and engagements - Due to high norm hours of teachers, there are no assistants at the professional study programme - Business hours of most Department employees are varying and uneven (work on Saturdays) - Impossibility of greater dedication to postgraduate study programme (especially teachers) due to extent of the workload - Insufficient cooperation within the Department - Lack of funds for equipping the laboratory to the desired standard
Opportunities	**Threats**
- Possibility of being involved in interdisciplinary projects (scientific and teaching) - Improvement of work conditions – in terms of laboratories and computers - Use of existing equipment for scientific research - Involving the Department in more applications for scientific projects after its younger members attain doctoral degrees - Cooperation with other institutions - Possibility of cooperation with foreign universities - Possibility of participation in interdisciplinary projects (scientific, educational and professional)	- Uncertainty regarding the development of the Department in terms of advancement of the existing members and increased number of new members - Uncertainty pertaining to the number of students taking this particular course of studies - Uncertainty pertaining to new scientific projects (national and international) - Uncertainty pertaining to advancement - Little possibility for increasing the number of employees - Uncertainty pertaining to separation of professional study programme and continued functioning of the Department

DEPARTMENT OF ARCHITECTURE AND URBAN PLANNING	
Strengths	**Weaknesses**
- Teachers' age structure (young teachers and associates) - Department delivers classes in many courses - Experience in interdisciplinary research and cooperation - Experience in managing and implementing of cross-border research projects (IPA HR-HU) - Cooperation with neighbouring regional universities and faculties (Novi Sad, Pecs, Mostar) - Teachers' involvement in European networking projects (COST, Erasmus) - Teachers are active in expert bodies (Croatian Chamber of Architects, Osijek Architects' Association, Croatian Architects Association, Matica Hrvatska) - Publication activities (university textbooks, books, manuals) - Expert activities (favourable structure – three licensed architects and two licensed architects – urban planners) - Scientific & research potential of assistants and lecturers – three employees at postgraduate study programme - Existing equipment for research in the field of construction physics and staff that is trained in conducting research with the equipment	- Unsatisfactory international recognisability - Overwhelming teaching workload and administrative workload - no administrative support when applying projects and collecting data in the Department - Lack of equipment for architectural imaging and research for the purpose of architectural heritage (measuring lasers, measuring station, materials for model making, etc.)
Opportunities	**Threats**
- Launching of undergraduate university study programme in architecture and urban planning as soon as possible - Fulfilling of prerequisites for organizing of graduate study programme in architecture and urban planning in the near future - Strengthening connections with the faculties with which we already have established cooperation in the field of joint application of scientific & research projects and projects whose objective is to improve teaching - Developing cooperation with professional bodies in the field of scientific and applied research - Intensifying cooperation with other Chairs	- Uncertainty pertaining to increasing the number of teachers upon the launch of the undergraduate and graduate study programme in architecture and urban planning - Instability of financing – non-existing sources of financing of scientific projects at the national level - Lack of mentorship/co-mentorship on doctoral research in the field of architecture and urban planning - Lack of support (in terms of staff) for accomplishing mobility of teachers

on the making of doctoral dissertations - Development of research in the field of construction physics, commercial use of existing equipment	

DEPARTMENT OF TECHNICAL MECHANICS	
Strengths	**Weaknesses**
- Quality equipment and good working conditions - Scientific & research potential of Department members - Active international cooperation initiated by some members of the Department - Excellent cooperation of postgraduate students and their mentors - Participating in the delivery of postgraduate study programme - Good cooperation between different Chairs within the Department	- Not enough scientific and teaching staff - Occasionally overwhelming administrative tasks - Not enough staff members to cover all the educational needs on the courses within the Department - Medium-intensity scientific productivity - Insufficient number of scientific and research projects
Opportunities	**Threats**
- Activities pertaining to improvement of existing and introducing of new courses - Activities pertaining to creating prerequisites for introducing a new specialisation at the graduate study programme level - Activities pertaining to motivating top students for scientific & research work - Activities pertaining to creating conditions for hiring of new assistants - Introducing assistants into the postgraduate study programme - Developing cooperation with other departments - Intensifying of international cooperation	- Uncertainty in transition from lecturing and assistant positions to scientific-teaching titles and positions - Uncertainty in transition from junior researchers' positions to scientific-teaching positions - Instability of financing of scientific & research activities at the national level

3. STRATEGIC OBJECTIVES OF THE FACULTY

Adopted Development Strategy of the Faculty of Civil Engineering Osijek 2016 – 2020, defines strategic objectives, measures and activities outlining the direction of the Faculty's development in the upcoming period. Special value of this Strategic Plan lies in the fact that all the stakeholders took part in its making: employees holding associate and scientific-teaching titles, employees in administrative and technical services, students at the undergraduate, graduate and postgraduate levels and representatives of construction companies. Based on the opinions and proposals of all the above-mentioned participants, the following objectives can be emphasized as being the most significant:

1. Overall increase in the scope, quality and visibility of scientific & research work;

2. Increase in the number of national and international scientific, research and technological projects;
3. Intensifying of national and international cooperation with faculties and research institutions, as well as maintaining the existing cooperation;
4. Strengthening the recognition of the postgraduate university study programme, as well as of the Faculty as a research institution;
5. Encouraging advancement and professional training of employees;
6. Fulfilling the prerequisites for founding of scientific centre of excellence for testing of structures;
7. Continuously developing postgraduate university study programme;
8. Establishing the system for encouragement and assessment of papers published in co-authorship with teachers at the university postgraduate study programme;
9. Interacting with teaching activities;
10. Accreditation of laboratories.

4. EXPECTED OUTCOMES OF THE STRATEGIC PLAN OF SCIENTIFIC RESEARCH

1. Increased quality of researchers by applying measures to encourage research excellence
2. Increased number of scientific projects accepted for funding, especially the competitive ones (Obzor 2020, UKF – Unity through Knowledge Fund, projects of the Croatian Science Foundation - HRZZ)
3. Intensified economic cooperation, which will support the application of research results and transfer of knowledge, innovations and technology
4. Improved knowledge of doctoral candidates and mentors in the field of project management area, with a special emphasis on research and scientific projects and with regard to connecting good practices in risk management, planning and project implementation with doctoral research activities.
5. Project funds will serve to upgrade of scientific infrastructure, especially of medium-value and high-value equipment. Organizational measures will ensure more efficient use of existing scientific equipment.
6. Increased mobility (incoming and outgoing) of mentors and doctoral candidates who gain relevant international experience in projects, thus encouraging the further development of an international researchers' network.

5. SCIENTIFIC TOPICS THE FACULTY INTENDS TO RESEARCH

Scientific topics the Faculty intends to research are shown in the Annex B of the Strategic Plan of Scientific Research, together with a detailed work programme and special objectives for each topic. The topics reflect the research interests of employees in each Department. In order to improve international recognition of scientific findings, the Faculty will encourage the establishment of larger research groups within and between the Departments focused on individual topics. It will also encourage the presentation of their topics and results on the Faculty’s webpage in English. Development directions of the Faculty in the field of scientific research are as follows:

- Encouraging the establishment of successful and internationally recognized research groups (Department of Technical Mechanics and Department of Materials and Structures)
- Encouraging implementation and development of collaborative scientific research (Department of Hydrotechnics and Ecology, Department of Organization, Technology and Management and Department of Architecture and Urban Planning)
- Encouraging more intense participation in the implementation of postgraduate study programme (Department of Geotechnics, Transportation and Geodesy)

6. ORGANIZATIONAL DEVELOPMENT PLAN OF THE FACULTY

Organizational development plan presents the main measures and initiatives related to the execution the strategic plan for scientific research:

- Establishment of research groups within and between the Institutes, and inclusion of researchers from the field of economy;
- Accreditation and reorganisation of the laboratories
- Use of purpose-specific resources to improve scientific research work by:
    - Adequately rewarding of researchers according to criteria of research excellence
    - Encouraging scientific project applications through adequate rewards for researchers, e.g. by reducing their workload
- Improving the researchers' quality by adopting criteria for assessment of assistants, doctoral candidates, teachers and mentors at the university postgraduate study programme
- Review of the existing University Postgraduate Study Programme in Civil Engineering
- Ensuring more efficient organizational structure and administrative support for project application and implementation

7. PERFORMANCE INDICATORS FOR THE IMPLEMENTATION OF THE STRATEGIC PLAN FOR SCIENTIFIC RESEARCH

7.1 Numerical performance indicators relating to scientific publications and international recognition

- Number of scientific papers published in journals indexed in the Web of Science database.
  Performance indicator: annual increase greater than 10%.
- Citedness of papers indexed in the database Web of Science.
  Performance indicator: annual increase greater than 10%
- Number of scientific papers in the five-year period published in databases CC, SCI, SCI-Expanded.
  Performance indicator: annual increase greater than 10% per categories of papers
- Number of scientific papers resulting from internal research projects
  Performance indicator: increase when compared with the previous period

7.2. Numerical performance indicators relating to scientific projects

- Number of applications of research projects in the five-year period
  Performance indicator: 50% increase by the end of the five-year plan
- Number of projects approved for financing in the five-year period
  Performance indicator: increase when compared with the previous period
- *Number of approved internal scientific and research projects*
  Performance indicator: increase when compared with the previous period

7.3 Scientific and professional training for doctoral candidates, postdoctoral candidates and other scientists

- Number of researchers who spent time at institutions abroad
  Performance indicator: increase when compared with the previous period
- Number of researchers included in COST
  Performance indicator: increase when compared with the previous period

ANNEX A List of projects agreed from 2011 to 2015

Table A.1 Croatian Science Foundation - HRZZ, Ministry of Science, Education and Sports – MZOS, projects agreed from 2011 to 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration	Approved funds
1.	Frame – masonry composites for modelling and standardization	Vladimir Sigmund, Faculty of Civil Engineering Osijek	HRZZ (Croatian Science Foundation)	From 2014 to 2017	EUR 100,000.00
2.	CompCroEU Closing the gap in compensation strategy and practice between Croatia and EU	Lovorka Galetić, Faculty of Economics and Business Zagreb, EFZG	HRZZ (Croatian Science Foundation)	From 15.9.2015 To 15.9.2018	HRK 292,000.00
3.	Seismic design of masonry infilled frames	Vladimir Sigmund, Faculty of Civil Engineering Osijek	MZOS (Ministry of Science, Education and Sports)	From 2007 to 2014	HRK 150,000.00
4.	Evaluation of relationships between investment projects and the environment	Ksenija Čulo, Faculty of Civil Engineering Osijek	MZOS (Ministry of Science, Education and Sports)	From 2007 to 2014	HRK 36,000.00

Table A.2 IPA projects agreed between 2011 and 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration	Approved funds
1.	IPA IV.1.1.1.05.01.c15 Strengthening women's position in the labour market	Faculty of Electrical Engineering Osijek-GFOS	European Social Fund, Operational Programme "Human Resources Development 2007 – 2013"	From 1.11.2013 to 30.6.2015	EUR 192,264.87

2.	Air Tightness, HUHR/1001/2.1.3/0009 Air tightness investigation of rooms from the point of view of energy and comfort in the frame of Hungary-Croatia	University of Pecs	Hungary-Croatia IPA Cross-border Cooperation Programme 2007-2013	2011-2013	EUR 124,243.58
3.	BUILDING ENERGETICS HUHR/1001/2.2.1/0009. Developing interdisciplinary study materials for architects, mechanical, civil and HVAC engineers, energy experts and installers in order to work together in multidisciplinary teams in the frame of Hungary-Croatia	University of Pecs	Hungary-Croatia IPACross-border Cooperation Programme 2007-2013	2011-2012	EUR 69,928.23
4.	„Development of investigation and analysis techniques for the assessment and lifetime expectancy of historical structures“	Faculty of Civil Engineering Osijek	Hungary-Croatia IPA Cross-border Cooperation Programme 2007-2013	2011-2012	HRK 387,765.00

Table A.3 Projects financed by the University of Osijek agreed between 2011 and 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration	Approved funds
1.	IZIP-2014-111 Micro models for seismic resistance forecast of loadbearing framed-masonry structures	Davorin Penava	Josip Juraj Strossmayer University of Osijek	From 2.3.2015 to 2.3.2016	HRK 15,000.00

2.	IZIP-2014-28 Analysis of infill effect on horizontal loading of framed masonry system	Jurko Zovkić	Josip Juraj Strossmayer University of Osijek	From 2.3 2015 To 2.3.2016	HRK 28,000.00
3.	IZIP-2014-125 Buckling of steel elements with variable cross section	Ivan Radić	Josip Juraj Strossmayer University of Osijek	From 2.3.2015 To 2.3.2016	HRK 20,000.00

Table A.4 Projects funded by the Faculty of Civil Engineering Osijek, agreed between 2011 and 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration	Approved funds
1.	Effects of explosions on span structures of overpass	Damir Varevac, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2018	HRK 77,877.56
2.	Controlled seismic behaviour of masonry-infilled steel frames	Damir Markulak, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2020	HRK 119,833.53
3.	Effects of soil-structure interaction in performance based design (abbr. PENDULARUM)	Dragan Morić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2020	HRK 160,000.00
4.	Influence of drainage canals on nitrate pollution and retention of pollutants in canal beds	Lidija Tadić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2018	HRK 168,200.00
6.	Microsimulation modelling of children pedestrian movements	Irena Ištoka - Otković, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2018	HRK 25,000.00
8.	Multi-objective optimisation for urban drainage systems	Marija Šperac, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2019	HRK 27,000.00
9.	Seismic vulnerability potential of urban areas	Marijana Hadzima - Nyarko, Faculty of Civil	Faculty of Civil Engineering	From 2016 to 2020	HRK 111,400.00

		Engineering Osijek	Osijek		
10.	Modelling and simulation of mineral mixtures convective drying process in the production process of asphalt mixtures	Zlata Dolaček - Alduk, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2018	HRK 45,170.00
11.	Humidity effect on properties of masonry structures	Ivanka Netinger Grubeša, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2019	HRK 274,500.00
12.	Evaluation of experimental methods for determination of the heat transfer coefficient in steady state conditions	Hrvoje Krstić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2019	HRK 177,354.42
13.	Influence of openings on the out of plane seismic response of framed masonry structures	Davorin Penava, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	From 2016 to 2020	HRK 50,000.00
14.	Preliminary experimental testing of concrete with crushed bricks and roof tiles	Ivana Miličevć, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 - 2012	HRK 20,000.00
15.	Experimental testing of concrete ceiling elements with crushed bricks and roof tiles	Ivana Miličevć, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2013 – 2014	HRK 18,000.00
16.	Composition optimization of pavement cement stabilized base course with slag	Ivana Barišić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 - 2012	HRK 20,000.00
17.	Design of steel frame structures with masonry infill	Ivan Radić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 - 2012	HRK 6,000.00

18.	Effects of explosions on small and medium span bridges	Hrvoje Draganić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 - 2012	HRK 20,000.00
19.	Experimental determination of explosion parameters	Hrvoje Draganić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2013 – 2014	HRK 18,000.00
20.	Seismic response spectra of shallow founded structures on soft soils	Ivan Kraus, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2013 – 2014	HRK 20,000.00
21.	Determining ultimate bearing capacity of infilled-frames	Goran Gazić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 - 2012	HRK 20,000.00
22.	Analysis of visual impacts of large infrastructure projects in river Drava corridor in Osijek-Baranja County	Dina Stober, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 – 2012	HRK 7,000.00
23.	Applicability of cost prediction model for buildings operation and maintenance	Hrvoje Krstić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2011 – 2012	HRK 7,000.00
24.	Use of pervious concrete made with steel slag for pavement	Krunoslav Ćosić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2013 – 2014	HRK 17,500.00
25.	Mechanical properties of available structural aluminium alloys	Tihomir Dokšanović, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2013 – 2014	HRK 14,400.00
26.	Impacts of hydro-melioration surface drainage systems maintenance on shallow ground waters of Drava and Danube river basins	Tamara Dadić, Faculty of Civil Engineering Osijek	Faculty of Civil Engineering Osijek	2013 -2014	HRK 15,570.63

Table A.5 EU FUNDS - projects agreed between 2011 and 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration	Approved funds
1.	HR.3.1.15-0025 Development and application of CROQF in higher education of civil engineers	Zlata Dolaček – Alduk, Faculty of Civil Engineering Osijek	European Social Fund, Operational Programme "Human Resources Development 2007 – 2013"	From 19.6.2015 To 30.9.2016	HRK 2,992,281.59
2.	Research of river-port sediment and its potential use in civil engineering	Ivana Barišić, Sanja Dimter, Lidija Tadić, Tamara Dadić, Faculty of Civil Engineering Osijek	Danube Region Strategy – START Danube Region Project Fund	From 2015 to 2016	EUR 16,499.00

Table A.6 COST projects agreed between 2011 and 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration
1.	COST Action TU1404 Towards the next generation of standards for service life of cement-based materials and structures	University of Minho, Azurem Campus, Portugal	COST – European Cooperation in Science and Technology	From 2015 to 2019
2.	COST TU1401 Renewable energy and landscape quality (RELY)	Nuertingen-Geislingen University, Nuertingen, Germany	COST – European Cooperation in Science and Technology	From 16.10.2014 To 15.10.2018
3.	COST Action TU1208 Transport and Urban Development, Civil Engineering Applications of Ground Penetrating Radar	Roma Tre University, Italy	COST – European Cooperation in Science and Technology	From 4.4.2013 to 3.4.2017

4.	TUD COST Action TU1301-NORM for Building materials (NORM4BUILDING)	Universiteit Hasselt, Campus Diepenbeek, Belgium	COST – European Cooperation in Science and Technology	From 2014 to 2016

Table A.7 Bilateral cooperation – research projects agreed between 2011 and 2015

No.	Code and title	Holder and institution	Programme or source of financing	Project duration	Approved funds
1.	Nonlinear analysis of RC frames with types of infill characteristic for Macedonia and Croatia	Vladimir Sigmund, Faculty of Civil Engineering Osijek	Ministry of Science, Education and Sports, Scientific and technical cooperation between the Republic of Croatia and Republic of Macedonia for 2012, 2013 and 2014	From 2012 to 2014	HRK 10,000.00
2.	Developing a model for assessment of building energy efficiency in terms of air tightness	Hrvoje Krstić, Faculty of Civil Engineering Osijek	Ministry of Science, Education and Sports, Co-financing of Croatian - Serbian research projects for 2016 and 2017	From 2016 to 2017	EUR 1,500.00

ANNEX B: Scientific topics of the Faculty of Civil Engineering Osijek

Topic 1	**Modelling and simulation of mineral mixtures convective drying process in the production process of asphalt mixtures**
Abstract	Within the proposed project, the numerical modelling will be made and verified through experimental research of reduction of moisture in the composition of mineral mixture by convection drying stone material. Moisture reduction directly affects energy consumption for heating and drying mineral mixture in a rotary drum. Potential of exhaust gas, as fuel in the drying process, the temperature of which is about 80° C at the outlet from the chimney of the asphalt plant, is examined. Special contribution of this research is modelling of drying curves for different fractions of mineral mixtures and formulating optimization models of stone material drying regime.
Research objective	Objective of the research is to determine the equation of the drying curve of moist stone material depending on drying time w = f (t), the equation of the temperature curve depending on drying time T = f (t) and the ratio of change in the moisture content of stone material and the speed of the material on a conveyor belt dw / dv. In addition to determining the relationship between moisture, temperature and drying speed, the research is aimed at determining the possible thermal potential of exhaust gas as a source of hot air for drying of stone material. Using heat recovery is imperative in terms of energy management, imperative of modern times and development of technics and technology and environmental protection. Objective of the research is to define the parameters that define the drying process of mineral mixture– drying speed, drying temperature and invested energy, which affect consumption of energy necessary for drying and heating of mineral mixture in a rotary drum.
Expected results	Research, mathematical modelling and laboratory tests will be conducted in order to develop a mathematical model that describes the kinetics of convection drying directly at the entrance of the rotary drum in the production of asphalt mixtures in cyclic asphalt plants. The developed model will describe the moisture content and temperature of the mineral mixture in relation to the hot air temperature and duration of the short-term drying process. These relationships will enable determination of the models and mechanisms of transfer of moisture that the material loses in the drying process and moisture the air receives in the drying process. The result of the research is the assessment of thermal potential of exhaust gases and contribution to possible energy savings in the process of drying and heating of the mineral mixture in the rotary drum.
Associates on the topic	2 researchers holding a scientific-teaching title 1 postdoctoral researcher 1 postgraduate student

Topic 2	**Evaluation of experimental methods for determination of the heat transfer coefficient in steady state conditions**
Abstract	The objective of the project proposal is to evaluate and compare the existing experimental and calculation methods used for determination of the thermal transmittance (U value) as the most important parameter for describing the thermal performance of building elements and, consequently, of the overall energy performance of a building. The research will focus on masonry made of wall elements typical for local area. Correlation will be established between the U values determined by non-invasive experimental methods (infrared thermography and in situ measurement) and analytical methods, together with influence of airtightness and humidity to the change of the U value of building elements. Research results will be used for more precise determining of input parameters of existing calculation methods and for improvement of existing experimental methods.
Research objective	The purpose of the research is evaluation, comparison and improvement of existing experimental methods (infrared thermography and in situ measurement) and calculation methods for determining the heat transfer coefficient (U-value) in controlled and steady

	state meteorological conditions. The research will enable broader implementation of the mentioned methods in existing buildings with increased accuracy of measurement results. Research objectives: • To determine the correlation coefficient between the heat transfers coefficients obtained by non-destructive experimental methods (infrared tomography and in situ measurement) and the values obtained by calculation methods in controlled conditions. • Correlation coefficients between heat transfer coefficients obtained by non-destructive experimental methods (infrared tomography and in situ measurement) and the values obtained by calculation methods will be described by existing mathematical models for each of the mentioned methods, with analysis and evaluation of existing models and required parameters. • After analysis of obtained results, a mathematical model will be made which will enable a more detailed insight into thermal performance of structural elements of existing buildings (more precisely, masonry) and application in existing buildings for more detailed prediction of heat transfer coefficient. • To determine the correlation coefficient between humidity level in structural elements, air-tightness and heat transfer coefficient of structural elements • To expand existing computer database with U-values of structural elements
Expected results	The conducting of proposed research is expected to yield the following results: • Determining the correlation coefficient between heat transfer coefficient (U-value) obtained by non-destructive experimental methods (infrared tomography and in situ measurement) and the U-values obtained by calculation methods. • Determining the correlation coefficient between humidity level, air-tightness and thermal performance of structural elements before and after occurrence of damage on it, with and without thermal insulation • Improvement of the existing calculation method for calculating U-value of structural elements and expanding the existing computer databases with U-values • Determining the quality of existing technologies of repair of damaged structural elements with the aim of achieving the prescribed thermal requirements of buildings after carrying out of repair works • Defining the effect of mechanical fixings for thermal insulation on the creation of thermal bridges and airtightness before and after occurrence of damage • Presenting the project and its results –A and B category journals • Possible OPTION – Defining thermal performance and air tightness level of steel and RC frames with masonry infill before and after occurrence of damage
Associates on the topic	5 researchers holding a scientific-teaching title 1 postgraduate student 1 assistant

Topic 3	**Seismic vulnerability potential of urban area**
Abstract	Seismic risk is the measurement of the damage expected in a certain area and in a given interval of time. It is based on the level of location seismicity (hazard), resistance of buildings (vulnerability), and the type, quality and quantity of exposed assets (exposure). It can be measured by the expected economic loss, loss of life or extent of damage to property. Reducing the seismic risk comprises three phases: assessment, planning and implementation. The risk assessment requires a multidisciplinary approach that takes into account the expected physical damage (damage to buildings and economic losses), as well as social, organizational and institutional factors. At the city level, a risk assessment should start with assessing of the physical damage as the basic tool and the result of connection between the hazard and vulnerability of buildings.
Research objective	Earthquakes are one of the most dangerous, most devastating and most unpredictable natural disasters that can destroy areas of several hundred kilometres in a second. It is impossible to predict where and when the next earthquake will occur, but people's awareness that continuous population increase is connected to increase in size of the cities and in their number in seismic areas can result in lessening of potential catastrophic consequences. For that reason, reducing losses caused by earthquakes is one of crucial

	points in the assessment of seismic risk. Area of the Republic of Croatia is characterized by pronounced earthquake activity and it is at risk from earthquakes with peak ground acceleration in the range between 0.1g and 0.38g. More than half of Croatian territory is designated as zones with a very high risk of seismic activities. National Protection and Rescue Directorate of the Republic of Croatia (DUZS) estimates there is a high risk of earthquakes of VIII and IX degree intensity on the MCS scale on 36.42% of the state territory. The area where there is a risk of earthquakes is populated by approximately two-thirds of the Croatian population (about 2,801,287 people). The risk of earthquakes of VII degree intensity on the MCS scale exists on more than half of the territory of the Republic of Croatia (56.22%), where just over a third Croatian population lives (about 1,633,529 people). In order to minimize catastrophic earthquake aftermath, procedures before, during and after an earthquake must be defined. Therefore, the main objective of this project is to develop the methodology for assessment of seismic vulnerability in line with the latest scientific achievements regarding social and economic losses of buildings using the city of Osijek for this project. It will enable risk assessment and it will serve as the basis for the future application in the region for effective measures to reduce seismic risk in urban areas. The project will include the development of a framework for seismic vulnerability and risk assessment for defined building typology in the selected urban complex (in this case, the city of Osijek). The objective of the project is development of new, scientifically based knowledge about the potential seismic risk we are exposed to on a daily basis, and deciding on measures to be taken in the short- and medium term to reduce the human casualties and economic losses to a minimum after a potential natural disaster. The objective of the project is to develop a framework for Seismic Risk Management Strategy, which represents a public risk management process, in order to reduce unacceptable risk to acceptable levels. It includes involvement of appropriate science and technology with the purpose of reducing the consequences of future earthquakes. In addition, it includes the regulatory process to ensure the reduction of unacceptable risk. To achieve this, the country must develop the ability to achieve scientific, technical, social, political, legal and economic consensus for establishment and implementation of public policy on reducing seismic vulnerability values and reducing unacceptable risk. This requires long-term investment in an entire complex of integrative and other aspects of earthquake risk reduction, such as mitigation, preparedness, emergency response (quick response to the occurring outstanding hazard), and measures related to reconstruction and recovery, and appropriate regulations.
Expected results	Main achievements and expected results of the project are the project are as follows: 1. Building typology for representative urban area (Osijek); 2. Building typology will be done within the GIS system; 3. Vulnerability curves for assessment of physical and socio-economic vulnerability for all risk elements; 4. Vulnerability coefficients for assessment of physical and socio-economic vulnerability for all risk elements of the observed urban area; 5. Development of methodology for risk assessment for the observed urban zone with possible application in any other zone. 6. Developing framework for implementation of strategy for reducing of seismic risk 7. Determining seismic risk – for an area (or a specific building) – that represents an analytical method that integrates information, data bases and maps showing general characteristics and vulnerability of developed area, in order to get answers to the following questions: - What could happen (economic losses, number of injured, number of dead and function losses – that can be expected due to soil vibrations)? - What are the probable consequences and losses that could be expected for every possible outcome? - What unexpected circumstances may occur for every possible outcome? 8. Possibility of application region-wide in terms of effective measures for reducing seismic risk in urban areas; 9. Defining a framework for developing of Seismic Risk Management Strategy.

Associates on the topic	2 researchers holding a scientific-teaching title 1 postgraduate student

Topic 4	**Influence of drainage canals on nitrate pollution and retention of pollutants in canal beds**
Abstract	In the continental part of Croatia, especially on small catchments of the rivers Danube and Drava, where agriculture is the predominant economic activity, the pressure on water quality and quantity is significant. Nitrate water pollution is the most significant pollution and it represents a dominant problem in the protection of surface and ground water. At the same time, due to climate changes, the need for water keeps increasing. For those reasons, approach to surface drainage has changed toward retention of water on catchment area and reduction of eutrophication sources by reduced canal maintenance. Effect of longer retention of vegetation in drainage canals depends on hydrological and pedological characteristics, as well as on the conditions of soil cultivation. At the same time, sediment polluted mostly with phosphorus and heavy metals is retained in canals and can be released in water. As part of technical maintenance of the canals, sediment is removed and disposed on arable fields without testing its quality. By means of field tests, spatial and temporal patterns of pollution of groundwater and sediment in drainage canals will be analysed. Based on the tests, a model of groundwater flow and pollution transport will be made and recommendations will be given for canal maintenance and disposal of extracted sediment.
Research objective	Agricultural plots situated on small river catchments represent potential contamination of surface water, but also of shallow groundwater reached by the leachate water from the plots, over a wide area. Therefore, it is very important to consider ways of preventing its further spreading and reducing its concentration in order to achieve the least possible impact on the environment. Research comprises two parts: (1) The first part of the research pertaining to nitrate transfer through subsurface soil layer aims to define the hydrological and hydraulic connection between pollution, natural conditions and types of tillage in order to clarify, as much as possible, the role of barriers between sources of pollution and the rest of the catchment area. (2) The second part of the research aims to determine the intensity of water erosion on a small catchment area where agriculture is the predominant economic activity, and the degree of contamination of sediments in a canal with phosphorus and heavy metals. The purpose of the research is to fully define the water-soil-contamination interaction within the complex processes occurring in the surface and subsurface soil layers and to give recommendations for the maintenance of the canal network, which would be in line with environmental protection and the applicable European Directives (Water Framework Directive 2000/60/EC, Nitrates Directive 91/676/EEC, Groundwater Directive 2006/118/EC).
Expected results	By conducting this research, the impact of particular parameters on nitrate concentration in shallow ground water around amelioration canals will be defined and the process itself will be thoroughly analysed. Because of vegetation, it is expected that nitrate concentration will not exceed the maximum allowed concentration of 50 mg/l. The study will result in a model of groundwater flow and pollution transfer in hydromorphic soil. It will grade the effectiveness of different ways of maintaining the canals in order to reduce nitrates and it will result in recommendations for practical application. The research will determine the dynamics of sediment formation in canals in the continental Croatia, for hydromorphic soil and mild terrain slope. It will also determine the correlation between the formation of sediment in canals and hydrological characteristics of the area and explain the process of sediment formation in these conditions. Based on the analysis of sediment/deposits contamination with phosphorus and heavy metals, recommendations will be given for dealing with the sediments extracted from the canals, as well as for further activities on the categorization and monitoring of such pollution.
Associates on the	1 researcher holding a scientific-teaching title 1 postgraduate candidate

topic	1 assistant

Topic 5	**Microsimulation modelling of children pedestrian movements**
Abstract	The subject of the project is microsimulation modelling of children pedestrian movements, with special emphasis on children between five and ten years of age. Indicators of risky behaviour in real traffic environment will be analysed and reaction time of children and adult traffic participants will be measured and compared. The results will be the starting point for 1) analysis of traffic safety parameters of the road network near the selected schools and kindergartens, and 2) calibration of microsimulation traffic model for modelling pedestrian movements of children. The calibrated model for simulation of children pedestrian movement enables us to analyse safety aspects of urban transport network in terms of most vulnerable traffic participants, but also to model the evacuation of children in the case of an extraordinary event.
Research objective	Objectives of the project are as follows: 1. Analysing behaviour of children in real traffic conditions at selected locations and assessment of the type and frequency of risky behaviour 2. Improving the safety of children in traffic by proposing measures pertaining to road infrastructure, traffic regulation, other traffic participants and parents 3. Applying microsimulations in modelling of children pedestrian movements 4. Applying microsimulations in the analysis of different scenarios of children's evacuation in an emergency event
Expected results	Working hypothesis is that the reaction time of target group reduces proportionally to age groups and that in the conditions of increased concentration (test) it will not deviate significantly from the control group. Greater deviations will show the response time in real-life traffic situations due to dissipated attention, especially when moving in groups. Within the project, expected results pertaining to objective 1: • Determining and comparing of reaction time of children, adult traffic participants and drivers, • Analysis of the children's risky behaviour in real-life traffic situations at selected locations near schools and kindergartens, in the primary and secondary road network. Expected results pertaining to objective 2: • Making of proposals and assessments of measures to improve traffic safety at selected locations through application of microsimulation modelling, • Improving of safety features of the observed locations, • Improving public informedness (parents, local government units, traffic police) and • Educating target group about desirable behaviour in real traffic conditions Expected results pertaining to objectives 3 and 4: • Applying microsimulations in choosing an optimum way to school in accordance with the criterion of safe movement of pedestrians • Applying microsimulations in choosing an optimum way of evacuation for different scenarios of emergency events in schools and kindergartens
Associates on the topic	2 researchers holding a scientific-teaching title 1 postdoctoral researcher 1 postgraduate student 1 assistant 6 students

Topic 6	**Controlled seismic behaviour of masonry infilled steel frames**
Abstract	Masonry products such as clay and autoclaved aerated concrete (AAC) blocks are often used for infill of steel and reinforced concrete frames due to their availability and acceptable cost. The fact that presence of masonry infill significantly changes the behaviour of the frame is well known by now, but there are still no clearly defined methods or code rules for detailed design of such type of structures. Two opposite approaches to decreasing possible detrimental effects of the masonry infill have been distinguished: strengthening of the

	masonry infill or separation of the masonry infill from the surrounding frame. This project proposal is aimed at researching of a “compromise” solution that would combine both approaches – utilizing of the beneficial effects of the masonry infill along with limiting of detrimental ones.
Research objective	When it comes to behaviour of frame-masonry infill interactive system, there is still no expert consensus or a harmonized method for structural modelling and calculation. Owing to the relatively frequent application of masonry infill in this geographical region, the objective of the project is to expand the understanding of the behaviour of this system. Another objective is to explore the possibility of application of a structural concept that would make it possible to use the beneficial effects pertaining to addition of masonry infill into steel frames, while simultaneously limiting the possible detrimental effects. This is to be achieved by using simpler structural interventions and recycled materials that are often regarded as waste materials, in order to keep the essential advantages of masonry infills (availability, simplicity of infilling and maintenance, acceptable cost). As a result, this would increase the probability of application of research results in practice.
Expected results	Based on the conducted experimental and numerical research, a final verification of the possibility of application of the suggested structural solution is expected. This solution would achieve (passive) controlled seismic behaviour of masonry infilled steel frames. A significant element in this process would be to adopt an adequate “recipe” which would enable making of precast elements or incorporation of self-compacting concrete made with recycled materials. This would make it possible to make the “weaker” part of infill right next to the steel frame. Moreover, other possibilities for making of such “controlled” passive layer of infill could be explored. These possibilities are in line with the suggested idea of controlled cracking at a certain level of seismic load. For enabling a broader practical application, a calculation method/procedure will be analysed and suggested. This method/procedure will serve as a means for defining the properties of composite infill and for selecting categories of stronger and weaker infill, depending on the design requirements pertaining to the location of the structure.
Associates on the topic	5 researchers holding a scientific-teaching title 1 assistant

Topic 7	**Effects of soil-structure interaction in performance based design**
Abstract	Foundation soil compliance affects the level of required ductility of shallow founded structures and thus it affects their level of safety and economic outlook. After more than 40 years of research, this is still an open question that requires further research. Through (i) experimental tests in new laboratory of the Faculty of Civil Engineering Osijek on different large scale soil-structure models by means of both reactive wall and reactive slab and (ii) through tests in new geotechnical centrifuge at the same laboratory using the equivalent small scale models together with (iii) detailed parametric study on numerical models calibrated with respect to the experiments, this project aims to shed new light on the seismic behaviour of the shallow founded structures.
Research objective	The main objective of the project is to further examine the effect of foundation soil compliance on seismic behaviour of shallow founded structures through original experimental tests on large-scale models and detail parametric analysis in order to develop new knowledge and to increase the level of safety of earthquake resistant structures. To date, large parts of seismically active areas have been covered with structures designed by using the standards we now consider obsolete and overly conservative, and often under the assumption that a structure can be considered fixed in non-deformable surface, which, of course, does not correspond to the actual situation. Furthermore, the objective of the project is to successfully carry out experimental tests on large-scale models of structures which are shallow founded on soft soil and can have their vertical load-bearing elements plasticized. This is done with the aim of contributing to the engineering practice and academic community in terms of understanding the effects of soil-structure interaction on the required ductility of structures. Considering that so far,

	worldwide, only few experimental tests were carried out on large-scale structure models, this project aims to contribute to the world database of experimental research results obtained from large models of structures with the purpose of their better understanding and final purpose of creating a safer surrounding for people living in seismically active areas. In addition, the successfully conducted experiment, the results of which would be globally available for use after the project completion, would undoubtedly contribute to the recognisability, competitiveness and reputation of the Faculty of Civil Engineering in Osijek.
Expected results	1) Original experiment in large-scale, which properly describes actual structures 2) Device/sieve for spreading sand over large surfaces 3) Structure model that may be used repeatedly with possible replacement of its integral parts or with upgrades 4) Addition to European functions for calculation of response spectrum for soft soils in terms of including the effects of dynamic soil-structure interaction 5) Impedance functions for horizontal movement and overturning calibrated with respect to the experiment 6) Algorithm for the inclusion of the effects of soil-structure interaction into the European N2 nonlinear static method, which would be tested with respect to the results of experiments and other similar existing proposals of performance based calculation methods 7) Graphs which enable for the prolongation of the oscillation period of a structure to be evaluated with respect to soil compliance over broad range of parameters 8) An improved and tested small geotechnical centrifuge as a tool for improving the quality of the curriculum at the Faculty and a platform for strengthening of knowledge and skills of future civil engineers 9) Doctoral thesis, as a valuable original paper that contributes to the existing engineering knowledge and to the design of structures that are safer and more reliable for people 10) At least three scientific papers (articles) published at international or global conferences 11) At least three scientific papers (articles) published in world-renowned journals represented in Science Citation Index (SCI) and Current Contents (CC) databases 12) Online database with open access to not-analysed results of the experimental tests carried out within the project framework.
Associates on the topic	1 researcher holding a scientific-teaching title 1 postdoctoral researcher 1 postgraduate student

Topic 8	**Multiobjective optimisation for urban drainage systems**
Abstract	The project pertains to integral optimization of existing and future urban drainage systems: from optimizing project size and optimizing system operation to optimizing maintenance and rehabilitation. Based on criteria and limits for achievement of the objective function (data collected from municipal utility companies), the base of conventional hydrological and mathematical models will be optimized. Models of expert systems such as decision trees, neural networks and genetic algorithms will be applied for the optimization of urban drainage systems. Analysis of obtained results will show the advantages and disadvantages of applying the models of expert systems in the process of system optimization.
Research objective	The purpose of the research is the application of the optimisation procedure on all segments of urban drainage system with the objective of increasing the efficiency of the system. The objective of the research is to explore the possibilities surrounding the application of models of expert systems in the optimisation process.
Expected results	Expected results: potential proposal of a doctoral thesis of a future doctoral candidate; publication of research results through articles published in journals indexed in WoS; papers published at science conferences with an international review
Associates on the topic	1 researcher holding a scientific-teaching title

Topic 9	**Effects of explosions on span structures of overpass**
Abstract	The research is aimed towards determining the sensitivity of the bridge (overpass)

	superstructure to the effects of an explosion on the road under the bridge. Because of its location and significance, collapse of such a structure may result in disruption of traffic on vital roads. Numerical simulations are conducted with using the so-called hydrocode software, specialized for solving fluid flow problems and fluid interaction with structures. However, such simulations are not reliable enough or studied enough and this research will be used for numerical model calibration, and for experimental investigation of the influence of explosion parameters (charge shape, distance, TNT equivalent, reflection of blast waves) on blast pressures. Experimental investigation of parameters would provide accurately measured data that could then be compared to the results of the numerical simulations.
Research objective	The testing has to be carried out in highly controlled conditions and it has to be carried out by specially trained persons with a licence to access and handle explosives. Given that the Faculty of Civil Engineering does not possess the required licences, the testing would be carried out in cooperation with the Anti-explosion Department of the Police Administration of Osijek (a contract on cooperation has been concluded with this Department, by virtue of which the Department agrees to provide personnel, explosives and the grounds for conducting the experiment). The purpose of the project is to carry out experimental testing of explosion parameters, to gather the results on the blast wave in a single database and to compare the obtained results with numerical simulations of the same scenario. Accurate determination of explosion parameters is an important initial step in the studying of effects of explosion on structures, considering the fact that accurate determination of explosion as a load is a prerequisite for correct further analysis of a structure (correct determination of cutting forces and sizing). Currently there are no standards or regulations prescribing the process of determining the load resulting from effects of the explosion, other than a few military manuals that are limited to military applications and are hardly accessible to the general public. A comparison of experimentally and numerically obtained results would evaluate the accuracy and reliability of numerical simulations in the analysis of new problems for which no experimental research can be conducted. The research would be conducted for two types of explosives that the Anti-explosion Department has at its disposal and that are most commonly used for destruction of discovered unexploded landmines left behind after the Croatian War of Independence. The parameters measured for both types of explosives would enable the determining of an equivalence coefficient and verification of the previously known coefficient used in daily practice for calculation of the amount of explosive charge required for destruction of unexploded landmines. This information is also interesting for the Anti-explosion Department, as it can help them optimize the use of available explosives.
Expected results	The project would result in conducted experimental research that would be the first of this kind in the territory of Croatia, but also one of the rare studies of this type in Europe and in the world. Experimental testing would yield a database of gathered data on pressure levels, speed and moments of impact of blast wave for explosions involving the selected quantities and types of explosive charge (two types of explosives). The researcher and the associates would become trained in handling the procured equipment, which would exclude the need for a third party to conduct measurements during experimental testing. The equipment would become part of the primary assets of the Laboratory of Materials and Structures of the Faculty of Civil Engineering in Osijek, and it could be used in future research of the similar or same type. Based on experimental data, one would be able to determine the accuracy of numerical simulations of detonation of explosives in the same scenario, as well as the loads on structures and the reliability of its application in future simulations. A comparison of experimental results for different types of explosives would result in determining the coefficient of equivalence based on which the Anti-explosion Department could optimize the use of explosives in various real-life situations that require its intervention. Another very important result is the determining of an optimum amount of final elements, so that the time of the calculation would reduce as much as possible but with accuracy of results remaining acceptable nonetheless. The results of the experiment would serve as a reference value in that context. Namely, previous research conducted by this project team has proven that oversized final elements (of 10 – 50 cm) do not provide accurate results, not

	even results that would have been approximately accurate, both when it comes to pressure levels and times of impact of blast wave. However, reduction of final elements exponentially prolongs the calculation time, but even such reduction does not guarantee increased accuracy. In previous simulations, it transpired that in the event of interaction between air and structure with reduced size of final elements the obtained results are still diverging. Furthermore, it would be possible to determine the effect of secondary parameters on relevant elements that impact pressure, such as the shape of the explosive, position of the ignition point within the explosive charge and alike.
Associates on the topic	2 researchers holding a scientific-teaching title 1 postdoctoral researcher 1 postgraduate student Anti-explosion Department of the Ministry of the Interior of the Republic of Croatia

Topic 10	**Influence of openings on the out of plane seismic resistance of framed masonry structures**
Abstract	Within the project, the out of plane seismic resistance of the reinforced concrete frame structure with masonry infill (framed walls) with openings will be investigated. The properties of the structure and excitation are provided within the framework of the research project "FRAmed-MAsonry Composites for Modelling and Standardization – FRAMA" supported by the Croatian Science Foundation. Masonry units used on real and calculation micro model will match the production of masonry units in Croatia, so research results will contribute to local production. Using the ATENA software, micro model will be built and calibrated with actual structural model. Then, the model will be used to investigate the response of the structure under simultaneous seismic action in two orthogonal directions, while exciting the framed-walls both in and out of plane. By taking into account the possibility of openings of different sizes and placement and walls without openings, most important properties for a simplified calculation model acceptable to practitioners will be found. Different damage states (undamaged - slightly damaged - heavily damaged but usable - heavily damaged and unusable - collapse) will be considered in the process. Additionally, it will be determined to what extent the existence of masonry infill in reinforced concrete structure contributes to seismic resistance of the frame and gives useful (positive) effect, and when it becomes disturbing element of the increasing vulnerability of the structure. The possibility of observing the framed walls as a single structural element will be Investigated and practical instructions for use in design of buildings will be determined.
Research objective	The project complements the research project "FRAmed-MAsonry Composites for Modelling and Standardization – FRAMA" of the Croatian Science Foundation that is conducted by the Faculty of Civil Engineering in Osijek, since it connects the results of experimental tests on actual model of reinforced concrete frame structure with hollow brick infill with openings (framed walls) and the calculation micro models and simplified models. The response of the two latter models will be calibrated with the response of the actual model. The suitability of calculation micro models and of existing simplified models will be determined with regard to the assessment of structure response. In addition, new simplified models will be introduced or the existing ones will be improved because no adequate method for determining the response in these structures has been found yet, especially in the case of simultaneous seismic action in two orthogonal directions, while exciting the framed-walls both in and out of plane. Masonry units used on actual and calculation micro model will match the production of masonry units in Croatia, so research results will contribute to local production. Based on the determined response of the calculation micro models of particular framed walls, curves will be determined defining the interaction between resistances of structural element in and out of plane. Moreover, the suitability of existing simplified models used for assessment of structure response will be determined, and new simplified models will be introduced or the existing ones will be improved. Based on the obtained results, guidelines for designers and contractors will be composed, with the aim of improving load-bearing capacities and reliability in the process of response calculation for existing structures and design of new structures. The ultimate objective is to determine to what extent the existence of masonry infill in reinforced

	concrete structure contributes to seismic resistance of the frame and provides a useful (positive) effect, and when it becomes a disturbing element that increases the vulnerability of the structure. All this will be done for the purpose of observing framed wall as a unique composite structural element.
Expected results	The outcomes of research pertaining to in and out of plane seismic resistance of the reinforced concrete frame structure with hollow brick infill (framed walls) with and without openings will contribute to the understanding to what extent it is possible to calibrate the response of calculation micro model with the actual structural model, using the software ATENA (Cervenka Consulting s.r.o. 2015), in order to compensate for the complex experimental research. Masonry units used on actual and calculation micro model will match the production of masonry units in Croatia, so research results will contribute to local production. Possibilities and limitations of application will be determined, and guidelines will be drafted for improving the reliability of calculation micro models. The following will also be determined: response of the model of the structure under simultaneous seismic action in two orthogonal directions, while exciting the framed-walls both in and out of plane (by taking into account openings of different sizes and placement and walls without openings); limits, i.e. values of storey drift, damages, and threats to stability of a structure or structural elements during different damage stages (undamaged - slightly damaged - heavily damaged but usable - heavily damaged and unusable - collapse). By conducting sensitivity tests, it will be determined what the most important material and geometric properties are that influence the response of actual and calculation micro model, by taking into account different damage states. Based on the determined response of calculation micro models of particular framed walls, curves defining the interaction between resistances of structural element in and out of plane will be determined. Also, the suitability of existing simplified models used for assessment of structure responses will be determined, and new simplified models will be introduced or the existing ones will be improved, via software OpenSees (McKenna et al. 2015). Based on the obtained results, guidelines for designers and contractors will be drafted, with the aim of improving load-bearing capacities, and reliability in the process of calculation of existing structures and design of new structures. During the process, the framed walls will be observed as a single composite structural element.
Associates on the topic	1 researcher holding a scientific-teaching title 1 postgraduate student

Topic 11	**Humidity effect on properties of masonry structures**
Abstract	The project deals with the effect of humidity on mechanical and thermal properties of historic buildings, and its objective is to: 1) Evaluate the rate and level of degradation of such buildings taking into account the type of bricks and mortar they are made of; 2) Optimize the brick production process taking into account chemical composition of raw materials, with the purpose of increasing frost resistance; 3) Evaluate the existing procedures for assessing resistance of bricks to frost; 4) Find an original method for assessing brick resistance to freezing/thawing cycles, as related to water absorption/release rate 5) Find an original indirect method for assessing brick resistance to freezing/thawing cycles, based on the proportion of individual pore sizes 6) Harmonize durability properties of wall components (bricks and mortars).
Research objective	The objective of the project is to expand knowledge on durability properties of masonry buildings made of bricks and on the durability of structural elements of such buildings (bricks and mortars). This will be done in the attempt to comply with the increasingly stringent requirements pertaining to such buildings during their renovation and adaptation. The projects is focused on historic buildings, as they are masonry buildings mostly made of bricks. It will be possible to apply the knowledge obtained from the project using brick as the main material to other brick elements. The purpose of the project may be summarized in the following several points: 1) Evaluation of degradation level of brick buildings/historic buildings serves as help for

	competent authorities to evaluate the necessary investments during rehabilitation and adaptation of buildings; 2) Through joint work of researchers from two fields (technologists and civil engineers), a proposal for quality management system of hand-made and machine-made bricks will be found, with the aim of minimising the quantity of finished products of insufficient quality, that is, the quantity of bricks that are insufficiently resistant to freezing/thawing cycles; 3) Knowledge a researcher obtains from the project will be transferred to a brick manufacturer (manufacturing process) which produces bricks for historic buildings, with the aim of manufacturing specific-quality bricks intended for rehabilitation of historic buildings; 4) By accomplishing the above-mentioned, referred to in points 2) and 3), a preparation for good-quality and permanent renovation of historic brick buildings will be made; 5) Finding of new methods for indirect assessment of brick resistance to freezing/thawing cycles would enable manufacturers to quickly assess brick resistance to freezing/thawing cycles in general, following the verification of initial manufacturing process via a direct method.
Expected results	The implementation of project is expected to expand knowledge on degradation rate and related durability of brick buildings/historic buildings, and durability of materials (bricks and mortar) such buildings are made of. Application of such knowledge will contribute in the attempt to comply with the increasingly stringent requirements pertaining to such buildings during their renovation and adaptation. In addition, it is expected that two new methods for indirect assessment of brick resistance to freezing/thawing cycles will be found (1st method: based on the proportion of individual pore sizes; 2nd method: based on the water absorption/release rate of brick). These methods would enable the manufacturers to quickly assess brick resistance to freezing/thawing cycles, following the verification of initial manufacturing process via a direct method.
Associates on the topic	7 researchers holding a scientific-teaching title 1 postgraduate student 2 assistants 2 postdoctoral researchers